



جامعة سيدي محمد بن عبد الله بفس
UNIVERSITÉ SIDI MOHAMMED BEN ABDELLAH DE FES

كلية العلوم والتقنيات فاس
FACULTÉ DES SCIENCES ET TECHNIQUES DE FES

RENA 23

Fez, 9-10-11
November 2023

NATURAL
RESOURCES &
SUSTAINABLE
DEVELOPMENT

Abstracts proceeding

2nd EDITION CONGRESS
FUNCTIONAL ECOLOGY AND
ENVIRONMENTAL
ENGINEERING LABORATORY

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https://rena23.sciencesconf.org

9 CCFE-USMBA

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ACKNOWLEDGMENTS

The organisation of RENA23, second edition of the international conference on “Natural Resources and Sustainable Development” of the Laboratory of Functional Ecology and Environmental Engineering of the Faculty of Sciences and Technology of Fez would not have been possible without the help of many people and establishments. The organising committee was extremely appreciative of their interest and active support throughout the preparation of this event.

Mr Mustapha Ijjaali President of Sidi Mohammed Benabdellah University opened the doors of the university to us and offered his support, we would like to offer him our warmest thanks. Mr Taoufiq Achibat, Acting Dean of the Faculty of Sciences of Fez, provided us with daily help and without his help, this scientific project would not have been possible in such good conditions.

Mr. Abderrahim Lahrach Director of the National School of Applied Sciences of Fez contributed very effectively to the organisation of this day, we hope he will find here a testimony of our deep gratitude.

We would like to express our gratitude to Mr. Omar Fassi-Fehri, president of the Hassane II Academy of Sciences and Technology, to Mr. Ansari Abdelouahed, President of the Fès-Meknes region, to Mr. Jawhar, president of the Fès Médina Commune, to Madam Director of the French Institute of Fez, at the French Embassy in Morocco, to Mr. Mohammed Chibout Director of Africa-Géoservices, for their financial support.

The organisation of the conference would not have been possible without the exceptional assistance of our dear and precious doctoral students on the organising committee. They were involved with remarkable efficiency, creative energy and unfailing dedication at each stage, investing their valuable time with us. Without the doctoral students, none of this would have been possible. to them, we our most sincere and deepest thanks. And finally, we also thank all the guests and participants for the interest they have shown in these scientific days. May this event be rich in fruitful debates, stimulating scientific exchanges, and interesting cultural discoveries.

Mohammed Benabdelhadi

President of the Organizing Committee

RENA 23

Humanity's development has always been intimately linked to its exploitation of natural resources. Unfortunately, industrial and technological evolutions, demographic expansion, and the demands of the society of consumption turned it into overexploitation and created an inescapable climate change.

Natural resources, water, air, minerals, soils, and biodiversity... are now degrading at an exponential rate. In addition to that, climate stress is further weakening the already disrupted ecosystems. Nowadays, the effects of these degradations impact our environment and will be increasingly showing in the very near future. As the entire planet is an integrated system, life on its surface depends directly on its state. It is therefore extremely urgent to contribute, on our own scale, to breaking this vicious circle by redirecting development towards the respect and conservation of our land. This represents a tremendous opportunity to evolve toward a more equitable and peaceful world. However, the challenge is immense and requires the mobilisation of the available will, resources, and energy.

This conference aims to bring together scientists who have developed innovative and eco-responsible strategies. The objective is to respond to this major challenge of our time and to make their work known. Scientists explore the incredible potential of nature and thus highlight specific adaptive necessary mechanisms to meet the needs of human activities. These include responsible agriculture and preserving resources, biodiversity, and the climate. Their vocation is to enable the technical implementation of these discoveries on a large scale and to ensure the management of their use. We aim to use the various natural control mechanisms discovered for the benefit of water management and responsible agriculture.

The integration of these multiple specialties is therefore essential for the emergence of a harmonious, inclusive, and sustainable future at both a local and global level. This is the ambition of this conference: to promote a fruitful dialogue, both academic and informal, between the various players in international sustainable development.

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CONFERENCE TOPICS

- SYMPOSIUM ON ENVIRONMENTAL AND HUMAN EVOLUTION IN SOUTH AMERICA

The aim of this symposium is to present and discuss aspects of ecological, climate, environmental, cultural and human changes and their evolution, at different time scales, notably in the Pleistocene, the Holocene and in recent centuries. The objective is to bring together researchers from different projects

financed by the São Paulo Research Foundation (FAPESP) and to present the results of their research in South America to the international community.

- Session 1 : Change and continuity in the genus Homo: resilience and adaptation in a changing world - Levy Figuti* & Mercedes Okumura**, **Museum of Archaeology and Ethnology, University of Sao Paulo, Brazil*, ***Institute of Biosciences, University of Sao Paulo, Brazil*.

Since its origins around 2 Ma, many different species considered to be part of the genus Homo have shown remarkable instances of adaptation to environmental challenges, including the dramatic climatic changes observed during the Pleistocene, as well as more discrete environmental fluctuations documented in more localized settings during the Holocene. From 2 Ma to around 200 ka, different species of hominins occupied a great variety of landscapes in the Old World, facing rather demanding challenges in terms of adaptation and resilience in these new environments, most of them quite different from the original African landscape. In the last 200 ka, populations of *Homo sapiens* have colonized, explored, and adapted to a changing environment. Such adaptive strategies can be observed in the myriad of different and innovative ways of adaptation and natural resources management observed in hunter-gatherer groups, as well as in the anthropogenic constructed niches (mostly) related to the advent of plant and animal domestication. The challenges faced by *Homo sapiens* today (global warming, emergent pathogens, overpopulation, among others), which apparently seem so distant from the Pleistocene and most of the Holocene period, are actually not that different. In the past, human populations also grappled with the stresses of climate change, exposure to new pathogens, as well as population growth. This call invites new research and knowledge, that critically explores the diverse ways in which the genus Homo colonized and adapted to a changing world in the last 2 Ma, including *Homo sapiens* and the more recent adaptations observed during the Holocene. We aim to present a wide range of case studies showing a great diversity of adaptations of Homo populations in the last 2 Ma, calling attention to potential cultural changes and continuities related to coping strategies in response to a changing world. We also would like to stress that the challenges faced by humans today can be considered as a continuation (albeit now in a more extreme level) of stressors which hominin populations have been exposed in the last 2 Ma.

- Session 2 : Environmental, ecological, and climate changes in South America in the Holocene and last millennia - Gregorio Ceccantini, *Institute of Biosciences, University of Sao Paulo, Brazil*

Multidisciplinary research, mainly in geosciences, shows that the Earth has already undergone profound ecological, environmental and atmospheric changes throughout its history. The best known are the appearance of much higher global temperatures in the Mesozoic (up to about 15°C above the current average) as well as the Pleistocene ice ages, with much lower global temperatures. They have had drastic effects on the landscapes of the Northern Hemisphere. The glaciations these past 2 million years have left visible effects, still present today, on the landscape, ecosystems and the living organisms of our planet. Nowadays, there is much discussion about the environmental and climate changes that have occurred over the past 10,000 years and especially over the last millennia, which was accelerated by activities of anthropogenic origin. The environmental changes over the past three centuries are even more marked and rapid. This symposium aims to bring together scientists who study all these climate changes and their implications on ecosystems and biota to fuel an in-depth debate and a better understanding of the phenomena with a determining impact. It is also important to address their already visible effects on the landscape and environment in South America thanks to the crucial participation of Brazilian researchers from various institutions in São Paulo. During this meeting, 19 researchers from São Paulo or from this state, whose research is funded by FAPESP, will meet and present their results to an international public: a very special dialogue will be established with Moroccan researchers who have expressed their desire to establish Moroccan-Brazilian cooperation networks for a better understanding and adaptation to the ecological, climate and environmental changes of our time.

- Application of geomatics to natural resource management and the environment - Abdelkader El Garouani, *Laboratory of Functional Ecology and Environmental Engineering, FST Fez, University Sidi Mohammed Benabdellah, Fez, Morocco.*

Natural resource management remains an important issue for public and private organizations. Research activities in the field of geomatics (Geographic Information Systems, cartography, airborne and spatial data acquisition, etc.) are helping to develop innovative processes in these areas, with strategies for implementing proposed solutions and supporting decision-making.

- Satellite Remote Sensing for an effective natural resource management - Hassan Tabyaoui, *Natural Resources and Environment Laboratory, FPT, Sidi Mohammed Benabdellah University, Fez, Morocco.*

Satellite-based Remote Sensing plays a vital role in a wide spectrum of applications. Remote Sensing technology has evolved to a new era with several kinds of earth observation data. The advanced technologies and upgraded sensors have revolutionized the ability of scientists to monitor and manage natural resources. This results in effective natural resource management with more accurate, advanced, and timely information on existing as well as potential future techniques.

In this session, we target areas related to advancing high-resolution and mid-resolution remote sensing data acquisition and sensor modeling combined with new data processing techniques for information extraction, including machine learning and deep learning. We are also interested in advances in Remote Sensing that help find solutions to modern human problems, including combating climate change and addressing sustainable development. We encourage participation from academia, space agencies, government stakeholders and industrial research and development leaders to share their latest technology and research.

- Soil erosion and quality of aquatic environments - Mohammed Benabdellahi, *Laboratory of Functional Ecology and Environmental Engineering, FST Fez, University Sidi Mohammed Benabdellah, Fez, Morocco.*

The development of urban planning and modern industrial and agricultural activities have resulted in serious damage and imbalances in natural environments, which have unfortunately been exacerbated by climate change. We therefore need to be aware of the importance of rational management of these natural resources and their protection against all risks likely to affect their quality. Among the aspects of this degradation is the deterioration in the quality of the aquatic environment and the phenomenon of soil erosion, which has accelerated at an alarming rate.

- Groundwater and Climate changes - Lahcen Benaabidate, *Laboratory of Functional Ecology and Environmental Engineering, FST Fez, University Sidi Mohammed Benabdellah, Fez, Maroc.*

Groundwater resources are the main resource for drinking water supply in arid regions, and a large part of these resources used also for irrigation, remain very vulnerable to the effects of climate change. Knowing and forecasting the future evolution of the climate and in particular of its impact on water resources remain essential. Furthermore, these resources, partly impacted by the degradation of their quality, require rational management to ensure the water bridge for future generations.

- Hydrology and watershed management - Lahcen Benaabidate, *Laboratory of Functional Ecology and Environmental Engineering, FST Fez, University Sidi Mohammed Benabdellah, Fez, Maroc.*

The hydrological investigation of watersheds, the analysis of the various physical and geomorphological parameters using geomatics, the analysis of precipitation trends, the evaluation of the quality of hydrological data and the calculation of floods are all means of carrying out the hydrological modeling. This modeling constitutes a rational mechanism that allows to best reproducing the global behavior of

watersheds in order to quantify the surface water resources and also to present the risk of flooding affecting the arid regions.

- **Waste recycling and recovery** - **Mohammed Benabdelhadi & Omar Kassou**, *Laboratory of Functional Ecology and Environmental Engineering, FST Fez, University Sidi Mohammed Benabdellah, Fez, Maroc, ** PHILIA DMCC, Dubai, United Arab Emirates.*

All human activities produce waste, whether green or not. The exponential increase in quantities of household and similar waste represents a major environmental, social and economic challenge. In recent years, however, a growing awareness has prompted governments, businesses and citizens to adopt more sustainable practices. The recovery and recycling of all types of waste has become a global priority. Non-recovered waste, such as household and similar waste, can have harmful consequences for the environment. The accumulation of waste in landfill sites contributes to soil and groundwater pollution, while its incineration without energy recovery leads to the emission of greenhouse gases and toxic substances into the atmosphere. By adopting waste recovery and recycling practices, we can significantly reduce these negative impacts.

Waste recovery and recycling offer significant economic benefits. By promoting a circular economy, where waste is transformed into resources, we can foster sustainable development and economic growth. By adopting a global approach that integrates reduction at source, the adoption of policies and regulations to promote reuse, recycling and energy recovery. New technologies play a crucial role in improving waste recovery and enhancing energy recovery possibilities. In this way, we can minimize environmental impact, generate economic benefits and improve the social conditions associated with waste management. Government policies, scientific research, citizens' initiatives and public-private partnerships are all levers for promoting sustainable waste management, thereby helping to preserve our environment for future generations.

- **Natural substances, their potential for protecting plants against disease** - **Jamila Al Figuigi**, *Laboratory of Functional Ecology and Environmental Engineering, FST Fez, University Sidi Mohammed Benabdellah, Fez, Morocco.*

Plant health has always been a real concern for scientists. Protecting them from pests and diseases is a key component of crop management. It is based on the respect of numerous rules and has often relied on the use of chemical inputs. Developing good practices and alternative control methods for sustainable agriculture is currently a challenge that needs to be met. Natural substances, in particular plant extracts, have been used since ancient times, and are now the subject of renewed interest. Of animal, vegetable or mineral origin, these substances are present in the natural environment and have the advantage of being non-toxic, biodegradable and selective towards their targets. As such, they offer a promising future for ecological plant protection in an increasingly environmentally conscious world.

- **Production and valorization of plant resources** - **Karima Mikou**, *Laboratory of Functional Ecology and Environmental Engineering, FST Fez, University Sidi Mohammed Benabdellah, Fez, Morocco.*

Food and non-food plants are likely to provide products of great interest. The identification of these products and their transformation is developing continuously thanks to very active worldwide research that led to a wide diversity of products with significant biological activities that can be exploited in the agri-food, pharmaceutical, cosmetics, energy and environmental sectors through the identification of the molecules responsible for these activities. The processes involved in adding value to these plant resources, as well as the different methods of production, are of great interest, in a spirit of sustainable development, using the plant as an organism interacting with its environment.

- Conservation of animal biodiversity - Lahsen El Ghadraoui, *Laboratory of Functional Ecology and Environmental Engineering, FST Fez, Université Sidi Mohammed Benabdellah, Fez, Morocco.*

The conservation of animal biodiversity has been a highly debated topic since the turn of the millennium. Mother Nature, which provides us with food and shelter and is home to many living creatures, an exuberant fauna that mankind must appreciate at its true value, is undergoing an unprecedented decline. There is no doubt that the industrial revolution has led to major upheavals in the functioning of many ecosystems, and as a result, the steady, sometimes even irreversible loss of biodiversity. The decline in this priceless natural wealth concerns a large number of taxa, the main causes of which are multi-scale and anthropogenic (destruction and fragmentation of habitats). This massive destruction of biodiversity has been the subject of much research in recent decades, particularly with the emergence of a new scientific discipline known as conservation biology. The organization of such an international scientific event (RENA-2023) is an opportunity to debate and exchange data on this subject.

- Soil management and biodiversity protection - Meryem Benjelloun, *Laboratory of Functional Ecology and Environmental Engineering, FST Fez, Sidi Mohammed Benabdellah University, Fez, Morocco.*

By destroying natural and agricultural areas, urban sprawl and soil artificialization contribute directly to the degradation of ecosystem functioning, the loss of species diversity and the accentuation of extreme weather phenomena. To face the destruction of these ecosystems and biodiversity, we need to promote sustainable agriculture and study the role of plants in soil conservation and ecosystem restoration, as well as mitigating the effects of invasive species on ecosystems.

- Protection and valorization of plants - Majida Hafidi, Hajjaj Hassan, Rahou Abdelilah, *Applied Mycology Team Plant Biotechnology and Valorization of Bioresources Laboratory Faculty of Sciences University Of Moulay Ismail, Morocco.*

Plant protection is a crucial aspect of agricultural practices and plays a significant role in ensuring global food security. It involves the implementation of various strategies and technologies to manage pests, diseases, and other harmful factors that can negatively affect plant health and productivity. Traditionally, chemical treatments have been extensively used for plant protection, but their overreliance has led to environmental contamination, health concerns, and the emergence of resistant phytopathogens. To address these challenges, alternative methods that promote sustainable plant protection, such as valorization that focuses on harnessing the potential of microorganisms, such as nitrogen-fixating rhizobacteria and biological control, have gained significant attention in recent years.

Disease management is a critical aspect of plant protection, as plant diseases can cause substantial yield losses and economic damage. Biological control has emerged as an effective strategy for disease management, as it offers an environmentally friendly and sustainable alternative to chemical products. Various microbial agents, including bacteria, fungi, viruses, and nematodes, have been identified and utilized for their ability to suppress plant pathogens. These agents can act directly by inhibiting the growth and development of pathogens or indirectly by stimulating the plant's natural defense mechanisms.

The application of biological control for disease management involves various approaches, including the use of antagonistic microorganisms, biocontrol agents, and induced systemic resistance. Antagonistic microorganisms, such as certain strains of bacteria and fungi, produce antimicrobial compounds that inhibit the growth of pathogens. Biocontrol agents, such as *Trichoderma spp.* and *Bacillus spp.*, have been extensively studied and utilized for their ability to suppress a wide range of plant pathogens. These agents can colonize the plant's rhizosphere or phyllosphere and outcompete the pathogens for resources. Induced systemic resistance is another mechanism employed in biological

control, wherein certain microorganisms or their by-products trigger the plant's defense responses, resulting in enhanced resistance against diseases.

- **Plant Biotechnology at the Service of the Improvement and Valorization of Plant Resources** - Abderrahim Lazaq, *Functional Ecology and Environmental Engineering Laboratory, FST Fez, Sidi Mohammed Benabdellah University, Fez, Morocco.*

Biotechnology represents a discipline that opens a new horizon for research and development. It brings together a set of important tools for the sustainable development of agriculture, fisheries and forestry, as well as the agri-food sector. Plant biotechnology is proving to be a promising niche in Morocco, this new discipline is able to provide concrete solutions to the problems of biotic and abiotic stress from which several crop varieties suffer. This could improve national productivity. It is therefore important to further integrate biotechnology techniques into research programs. Morocco's policy in terms of plant biotechnology is based on the following axes : plant protection ; clonal propagation ; conservation and exchange of germplasm and plant breeding.

- **Aquatic ecosystems: resources and valorization** -El-Ouazna Bouchamma & Saad Rachig, *Laboratory of Functional Ecology and Environmental Engineering, FST Fez, Sidi Mohammed Benabdellah University, Fez, Morocco*

Aquatic ecosystems, whether continental or marine, are home to a large number of micro-organisms, algae, invertebrates and vertebrates. This biodiversity constitutes a natural capital essential to economic growth and social well-being. The great biological wealth of aquatic environments is also one of the most threatened by the development of human activities that modify and degrade these ecosystems. The preservation of this biodiversity is therefore a necessity to ensure sustainable economic growth; this is achieved through a multi-disciplinary approach presenting different aquatic resources, their development, and the challenges in terms of innovation and conservation.

- **Blue biotechnologies: Economic and environmental valorization of natural and bioactive substances** - Abdellah Zinedine & Samira Etahiri, *Biomare Laboratory, Chouaib Doukkali University, Faculty of Sciences, El Jadida, Morocco*

The marine environment constitutes an inestimable wealth of inexhaustible natural resources for man, providing him with food, energy and water. These natural resources (algae, marine microorganisms, animals) are considered excellent natural sources of biomolecules with diverse and potentially interesting biological activities. The biological activity of these substances depends on their chemical composition and biochemical properties. Their most sought-after biological activities are their antimicrobial, antioxidant, etc. properties. Currently there is a significant demand for the research and identification of biomolecules of marine origin, given their potential application in various fields against pathogenic and spoilage microorganisms; this includes in particular the medical, cosmetic, agri-food and environmental fields, as well as their application as biopesticides.

Conference 1 : Groundwater management and global challenges – a revision for future

Margarida Antunes, *Institute of Earth Sciences, Pole of University of Minho, Braga, Potugal*

Globally water availability is a critical issue particularly due to limited rainfall, high evaporation, and lack of surface water, which have an adverse effect on groundwater resources. Groundwater is the main source of water with a limited availability due to anthropogenic activities stress and associated natural features. Groundwater management considers a broad range of activities and contamination prevention will represent the main topic. Furthermore, the identification of contamination risk zones is the first step to develop useful strategies to protect groundwater, particularly in different scenarios of climate change.

Groundwater vulnerability is a relative non-measurable concept and can be differentiated into intrinsic or specific vulnerability. Groundwater intrinsic vulnerability is defined as the sensitivity of an aquifer system to human and/or natural impacts, mainly associated to its geological and hydrogeological characteristics, while specific vulnerability is associated to the effect of a contaminant within the aquifer system. Groundwater vulnerability assessment employing vulnerability indexes and GIS techniques has become a very useful tool for the planning and decision-making involving groundwater protection and future availability of water resources.

Key words : Water scarcity, Aquifer vulnerability, Contamination indexes, vulnerability methodologies, climate change

Conference 2 : Quaternary continental carbonate deposits: good climatic proxies. Their chronological interest in prehistory

Christophe Falguères, *UMR7194, Sorbonne Université, Institute of Human Paleontology, Paris, France*

Continental carbonate deposits consist mainly of tuffs and travertines, which are limestone concretions at the emergence of springs and in shallow water courses, and speleothems which form in caves. They are excellent climatic proxies because they generally develop in temperate and humid periods. What's more, they can be dated using a variety of independent methods with good accuracy when certain conditions are met. The multiplicity of analytical, radiometric, isotopic and stratigraphic approaches makes these formations of particular interest in terms of climate and chronology.

Travertines are accumulations and deposits of calcium and magnesium carbonate formed in fluvial contexts or of hydrothermal origin. They are often related to karstic systems and waters charged by the dissolution of older carbonates. When travertines are well crystallised and have a calcite content of over 95%, they can be dated by uranium series with good accuracy. In most cases, however, it is necessary to make corrections for exogenous thorium from clays mixed with calcite layers. When the ratio of thorium from the decay of uranium dissolved in calcite (^{230}Th) and thorium from external clays (^{232}Th) is less than 20, a correction is required to obtain an age that is closer to the real age of these formats.

The carbonate strata of the Maghreb, and in particular the travertine formations of Morocco, have been dated by several independent methods. Speleothems, when associated stratigraphically with prehistoric sequences, enable the layers containing evidence of human occupation to be dated chronologically. Many important prehistoric sites, particularly in Europe, have been dated using uranium series with a high degree of accuracy and reliability. Some examples are presented in this work.

Conference 3 : Peopling of Brazil during the end of the Pleistocene.

Águeda Vilhena Vialou, *MNHN-Paris France USP-Sao Paulo Brazil*

Research and discoveries in America over the last thirty years have completely disrupted the paradigms established for the antiquity of settlement in the Americas: 12,500 -13,000 years BP, defined by the very rich Clovis culture, especially in the middle West of the United States. The research programs led by Brazilians and French, started in the 1970s, were not only able to confirm a human presence in the transition from the Pleistocene to the Holocene through human remains, but also to highlight older occupations. , between 25 and 30,000 years BP.

Sites in the Serra da Capivara in Piauí and the Santa Elina shelter in the Serra das Araras in Mato Grosso provide a good and coherent Pleistocene stratigraphic sequence and a rich corpus of dates, UTh, OSL and 14C. Lithic artifacts are found at Santa Elina in perfect direct association with the extinct fauna, Glossotherium, giant sloth.

WORKSHOP / Behavior of organic micropollutants and trace metals in aquatic system

Baghdad Ouddane, *Lille university, LASIRE laboratory - UMR CNRS 8516, F-59655 Villeneuve d'Ascq, France.*

The quantification of organic micropollutants and trace metals elements in the natural environment is of lots of interests to scientists in aquatic systems because of their persistence, toxicity and bioaccumulation effects. Their presence in irregular contents in waters, sediments and suspended particles could reveal the incidence of anthropogenic sources. They can degrade the ecological and chemical state even at very low concentrations and can affect the trophic chain. In certain cases, they can also serve as tracers of source pollution. Many organic pollutants and trace metals can adsorb on particles and tend to be trapped and concentrated in sediment, they constitute a real reservoir of pollutants and represent a danger for all species that live or feed in the sediment. Their releases into overlying waters through sediment resuspension or by organism degradation, desorption from in-place sediments primes to an increased bioavailability, and thereby disturb the aquatic ecosystem. Numerous hydrodynamic processes (tides, floods, storms, etc.), physicochemical (oxidation-reduction potential) and biological (bioturbation) processes and finally human activities (dredging, construction of structures, river traffic, etc.) can lead to the rapid destocking of accumulated pollutants in the sediments and thus stance a risk to species living in the water column. For all of these reasons, it appears essential to measure the contamination of sediments and the conditions for desorption of pollutants during the resuspension of the sediments. The study of the fate and origin of pollutants is of capital importance in the monitoring and modeling of the behavior in aquatic systems. The water–sediment interface constitutes a barrier separating two environments with radically different properties. The transfer of contaminants between the two phases (solid–liquid) causes a strong heterogeneity in the concentrations of the trace metals species. In fact, the impact of the sediment on the water column manifests itself either by a trap or by a source or a simple recycling of organic or metallic contaminants. In order to better define the role of sink or source of contaminants played by sediments, the study of the reactivity of the superficial sedimentary layers can be carried out in terms of remobilization (adsorption, desorption, etc.) and must be approached with a multidisciplinary methodology by mobilizing multiple skills.

WORKSHOP / At the Crossroads of Challenges : Agriculture in Morocco - Water, Climate, and Food Sovereignty

Abouabdillah Aziz, *National School of Agriculture of Meknes,*

Agriculture in Morocco finds itself at a complex crossroads of major challenges. Climate change is putting increasing pressure on this vital sector, with periods of drought becoming more and more frequent and unpredictable. The scarcity of water, essential for agriculture, accentuates these challenges, affecting various sectors, such as cereals, sugar, oil, citrus fruits, as well as other market gardening and tree crops.

To achieve food sovereignty, key strategies must be implemented, including the choice of crops adapted to local conditions and water availability. Additionally, more efficient water management, including the adoption of smart irrigation and the Internet of Things (IoT), can help alleviate water scarcity and improve agricultural yields.

These strategic solutions, such as smart irrigation, are crucial to ensuring the resilience of agriculture in Morocco, simultaneously addressing the challenges related to water, climate, food security and the production of cereals and crops. other cultures. Additionally, alternative solutions, such as seawater desalination and reuse of treated wastewater in agriculture, are essential. All these measures must be analyzed within a framework of "water-energy-environment nexus" to ensure overall sustainability and

guarantee the country's food sovereignty. This is an essential step to ensure a safer and more sustainable future for Moroccan agriculture.

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ORAL COMMUNICATIONS

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ORAL COMMUNICATIONS

Theme 1 : - Symposium on environmental and human evolution in South America

SESSION 1 : CHANGEMENT ET CONTINUTE DANS LE GENRE HOMO : RESILIENCE ET ADAPTATION DANS UN MONDE QUI CHANGE

001 CITY OF STONES IN THE MOROCCAN MIDDLE ATLAS, SPECIAL FUNERAL RITES.

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The Middle Atlas and particularly the Boulmane region is full of pre-Islamic funerary monuments. The overwhelming majority of them are circular tumuli. However, two burials located in the “City of Stones” site are completely different from this common pattern and are exceptional in many respects. They are an extension of each other. Each one is topped by an imposing horizontal sandstone slab which gives it a megalithic appearance although they are in reality natural formations. The underlying cavity was used as a burial chamber. The first CPSI site delivered the incomplete skeleton of 3 individuals (1 man and 2 women). One of them found in lateral decubitus is relatively complete up to the pelvis and its bones were lying in anatomical connection at the level of the rib cage and upper limbs. The remains of another female individual were found but her skeleton was only very partially represented. On the other hand, a copper alloy bracelet was found on her left carpus as well as a thin metal needle. Other scattered bones were found mixed with the remains of these two individuals. The second CPSII burial, however, does not contain any skeleton in anatomical connection but a few bones (4 skulls, a few long bones, sacrum, vertebrae, a few ribs) from 4 different individuals (1 woman, 2 men and 1 undetermined). The skulls are all located at the end of the deposit. A domestic bovine shoulder blade was even found among these human remains. In both cases, these are therefore multiple burials.

The fact that these are never whole skeletons raises questions. We are in the presence of secondary burials perhaps reusing a primary burial already degraded in the case of the first site. The individuals who benefited from it probably present family and social relationships, even pathological ones, between them and possible differences compared to individuals buried in “classic” tumuli. The type of bones chosen and extracted from the primary burial is representative of the individual. These are probably iterative secondary burials in the same monument. The purpose of this type of burial, which is completely original in the region, remains to be determined.

002 INTERACTIONS BETWEEN HUMANS AND ENVIRONMENT THROUGHOUT THE

HOLOCENE IN SÃO PAULO STATE, SOUTHEASTERN BRAZIL.

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The variability of stone tools has often been linked to the human adaptation in different biomes. São Paulo State, situated in an ecotone between very different biomes configure as an ideal case study to evaluate this hypothesis. To do so we conducted a comprehensive bibliographical survey with the aim of understanding the dispersion of the different artifacts assemblages in space. The results suggested that cultural transmission, understood as the maintenance of cultural lineages over time, would be a more plausible explanation for the observed patterns.

O03 PATTERNS OF INFECTIOUS DISEASE IN ANCIENT BRAZILIAN GROUPS : THE ROLE OF DIFFERENT ENVIRONMENTS AND DEMOGRAPHIC PARAMETERS.

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In the last 200ka, humans have explored and adapted to a changing world. Environmental challenges faced by humans today, like emergent pathogens and overpopulation, are not that different from the ones in the past. This paper aims to discuss the patterns of disease observed in ancient human populations in southeastern Brazil (hunter-gatherer groups associated to riverine and coastal shellmounds and agriculturalists). The role of new pathogens and high demographic density will be discussed.

O04 SUSTAINING AGROFORESTRY COMMUNITIES IN SÃO PAULO, BRAZIL: EXCHANGE OF KNOWLEDGE AND MATERIALITY THROUGH TIME.

Marianne SALLUM ¹, Francisco Silva NOELLI ²

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The agroforestry communities of São Paulo have long been the custodians of unique plant cultivation knowledges and ecological practices that have shaped the region's landscape and cultural heritage. This paper explores these communities' enduring persistence and dynamic engagement in exchanging food sovereignty practices and materialities with Europeans and people from outsiders in colonial times. They have articulated practices over generations until the present, integrating the cultivation of food crops within complex, sustainable ecosystems. The global community's growing interest in agroforestry as a sustainable land-use practice has also led to international collaborations and funding opportunities that further strengthen these communities.

O05 THE EVOLUTION OF HUNTER-GATHERERS IN THE HIGHLAND REGIONS OF THE CENTRAL SOUTHERN ANDES.

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A broad evolutionary theoretical framework in archaeology enables the integration of empirical patterns of human behavior across extended temporal scales, viewed from an ecological perspective, along with patterns of descent with modification in artifacts. Building upon this foundation, this study presents diversification rates in projectile points from the Middle Holocene in the southern Andean region, alongside the regional-scale representation pattern of camelids during the Early and Middle Holocene.

From this point, we discuss the role of technology in the economic specialization of highland hunter-gatherers in the central southern Andes. The temporally calibrated phylogeny documents an adaptive radiation in artifacts, marked by a point of maximum innovation and lineage emergence around the mid-Middle Holocene. Simultaneously, the archaeofaunal representation pattern records a progressive increase in camelid presence, with dominance of this taxon in assemblages dating after the peak of maximum technological innovation. We emphasize that this enhancement in predatory efficiency suggests that the process is unlikely to be one of intensification, which, by definition, entails a gradual loss of economic efficiency. Instead, we propose the hypothesis of an adaptive evolutionary process, wherein the technological evolution of a greater diversity of lithic points allowed, in the long run, for increased productivity within the economic niche of hunter-gatherers. As the Middle Holocene draws to a close, this results in a faunal utilization pattern dominated by camelids, the prey species with the highest energy yield in that context.

**O06 THE FAUNAL REMAINS ON SOUTH-EAST BRAZIL RIVERINE SHELL-MOUNDS :
SUBSISTENCE PATTERNS ON RAIN FOREST HUNTERS-GATHERERS DURING
THE HOLOCENE.**

Levy FIGUTI ¹, Claudia PLENS ², Camila ALVES ³, Caroline BORGES ⁴, Anderson TOGNOLI ³.

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In Southeast of Brazil, the Ribeira basin riverine mound builders inhabited this area since the beginning of the Holocene and vanished a thousand years ago. The zooarchaeological analyses on seven sites samples show a great reliance and resilience on the exploitation of the Serra do Mar mountain rain forest. The sites near the main river (Ribeira de Iguape) have fish as major element, as the topographical relief becomes higher, the terrestrial vertebrates became dominant, mostly mammals and amphibians. The diversity of vertebrate remains indicates the use of resources in a relatively small radius, but there are a few vestiges from coastal environments. The data indicates when the sites were active there were very few temporal variations. Meanwhile, the human remains isotopic data also suggest few variations between the sites near river from those upland. All these analyses seem to indicate that the several occupation events were brief allowing a restrict exploitation of the vicinities of each site, these mound builders also had an ecological diverse set of seasonal encampments. The few but frequent presence of sea animals suggest a possible trade relationship with the coastal mound- builders.

**O07 THE RELATIONSHIP BETWEEN HUMANS AND PALEOENVIRONMENTS IN
BRAZIL DURING THE HOLOCENE.**

Astolfo ARAUJO

University of São Paulo.

About 15 years ago, Araujo et al., (2005, 2006) suggested that the low frequency of archaeological sites dating from the mid-Holocene in several regions of Lowland South America (which was called the “Archaic Gap”) was due to an increase in the magnitude of dry periods related to the mid-Holocene hypsithermal. Since then, data regarding paleoenvironmental reconstructions for this vast area, coupled with an increase in the archaeological knowledge, allow us to reassess the idea of the “Archaic Gap” and redefine both the spatial extent of the phenomenon and its possible causes. Our present analysis aims to present a broader picture of the relations between humans and the environment in Eastern South America since the Late Pleistocene. The obtained results suggest that the extent of the areas that were somewhat depopulated during the mid-Holocene is larger than previously thought; not only Central Brazil, but parts of the Amazon and the Pantanal (close to the Bolivian border) seem to show the same pattern. However, as expected when larger datasets are available, it is possible to perceive oscillations in the archaeological signal that suggest reoccupation of some areas. Although we maintain that the main reasons underlying these patterns are related to climate, they are most probably related to an increase in climatic variability, and not necessarily to an increase in dryness. These observations are of interest to the current debate about the effects of the global warming on human populations.

008 THE USE OF CLADISTICS TO EXPLORE CULTURAL TRANSMISSION AMONG TUPIGUARANI GROUPS IN SAO PAULO STATE, BRAZIL.

Perez GLAUCO ¹, Astolfo ARAUJO ¹, Mercedes OKUMURA ¹, Ethan COCHRANE ².

1 : University of São Paulo, 2 : University of Auckland.

Tupiguarani is an archaeological tradition associated to agriculturalist groups and their characteristic pottery from the Late Holocene in Brazil. In this paper, we applied phylogenetic methods to qualitative data on Tupiguarani pottery to reveal potential patterns of cultural transmission and interaction among groups from Sao Paulo state. Our results demonstrate how Cultural Transmission Theory can be used to generate useful hypotheses that can be fruitfully tested using cladistics applied to material culture.

009 THE PREHISTORIC CAVE OF GUENFOUDA, EASTERN MOROCCO: A SUMMARY OF MULTIDISCIPLINARY RESEARCH CONDUCTED BETWEEN 2004 AND 2022.

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The Guenfouda Cave (also known as Ghar Zebbouj) is a karst formation located in the Aenobajocian dolomitic limestones of Jebel Metssila in the Oujda Mountains. It is situated 10 kilometers from the village of Guenfouda and 30 kilometers south of the city of Oujda. Due to the richness and significance of the materials collected, the site has been recognized for its archaeological importance and deserves to be designated as a national heritage site. The initial excavations began in 2004 with a team from Mohamed 1st University and the Quinson Museum in France, with support from the French Institute of Oriental Studies. Given the importance of the discoveries and the wealth of archaeological remains unearthed, excavations have continued annually, with the involvement of students from Mohamed 1st University in Oujda and other regions.

Archaeological excavations have reached the sedimentary fill at the bottom of the cave, reaching depths of up to 2 meters. Tomographic analysis estimates the depth of the sediment fill to be 5 meters near the cave walls. The rich and abundant lithic industry is well-preserved across all levels. The artifacts

collected from different levels of the fill correspond to the Neolithic, the final Upper Paleolithic or Epipaleolithic, and the Middle Paleolithic periods. Systematic water sieving of the sediment has enabled the recovery of a unique small vertebrate fauna, characterized by the presence of fossil species reported for the first time in Morocco and the Maghreb. As for the large fauna remains, they are well-preserved and belong to around thirty species that inhabited the Mediterranean region, primarily within the subhumid, semi-arid, and arid bioclimatic zones. The pottery found in Guenfouda is highly diverse, with some sherds decorated with motifs indicative of a Cardial Neolithic culture.

O10 TAPHONOMY AND PALÉOENVIRONNEMENT OF SMALL VERTEBRATES FROM THE HOLOCENE LEVELS OF GUENFOUDA CAVE (EASTERN MOROCCO).

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Small vertebrates are well known for accumulating in large quantities in fossil sites and provide relatively precise information in terms of taphonomy and paleoenvironment. The taphonomic analysis carried out on remains of micromammals and squamates from the Quaternary site of Guenfouda highlights that the different assemblages of small vertebrates are linked to a nocturnal raptor, although some remains presenting stronger alterations suggest the presence of other predators.

The paleoecological reconstruction based on the analysis of the assemblages of small vertebrates from the different levels excavated indicates that the environment around the Guenfouda cave was composed of a mosaic of landscapes dominated by open steppic landscape, with patches wooded areas and water ponds.

O11 LE MONUMENT FUNÉRAIRE ISFOULA (MOYEN ATLAS, MAROC) : ÉTUDE PRÉLIMINAIRE.

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Dans le cadre de notre programme de recherche "Fouille et étude des monuments funéraires de la région de Guigou (Moyen Atlas, Maroc)", nous avons inventorié une centaine de monuments funéraires. Le site archéologique Isfoula s'inscrit dans une vallée nécropole, constituée de monuments funéraires implantés sur les lignes des crêtes et sur les flancs des versants le long de l'Oued d'Isfoula. Ce sont des tumuli de forme arrondie ou ovale et correspondent à des amoncellements de pierres en calcaire et en grès. Les calcaires sont sous forme de dalles, alors que les grès constituent des blocs de forme irrégulière. Le monument funéraire Isfoula I est un tumulus d'une forme ovale qui mesure 10 m de longueur, 8m de largeur et 1,25m de hauteur ; il présente une enceinte périphérique qui correspond à une circonférence de dalles calcaires. L'érosion a dégagé sa moitié ouest, et a mis à nu un alignement de dalles calcaires implantées verticalement. La fouille du quart sud-ouest du tumulus a mis au jour les restes humains d'individu adulte de sexe féminin, des restes osseux de microfaune et une paire de boucle

d'oreille en alliage cuivreux, avec deux perles probablement en cornaline. La datation radiométrique des ossements humains a fait remonter le tumulus à l'âge de 4415 ± 35 ans 14C BP.

Mots clés : Site archéologique, tumulus, Oued Isfoula, monument funéraire, datation.

SESSION 2 : CHANGEMENTS ECOLOGIQUES, CLIMATIQUES, ET ENVIRONNEMENTAUX EN AMERIQUE DU SUD AU COURS DES DERNIERS MILLENAIRES ET DE L'HOLOCENE

O12 DRIVERS OF DIVERSIFICATION IN THE SOUTH AMERICAN ATLANTIC FOREST: THE ROLE OF THE LAST INTERGLACIAL AND GLACIAL MAXIMUM.

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The forest refuge hypothesis (FRH) was first proposed to explain the high diversity of birds in Amazonia (Haffer, 1969). This hypothesis suggests that climatic fluctuations during the Pleistocene led to forest fragmentation and divergence of lineages (Haffer, 1969). This hypothesis was also applied to the Atlantic Forest, the forest covering the eastern coast of South America (Prance, 1983). The Atlantic Forest is listed as a priority area for conservation due to the high levels of endemism and progressive loss of habitat (Myers et al., 2000). However, for explaining the high diversity and endemism in the Atlantic Forest, that holds ca. 15,000 flowering plant species, with half of it endemic to this region (BFG, 2021), other mechanisms than the allopatric speciation as suggested by the FRH may be invoked. For example, for forest specialist small mammals instead of population retraction during the last glacial maximum (LGM, c. 20 kybp), as expected by the FRH, there was spread in the population due to the expansion of the Atlantic Forest to the Brazilian continental shelf by this time above sea level, the Atlantis Forest hypothesis (Leite et al., 2016). Other processes that may have contributed to the biotic diversification in the Atlantic Forest are lineages dispersals from the Amazon Forest to the Atlantic Forest (Peres et al., 2020). Ancient connections between the Amazon Forest and the Atlantic Forest existed during both the LGM and the last interglacial (LIG, 125 kybp) through the northern and southern part of the Atlantic Forest allowing biotic interchanges between both forests (Ledo & Colli, 2017). The origin and diversification of the Atlantic Forest is still in debate, however the climatic fluctuations in the Pleistocene had an important role in driving the high species diversity and endemism in this biome.

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O12 PLANT MIGRATIONS DURING THE LATE QUATERNARY OF BRAZIL UNDER THE LIGHT OF PALYNOLOGICAL RECORDS.

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The origin of modern disjunct plant distributions in the Brazilian Highlands with strong floristic affinities to distant montane rainforests of isolated mountaintops in the northeast and northern Amazonia and the Guyana Shield remains unknown. We tested the hypothesis that these unexplained biogeographical patterns reflect former ecosystem rearrangements sustained by widespread plant migrations possibly due to climatic patterns that are very dissimilar from present-day conditions. To address this issue, we mapped the presence of the montane arboreal taxa *Araucaria*, *Podocarpus*, *Drimys*, *Hedyosmum*, *Ilex*, *Myrsine*, *Symplocos*, and *Weinmannia*, and cool-adapted plants in the families *Myrtaceae*, *Ericaceae*, and *Arecaceae* (palms) in 29 palynological records during Heinrich Stadial 1 Event, encompassing a latitudinal range of 30°S to 0°S. In addition, Principal Component Analysis and Species Distribution Modelling were used to represent past and modern habitat suitability for *Podocarpus* and *Araucaria*. The data reveals two long-distance patterns of plant migration connecting south/southeast to northeastern Brazil and Amazonia with a third short route extending from one of them. Their paleofloristic compositions suggest a climatic scenario of abundant rainfall and relative lower continental surface temperatures, possibly intensified by the effects of polar air incursions forming cold fronts into the Brazilian Highlands. Although these taxa are sensitive to changes in temperature, the combined pollen and speleothems proxy data indicate that this montane rainforest expansion during Heinrich Stadial 1 Event was triggered mainly by a less seasonal rainfall regime from the subtropics to the equatorial region.

FAPESP Proc. 2016/04982-0 and F.W. Cruz by FAPESP grants 2013/50297-0 and 2017/50085-3.

O13 THE ROLE OF CLIMATE CHANGE ON THE LONGEVITY OF TROPICAL TREES.

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Climate change poses severe limitations to world forests hampering key biogeochemical cycles. For instance, the global carbon cycle largely depends on the tropical forests functioning since tropical lowland forests are amongst the most productive systems on Earth. How trees in these forests react to changes in temperature and precipitation will largely define their roles as carbon sources or sinks. Monitoring plots provided valuable insights into the responses of tropical forests to changing conditions during the last decades. However, the long-term responses of trees across tropical biomes are still an open question. In this study, we endeavoured to assess how temperature and water availability modulate the longevity and growth of tropical trees based on secondary tree-ring data. We assessed 3343 populations of 438 species across world biomes and revealed that longevity and growth rate covary along a temperature gradient from high latitudes/altitude to low latitudes/altitude. On average, tropical trees grow twice as fast as temperate ones but live significantly shorter lives. In tropical lowlands, the Bayesian Model revealed a temperature tipping point of 25.4°C, above which the longevity of tropical trees displays a substantial reduction without affecting their average growth rate. Longevity also depends on water availability and decreases under drier climate conditions. These trends could explain changes in tree mortality in the Amazon and Congo Forests, as well as shifts in tree composition in African Forests. Thus, warming and drier conditions can limit the future capacity of tropical lowland forests to hold long-lived trees impacting forests' carbon stocks.

O14 TREE RINGS INDICATE A DECREASE IN RIVER FLOW IN THE BRAZILIAN SEMI-ARID REGION.

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The Brazilian semi-arid region is the most vulnerable tropical region in the world to events related to temperature increases in the Anthropocene. In this region flows the São Francisco River, the main source of surface water, which supplies more than 20 million people, in addition to its use in irrigated agriculture, electricity production and pisciculture. Due to the intense use of water, alarming scenarios of water crisis in the region become more frequent. Thus, the monitoring of water resources is of paramount importance for the formulation of public policies, but instrumental data are scarce and discontinuous in the region. In this context, dendrochronology emerges as a tool to fill this gap, with the construction of long-term annual time series. In addition to the width of growth rings, the use of stable oxygen isotopes has shown promising results in hydroclimatic reconstruction. In this research we present a time series of 168 years (1850-2017) of oxygen isotopes in the growth rings of trees of the species *Cedrela fissilis*. The collection region is located in the north of the state of Minas Gerais, close to the Cavernas do Peruaçu National Park and the state of Bahia. The streamflow series of five tributary rivers of the São Francisco River (Carinhanha, Itaguaí, Verde Grande, Pandeiros and Coxá) correlated significantly ($p < 0.05$) with the isotopic chronology, with values around $r = 0.60$. The instrumental data of the five tributary rivers of the São Francisco were obtained from the 1950's onwards and it is noted the decline in the flow of all rivers from the 1980s onwards, which coincided with the tendency of the increase of $\delta^{18}O$ in the rings of growth. With the promising results, the formation of a network of multi-proxy growth ring chronologies (width, wood density, chemistry, etc.) is important for a deep understanding of the regional hydrological dynamics.

O15 X-RAY DENSITOMETRY APPLIED IN THE DETERMINATION OF DENSITY, BIOMASS AND CARBON IN THE ANNUAL TREE RINGS OF TROPICAL SPECIES.

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The increase in the concentration of carbon dioxide in the atmosphere and its predicted impact on the climate has been the focus of intense discussion in the world context. With regard to tropical forests, there are still few studies related to primary production and the carbon storage/release rate. The ability of tropical forests to sequester carbon from the atmosphere has been gradually affected in recent decades by the negative impact of rising temperatures and intense and frequent dry periods, slowing growth and causing trees death. In this regard, studies to calculate biomass in tropical forests use allometric equations, with the wood density value commonly taken from the databases. The use of these data sources, which can lead to inaccurate results, due to the trees wood density variation, according to age, trunk position, environment, etc. In this regard, X-ray densitometry is an efficient and accurate method, recording the density, biomass and carbon in the annual tree rings of tropical species. This methodology thus allows obtaining tree-rings annual multi-proxy parameters of tropical species, with application in carbon cycle, assessment of climate change effect, dendroclimatology and dendroecology, among others.

O16 A NEW CHRONOLOGY OF CEDRELA FISSILIS (MELIACEAE) FOR SOUTHERN BRAZIL: A COMBINATION OF CLASSICAL DENDROCHRONOLOGY, CLIMATE, AND RADIOCARBON DATING.

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In Brazil, most of the climate database began to be built in 1960. However, to understand the phenomena related to climate change, it is necessary to go back much further in time. One way to access past climate data is using proxies, such as dendrochronology, centred on dating the growth rings of trees. Therefore, it is necessary to use plants that form yearly rings that coincide with recurrent variations in the environment, and these organisms have a long lifespan as well. *Cedrela fissilis* is a long-lived tree that exceed 350 years, the growth rings are formed annually, and it is widely distributed in the South American Hemisphere. Starting from the premise that in the tropical regions of Brazil, the genus *Cedrela* forms annual growth rings, the present work aims to develop a chronology of *Cedrela fissilis*: i. to investigate by cross-dating whether trees (70-110 years of age) form synchronous rings in time that can be cross-dated; ii. to validate the dating of the chronology by the 14C bomb pulse method; iii. to test the influence of temperature and precipitation on the radial growth of the species. If the growth rings are well correlated with each other and with local climate variables, it will be possible to use the *C. fissilis* chronologies to reconstruct the past climate of the region. The study area is in the Brazilian

Southern Plateau (27° 9.908'S; 51° 34.639'W). The chronology was built using 24 trees. High resolution images were used to date the growth rings. Visual dating was checked using Cofecha, and the chronology built in Arstan. The years 1957, 1962, 1963, 1966, 1969 and 1974 were selected to be evaluated by the 14C bomb pulse method. To test the regional climate, the standard deviations of the data obtained from two meteorological stations were calculated. The chronology covers the period 1907-2018 (111 years). Statistics indicate that the chronology is highly reliable and of good quality ($r = 0.49$; $r\text{Bar} = 0.30$; $\text{EPS} = 0.86$; $\text{MSI} = 0.40$). The 14C bomb pulse showed that the trees were accurately dated by the classical cross-dating approach. The comparison between the interannual variation of growth and the deviations of precipitation from November to January (wet period), the growth rings are positively correlated ($r = 0.36$, $n=49$; $p<0.05$). Likewise, May-July temperature deviations and interannual variations in ring width are positively correlated ($r=0.39$, $n=49$; $p<0.05$). Summarizing, the growth is favoured by periods with abundant rainfall and low winter temperatures act negatively. This response suggests that the species is very sensitive to climatic variations, mainly to interannual changes in soil moisture during the growth period. Radiocarbon analysis showed that *C. fissilis* forms annual growth rings, even in places where the rainfall regime is relatively equally distributed throughout the year. The consistent match between 14C signatures in tree rings with those expected for the atmosphere during the nuclear era (after 1950) confirmed that well-dated subtropical tree-ring records can be used for paleoclimatic reconstructions of these regions, in addition to many other applications in ecological studies.

O17 A TROPICAL TO TEMPERATE FOREST SHIFT IN SOUTH AMERICA: HISTORICAL BIOGEOGRAPHIC CONNECTIONS BETWEEN THE ANDES AND THE ATLANTIC COAST DURING THE LGM.

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The presence of Andean plant genera in moist forests of the Brazilian Atlantic Coast has been historically hypothesized as the result of cross-continental migrations starting at the eastern Andean flanks. Here we test hypotheses of former connections between the Atlantic and Andean forests by examining distribution patterns of selected cool and moist-adapted plant arboreal taxa present in 54 South American pollen records of the Last Glacial Maximum (LGM), ca. 19-23 K cal. yrs BP, known to occur in both plant domains. Pollen taxa studied include *Araucaria* Juss., *Drimys* J.R. Forst. & G. Forst., *Hedyosmum* Sw., *Ilex* L., *Myrsine* L., *Podocarpus* L'Hér. ex Pers., *Symplocos* Jacq., *Weinmannia* L., *Myrtaceae* Juss., *Ericaceae* Juss. and *Arecaceae* Bercht. & J. Presl; (sin. *Palmae* Juss., palms). Past connectivity patterns between these two neotropical regions as well as individual ecological niches during the LGM were explored by cluster analysis of fossil assemblages and modern plant distributions. To strengthen our genus-based interpretation, as well as to verify if modern landscapes in Brazil reveal signs of relict populations left by times of connection between these two areas, we carried out a cluster analysis of present-day distributions of six key arboreal species found in both ecosystems. Additionally, we examined the ecological niche of 164 plant species with shared distributions between

the Andes and coastal Brazil. Our results revealed five complex connectivity patterns for South American vegetation linking Andean, Amazonian and Atlantic Forests and one disjunction distribution in southern Chile. This study also provides a better understanding of vegetation cover on the large and shallow South American continental shelf of ca. 1.94 million km² that was exposed due to a global sea level drop of at least 120 m below modern levels during the LGM. Our climatic reconstruction points to very moist and cold conditions for most of South America during the LGM, when cold fronts were intensified and could have been displaced further north than at present.

Keywords: Andes, Atlantic coast, Brazil, connectivity, pollen, LGM.

O18 TROPICAL TREE SPECIES SHOW VARYING DROUGHT RESPONSES OF GROWTH AND INTRINSIC WATER USE EFFICIENCY.

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The rich diversity of tree species in the tropics is seemingly reflected in their variety of responses to climate conditions. We assessed the drought responses of 6 tree species from a seasonally dry tropical forest from southeast Brazil. Species grew more during wet years and show improved water use efficiency as they get bigger and more water-stressed, as expected. However, at least on other species showed the opposite. These findings reveal very different strategies of tropical tree species to cope with water stress, which will likely determine their adaptability to climate change.

O19 ENVIRONMENTAL CHANGES SHOWN BY TREE-RING IN DIFFERENT TIME-SCALES – CASE-STUDIES IN BRAZIL.

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For over a century, tree growth rings have proven to be excellent indicators of the environmental changes where trees have grown, pointing to changes on larger scales, such as regional and even global. Additionally, they are the most accurate dating method available, having perfect annual resolution and even offering intra-annual resolution. This work shows case studies in which Brazilian trees have been used to show environmental changes in decadal and secular timescales. Phenomena that have been observed will be exemplified and how growth rings can be used to understand environmental changes in Brazil and South America in a more integrated way, especially when coupled with other environmental indicators, such as speleothems, paleopalynology and lake sediments.

Theme 2 : Application of geomatics to natural resource management and the environment

O20 CARTOGRAPHIQUE DE LA POLLUTION ATMOSPHÉRIQUE D'O₃ PAR LES MÉTHODES D'INTERPOLATION GÉOSTATISTIQUES PROBABILISTES (KU) ET DÉTERMINISTES (IDW), CAS DE LA VILLE DE KÉNITRA.

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La ville de Kenitra semble connaître une pollution atmosphérique dont l'intensité et la variabilité spatio-temporelle restent à caractériser. En vue de cartographier automatiquement cette pollution et d'élaborer un outil susceptible de permettre de l'évaluer et de faire des prédictions nous avons recours à deux méthodes d'interpolation distinctes : le Krigeage Universel (KU) et la Pondération par l'inverse de distance (PID/IDW). Pour ce faire, 16 sites de typologies différentes sont ciblés.

Les résultats obtenus montrent que l'aspect général des cartes élaborées d'Ozone (O₃) par KU et IDW est approximativement similaire. Cependant la méthode du KU permet de minimiser les problèmes induits par la méthode IDW (pics et puits, information manquante), et de mieux rendre compte de l'aspect continu de la pollution de l'air. Aussi cette méthode a permis également d'obtenir des représentations plus proches de la réalité.

L'utilisation du KU et IDW nous a permis de montrer que la ville de Kénitra pourrait être affectée par une pollution à caractère envahissant par O₃ lequel présente une variabilité saisonnière et une distribution spatiale opposée dans ses teneurs. Les conditions météorologiques (vent, température, humidité...) ont des effets évidents sur les différents aspects de la pollution.

O21 L'ÉVOLUTION DES ÉTAGES BIOCLIMATIQUES DANS LE BASSIN VERSANT D'OUERGHA SOUS L'EFFET DE LA VARIABILITÉ CLIMATIQUE (RIF CENTRAL, MAROC).

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Le changement climatique est devenu l'un des défis environnementaux les plus importants auxquels l'homme est confronté au cours du XXI^{ème} siècle. Ce changement prend plusieurs formes et aspects dont l'essentiel est lié à la variabilité climatique, qui a engendré des effets négatifs sur les territoires menacés, parmi ces effets : la longueur des périodes de sécheresse, la fréquence des inondations. Les scénarios futurs prévoient que le climat du pays enregistrera une régression des précipitations qui atteint 20%, avec une élévation de température entre 2° C et 6° C (GIEC, 2007, 2019). Ce statut effrayant impacte négativement la diminution des ressources en eau d'une part, et d'autre part en raison de la demande croissante de nombreuses utilisations de la population, surtout en vue du nombre croissant des années sèches au détriment des années humides. L'intensité des effets de la variabilité climatique affectera les zones les plus humides et subhumides, comme le cas du bassin versant d'Ouergha.

À travers cette étude, nous voulons analyser les taux des précipitations annuelles fournies par les stations météorologiques selon des échelles variables du temps de 1960 à 2020 (sous forme de cartes de

précipitations), tout en se basant sur la classification bioclimatique de SAUVAGE (1963), afin de détecter spatialement la tendance de l'évolution des précipitations en fonction de la variabilité climatique. Les résultats de l'étude indiquent une régression significative au niveau des apports d'eau, estimée à environ 30%. Les effets de cette variabilité sur les écosystèmes locaux ont été démontrés par le fluage des niveaux bioclimatiques semi-arides et sub-humides au détriment des niveaux humides et per-humides, à des taux qui varient entre 3,3% et 22,6%, suivis d'une exacerbation de la crise de l'eau et son intensité croissante pendant la saison sèche.

O22 LANDSLIDE SUSCEPTIBILITY MODELING APPLYING MACHINE LEARNING METHODS : A CASE STUDY OF AOULAI WATERSHED, PROVINCE OF TAOUNATE, MOROCCO.

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Landslides are devastating natural phenomena that can affect large areas of the world. These events can cause significant damage to habitats, infrastructure and the environment, as well as endangering the lives of people. Understanding the causes, consequences and vulnerable areas and prevention methods is essential to minimize their impact on communities and ecosystems.

Morocco is not immune to this phenomenon, and landslides are relatively frequent there due to the mountainous geography and climatic conditions of certain regions of the country.

The study area subject to this communication is the Aoulai watershed which is a sub-basin of the Ourgha, located to the NW of the province of Taounate. Geologically the study area is part of the Rif chain which extends from the Triassic to the upper Miocene with Palaeozoic cores having recorded traces of the Hercynian orogeny, it is characterized by a complex structure predominantly deep thrusts and surface landslides.

Given this situation in a relatively unstable area, landslide susceptibility mapping has become a necessity to reduce risks and mitigate the potential impacts of these landslides.

In this study we used Machine Learning, this method is based on the development of algorithms and uses several factors, either geological or climatic; Two algorithms were chosen (i) decision tree (DT) and (ii) SUPPORT Vector Machine (SVM). The resulting susceptibility map divides the Aoulai watershed into five landslide risk zones ranging from very low risk zones to very high-risk zones, with differences between the two algorithms in the location of these zones.

O23 SIMULATIONS OF OZONE CONCENTRATIONS IN THE CITY OF MARRAKECH.

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Systematic ambient air pollution data is necessary in order to conduct epidemiological studies necessary to curb and manage the impact of Air pollution on human health in the dust belt region. However, lack of data plagues the regions most impacted by low air quality, due to daunting challenges faced when monitoring air quality such as reference grade air quality monitoring stations that require stable alternating-current electric power supply, expensive reference grade analyzers, and frequent calibration and maintenance, which are all standards that can hardly be met in Africa. Thus, numerical models are an important tool to understand the behavior and estimate the concentrations of species and pollutants in the atmosphere. In this conference, we present Maximum 8hour daily average Ozone concentrations for the city of Marrakech for Winter 2009 and Summer 2015 resulting from forcing simulations with CHIMERE-WRFv2021 with a detailed spatialized inventory. Results compared to observations from two local monitoring stations, show that the model accurately simulates (MDA8) O3 concentrations at JEF Station with a slight overestimation of 16% (NMB) in Summer (Avg: 45ppb) and 37% in Winter (Avg: 33ppb). However, at MHD station, which is less affected by the significant change in anthropogenic activity, the model overestimates O3 concentrations by 91% (Avg: 49ppb) in Summer and by 50% (Avg: 38ppb) in Winter. Looking at the Diurnal O3 average concentrations, the CHIMERE model system overestimates both daytime and nighttime surface O3 concentrations by up to 91% (NMB) in Summer. Pearson's correlation coefficient (r) on the basis of (MAD8) 8h-Maximum daily average O3 concentrations was found to be (S: 0.46, W: -0.07) <0.5 , for LOCAL/ON (S: 0.33, W: 0.21) <0.5 with the MEMSD inventory and (S: 0.36, W: 0.29) with the CAMS inventory, which indicates that the model does not reproduces temporal variability accurately in Marrakech.

O24 STRUCTURAL FEATURES OF THE SOUTH-EAST OF THE SAGHRO INLIER (EASTERN ANTI-ATLAS, MOROCCO): INSIGHTS FROM REMOTE SENSING DATA.

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The Anti-Atlas fold and thrust belt is considered an important metallogenic province on the northern margin of the West African Craton (WAC). This structural domain is mainly controlled by structural features inherited from many orogeneses that underwent an evolution from the Paleoproterozoic onward. Remote sensing investigation is considered an effective tool for studying fracturing and establishing structural maps of sedimentary basins and inaccessible areas.

The Saghro massif of the Eastern Anti-Atlas is a large Precambrian inlier including the highest peak in the range, Jbel Mansour, reaching 2600 meters, along with many other inaccessible areas. In this work, we highlight the use of remote sensing data in the South-East part of the Saghro inlier to depict the tectonic framework and to establish the structural map of this part of the Pan-African belt. Remote sensing allows us, as a first step, to identify promising areas and create lineament maps, which provide an idea of areas with high mineral potential. We particularly focused on determining the local structures and tectonic units by applying many lineament extraction techniques, by processing satellite images from ASTER L1B and Landsat 8 Oli, compared with the mapped faults based on the geological map and the fieldwork.

The results outline directions that are the same as the general tectonic structures of the area. NE-SW and E-W directions correspond mainly to Hercynian faults, while the NW-SE to ESE-WNW directions are related to the late Pan-African phase. The interpreted lineament maps identified new profound faults

in this region and confirmed other linear structures already highlighted by previous geophysical investigations. This work aims to use remote sensing to guide prospectors toward areas that may contain ore concentrations. Therefore, Our synthetic structural map of remote sensing lineaments serves as a framework for future mining exploration.

Theme 3 : Satellite Remote Sensing for an effective natural resource management

O25 ASSESSING NDVI IN THE BEHT WATERSHED THROUGH TIME SERIES ANALYSIS IN GOOGLE EARTH ENGINE (GEE) AND APPLICATION PROGRAMMING INTERFACE (API).

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Climate change represents the most significant menace to the global food system, and its undeniable impacts have spurred extensive scientific research aimed at identifying and assessing its short and long-term consequences. This study integrates two methodologies: the Normalized Difference Vegetation Index (NDVI) and data from the Moderate Resolution Imaging Spectroradiometer (MODIS). Two distinct approaches were employed to extrapolate short-term changes in agricultural regions within the Beht watershed, spanning from 2000 to 2020. Furthermore, the utilization of the Google Earth Engine (GEE) in conjunction with the Application Programming Interface (API) enables the development of JavaScript-based code for this analysis.

The primary contribution of this study lies in the utilization of the Normalized Difference Vegetation Index (NDVI) within the Beht watershed. Time series models were employed to depict the progression of the Vegetation Index during two distinct periods: '2000-01-01' to '2020-01-31' and '2020-01-31' to '2020-12-31'.

The findings indicated that in the year 2000, specifically during the spring season, the index exhibited an evolution from 0.858 (on May 24, 2000). Similar patterns were observed for the year 2020, with values reaching 0.78 (on March 16, 2001), when both variables were associated with a spatial scale of half a square degree. Consequently, NDVI emerges as a valuable indicator for identifying the initiation and conclusion of rainy seasons spanning across decades.

O26 COMPARAISON DES CLASSIFICATIONS DES IMAGES RADAR ET OPTIQUES DANS LA RÉGION SUD-EST DU MAROC.

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La classification de la surface terrestre constitue une application importante dans les données optiques et radars à synthèse d'ouverture.

Dans la présente étude, des classifications supervisées et non supervisées des données Aster et ALOS PALSAR 2 entièrement polarimétriques ont été utilisées pour cartographier les différentes unités géologiques .L'étude couvre la partie Sud-est du Maroc.

L'image polarimétrique complète d'Alos Palsar 2 a été décomposée, filtrée et géoréférencée pour extraire la réponse de diffusion des différentes couvertures terrestres et unités géologiques couvrant la zone d'étude. En outre, la décomposition des cibles polarimétriques et la classification supervisée de Wishart avec 8 classes ont été effectuées. Les signatures de polarisation extraites montrent une corrélation significative avec les classes obtenues en termes de caractéristiques géométriques (rugosité de surface) et dans les compositions minérales. Les résultats montrent que la classification supervisée Wishart et les signatures de polarisation sont excellentes pour distinguer les classes en termes de rugosité de surface, de tailles de grains.

O27 ELABORATION DÉTECTION ET ANALYSE SPATIALE DES RISQUES DES DÉPRESSIONS KARSTIQUES DE L'ATLAS MAROCAIN À L'AIDE DES MODÈLES NUMÉRIQUES D'ÉLEVATION ASTER, ALOS/PRISM ET SRTM.

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Les dépressions karstiques causent des dommages à la fois dans les zones rurales par la perte de terres arables et dans les zones urbaines en raison des dommages aux bâtiments, aux routes et aux systèmes d'approvisionnement en eau. En outre ces dépressions sont des voies d'écoulement préférentielles pour les eaux souterraines dans un système karstique. Dans ce sens, sont motivés de nombreuses études sur leur identification et leur répartition spatiale. Les changements historiques et les variations du nombre et de la forme des dépressions karstiques peuvent être obtenus à partir d'études comparatives de données de télédétection.

Les données d'élévations telles que les contours (forme vecteur) ou sous forme de grille générant des modèles numériques au format 3D, ont été généralement utilisées à des nombreuses fins. Elles sont utiles pour l'interprétation géologique, particulièrement en termes de morphologie, de types de roches et de la structure. Ces informations permettent d'anticiper les caractéristiques de base d'une zone, ce qui est très utile pour les travaux de détail.

Le modèle numérique de terrain est un réseau bidimensionnel de pixels. Chaque pixel correspond à des valeurs d'élévation, représentant des points de la topographie de la Terre. Chaque cellule (pixel) de ce MNT contient une valeur de hauteur. Selon le moyen de génération de cette surface et la taille définie pour les cellules, la hauteur affectée à la cellule est plus ou moins proche de l'exacte réalité.

L'image issue d'un MNT est, en général, composé de 7 éléments de base utiles pour l'interprétation. Ceux-ci incluent la couleur, la texture, le modèle, la forme, l'ombre et l'association (Lillesand et Kiefer, 1979 ; Gupta, 1991). Les techniques d'analyse permettent d'extraire d'autres informations

utiles pour l'analyse de surface. L'extraction automatisée des caractéristiques hydrologiques à l'aide de MNT nécessite l'élimination des dépressions (puits) de la surface du MNT. Un puits ou dépression est considéré comme un pixel parasite qui a une valeur d'élévation inférieure à ses pixels environnants

La zone d'étude est un paysage karstique caractérisé par des dépressions karstiques (dolines), des dépressions fermées dans le calcaire, dont beaucoup contiennent de l'eau stagnante reliée à la nappe phréatique. La base des dolines est généralement scellée par une couche d'argile imperméable recouverte d'eau stagnante ou de végétation herbacée. Nous identifions les dolines en combinant l'extraction de la profondeur du puits à partir des modèles numériques d'élévation (DEM) dérivés d'ASTER, SRTM et ALOS/PRISM, l'analyse morphométrique à l'aide du SIG et l'interprétation visuelle. Notre méthodologie est une approche semi-automatique comportant plusieurs étapes : (a) acquisition de DEM ; (b) calcul de la profondeur du puits en utilisant la différence entre le DEM brut et le DEM correspondant avec les puits comblés à l'aide de l'algorithme de Planchon et Darboux (2001) ; et (c) l'élimination du karst faussement identifié dépressions à l'aide d'attributs morphométriques. Les paramètres suivants ont été obtenus pour chaque DEM : nombre de dépressions, nombre de cellules de dépression, superficie combinée de toutes les dépressions, volume combiné de toutes les dépressions, nombre de cellules de chaque dépression, superficie de chaque dépression et volume de chaque dépression. Pour la comparaison visuelle, les grilles de pente ont été dérivées de chaque DEM en utilisant la méthode développée par Horne (1981). Les paramètres hydro-géomorphologiques ont été, par la suite, évalués à partir des fonctions de la série de traitements d'Arc Hydro. Il s'agit de cours d'eau, les sous-bassins et bassins versants. Ces données au format vectoriel, ont servi de comprendre certaines relations entre, par exemple, la position des puits et dépressions et la pente, ou la densité du drainage, ou la surface du sous bassin, etc.

Les avantages et les limites de la méthodologie appliquée utilisant différents DEM dérivés d'ASTER, SRTM et ALOS/PRISM sont examinés par comparaison avec une carte des karsts générée à partir d'enquêtes géomorphologiques traditionnelles (interprétation visuelle des images de télédétection à haute résolution et des enquêtes sur le terrain). Les données sur la forme, dimension, direction, profondeur, la taille de la zone et l'indice de circularité appropriées des dolines ont été identifiées avec précision et ont permis de générer une véritable carte des dolines. Nos résultats indiquent que la meilleure performance de la méthodologie proposée pour la détection des caractéristiques karstiques à méso-échelle était l'utilisation de données ALOS/PRISM avec une profondeur seuil > 2 m ; surfaces $> 13\ 125$ m² et indices de circularité $> 0,3$ (précision globale de 0,53).

028 L'UTILISATION DE TECHNIQUE SBAS-DINSAR, À L'ÉTUDE DE LA STABILITÉ DES ZONES URBAINES DANS LA VILLE D'AL HOCEIMA, AU MAROC.

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Cette étude se base sur le calcul de la différence de phase DINSAR d'un certain nombre d'images SAR (radar à synthèse d'ouverture) dans la région d'Al Hoceima, en se basant sur l'approche SBAS (Small Baseline Subset), afin d'obtenir un aperçu des performances pour l'étude des déplacements locaux de terrain urbaines, à une échelle millimétrique. L'avantage de sbas est la formation de plusieurs

interférogrammes, en choisissant les bons images masters, par le logiciel ENVI, avec sa plate-forme Sarscape. Les différentes phases de traitement se basent sur la comparaison de changement de phase de plusieurs prises de vue du même endroit en éliminant toutes les perturbations de la géométrie, de la topographie, des conditions atmosphériques... afin de déterminer des points de déplacements verticaux soient des soulèvements ou des affaissements. Les résultats sont représentés sous forme des polygones, par des interpolations SIG. Ils confirment que la zone rifaine est le siège d'instabilités inquiétantes surtout, dans les zones urbaines où il y a un nombre assez important d'habitants, d'infrastructures, et constructions. Tout ça peut être exploiter, dans plusieurs domaines tel que le génie civil, l'industrie, la sécurité humaine ...

O29 LITHOLOGICAL MAPPING USING ARTIFICIAL INTELLIGENCE AND REMOTE SENSING DATA: A CASE STUDY OF BAB BOUDIR REGION, MOROCCO.

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Lithological mapping stands as a critical facet within geological cartography, bearing profound implications for unraveling a region's potential mineralization and facilitating mineral prospecting endeavors. However, the manual execution of this task can be exceedingly challenging, particularly in remote areas necessitating substantial human and material resources. The integration of artificial intelligence (AI) in conjunction with remote sensing data emerges as an innovative approach, promising swiftness, cost-effectiveness, and heightened precision in lithological mapping. This study harnesses AI's capabilities, employing machine learning algorithms such as Support Vector Machine (SVM), Random Forest (RF), and Artificial Neural Network (ANN), along with deep learning using Convolutional Neural Networks (CNN), to chart the lithological units of this region. Notably, half of this area had remained devoid of existing geological maps.

It's worth noting that this region presents several challenges, including access difficulty and high topographic slopes. Additionally, this study delves into the efficacy of two types of remote sensing data: multispectral data sourced from Sentinel-2A and hyperspectral data from Hyperion. The results unequivocally showcase that SVM and CNN methods yielded the highest overall precision levels, accompanied by significantly elevated Kappa coefficients. The RF classifier also exhibited robust performance, while the ANN approach displayed comparatively lower precision among the methods evaluated. This study underscores the transformative potential inherent in the integration of AI and remote sensing for lithological mapping, particularly in less-explored regions. These findings offer profound insights for future research within the realm of geological cartography, spotlighting the most promising methodologies for this intricate task.

O30 DISTRIBUTION OF VOLCANIC OUTCROPS HIGHLIGHTED BY GEOLOGICAL LINEAMENT MAPPING USING LANDSAT 8-OLI, SENTINEL 2B DATA: SAKA REGION AND ITS SURROUNDINGS IN NORTHEAST MOROCCO.

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The Saka region and its surroundings are located in the North-East of Morocco. The objective of this study is to highlight the relationship between the distribution of volcanism in the region and geodynamics based on the comparison of geological lineament mapping from Landsat-8 optical satellite and Sentinel-2B radar data.

Lineament mapping, a vital component of any structural geology investigation, is made more effective and easier by the availability of optical and radar remote sensing data, such as that from Landsat-8OLI and Sentinel-2B, with medium and high spatial resolutions. The results from these multi-resolution data vary due to differences in their spatial resolution and sensitivity to soil occupation. The accuracy and clarity of the lineaments that can be retrieved are significantly influenced by the spatial resolution of the satellite images. The obtained results show a strong correlation between the directions (three main directions: NE-SW, E-W, NW-SE) of the lineaments and faults which are followed by the distribution of volcanic outcrops in Saka region and its surroundings.

The lineaments manually obtained from digitizing the existing Neo-tectonic map (faults) and satellite photos (Lineaments) of the field of research are compared to the lineaments extracted using directional filtering in order to confirm the accuracy of the results. The density was utilized to research the correlation between the concentration of lineaments and the distribution of existing faults, and the geologic map was used to better correlate the density distribution with the orientations of the spatial distributions of volcanic rocks in the study area.

Keywords: Landsat-8OLI, Sentinel-2B, Automatic Lineament Extraction, mapping lineaments, Saka, volcanic rocks.

Theme 4 : Soil erosion and quality of aquatic environments

031 APPLICATION OF INDICES TO EVALUATE SEDIMENT QUALITY IN THE INAOUENE WATERSHED, UPSTREAM THE IDRISSE 1ST DAM, MOROCCO.

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In order to approach the quality of the sediments in the Upstream Inaouene watershed, a physico-chemical study covering various parameters was carried out at several sites in this watershed, which

covers an area of 3,597.13 km². The study focused mainly on trace metal elements (TMEs), granulometric analysis, total limestone content, organic matter, conductivity and pH. For this purpose, the approach adapted is based on the calculation of contamination and pollution indices, such as the geoaccumulation index (Igeo), the contamination factor (CF), the degree of contamination (DC) and the sediment pollution index (SPI). Obtained results that particles with a predominantly coarse particle size predominate in the Inaouene watershed, but while approaching the dam, fine particles become dominant. These sediments have a high carbonate content, but a low organic matter content. The analysis of TMEs revealed significant contamination of both natural and anthropogenic origin in the proximity of urban areas (Taza, Oued Amlil), which generate large quantities of wastewater that is discharged directly into the Inaouene river. This situation is favoured by the environment physico-chemical conditions, in particular the alkaline pH of the water, which facilitates the precipitation of TMEs. The geoaccumulation (Igeo), contamination factor (CF) and degree of contamination (DC) indices highlight levels of polymetallic contamination dominated by two or more elements. By comparing the classification of stations according to their average contamination index, the following decreasing order of contamination was observed: Ech1 > Ech6 > Ech5 > Ech4 > Ech2. The index-based approach allows predicting the extent of sediment pollution and identifying polluted sites requiring priority attention in the watershed.

O32 ESTIMATION DE L'ÉROSION HYDRIQUE A PARTIR DES DIRECTIVES PAP/CAR DANS LE BASSIN VERSANT BAS ZIZ.

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Le bassin versant du Bas Ziz est situé au Sud-Est du Maroc et étalé sur une superficie d'environ 2210 km² en occupant la partie Est du bassin Ziz. Ce bassin connaît continuellement les effets de fortes érosions hydriques influencées par l'interaction de plusieurs facteurs naturels telles que la quantité et l'agressivité des précipitations, l'abondance de fortes pentes, la densité faible du couvert végétal et aussi la dominance de terrains friables. Le bassin versant du Bas Ziz a subi aussi l'action anthropique qui rend le milieu très vulnérable à l'érosion. La PAP/CAR est une méthode d'étude qualitative de l'érosion hydrique permettant d'hierarchiser la surface d'un bassin versant en unités distinctes selon la vulnérabilité à l'érosion.

Dans cette étude la cartographie de l'érosion hydrique, ainsi que la définition des tendances et des facteurs causaux grâce à la méthode consolidée PAP/CAR qui est basées essentiellement sur les facteurs naturels permis d'analyser et de comprendre le degré d'état du risque érosif en se basant sur deux approches.

La cartographie de l'approche prédictive fournit des informations sur l'état actuel de la dégradation des sols. La carte fait ressortir trois états, 37,34% des terrains présentent une faible à très faible prédisposition à l'érosion hydrique, 55,96% de la surface du terrain d'étude a une érosion moyenne, le reste soit 6,7% de la surface est très érodable d'une part. D'autre part, la carte de l'approche descriptive a montré que l'érosion en rigoles et ravinement supérieurs et l'érosion en ravinement profond sont les formes les plus apparentes dans la zone d'étude, couvrant respectivement 49.32% et 41.89%.

En effet, la combinaison de ces deux approches montre que l'érosion en rigoles et ravinement sont les plus représentées et coïncident avec des zones où le degré d'érosion est notable à élever. Les formes d'érosion en ravinement profond se trouvent sur des terrains où le degré d'érosion est faible.

O33 SIMULATING THE IMPACT OF FUTURE LAND USE AND CLIMATE CHANGE ON SOIL EROSION IN THE TIGRIGRA WATERSHED (AZROU REGION, MIDDLE ATLAS, MOROCCO).

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Globally, soil erosion is one of the risks that seriously threaten soil and water resources, especially in the most affected regions. In Morocco, this phenomenon constitutes a major problem in the natural territory, particularly in the Rif, montages in the north of the country, where fragile rocks dominate on steep slopes.

This work aims to evaluate erosion of the Tigrigra watershed over the reference period 1985-2020 and two future periods 2050-2070, using the Revised Universal Soil Loss Equation (RUSLE). For future climatic periods (2050-2070), precipitation was produced using a classical statistical downscaling model (SDSM).

On the other hand, the Automata/Markov model (CA_Markov) was used to characterize future land use by modeling in the Idrisi software. Over the two periods, the results showed that annual erosivity varies decreases, or increases. The annual soil loss maps showed that 50% of our study area was in the very low class (80 t/ha/year). These variations are largely due to the effects of climate change and the deforestation/reforestation that the region is experiencing, which then leads to changes in soil erosion due to the important role of these two factors. Furthermore, the average annual erosivity could decrease or increase compared to the current period depending on the projected scenarios of precipitation and land use.

O34 THE IMPACT OF SOIL EROSION ON AQUATIC ENVIRONMENTS : A CASE STUDY OF THE OUED BEHT WATERSHED (MOROCCO).

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A significant environmental issue that impacts the quality of aquatic ecosystems is soil erosion. The risk of soil erosion and deteriorating water quality is rising in the Oued Beht watershed (Morocco) due to its location in a sensitive geographic area. This study intends to examine the causes of soil erosion in this watershed and assess its effects. To accomplish this goal, changes in land use, agricultural practices, soil properties, and precipitation patterns in the Oued Beht watershed were evaluated using a combination of GIS tools and field techniques. The data gathered were evaluated to determine the degree of soil erosion and its effects on aquatic ecosystems.

The results of the study demonstrate a clear relationship between soil deterioration in the watershed and a decline in the water quality of nearby aquatic ecosystems. The main contributors to soil erosion, which increase silt and pollutants in water bodies, are characterized as intensive agricultural expansion, climate change, deforestation, vegetation deterioration, and the slope of the terrain. To anticipate future erosion rates in the Oued Beht watershed while accounting for possible scenarios of climate change and human

development, soil erosion prediction models were used. These simulations highlight the significance of proactive management in halting soil erosion and maintaining the integrity of aquatic habitats. Sustainable agriculture methods and soil conservation measures are suggested as solutions to this environmental problem. In the Oued Beht watershed, incorporating conservation techniques including agroforestry, vegetative buffer strips, and slope management can lessen soil erosion and mitigate its effects on water quality. It emphasizes the necessity of creating and implementing integrated management methods to protect the biodiversity of aquatic ecosystems and soil health. To ensure the protection of aquatic ecosystems and promote environmental sustainability in the Oued Beht watershed region, these findings provide policymakers with crucial information they can use to adopt more sustainable land conservation and management policies.

Theme 5 : Groundwater and Climate changes

O35 ASSESSMENT OF PHYSICOCHEMICAL AND MICROBIOLOGICAL QUALITY USING THE SEQ-EAU APPROACH FOR GROUNDWATER IN THE SAISS BASIN (FEZ-MEKNES REGION, MOROCCO).

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The Saïss water table is one of Morocco's major agricultural regions. Its water resources are used to satisfy domestic, agricultural, industrial, and tourist needs.

The present work focuses on the technique used to detect spatiotemporal variations in the overall physico-chemical, microbiological, and heavy metal quality of groundwater in the Saïss basin, based on the water quality assessment system (SEQ-Eau). A total of 28 samples were collected during high and low water periods, respectively.

The results show that 25% of the stations present average quality during the dry season, and are located mainly in the southern part of the Meknes plateau in the El Hajeb, Boufekrane, and Agouray regions, while this pollution is reduced during the wet season with a percentage of 7.14%. However, the poor quality of groundwater indicates that 75% and 92.85% occupy almost the entire rest of the basin during the dry and wet seasons.

In order to map nitrate pollution in groundwater, the lowest nitrate concentrations were recorded in the southwestern part of the aquifer. The highest values were recorded in the center of the study area, with a maximum value of 118 mg/l, which exceeds the Moroccan standard due to the anthropogenic impact of agriculture and water use.

O36 ETUDE STRUCTURALE PAR LA MÉTHODE SISMIQUE DE RÉFLEXION DANS LE BASSIN DE BOUDNIB (ERRACHIDIA-MAROC).

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La province d'Errachidia-Boudnib, située au sud-est du Maroc, est une zone aride connue pour sa rareté des précipitations. La désertification et la surexploitation des eaux souterraines ont accentué la tendance à la baisse du niveau des eaux souterraines dans les aquifères. Cette étude est faite pour la réalisation en parallèle des programmes d'exploitation, d'études approfondies comprendre et d'identifier la structure et la géométrie des aquifères du bassin. Pour répondre à cet objectif, trois méthodes géophysique ont été menées : sismique, sondage électrique et tomographie électrique.

L'analyse de quelques profils sismiques exécutés dans le bassin de Boudnib a permis de ressortir les réflecteurs sismiques. Le premier réflecteur est attribué au toit de l'Oligocène avec une vitesse moyenne de 1857 m/s. Le toit du Turonien présente une bonne continuité régionale avec une vitesse moyenne de 2840 m/s. L'horizon sénonien, situé au-dessus du réflecteur Turonien présente des vitesses plus faibles (2667 m/s), la vitesse moyenne du réflecteur paléozoïque-mésozoïque est de 3250 m/s. L'horizon le plus profond (3516m) est attribué au Viséen avec une valeur de 5172 m/s.

O37 INFLUENCE DE LA STRUCTURE TECTONIQUE SUR L'ÉCOULEMENT DES EAUX SOUTERRAINES DE LA NAPPE D'EAU LIBRE DU CAUSSE D'EL MENZEL – RIBAT EL KHEIR (MOYEN ATLAS).

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Ces dernières décennies, la demande en eau potable et d'irrigation ne cesse d'augmenter, et les réserves en eau ne cessent de diminuer. Ceci est due à plusieurs facteurs : i) le développement socio-économique lié surtout aux activités agricoles (qui utilisent 88% des ressources hydrique du Maroc selon le rapport de la cour des comptes 2019-2020), ii) l'explosion démographique, et iii) les changements climatiques, ce qui a mis les ressources en eaux souterraines en surexploitation.

Notre projet de recherche consiste à étudier les caractéristiques structuro-hydrogéologiques de la nappe d'eau libre du causse d'El Menzel – Ribat El Kheir (Province de Sefrou). Cette nappe est emmagasinée dans un réservoir multicouche, constitué principalement par des formations carbonatées facturées et bréchifiées du Lias inférieur et moyen, par les dépôts fluvio-lacustres du Plio-Quaternaire, ou par endroit par les basaltes doléritiques altérés du Trias supérieur. La couche basale imperméable est formée par les argiles rouges triasique localement riches en évaporites ; dites « Tamellahte ». De point de vue structurale, la zone d'étude est limitée au NE par un réseau de failles orthogonales près de la boutonnière de Tazzeqa, dont la faille de Qassioua d'orientation N130 à N140, et au SW par la boutonnière d'El-Menzel entourée par des paliers et des rampes érodées orientées N130-N140 et N20-N50. Au NW et au SE, la zone est limitée par les deux branches de l'Accident Nord Moyen Atlasique (ANMA) orientée NE-SW et à jeux polyphasés.

Pour atteindre notre objectif, nous avons effectué des mesures piézométriques dans les puits, durant les

mois de Juillet et Août 2022, pour connaitre les directions et les sens des écoulements souterrains. La géométrie et la structures de l'aquifère sont étudiées par les mesures microtectoniques des failles striées, des fentes de tensions et des diaclases, en plus de la cartographie de la fracturation. La superposition de la carte piézométrique et de la carte de fracturation, nous a permis de mettre en évidence le sens d'écoulement des eaux souterraines, qui se fait du SE vers le NW, le long des failles transversales orientées N130 à N140. Ces failles ont contribué à l'émergence de quelques sources comme celles d'Endouzen et de Tamezourht, et perpendiculairement aux failles N30 à N50. Les jeux normaux de ces dernières ont contribué à l'effondrement des formations liasiques vers le NW. D'autres sources apparaissent au niveau des surfaces de décollement en paliers de chevauchements entre les formations liasiques et leur substrat argileux triasique. A titre d'exemple la source de Ain El kebir (Aghbalou Amoukrane) et la source d'Ain Kebira (Taghbalout Tamoukrante) respectivement à l'W et au SE du village de Qassioua.

O38 WATER RESOURCE VULNERABILITY ASSESSMENT USING ANALYTIC HIERARCHY PROCESS AND GEOGRAPHIC INFORMATION SYSTEMS IN THE FEZ-MEKNES BASIN, MOROCCO.

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During the last decades, research work has led to the questioning of being limited only to the physical parameters of the problem of water scarcity. Researchers, managers and decision makers have therefore adopted a multidimensional approach to all the factors that can affect vulnerability, particularly demographic, socioeconomic and infrastructure factors. The Fez-Meknes basin suffers from overexploitation and groundwater levels continue to decline. The assessment of territorial vulnerability to water scarcity and climate variability is a necessity to spatially delimit the areas likely to be affected. The vulnerability factors of water resources do not have the same impacts in terms of vulnerabilities. It is therefore necessary to rank them and assign them weights according to their relative contributions. A survey was conducted to identify vulnerability factors and to determine the relative importance of each factor.

The main objective of this study is to identify with experts in water resources management and the literature a set of factors deemed relevant, and to know the relative contribution of each factor in terms of vulnerability. To this end, a model, based on the combined use of the method of Analytic Hierarchy Process (AHP), Geographic Information Systems (GIS) and the opinions of experts in the field has been developed in order to define and weigh the vulnerability factors of water resources in the Fez-Meknes basin. The result of this study shows that 25 indicators divided into 4 components (Water resources, demographic and socioeconomic, infrastructure and environment) of vulnerabilities are likely to affect the state of water resources in the study area. The weightings of these indicators and of the 4 components of vulnerability are different from each other, which underlines the relative nature of territorial vulnerability to water scarcity and climate variability. Indeed, the "water resources" and "demographic and socioeconomic" factor groups have the highest values with 0.56 and 0.26 respectively. While the "Infrastructures" and the "Environment" factors presented the lowest values with respectively 0.12 and 0.06.

The investigation to define the different components with their vulnerability indicators, and their hierarchies is important for water resource managers. This research on the selection of factors and especially their weightings showed that the concept of water resources vulnerability has a relative implication because the indicators do not have the same importance in a given territory. This can help water managers in the study area to be more effective and relevant in analyzing the vulnerability of water resources.

O39 UNDERSTANDING SALINITY EVOLUTION IN THE MOROCCAN GHISS-NEKOR AQUIFER USING DIFFERENTIAL MAPPING TECHNIQUE.

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Assessing the spatio-temporal evolution of groundwater hydrochemistry is essential for ensuring the sustainable management of aquifers. The Ghiss-Nekor coastal aquifer, situated in a semi-arid region renowned for long periods of droughts and overpumping, necessitates a comprehensive understanding of its hydrochemical changes to proactively address potential degradation through appropriate management strategies. In this regard, the GIS-based differential mapping technique (DMT) has been employed to assess the salinity evolution in the study area. For this purpose, 48 and 52 samples from the years 2015 and 2022 were analyzed, respectively. As a result, an overall increase in salinity was observed within the Ghiss-Nekor aquifer over time, particularly near the shoreline, namely in the east bank of the Nekor river and near the mouth of the Ghiss river where TDS differences exceeded +7000 mg/L. The examination of Cl⁻ levels over time revealed a notable increase, +129 meq/L near the coastline. Similarly, there was an observed elevation in the levels of various ions, including Na⁺, SO₄²⁻, Mg²⁺, Ca²⁺, K⁺, and HCO₃⁻, reaching differences up to +93.74 meq/L, +21.52 meq/L, +17.28 meq/L, +9.88 meq/L, +0.98 meq/L, and +4.96 meq/L, respectively, along the coastline. In contrast, a decline in the concentration of these ions was noted across most of the study area, particularly in the southern portion (-37.4 meq/L for Cl⁻). The increase of major ion levels in locations near the sea suggests the ongoing deterioration of freshwater sources in the Ghiss-Nekor aquifer due to seawater intrusion. The DMT approach showed its effectiveness in assessing the spatio-temporal changes occurring within aquifers. Thus, the current results encourage the application of this approach in facilitating sustainable development of threatened aquifers affected by salinization processes.

Theme 6 : Hydrology and watershed management

O40 ASSESSING THE IMPACT OF CLIMATE CHANGE ON THE FLOW REGIME OF ZLOUL RIVER AFFLUENTS.

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The Zloul River, one of the principal tributaries downstream of the Sebou River, plays a pivotal role in the overall hydrology of the region, contributing up to nearly 60% of the total flow. However, it faces significant challenges, including flow deficits, evapotranspiration, and inter-basin water transfer. Despite its permanent flow, the Zloul River has been chosen as a case study to investigate the effects of climate change on its hydrological regime.

In its reference state, the Zloul River exhibits a remarkable absence of seasonality, with a high degree of permanence in its flow, rarely experiencing dry periods. To project potential alterations in aquatic conditions resulting from climate change, we analyzed the frequency of aquatic states in the Zloul River using simulations from various Regional Climate Models (RCMs) under two emission scenarios, RCP 4.5 and RCP 8.5, for two future periods: (1) 2030-2060 and (2) 2070-2100. Our analysis, represented in Aquatic States Frequency (ASF) graphs, indicates that most RCMs predict a subtle yet discernible increase in dry states and reduced flow periods for the Zloul River under both RCP 4.5 and RCP 8.5 scenarios. While the Temporary Regime Plot (TRP) indicates the current state of the Zloul River as Permanent (P), under both scenarios anticipate a shift toward Intermittent-Permanent (I-P), particularly in the second period.

In summary, our findings reveal that, during the reference period, the Zloul River maintains a Quasi-perennial regime. However, under the influence of climate change, most models project a slight transition towards Fluent-Stagnant in the first period and Alternate-Stagnant in the second period, highlighting the need for proactive adaptation strategies to ensure the long-term sustainability of this vital watercourse.

O41 ETUDE CLIMATIQUE, COMPARATIVE ENTRE LA PLUVIOMETRIE DE DEUX BASSINS VERSANTS (SOUSS-MASSA ET OUERGHA).

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Le bassin versant du Souss-Massa est situé au centre-ouest du Maroc avec une superficie de 27 800 km². Il est limité par les montagnes de l'Anti-Atlas au sud et du Haut Atlas au nord, l'océan Atlantique à l'ouest et le massif de Siroua à l'est. Le bassin versant d'Ouergha, est un sous bassin versant du Sebou situé sur le Rif Central, il s'étend sur 6150 km². Il est limité au Nord par la crête rifaine, au Sud par les bassins versants des affluents prés rifains du Sebou, à l'Ouest par le bassin versant de Loukous, et à l'Est par le bassin d'Inaouen et ses affluents et du Sebou du pré-rif oriental. Le bassin de Souss-Massa a un climat semi-aride à aride typique. La variation des précipitations est très importante dans le temps et dans l'espace, montrant une nette décroissance des précipitations depuis les montagnes vers les plaines.

Le climat de l'Ouergha est globalement de type méditerranéen, semi-humide, il est caractérisé par de forts contrastes saisonniers et des irrégularités très nettes des précipitations ; une saison sèche estivale et une saison pluvieuse hivernale.

Dans cette étude nous nous sommes appuyés sur une méthode statistique pour analyser le régime pluviométrique au niveau de six stations, Bab Ouender et Mjaara pour le bassin versant d'Ourgha et les stations d'Immerguen, Tamri, Oujjane et Pont Aoulouz pour le bassin du Souss Massa au cours d'une période allant de 1966 à 2017. L'étude comparée des analyses de la tendance, sur les précipitations annuelles au niveau des deux bassins montre une tendance à la baisse des précipitations annuelles au niveau de toutes les stations. Ces résultats montrent que malgré la différence entre les deux bassins de point de vue situation géographique, climatique et exposition des versants, les précipitations connaissent la même nette diminution dans le temps dans toutes les stations. Ce qui nous amène à conclure que nous sommes dans une phase importante de sécheresse climatique qui va durer et par conséquent les ressources en eau au Maroc sont menacées. Ceci s'explique par des circulations atmosphériques qui se distinguent par la présence de l'anticyclone des Açores déterminant les types des temps les plus fréquents et qui se caractérisent par une stabilité atmosphérique.

042 MODÉLISATION HYDROLOGIQUE DU BASSIN VERSANT DE BEHT AVEC LE MODÈLE SWAT.

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La présente étude vise à appliquer le modèle hydrologique pour le bassin versant de Beht en utilisant la modélisation continue via le modèle SWAT (Soil and Water Assessment Tool), mettant en évidence sa performance et son adaptabilité pour des applications régionales plus larges dans des conditions semi-arides. Le modèle a été exécuté sur une période de 17 ans, comprenant deux années de réchauffement (1998-1999), une phase de calibration de janvier 2000 à décembre 2007, et une période de validation de janvier 2008 à juillet 2014.

La méthodologie adoptée comprend la création et la préparation des différentes données d'entrée du modèle, notamment des informations sur le relief, le sol, l'occupation du sol et le climat, suivies de l'analyse de sensibilité du modèle, ainsi que les différents résultats obtenus de calibration, validation et bilan hydrique.

L'analyse de sensibilité a permis d'identifier les paramètres les plus influents, principalement associés aux eaux souterraines : CN2, GW_DELAY, ESCO, EPCO, GWREVP, GWQMN, ALPHA BF, SOL_AWC, et REVAPMN. Les résultats du modèle, à la fois journaliers et mensuels, ont démontré une performance satisfaisante, en termes de critères statistiques, durant les périodes de calibration (NSE=0.64/0.73, R2=0.7/0.75, RSR=0.4/0.3) et de validation (NSE=0.66/0.78, R2=0.8/0.82, RSR=0.28/0.2), en dépit des diverses limitations de l'étude. Le modèle SWAT a été utilisé pour évaluer le bilan hydrique dans le bassin versant de Beht, où l'évapotranspiration (183.35 mm) a dominé, ce qui est typique des conditions semi-arides.

Cette étude démontre la robustesse du modèle SWAT dans la simulation du comportement hydrologique du bassin, soulignant son potentiel pour des applications régionales plus étendues. Ces résultats sont significatifs pour la gestion des ressources en eau dans des bassins similaires.

O43 STUDY AND ASSESSMENT OF THE DROUGHT WITH SPI, SPEI, RDI, NDVI AND EVI INDICES AND ANALYSIS OF THE TRENDS IN MEDITERRANEAN WATERSHED, CASE STUDY OF THE UPPER OUM ER RABIA BASIN, MOROCCO.

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Drought is a severe disaster that affects the world, irrespective of the country or region. Morocco, with its mainly arid to semi-arid climate, is amongst the countries most susceptible to drought. Drought indices have demonstrated their efficacy and have been explored in numerous studies across various regions of the world. The aim of this study is to evaluate the occurrence of drought in the Upper Oum Er Rabia catchment area. For this study, remote sensing data including NDVI and EVI from MODIS Terra and drought indices SPI, SPEI, and RDI were employed in the Upper Oum Er Rabia catchment. The Mann–Kendall test and Sen's slope estimator was employed to conduct a comprehensive trend analysis of precipitation, potential evapotranspiration, temperature, SPI, SPEI, RDI, and NDVI. Results showed a strong correlation between the SPI and RDI indices at various time intervals, while the NDVI had a more significant correlation with SPEI than the other indices. The trend analysis reveals a clear increase in both temperature and potential evapotranspiration. In contrast, there has been a decreasing trend in precipitation and the different drought indices, especially between 2010 and 2022, where we can observe a very significant decrease of -44 mm/year and -0.2/year, respectively.

Keyword : Drought, NDVI, EVI, Trends, Morocco.

Theme 7 : Waste recycling and recovery

O44 ANAEROBIC DIGESTATES FROM COW DUNG AND FOOD WASTE AS FERTILIZERS: EFFECT ON TOMATO GROWTH AND YIELD.

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Organic farming systems aim to reduce chemical inputs including fertilizers and ensure sustainable and eco-friendly production while recycling local renewable resources such as organic wastes. The aim of this study is to investigate the effect of two anaerobic digestates on tomato yield and growth in open field conditions. Digestates consisting of cattle dung and food waste from a 15 m³ demountable digester and fixed-dome digester, respectively, were applied to tomato cultivation using tree fertilization

treatments: 1) raw (PD100) and 2) diluted up to 50% (PD50) cattle dung digestate, 3) food waste digestate (DD), and an unfertilized treatment (control) for 21 weeks. The results showed that tomato plants fertilized with PD50 and DD were significantly higher (+34% and +33%, respectively) compared to the control and PD100 ($p < 0.05$), and all digestate treatments significantly ($p < 0.05$) enhanced plant elongation compared to the control. This study suggests that anaerobic digestates can be a helpful alternative in the perspective of partial substitution of chemical fertilizers for sustainable tomato production.

O45 ENVIRONMENTAL IMPACT ASSESSMENT OF UNCONTROLLED LANDFILLS IN FEZ: A DPSIR ANALYSIS.

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The complex relationship between socio-economic growth and environmental protection remains a controversial topic in the urban landscape. As the city of Fez undergoes a rapid transformation induced by technological advances and urban expansion, the concept of environmental impact emerges as a multifaceted tool, serving both as a spotlight, highlighting the environmental repercussions of anthropic actions, and as a decision-making tool for governing bodies.

The main objective of this work is to provide a transparent and comprehensive assessment of potential environmental impacts, covering areas such as water and air resources, landscape, soil, socio-economic activities, fauna and flora, as well as infrastructure and equipment, in line with the legal and normative framework established by law 28-00, relating to waste management and disposal.

As part of this study, we explored 43 uncontrolled urban landfills, which represent a critical problem affecting several points scattered around the city of Fez. Our approach is rooted in the application of the DPSIR method (Driving forces, Pressures, State, Impacts, Responses), a framework designed to meticulously analyze the causal relationships between the various factors influencing the environment. In addition, we will evaluate each element in terms of its sensitivity, intensity, duration, importance and geographical extent, according to an evaluation matrix. This assessment matrix provides a methodology for quantifying and classifying the adverse effects of landfills on the various ecosystem components at each site, enabling us to establish whether these effects are major, moderate or minor. In response to this assessment, it generates a transparent and comprehensive overview of the significance and degree of each environmental impact.

Analysis using the DPSIR model, and assessment of the negative impacts, show a variability of impact ranging from slight to major, mainly local but continuous. Impacts affect soil, water (changes in flow regime and pollution) and air (dust), with limited biodiversity in the area. Human impacts include noise nuisance, safety concerns for local residents, but also the creation of local jobs with a moderate economic impact thanks to waste collection and recycling. The results of this study show that 43 sites unfortunately present a major to medium impact in all categories. More than fifteen sites have major impacts on the landscape, flora and fauna, socio-economic activities, water and biodiversity. The most

significant impact is concentrated on the landscape, soil and air at 40 of the landfills studied. Riverbeds and watercourses are greatly affected by the dumping of waste, but given that we have been in a period of drought for several years, the impact on water remains relatively low.

In the light of this study, it is clear that illegal landfills interfere with the fragile balance of natural and human ecosystems. This global assessment gives us a better understanding of the impact of illegal landfills on our environment and society. We have been able to highlight areas that require particular attention in terms of waste management and environmental preservation.

O46 PRODUCTION OF LIGHTWEIGHT ECO-FRIENDLY BRICKS BASED ON ORGANIC WASTE AND ITS EFFECT ON THE MATERIAL'S PROPERTIES.

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The current study intends to investigate and contrast the effects of organic wastes in clay mixtures as a construction material additive on the structural, physical, mechanical, and thermal properties of clay bricks. Three clay mixtures have been prepared including 0 wt.%, 5 wt.% and 10 wt.% of waste, and fired at 900°C. The used raw materials have been studied using X-ray diffraction (XRD), X-ray fluorescence (XRF), Scanning Electron Microscopy (SEM), Thermal analysis (TDA-TGA), while the different technological properties of the elaborated bricks have been investigated such as loss on ignition, linear shrinkage, water absorption, bulk density, apparent porosity, flexural strength, compressive strength, and thermal conductivity. It has been noticed that the addition of the organic waste reduced the bulk density and thermal conductivity while increasing the apparent porosity and water absorption, which is typically related to the specimen's porous structure. The mechanical properties (flexural and compressive strength) fulfilling the requirements of the norms for clay masonry units

Theme 8 : Natural substances, their potential for protecting plants against disease

O47 A COMPARATIVE STUDY ABOUT PHENOLIC COMPOSITION AND ANTIOXIDANT ACTIVITY OF SEEDS BELONGING TO APIACEAE.

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The present study aimed to determine the total phenolic, flavonoids content and the antioxidants activities from four seeds belonging to the apiaceae family, caraway (*Carum carvi*) coriander (*Coriandrum sativum* L.), mystical cumin (*Ammodaucus leucotrichus*) and cumin (*Cuminum cyminum* L.) using solvents extractions of varying polarities (water, ethanol, methanol and hexane) Antioxidant activity were assessed by applying Total antioxidant capacity (TAC), 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid (ABTS), 1,1-diphenyl-2-picrylhydrazyl methods (DPPH), ferric reducing antioxidant power (FRAP), and Metal ions chelation.

Based on obtained results from this study present significant deference among the four analyzed seeds. It is clear that the lowest percentage was obtained in hexanic extract for all studied spices. Beside mystical cumin showed a high level of phenolic compounds especially aqueous, ethanolic, and methanolic extracts with yields ranged from 12.59 ± 1.71 to 15.01 ± 1.68 , mg gallic acid equivalents (GAE)/g dry weight (DW) respectively. The analysis revealed variation among the four seeds and even in the same sample concerning to the capacity of each solvent in bioactive compounds extractions. The study is important for our dissertation especially since this spice has been studied in a limited way as food preservative.

O48 EFFECT OF MULCHING, AQUEOUS EXTRACT OF THYMUS ZYGIS L. AND MELIA AZEDARACH L., AND INTERCROPPING WITH CORIANDRUM SATIVUM L., ON WEED MANAGEMENT, YIELD, AGRONOMIC AND PHYSIOLOGICAL PARAMETERS OF BELL PEPPER CROP (CAPSICUM ANNUM L.).

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Weeds, considered as a limiting biotic factor, remain a serious problem for farmers despite the evolution of agronomic science. Faced with this problem, the introduction of agroecological practices in the ecosystem can contribute to meeting the challenges posed by the current agricultural production systems towards efficient production methods that are more respectful of human health and the environment. The objective of this work is to study the effects of aqueous extracts of *Melia azedarach* L. (T2), *Thymus zygis* L.(T3), wheat straw mulching (T4), and intercropping of bell peppers with *Coriandrum sativum* L. (T5), on weeds management and yield of bell pepper crop, and to investigate qualitative and quantitative chemical compounds of aqueous extract of *Thymus zygis* L. *Melia azedarach* L, tested in the laboratory and in the field to understand their herbicidal properties and potential applications. The experiment was carried out at the Agroecology and Environment platform of the National School of Agriculture in Meknes, Morocco, in 2020-2021. Five treatments were tested in a complete randomized block design (CRBD) with three replications. The results showed that there is a significant effect of all treatments on weeds density and biomass, yield, and agronomic and physiological parameters of bell pepper crop compared to the control. In addition, the efficiency of aqueous extracts of *Thymus zygis* L. and *Melia azedarach* L in the field and in the laboratory test on the germination of two weeds: *Glebionis*

coronaria L. and Amaranthus blitum L. The intercropping system treatment showed the highest yield and yield component followed by mulching. The results obtained show that agroecological practices have a significant effect on the parameters measured and yield without any chemical input.

O49 THYMUS ATLANTICUS (BALL) ROUSSINE SUPPLEMENTATION ATTENUATES HEPATIC STEATOSIS IN HIGH-FAT DIET-FED GUINEA PIGS.

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Thymus atlanticus (Ball) Roussine (*T. atlanticus*) is an interesting thyme species that exerts several biological properties, mainly anti-hyperlipidemic, anti-inflammatory, and anti-coagulant activities. The present study aims to evaluate the potential protective effect of *T. atlanticus* aqueous extracts against hepatic steatosis and hyperlipidemia in high-fat diet (HFD)-fed guinea pigs. Twenty-four male guinea pigs were randomly divided into four groups and orally administered daily for 3 months with a normal basal diet for the normal control group, an extract-treated group at 400 mg/kg, the HFD diet, or the HFD supplemented with thyme extract at 400 mg/kg. The findings revealed that the administration of *T. atlanticus* extract significantly decreased liver weight (-26.61%) and plasmatic and hepatic lipids (cholesterol: -54.05%; triglycerides: -43.91%), compared to the HFD group. Additionally, thyme extract remarkably improved the altered hepatic markers (aspartate aminotransferase, alanine aminotransferase, lactate dehydrogenase, and gamma-glutamyltransferase). Furthermore, the histological study revealed that *T. atlanticus* supplementation reduced hepatocyte ballooning and lipid droplets accumulation. Our findings suggest that the dietary intake of *T. atlanticus* aqueous extract could prevent the development of hepatic steatosis.

O50 IN VITRO STUDY: EVALUATING ANTI-AGGREGATION AND PRO-AGGREGATION ACTIVITIES ON RAT BLOOD PLATELETS INDUCED BY TEN MARINE ALGAE FROM THE MARCHICA LAGOON.

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Platelet aggregation has a key role in hemostasis, but dysregulated aggregation can lead to thrombotic disorders. This study explores the potential of marine algae as a novel therapeutic possibility to modulate platelet aggregation. Marine algae are rich sources of bioactive compounds, including polysaccharides and polyphenols, which have demonstrated anti-inflammatory and antithrombotic

properties. This study aims to investigate the impact of ten marine algae (collected from four sites of the Marchica lagoon (Nador, Morocco)) on platelet aggregation.

Through a comprehensive experimental approach, we isolated washed platelets by a series of centrifugation of the whole blood rat, we tested the methanolic extract effect of each marine algae (1 mg/mL) on platelet aggregation induced in vitro by thrombin (0.5 U/mL) in the absence (control) and presence of algae extract.

Our findings reveal that the methanolic extract of four species of green algae and one species of red algae inhibited significantly ($p < 0,05$; $p < 0,01$; $p < 0,001$) platelet aggregation (20 to 90%). While the other algae showed a significant ($p < 0,01$; $p < 0,001$) pro-aggregating activity (12 to 19%).

Phytochemical analyses should be conducted to characterize and isolate the bioactive molecules presented in the marine algae, consequently, evaluate their activities on other hemostasis parameters: bleeding time, coagulation, fibrinolysis, and thrombosis model.

Theme 9 : Production and valorization of plant resources

051 ANTITUMOR EFFECT OF INULA VISCOSA EXTRACTS ON DMBA-INDUCED SKIN CARCINOMA ARE MEDIATED BY PROTEASOME INHIBITION.

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The aim of this work is to study the anti-tumor effect and proteasome inhibitors of *Inula viscosa* extracts on skin carcinogenesis. Female Swiss albino mice were divided into five groups depending on the combination of skin cancer-inducing 7,12-dimethylbenz(a)anthracene (DMBA) and extract of *Inula viscosa* treatments. Histology of the affected skin and measurement of proteasome activity were performed to demonstrate the effect of *Inula viscosa* in mice. The identification of the molecules responsible for this inhibitory activity was carried out through the docking studies. The results showed that *Inula viscosa* extracts inhibit the development of papilloma in mice. Therefore, the best chemopreventive action of *Inula viscosa* was observed in mice in which extract treatment was performed before and after the induction of skin carcinogenesis. Ingestion of extracts *Inula viscosa* delayed the formation of skin papillomas in animals and simultaneously decreased the size and number of papillomas, which was also reflected in the skin histology of the mice treated. Structure-activity relationships information obtained from component of *Inula viscosa* particularly tomentosin, inuviscolide, and isocosticacid demonstrated that distinct bonding modes in $\beta 1$, $\beta 2$ and $\beta 5$ subunits determines its selectivity and potent inhibition for $\beta 5$ subunit.

052 CARACTÉRISATION MORPHOLOGIQUE ET BIOCHIMIQUE DE DEUX VARIÉTÉ DE DATTE BOUEGGOUS ET MEJHOUL ISSUS DE QUATRE RÉGIONS

DIFFÉRENTES AU MAROC.

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Au Maroc, le dattier est cultivé au niveau de plusieurs zones situées généralement au flanc Sud des montagnes de l'Atlas au long des oueds. La majorité de ce patrimoine est concentrée principalement au niveau des vallées du Drâa, du Ziz, de la plaine du Tafilalet et de la zone du Bani (Tata) (Sedra, 2012). La production des dattes au Maroc occupe une place importante parmi les productions arboricoles nationales, elle a augmenté de 101351 tonnes en 2010 à 129562 tonnes en 2017 (FAO)

Dans ce contexte notre étude porte sur différent point :

-Comparaison entre deux variétés des dattes (Mejhoul et Befougous) qui est très demandé au marché de consommation de quatre région Marocain Figuig ; Zagoura ; Tata et Rissani :

ü Caractéristiques morphométriques des dattes.

ü Etudes biochimiques et qualité nutritionnelle des dattes.

ü Détermination de la teneur en minéraux.

-La valorisation de déchets des dattes.

Mot clé : dattes ; morphométrique ; Mejhoul et Beffougous.

053 ETUDE DU COMPORTEMENT DE DEUX GÉNOTYPES DU HARICOT (PHASEOLUS VULGARIS L.) SOUS STRESS SALIN.

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FST Mohammedia.

La salinité est actuellement l'un des problèmes majeurs de l'agriculture dans le monde, ce stress abiotique à côté de la sécheresse est un facteur limitant de la croissance et développement des plantes, la tolérance des plantes reste la solution la plus efficace pour remédier à la situation de stress.

Ce travail est une synthèse d'un travail scientifique qui traite l'impact du stress salin (NaCl) à différentes concentrations (50, 100 et 200 meq) sur certains paramètres de la germination, de la croissance, et de la biochimie de certains génotypes de haricot (coco rosa, coco rose atlas, Haricot blanche) cultivés en pots sous serre contrôlée. Le stress salin est imposé aux plantes à deux stades différents, pendant la floraison et pendant la fructification. Les résultats des indicateurs hydriques tels que la teneur en eau relative (TRE ou RWC) démontrent que les différentes concentrations en sel ont provoqué une dévalorisation de la teneur en eau relative des plantes pendant la période de fructification avec une variation d'un génotype à l'autre. Les valeurs enregistrées des taux de réduction de la TRE passent de 8% pour les plantes traitées à 50 meq de NaCl pour atteindre 10% de chute pour les plantes stressées à 100 meq alors que ces taux s'annulent sous l'effet de 200 meq de NaCl toujours par rapport aux plantes témoins. Pour les paramètres biochimiques, la salinité influence la quantité de sucres solubles et la concentration en

chlorophylle a et b ainsi que la quantité de protéines. Les travaux montrent que la résistance de cette plante varie d'un génotype à l'autre face à ce stress abiotique.

O54 EVALUATION OF THE QUALITY AND OXIDATIVE STABILITY OF VIRGIN OLIVE OIL FORTIFIED WITH ROSMARINUS OFFICINALIS L ESSENTIAL OIL DURING STORAGE.

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The olive tree is among the oldest known cultivated trees worldwide. In Morocco, the land are suitable for its growing, climate is favorable and the ancestral olive growing traditions wich constitute important competitive advantages for the Moroccan olive industry. However, the quality of the olive oil produced is influenced by several factors. In the pursuit of improving and preserving the quality of virgin olive oil, new practices are being tested such as fortification with essential oils. In fact, several studies show that essential oils have powerful properties to capture free radicals. Thus, they were used to improve free radical scavenging activity.

The aim of this work is to evaluate the effect of fortification by Rosmarinus officinalis L essential oil on the quality and oxidative stability of virgin olive oil during storage.

Virgin olive oil was obtained by harvesting olive in discontinuous system, then it was fortified by adding three different concentrations (0.025%, 0.05% et 0.1 %) of Rosmarinus officinalis L essential oil, and were stored at room temperature in opaque glass bottles during a period of eleven months.

The evaluation of the quality (free fatty acids, peroxide value) was carried out every month. The K232, K270 and ΔK was tested every three months. In addition, Polyphenol content DPPH test color assessment and sensory evaluation were carried every three months.

Results obtained showed that the addition of the essential oil of Rosmarinus officinalis L have a significant effect on quality parameters (free fatty acids, peroxide value, The K232, K270, ΔK , color assessment and sensory evaluation), especially free fatty acids (expressed as % oleic acid) that have decreased significantly all over the storage period. In addition, DPPH test showed that IC50 had decreased after the third month of storage. However, Polyphenol content did not show a significant change throughout the storage period. Overall, this study showed a remarkable improvement of the quality of virgin olive oil after the fortification with Rosmarinus officinalis L essential oil.

O55 EXPLORING THE USE OF MEDICINAL PLANTS FOR WEED CONTROL IN AN AGROECOLOGICAL MODEL.

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Weeds pose a significant agricultural challenge for farmers as they cause substantial reductions in crop yields due to their strong competitiveness, rapid reproduction, and short life cycle, which gives them a competitive advantage over other crops. Although considerable advancements have been made in synthetic pesticides that selectively hinder the growth and spread of harmful weeds, thereby greatly reducing or eliminating their germination, these pesticides also present serious environmental and health risks when excessively or improperly applied. Furthermore, traditional weeding techniques are impractical when dealing with larger-scale farming operations. Therefore, it is essential to develop innovative and environmentally sustainable methods to effectively combat detrimental weeds while ensuring the quality and quantity of crops necessary for sustaining the population. Agroecology emerges as a viable and promising approach as it involves the integration of ecological principles into agricultural practices, including the utilization of natural allelopathic properties exhibited by plants, particularly medicinal plants, for weed control. Numerous medicinal plants have demonstrated herbicidal activities against detrimental weeds, and extensive research has been conducted to showcase their efficacy in combating major weed species that affect popular crops such as cereals and legumes. Additionally, various strategies have been proposed to incorporate these plants into large-scale agricultural systems. The present study aims to present notable medicinal plants with well-documented allelopathic effects, along with innovative methodologies for harnessing their potential in the management of hazardous weeds.

O56 JUGLANS REGIA (WALNUT) EFFECT ON HUMAN HEMOSTASIS.

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4: FS, UMV, Rabat, 5: Laboratory of Mineral Solid and Analytical Chemistry, FS-Oujda, UM1.

Objective : Thrombosis is a vital physiological process which consists to form a clot within a blood vessel to stop hemorrhage in case of vascular injury. But, pathophysiological thrombosis, referring to an abnormal situation, occurs when the hemostasis balance is disrupted such as in many chronic diseases. Many drugs directed against hemostasis disorders are used for treating effectively thrombosis, but these molecules present serious negative effects, mainly undesirable bleeding. Currently, there is a need to discover novel and natural antithrombotic drugs with less side effects. Previously, we demonstrated some activities of walnut (*Juglans regia*) on animal hemostasis. In this context, the current study is conducted to search these effects on human hemostasis.

Methodology: The crude aqueous extract (CAE) of bark of *Juglans regia* roots was tested in vitro on the human hemostasis. After giving their consent, blood was collected from healthy volunteer donors. Then, we studied the effect of CAE on different parameters of the primary hemostasis (platelet adhesion on the collagen-coated surface ; different agonists-induced platelet aggregation), and the secondary hemostasis (coagulation) by measuring prothrombin time (PT) and activated partial thromboplastin time (aPTT).

Results: The data obtained showed that the CAE (1 mg/mL) significantly ($p < 0.001$) reduced the activated platelet adhesion on the collagen-coated surface. In the same way, its effect on platelet aggregation seems to depend on its concentration and on the agonist used. The strongest inhibition of aggregation was observed in case of collagen, while there was no observed effect on arachidonic acid-induced aggregation. Moreover, the extract delays the human blood coagulation cascade by extending significantly ($p < 0.001$) both PT and aPTT.

Conclusion : This study provides evidence that walnut bark extract, by its antiadhesive, antiaggregant, and anticoagulant, could be considered as a promising source of biological compounds for the prevention and treatment of thrombosis.

O57 LES LÉGUMINEUSES ALIMENTAIRES, ENTRE L'AUTOGAMIE ET L'ALLOGAMIE : CAS DES FÈVES AU MAROC.

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Institut national de la recherche agronomique Maroc.

La fève (*Vicia faba* L.) est une culture d'importance agro-écologique et socio-économique au Maroc. Ainsi, dans un contexte climatique changeant, il est important de développer des variétés résilientes et adaptées à différentes contraintes abiotiques et biotiques, notamment des variétés synthétiques performantes et stables en matière de rendement. Pour ce faire, le système de reproduction de la culture doit être parfaitement connu et compris. Le présent travail s'est fixé comme objectif l'estimation du taux d'allogamie chez la fève en conditions marocaines naturelles. Deux variétés de fève et féverole, inscrites au Catalogue officiel, à savoir 'Rena Mora' et 'Zina', respectivement, ont été plantées dans deux environnements contrastés, Douyet (Saïs) et Sidi Allal Tazi (Gharb). Deux marqueurs phénotypiques ont été utilisés pour repérer le croisement ou l'allopollinisation entre les deux variétés : la couleur du tégument de la gaine et la taille et forme des graines. Les deux variétés sont semées en six lignes alternées à raison de six graines par ligne. La parcelle élémentaire s'étend sur une superficie de 12,96 m² et est répétée trois fois par localité. L'expérimentation consiste à compter le nombre de graines à tégument violet dans la descendance de Zina à grains beiges. En outre, l'ensemble des graines récoltées des plantes de 'Reina Mora', a été compté et traité en vue de dépister des différences en termes de taille et de forme. Au total, 859 graines ont été mesurées, notamment leur longueur, largeur et épaisseur. Ces mesures renseignent sur le diamètre géométrique, la surface et la sphéricité et distinguent les graines issues de croisement de celles dérivées d'autofécondation et des parents. A l'issu de cette étude, le taux d'allogamie est estimé à 3,7% à Douyet sur l'ensemble des répétitions et il s'élève à 7,22% à Sidi Allal Tazi. Une pollinisation libre plus fiable pourrait être obtenue en introduisant des colonies d'abeilles et de bourdons ainsi qu'en utilisant des variétés provenant des mêmes pools génétiques géographiques. Les résultats générés peuvent servir de base au programme ultérieur de développement de variétés à pollinisation libre et aux études relatives aux changements climatiques notamment l'évolution de l'abondance des pollinisateurs dans le temps et dans l'espace. En effet, les régions étudiées ont montré une rareté de pollinisateurs naturels, ces résultats peuvent orienter les sélectionneurs dans le choix des variétés parentales et les inciter à introduire des colonies d'abeilles et de bourdons pour garantir une pollinisation adéquate. De plus, une augmentation du taux d'allogamie au fil des années, peut indiquer une amélioration de l'habitat pour les pollinisateurs ou des efforts de conservation fructueux. À l'inverse, une diminution peut alerter sur la nécessité d'interventions pour préserver ces espèces.

058 SIMULTANEOUS OPTIMIZATION OF PHENOLIC COMPOUNDS AND ANTIOXIDANT ABILITIES OF MOROCCAN PIMPINELLA ANISUM EXTRACTS USING MIXTURE DESIGN METHODOLOGY.

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Pimpinella anisum (anise) is a dense vegetal matrix with considerable amounts of bioactive components known for its pharmacological properties. The optimization of extraction constitutes an important key to improving efficacy and avoiding wasting time. Within this framework, the present study was designed to select the most appropriate extractor solvent mixture to extract phenolic and flavonoids using Mixture Design Methodology. The concerned responses were the total phenolic content (TPC), total flavonoid content (TFC) and antioxidant ability examined by 2,2-diphenyl-picrylhydrazyl (DPPH) assay. Before mixture design optimization, a screening of solvents was conducted on ten polar and nonpolar solvents to choose the best solvents that give a maximum of total phenolic compounds. This first step has shown that water, ethanol and methanol were the best-used solvents. Later, an augmented centroid design investigated the solvent system's optimization. The results of simultaneous optimization have shown that the ternary mixture containing 44% of water, 22% of ethanol and 34% of methanol was the most appropriate for simultaneous maximization of TPC, TFC and antioxidant activity with 18.55 mg GAE/g, 7.16 mg QE/g and 0.56 mg/mL, respectively. Our results have shown that using mixture design as an optimization technique was an excellent way to choose the most suitable mixture to extract bioactive compounds, which may represent a promising method of multi-purpose extraction, especially in the pharmaceutical and food sectors.

059 COMPARATIVE STUDY OF THE MINERAL COMPOSITION OF THE CONSTITUENTS OF FIVE CATEGORIES OF AJUGA IVA IN THE FES-MEKNES REGION OF MOROCCO.

Lahrizi LAILA, El GHADRAOUI Lahsen, ERRACHIDI Faouzi

Laboratoire Écologie Fonctionnelle et Génie de l'Environnement, Laboratory of functional ecology and environmental engineering, FST, USMBA, Fez, Morocco

Medicinal plants have played an important role in human nutrition since ancient times. In both culinary and therapeutic systems, whether in conventional or modern medicine, they provide various functionalities as raw materials. The fundamental reason why medicinal plants are used in both traditional and modern medicine is their complex chemical composition. The section of the plant, the type of extract, the components isolated and the method of purification are just some of the many variables that affect the therapeutic potential of a natural medicine.

In this work, we present a comparative study of certain chemical elements in five varieties from five distinguish zones of Ajuga iva, in order to learn more about the nutritional status of this plant.

The mineral elements studied were assayed in the residue of the product calcined at 100°C for 6h, with a test sample of 10g of plant material for each Ajuga iva variety, and the analysis is carried out by Inductively Coupled Argon Plasma Atomic Emission Spectrometry (ICP-AES).

Analysis of these results shows the richness of the Azzeba and Fez varieties in Ca content (58.765 and 55.278) mg/l respectively, compared with the Imouzzar variety with a Ca content of (32.075) mg/l. This compares with the two varieties of Jbel Zerhoune and Moujou with an Fe content of (0.6185 and 0.6869) respectively.

These and other results show that mineral element composition can vary depending on the collection period of the plant analyzed, the living environment, and can even vary significantly depending on the genotype of the same species.

O60 CURED MEAT OPTIMIZATION BY EXPERIMENTAL DESIGN.

Hiba BOUZAIID ¹, Faouzi ERRACHIDI ², Fouad OUZZANI CHAHDI ¹, Lahcen EL GHADRAOUI ², Rachida CHABIR ³, Youssef KANDRI RODI ¹

1: Laboratory of Applied Organic Chemistry, FST Fez, USMBA,

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3: Team of Nutrition, Agri-Food and Environment. Laboratory of Human Pathology, Biomedicine and Environment. FMDP- Fez, USMBA.

The study aimed at the improvement of cured meat products (khlaa) using experimental plackett-Burman design. The idea was to control some factors that impact the formulation, nutritional and organoleptic quality such as salt and spices of marinade. Also, we tried to meet consumer's requirements even we know that they are not willing to compromise their favorite taste for health. Whereas the concentration of salt garlic and coriander cumin and caraway five variables distribute by plackett-Burman design. Khlaa formulations were made and 12 combinations' which was run in triplicate, were developed through experimental design process and stored one year.

Sensory analysis was made by tow statistical tools plackett-Burman design by (JMP) and ACP (Principal component analysis).

The results showed the power of some spices to preserve the taste of the original products after one year of preservation also concluding that the interactions between some spices could be powerful in the preservation and sensory quality even with less salt. Rancid-free products are often associated with either high salt and/or spice, which confirms the possibility of partially dispensing salt, depending on the spices concentrations. Which makes the concentrations of variables able to change the organoleptic quality and even extend the shelf- life and with these results we could start new formulations since we now the most significant factors.

O61 EVALUATION OF THE QUALITY AND OXIDATIVE STABILITY OF VIRGIN OLIVE OIL FORTIFIED WITH ROSMARINUS OFFICINALIS L ESSENTIAL OIL DURING STORAGE.

Latifi HANANE ^{1,2}, Hafida ZAHIR ¹, Salah LAARAJ ², Oumaima AMESLEK ¹, Lamyaa HALTOUT ¹, Kaoutar ELFAZAZI ².

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2: Laboratory of Agro-food Sciences and Technologies of Tadla, CRRAT, INRA-Béni Mellal.

The olive tree is among the oldest known cultivated trees worldwide. In Morocco, the land is suitable for its growing, climate is favorable and the ancestral olive growing traditions which constitute important competitive advantages for the Moroccan olive industry. However, the quality of the olive oil produced is influenced by several factors. In the pursuit of improving and preserving the quality of virgin olive oil, new practices are being tested such as fortification with essential oils. In fact, several studies show that essential oils have powerful properties to capture free radicals. Thus, they were used to improve free radical scavenging activity.

The aim of this work is to evaluate the effect of fortification by *Rosmarinus officinalis* L essential oil on the quality and oxidative stability of virgin olive oil during storage.

Virgin olive oil was obtained by harvesting olive in discontinuous system, then it was fortified by adding three different concentrations (0.025%, 0.05% et 0.1 %) of *Rosmarinus officinalis* L essential oil, and were stored at room temperature in opaque glass bottles during a period of eleven months.

The evaluation of the quality (free fatty acids, peroxide value) was carried out every month. The K232, K270 and ΔK was tested every three months. In addition, Polyphenol content DPPH test color assessment and sensory evaluation were carried every three months.

Results obtained showed that the addition of the essential oil of *Rosmarinus officinalis* L have a significant effect on quality parameters of especially free fatty acids (expressed as % oleic acid) that have decreased significantly all over the storage period. Overall, this study showed a remarkable improvement of the quality of virgin olive oil.

O62 STUDY OF THE INTERACTION EFFECT OF CURCUMA LONGA L WITH ZINGIBER OFFICINALE BY THE DESIGN OF EXPERIMENTS (DOE) MODEL.

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Microbial load of two spices widely used in the Moroccan culinary art, of Zingiberaceae family, in particular turmeric (*Curcuma longa* L) and Ginger (*Zingiber officinale*), revealed the dominance of bacteria and yeasts when compared to molds. We noticed antibacterial activities of Turmeric and antifungal of Ginger. Mathematical model of survival is logarithmic for yeasts and bacteria in Turmeric powder and logarithmic in nature for bacteria and polynomial for yeasts in Ginger powder matrix.

Interactions between studied spices under experimental design were used to evaluate the effects of Turmeric, Ginger and their combination on overall microbial load. To validate obtained results in

experimental design, we applied optimal formula (1% Turmeric and 0.5% Ginger) on animal model by incorporating the optimal formula in chicks' feed. Results showed yeast survival and bacterial absence in Turmeric powder, which means that it has a very important antibacterial activity. On the other hand, Ginger powder showed bacterial survival and very high antifungal activity. From results overall microbial load experimental design, Turmeric showed a negative effect on bacterial growth, while Ginger exerted a positive effect and interaction with a significant amount of Turmeric reduced the indigenous contamination.

Theme 10 : Conservation of animal biodiversity

O63 CARACTÉRISATION DES ÉCOSYSTÈMES NATURELS, DE LA BIODIVERSITÉ, SOCIO-ÉCONOMIQUES ET DES INFRASTRUCTURES POUR UN TOURISME DURABLE DANS LE PARC NATIONAL DE TAZEKKA DANS LA PROVINCE DE TAZA (MAROC)

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1 : FS- Kénitra, UIT,

2 : UCA- Marrakech,

3 : FST-Errachidia.

Cette étude vise à étudier la diversité des écosystèmes naturels, de la faune, de la flore et des infrastructures touristiques de la province de Taza et leur attractivité pour les visiteurs. Nous avons également interrogé les visiteurs et les populations locales sur les activités socio-économiques de la zone d'étude. Des visites de terrain ont été réalisées pour délimiter les écosystèmes, le réseau routier et les infrastructures de la province de Taza. Des transects ont été utilisés pour collecter des données sur la faune et la flore, tandis qu'un questionnaire a été utilisé pour collecter les caractéristiques démographiques et les activités socio-économiques dans le parc national de Tazekka. Les résultats obtenus ont montré une grande diversité d'écosystèmes, notamment des forêts, des steppes, des terres agricoles et des systèmes aquatiques. La faune et la flore documentées étaient diversifiées avec 86 espèces aviaires et 16 espèces de mammifères. Deux oiseaux *Carduelis carduelis* et *Streptopelia turtur arenicola* ont été classés comme vulnérables, tandis que *Neophron percnopterus* a été classé comme espèce en voie de disparition. Deux mammifères *Macaca sylvanus* et *Cervus elaphus barbarus* étaient en voie de disparition. Le réseau routier était avancé avec quatre types de routes (autoroutes, nationales, régionales et provinciales) et les infrastructures hôtelières (hôtels, restaurants, stations-service) étaient diversifiées et bien réparties dans chaque coin de la zone. La disponibilité de ressources naturelles et d'infrastructures bien développées est suggérée pour soutenir des activités durables telles que l'écotourisme, qui devraient ajouter des revenus aux populations locales. En fait, les entretiens sur le terrain ont montré que la zone, principalement le parc national de Tazekka, était visitée par des touristes nationaux et internationaux, ce qui crée des emplois pour les résidents locaux. De même, de nombreuses autres activités telles que l'agriculture, le pastoralisme, les transports et le commerce ont été enregistrées parmi les habitants. Par conséquent, des recherches plus avancées sont nécessaires pour caractériser de nouveaux écosystèmes qui méritent des visites touristiques et comment équilibrer les activités humaines et la durabilité des ressources naturelles.

O64 INTERACTION ENTRE LES RÉSIDUS PÉTROLIER ET LE NOROVIRUS DANS L'ENVIRONNEMENT MARIN.

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Les mollusques bivalves sont des animaux filtreurs, ils cumulent dans leur tube digestif des particules comme les virus et les produits chimiques. Les Norovirus résultant d'une contamination fécale et les produits pétroliers issus des rejets industriels sont retrouvés fréquemment dans les eaux marines. Ce travail vise à révéler la relation entre les Norovirus et les diverses substances pétrolières, et leur influence sur les moules comme un indicateur de pollution de l'environnement marin. A l'aide de la modélisation moléculaire, des modèles des récepteurs du Norovirus basés sur deux entrées PDB : 5J35 et 4QPX ont été établis dans la première phase, ensuite le criblage virtuel des substances pétrolières a été réalisé par rapport aux deux cibles à l'aide du logiciel IgemDock. L'analyse des résultats du Docking ont montré que plusieurs substances pétrolières pourraient former un complexe stable avec des protéines modèles. La stabilité des complexes sélectionnés a été étudiée en utilisant la dynamique moléculaire réalisée avec YASARA Structure.

O65 LARGE-SCALE SURVEY OF BIRD RICHNESS IN MOULOUYA HIGH PLAIN (MOROCCO): COMPARATIVE ANALYSIS AMONG FARMLAND, WETLAND, AND FOREST HABITATS.

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The survey of avian diversity in a specific environment is the first step to comprehend and categorize the importance of this area, then the implementation of suitable conservation policies. In this study, we investigated the avian species in Moulouya High Plain, Morocco, from January 2015 to the end of January 2023. We recorded the richness, phenology, and conservation status of birds among the most dominant ecosystems of the High Plain. In total, 136 avian species, belong to 44 families, and 21 orders were documented in Moulouya High Plain. The phenology status of recorded birds varied among resident breeders (103), migrant breeders (27), and winterer migrants (25) ...

The Near Threatened *Aythya nyroca* (wintering) and *Gypaetus barbatus* (resident summering), Endangered *Neophron percnopterus* (migrant), Vulnerable *Streptopelia turtur* (migrant breeder), and *Chersophilus duponti* (resident breeder) were all spotted in Moulouya High Plain. When comparing diversity indices (such as the Margalef, Simpson, and Shannon-Wiener indexes) and compositional factors (such as taxa and abundance), it was found that farmlands have the least diversity among tested habitats. Finally, our study offers the first and only in-depth data on the abundance of bird life in the Moulouya High Plain. The findings of this inquiry yield priceless information for upcoming monitoring and conservation efforts, at the very least for the most threatened species and habitats.

066 PREHISTORIC LARGE VERTEBRATES IN THE PROVINCE OF JERADA (AÏN BÉNI MATHAR-GUÉFAIT), EASTERN MOROCCO: NEW DISCOVERIES.

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Over the course of more than a decade, our geological and archaeological surveys in the regions of Ain Béni Mathar and Guéfait, located in the Jerada Province of Eastern Morocco, have led to the excavation of remarkable paleontological findings within the nested Quaternary terraces of Oued El Hay/Oued Charef in Ain Béni Mathar. Specifically, complete skulls with intact bone articulations and whole post-cranial skeletons of large vertebrates from diverse taxonomic groups, thriving in a dense forest within the Ain Béni Mathar basin, have been identified.

These Quaternary large vertebrate assemblages are exceptionally well-preserved and represent the first reported instances of their kind in this region. These taxonomic discoveries are poised to enhance the Moroccan faunal diversity spectrum and offer valuable insights into the ecosystems that prehistoric humans in the Ain Béni Mathar and Guéfait regions inhabited. Human activity and subsistence behaviors are likely to have played a significant role in the accumulation of these skeletal remains at these sites. Moreover, at select open-air sites, substantial prehistoric tools belonging to various prehistoric cultures within the "lithic industry" have been associated with these large vertebrate findings, potentially serving as crucial chronological markers.

067 TOWARDS AN ATLAS AND A MONITORING SYSTEM OF CHIROPTERA (MAMMALIA) IN MOROCCO.

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Morocco hosts 105 species of mammals, including 29 Chiroptera taxa. As well as the other vertebrates, they are exposed to multiple severe pressures that led to the rarefaction, and even the disappearance, of several populations. Chiroptera are considered among the best indicators of environmental stressors, while they are implicated in insect pest control and in some infectious diseases. Despite this, insectivorous bats remain insufficiently known in Morocco, mainly due to the very low funding resources. Our research program aims to create a monitoring system of Moroccan bat populations, which can demonstrate how these nocturnal mammals are undergoing an unprecedented collapse in population and initiate a strategy to reverse this trend. The main result of this monitoring is an atlas of Moroccan bats, based on detailed updates of the state of knowledge on bats in Morocco (species list with synonymy and distribution maps, with eventual information on preferred habitats, threatening factors, bio-ecology, predation, parasites, etc.). This update consisted in compiling the published literature on Moroccan bats since 1897, to which we added the several unpublished sources. Using this compilation, we revealed five periods of intensive field investigations that show the progress pattern of the research methods, the number of species identified and the geographical areas investigated. Until the year 2023, 32 bat species were identified in Morocco. This fauna has three patterns of biogeographical distribution : Mediterranean (11 taxa), Palearctic (11 taxa) and Saharan (10 taxa). In

the IUCN Red List, four Moroccan bat species are vulnerable and five others are Near Threatened, while 18 taxa are considered of Least Concern. The remaining five taxa have status of 'Data Deficient' (2 species) or unassessed (3 species). In Morocco, more species seem to be vulnerable or endangered. Indeed, Moroccan bats suffer from huge decline in both population size and geographical extent, mainly due to human disturbances and harvesting of individuals, habitat loss and modification and overuse of pesticides. To define these statuses, we expect to carry out an intensified monitoring of bats, through the entire country.

O68 STUDY OF THE INTESTINAL MICROFLORA OF LOCUST SPECIES IN THE MIDDLE ATLAS MOUNTAINS.

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Locust orthopterans are characterized by a diversification of their diet, which can be explained by many factors including their ability to move, the nature of their mouthparts, the type of environment in which they live and others. In order to identify the elements involved in the choice behavior of these insects, we collected locust species in the Middle Atlas, and studied the microbial composition of their gut microflora (microbiome).

To do this, we dissected each of the individuals studied and recovered the digestive tract. This was segmented into three parts: the stomodeum, mesenteron and proctodeum. These fragments were then ground separately and suspended in a hemolysis tube containing sterile physiological water.

Standard protocols were then used to extract and sequence the genomic DNA of the bacterial strains isolated.

The results revealed a remarkably high bacterial load in the mesenteron of the locust species studied. This composition seems to vary according to the nature of the species' trophic diet. The more diversified the diet, the greater the microbial composition. This shows that the intestinal microflora, via its involvement in plant digestion, contributes to the nutritional choice of a locust species.

O69 STUDY ON THE TOLERANCE OF THE HONEYBEE 'APIS MELLIFERA' TO TWO VARIETIES OF OREGANO ESSENTIAL OILS FOR THE PURPOSE OF DEVELOPING AN ALTERNATIVE METHOD FOR VARROA MITE CONTROL.

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The alarming decline observed in domestic honeybees (*Apis mellifera*) and the high mortality rates of their colonies are attributed to various factors, including pathogens and pests such as the Varroa mite.

The use of aromatic plants or their derivatives as anti-Varroa agents offers a promising alternative to chemical treatments.

The present study aims to assess the survival of bees treated with two varieties of oregano essential oils (EOs) selected for their acaricidal potential against the Varroa mite. These EOs, obtained through hydrodistillation (Clevenger method), underwent Gas Chromatography/Mass Spectrometry (GC/MS) analysis to identify and compare their chemical profiles. Multivariate analysis (Principal Component Analysis - PCA) was employed to correlate their biological activities with their chemical constituents. Bee tolerance was evaluated using two techniques: micro-atmosphere exposure and direct spraying. Bee mortality and their behavior, characterized as 'attractive or repulsive effects of the EOs,' were assessed at concentrations ranging from 0.1% to 5%.

Chemical analysis revealed that Carvacrol is a common major compound in both EOs, constituting 66.90% in OV and 31.37% in OC. Three other major compounds were identified, namely Thymol, γ -terpinene, and p-cymene. PCA analysis unveiled the presence of different chemotypes in Morocco, correlated with the biosynthesis pathway of γ -terpinene and p-cymene, which serve as biogenetic precursors for the two phenolic terpenes, Thymol and its isomer Carvacrol.

The inhibition rate of bees, calculated using the micro-atmosphere technique, ranged from 3.7% to 10.04% for a maximum concentration of 5% for OC and OV EOs, respectively. These low inhibition rates reflect the non-toxic effect of both tested EOs on bees. Regarding the direct contact technique, the results indicated an attractive effect of OC EO, in contrast to OV EO, which had a repellent effect on bees at all studied concentrations.

The results obtained regarding bee tolerance to the two-tested EOs suggest that this treatment approach presents a viable alternative for Varroa mite control in bee colonies. This hypothesis remains to be confirmed through *in vitro* and *in vivo* experiments on contaminated bees over an extended duration. It is important to note that several factors can influence the chemical composition of EOs, and their usage should be approached with caution, ensuring an acceptable acaricidal activity without adverse effects on bees and with minimal to no residues in hive products.

O70 EFFECT OF THE HYDROCARBONS AS PETROLEUM RESIDUES ON THE INTERNALIZATION PROTEIN OF NOROVIRUS IN MUSSELS.

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Bivalve molluscs are filter-feeding animals; they accumulate particles such as viruses and chemicals in their digestive tract. Noroviruses resulting from fecal contamination and petroleum products from industrial discharges are frequently found in marine waters. This work aims to reveal the link between Noroviruses and various petroleum substances, and their influence on mussels as an indicator of pollution of the marine environment. Using molecular modeling, models of Norovirus receptors based on two PDB entries: 5J35 and 4QPX were established in the first phase, then virtual screening of petroleum substances was carried out against the two targets using IGenDock software. Analysis of Docking results showed that several petroleum substances could form a stable complex with model

proteins. The stability of the selected complexes was studied using molecular dynamics performed with YASARA Structure.

Theme 11 : Soil management and biodiversity protection

071 A COMPARATIVE ANALYSIS OF FUNCTIONAL ACTIVITY AND MICROBIAL COMMUNITY COMPOSITION IN AGROECOLOGICAL AND CONVENTIONAL SOIL OF TOMATO CROPS.

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Land management practices are widely known to influence soil quantity. In this ecosystem, telluric microorganisms participate in the biogeochemical cycles of the soil, in particular the transformation of organic matter essential for plant nutrition. The aim of this study was to assess the differences in the functional diversity and structure of microbial communities of soil from two different cultures of tomato plants in Morocco, one with conventional management and the other with agroecological practices. The soil functional diversity was assessed by evaluating the microbial metabolic capabilities using the Biolog EcoPlate™ microplate method and measuring soil enzyme activities. The microbial biomass of bacteria, actinomycetes, and fungi was evaluated by medium-based cultures. The analysis demonstrated that the soil microbial community reacts differently depending on the mode of fertilization. Recording, the biological soil exhibited a significantly upright metabolic activity (AWCD) and diversity compared with the conventional soil. Similarly, the soil activities of b-galactosidase, urease, phosphatase and the number of bacteria, actinomycetes and fungi were higher in the agroecological soil.

072 ETUDE ETHNOBOTANIQUE SUR LA CONNAISSANCE ET L'UTILISATION ALIMENTAIRE ET MEDICINALE DE SILYBUM MARIANUM L. GAERTN DANS LA REGION D'OUZZANE.

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Silybum marianum L. Gaertn est une plante spontanée, identifiée depuis deux mille ans et utilisée pour ses propriétés thérapeutiques. Elle a été utilisée comme médicament populaire et traditionnel en Europe et en Asie. Dans ce contexte nous avons effectué une enquête ethnobotanique menée dans la région d'Ouezzane. L'objectif principal de l'enquête était de mettre en lumière le savoir et l'usage de la plante de *Silybum marianum* L. par la population locale de cette région, afin d'évaluer le niveau de valorisation de cette plante.

L'enquête a été conduite dans différentes communes rurales et urbaines de la province d'Ouezzane (Ouezzane, Zoumi, moqrisset, masmouda et Asjen) sur un échantillon de 140 personnes de différentes catégories d'âge, de sexe, niveau d'étude, etc. Les informations collectées sont analysées statistiquement à l'aide du logiciel de SPSS (IBMq SPSS Statistics version 26). Les résultats de l'enquête ont révélé un degré de valorisation de la plante de *Silybum marianum* fortement restreint.

À l'aide de test statistique khi- carré de Person effectué, nous avons identifié des relations significatives entre nos variables et la connaissance de la plante de *Silybum marianum* d'une part et leurs utilisations d'autre part. Nous avons constaté une relation significative d'abord entre l'âge et la connaissance de la plante de *S. marianum*, ensuite entre le niveau socioéconomique et la connaissance de la plante. De plus entre le niveau d'étude et l'utilisation de la plante, et finalement entre le sexe et l'utilisation de *Silybum marianum*.

L'intensité de corrélation a été évalué à l'aide de test de χ^2 de cramer et Le coefficient Phi Malgré les nombreux avantages de la plante de *S. marianum*, elle reste parmi les plantes les plus négligeables et les moins valorisées au Maroc.

O73 ÉVALUATION COMPARATIVE DE L'ETAT DE CROISSANCE ET DE BIOACCUMULATION DU MANGANESE CHEZ LES POACEES POUSSANT SUR LA MINE DE MANGANESE DE MBEMBELE AU GABON.

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Université Ibn Tofaïl.

Une étude dans les conditions naturelles du site a été menée sur les sols de la digue à résidus de traitement miniers de la mine de manganèse de Mbembele, à Ndjolé dans le centre du Gabon, afin d'évaluer le niveau de Manganèse (Mn) présent dans le sol ainsi que la capacité des Poaceae pour la phytoremédiation du Mn à partir des sols contaminés. Quatre spécimens différents : *Phacelurus gabonensis* - *Cenchrus setosus*, *Panicum* sp, et une espèce de graminée non déterminée (nd), ont été choisies pour leur croissance rapide, leur forte production de la biomasse ainsi que leur adaptation aux sols de la digue à résidus de traitement miniers de la mine de Mbembele. Après une digestion en acide des échantillons de sol et des végétations, les teneurs en Mn ont été analysées dans les extraits en utilisant un ICP-AES. Les résultats concernant le sol montrent de fortes concentrations en Mn, largement supérieures à la composition moyenne de la croûte continentale supérieure (UCC), ce qui indique une forte contamination des sols étudiés en Mn. La biomasse des plantes significativement plus importante après six mois de croissance comparée à zéro et trois mois de croissance indique une bonne adaptation des Poaceae à des fortes teneurs en Mn dans des sols. En général, le Mn est plus accumulé dans les racines des Poaceae que dans les feuilles, excepté l'espèce *Phacelurus gabonensis* qui présente de plus fortes concentrations en Mn dans les feuilles que dans les racines. Cependant, pour tous les spécimens utilisés, Mn est significativement plus concentré dans les tissus des plantes à 3 mois qu'à 6 mois, ce qui indique une capacité d'absorption biologique limitée dans le temps pour ces spécimens. Bien que le facteur de bioconcentration (FBC) < 1 dans toutes les plantes, seule l'espèce *Phacelurus gabonensis* présente un facteur de translocation (FT) > 1 . Ces résultats montrent que parmi toutes les espèces de Poaceae étudiées, *Phacelurus gabonensis* peut être potentiellement utilisée pour la

phytoremédiation du Mn dans les sols. Cette espèce, renouvelée tous les trois mois, pourrait être efficace pour la réhabilitation des sols miniers contaminés en Mn du Gabon.

O74 - EVALUATION OF MICROPLASTICS IN AGRICULTURAL SOILS : A CASE STUDY ON A FARM IN MONCARAPACHO, PORTUGAL - SAMPLING METHODOLOGY, IDENTIFICATION, AND CHARACTERISTICS.

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Microplastics in agricultural soils are of concern due to their potential impact on the ecosystem and have become an important research topic in recent years. Some studies have shown that the size, shape, type, concentration and exposure time of microplastics play a key role in their impact on the environment. The aim of this study was to assess the extent of microplastic pollution in four areas of a farm in Moncarapacho, Portugal, and to verify the effectiveness of our microplastic extraction protocol. The results showed that the abundance of microplastics varies, with microplastic particles in the soil mainly between 50 and 1200 µm in size. The microplastics collected in the samples were classified into four types: Fibres, Foils, Granules and Fragments, with the fibre type being the most abundant and the colour white dominating. The main components of the validated microplastic were the types PES and PE. The colour and shape characteristics of the microplastic in the soil indicate that it probably originates from irrigation systems and plastic waste other than plastic mulch.

Theme 12: Protection and valorization of plants

O75 AMELIORATION D'UN PRODUIT LAITIER PAR MORINGA OLEIFERA.

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This contribution aims to evaluate the potential of Moringa oleifera (MO) as a source of nutritional improvement in human food. The nutritional characterization of MO leaf powder showed a digestibility percentage of 76.51%. Additionally, lactic product supplemented with OM leaves (0–20%) were evaluated. The 5% product was characterized by the best protein digestibility. This study led to the formulation of a lactic food supplemented with dried OM leaves. The drying carried out preserves the proteins (18.4%) and thandryingintheshade (16.44%). The formulated product has the advantage of being part of the food repertoire of our population and easy to prepare.

An analysis of the nutritional and sensory properties using the experimental design method will take place in order to determine the best proportion.

076 COMPARISON OF THE ANTIOXIDANT ACTIVITY OF SELECTED MEDICINAL PLANTS EXTRACTS IN MOROCCO.

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The purpose of this work was to evaluate and compare the antioxidant activity of Hydro-ethanol extracts from a selected number of medicinal plants found in Morocco (*Eucalyptus torquata*, *Thymus broussonetii*, *Lavandula angustifolia*, *Rosmarinus officinalis*, *Ziziphus lotus* and *Acacia raddiana*). The extraction method used was ultrasound. DPPH, TAC, FRAP and ABTS were determined to assess the antioxidant power of each plant studied. *Eucalyptus torquata* was found to have the most powerful antioxidant activity and reductive power of iron (0.048 mg/ml for DPPH and 209.375 mg/g for FRAP), *Rosmarinus officinalis* had the best antioxidant capacity of 1,03 mg AAE g⁻¹ D, while *Ziziphus lotus* had the best ABTS activity of 2.52 x10⁻⁴ mg/ml. All extracts have shown a good antioxidant activity overall, except for *Acacia raddiana*.

077 ESTIMATION DE LA VIRULENCE DES BACTERIES PECTINOLYTIQUES ISOLEES DE DIFFERENTS SOLS DE LA REGION DE CASABLANCA-SETTAT AU MAROC.

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La pomme de terre joue un rôle socio-économique très important au Maroc. Cependant, sa culture est menacée par les bactéries pectinolytiques responsables des maladies, telles que la jambe noire et la pourriture molle, en entraînant des pertes de rendement et une réduction de la qualité des fruits.

L'objectif de cette étude est d'évaluer la virulence de 26 souches bactériennes isolées à partir des échantillons de sol collectés de différentes localités de la grande région de Casablanca-Settat au Maroc. L'isolement a été réalisé par la technique de piégeage. Après l'isolement, la purification d'isolats obtenus a été réalisée par plusieurs repiquages successifs en utilisant la technique quadrant. Par contre, la virulence a été estimée en mesurant le poids de la pourriture formée sur la tranche de la pomme de terre de la variété Désirée, inoculée par un inoculum ayant une concentration d'environ 2.108 UFC/ mL. Un puit d'environ de 3 mm de profondeur confectionné sur la tranche a été inoculé par 1 ml d'inoculum de chaque isolat. Par la suite, les boîtes de Pétri renfermant ces tranches inoculées ont été incubées à 37°C pendant 48 h.

L'observation microscopique des isolats, en utilisant la coloration de GRAM, a révélé que tous les isolats sont des bacilles GRAM négatifs. En plus, tous les isolats sont catalase positive.

En ce qui concerne la virulence, nos résultats ont montré que tous les isolats testés ont provoqué de la pourriture molle sur les tranches inoculées. Également, ils nous ont permis de classer notre souchier en 4 groupes. A ce propos, les pourcentages des isolats faiblement virulents, moyennement virulents, virulents et très virulents sont (11,53 %), (26,9 %), (38,4 %) et (23,07 %) respectivement.

Le résultat de cette étude a mis en évidence l'existence d'une hétérogénéité des souches pectinolytiques dans cette région d'étude. En conséquence, il serait très judicieux d'élaborer une carte géographique à l'échelle nationale pour déterminer est ce qu'il y a une spécificité régionale ou il y a un échange entre les différentes régions par un moyen de contamination.

078 EXPLORING TRADITIONAL MEDICINAL PLANTS FOR ORAL HEALTH IN MEKNES PREFECTURE, MOROCCO: A COMPARATIVE INVESTIGATION OF HERBALISTS' EXPERTISE AND PUBLIC PRACTICES.

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This study aimed to compare the herbalists' knowledge with that of the local population, their prevalence of the use of modern non-pharmacological medicine, and to investigate the traditional knowledge of the use of medicinal & aromatic plants (MAPs) for oral health in Meknes, Morocco. A cross-sectional survey was conducted using a structured questionnaire. Numerous medicinal plant species were identified for oral health, namely *Origanum vulgare* L., *Juglans regia* L., and *Ammi visnaga* L., etc. Most participants reported using these plants for the treatment and prevention of dental caries, gingivitis, and toothache. Herbalists were found to have a greater knowledge of plants and their uses than the general population. However, a significant proportion of participants reported not using MAPs or any traditional remedies and instead opted for modern medicine or dental care and extraction as alternative treatments. This study highlights the abundance of knowledge on medicinal plants for oral health and suggests that herbalists are a significant source of information regarding the traditional use of plants and their importance in relieving various oral diseases. Additionally, the substantial shift of the population towards modern mechanical dentistry treatments indicates the limitations of these natural remedies in treating severe oral ailments. However, efforts should be made to appropriately use these plants for oral health prevention in conjunction with modern dentistry.

079 IDENTIFICATION AND BIOCONTROL STRATEGIES AGAINST DIEBACK DISEASE IN OLIVE TREES (OLEA EUROPAEA L.).

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The olive tree (*Olea europaea* L.) is one of the Mediterranean basins oldest and most traditional cultivated crops. Oliviculture is beneficial to the economies of Mediterranean countries, including

Morocco, which is one of the largest in terms of surface area and olive production worldwide. However, the olive tree, like all cultivated trees, is extremely vulnerable to a wide range of pests and diseases, which can have serious consequences and financial losses. Severe root and crown rot symptoms were observed on olive trees inside an orchard in Ain Blouz, located in the Fes-Meknes region of the country, in February 2020. Based on morphological traits (micro- and macroscopic observations) and cytochrome oxidase subunit II (COXII) gene sequence analysis, *Pythium schmitthenneri* was identified as the main pathogen. The re-isolation of the *P. schmitthenneri* fungus from artificially inoculated olive plants supported Koch's hypothesis. In order to find effective and environmentally friendly approaches to the management of root rot diseases, therefore, the ability of ten antagonistic bacteria to control the pathogen *P. schmitthenneri* was assessed *in vitro* as well as in the greenhouse. These bacterial isolates, belonging to the genera *Alcaligenes*, *Pantoea*, *Bacillus*, *Sphingobacterium*, and *Stenotrophomonas*, were chosen for their potential antimicrobial effects against a variety of pathogens. Results of the dual culture bioassay between the pathogen and the bacterial isolates underlined significant inhibition of mycelial growth, with inhibition rates higher than 70% after 6 days of incubation at 25 °C. The antifungal effect of the volatile organic compounds (VOCs) was observed for all the isolates, with mycelial inhibition rates ranging from 28.37 to 70.32%. Similarly, the bacterial cell-free filtrates showed important inhibition of the mycelial growth of the pathogen. Overall, their efficacy was substantially affected by the nature of the bacterial strains and their modes of action. A greenhouse test was then carried out to validate the *in vitro* results. Interestingly, two bacterial isolates, *Alcaligenes faecalis* ACBC1 and *Bacillus amyloliquefaciens* SF14, were the most successful in managing the disease. These findings suggest that these two antagonistic bacteria could be potential candidates for the biocontrol of olive decline.

O80 OPTIMIZED EXTRACTION OF POLYPHENOLS FROM MILK THISTLE (*SILYBUM MARIANUM* L. GAERTN) USING AUGMENTED SIMPLEX CENTROID DESIGN (THE TAOUNATE REGION).

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Silybum marianum L. Gaertn or milk thistle is a medicinal plant belonging to the Asteraceae family, which has been used in traditional European medicine for almost 2,000 years for its medicinal properties. Some of the health benefits attributed to milk thistle are related to polyphenyls composition (*Silymarine*).

In this study, a 10-point augmented simplex-centroid design was used to formulate a three- component mixture system using water, ethanol, and methanol, adequate for the extraction of polyphenols from different plant parts.

The optimal extraction mixture was:

-For the leaves was 54% water, 24% ethanol, and 22% methanol. The yields of total phenolic were 14.66 ± 0.58 mg gallic acid g⁻¹

-For the stems was 100% water, 0% ethanol, and 0% methanol. The yields of total phenolic were 6.01 ± 0.51 mg gallic acid g⁻¹

-For the flowers was 44% water, 27% ethanol, and 29% methanol. The yields of total phenolic were $16,41 \pm 0.72$ mg gallic acid g⁻¹

-For the whole plant was 55% water, 0% ethanol, and 45% methanol. The yields of total phenolic were 14.97 ± 1.39 mg gallic acid g⁻¹

The results obtained were validated experimentally for the different parts of the plant.

O81 RECENT ADVANCES IN CONTROLLING CROWN GALL DISEASE IN GRAPEVINE (VITIS VINIFERA L.): STRATEGIES FOR SUSTAINABLE MANAGEMENT.

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Grapevine (*Vitis vinifera* L.) is a highly significant perennial plant with more than 6.95 million hectares of vineyards worldwide, producing table grapes, wine grapes, and derivatives. Wine production alone generates a global market value of over 29 billion euros in 2020. Morocco ranks fourth among major grapevine-producing countries, with a vineyard area of 42,286 hectares. Crown gall (CG), caused by the plant pathogenic bacterium *Allorhizobium vitis*, is a critical soil-borne disease affecting grapevines globally. CG leads to tumor-like overgrowths on roots and can cause severe productivity loss and even death in infected plants. This review aims to provide insights into the recent research on grapevine crown gall, focusing on management strategies to control this disease. The review examines current methods such as preventive agricultural practices, and curative biological control based on beneficial microorganisms. It also explores the use of resistant vine varieties and agronomic practices to limit disease spread. Identifying gaps in knowledge, the review suggests future research directions, including the development of innovative technologies and biological approaches to protect vine crops and manage this destructive disease.

O82 STRATEGIE DE COMBINAISON DES SOLVANTS POUR UNE EXTRACTION AMELIOREE DES COMPOSES PHENOLIQUES ET DE L'ACTIVITE ANTIOXYDANTE DU MYRTUS COMMUNIS.

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L'objectif principal de notre étude est d'améliorer le processus d'extraction et d'augmenter le rendement des composés du *Myrtus communis* en utilisant une approche de mélange de solvants. Cette optimisation a été réalisée en utilisant un plan de mélange qui comprenait 12 essais et 3 points centraux, basé sur une matrice expérimentale (Augmented Simplex centroid designs), et axé sur deux variables clés : la teneur en composés phénoliques et la valeur de l'IC50. L'éthanol, le méthanol et l'eau ont été choisis comme solvant à mélanger du fait de leur grande utilisation dans l'extraction des métabolites secondaires des plantes.

L'analyse des résultats a été effectuée à l'aide de la réponse iso et de la fonction de désirabilité, permettant d'aboutir à la détermination d'un mélange optimal avec des valeurs anticipées se révélant supérieures à celles obtenues par le biais d'une extraction conventionnelle à l'aide d'un unique solvant. Après validation par point de test, le mélange optimal obtenu a effectivement montré des valeurs supérieures de +31,57% ; +39% et +47,4% en teneur de Polyphénols et un rabaissement de l'IC50 de -20,4% ; -23% et -18,79% en comparaison avec l'extraction à solvant unique respectivement de l'éthanol, l'eau et le méthanol.

083 COMPARATIVE STUDY OF THE EFFECT OF AN ORGANIC HERBICIDE (NETTLE AQUEOUS EXTRACT, URTICA DIOICA L.) AND TWO CHEMICAL HERBICIDES (BENTAZONE AND PYRIDATE) ON AGRONOMIC PARAMETERS, WEED CONTROL EFFICIENCY, AND YIELD OF LENTIL CROP UNDER DIRECT SEEDING SYSTEM.

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Lentil (*Lens culinaris* Medik) is characterized by low weed competitiveness due to its small size and slow development, resulting in the reduction of quality and quantity of production. Controlling these weeds with biological alternatives is necessary because lentils are phytotoxic to most herbicides. To address this gap a field experiment was carried out at the pedagogical research farm of the National School of Agriculture in Meknes, Morocco, during the 2020-21 and 2021-22 crop years, to evaluate the effectiveness of two weeds control strategies, one chemical and the other agroecological. Three treatments were tested in a complete randomized block design (CRBD) with four replications. A nettle aqueous extract (T3), and two post-emergence herbicides (bentazone (T2) and Pyridate (T1)) were tested and compared to the control (untreated) (T0). All treatments resulted in effective weed management (density and biomass), and significant difference in agronomic parameters compared to the control. However, both herbicides used had a phytotoxic effect on the lentil plants, and the minimum yield was achieved in plots treated with Pyridate. In contrast, nettle aqueous extract had no phytotoxic effect, with the highest protein content in the lentil's seeds, the highest economic grain, and a yield almost similar to that of bentazone. The weed species observed in this study require sequential or combined treatments for more effective control and maximum lentil yield.

084 ETHNOBOTANICAL SURVEY OF SILYBUM MARIANUM L. GAERTN IN THE OUEZZANE REGION : KNOWLEDGE AND USE OF THE PLANT.

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Silybum marianum L. Gaertn is a spontaneous plant, identified two thousand years ago and used for its therapeutic properties. It has been used as a popular and traditional medicine in Europe and Asia. In this context, we conducted an ethnobotanical survey in the Ouezzane region, with the primary objective of elucidating the knowledge and utilization of the *S. marianum* plant by the local population of this region, with the aim of assessing the level of recognition and exploitation of this plant.

The survey was conducted across various rural and urban municipalities in the Ouezzane province (Ouezzane, Zoumi, Mokrisset, Masmouda et Asjen), involving a sample of 140 individuals representing diverse age groups, genders, educational backgrounds...

Survey results are analyzed using SPSS (Statistical Package for the Social Sciences (IBMq SPSS Statistics version 26)) software. This powerful statistical analysis platform is used to examine the collected data, in order to extract significant trends and correlations that will contribute to an in-depth understanding of the survey results.

The survey results have revealed a significantly limited level of appreciation for the plant *S. marianum*. Through the use of khi- square statistical tests, we identified significant relationships between our variables and both the knowledge of plant *S. marianum* on the one hand and its use on the other. Specifically, we observed a significant relationship between age and plant knowledge, as well as a similar association between socio-economic level and plant knowledge. Furthermore, significant associations were noted between educational level and plant usage, and ultimately, between gender and *S. marianum* usage.

According to the results of our survey, *Silybum marianum* L. remains one of the most neglected and under-utilized plants in Morocco. This may be due to a lack of knowledge or adequate information on its applications, a general lack of interest or even socio-economic factors that limit its exploitation.

O85 JUNIPERUS THURIFERA AU NIVEAU DU MASSIF DE BOUIBLANE : SURVIE EN PERIL.

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Juniperus thurifera, une espèce qui prospère en altitude, est confrontée à des menaces importantes au Maroc et dans la région méditerranéenne en raison de la détérioration de son environnement, de l'impact de l'activité humaine et de difficultés de régénération. Cette étude se focalise sur l'analyse des variations des caractéristiques dendrométriques associées au dimorphisme sexuel chez le *Juniperus thurifera*. Les

paramètres dendrométriques examinés comprennent la hauteur moyenne, la circonférence à la base et à 1,30 m de hauteur, le nombre de tiges par arbre, le nombre de fruits par pied femelle, et la projection au sol. Ces mesures serviront à estimer l'âge de la population étudiée en utilisant la circonférence à la base comme indicateur. Il est intéressant de noter que la corrélation ($r = 0,511$) entre la projection au sol des individus et l'épaisseur du sol sous le couvert suggère que les peuplements de *Juniperus thurifera* jouent un rôle essentiel dans la rétention du sol et de l'humus, favorisant ainsi la régénération naturelle de la végétation et la germination des graines. Par conséquent, ces peuplements contribuent positivement à la préservation du sol dans cette région montagneuse en fournissant d'importants services écosystémiques, tels que la stabilisation des pentes et la prévention de l'érosion. Un déséquilibre du sex-ratio en faveur des mâles (2,15) provoquera une diminution significative de la production totale de cônes et de graines par les femelles, constituant ainsi une menace sérieuse pour la pérennité des peuplements déjà fragiles au sein du massif de Boulblane. Il est donc impératif d'instaurer un programme de restauration du *Juniperus thurifera* dans son habitat naturel, agissant préventivement avant que la dégradation ne devienne irréversible.

Mots clés : *Juniperus thurifera*, Espèce menacé, Sex-ratio, Dégradation, Régénération, Restauration, Analyse dendrométrique.

Theme 13 : Plant Biotechnology at the Service of the Improvement and Valorization of Plant Resources

086 CHARACTERIZATION AND RECOVERY OF EXTRACTION RESIDUES FROM CANANGA ODORATA YLANG-YLANG FLOWERS.

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Cananga odorata Hooker et Thomson is a tropical tree in the Annonaceae family, recognized by its flowers, which give off a highly fragrant scent due to its high-quality essences. Ylangylang is mainly grown on the islands of Comoros, Madagascar and Mayotte to extract its essential oils. These essences are widely used in various fields, including the perfume, cosmetics and soap industries. Today, they are also used in culinary preparations and for medicinal purposes. Extraction by hydro-distillation involves exposing the flowers to streams of steam, which carry with them all the etheric, water-soluble substances which, after condensation in a watercooled column, yield the essential oil and hydrosol. It should be noted that this extraction process generates a sizeable quantity of by-products (residues), which can have considerable potential (medicinal, cosmetic, fertilizing). These by-products are discharged into the environment as undesirable waste. However, despite the socio-economic importance of these residues, very little information is available on the study of their valorization. As a result, there are increasing problems with the proper management of hydrodistillation residues, which in most cases are burnt and released into the environment. It should be noted that essential oil represents only 2.5% of the raw plant material. It is therefore a real waste to systematically reject the rest of the plant material, which represents over 97.5%. The present work is part of a research program aimed at enhancing the value of waste from industrial units producing ylang-ylang essential oils. The aim is to exploit hydrodistillation

residues as sources of valuable biomolecules. To do this, we brought back samples of ylang-ylang flower residues from the Comoros Islands, cleaned, dried and ground to powder. Biochemical analyses are carried out and biological activities are tested. The results obtained are promising, with biochemical compounds of great interest and antimicrobial activities highlighted. This study is of great interest in the sustainable management of plant resources.

087 EFFET DE CHARBON ACTIF ET DE L'ACIDE GIBBERELLIQUE (AG3) SUR LA PHASE ELONGATION-ENRACINEMENT DES SOUCHES BOURGEONNANTES DE PALMIER DATTIER (PHOENIX DACTYLIFERA .L) CV MAJHOUL.

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Au sud du Maroc, le palmier dattier est l'arbre emblématique de la région de Draâ-Tafilalet. Il est une précieuse ressource économique, alimentaire et écologique. En raison de son importance, le Maroc a lancé un programme ambitieux visé à planter 5 millions de plantules de palmiers dattiers d'ici 2030. Pour répondre à la demande en plantules on a eu recours à la technique d'organogenèse qui permet une production massive, rapide et génétiquement uniforme de vitro plantes. Dans ce travail nous visons l'optimisation de la phase élancement -enracinement par la production des plantules de bonne qualité, le raccourcissement de la durée de cette phase, et l'augmentation du taux de reprise en serre d'acclimatation en étudiant l'effet de charbon actif et de L'acide gibbérellique (AG3) sur la phase élancement-enracinement des souches bourgeonnantes de palmier dattier. Tout en suivant la démarche suivante :

Dans la première expérience, on a repiqué des souches bourgeonnantes de cv majhoul sur un milieu MS dilué à moitié sans hormones semi solide et liquide- additionné par diverses concentrations (1g/l, 2g/l 3g/l, 4g/l, 5g/l) de charbon actif. D'un autre côté, dans la deuxième expérience, nous avons repiqué des souches bourgeonnantes dans les milieux MS dilués à moitié sans hormones semi solides et liquides contenant différentes concentrations d'GA3 (0,5.1.1,5 mg/l). Le témoin est le milieu MS dilué à moitié sans hormones semi solide.

Le résultat montre qu'un bon allongement des feuilles et un bon enracinement ont été enregistrés par le milieu MS dilué à moitié liquide additionné de 5 g de charbon actif. En effet, en utilisant ce milieu, on a obtenu 4 plantules à partir d'une souche bourgeonnante en quatre mois. Ce résultat ouvre la voie à une production de vitro-plants de palmier dattier plus rentable et efficace.

088 EFFET DU STRESS HYDRIQUE SUR LES PARAMETRES MORPHOLOGIQUES ET PHYSIOLOGIQUES DE QUELQUES VARIETES MAROCAINES DU POIS CHICHE (CICER ARETINUM L.).

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Les légumineuses à graines, notamment le pois chiche, constituent une source importante de protéines, des minéraux et de vitamines essentiels pour l'alimentation humaine. Elles occupent la deuxième place dans l'agriculture marocaine après les céréales. Egalement, elles jouent un rôle agronomique essentiel en termes de rotations culturales et de fixation symbiotique d'azote atmosphérique. Le pois chiche, contribue jusqu'à 25 % dans la production nationale des légumineuses après la fève.

Malgré cette importance, le secteur des légumineuses au Maroc, a connu un déclin considérable ces dernières années. La faible production agricole se justifie principalement par la persistance des contraintes abiotiques dont le stress hydrique reste le principal facteur limitant en provoquant des changements dans les traits physiologiques, morphologiques, biochimiques et moléculaires chez la plante.

L'objectif de ce travail, est d'évaluer le comportement de sept variétés marocaines sélectionnées du pois chiche (V1ar, V2bo, V3far, V4mou, V5riz, V6zah et V7roz), vis-à-vis un stress hydrique. Les trois traitements étudiés ont été déterminés en fonction de la capacité au champ : 100 %, 75 % et 50 %. L'expérience a été conduite sous serre en plastique. Les mesures ont été portées sur les paramètres agronomiques, physiologiques et sur la fluorescence chlorophyllienne.

Les résultats obtenus ont montré que le stress hydrique appliqué a induit une diminution de la plupart des paramètres analysés chez la majorité des variétés. Ces manifestations ont été plus accentuées en appliquant un traitement sévère de 50%.

La variété V1ar, est la plus sensible car la hauteur de sa tige et les nombres de ses feuilles ont diminué respectivement de 71 % et 50 %. Tandis que la longueur de la racine a enregistré une diminution de 59 % chez la variété V7roz. En plus, cette dernière variété a produit le taux de matière fraîche le plus faible. Pour la surface foliaire, la réduction la plus élevée (50 %) a été observée chez la variété V4mou, ainsi que sa sensibilité aux stress appliqués a été marqué au niveau de tous ses organes végétaux en termes de la teneur en eau.

Cette étude montre que les paramètres morpho-physiologiques peuvent constituer des bons marqueurs pour déterminer la sensibilité ou la tolérance des variétés de pois chiche au stress hydrique. Et ils peuvent être consolidés par d'autres marqueurs biochimiques et / ou génétiques.

089 IMPACT OF GAMMA IRRADIATION ON MORPHOLOGY/PHYSIOLOGY PARAMETERS AND SEED GERMINATION OF GROUNDNUT (ARACHIS HYPOGAEA .L) IN M5 GENERATION .

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Peanut (*Arachis hypogaea* L.) is an autogamous, annual plant, a good source of vitamins and fats, mainly grown for oilseed, reproduces by self-fertilization, which makes it susceptible to several biotic and

abiotic stresses due to the low genetic variability. In this sense, induced mutagenesis is an effective approach to create new resistant cultivars with desirable morphological characteristics by inducing heritable mutations in the plant genome that affect plant physiology, morphology, and photosynthesis. The objective of this study is to evaluate the morphological and physiological development of two peanut varieties irradiated with three different doses of gamma rays (100Gy, 150Gy, 200Gy) compared to the control (0Gy). Morphometric characterization of descriptive data included, number of days to 80% flowering, germination rate, plant height, stem diameter, number of leaves/plant, number of flowers, stem length and width, length and width of leaflets, the number of branches/plant and the observation of diseases (Chlorosis, Sigatoka and dwarfism). The qualitative and quantitative data obtained were analyzed using SPSS 26.0. The results showed that the doses of gamma irradiation used significantly affected the appearance of flowers; on the other hand, they did not have a significant effect on the rate of germination. Quantitative data showed that gamma ray treatment did not significantly affect leaf number, leaflet length and width, stem diameter and stem length for flower 11. On the other hand, there is a significant difference in plant height and number of branches per plant between control and doses for KP29 compared to other parameters. Irradiation also caused changes in number and color of flowers. The qualitative data showed that the percentage of yellowing and Sigatoka diseases is very low compared to the dwarfing disease for the two varieties.

O90 INDUCEMENT OF TOMATO FRUIT QUALITY UNDER DROUGHT STRESS WITH BIOSTIMULANTS DERIVED FROM OLIVE-MILL-WASTEWATER-COMPOST AND SELECTED MICROORGANISMS.

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Plants growing under drought conditions of the Mediterranean regions suffer from water limitation and nutrient deficiencies, which allows for several mechanisms to cope with these adverse factors. Tomato is one of the most commonly produced vegetables in the Mediterranean regions and is considered a food with high nutritional value as it is low in fat, calories and cholesterol free and rich in vitamins A, E and C.

Nevertheless, until date, the effect of Olive-Mill-Wastewater-Compost (OMWW-Compost) application in combination with soil microorganisms on tomato fruits production and quality under drought conditions has not been evaluated in Moroccan pedo-climate conditions.

This study aims to assess, in semi-controlled conditions, the effect of arbuscular mycorrhizal fungi (pure strain; *Rhizoglyphus irregularis* (M) and *Aoufous consortium* (M')), OMWW-Compost (C), and plant growth-promoting rhizobacteria (*Actinomycetes* (A) and consortium (B) of two bacterial strains *Bacillus* sp. and *Bacillus subtilis*) on yield, quality, and antioxidant richness under drought conditions. Tomato plants (Campbell 33 cultivar) were subjected to two water regimes: 35% of field capacity (Fc) as the unfavorable water regime and 75% of Fc as the favorable one.

The application of C, with double inoculation by M¹ and A (CM'A) increased yield by 282% and the phenol content by 166%, compared to the control. This triple combination improved also the refractive index (Brix), total titratable acidity, total tocopherols and ascorbic acid contents in fruits by 70%, 88%, 157% and 185% compared to the control under drought stress. This combination of biostimulants seems to activate some metabolic processes involved in the growth and tolerance of tomato plants to oxidative stress caused by drought conditions

Amendment with OMWW-compost in combination with AMF and PGPR appears to be a suitable alternative for drought stress management and seems to offer a relatively cheap, easy to apply and effective biostimulants to improve tomato fruits quality.

O90 SOCIAL, ECONOMIC, AND ENVIRONMENTAL IMPACTS OF BIOTECHNOLOGICAL INNOVATION ON THE SUSTAINABILITY OF DATE PALM PRODUCTION IN TAFILALET PALM GROVES (SOUTHEAST OF MOROCCO).

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The sustainability of date palm production, in Tafilalet's palm groves, is threatened by many constraints related to the dryland's severe environment, climate change, and improper human activities. Biotechnological innovations are new agricultural research discoveries increasingly used to improve agricultural sustainability. Such biofertilizer, which has proven its benefits in facing date palm production constraints, improving its productivity, and enhancing soil health.

This article aims to determine the social, economic, and environmental impact of biotechnologies (compost, biofertilizer) on the sustainability of date palm production. Two types of investigation tools were conducted on 47 IPs members. Data were analyzed using factorial, content, and communication network analysis. The results show. Biotechnological innovation can improve soil's water-holding capacity, increase yield, and reduce expenses by decreasing the need for water, fertilizers, and phytosanitary treatments, thus, date producers could reducing the inputs costs and improve their profitability.

Theme 14 : Aquatic ecosystems: resources and valorization

O91 HEPATITIS E VIRUS DETECTION BY RT-QPCR AND HEAVY METAL CONCENTRATIONS IN OYSTER SAMPLES FROM THREE MOROCCAN ATLANTIC COASTAL AREAS, DAKHLA AND OUALIDIA.

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This comparative study assessed hepatitis E virus (HEV) and heavy metal contamination in two shellfish harvesting areas in Morocco, and the correlations between viral and metallic contamination and rainfall. To this aim, HEV and heavy metal contamination was evaluated in 104 oysters samples collected at two Moroccan coastal areas (52 samples/area): Dakhla (class A) and Oualidia (class B). Samples were collected monthly between March 2018 and March 2019, and included oysters from different farms at the Oualidia and Dakhla coastal areas.

HEV were detected by realtime reverse transcription polymerase chain reaction (qRT-PCR) according to the ISO/TS 15216 method. HEV was not detected in any shellfish samples. This qualitative study on contamination by enteric viruses (HEV) highlights the value of regular monitoring of the viral risks associated with bivalve mollusks intended for human consumption.

The study aimed also to investigate heavy metals such as Cd, Hg and Pb in the cultured oysters. The results showed that the heavy metal concentrations in the oysters were in a decreasing gradient in the order Cd > Pb > Hg. The highest concentrations observed were with Cd among the three heavy metals studied in two sampling sites for Oualidia and Dakhla respectively 0.40 ± 0.06 and 0.21 ± 0.012 mg/kg wet weight. Investigated heavy metals in cultured oysters indicated potential risks for human health in future by assessment of the heavy metals.

Generally, oysters from the Dakhla southern coasts presented lower metal pollution and higher quality than those from Oualidia in the north.

092 INCORPORATION OF G-C3N4 NANOSHEETS AND CUO NANOPARTICLES ON POLYESTER FOR THE DIP-CATALYTIC REDUCTION OF 4 NITROPHENOL.

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It's still problematic to figure out how to employ homogeneous catalysts and recycle heterogeneous catalysts in a way that works well together. The primary concern in this work is how to create a competent, affordable, heterogeneous catalyst with great recyclability, easy recovery, and straightforward retrieval and monitoring between reaction cycles. Despite significant work put into developing Copper nanoparticle-based catalysts for the 4-nitrophenol hydrogenation process, the aforementioned parameters are rarely present in a given system. Here, we present a new emerged heterogeneous catalyst by in situ deposition using graphitic carbon nitride g-C3N4/CuO nanoparticles as the active catalyst and polyester (PE) as the inert support. An effective and reusable "dip catalyst" for the reduction of 4-nitrophenol in the presence of NaBH4 has been created by covering the PE matrix with graphitic carbon nitride (g-C3N4) using sonication, followed by the deposition of copper oxide nanoparticles CuO. The prepared fabric PE/g-C3N4/CuO showed very prominent results which displayed in having a great catalytic activity in the reduction of 4-nitrophenol into 4-aminophenol. Further evidence that this catalyst based on prepared PE support can be a good contender for long-

lasting chemical catalysis comes from the remarkable stability at recycling that has been achieved up to 10 reaction cycles without noticeably degrading the catalytic activity.

O93 SPATIO-TEMPORAL MONITORING OF NOROVIRUS BY REALTIME PCR IN OYSTERS FROM THE ATLANTIC COASTAL AREAS OF DAKHLA AND OUALIDIA, MOROCCO.

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Norovirus (NoV) is one of the main causes of global outbreaks of acute viral gastroenteritis. This gastroenteritis are often linked to the consumption of bivalve shellfish, primarily due to the fact that these products are frequently consumed in their raw or lightly cooked forms.

This comparative study assessed Norovirus (NoV) contamination in shellfish harvesting areas in Morocco, and the correlations between viral contamination and rainfall. Samples were analysed using real-time RT-PCR in accordance with the ISO 15216-2 method.

To this aim, NoV contamination was evaluated in 104 Oyster samples (*Crassostea gigas*) collected from two Moroccan coastal areas (52 samples/area): Dakhla (class A) and Oualidia (class B). Samples were collected monthly between March 2018 and March 2019, NoV was detected by RT-qPCR in 5/104 (15.38%) samples.

The 5 oyster-positive samples (5/52) were collected at Oualidia, and none at Dakhla (class A). A non-significant, positive correlation between NoV-positive samples and mean rainfall was observed. The significant detection of Norovirus (NoV) in bivalve molluscs from the Oualidia lagoon highlights the necessity for ongoing monitoring of viral contamination in these molluscs and outline the importance of enhancing wastewater quality to improve the safety of shellfish.

O94 STUDY OF THE GROWTH AND THE PRIMARY METABOLISM OF CHLORELLA VULGARIS AND SCENEDESMUS INCRASSATULUS IN RESPONSE TO THE GROWTH PHASE AND TO NITROGEN AND PHOSPHORUS DEFICIENCY.

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With the aim of valorising the green microalgae *Scenedesmus Incrassatulus* and *Chlorella vulgaris*, the growth and primary metabolites composition of these species were determined under optimal nutrients conditions and in cultures deficient in nitrogen (N-NO3) and phosphorus (P-PO4). Growth was monitored by daily measurements of absorbance at 750 nm and chlorophyll a level (Marker et al., 1980). Proteins were extracted and assayed using the technique of Lowry et al. (1951). Carbohydrates were analyzed using the method of Dubois et al. (1956), while lipids were extracted and assayed using the technique of Folch et al. (1957). Evaluation of the biochemical composition according to the different

growth stages showed that the maximum protein contents is 53.8% and 54.3%, respectively, of the algal biomass of *Scenedesmus Incrassatus* and *Chlorella vulgaris*, were obtained in a culture in the exponential growth phase. The stationary growth phase was marked by an accumulation of carbohydrate contents about 48% and 49.2%. Nitrogen deficiency appears to have a significant effect on primary metabolism of microalgae. This effect is marked by a significant decrease in protein content, followed by an accumulation of lipid substances reaching 45.8% and 53.7% of algal biomass of *Scenedesmus Incrassatus* and *Chlorella vulgaris* respectively. However, the culture deficient in phosphorus, show a lower accumulation of all primary metabolism obtaining 29% and 32.2% for lipids, 21,8% and 21,3% for carbohydrates and 15,6% and 23,3% for proteins of *Scenedesmus Incrassatus* and *Chlorella vulgaris* respectively.

Theme 15 : Blue biotechnologies: Economic and environmental valorization of natural and bioactive substances

O95 ANTIFUNGAL ACTIVITY OF SEVEN RED ALGAE COLLECTED FROM THE REGION OF SIDI BOUZID – EL JADIDA – MOROCCO.

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Pathogenic fungi are responsible for several fungal infections in plant, animal and human populations. An unprecedented number of fungal diseases have recently caused many deaths and extinctions never seen before in wildlife. These infections can cause increasing biodiversity attrition, with broader implications for human and ecosystem health. Despite the numerous studies carried out and the antifungal substances discovered, there are still animal and plant fungal alerts.

Phytopathogenic fungi are responsible for serious plant diseases that might negatively affect crop productivity and its yield, studies and researches are focusing on stopping or at least minimizing this negative effect that threatens our agriculture security.

In this context, a study was carried out with the aim of obtaining new natural compounds with antifungal effects. For this, seven red algae (*Ellisolandia elongata*, *Osmundea pinnatifida*, *Caulacanthus ustulatus*, *Bornetia secundiflora*, *Gracilaria multipartita*, *Gelidium pulchellum* and *Jania rubens*) collected on the coast of El Jadida were extracted in five organic solvents with decreasing polarities and were tested against five phytopathogenic fungi strains. The results obtained showed a significant reduction of diseases caused by the five strains using the extract of different algae species, among which the methanolic extract of *Ellisolandia elongata* and *Gracilaria multipartita* showed a significant reduction in the growth of strain 2. The lowest minimum inhibitory concentration obtained was 1.95 mg/mL.

O96 ASSESSING THE ANTIOXIDANT AND ANTIFUNGAL POTENTIAL OF TOTAL FLAVONOIDS EXTRACTED FROM SEAWEED GROWING ON THE SIDI BOUZID

COAST IN EL-JADIDA, MOROCCO.

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Fungal infections present a significant health challenge due to their substantial impact and the increasing resistance observed against conventional antifungal drugs. Simultaneously, oxidative stress has garnered substantial attention in the realm of health and well-being. In response to these pressing issues, this study aims to pioneer the development of innovative, broad-spectrum, highly potent, and less toxic antifungal and antioxidant compounds.

The primary objective of this investigation was to evaluate the antifungal and antioxidant properties of total flavonoids extracted from seven species of seaweed. To achieve this, five pathogenic fungal strains, affecting both humans and plants, were meticulously isolated and identified. Bioactive compounds were subsequently extracted from algae collected along the shores of Sidi Bouzid, El Jadida, Morocco.

The results unveiled the remarkable antifungal efficacy of these extracts, particularly against two resistant strains, as evidenced by their exceptionally low minimum inhibitory concentrations (MICs). *F. spiralis*, in particular, exhibited the lowest MIC values (7 µg/mL), while other strains required MICs ranging from 500 µg/mL to 150 µg/mL when treated with the studied algae. Furthermore, the antifungal effects of ketoconazole and thymol were evaluated and compared with those of seaweed extracts, acting as positive controls.

Regarding the assessment of the anti-radical potency of total flavonoid extracts, these compounds demonstrated remarkable efficiency, as indicated by the lowest IC50 values (37.5 mg/ml). Importantly, our findings suggest that these extracts could serve as valuable natural antioxidants.

Our ongoing research involves comprehensive chemical analyses aimed at identifying the active components within seaweed extracts and elucidating their mechanisms of action against fungal infections. These results are poised to deepen our understanding of extract efficacy and offer fresh perspectives on the development of targeted, highly effective antifungal treatments with antioxidant properties.

In conclusion, this study underscores the potential of marine algae extracts as a promising reservoir of antifungal and antioxidant compounds. The results highlight their significant activity against specific fungal strains and their ability to counteract lipid peroxidation, thus opening new avenues in the realm of treatment. Continuous chemical analysis and exploration of extract mechanisms of action constitute pivotal steps toward a more profound understanding of their efficacy, paving the way for future research endeavours aimed at developing more effective and precisely tailored antifungal and antioxidant therapies.

Key words: Marin algae, bioactive compounds, total flavonoids, antifungal activity Antioxidant activity.

097 ELABORATION OF SOURDOUGH BREAD SUPPLEMENTED WITH MARINE

ALGAE POWDER USING MIXED TRADITIONAL STARTERS.

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Sourdough can be defined as an acidic sharp-tasting mixture of flour (or flours) and (salted) water obtained after fermentation and used for the development of bread and other cereal-based products. These fermented doughs are very complex biological ecosystems, where lactic acid bacteria (LAB) are dominant organisms, and mostly synergistically co-existing with yeasts. The objective of this study was to elaborate and characterize sourdough bread supplemented with different algae powder and fermented using a mixture of traditional starters of selected lactic acid bacteria (Strain N3, Strain KUH8, Strain BTA 85, Strain 3347, Strain CSCWL2-4, Strain Bi-OTA12, Strain 200434 m, Strain UCCLB95, Strain 22MgMLAF, Strain I5, Strain UCCLB95, Strain HBM-IAUF-5 and Strain HBUAS53641).

Chemical composition of algae and cereal powders were characterized via numerous tests such as determination of pH, dornic acidity, total sugars, flavonoids, total phenolic content (TPC), total proteins content (TP) and microbiological profile. Results of chemical composition showed the pH values ranged from 5.5 to 6 for algae powder samples and from 5.81 to 6.04 for cereal powder samples. Total sugars of algae powder samples were between 0.5 and 0.9 µg/ml and for cereal powder was between 2.9-8 µg/ml. Flavonoids analysis ranged between 1.04-3.50 mgQE/g in seaweed powder and from 7.95 to 18.38 mgQE/g for cereal powder of sample in dry weight. TPC varied between 0.5 and 1.2 µgGAE/g and between 2.840-13.128 µgGAE/g for algae powder and cereal powder samples, respectively.

Microbiological analysis of algae and cereal powder samples revealed that were contaminated with total viable count (TVC) that ranged between 3.6-4.5*10³ CFU/mL and 4.5*10³ CFU/mL, respectively. Seaweed powder contain *Klebsiella* spp. with 4.6-30*10³ CFU/mL and low charge of *Shigella* spp. Moreover, *Escherichia coli*, *Staphylococcus aureus*, *Salmonella* spp. and yeast and molds are absent in both powders. Cereal flour enriched with algae powder was then fermented by a mixture of traditional starters previously isolated in the laboratory and the obtained bread was characterized. Results showed that the supplemented bread with algae is microbiologically safe (absence of soilage bacteria), is rich in bioactive and nutritional compounds and was accepted by the consumers. In conclusion, traditional bread supplemented with algae powder has a high potential added value, shows high nutritional and organoleptic qualities and may have potential benefits for human health.

098 IDENTIFICATION AND CHARACTERIZATION OF PHOTO-PROTECTIVE COMPOUNDS : MYCOSPORINES LIKE AMINO ACIDS FROM THE RED ALGA GRACILARIA GRACILIS.Sara Al QOH ¹, Jamal AMINE ¹, Omar ASSOBBHEI ², Samira ETAHIRI ¹.

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The sun's ultraviolet (UV) rays, known for their harmful effects on the skin, represent a potential danger to human health. To counter these harmful effects, mycosporines-like amino acids (MAAs) produced by marine organisms, such as red algae, offer natural UV protection. In this study, we report the extraction and analysis of MAAs from the red algae *Gracilaria gracilis* collected in the Oualidia lagoon. The extracted mycosporines were fractionated, identified and analyzed by silica gel chromatography

and high-performance liquid chromatography coupled to UV and mass spectrometry (HPLC/UV/MS). Six major mycosporines were identified: Shinorine, Palythine-glutamine (Bostrychine-A), Porphyra 334, Palythine, Mycosporine-GABA, and an unknown in *G. gracilis* extracts. Total mycosporines content was found to be 4.6 ± 0.52 mg g⁻¹ dry weight. The sun protection factor (SPF) of MAAs extracts was calculated using an in vitro spectrophotometric method, and the SPF values obtained ranged from 17.5 ± 0.07 to 28.05 ± 0.21 , depending on extract concentration. These results suggest that *G. gracilis* collected from the Moroccan coast is a rich source of mycosporines and has potential applications in pharmaceuticals and cosmetics.

099 MACROALGAE BIOCOMPOUNDS, AN ALTERNATIVE SOURCE FOR NEW DRUGS IN THE CANCER TREATMENT AND FOR A SUSTAINABLE AGRICULTURE.

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Phytopathogenic diseases are a limiting factor in agricultural production. Approximately, 22% of potato (*Solanum tuberosum* L) are lost each year due to viruses, bacteria, fungi and parasites attacking either tuber or potato plant. Bacterial soft rot it is one of the major diseases of potato with 30-50% of annual loss. The excessive use of synthetic pesticides in the environment causes an increased risk of pesticides resistance, increased pollution, and toxicological implications to human and environmental health. Nowadays, cancer is a critical worldwide public health challenge and its incidences are in increasing trend, it is considered as the leading cause of deaths with a total of 12.5% deaths worldwide.

Natural bioactive molecules derived from seaweed can help plant survival by providing protection against stress imposed by pathogens, could be also powerful anticancer agents, and have higher activities than conventional chemotherapy drugs. The Moroccan coasts, especially the Atlantic coast of Sidi Bouzid (El Jadida) is particularly rich in seaweed and is a reserve of species with considerable economic, social and ecological potential.

As such, the main objectives of this study were to evaluate the effectiveness of algal extracts harvested from the coast of Sidi Bouzid (El Jadida-Morocco) as activators of plant defenses in controlling soft rot of potato in vitro and in vivo, and to characterize the bioactive compounds that can be used as anti-cancer agent.

The brown algae extracts was the best extracts that significantly reduced soft rot disease severity until 90%, the observed protection after treatment was higher than that observed in plants inoculated and pre-treated with reference pesticide. This protection ability was associated with the induction of an activation of the growth parameters. Moreover, the search for active fractions using different purification methods and bioguide tests, showed that one brown algae present a significant antiproliferative activity against human lung cancer cells (NSCLC-N6 and A549) with an IC50

As a result, it can be concluded that seaweeds from the coast of El Jadida are potential sources of new bioactive compounds wish should be investigated as a new alternative source for new drugs in the cancer treatment and for a sustainable agriculture.

O100 MICROBIOLOGICAL AND PHYTOCHEMICAL STUDY OF THE ALGAE ULVA LACTUCA COLLECTED FROM THE MOROCCAN ATLANTIC COAST FOR BIOTECHNOLOGICAL VALORIZATION.

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The Moroccan Atlantic coast, particularly the region of Sidi Bouzid (El Jadida), is known for its richness in algae species. It offers an opportunity for research and development to exploit and valorize these precious bioresources, thus contributing to the economic growth of the region while preserving its marine environment sustainably and rationally.

The present study aims at studying the microbiological and phytochemical properties of the green alga *UlvaLactuca* collected in the Atlantic coast of Sidi Bouzid (El Jadida) was carried out for a biotechnological valorization. Microbiological study consisted of the isolation of new lactic acid bacteria (LAB) strains from algae powder on MRS medium and the study of their biotechnological properties. Regarding the phytochemical study, an economic and ecological solid-liquid extraction process was developed to study the phenolic composition, flavonoids, antioxidant activity, sugars (total and reducing), proteins and chlorophyll determination.

Results showed the isolation of several LAB strains with significant biotechnological potential in terms of fermentation of the algae and the production of bioactive substances (Exopolysaccharides, Enzymes, Antibacterial and antifungal substances, etc.). The identification of isolated LAB strains is still in progress. While the phytochemical study revealed that the weight yields of the phenolic and flavonoid compounds of the studied algae are of the order of 2.89 EAG/100g DM and 9.96g EQ/100g DM respectively. Analysis of total sugars and reducing sugars showed values of 4.06 eq g/L and 9.10 eq Glucose g/L, respectively. The antioxidant activity of the algae based on the reducing capacity of DPPH was of IC50 = 0,49mg/mL. This activity may be linked to the phenolic composition of green algae, which opens up avenues of applied research in the pharmaceutical and agri-food industries. The ability of LAB strains to grow on a culture medium based on algal powder showed a significant acidifying capacity and a significant decrease in pH from an initial value of 7.04 to 2.63 after growth for 10 days by strain U5. Obtained results the green alga *UlvaLactuca* showed a significant potential for the valorization of the studied algae by a biotechnological process using selected LAB strains.

Keywords : Marine algae, *UlvaLactuca*, Lactic acid bacteria, biotechnological properties, Phytochemical analysis, Valorization.

O101 ANTI-CANDIDA SP., POTENTIAL AND FTIR-GC/MS CHARACTERIZATION OF BIOACTIVE COMPOUND FROM PTEROSIPHONIA CAMPLANATA.

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Candida is a fungal pathogen that has been linked to an increase in fungal infections in humans worldwide and it has been linked to contagious diseases of the mucosal surfaces as well as intense muscles. *Candida* can infect mucous membrane tissues such as the mouth, oesophagus, and intestine. *Candida* infections can occur in hospitalized patients and the elderly, which are difficult to treat. Approximately 50% of grownups have *Candida* yeasts in one's mouth, and it is mainly accountable for superficial treatable infectious diseases. On the other hand, *Candida* infections can spread throughout the body and be fatal, especially in immune-compromised patients. Candidiasis is a leading cause of mortality, and *Candida* can switch among two main forms as yeast and hyphae. The transition from yeast to hyphae is thought to be an important major pathogen of *Candida*. Furthermore, *Candida* species produces biofilms on synthetic fabrics that also aids microbe adherence to gadgets and produces the organism remarkably resistant to antifungal agents.

The purpose of this research was to evaluate the *in vitro* antifungal (*Candida tropicalis*, *Candida albicans*) potential of extracts and fractions obtained from red algae *Pterosiphonia camplanata* collected on the Moroccan Atlantic coast. The crude extract was fractionated by silica column chromatography using different combinations of solvents, and the compounds present in the bioactive fraction were identified by FTIR and GC/MS analyses.

The bioactive fraction 1-6-3 eluted with the Hexane/Ether showed a very significant antifungal activity ($P < 0.001$). The fungicidal values of the algae extract fractions studied were found ranged between 13 mm and 37 mm. Likewise, the minimum inhibitory concentration (MIC) and minimum fungicidal concentration (MFC) ranged from 0.07 $\mu\text{g/mL}$ to 0,62 $\mu\text{g/mL}$. Yielding the conclusion that a polar fraction obtained from studied algae presented the best activity against resistant pathogenic fungi.

O102 THE EFFECT OF PHYSICO-CHEMICAL PARAMETERS AND NUTRIENTS ON THE BIOECOLOGY OF GELIDIUM CORNEUM HARVESTED FROM THE MOROCCAN ATLANTIC COAST OF DOUKKALA.

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Gelidium corneum (Hudson) J. V. Lamouroux 1813 (Gelidiaceae, Gelidiales) present on the coast of Morocco is the main important source of raw materials for agar industry in Morocco. This activity provides permanent or temporary employment to more than 8,000 people and brings in more than 274 million dirhams/year. This industry places Morocco among the world's leading producers. The study of the growth of this species has been carried out in four sites of Doukkala Coast in allowtide. This monitoring in the natural environment over a period of two years (March 2019-March 2021) was to evaluate the impact of physicochemical parameters on the algae distribution. Biometric studies (weight and size) were carried out on different thallus in addition to stereomicroscopic observations to identify

fertile thallus. Additionally, measurements of physicochemical parameters and nutrients were conducted each month in situ and in the laboratory.

This study's results showed that the rate of elongation of *G. corneum* is very low, caused probably by the anarchic exploitation of natural fields and the easy access to algae from the upper infralittoral by fishermen on foot. Monthly variation in morphology showed that this species did not reveal any significant morphological variations. The analysis of the frequency histograms of the growth parameters studied (Length, Weight) shows heterogeneity of the population. Multiple regression analyses revealed significant positive relationships between thallus size and weight of the *G. corneum* thalli at the different study sites. The minimum thallus size (13,1 cm) and weight (1,8 g) were recorded in July-August. However, the maximum thallus size (17,3 cm) and weight (4,6 g) were noted in February-March. Fertility started in early winter and continue until summer but the peak of fertility for this species is observed in spring. Total absence of fertile thalli was recorded. From September until January. In conclusion, this study shows that indeed physicochemical parameters have a slight effect on the bioecological parameters.

O103 IMPROVING THE QUALITY AND FUNCTIONALITY OF TRADITIONAL MOROCCAN FOOD PRODUCTS THROUGH INNOVATIVE AND SUSTAINABLE SOLUTIONS: INNOSOL4MED PROJECT.

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The InnoSol4Med project, supported by the PRIMA funding agency, is based on the easy acceptability and adaptability of Mediterranean diet in different cultures, as well as its promotion of individual health and well-being in all regions. The aim of this project is to contribute to individual and overall public health by implementing the concept that the prevention of unhealthy lifestyle habits and dietary practices is more effective when healthy foods are formulated to fit modern lifestyles and are readily available and ready to consume.

The project explores strategic options for the development and commercialization of healthier foods through the formulation of new perceptions, including ingredient enhancement (from nutritive to functional/nutraceutical) and technological solutions (from intense to mild). In this context, InnoSol4Med aims to introduce natural matrices, such as essential oils, natural compounds, and extracts, sourced from sustainable origins, including agricultural by-products, as well as autochthonous microbial strains as new functional ingredients to improve the quality, safety, nutritional value, and functionality of traditional foods.

Ultimately, the project aims to raise public awareness of the health benefits of the Mediterranean diet associated with the positive impact of the innovative solutions developed which would thus contribute to a radical change in bad consumption habits towards a healthier and more sustainable diet. Alongside the nutritional virtues, a positive environmental impact will be established via the valorisation of local agricultural by-products by formulating new functional compounds of high added value, thus promoting the application of profitable industrial processes which will contribute, to waste reduction implying agricultural sectors sustainability.

Keywords : Traditional foods, safety, quality, functionality, innovation, sustainable solutions, Morocco.

O104 VALORISATION ET UTILISATION DES FEUILLES DE CHOU COMME ANTIFONGIQUE NATURELLE CONTRE LES MICROORGANISMES.

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Introduction : Brassica oleracea est une variété de chou à mille têtes ou chou-tige appartenant à la famille des Brassicaceae. Elle est appréciée par son aspect perpétuel, sa productivité, sa rusticité et sa polyvalence culinaire. B. oleracea présente des caractéristiques intéressantes, notamment ses interactions avec les microorganismes du sol et les organismes symbiotiques. Elle est également connue pour produire des glucosinolates, qui peuvent avoir des effets sur les microorganismes du sol, en inhibant la croissance de certains pathogènes ou en modifiant la composition microbienne du sol de manière plus favorable à la plante. Les plantes de la famille des Brassicaceae interagissent avec certaines bactéries qui produisent des substances antimicrobiennes et qui protègent la plante contre les maladies. Par ailleurs, B. oleracea est réputée pour ses effets antifongiques. Lorsqu'une cellule fongique tente d'envahir la plante, les glucosinolates sont hydrolysés par l'enzyme myrosinase pour donner naissance à des isothiocyanates, qui sont toxiques pour de nombreux micro-organismes, y compris les champignons pathogènes. Certains isothiocyanates sont volatils et peuvent agir à distance, ce qui signifie qu'ils peuvent affecter les pathogènes fongiques sans contact direct.

Objectifs : Ce travail a pour objectif, l'exploitation et la valorisation de composés secondaires comme les glucosinolates de la plante sauvage marocaine B. oleracea ainsi que l'effet de ses métabolites sur la rhizosphère.

Méthodologie : Pour se faire, les composés antifongiques vont être extraits à partir des feuilles saines de B. oleracea préalablement cultivé. Des tests *in vitro* seront ensuite réalisés pour évaluer l'efficacité antifongique de l'extrait contre différentes espèces de champignons pathogènes, et des tests de diffusion en gélose ou des tests de dilution en bouillon pour déterminer la concentration minimale inhibitrice (CMI) des extraits obtenus.

Résultats attendus : Obtenir des extraits de feuilles contenant des concentrations significatives de glucosinolates et d'isothiocyanates seront préparés, ainsi que d'autres composés phénoliques ayant une activité antifongique démontrée *in vitro* stable et efficace en conditions de terrain sans aucun effet négatif sur les plantes et l'environnement.

Conclusion : L'utilisation de B. oleracea comme agent antifongique naturel s'inscrit dans une démarche innovante et durable pour la protection des cultures. En exploitant les propriétés bioactives de cette plante, ce travail pourrait offrir une alternative écologique aux fongicides synthétiques, réduisant ainsi la charge chimique dans l'environnement et favorisant une agriculture plus saine.

Mots Clés : Brassica oleracea, glucosinolates, activité antifongique, champignons pathogènes, propriétés bioactives.

Theme 16 : Natural resource compounds: chemical composition, biological activity and toxicity assessment

O105 ANTIFUNGAL MOLECULES POTENTIALISATION BY ESSENTIAL OIL EXTRACTED FROM MOROCCAN CUMIN SEEDS.

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We report in this work the evaluation of cumin essential oil antifungal activity and its interactions when used in combination with some conventional antifungal drugs widely used in the treatment of some skin pathology against yeasts *Candida albicans* and *Candida glabrata*. The pharmacological parameters (minimum inhibitory concentrations (MIC) and fungicides (CMF) were evaluated on liquid YPG medium where growth rate μ (h⁻¹) is the parameter followed to determine the effect of essential oil and its interaction with commercial fungicide molecule by experimental design method. The essential oil was obtained from cumin seeds by hydro-distillation and was then evaluated for the presence of the majority compounds by gas chromatography coupled to mass spectrometry (GC-MS-MS). Analisis revealed the abundance of Cumin-aldehyde (32.5%), γ terpinene-7-al (23.4%), α -terpinene-7- al (13%), γ -terpinene (9.5%), β -cymene (4.2%), β pinene (4.36%) and p-mentha-1,4-dien-7-ol (0.82%). Growth inhibition demonstrated a very potent antifungal effect against pathogenic *Candida* species. Moreover, the combination of cumin essential oil with conventional antifungal drugs reduces MIC and CMF values of antifungal drug by more than 80%, suggesting the potentiation antifungal molecule belongs to the Econazole family. Therefore, therapy involving combinations of cumin essential oils and conventional antifungal drugs can be used to reduce the toxicity induced by antifungal drugs and at the same time improve their antifungal efficacy in controlling infections caused by pathogenic *Candida*.

O106 COMPARATIVE PHYTOCHEMICAL AND BIOCHEMICAL STUDY OF THREE SWEET POTATO VARIETIES PLANTED IN MOROCCO.

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In Morocco, there are three sweet potato varieties on the market, with a clearly defined geographical distribution. Their consumption remains much lower than that of potatoes. The aim of this study is to investigate the phytochemistry and biochemistry of the three sweet potato varieties to verify their

nutraceutical potential in the prevention and control of several chronic diseases that are highly prevalent in Morocco. The results obtained on the three varieties are compared with two potatoes widely consumed in Morocco.

The study of micronutrients shows that the three sweet potato varieties are richer in these elements than the potato. In terms of these analyses, we noted that the purple sweet potato variety is richer in flavonoids and carotenoids, while the yellow variety is richer in Vitamin C. With regard to macronutrients, the two potato varieties are richer in total sugars but very poor in proteins and lipids when compared to the performance of the three sweet potato varieties.

The phytochemical and biochemical assessment of the three sweet potato varieties reveals that they can play a key role in public health management, if these tubers (sweet potatoes) are integrated into a national valorization plan.

O107 ENHANCING COMPOSTING EFFICIENCY AND PLANT GROWTH THROUGH ACTINOMYCETES CONSORTIUM INOCULATION.

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This research primarily centered on the selection of proficient actinomycetes strains isolated from soil samples, with the aim of enhancing the composting process. The isolated strains underwent a comprehensive characterization, focusing on their hydrolytic and antimicrobial activities. This characterization aimed to identify actinomycetes bacteria that possess the capability to metabolize various carbon and energy sources effectively. The effectiveness of the actinomycetes consortium in composting was evaluated by monitoring temperature and pH throughout the composting cycle. Additionally, the quality of the resulting compost was assessed by measuring factors such as conductivity, total nitrogen content (TNK), and total organic carbon (TOC). Furthermore, the impact of the produced compost on the growth of vicia faba L plants was examined by assessing three key parameters: aerial system weight (ASW), root system weight (RSW), and primary root length (PRL). This research aimed to bring about a significant transformation in the composting process and its impact on plant growth. The outcomes of the antimicrobial tests highlighted that the majority of the isolated strains exhibited potent inhibitory effects, particularly against Gram-positive bacteria and yeast strains. These strains' possession of hydrolytic enzymes endowed them with the ability to assimilate various polymer substrates effectively. In the compost, the total nitrogen content reached 1.18% when inoculated with the strains, whereas the control only registered 0.84% nitrogen content. This stark contrast underscored a significant disparity in the quality of the compost produced with bioinoculants compared to the control group. Inoculation clearly demonstrated its potential to enhance the efficiency of the composting process. As a result, the application of compost-enriched soil exhibited a remarkable positive impact on the growth of Vicia Faba plants, thereby indicating the substantial benefits of this approach for plant cultivation.

O108 ETUDE COMPARATIVE DE L'EFFET DE LA SUPPLEMENTATION DE DEUX HUILES ESSENTIELLES SUR LES PARAMETRES AVANCES DU SPERME ASTHENOZOOSPERMIQUE HUMAIN ET SA CAPACITE ANTIOXYDANTE.

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La phytothérapie est l'un des types de traitement les plus anciens. Malgré les progrès incroyables réalisés dans les secteurs pharmaceutique et chimique, certaines personnes utilisent encore les plantes pour soigner ou prévenir certaines maladies. De plus, l'utilisation d'huiles essentielles végétales est devenue plus répandue ces derniers temps. C'est dans ce contexte que notre laboratoire a mené une série d'études, principalement consacrées aux effets des huiles essentielles sur l'infertilité, notamment chez l'homme. La mobilité réduite des spermatozoïdes est l'une des causes les plus importantes d'infertilité masculine. Plusieurs rapports ont indiqué que le traitement d'échantillons de sperme inférieurs à la normale avec certains agents avant l'insémination artificielle améliore considérablement le potentiel fécondant du sperme. Pourtant, les preuves de l'efficacité du médicament restent minimes. Dans la présente étude nous avons donc étudié, d'une part, la supplémentation de deux huiles essentielles (*Origanum vulgare*, *Origanum compactum*) sur les paramètres physiologiques (mobilité et vitalité), la qualité de l'ADN des spermatozoïdes (indice de la fragmentation de l'ADN). D'autre part, nous avons vérifié l'activité spécifique de certaines enzymes antioxydantes comme la catalase (CAT), la superoxyde dismutase (SOD). Les résultats trouvés ont montré que les deux huiles essentielles améliorent significativement la mobilité, la vitalité et les activités antioxydant sans action délétère sur l'intégrité de l'ADN spermatique.

O109 EVALUATING THE STABILIZING POTENTIAL OF AQUEOUS BASIL EXTRACT (*OCIMUM BASILICUM* L.) AS AN ANTIOXIDANT FOR SOYBEAN OIL.

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Antioxidants play a crucial role in preserving the quality of vegetable oils by preventing lipid oxidation. Basil (*Ocimum basilicum* L.), an aromatic plant rich in bioactive compounds, some of which have shown promising antioxidant properties. This study focuses on evaluating the potential of basil extracts on the oxidative stability of soybean oil.

Dried basil leaves were subjected to extraction using distilled water to isolate the active compounds. The obtained extract was then evaluated for its antiradical and antioxidant capacity using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method and malondialdehyde (MDA) assay. The extract, at different concentrations, was added to soybean oil using ultrasonic maceration as a method to enhance its stability during storage at 60°C. Several quality indices were monitored, including peroxide value, acid value, para-anisidine value, MDA levels, and TOTOX value.

Our results demonstrate that basil extract exhibits strong antioxidant activity, resulting in the oxidative stabilization of soybean oil. In conclusion, basil extract can be considered as a valuable source of natural antioxidants for enhancing the stability of edible fats.

O110 EXPLORING THE PHYTOCHEMICAL PROFILING OF ANACYCLUS PYRETHRUM

EXTRACTS : A SURFACE MIXTURE DESIGN APPROACH FOR LC-MS ANALYSIS.

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The hunt for new bioactive chemicals derived from natural sources has long been important in pharmaceutical and medical research. The choice of solvent for phenolic component extraction from medicinal plants is critical to extraction efficiency. This work offers a novel technique that merges extraction science, analytical chemistry, and experimental design to better understand plant extracts' phytochemical composition.

The primary objective of this study is to elucidate the chemical diversity within *A. pyrethrum* by utilizing a Surface Mixture Design (SMD) coupled with Liquid Chromatography-Mass Spectrometry (LC-MS) to unveil the multi-dimensional view of the plant's phytochemical profile, exposing compounds that may remain concealed when employing a single-solvent approach.

Quantitative insights into the relative abundance of various compounds within the extracts were obtained by quantifying the areas of chromatographic peaks from LC-MS analyses. This method was used to extract phenolic chemicals from *A. pyrethrum*, and the extracts were then examined for phenol concentration using four distinct wavelengths (280 nm, 320 nm, 340 nm, and 460 nm). Notably, the total peak area comparison revealed that the water-ethanol mixture outperformed all other solvents, indicating its superior efficiency in extracting phenolic compounds from this botanical species.

Furthermore, our chromatographic analysis identified a prominent peak with a retention time of 12 minutes, unequivocally identified as 3,5-Di-O-caffeoylquinic acid ($[M-H]^- = 515$; MS2: 179, 191, 203, 247, 255, 291, 299, 317, 335, 353, 354, 379, 497). Quantification of the 3,5-Di-O-caffeoylquinic acid peak area for each extract demonstrated the highest yield in the water-ethanol extract, emphasizing its exceptional ability to extract this specific phenolic compound from *A. pyrethrum*.

These findings highlight the critical significance of solvent selection in the extraction of phenolic compounds from botanical sources, with water-ethanol combinations appearing as a particularly efficient choice for improving 3,5-Di-O-caffeoylquinic acid output in *Anacyclus pyrethrum* extracts. This study provides useful data for researchers and industry experts interested in leveraging this botanical species' phenolic potential for a variety of uses.

O111 EXPLORING THE VARIABILITY IN PHYTOCHEMICAL PROFILES AND ANTIOXIDANT ACTIVITY OF VARIOUS COMPONENTS OF AMMI VISNAGA (L.) COLLECTED FROM THE TAOUNAT REGION.

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Ammi visnaga L. is a highly popular medicinal plant, well-known for its biological properties resulting from its dense chemical composition, which is heavily influenced by the type of organ considered. This study aimed to assess the antioxidant potential using four complementary tests (total phenolic content (TPC), total antioxidant capacity (TAC), dihydroxycinnamic acid derivatives content (HCA), and cupric ion reducing antioxidant capacity (CUPRAC)), as well as to analyze the phenolic profile of various parts of Moroccan Ammi visnaga. The results revealed that the flower extract exhibited the highest TPC (49.71 ± 0.12 mg/g of gallic acid equivalent) and the strongest TAC (62.07 ± 2.98 mg/g of ascorbic acid equivalent). The most abundant individual phenolic compounds were chlorogenic acid (56.03%, 11.23%, and 32.29% for stem, leaves, and flowers, respectively), isorhamnetin-3-O-rutinoside (17.86%, 12.16%, and 19.01% for stem, leaves, and flowers, respectively), isorhamnetin-3-O-glucoside (15.96%, 10.69%, 10.37% for stem, leaves, and flowers, respectively), quercetin-3-O-glucoside (1.61%, 21.11%, and 2.85% for stem, leaves, and flowers, respectively), kaempferol-3-O-glucoside (1.04%, 3.17%, and 7.40% for stem, leaves, and flowers, respectively), and isorhamnetin (0.57%, 7.59%, and 2.77% for stem, leaves, and flowers, respectively). Additionally, the in-silico toxicity prediction showed that the main phytochemicals did not possess any toxicity, including hepatotoxicity, carcinogenicity, mutagenicity, and cytotoxicity. The present findings indicate the possible application of Ammi visnaga L. as a useful antimicrobial agent replacing chemical drugs inducing the emergence of resistance.

O112 FLAXSEED GUM-BIOPOLYMERS BIOLOGICAL CHARACTERISTICS, AND ITS RHEOLOGICAL STUDY.

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Recently, the application and demand for biodegradable materials have increased throughout the world. Morocco has a significant flax (*Linum usitatissimum*) diversity which remains unexploited. Flaxseeds are known to be one of the richest sources of omega-3 and α -linoleic acid. This composition is very promising for its application in several food products and in the treatment of several human pathologies. This study aims to assess the molecular masses of polysaccharides (mucilage) extracted from five varieties of flax seeds (LK, LC, LE, LF, LM) by viscosimetry and by gel exclusion chromatography (Sephadex 50). Afterwards, we evaluated their antioxidant potential, in order to enhance flax seeds mucilage valorisation. This biopolymer establishes specific interactions with water and can thicken, stabilize or gel a solution, even at low concentrations. The extraction was carried out using the traditional method most commonly used due to its economical nature and practical use. Extraction yield is relatively high, of the order of 5.47 to 6.67%. Mucilage antioxidant activity reveal a high antioxidant potential for the Moroccan variety, which will be strongly exploited in cosmetic, pharmaceutical and food industries. The rheological study of the extracted mucilage made it possible to identify its molecular weight between 496.63 and 1311.96 KDa, and its intrinsic viscosity between 1.5 and 4.3 dL/g.

O113 IDENTIFICATION DES HUILES ESSENTIELLES DU FAUX POIVRIER (SCHINUS MOLLE) AU MAROC.

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Le présent travail vambitionne la valorisation des huiles essentielles extradites des feuilles du Schinus molle dans les domaines pharmaceutiques, agro-alimentaires, metallurgique et cosmétiques. Pour maximizer le profit, nous avons jugé utile d'étudier l'effet de deux facteurs (période de récolte et la technique d'extraction) sur le rendement ponderal, la composition chimique des huiles essentilles ainsi que leurs activité biologique (antibactériennes, et anti-oxydantes).

L'extraction des huiles essentielles à partir des feuilles séchées de la plante Schinus molle a été réalisée par hydro-distillation avec un appareil type Clevenger. La composition chimique est obtenue par chromatographie gaseuse couplée à la spectrometrie de masse (GC-MS-MS).

L'analyse GC-MS-MS a permis d'identifier 15 composés représentant 100 % de la totalité des constituants pour l'espèce Schinus molle. Les composés majoritaires sont : α -Phellandrene (28.01 %), Limonène (10.32%), le Camphène (10.13 %), et le DeltaCadinène (8.08 %).

Les resultast obtenus ont montré que la période de la récolte affecte le rendement en huile essentielle. Ainsi, le mois de Mars 2021 est la bonne période par rapport aux autres mois pour obtenir un rendement important d'huile essentielle. Nous avons constaté aussi que la période de récolte des feuilles de l'arbre Faux poivrier (Schinus molle) na aucun effet sur la composition chimique de notre huile essentielle extraite.

O114 ISOLATION AND CHARACTERIZATION OF AFLATOXIN PRODUCING FUNGI ON SELECTED MOROCCAN FOOD COMMODITIES AND THEIR CONTROL ASSAY WITH SELECTED LACTIC ACID BACTERIA.

Nysrine MANNANI ¹.

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Molds are a group of microorganisms responsible for food spoilage. Their presence is highly linked to the synthesis of toxic substances such as mycotoxins which can cause considerable economic losses due to the rejection of contaminated products by consumers as well as myriad of serious risks to human and animal health. In this study, samples of food commodities including tea leaves of different brands and dried fruits (peanuts, walnuts, raisins, pistachios and figs) were collected from different Moroccan areas to isolate and identify potential aflatoxin fungi (molds). Interestingly, results showed that *Aspergillus* (*A. flavus* and *A. niger*) was the dominant genus represented by 42 strains (66.7%), with an abundance of 26.1, 23.8, 19, 14.2, 11.9 and 2.3% in tea, peanuts, figs, nuts, raisins and pistachios, respectively. The second genus *Penicillium* represented by 18 strains (28.5%) was isolated in variable proportions of 38.9, 33.3, 16.7, 5.6 and 5.6, respectively for fig, raisins, peanuts, dates and walnuts samples. Analysis of the isolated mold cultures by TLC indicated that out of 30 total strains, 13 (43.3%) were aflatoxinogenic

and able to produce type B aflatoxin. The cytotoxicity test (LC50) of isolated fungal strains on *Artemia salina* larvae showed that species from the two genera remain the most toxicogenic, with mortality rates ranging from 70 to 100%. The use of lactic acid bacteria (LAB) as control agent against toxicogenic fungi showed an inhibitory effect of fungal growth and toxinogenesis using selected LAB strains isolated from different Moroccan biotopes.

O115 PHENOLIC COMPOSITION, ANTIOXIDANT ACTIVITY AND HYPOLIPIDEMIC EFFECT OF IMMATURE CAROB PODS (*CERATONIA SILIQUA* L.) EXTRACT AND ITS FRACTIONS : IN VITRO AND IN VIVO STUDY.

Mohammadine MOUMOU, Amani TAYEBI, Souliman AMRANI, Hicham HARNAFI

University Mohammed First.

This study was designed to analyze the phenolic composition and evaluate the antioxidant activity as well as the hypocholesterolemic effect of immature carob (*Ceratonia siliqua*) pods extract and its fractions. Total phenolic compounds, flavonoids and tannins, were quantified using the Folin Ciocalteu colorimetric method, aluminum chloride method and precipitation with bovine serum albumin, respectively. High performance liquid chromatography (HPLC) was used to analyze the phenolic composition of the extract. Antioxidant activity was evaluated using the DPPH radical scavenging activity as well as the oxidation of mouse lipoprotein-rich plasma. The cholesterol-lowering activity was investigated in Triton WR-1339 induced acute hyperlipidemia. Results showed that the extract of unripe carob pods and its fractions contain great amounts of polyphenols, flavonoids and tannins. Indeed, the HPLC analysis revealed the presence of gallic acid, cinnamic acid and naringenin in the pods extract. Moreover, carob pods extract and its fractions exhibited important antioxidant activities. In fact, they neutralized free radicals and prevented lipoproteins oxidation in a dose-dependent manner. Moreover, total phenolic compounds, flavonoids, and tannins content correlated with the antioxidant activity. In the acute hypolipidemic study, mice treated with the carob pods extract and its fractions exhibited a significant ($P < 0.001$) reduction in the plasma total cholesterol (TC), triglycerides (TG), and low-density lipoprotein cholesterol (LDL-C) levels. The carob pods extract was more effective in reducing both the atherogenic index (AI) and the LDL-C/HDL-C ratio. Indeed, the acute oral toxicity study reveals that the extract and its fractions have a median lethal dose (LD50) greater than 2000 mg/kg body weight in mice. In conclusion, unripe carob pod extract, which contains a great amount of phenolic compounds and has considerable antioxidant and hyperlipidemic activity, could be used in the development of new functional foods.

O116 PLAN EXPERIMENTAL D'OPTIMISATION DU SECHAGE DES ABRICOTS.

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L'étude du processus de séchage de l'abricot à travers un plan factoriel expérimental nous permet de réduire l'altération du produit final. Les variables quantitatives ciblées sont la concentration en métabisulfite de sodium (g/l), le temps de trempage (min) et la température de séchage (°C). Un plan

factoriel complet (23) a été réalisé afin de déterminer les facteurs et leurs interactions qui ont une influence statistiquement significative sur la réponse étudiée. Des valeurs élevées de concentration en métabisulfite de sodium, de temps de trempage et de température de séchage ont un effet négatif sur la réduction de l'altération. La production optimale de facteurs est de 80 g/l de métabisulfite de sodium, 45 min de temps de trempage et 72°C de température de séchage. Ce dernier a un grand impact sur la qualité du produit final.

O117 RECENT PYRIDOPYRAZINE DERIVATIVES : BIBLIOGRAPHIC REVIEW, SYNTHESIS AND EVALUATION OF BIOLOGICAL ACTIVITIES.

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Pyridopyrazine stacks are among heterocyclic substances that have received a lot of academic and commercial attention because of their numerous uses as intermediaries in the preparation of advanced and biologically powerful pharmaceutical materials. There are several pyridopyrazine compounds on the market to treat different pharmacological disorders. These candidates can be synthesized by a number of synthetic pathways using various reagents, etc. In this review, and after having made a broad overview of the most significant methods of preparation of pyridopyrazine derivatives, as well as their roles in the therapeutic field, The utilization of metal catalysts, solvent-free and microwave irradiation, one-pot synthesis, etc. Were some of the different factors and reaction conditions which we used to build all these protocols. High selectivity and yields have been achieved as a result. This review focuses on various pyridopyrazine derivatives that have been synthesized over the last ten years using various synthetic methods.

O118 RESTITUTION DES CRITERES DE QUALITE DES HUILES ALIMENTAIRES USAGEES A TRAVERS LEUR ENRICHISSEMENT AVEC L'EXTRAIT Poudre DU ROMARIN.

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Dans ce travail, nous avons évalué l'effet de l'enrichissement des huiles usagées avec l'extrait poudre du romarin. Des analyses physico-chimiques et thermiques ont été effectuées sur ces huiles fixes après traitement pour évaluer leurs indices de qualité. D'après les analyses réalisées, nous avons remarqué que l'évolution de l'indice d'acide, montre que l'huile de friture usagée présente une dégradation minimale après le 11 jours de stockage, grâce à l'enrichissement avec 0.01%, 0.05%, et 0.100% de l'HE. L'enrichissement rend également l'huile fixe plus conforme aux normes alimentaires. L'enrichissement avec à 0.01%, 0.05%, et 0.10% de l'HE du romarin montrent une meilleure résistance à la dégradation thermique à des températures élevées par rapport à l'huile vierge (témoin positif) et à l'huile usagée (témoin négatif), suggérant un potentiel protecteur de l'huile essentielle de romarin. Cette approche pourrait avoir des applications significatives dans l'industrie alimentaire pour améliorer la durée de conservation des huiles fixes recyclées.

Mots-clés : Huiles usagées, Activité antioxydante, Qualité des huiles, stabilité thermique et conservation.

O119 STATUT DE LA FORMATION EN GENIE DE L'ENVIRONNEMENT DANS L'UNIVERSITE SIDI MOHAMMED BEN ABDELLAH (USMBA).

Nabila DIOURI, Driss BENTIR, Faouzi ERRACHIDI

Améliorer la formation des ingénieurs est une tâche essentielle pour le développement, la production, le progrès socio-économique et les services sociaux à l'avenir pour la plupart des pays en développement.

Aujourd'hui, les universités peuvent fournir les compétences et les progrès techniques nécessaires grâce à des programmes d'éducation et de recherche appropriés. Ces programmes ont un état dynamique dans les pays développés. Dans ces pays, outre une bonne éducation des cours théoriques et spéciaux, les programmes académiques et les travaux de laboratoire sont également pris en compte pour favoriser la participation des étudiants dans l'industrie, de sorte que la plupart des unités suivies par les étudiants se présentent sous la forme de projets de laboratoire ou en temps réel. Dans cet article, des programmes et des systèmes éducatifs efficaces en génie de l'environnement dans différents pays ont été étudiés de manière approfondie et comparés à la situation de l'USMBA. Ensuite, les forces, les faiblesses, les opportunités et les menaces des différents programmes éducatifs ont été analysées et des stratégies correctives pour améliorer le système éducatif à l'USMBA dans le domaine du génie civil et environnemental sont proposées.

O120 THE MOROCCAN POMEGRANATE : STUDIES ON GUIDED FRACTIONATION OF JUICE PROCESSING BYPRODUCTS AND ITS EFFECTS ON IN VITRO ANTIOXIDANT AND ANTI-INFLAMMATORY PROPERTIES.

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Pomegranate rind (PR) (*Punica granatum* L.) is a rich source of polyphenols, particularly tannins, and the quantities of these substances may vary depending on the methods used for extraction. This study was aimed to examine phenolic composition and biological activities of pomegranate rinds Methanolic (ME), Hydromethanolic (HM) and Aqueous (AE) extracts, and their fractions (Ethyl acetate, n-butanol and water) obtained by liquid/liquid extractions. Crude extracts were analyzed for phenolic contents and the highest Total Phenolic Content (TPC) was registered by ME (141.51 mg GAE/g DM) while the highest contents of Total Flavonoids (TFC) and Condensed Tannins (CTC) contents were obtained in AE (26.14 mg QE/g DM and 8.20 mg CAE/ g DM, respectively). Mostly, crude extracts are showing higher contents than their fractions, except water fractions that showed higher content of CTC. Antioxidant activity was evaluated by three different methods, and AE crude extract was the most active in 2,2-diphenyl-1-picrylhydrazyl (DPPH) and 2,2'-azino-bis (3-ethyl-benzothiazoline-6-sulfonic acid)

(ABTS) assays, whereas butanol and ethyl acetate fractions were the most effective fractions against these free radicals. Total antioxidant capacity (TAC) was evaluated with the phosphate–molybdate method and revealed the ME and its ethyl acetate fraction as the most effective antioxidants. All crude extracts and their fractions showed better inhibitory effect on protein denaturation (I% = 5- 74%), and the most effective anti-inflammatory agent was AE. PR could be considered as a valuable agro-industrial waste product which could be used as low-cost, natural and ecologic source of biologically active compounds.

O121 VALORISATION AGROALIMENTAIRE DE LA CITRONNELLE (CYMBOPOGON CITRATUS) PLANTEE AU MAROC.

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La plante *Cymbopogon citratus*, appelé également citronnelle (lemon grass), caractérisé par son odeur typique de citron. Son intérêt réside dans la grande valeur commerciale de ses huiles essentielles, mais les autres métabolites secondaires, composés phénoliques par exemple, sont peu étudiés. La valorisation d'extrait phénolique de cette plante fait l'objectif de ce travail, et ce par le billet d'une analyse phytochimique et biochimiques complété et validé par un test de dégustation.

Les feuilles du *cymbopogon citratus* séchées et broyées sont extraites par macérations avec trois solvants à savoir l'eau distillée, le méthanol et l'éthanol. Le dosage des composés phénoliques à été déterminé par la méthode de Folin-Ciocalteu. Le dosage des flavonoïdes totaux par méthode colorimétrique du trichlorure d'aluminium. L'évaluation de l'activité antioxydante est réalisée par le test de DPPH. Les sucres totaux ont été évalués la méthode de Dubois. Les décoctions préparées ont été dégustées par un jury formé pour atteindre les objectifs de l'étude.

La concentration la plus élevée des phénols a été mesurée dans l'extrait méthanolique 0,226 mg EAG/g MS, par rapport aux extraits aqueux et éthanolique. L'extrait méthanolique enregistre un maximum de flavonoïdes 0,130mg EQ/g MS, suivi par l'extrait aqueux qui renferme des teneurs plus faibles 0,120 mg EQ/g ES. L'IC50 des extraits montre que l'extrait méthanolique a une activité antiradicalaire plus importante que l'eau et l'éthanol sachant que l'IC50 de méthanol est égal 1,8mg/ml alors que l'IC50 de l'eau et l'éthanol sont respectivement égal 2,4 mg/ml et 3 mg/ml. La quantité des sucres totaux est égal à 0,376 g/g MS. Le test dégustation, étayé par des méthodes statistiques, a montré que l'infusion à base de la citronnelle est le préféré par les membres du jury de dégustation.

O122 CHEMISTRY, ANTIMICROBIAL PROPERTIES AND MECHANISM OF ACTION OF MENTHA SUAVEOLENS ESSENTIAL OIL.

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Antimicrobials are an important tool in therapeutics for infectious diseases caused by bacteria, fungi, and even viruses. The quest for new antibacterial biomolecules from natural sources, particularly essential oils, holds paramount importance in our battle against antibiotic resistance and the rising threat of drug-resistant bacteria. Additionally, comprehending the intricate mechanisms by which essential oils exert their antibacterial effects is pivotal for harnessing their therapeutic potential effectively.

In our investigation, we conducted a chemical analysis of the essential oils using GC-MS. Additionally, we evaluated the antibacterial efficaciousness of *Mentha suaveolens* essential oil against five bacterial strains: *Bacillus cereus*, *Staphylococcus aureus*, *Listeria innocua*, *Pseudomonas savastanoi*, *Escherichia Coli*, and compared its performance to the antibiotic gentamicin. Likewise, we evaluated its efficacy against the fungus *Candia albicans*, comparing it to the antifungal Amphotericin B.

Additionally, in our pursuit of understanding the antibacterial mechanisms; we conducted assays to assess the inhibition of protein synthesis, lipid peroxidation, protein carbonylation, and superoxide dismutase activity, which is a useful marker for understanding how antibiotics affect bacterial cells and their ability to defend against oxidative stress, which is an important aspect of their antibacterial mechanism of action.

The chemical analysis unveiled the substantial presence of the monoterpene camphor in the essential. Our finding demonstrated that the essential oil exhibited strong dose-dependent antibacterial activity against all the bacterial strains tested, with the most pronounced bactericidal effect observed against *B. cereus*. Furthermore, the results revealed a remarkable ability to inhibit protein synthesis in all bacterial strains and the fungus, akin to the efficacy demonstrated by the antibiotic. This inhibitory effect was very distinct for *P. savastanoi* followed by *C. albicans*, noting that the essential oil's effectiveness was similar to that of the antibiotic.

In terms of lipid peroxidation, the essential oil exhibited a reduction similar to that of the antibiotic. Notably, the essential oil outperformed the antibiotic in reducing lipid peroxidation in *P. savastanoi*. Additionally, relating to the protein carbonylation, the essential oil exhibited superior efficiency compared to the antibiotic across all tested strains.

Furthermore, both the essential oil and the antibiotic exerted a strong prooxidant activity, by reducing the superoxide dismutase (SOD) activity. This highlights the effectiveness of the essential oil in triggering oxidative stress, magnifying the disruption of redox status, and ultimately resulting in the bactericidal effect.

O123 PHYTOCHEMICAL AND BIOLOGICAL STUDIES OF PLANTS WITH NEUROPROTECTIVE PROPERTIES.

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Neurodegenerative disorders, such as Alzheimer's and Parkinson's disease, are due to several causes such as oxidative stress, imbalance of metal metabolism, low levels of acetylcholine, synaptic dysfunction or neuroinflammation, which ultimately lead to neuronal death and deficiency of neurotransmitters. In general, the drugs for these diseases are effective especially for the symptomatic treatment, not being able to prevent the progression of neurodegeneration, that's why nowadays an intense research activity is allocated to the development of new drugs to target these diseases. This study aimed to study extracts enriched in polyphenols, from four plants known for their anti-neurodegenerative properties, and evaluate their antioxidant, antimicrobial and anticoagulant potential. The same antioxidant, antimicrobial and anticoagulant properties of some mixtures of the studied extracts with synergistic properties were also studied and evaluated.

Keywords: neurodegenerative disease, antioxidant and antimicrobial activity, anticoagulant effect, polyphenol compounds.

Theme 17 : Biodiversity and the functioning of natural ecosystems.

O124 STUDY OF THE EFFECT OF PRETREATMENTS ON THE GERMINATION AND GROWTH OF PISTACIA ATLANTICA SUBSP. ATLANTICA : INVESTIGATIONS FOR THE CONSERVATION OF AN ENDANGERED SPECIES IN MOROCCO.

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Due to the combination of numerous degradation factors, we are currently witnessing the decline of specific populations of Moroccan endemic species of agro-sylva-pastoral and medicinal interest. Faced with this alarming situation, we have focused on optimizing the germination and growth parameters of *Pistacia atlantica* subsp. *atlantica* seeds from three distinct sources in the Middle Moulouya region. The ultimate goal is to master appropriate propagation techniques for this species to consider conservation and rehabilitation programs.

The germination study of the seeds was conducted using batches of 25 seeds for each source/treatment. Nine treatments were implemented to break seed dormancy, including chemical, thermal, and mechanical scarification methods. Seed viability was assessed using mechanical testing, floatation testing, and the standard germination test. Subsequently, to understand the physiological significance of seed germination behavior, we calculated key germination parameters, such as the final germination rate, germination speed, velocity coefficient, daily mean, and germination index. In addition, the growth of young seedlings was closely monitored in the nursery. The results obtained reveal that mechanical scarification significantly improved the germination capacity of seeds from all three sources: Oled Ali (81.11%), El Orjane (38.88%), and Fritissa (71.11%). These percentages are notably higher than those of the control group, which showed 67.78%, 25.56%, and 44.44%, respectively. Germination tests highlight that the optimal germination capacity primarily depends on the seed source, their viability, and pre-germination treatments.

Furthermore, the study also demonstrated a significant effect of treatments on the growth of both above-ground and underground parts of the seedlings. The most promising results were recorded with mechanical scarification, gibberellin application, and 30-day cold stratification. These treatments promoted vigorous seedling growth, thus highlighting their potential to enhance propagation practices for the species from its seeds.

O125 CARACTERISATION PHYTOCHIMIQUE ET EVALUATION DES ACTIVITES BIOLOGIQUES DE DEUX MORPHES DE PISTACIA ATLANTICA DESF SUBSP ATLANTICA DANS LA REGION FES-MEKNES.

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Pistacia atlantica Desf Subsp *Atlantica* est une espèce dioïque menacée d'extinction qui formait jadis des écosystèmes multifonctionnels dans les zones arides et semi arides du Maroc. Par ailleurs, la conservation des espèces médicinales utiles pour la restauration des écosystèmes dégradés et de leurs usages passe aussi par leur valorisation photochimique et la détermination de nouvelles substances naturelles bioactives pourvues des propriétés thérapeutiques. C'est dans cette perspective que nous nous sommes intéressés à l'évaluation des activités anti-oxydante et antimicrobienne de différents extraits aqueux et hydro-méthanolique des deux morphes, mâle et femelle, de *Pistacia atlantica* Desf.

Les prospections de terrain nous ont permis d'identifier les pieds mâles et les pieds femelles et d'en récolter des échantillons de feuilles pendant le mois d'Avril-Mai 2021. Après les feuilles ont été séchées et utilisées pour la préparation des extraits. Dans la suite de notre étude, nous nous sommes penchés sur la mise en évidence des familles de composés chimiques par screening phytochimique, la quantification des polyphénols totaux, des flavonoïdes et des tanins par des méthodes colorimétriques et l'activité antioxydante qui est évaluée en utilisant différentes méthodes dont le DPPH et l'activité antioxydante totale. Les activités antimicrobiennes des différents extraits des deux morphes étudiés ont été testés sur des souches pathogènes (*Candida albicans*, *Escherichia coli* (ATB 57), *Escherichia coli* (ATB 97) et *Staphylococcus aureus*) par la méthode de diffusion sur un solide disque.

De nos résultats des différents extraits des deux morphes, l'analyse de l'étude phytochimique révèle des teneurs importantes en métabolites secondaires notamment en composés phénoliques avec une forte concentration en polyphénols totaux. Par ailleurs, l'étude de l'activité anti-oxydante des différents extraits révèle qu'il y a une différence de concentration au niveau des deux morphes et que les mâles ont toujours une forte capacité antioxydante totale supérieur à celle des femelles, alors que l'étude de l'activité antimicrobienne montre un effet remarquable contre des souches pathogènes dont l'extrait MF qui a un effet antimicrobien sur toutes les souches étudiées avec des zones d'inhibitions allant de 12,5 mm pour *C. albicans* à 31 mm pour *E. coli* (ATB 57), *E. coli* (ATB 97) et *S. aureus* tandis que les autres échantillons ont des effets variables, puisqu'on a une activité très importante pour l'extrait ExM contre le *S. aureus* ($33 \pm 0,00$ mm), alors que nous avons trouvé une activité très faible contre *C. albicans* par l'extrait Inf/F ($10 \pm 0,00$ mm). L'ensemble des résultats obtenus nous permettent de faire des recommandations sur les caractéristiques phytochimiques et thérapeutiques des deux morphes du *Pistacia atlantica* Desf. Et de dresser des recommandations pour une meilleure exploitation de cette espèce.

O126 DIVERSITE DES OISEAUX D'EAU HIVERNANTS DANS LES ZONES HUMIDES DE LA REGION DE FES-MEKNES (CENTRE DU MAROC) : COMPARAISON ENTRE LES ZONES HUMIDES NATURELLES ET ARTIFICIELLES, ET EVALUATION DE LA PERTE D'HABITAT.

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Les zones humides sont l'un des rares environnements des régions arides d'Afrique du Nord qui fournissent un soutien en eau, des possibilités d'alimentation et un habitat aux oiseaux d'eau. Ces habitats offrent à des milliers d'oiseaux, notamment des espèces hivernantes, reproductrices et migratrices, des sites de nidification, de la nourriture et des étangs d'eau comme sites de repos et de refuge. Cependant, ces écosystèmes sont menacés par des facteurs anthropiques et environnementaux. Dans cette étude, nous avons suivi à raison de deux visites par mois, 11 zones humides de la région de Fès-Meknès (Dayet Afergagh, Amirate, Hachlaf, Ifrah, La rivière d'Oued Fès, Barrage El Gâada, El Mahraz, Allal El Fassi, Idriss I, Ennjil, et Echahed), à l'aide des jumelles et d'une longue vue. Ainsi nous avons déterminé la diversité et l'abondance des oiseaux hivernants entre Décembre-Janvier 2018 et 2021. Nous avons comparé les oiseaux hivernants dans les zones humides naturelles, périurbaines et artificielles. Le développement des zones humides et les impacts potentiels ont été étudiés, y compris les facteurs environnementaux et anthropiques au cours des deux dernières décennies (2003-2022).

Au cours de quatre saisons d'hivernage, 19 713 oiseaux de 51 espèces hivernantes, appartenant à 17 familles et 11 ordres, ont été recensés dans les zones humides étudiées. Des populations importantes de l'espèce vulnérable la Fuligule milouin, la Fuligule nyroca, la Barge à queue noire, quasi menacées, et de l'Erimature à tête blanche, une espèce en voie de disparition, ont été documentées. La diversité des oiseaux hivernants était plus élevée dans les écosystèmes artificiels que dans les écosystèmes périurbains et naturels, tandis que les populations hivernantes étaient similaires dans les zones humides périurbaines et non urbaines. De 2003 à 2022, les zones humides ont perdu des portions importantes de leur superficie estimée à 348,49 ha ; le périurbain a perdu 50,39 ha ; zones naturelles 125 ha et habitats aquatiques artificiels 108,39 ha. Dans le même temps, les terres agricoles et les paysages urbanisés ont augmenté respectivement de 244 ha et 281 ha. En revanche, les impacts des précipitations et de l'augmentation des températures ont été moins prononcés et limités aux lacs naturels des zones montagneuses.

O127 SOLITARY BEES' POLLINATION SERVICES AND EFFICIENCY OF ALMOND ORCHARDS IN MOROCCAN AGROECOSYSTEM.

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Insect pollination is key to global agricultural productivity due to the increasing demand for entomophilous crops. The nutritional and economic importance of insect-pollinated crops and the inability of domesticated pollinators (*Apis mellifera*) to meet the demand for pollination services

indicates that agriculture is highly dependent on wild pollinators, including solitary bees. In Morocco, there are about 961 distinct solitary bee species of which 81 are endemic. Although the importance of wild bees for crop pollination is well established, there is a huge gap of information about the species that contribute these services in agriculture, monitoring and conservation. Almond is an economically valuable crop in Morocco and constitutes the second most important crop after the olive tree. Therefore, understanding the basic pollination requirements of the main almond varieties is essential for promoting production. To that aim, we have evaluated the diversity and abundance of solitary bees in almond orchards in the region of Marrakech. In addition, the effect of wind, insect and optimal pollination on fruit set and yield was investigated, using insect-proof mesh bags constructed around the twigs of three almond varieties in comparison with to open flowers and manually pollinated. The results obtained revealed a highly diverse wild bee fauna with high abundance rates depending on flowering. Furthermore, the fruit set experiments confirmed that two three varieties require pollination, as the fruit set and yield were significantly higher in hand-pollinated trees than in bee-pollinated trees, while third example shows no significant difference. Results of the current study highlight the important role that solitary bees will play as pollinators of almond crops to achieve optimal pollination.

Theme 18 : Biotechnology and development of natural resources

O128 ANTIBACTERIAL ACTIVITY AND PHYTOCHEMICAL COMPOSITION OF EIGHT MEDICINAL PLANTS AGAINST NOSOCOMIAL INFECTIONS BACTERIA.

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Healthcare-associated infections (HAIs) caused by multi-drug-resistant bacteria have a high impact in terms of morbidity, mortality, and costs. Many pathogens may be involved in these infections. In this study, we have investigated the antibacterial activity of 8 ethanolic extracts prepared from Moroccan medicinal plants against *Staphylococcus aureus* (Sa), *Pseudomonas aeruginosa* (Pa), methicillin resistant *Staphylococcus aureus* (MRCH), *Escherichia coli* strain 1 (Ek), *Escherichia coli* strain 2 (Ec), *Bacillus subtilis* (Bc) and *Klebsiella pneumoniae* (Ksp) using the well-diffusion assay. A phytochemical assay was performed using the Folin-Ciocalteu method for the quantification of polyphenols, the aluminum chloride method (AlCl₃) for the quantification of flavonoid content, and Ribéreau-Gayon protocol for the quantification of tannins. *Corrigiola telephiifolia*, *Ruta graveolens*, and *Anastatica hierochuntica* extracts were the most active against all tested strains, while *Klebsiella pneumoniae* was resistant. The phytochemical quantification showed that these plant extracts are rich in polyphenols, but have a low concentration of flavonoids and tannins. The current data suggested that the most active extracts can be a good source of natural antibacterial compounds and warrant further investigations to isolate bioactive molecules.

O129 ANTIDIABETIC AND ANTIDYSLIPIDEMIC EFFECTS OF ARTEMISIA MESATLANTICA, AN ENDEMIC PLANT FROM MOROCCO.

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Aims: The study aimed to assess the antihyperglycemic and antidyslipidemic activities of *Artemisia mesatlantica*.

Background: *Artemisia mesatlantica* is an endemic plant of Morocco used in traditional medicine as an alternative treatment for diabetes.

Objective: The study was designed to examine the antihyperglycemic and antidyslipidemic abilities of aqueous extract of *Artemisia mesatlantica* (AMAE) in experimental animal models.

Methods: The effect of the single and repeated oral administration (7 days of treatment) of AMAE (60 mg/kg) on blood glucose and lipid profile was assessed in normal and streptozotocin (STZ)-induced diabetic rats. Furthermore, to confirm the antidyslipidemic effect of *Artemisia mesatlantica*, a model of hyperlipidemia induced by tyloxapol (Triton WR-1339) in rats was used.

Results: The AMAE (60 mg/kg) was able to significantly reduce glycaemia, improve lipid profile and increase hepatic glycogen content in STZ-induced diabetic rats. In addition, pretreatment of rats for 7 consecutive days with aqueous extract of *Artemisia mesatlantica* (60 mg/kg) prior to tyloxapol injection, prevented increases in plasma levels of total cholesterol, triglycerides and LDL-c.

Conclusion: The study demonstrates that *Artemisia mesatlantica* possesses antidiabetic and antihyperlipidemic properties.

O130 ANTIHYPERTENSIVE ACTIVITY OF *PRUNUS ARMENIACA L.* IN HYPERTENSIVE RATS.

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Aims: The goal of this work was to evaluate the antihypertensive activity of *Prunus armeniaca*.

Background: *Prunus armeniaca* is known for its beneficial medicinal properties.

Objective: This study aimed to evaluate the effect of the aqueous extract of *Prunus armeniaca* (*P. armeniaca*) leaves (PAAE) on arterial blood pressure in normotensive and hypertensive rats.

Materials and methods: In the *in vivo* examination, N-omega-Nitro-L-arginine methyl ester hydrochloride (L-NAME)-induced hypertensive and normotensive rats have received orally PAAE (160 and 100 mg/kg) during six hours for the acute experiment and during seven days for the subchronic treatment and blood pressure parameters were evaluated. In the *in vitro* experiment, isolated intact

thoracic aortic rings were precontracted with KCl (80 mM) and epinephrine (EP) (10 μ M) and vascular dilatation was assessed.

Results: PAAE lowered blood pressure parameters in L-NAME-induced hypertensive, without affecting normotensive rats following oral administration, suggesting that PAAE possesses an antihypertensive effect. In addition, PAAE (0.25-1 mg/mL) revealed a vasorelaxant effect in thoracic aortic rings precontracted by EP (10 μ M), and this effect was especially reduced in the presence of glibenclamide or nifedipine. However, PAAE (0.25-1 mg/mL) had only a minimal vasorelaxant effect on thoracic aortic rings precontracted by KCl (80 mM).

Conclusion : The results demonstrate that the *P. armeniaca* aqueous extract possesses potent antihypertensive and vasorelaxant activities and its vasorelaxant activity seems to be mediated through opening of ATP-sensitive K⁺ channels and inhibition of L-type calcium channels.

O131 BIOLOGICAL PROPERTIES OF CHAMAEROPS HUMILIS L.: ANTIOXIDANT AND ANTIBACTERIAL ACTIVITIES OF LEAVES, FRUIT AND PULP EXTRACTS.

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The objective of this work is to evaluate the polyphenol and flavonoid composition, antioxidant and antibacterial activity of leaf, fruit and pulp extracts of *Chamaerops humilis* L. Dry extracts of leaves, fruits and pulp were prepared by ultrasonic extraction and examined as potential sources of phenolic compounds and flavonoids. Different methods were used to evaluate the antioxidant activity of the extracts, including DPPH free radical scavenging assay and total antioxidant capacity (TAC). The total polyphenol content (TPC) and total flavonoid content (TFC) of the tested extracts were examined by the Folin-Ciocalteu and aluminum chloride (AlCl₃) methods, respectively. The antibacterial potency of leaf, fruit and pulp extracts against bacterial strains was evaluated using various in vitro methods including well diffusion, minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC).

The results suggest that leaf, fruit and pulp extracts have good potential as sources of bioactive compounds, The TPC and TFC of leaves was and mg GAE/g dry weight respectively. The TPC and TFC were and mg GAE/g dry weight in fruits respectively. The best ability to trap DPPH radical was observed in the leaf extract (mg/ dry weight), also this extract revealed better total antioxidant capacity of mg AGE/g dry weight Regarding antibacterial activity, the leaves showed moderate antibacterial action against the tested microorganisms with MIC ranging from mg/ml to mg/ml and with an inhibition diameter ranging from mm to mm. Furthermore, a strong correlation was observed between phytochemical parameters (TPC and TFC) and biological activities (antioxidant activities and antimicrobial activities).

These results revealed that leaf, fruit and pulp extracts are a good source of bioactive compounds with potent antioxidant and antibacterial potentials. Therefore, they can be a new and alternative source of products for medical and industrial applications.

O132 COMPARATIVE ANALYSIS OF CHEMICAL COMPOSITION AND ANTI-OXIDANT ACTIVITY BETWEEN WILD SALVIA LAVANDULIFOLIA AND SALVIA OFFICINALIS FROM THE MIDDLE ATLAS (CENTRAL MOROCCO).

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Medicinal plants are considered to be the richest source of active principles used throughout human history for multiple purposes. However, the use of natural plants threatens native and threatened species. Therefore, the first step to use them in human diseases is to understand their chemical constituents and biological activities. In this study, we aimed to investigate the chemical composition via G-C, and antioxidant activity (DPPH, TAC, and FRAP) of essential oils of *Salvia lavandulifolia* and *Salvia officinalis*. In *Salvia officinalis*, 20 chemical constituents were recorded in EOs compared to only 10 constituents in EOs of *Salvia lavandulifolia*. In *Salvia officinalis*, Camphor with 26.70%, followed by β Thujone with 17.14%, and Eucalyptol with 16.96% were the major chemicals recorded in Eos, while in essential oils of *Salvia lavandulifolia*, Camphor with 39.24%, followed by Eucalyptol with 22.01%, and Camphene with 9.71% were the major constituents. Recorded Scavenging of the Free Radical DPPH was at 97.31% for essential oils of *S. lavandulifolia* compared to 77.88% in EOs of *S. officinalis*. The Total Antioxidant Capacity (TAC) was at 87.52% for EOs of *S. officinalis*, while for essential oils of *S. lavandulifolia* the TAC was at 77.88%. This study could serve as a reference study for upcoming research because it provides pertinent information regarding the phytochemical composition of the *S. lavandulifolia* and *S. officinalis*. However, more investigations are needed to compare commercial varieties to native ones in terms of chemical constituents and biological properties, which is suggested to prove the importance of cultivated plants and protect the wild resources.

Keywords : Chemical composition, *Salvia lavandulifolia*, *Salvia officinalis*, anti-oxidant activity.

O133 COMPARATIVE EVALUATION OF THE ESSENTIAL OIL CHEMICAL VARIABILITY AND ANTIMICROBIAL ACTIVITY BETWEEN MOROCCAN LAVENDER SPECIES.

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The present study was conceived to compare the chemical composition and the related antimicrobial activity of essential oils (EOs) obtained from nine commonly used Moroccan lavender species, namely *L. mairei*, *L. multifida*, *L. tenuisecta*, *L. maroccana*, *L. latifolia*, *L. pedunculata* subsp. *atlantica*, *L. stoechas*, *L. angustifolia* and *L. dentata*. The purpose of this comparative study was to classify these widely used Moroccan lavenders based on their chemical profiles and their antimicrobial effectiveness against some human pathogenic microorganisms. The plants were steam-distilled and the obtained EOs were first analyzed using GC/MS system, and then investigated for their antimicrobial activity against six bacteria and four candida strains by disc diffusion and broth microdilution methods. The results of the chemical analyses revealed that all EOs investigated were classified as oxygenated monoterpenes-

rich oils (61.78 % - 92.46 %). Hierarchical cluster analysis (HCA) based on the EO chemical compositions allowed the classification of Moroccan lavender species into four distinct chemical groups: a carvacrol group (Group I), comprised by the species *L. tenuisecta*, *L. maroccana* and *L. mairei*, a carvacrol/camphor group (Group II), represented by the species *L. multifida*, a camphor group (Group III), composed of *L. dentata*, *L. stoechas*, *L. pedunculata* subsp. *atlantica*, *L. latifolia*, and a camphor/endo-borneol/1,8 cineole group, represented by *L. angustifolia* (Group IV). The highest antimicrobial activity was observed for oils obtained from *L. tenuisecta*, *L. maroccana* and *L. mairei* (Carvacrol group), with inhibitory zone diameter ranging from 10.30 ± 0.16 to 35.34 ± 0.85 mm, and minimum inhibitory concentration (MIC) and minimum microbicidal concentration (MMC) ranging from 0.039 mg/mL to 5 mg/mL. *L. multifida* EO (carvacrol/camphor group) showed also potent activity, while the lavender EOs from groups III and IV demonstrated the weakest effects. These results support the potential use of some native Moroccan lavenders, particularly those characterized by carvacrol and/or carvacrol/camphor rich oils as promising sources of natural antimicrobials to combat some human infectious diseases.

O134 CONTRIBUTION TO THE VALORIZATION OF NATURAL RESOURCES OF NORTH CENTRAL MOROCCO: AN ETHNOBOTANICAL STUDY.

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Research of bioactive molecules extracted from medicinal and aromatic plants (MAPs) is part of the valorization of natural resources. Ethnobotanical studies carried out in different regions of the world are of extreme importance, as they constitute a fundamental pillar of ethnopharmacology. Thus, in order to contribute to the development of this science, which is based on the traditional therapeutic uses of MAPs for the discovery of new medicines based on these plants, we have carried out an ethnobotanical study in North central Morocco. In fact, 183 individuals were interviewed. The collected data was analyzed using several plant citation indexes: relative frequency of citation 'RFC', Family Importance Value 'FIV', Plant part value 'PPV' and Fidelity level 'FL'. Correlations between humans of different ages, genders, educational levels, and marital status and plants they use, were investigated by multiple components analysis (MCA) using XLSTAT software. The obtained results show that 48 species are used, belonging to 27 botanical families. The most frequently cited were *Origanum compactum* Benth. *Chenopodium ambrosioides* L. *Cuminum cyminum* L. and *Mentha pulegium* L. the dominant parts used were leaves. The principal preparation methods are the infusion and decoction. MCA showed that people highly (> 7) or moderately (4 to 7) using MAPs are mainly: Female, married, with low educational level, >40 years aged, whereas those not or low using MAPs (< 3) are: Male, not married, having high educational level and < 40 years aged. This information highlights the traditional therapeutic use of MAPs by Moroccan people of the studied area. Thus, it provides an important source of information for researchers in order to discover a new drug based on plant replacing synthetic drugs.

O135 ÉTUDE DES EXOPOLYSACCHARIDES DE NOUVELLES SOUCHES ISOLEES DU LAIT CRU D'ÂNESSE MAROCAIN : CRIBLAGE, OPTIMISATION ET CARACTERISATION.

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Deux souches productrices d'exopolysaccharides (EPS), isolées du lait cru d'ânesse, ont été identifiées comme *Leuconostoc mesenteroides* RSDM4 et *Enterococcus viikkiensis* RSDM3 à l'aide du séquençage de l'ADNr 16S. La conception Box Benheken a présenté le rendement le plus élevé d'EPS-SL (672,342 mg/L) produit par RSDM4 et d'EPS-RSDM3 (901 mg/L) produit par N5. Le poids moléculaire était de $1,68 \times 10^4$ pour EPS-RSDM4 et de $1,55 \times 10^4$ Da pour EPS-RSDM3. Les analyses FTIR, RMN et GC – MS ont montré que les EPS sont des hétéropolysaccharides. L'image SEM a montré que l'EPS-RSDM4 était lisse et représentait une forme de feuille de lotus et que l'EPS-RSDM3 révélait un aspect rigide et poreux et était plus compact que l'EPS-RSDM4. Les analyses TGA ont montré une stabilité thermique et une température de dégradation élevées. De plus, les deux EPS possédaient une activité antibactérienne et antioxydante, et l'EPS-RSDM3 avait l'activité antioxydante la plus forte. Par conséquent, ces résultats suggèrent que les propriétés fonctionnelles et biologiques de l'EPS-RSDM4 et de l'EPS-RSDM3 impliquent une application potentielle dans les industries alimentaire et pharmaceutique.

O136 EVALUATION DES PROPRIETES PROBIOTIQUES DES BACTERIES LACTIQUES ISOLEES DU GUANO DE CHAUVE-SOURIS..

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Cette étude vise à évaluer les propriétés probiotiques des bactéries lactiques isolées du guano de chauve-souris. Parmi les 20 bactéries isolées, sept ont été criblées, identifiées par séquençage de l'ADNr 16S et testées pour leur potentiel probiotique en fonction de leur tolérance aux sels biliaries (0,3%) et au suc gastrique, leurs propriétés d'adhérence par hydrophobicité, auto-l'agrégation et la co-agrégation avec des bactéries pathogènes, leur innocuité (activité hémolytique, gélatinase et sensibilité aux antibiotiques), leur activité antibactérienne contre trois bactéries d'origine alimentaire, *Listeria monocytogenes*, *Staphylococcus aureus* et *Escherichia coli*. Elles ont également été testées pour leur activité β -galactosidase et pour leur propriété antioxydante. Seules cinq bactéries ont montré un effet antibactérien et une activité β -galactosidase, en revanche, toutes les souches ont pu résister aux différentes conditions gastro-intestinales et ont montré une propriété antioxydante élevée.

O137 EXPLORING THE DISINFECTANT POTENTIAL OF PLANT EXTRACTS AGAINST VARIOUS BACTERIAL STRAINS.

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Since the beginning of the COVID-19 pandemic, disinfectants have become necessary to prevent the transmission of the virus. However, massive and excessive use of disinfectants has harmful effects on ecosystems and human health. This study aimed to evaluate the potential effect of the methanol extracts of *Peganum harmala*, *Pistacia lentiscus*, *Rubia tinctorum*, and *Nardostachys grandiflora*. Antimicrobial activity was tested against *Escherichia coli* ATCC 25922, *Staphylococcus aureus* ATCC 29213, and *Pseudomonas aeruginosa* ATCC 27853, the disinfectant potential was determined using the dilution-neutralization method (NF EN1040/T72-152, 2006). A phytochemical assay was carried out on plant extracts using the Folin-Ciocalteu method for the quantification of polyphenols, and the aluminum chloride method (AlCl₃) was used to determine the flavonoid content. The results revealed the antimicrobial activity of *Peganum harmala* against all the strains, with a minimum inhibitory concentration (MIC) between 1 and 4 mg/mL, followed by *Pistacia lentiscus* and *Rubia tinctorum*, with MICs between 2 and 16 and 4 and 16 mg/ml, respectively. However, only *Peganum harmala* showed significant disinfectant activity, with microbial reduction ranging from 4.66 log₁₀ CFU/mL to 3.19 log₁₀ CFU/mL after 5 minutes of contact. The phytochemical assay revealed a flavonoid content of 79 ± 2.5 µg eq Que/mg E and a phenol content of 72 ± 0.88µg eq AG/mg E in *Peganum harmala*. *Peganum harmala* has significant potential as a natural disinfectant. Further research should focus on the development of eco-friendly and cost-effective disinfection methods. This would help mitigate the negative impacts of chemical disinfectants on ecosystems and human health.

O138 INVESTIGATION ETHNOBOTANIQUE ET ETHNOPHARMACOLOGIQUE SUR L'UTILISATION DE L'ESPECE AJUGA IVA AU NIVEAU DE LA REGION FES-MEKNES.

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Au Maroc, la phytothérapie constitue une partie intégrante de la culture locale, la population est dépositaire depuis de longues dates d'un savoir endogène qu'elle a acquis de façon empirique à travers les générations. Les Plantes Médicinales et Aromatiques (PMA) constituent un trésor inestimable offert par la mère nature, et sont considérées comme une bonne source de substances fonctionnelle multiples. Celles-ci, sont largement utilisées dans la thérapie traditionnelle et peuvent être exploitées pour l'élaboration de médicaments conventionnels.

L'ivette musquée "Ajuga Iva " est l'une des plantes aromatiques et médicinales très connue pour ses propriétés bénéfiques dans la médecine populaire. Elle est utilisée dans le traitement de nombreuses maladies dont les troubles digestifs, le diabète et autres. Dans le présent travail, nous nous sommes intéressés à la compréhension de la nature thérapeutique de cette plante auprès des populations locales marocaines dans la région de Fès Meknès. Pour ce faire, nous avons élaboré un questionnaire pour

recueillir des informations relatives à l'usage des différentes parties de la plante auprès des informés des diverses catégories de populations.

Les résultats obtenus sur un total de 207 informées ont montré que la plante est plus utilisée par les femmes que par les hommes (54,60 %) et que la partie aérienne de la plante, notamment les feuilles sont les plus employées. Concernant le mode d'emploi, la décoction étant la meilleure méthode de préparation. Un bon pourcentage de populations étudiées (80,20 %), utilise *Ajuga iva* pour remédier aux troubles digestifs, par contre (23,20 %) des informés ont indiqué son utilisation contre la fièvre.

De ces résultats, il ressort que l'espèce *Ajuga Iva* se montre d'un grand intérêt thérapeutique pour les populations locales. La réalisation de certains tests biologiques de l'espèce, nous nous semble nécessaire pour confirmer ou infirmer les effets thérapeutiques manifestés par les populations étudiées.

O139 ISOLATION OF SOIL MICROALGAE AND SCREENING OF THEIR AQUEOUS EXTRACTS BIOSTIMULANT EFFECTS ON WHEAT GERMINATION.

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Soils harness an important diversity of microorganisms assuring different ecological key roles. Cyanobacteria and eukaryotic microalgae represent a large part of the total diversity as they support soil stability, water retention, fertility, and nutrient availability. The use of microalgae-based products, especially in agriculture, is an emerging tool for sustainable agriculture, especially microalgae-based biostimulants. The aim of this study was to investigate the diversity of soil microalgae in the Marrakech area, and to screen their aqueous extracts' biostimulant effects on wheat seeds germination. The soil cultivation approach showed 29 taxa in collected soils including 16 Cyanobacteria, 11 Chlorophyta, and 2 Diatoms. Out of 29 taxa, 6 strains were produced and selected for biostimulation trials based on their biomass productivity, of which 3 Cyanobacteria *Nostoc* sp.1, *Nostoc* sp.2, and *Phormidium* sp. and 3 Chlorophyta *Stichococcus bacillaris*, *Coellastrella* sp., and *Chlorococum* sp. The results showed that all extracts displayed a positive effect on wheat seeds by increasing the germination index, coleoptile length, and root length compared to the control (two-way Manova, $p < 0.05$). Nevertheless, significant differences in terms of extract performance were observed. Aqueous extracts of *Nostoc* sp.1, *Stichococcus bacillaris*, and *Coellastrella* sp. were the most performant among tested extracts, as they increased germination index by 25.14%, 20%, and 19% respectively. Whereas in the case of coleoptile and radicle length, the increases were between 54.65% and 38.83% in comparison with the control. Our findings highlighted the potential of soil microalgae isolates for the production of liquid extracts with biostimulant activity and potential uses in agriculture.

O140 L-TARTARIC ACID EXHIBITS ANTIHYPERTENSIVE AND VASORELAXANT EFFECTS: THE POSSIBLE ROLE OF ENOS/NO/CGMP PATHWAYS.

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The aim of the study was to investigate the antihypertensive effect of L-Tartaric acid (L-TA). This molecule is a well-known as an organic acid that naturally occurs in a wide range of fruits, most notably in grapes, tamarind, and citrus. This study aimed to assess the effect of acute and subchronic administration of L-TA on blood pressure parameters in normotensive and hypertensive rats as well as its vasorelaxant potency. In the current study, the antihypertensive activity of L-TA was pharmacologically studied. L-NAME-induced hypertensive and normotensive rats received L-TA (80 and 240 mg/kg) orally over six hours for the acute experiment and seven days for the subchronic treatment. Thereafter, systolic, diastolic, mean arterial blood pressure, and pulse pressure as well as heart rate were evaluated. In the in vitro experiment, the vasorelaxant ability of L-TA was performed in rat isolated thoracic aorta. The results have shown an important drop in blood pressure in L-NAME-induced hypertensives treated with L-TA. This molecule also produced a dose-dependent relaxation of the aorta precontracted with norepinephrine (NEP) and KCl. The study demonstrated that the vasorelaxant capacity of L-TA seems to be exerted through the activation of eNOS/NO/cGMP pathways.

Funding: This research was funded by the Hassan II Academy of Science and Technology, Morocco.

O141 SALVIA AUCHERI EXHIBITS ANTIHYPERTENSIVE ACTIVITY IN HYPERTENSIVE RATS.

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The present work aimed to assess the antihypertensive activity of *Salvia aucheri*. *Salvia aucheri* (*S. aucheri*) is an aromatic and medicinal herb belonging to the Lamiaceae family. In Morocco, this plant is locally used for used to treat stomach, digestive disorders, rheumatism, and hypertension. Nevertheless, the effect of *S. aucheri* on hypertension has not yet been studied. The objective of this investigation was to evaluate the beneficial effect of the aqueous extract of *S. aucheri* leaves on arterial blood pressure, systolic blood pressure (SBP), mean blood pressure (MBP), diastolic blood pressure (DBP), and heart rate (HR) in normotensive and hypertensive rats. In addition, the effect of the aqueous extract of *S. aucheri* leaves on vasodilatation was assessed in isolated rat aortic rings with functional endothelium precontracted with epinephrine EP or KCl. The aqueous extract of the aerial parts of *S. aucheri* (AESA) was obtained, and its antihypertensive ability was pharmacologically investigated in L-NAME hypertensive and normotensive rats. The rats received AESA orally at two selected doses of 100 and 140 mg/kg for six hours (acute experiment) and seven days (sub chronic). Thereafter, systolic, diastolic, mean arterial blood pressure and heart rate were evaluated. Moreover, the vasorelaxant activity of AESA was performed in thoracic aortic ring rats. In addition, the mechanisms of action involved in the vasorelaxant effect were studied. The results indicated that AESA significantly reduced the systolic, diastolic, and mean arterial blood pressure in hypertensive rats over both single and

repeated oral administration. However, AESA did not change the blood pressure parameters in normotensive rats. In addition, the results showed that AESA was able to provoke a potent vasorelaxant ability, which seems to be mediated through direct nitric oxide (NO) and NO-cyclic guanosine monophosphate pathways. The study elucidates the beneficial action of AESA as an antihypertensive and vasorelaxant agent.

O142 EVALUATION OF THE ANTIMICROBIAL POTENTIAL OF SELECTED PLANT EXTRACTS AGAINST STRAINS INVOLVED IN NOSOCOMIAL INFECTIONS.

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On a global scale, nosocomial infections represent a significant public health problem with considerable consequences both at an individual and economic level. The majority of pathogens involved in these types of infections have developed antimicrobial resistance. This study aims to evaluate the antimicrobial activity of *Chenopodium ambrosioides*, *Anacyclus valentinus*, *Ajuga iva*, *Centaurium erythraea*, *Ptychotis verticillata*, and *Thapsia garganica*. These special plants have been used for generations in traditional Moroccan medicine for therapeutic purposes. Ethanolic extracts are tested against *Escherichia coli*, extended-spectrum β -lactamase-producing *Escherichia coli*, *Staphylococcus aureus*, methicillin-resistant *Staphylococcus aureus* (MRSA), *Staphylococcus aureus* ATCC 29213, *Pseudomonas aeruginosa*, *Bacillus cereus*, *Klebsiella pneumoniae*, and *Candida albicans*. The evaluation of the antimicrobial activity of the extracts using the well diffusion test showed that only *Ptychotis verticillata*, *Centaurium erythraea*, and *Anacyclus valentinus* inhibited the growth of the majority of strains with diameters ranging from 11 to 35 mm. Using the antimicrobial microdilution method, all strains were susceptible to the *Ptychotis verticillata* extract with minimum inhibitory concentration values (MIC) \leq 8 mg/mL. Bioguided fractionation of this extract generated 5 fractions (F1-F5), of which F2, F3 and F4 were the most active with MICs ranging from 125 μ g/mL to 1000 μ g/mL. The phytochemical quantification has shown that the plant extracts contain flavonoids, phenols and condensed tannins in varying amounts. In conclusion our results scientifically confirm the traditional use of *Ptychotis verticillata*, which has shown antimicrobial activity against nosocomial bacteria, and encourage us to pursue the purification of fractions to develop new antimicrobial compounds.

Theme 19 : Climate Change and Natural Resource Management

O143 EVOLUTION OF HOURLY CONCENTRATIONS OF O3 AND ITS PRECURSORS AT THE CDER'S "NESMA" AIR QUALITY MONITORING STATION IN ALGIERS.

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Context/Purpose: The main objective of this work is to process the various pollutants measured data of the Nesma air quality monitoring station of the Development Center of Renewable Energies (CDER) installed at the Mustapha University Hospital Centre during the year 2017. This statistical and graphic processing has made it possible to know the pollutants levels and the required standards overruns. In addition, to assess their impact on health, solar radiation intensity and renewable energies production. The Mustapha University Hospital Centre was chosen to be representative of an urban site (dense car traffic). The Sidi M'hamed commune is among the commercial activities main centers in central Algiers, with a population of 67,873 inhabitants. The site is located at 36.772484 North latitude and 3.0551159 East longitude. In detail, the national rolling fleet, all vehicles combined, had 6,577,188 units in 2019.

Methods: The Nesma station contains five analyzers to measure: O₃, NO_x, VOC (NMVOC, CH₄), PM (Fine Particles) and BC (Black Carbon). This station is also equipped with a mini weather station. The Nesma station is equipped with a data recording computer which is linked to the CDER database via the Internet. It is thus possible to have real-time access to the data.

Results: It can be seen that, over the study period, the hourly pollutants concentrations vary from one hour to another, from one day to another and from one month to another; which made it possible to establish the different (daily and monthly) variations. The obtained profiles were very characteristic of an urban site. The hourly O₃ concentrations fluctuate between 09.30ppb and 97.90ppb. The hourly concentrations fluctuate between 0.80 and 923.33ppb; 14.80 and 113.10ppb and 11.60 and 1008ppb respectively for NO, NO₂ and NO_x. NMVOC concentrations oscillating between 0.04 and 2.16 ppm.

Interpretation: Hourly NO_x concentrations were higher in winter than in summer; hourly NO concentrations were higher than NO₂ concentrations. Similarly, the hourly NMVOC concentrations showed the same evolution. Except for ozone, where concentrations were higher in summer. Summer conditions (strong sunshine and high temperature) are conducive to ozone photochemical formation. In winter (reduced sunshine and low temperature) favor precursors accumulation (NO_x and VOC).

Conclusion: Required standards exceedances of (WHO and Algeria) were observed for O₃ and NO₂. According to this study results, it is concluded that the Mustapha University Hospital Centre site is polluted and it is at the same pollution level as the large Mediterranean cities.

O144 HOMOGENEITY AND QUALITY CONTROL OF RAINFALL DATA IN THE UPPER OUM ER-RBIA BASIN, NORTHERN MOROCCO.

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Climatic data quality is crucial for the reliability and accuracy of hydroclimatic studies. In data-scarce regions, time series are often incomplete, with a lot of gaps, possible errors, and outliers. Moreover, changes in station location, instrument used, or any other gauge condition can affect these series by causing shifts unrelated to natural variability, leading to false conclusions about climate trends. This study intends to evaluate the quality and homogeneity of rainfall time-series data in order to fill in missing values, identify non-climatic inconsistencies that may affect the data's dependability, and fix them. It focuses on the Upper Oum Er-Rbia basin, located in Northern Morocco, where data scarcity poses challenges for conducting comprehensive analyses. The study utilizes monthly rainfall data from six-gauge stations spanning the period from 1970 to 2022. To ensure data integrity, the Standard Normal Homogeneity Test (SNHT) method is employed in the R environment through the package Climatol. As a result, quality control detected 12 outliers, three of which were automatically deleted. The homogeneity test highlighted 4 breaks in total; one of them concerns the series of station S1, which can be explained very probably by the construction of the Ahmed El Hansali dam; the other 3 breaks concern the series of station S4, whose explanation remains unfortunately inaccessible in the absence of metadata providing the history of the station. The homogenized series finally obtained consists of 79.3% of observed data (original), 6.3% of filled-in data (originally missing), and 14.4% of corrected data (due to inhomogeneities or excessive anomalies). To assess the quality of the homogeneity process, the RMSE statistical index was calculated on anomaly series. The results show low values that vary between 11.97 and 34.78 with an average of around 17.53, indicating a good performance of the SNHT test. The findings highlight the significance of employing rigorous statistical methods like SNHT to detect anomalies and ensure the reliability of climatic datasets. Ensuring data consistency and accuracy enables researchers, policymakers, and stakeholders to make informed decisions and develop appropriate strategies to manage water resources and address climate-related challenges in the Upper Oum Er-Rbia basin and similar data-scarce regions.

O145 L'EVOLUTION DES PHENOMENES DE LA SECHERESSE DANS LE BASSIN VERSANT DE SOUSS-MASSA AU SUD DU MAROC PAR L'INDICE PLUVIOMETRIQUE STANDARDISE (SPI).

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Le bassin versant de Souss-Massa est situé au centre-ouest du Maroc avec une superficie de 27 800 km². Il est limité par les montagnes de l'Anti-Atlas au sud et du Haut Atlas au nord, l'océan Atlantique à l'ouest et le massif de Siroua à l'est. La région de Souss-Massa a un climat semi-aride à aride typique. La variation des précipitations dans ce bassin montre une nette décroissance depuis les montagnes vers les plaines liée à plusieurs facteurs comme la latitude, l'altitude, la continentalité et l'exposition des versants. La température moyenne annuelle varie entre 14 et 18 °C dans le Haut Atlas et l'Anti-Atlas, et 20 °C sur la plaine. Les températures journalières maximales atteignent 49°C et les minimales descendent à -3°C.

Dans cette étude nous nous sommes appuyés sur la méthode statistique pour déterminer et analyser l'évolution des phénomènes de la sécheresse dans le bassin versant de Souss-Massa au niveau de deux stations à partir d'une analyse quantitative de l'indice pluviométrique standardisé SPI qui nous a permis de mesurer la sécheresse météorologique d'une série pluviométrique de 51 ans, au cours de la période 1966-2017. C'est un indice de probabilité qui repose seulement sur les précipitations, il est négatif pour les sécheresses, et positif pour les conditions humides. L'analyse des résultats de cet indice montre que nous avons une remarquable dominance des années sèches au cours de toute la période d'étude pour les deux stations. L'indice SPI atteint (-2,5) dans la station de Taliouin enregistré en 1977/1978 et (-2,34) dans Immerguen enregistré en 2009/2010.

On note également des périodes humides dans les deux stations. La période 1987-1998 au niveau de Taliouin dont l'indice SPI atteint (3,88) enregistré en 1995/1996 et la période 1987-1998 dans Immerguen, où l'indice SPI atteint (3,4) enregistré en 1995/1996.

Nous ne pouvons pas lier cette sécheresse uniquement à l'aspect naturel concernant principalement le phénomène de l'effet de serre et l'augmentation de la température moyenne de la terre puisque l'homme joue également un rôle important par ses exploitations agricoles, industrielles et domestiques.

O146 ETUDE PETROGRAPHIQUE MINERALOGIQUE ET GEOCHIMIQUE DU MASSIF DE TIDIENNET.

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The Tidiennit massif corresponds to a Miocene volcanic apparatus which represents one of the two known neovolcanic manifestations in the Nador region (north-east Morocco), it is a satellite volcano of the neogenous volcanic edifices of Gourougou (calc-alkaline shoshonite) which is characterised by the presence of various deposits of useful mineral substances (bentonite, perlite). The studies carried out on the Tidiennit massif focused on the bentonites of the three sectors of Prévencia, Trébia and Taghzoute.

The field work, the petrographic and structural study (microscopy) and the EDAX/MEB analysis of the samples aim to verify and validate the results obtained in order to understand the genetic mode of formation of the bentonites. The results show the rhyolitic magma shows a clear linear magmatic fluidity superimposed on a second nested fluidity, the succession of two phases marking the passage from a plastic to a brittle deformation stage, the evolution of a set of structures and microstructures that facilitated meteoric (notably water) and hydrothermal alteration.

O146 QUELLES VARIETES DE FEVE (*VICIA FABA L.*) ADOPTER SOUS CONTRAINTE D'OMBRAGE DANS UN SYSTEME AGROFORESTIER ?

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La fève joue un rôle important dans les systèmes de cultures intercalaires en raison de ses nombreux avantages agronomiques. Toutefois, l'ombrage représente une contrainte majeure lors sa conduite en ces systèmes. L'objectif de cette étude est d'examiner la performance de différentes variétés de fèves et de féveroles sous l'influence de cette limitation. Pour atteindre cet objectif un essai au champ a été conduit dans lequel six variétés de fèves et de féveroles ont été exposées à une lumière solaire complète et à une lumière solaire réduite interceptée sous deux filets d'ombrage (50% et 90%) à partir du stade pleine floraison. Le dispositif expérimental est en split plot à deux répétitions avec le traitement ombrage en grande parcelles et le traitement variétés en petites parcelles. A maturité, le rendement et ses composantes ont été déterminés. Les résultats ont montré une différence significative entre les trois traitements, en effet, le traitement d'ombrage (50%) a eu un effet positif significatif sur la majorité des variétés à l'exception d'Aguadulce et Defes. La hauteur de ces deux variétés a été plus élevée en plein soleil qu'en ombrage. Le nombre de tiges totaux a été négativement impacté par les deux niveaux d'ombre. Toutefois, le niveau d'impact est changeable entre les deux niveaux. La variété Hiba a produit plus de tiges sous le filet de 50%, tandis que la variété Zina a donné plus de tiges sous le filet d'ombre de 90%. Quant à rendement/plante, toutes les variétés ont réagi de manière positive à l'ombre de 50% par rapport à celui de 90%. Néanmoins, les deux variétés Hiba et Aguadulce ont été les plus productives en O1 (50%), tandis que la variété Extra hative a été la moins productive en O2 (90%). A cet effet, certaines variétés de fèves sont plus adaptées à la plantation sous ombrage. La variété Hiba est la plus recommandée à planter dans un système d'agroforesterie par rapport aux autres.

POSTER COMMUNICATIONS

Theme 1: Application of geomatics to natural resource management and the environment.

P01 ANALYSE DE L'INTERACTION ENTRE LES BIOCLIMATS ET LES INCENDIES FORESTIERS DANS LE RIF (MAROC).

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Les incendies ont toujours constitué une menace sérieuse pour les forêts du monde entier. Le changement climatique actuel, caractérisé par une augmentation des températures, une diminution des précipitations et une augmentation de la fréquence des événements météorologiques extrêmes, pourrait augmenter l'ampleur du risque d'incendie. Au Maroc, les incendies de forêt sont considérés comme la principale menace de dégradation des forêts, causant d'immenses dégâts économiques et écologiques. L'atténuation des impacts des incendies nécessite une analyse détaillée des tendances climatiques et de la réponse des forêts aux changements climatiques.

L'objectif de cette étude est d'analyser la relation entre les bioclimats et les incendies dans le Rif central. Une série d'incendies survenus entre 2012-2022 ont été classés en fonction de leur sévérité et confrontés à la carte des étages bioclimatiques. Le test ANOVA montre une relation significative entre la gravité des incendies et les stades bioclimatiques. Les forêts développées dans des étages bioclimatiques humides, et subhumides avec des hivers frais ou tempérés sont vulnérables aux incendies en raison de la forte biomasse combustible qui s'y développe. Le changement climatique pourrait amplifier la vulnérabilité des écosystèmes forestiers aux incendies et augmenter la saison de propagation des feux.

Mots-clés : Bioclimat, Incendie, Sévérité, Changement climatique, Rif central, Maroc

P02 COMPARING AND EVALUATING PROBABILISTIC AND DETERMINISTIC SPATIAL INTERPOLATION METHODS FOR THE GROUNDWATER LEVEL SAÏS BASSIN (FEZ-MEKNES REGION, MOROCCO).

Hind RAGRAGUI ¹, Abdellah EL HMAIDI ¹, My Hachem AOURAGHE ¹, Jihane SAOUITA ¹, Habiba OUSMANA ¹, Zineb IALLAMEN ¹, Hajar JADDI ¹, Anas EL OUALI ².

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In the heart of the Sebou Basin, the Saïss plain houses an aquifer system consisting of two superimposed and interconnected aquifers, playing a significant role in the socio-economic development of the Fez-Meknes region by contributing to drinking water and irrigation needs. Since the 1980s, with the onset of drought, this aquifer has experienced significant overexploitation, resulting in an annual deficit of 100 million cubic meters. Therefore, it is necessary to study the behavior of this aquifer system. This

study aims to compare and evaluate spatial interpolation methods for water levels in the Saiss Basin using a dataset from 30 piezometers, employing spatial interpolation and geostatistics. The deterministic methods used in this study include Inverse Distance Weighted (IDW), Global Polynomial Interpolation (GPI), Local Polynomial Interpolation, Radial Basis Functions (RBF), and probabilistic methods such as Ordinary Kriging (OK), Simple Kriging (SK), Universal Kriging (KU), and Interpolation with Barriers (Kernel Smoothing). The best model is the one that provides the highest accuracy. In our case, it was found that Ordinary Kriging (OK) is the best method for representing the piezometric level with a determination coefficient of approximately 0.99.

P03 SPATIOTEMPORAL EVOLUTION OF WATER QUALITY IN THE UPPER ZIZ USING QUALITY INDICES AND SIG.

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The Upper Ziz is located in central-eastern Morocco. It covers an area of 4,414 km² on Jurassic soils and is drained by the upper Ziz River. An assessment of water quality allows us to account for variations in this quality as a result of the strong anthropic pressures generated by the development and extension of agricultural and domestic activities.

This study aims to compare the spatio-temporal assessment of river water quality using four international quality indices: the WQI water quality index (Horton 1965 and Brown et al. 1970), the WQAS water quality assessment system SEQ-EAU (SEQ-EAU, 2003; SEEE, 2008) and the OPI organic pollution index (Leclercq, 2001).

The SEQ-Eau and IPO indices show a deterioration in water quality along two gradients. One is seasonal, from winter to summer, and the other is spatial, from upstream to downstream. The WQI index also shows a seasonal and spatial variation, but less obvious than that shown by the SEQ-Eau and the OPI.

The seasonal gradient is also marked by a change in hydrochemical facies from winter to summer for seven water points. For irrigation, water quality remains generally good to acceptable.

Theme 2: Groundwater and Climate changes.

P04 HYDRO-GEOPHYSICAL AND GEOCHEMICAL INVESTIGATIONS ON AQUIFER SYSTEMS IN ARID REGION: INSIGHTS INTO WATER RESOURCES IN SOUTHEASTERN TUNISIA.

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The Gabes region (Southeastern Tunisia) is located in a semi-arid area and is facing increased water demand due to agricultural and industrial activities, resulting in intensified groundwater extraction. This study aims to enhance the region's water resources availability through geologic and geophysical investigations. The reservoir geometry and structural architecture of aquifer systems from Gabes region,

particularly Mio-Plio-Quaternary and Cretaceous aquifers will be analyzed. Geochemical data and geophysical behavior will be combined to assess fault structures and groundwater hydrodynamics. Horizontal gradient and upward extension techniques will help to identify structural features location and density contrasts. The study will be completed by a spatiotemporal evolution of aquifer hydrodynamics and groundwater mineralization. Gabes aquifer system present four different groundwater facies: Ca–Mg–SO₄, Na–Cl–NO₃, Ca–Mg–HCO₃, and Na–K–HCO₃. Isotopic analysis (H₂ an O18) provided insights into groundwater recharge, source mixing, and paleoclimate. The findings revealed relative isotopic depletion in the Gabes groundwater compared to present-day meteoric waters, indicating recharge under colder climates and at higher altitudes. However, increasing temperature and decreasing precipitation since the latter half of the 20th century in North Africa suggest the influence of climate change. This study provides valuable information for sustainable water management, emphasizing the necessity to consider climatic change conditions in groundwater resource management. The detailed study of Gabes region hydrogeological characteristics and aquifer system dynamics represents a crucial contribution to effective groundwater resources management strategies and decision-making processes in semi-arid areas.

P05 THE MONITORING OF METEOROLOGICAL AND HYDROLOGICAL DROUGHT BY ADOPTING A DIVERSE DROUGHT INDICES IN THE SOUTH-EASTERN PART OF MOROCCO.

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Drought is the most significant natural risk in Morocco, in fact, several sectors frequently are threatened by the impacts of drought, including agriculture, which was affected. This natural risk causes considerable economic and environmental damage, as well as major social disturbance. This situation has prompted in-depth reflection on the study of drought. The present work was conducted to assess and characterize meteorological and hydrological drought in the Guir basin located in South-eastern Morocco. This, by calculating three indices: the Standardized Precipitation Index (SPI), based solely on precipitation; the Reconnaissance Drought Index (RDI), which calculation is based not only on precipitation but also on potential evapotranspiration; and the Standardized Streamflow Index (SSI), determined by stream flow. These indices are calculated on time scales of 3, 6, 9 and 12 months and they enable the identification of dry and wet periods, as well as the degree of these climatic conditions. The trend of climatological and hydrological time series data was also studied. Drought monitoring and analysis enable the current and the future management of the hydric situation.

Theme 3: Natural substances, what potential in the protection of plants against diseases?

P06 PHYTOCHEMICAL ANALYSIS OF THE FRACTIONS OF CORRIGIOLA TELEPHIFOLIA STEMMING FROM THREE DIFFERENT REGIONS OF MOROCCO.

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This study was conducted for the first time to assess the total polyphenols, flavonoids, and antioxidant activity (DPPH, FRAP, and chelating power) in fractions of raw, organic (Hexane, dichloromethane, and ethyl acetate), and aqueous extracts of 8,9% methanol, 30,3% Ethanol, and 60,8% water extract (Crude extract) of *Corrigiola telephifolia* roots from three chosen areas (Azrou 'A', Agourai 'Ag' and Sefrou 'S'). The crude extract and the different fractions showed significant results for all the tests below. The obtained results demonstrated that the TPC, TFC, and antioxidant activity in *Corrigiola telephifolia* varied depending on fractions and sampled sites. The fraction of raw extract exhibited the highest TPC values in all sampled sites (44,76±0,05 in Agouray, 35,89±0,02 in Sefrou, and 14,99±0,03 in Azrou). The highest values of TFC were recorded in the fraction of raw extracts for all sampling sites (20,80±0,01 in Agouray, 18,62±0,01 in Sefrou, and 11,54±0,01 in Azrou). The highest values of FRAP were recorded in the fraction of raw extract, principally in samples of Agouray (2,00±0,00), followed by Azrou (1,94±0,00), and Sefrou (1,80±0,00). The highest value of DPPH and chelating power with IC50 respectively equal to 0.46±0.02 and 0.10±0.00 were recorded in the raw extract, mainly in samples from Agouray. The samples brought from Agouray showed optimal results and the crude extract followed by the Dichloromethane fraction of *Corrigiola Telephifolia* has a strong ability to act as antioxidants and may be considered a natural source of active compounds.

P07 CHEMICAL COMPOSITION, ANTIOXIDANT PROPERTIES, AND ANTIFUNGAL ACTIVITY OF WILD *ORIGANUM ELONGATUM* EXTRACTS AGAINST *FUSARIUM OXYSPORUM*.

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Fusarium oxysporum, the causal agent of dry rot disease, has become notorious for its destructive potential, resulting in significant losses in potato yields (up to 75%). While conventional systemic fungicides have proven effective in controlling plant pathogens, growing environmental concerns have necessitated the exploration of more integrated disease management approaches. In this context, biopesticides show promise in promoting sustainable food production systems. Therefore, this study investigated the effectiveness of wild *Origanum elongatum* extracts as biopesticides in controlling *F. oxysporum* and potentially mitigating its devastating impact in plants.

The aerial parts of *O. elongatum* underwent sequential extraction using water, hexane, chloroform, and methanol. The resulting extracts were tested in vitro using the poisoned food procedure to assess their ability to impede *F. oxysporum* growth and alleviate potato leak severity in vivo. Phytochemical contents (TPC and TFC) as well as antioxidant activities were determined spectrophotometrically in all extracts, and the phytoconstituents of the most active extract (methanolic extract) were analyzed via HPLC-PDA-MS/MS.

The highest inhibition rate of *F. oxysporum* (100%) was achieved using the methanolic extract at 10 mg mL⁻¹, followed by the hexane and chloroform extracts at 15 mg mL⁻¹. Interestingly, complete pathogen inhibition was achieved with the application of the aqueous extract at 20 mg mL⁻¹. In vivo, the aqueous extract at 25 mg mL⁻¹ reduced *F.oxysporum* severity rate to 27.25%, while the methanolic extract at 20 mg mL⁻¹ resulted in the lowest severity rate (5.75%). Additionally, the hexane and chloroform extracts reduced pathogen severity to 50% and 41% at 20 mg mL⁻¹, respectively. Total phenolic and flavonoid contents in the extracts varied, with high concentrations detected in the methanolic extract at 485.42 ± 1.04 and 58.24 ± 0.15 mg mL⁻¹, respectively. Furthermore, the antioxidant activities of the extracts

indicated that the methanolic extract was the most active ($EC_{50} = 87.66 \pm 0.57 \mu\text{g mL}^{-1}$), while the chloroform extract exhibited the lowest activity ($EC_{50} = 162.55 \pm 0.43$).

LC-MS/MS analysis of the methanol extract revealed a total of 56 components from diverse classes, including organic acids, phenolic acids, flavonoids, tannins, and coumarins.

These findings suggest that *O. elongatum* could be investigated as a potential source of antifungal compounds targeting different phytopathogens."

P07 HOW DO TO COMBAT BEAN APHIDS?

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By protecting vegetables against disease damage, we are helping to optimise crop profitability and ensure regular market supplies in terms of quantity and quality. To do this, we strive to find protection products that will provide precise answers to growers, but also to all the members of the sector, from the field to the consumer.

So many insects, microscopic fungi, diseases and parasites invade vegetables. Identifying the damage is the first thing to do, then treating and caring for the vegetables. Like all legumes, beans can be affected by diseases or infested by parasites specific to these plants.

Aphids are tiny insects that can cause serious damage to crops by sucking the sap from plants.

This work focuses on the aphids that can be found in broad beans, and proposes a biological method for controlling these insects in order to maintain healthy crops. This method reduces the use of pesticides and protects the environment.

Theme 4: Production and Valorization of plant resources.

P08 ANALYSES DE LA COMPOSITION CHIMIQUE DES EXTRAITS DE LA PARTIE AÉRIENNE DE *AJUGA IVA* DU MAROC.

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L'ivette musquée "*Ajuga iva*", appelée, Chendgora, est une petite plante vivace de goût amer, largement distribuée dans la région méditerranéenne : le sud de l'Europe et le nord de l'Afrique, en particulier au Maroc, Algérie et Tunisie. Cette espèce est largement utilisée pour ses vertus thérapeutiques. Au Maroc, le macérât aqueux de la partie aérienne de cette plante est utilisée pour traiter le diabète et l'hypertension ; la poudre sèche est utilisée pour traiter les troubles gastro-intestinales et contre l'ulcère de l'estomac.

Dans le présent travail, nous nous sommes intéressés à la valorisation de cette plante issue des différents sites dans la région de Fès-Meknès, par une détermination de la composition chimique des dérivés des extraits (aqueux, éthanolique et méthanolique) de la partie aérienne de la plante et une étude du rendement de ses composés phénoliques. Ainsi, les échantillons sont récoltés et séchés à l'ombre, puis ils sont broyés en poudre.

Les résultats obtenus ont montré que l'ivette musquée est riche en composés polyphénoliques, qui sont les meilleurs antioxydants ; les flavonoïdes et les tannins se trouvent aussi, en grande quantité. En outre, elle abrite d'autres substances, comme les anthocyanes et les acides phénoliques. Les flavonoïdes déterminés par la méthode de Bahroun (1966) en utilisant AlCl_3 à 10%, NaOH (1M) et le NaNO_3 à (5%) le rendement été représenté d'une valeur entre $(2,31 \pm 0,63 \text{ g/1EAQ } 5\text{gMS})$, les composés phénoliques ont été dosés selon la méthode de Li et al.(2017) en utilisant le réactif du Folin Ciocalteu et le Na_2CO_3 à 20% avec un rendement de $(232,03 \pm 46,19\mu\text{g/ml EAT } 5\text{gMS})$.

La richesse de l'ivette en ces composés chimiques semble l'une des raisons pour laquelle, cette plante a pour longtemps servi à une grande tranche de population comme moyen incontournable de médication.

Mots Clés : Ajuga Iva ; Effet thérapeutique, Extraction, Composés Phénoliques ; Rendement.

P09 ANTIOXIDANT POTENTIAL OF THYMUS WILLDENOWII BOISS & REUT. AND EFFECT OF ITS SUPPLEMENTATION ON HYPERLIPIDEMIA AND PARAOXONASE-1 ARYLESTERASE ACTIVITY IN HIGH-FAT DIET-FED RATS.

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Thymus willdenowii Boiss & Reut. (*T. willdenowii*) is a medicinal plant that grows in the Moroccan High Atlas Mountains. It is used in local folk medicine to treat several disorders including cardiovascular disease. In this study, we aimed to evaluate the antioxidant and anti-hyperlipidemic effects of the traditionally used aqueous extract of *T. willdenowii*. The extraction of the plant was assessed using the traditionally used decoction method. Total contents of polyphenols (TPC), flavonoids (TFC), and tannins (TTC) were estimated and *in vitro* antioxidant assays namely DPPH, FRAP, and TAC were carried out to evaluate its antioxidant potential. Moreover, the anti-hyperlipidemic activity was tested on rats fed a high-fat diet (HFD) containing sucrose (15%), lard (15%), and cholesterol (2%). Thyme extract was given daily at 500 mg/kg. After 2 months of treatment, lipid profile parameters and arylesterase activity were determined. The findings showed that *T. willdenowii* extract is rich in phenolic compounds (TPC = 127.34 GAE mg/gE; TFC = 105.43 RE mg/gE; TTC = 24.08 CE mg/gE) and exhibits important antioxidant activity (DPPH IC₅₀ = 0.41 mg/mL; FRAP value = 1.31 Fe₂+E mM; TAC value = 322.13 AAE μg/gE). Moreover, *T. willdenowii* extract significantly reduced the alterations caused by HFD intake by decreasing blood lipids (TC: -28.19 %; TGs: -22.82 %; LDL-C: -35.11 %) and increasing paraoxonase-1 arylesterase activity (+12.83 %). We conclude that the traditional use of *T. willdenowii* is effective in the treatment of hyperlipidemia and its complications.

P010 APPLICATION OF RESPONSE SURFACE METHODOLOGY FOR BIOACTIVE COMPOUNDS EXTRACTION AND THE VARIABILITY IN PHYTOCHEMICAL PROFILE FROM ROOTS OF AMMI VISNAGA (L.) LAM.

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Ammi visnaga L. Lam. is the most popular therapeutic plant in the Mediterranean region. Umbel is a traditional Moroccan remedy for diabetes, toothaches, and oral care. The main goal of this study was to determine which extractor solvents had a particular affinity for the total phenolic content (TPC) found

in the roots of Ammi visnaga. Using solvents shosen from the first step, the phenolic contents were maximized using the mixture design response surface methodology. The optimal solvent mixes of 10% methanol, 50% water, and 40% ethanol were used to prepare the root extracts.

The present study was also designed to examine the antioxidant potencies using four complementary assays (Total phenolic content (TPC), total antioxidant capacity (TAC), dihydroxycinnamic acid derivative content (HCA), and cupric ion reducing antioxidant capacity (CUPRAC)) as well as the phenolic profile of Moroccan Ammi visnaga L. roots using UHPLC/DAD/HESI-MS/MS. The obtained results showed the highest amount of TPC (15,99±0,43 mg GAE/g mg/g GAE) and antioxidant activity TAC (10.17±1.46 mg/g AAE).

21 substances with various concentrations were identified, including isorhamnetin_3-O-glucoside (25.856%), isorhamnetin_3-O-rutinoside (22.383%), and p-Coumaric acid (11.56%), which are the three most prevalent individual phenolic compounds. The findings revealed the presence of numerous bioactive substances with important biological capabilities in the roots of A. visnaga L., emphasizing the need for further experimental model validation of the data.

P011 CARACTÉRISATION POMOLOGIQUE ET BIOCHIMIQUE DES VARIÉTÉS DU CAROUBIER ISSUES DE TROIS RÉGIONS DU MAROC.

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Ceratonia siliqua L, connue sous le nom de caroubier, appartient à la famille des légumineuse (syn. Fabacées). Cet arbre fruitiers et forestiers est originaire des zones arides et semi-arides de la méditerranée et de la péninsule arabique. Il présente un grand intérêt non seulement de sa rusticité, son indifférence vis-à-vis de la nature du sol, son bois de qualité, sa valeur ornementale et paysagère, mais également pour ses graines qui font l'objet de transactions commerciales dont la valeur dépasse de loin celle de la production ligneuse. Le caroubier est cultivé dans les pays méditerranéens, surtout pour ses fruits comestibles et sucrés. Sa production mondiale, estimée à 250 000 tonnes, est essentiellement concentrée en Espagne, au Maroc, en Italie, au Portugal, en Grèce, en Turquie, au Chypre et en Algérie. La présente étude porte sur la caractérisation pomologique, et l'estimation biochimique de trois variétés du caroubier (*Ceratonia siliqua* L.) récoltées dans différentes régions du Maroc, Taza, Guelmim et Agadir. Et ce dans le but de contribuer à la valorisation durable de ce patrimoine végétal, pour maintenir son développement durable. Pour ce faire, deux séquences seront traitées : La première partie, porte sur une caractérisation pomologique des trois variétés du caroubier en fonction des régions étudiées. Les résultats obtenus ont révélé une diversité intéressante entre les trois régions et une grande variabilité au niveau des traits morphologiques des graines et de la pulpe de cette espèce. Quant à la deuxième partie de notre étude, elle porte sur la quantification biochimique des graines et de la pulpe des trois variétés en provenance des trois régions.

Mots clés : caroube, pomologie, biochimie et diversité.

P012 ENQUÊTE ETHNOBOTANIQUE À PROPOS DES PLANTES MÉDICINALES UTILISÉES DANS LE TRAITEMENT TRADITIONNEL DES MALADIES FÉBRILES À CASABLANCA-MAROC.

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FS-Ain Chock, UH- II de Casablanca.

La phytothérapie est connue depuis l'Antiquité pour soigner les différentes affections au Maroc. La présente étude a été menée pour recueillir les connaissances des herboristes sur les plantes utilisées en médecine traditionnelle pour traiter les maladies fébriles. À Casablanca, 105 herboristes ont fourni des informations. Les données ont été examinées à l'aide de sept indices quantitatifs : le niveau de fidélité (FL), la valeur d'usage (UV), la fréquence de citation (FC), la fréquence relative de citation (RFC) et le facteur de consensus des informateurs (ICF). Au cours de l'enquête, vingt-deux espèces de plantes médicinales appartenant à onze familles ont été signalées comme étant utilisées pour traiter la fièvre. La plante la plus recommandée avec une fréquence relative de citation élevée (RFC = 0,15) est *Dysphania ambrosioides* L., ce qui indique l'importance de cette espèce dans le contrôle de la fièvre, notamment lorsqu'elle est associée à *Citrus × limon* (L.) Osbeck (RFC = 0,139). Ainsi, l'utilisation de ces plantes a été comparée à la littérature. Cette recherche a contribué à documenter et à préserver d'importantes connaissances des herboristes traditionnels marocains sur les plantes utilisées pour soigner les maladies fébriles.

P013 ETUDE DE LA COMPOSITION CHIMIQUE ET DE L'ACTIVITÉ ANTIOXYDANTE ET ANTI-MICROBIENNE DES HUILES ESSENTIELLES DE *JUNIPERUS PHOENICEA* L.

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Juniperus phoenicea (L.) est une plante médicinale qui a été utilisée en phytothérapie pour traiter certaines infections pathologiques. Le présent travail visant à valoriser l'huile essentielle des graines de *J. phoenicea* (EOGP) en étudiant sa composition chimique et ses activités antioxydantes et antimicrobiennes.

L'EOGP a été extraite par hydrodistillation et caractérisée par chromatographie en phase gazeuse (GC-MS). Le pouvoir antioxydant a été évalué par trois méthodes (TAC, DPPH et FRAP). Le pouvoir antimicrobien a été évalué contre *Staphylococcus aureus* (ATCC6633), *Escherichia coli* (K12), *Bacillus subtilis* (DSM6333), *Proteus mirabilis* (ATCC29906), *Candida albicans* (ATCC10231), *Aspergillus niger* (MTCC282), *Aspergillus flavus* (MTCC9606) et *Fusarium oxysporum* (MTCC9913).

Les résultats de la GC/MS ont révélé une identification totale de 99,98 %, avec une dominance du carvacrol (39,81%) suivi du p-cymen-3-ol (39,81%) et du carvacrol (39,81%). p-cymen-3-ol (34,44%) et de l'o-cymène (13,60%). Les résultats ont montré que l'EOGP présentait un important pouvoir antioxydant. La CI50 a été déterminée comme étant de 26 µg/mL pour le 2,2-diphényl-1-picrylhydrazyl, tandis que la CE50 était de 216,34 µg/mL pour le pouvoir antioxydant ferrique. Le pouvoir antioxydant réducteur et la capacité antioxydante totale étaient de 720 mg AAE/g. Pour le pouvoir antimicrobien, de 11,30 ± 0,58 à 20 mm pour les souches bactériennes et de 9,33 ± 0,57 à 54,43 ± 0,29 mm pour les champignons. Notamment, les concentrations minimales inhibitrices variaient de 18 à 19 µg/mL pour les souches bactériennes et de 5,04 à 10,09 µg/mL pour les souches fongiques.

Dans l'ensemble, nos résultats démontrent l'importance du EOGP en tant que source d'antioxydants et antibactériens naturels contre les souches cliniquement pertinentes.

P014 ETUDE NUTRITIONNELLE, CARACTÉRISATION BIOCHIMIQUE DE QUELQUES VARIÉTÉS DE DATTES (*PHOENIX DACTYLIFERA* L.) DE LA RÉGION DE DRAA-TAFILALET.

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Le palmier dattier est une plante d'intérêt écologique, économique et social majeur dans les régions désertiques de nombreux pays. Le palmier dattier est le pilier des écosystèmes oasiens où il permet de créer un microclimat favorable au développement de cultures sous-jacentes (arbres fruitiers, cultures maraîchères et céréales). La production des dattes contribue incontestablement à la création d'emplois et constitue 60% des revenus agricoles de plus d'un million des populations oasiennes. Ainsi le développement de la filière phœnicicole permet d'une part de lutter durablement contre l'insécurité alimentaire dans les régions où la désertification est accélérée par les changements climatiques et d'autre part de contribuer la stabilisation des populations dans les zones présahariennes. Le Maroc est un pays phœnicicole classé au douzième rang mondial et au neuvième rang arabe avec une production annuelle moyenne de dattes qui s'élève à plus de 107 mille tonnes (FAOSTAT., 2013). La palmeraie marocaine recèle un patrimoine phœnicicole diversifié représenté par environ 55,6% de "Khalts" qui sont des clones issus de semis naturel spontané et plus de 223 variétés.

La caractérisation de la consommation des dattes dans la province d'Errachidia à travers une étude nutritionnelle, tandis que la deuxième est réservée à la caractérisation morphologique et biochimique de cinq des variétés de dattes à savoir le Mejhoul, Boufeggous, Outoukdime, Bousthami et Jihel les plus connues dans la zone d'étude.

Les propriétés organoleptiques de ce fruit notamment la taille, la couleur et la fermeté constituent les raisons principales qui influencent l'appréciation et la préférence des consommateurs pour certaines variétés comme Majhoul et Boufeggous. Sur le plan biochimique les variétés de dattes analysées montrent une variabilité significative de la teneur en eau, en glucides, en protéines, en lipides, en minéraux et en vitamines. Elles se sont révélées faibles en lipides, en protéines et en vitamines B mais riches en sucres et en minéraux, en particulier le potassium, le calcium et le magnésium.

Mots clés : dattes, pomologie, biochimie et qualité.

P015 EVALUATION DE L'ACTIVITÉ ANTIOXYDANTE ET ANTIBACTÉRIENNE DES EXTRAITS DES CO-PRODUITS DE *CANNABIS SATIVA L.*

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Cannabis sativa est l'une des espèces médicinales les plus utilisées en médecine traditionnelle en raison de ses propriétés biologiques diverses.

Dans la présente étude, nous avons cherché à évaluer l'activité antioxydante et antibactérienne des extraits des co-produits de trois variétés du Cannabis sativa (Beldia, Khardala et Critical) fournis par les agriculteurs de la région de Daour-Rkiba-Taounate Maroc. L'extraction a été réalisée par sonication. Les extraits ont été préparés en utilisant les combinaisons suivantes ; 42% eau, 58% éthanol ; le mélange 39% eau, 34% éthanol et 27% méthanol ; 42% eau, 27% éthanol et 31% méthanol pour les variétés Beldia, Khardala et Critical respectivement.

Le pouvoir antioxydant a été testé par la méthode de DPPH, de CAT, d'ABTS et du FRAP. Les résultats obtenus ont montré que les trois variétés possèdent un pouvoir antiradicalaire remarquable, la valeur la plus importante a été enregistré chez la variété Critical. De plus, l'activité antibactérienne a été évaluée par la méthode de micro-dilution contre *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis* et *Staphylococcus aureus*. Ainsi la CMI a été déterminés. Nos résultats

ont enregistré que les quatre souches testées présentent une sensibilité par apport aux différents extraits avec des CMI comprises entre 0,12 et 4 mg/ml.

P016 MS PROFILING, IN VITRO ANTIOXIDANT, ANTIMICROBIAL, AND IN SILICO NADPH OXIDASE INHIBITION STUDIES OF ESSENTIAL OIL OF *JUNIPERUS THURIFERA* BARK.

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Juniperus thurifera is a native species to the mountains of the western Mediterranean region. It is used in traditional medicine as a natural treatment against infections. The present study aimed to carry out the chemical analysis and evaluate the antioxidant, antimicrobial, as well as *in silico* inhibition studies of the essential oils from *Juniperus thurifera* bark (EOEJT). Chemical characterization of EOEJT was done by gas chromatography (GC-MS). We have performed three antioxidant assays (Reducing power (FRAP), 2, 2-diphenylpicrylhydrazyl (DPPH), and total antioxidant capacity (TAC)) of the EOEJT. We next evaluated the antimicrobial activity against *in silico* study, which was carried out to help evaluate the inhibitory effect of EOEJT against NADPH oxidase. Results of the GC/MS analysis revealed seven major compounds in EOEJT wherein muurolol (36%) and elemol (26%) were the major components. Moreover, EOEJT possessed interesting antioxidant potential with an IC50 respectively of 21.25 ± 1.02 µg/mL, 481.02 ± 5.25 µg/mL, and 271 µg EAA/mg in DPPH, FRAP, and total antioxidant capacity systems. Molecular docking of EOEJT in NADPH oxidase active site showed inhibitory activity of α -cadinol and muurolol with a glide score of -6.041 and -5.956 Kcal/mol, respectively. As regards the antibacterial and antifungal capacities, EOEJT was active against all tested bacteria and all fungi, notably, against *Escherichia coli* K12 with an inhibition diameter of 21 mm and a MIC value of 0.67 mg/mL, as well as against *Proteus mirabilis* ATCC 29906 with an inhibition diameter of 18.33 ± 1.15 mm and a MIC value of 1.34 mg/mL. A more pronounced effect was recorded for the fungal pathogens *Fusarium oxysporum* MTCC 9913 with inhibition of 37.44 ± 0.28% and MIC value of 6.45 mg/mL, as well as against *Candida albicans* ATCC 10231 with an inhibition diameter of 20.33 ± 1.15 mm and a MIC value of 0.67 ± 0.00 mg/mL. Altogether, these results highlight the importance of EOEJT as a source of natural antibacterial and antioxidant drugs to fight clinically important pathogenic strains.

P017 METHODOLOGY OF STUDYING RHIZOBIUM GENETIC DIVERSITY IN MEKNES AND AGADIR REGION IN MOROCCO.

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Rhizobia are bacteria of the *Rhizobiaceae* family capable of living in symbiosis with legumes such as Alfalfa, allowing them to transform atmospheric nitrogen into ammonia that can be absorbed by the plant or ejected as a natural fertilizer the soil, the importance of these bacteria in protecting groundwater, improving yield and product quality should not be underestimated.

Several authors (Porter *et al.*, 2014) have found that some Rhizobia cheat by forming a lopsided symbiosis that favors them, these bacteria are often better adapted to soils and are more competitive by their mobility and their non-specificity to the host. Therefore, the study of the genetic diversity of

Rhizobia is important to obtain more suitable, more effective and more durable strains that can be used as a bio-fertilizer for legumes.

To study the genetic diversity of Rhizobia within the Kingdom of Morocco, a study is underway in Meknes and Agadir to test the effectiveness of different strains isolated from alfalfa, as well as gene sequencing (NM ISO 20837-2008) of the 16S gene, housekeeping genes *recA*, *gyrB*, *nifH*, as well as nodulating genes *nodA* and *nodD*. Alfalfa plants were inoculated with different strains isolated from Alfalfa grown on different locations throughout Morocco, and planted in controlled conditions under different water stress conditions. Various analysis will be conducted on these plants such as nitrogen concentration in the plant and in the soil with and without inoculation, which will determine practically the best strains. These results will be combined with those of gene sequencing will allow us to appraise the genetic diversity and capabilities of Rhizobia in Morocco as well as formulate an efficient bio-fertilizer to improve areas where Rhizobia might be more cheating, thus improving yield.

P018 OPTIMISATION DU RENDEMENT EN COMPOSÉS PHÉNOLIQUES DES CO-PRODUITS DE *CANNABIS SATIVA* L. EN UTILISANT LA CONCEPTION "AUGMENTED SIMPLEXCENTROIDE DESIGNS."

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La présente étude a été menée dans le but d'optimiser l'extraction des composés phénoliques et d'évaluer leur activité antioxydante à partir de coproduits des deux variétés de *Cannabis sativa* L. (Khardala et Critical) provenant de la région de Taounate.

Pour atteindre cet objectif, un plan de mélange "Augmented Simplexcentroide designs" a été utilisé, en utilisant un système de solvants comprenant de l'eau, du méthanol et de l'éthanol. Les deux réponses évaluées étaient la teneur totale en phénols (TPC) et l'activité antioxydante mesurée par la méthode de DPPH. L'extraction a été réalisée en utilisant la méthode de sonication. Les résultats de l'optimisation simultanée ont montré que le mélange binaire (42% eau, 58% éthanol), le mélange ternaire (39% eau, 34% éthanol 27% méthanol) et la combinaison de trois solvants (42% eau, 27% éthanol et 31% méthanol) étaient les plus appropriés pour maximiser le TPC et l'activité antioxydante pour les variétés Khardala et Critical.

P019 OPTIMIZATION OF ACORN FLOUR PRODUCTION BY MICROWAVE DRYING PROCESS: ANALYSIS AND AMELIORATION.

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Oak acorns are consumed by humans in various forms, including as fresh snacks, roasted, boiled, ground and mixed with milk, in the form of bread, and prepared like couscous. They can also be used to meet the energy, protein, and mineral needs of livestock in various parts of the world. However, due to their relatively high water content at the time of harvest, they must be stored as they are to prevent nutrient loss and deterioration during storage.

The objective of this study was to valorize oak acorns in the form of flour using the microwave drying process, with different power settings to optimize the parameters that impact the drying of the acorns. The experiments were designed using a 2ⁿ-1 factorial design with three factors, each having two levels, "max" and "min".

The results obtained for the optimization of the microwave drying process for this food requires setting the following parameters: a drying power of 550 W, a cooking time of 30 minutes, and a slice thickness of 0.35cm; to obtain a flour with: pH=6; Titratable acidity=0.69375%; Moisture content=11.2675%; Yield=33.7575%; Drying time=11.225 min.

P020 POTENTIAL OF NATURAL PLANT EXTRACTS TO IMPROVE OXIDATIVE STABILITY OF OILS.

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Issues with synthetic food preservatives led scientists to discover new alternatives such as the use of bioactive substances derived from natural sources to replace synthetic additives to improve the shelf-life of food products. Plants extracts are a good source of various bioactive chemicals with antibacterial, antioxidant, and preservative characteristics, therefore their application as natural additives has drawn increased attention as an eco-friendly and non-toxic alternative. Essential oils (EOs) application is still challenging due to their low water solubility, high volatility nature, and instability. Several technological advances involving innovative delivery methods have been tested and used to rectify these problems, such as polymer-based coating, active packaging, and encapsulation in biodegradable and non-toxic agents. These forms are especially applied to some specific types of foods including fruits, vegetables, dairy products, meat, and baked foods. The topic of our work addresses EOs' potential to improve the stability of fat and oil products, which is an understudied approach. The consumption of oxidized oils or fats is dangerous because they can contribute toxic molecules. Many studies have confirmed the efficiency of EOs to reduce lipid oxidation. This study examines the effect of several EOs on the functional properties of fats and oils by evaluating their antioxidative and antimicrobial properties and analyzes their impact on the shelf-life of the products to evaluate their potential to be introduced to the food industry as a smart green preservative.

P021 STUDY OF THE INTERACTION EFFECT OF CURCUMA LONGA L WITH ZINGIBER OFFICINALE BY THE DESIGN OF EXPERIMENTS (DOE) MODEL.

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Microbial load of two spices widely used in the moroccan culinary art, of Zingiberaceae family, in particular turmeric (*Curcuma longa L*) and Ginger (*Zingiber officinale*), revealed the dominance of bacteria and yeasts when compared to molds. We noticed antibacterial activities of Turmeric and anti-fungal of Ginger. Mathematical model of survival is logarithmic for yeasts and bacteria in Turmeric powder and logarithmic in nature for bacteria and polynomial for yeasts in Ginger powder matrix. Interactions between studied spices under experimental design were used to evaluate the effects of Turmeric, Ginger and their combination on overall microbial load. To validate obtained results in experimental design, we applied optimal formula (1% Turmeric and 0.5% Ginger) on animal model by incorporating the optimal formula in chicks' feed. Results showed yeast survival and bacterial absence in Turmeric powder, which means that it has a very important antibacterial activity. On the other hand, Ginger powder showed bacterial survival and very high antifungal activity. From results overall microbial load experimental design, Turmeric showed a negative effect on bacterial growth, while Ginger exerted a positive effect and interaction with a significant amount of Turmeric reduced the indigenous contamination.

Theme 5: Conservation of animal biodiversity.

P022 CONTRIBUTION TO THE UNDERSTANDING OF THE APICULTURAL SECTOR AND THE CONSTRAINTS FACED BY BEEKEEPERS IN THE 'FES-MEKNES' REGION.

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Morocco boasts an extraordinary wealth of biodiversity, fostered by its geography and climate, which bestow significant potential upon its apicultural sector. This sector assumes a prominent socio-economic role, serving as a potent tool in poverty alleviation and a vital source of domestic market sustenance. Furthermore, its significance extends to the critical role it plays in pollinating both native and cultivated flora. However, the bee colonies now confront an array of environmental pressures that jeopardize their stability and lead to their dwindling numbers. Among these pressures, notable factors include the pervasive use of pesticides in agriculture, the spread of the Varroa mite parasite, and the dearth of training among some beekeepers, who seek to enhance their yields at the expense of the health of their honeybee populations.

In this context, our current study endeavors to delve deeply into various parameters associated with beekeepers' practices in the Fes-Meknes region. To this end, we have crafted a comprehensive questionnaire, encompassing key elements capable of influencing apiary management. These elements include the bee breeds under cultivation, prevalent diseases, employed treatments, and several other aspects. It was addressed to the local population of the region studied, interested in the products of the hive, hoping to collect a maximum of data concerning the various disorders observed too frequently. The results reveal that the apicultural sector in the Fes-Meknes region is characterized by the predominance of modern techniques, yet it also exhibits a diverse range of factors that impact honey production in this area. According to the survey, beekeeping is a secondary activity, and it is rare that the actors are specialized in this sector. The allocation of apiaries tends to concentrate in specific locales, often linked to sought-after plantations such as eucalyptus, lavender, and thyme. Additionally, Varroosis remains the most frequently encountered ailment within the region's beehives. The scarcity of adequate nourishment and effective treatments bears substantial consequences, not only for the health of the predominantly raised black bee but also for the overall productivity and diversity of hive products. The findings of this study underscore the imperative need to further explore and broaden these investigations to encompass a larger cohort of beekeepers and different regions of Morocco. This would serve as a means to effectively raise awareness about the necessity for a coherent coordinated strategy among diverse stakeholders. The establishment of training and mentoring programs would facilitate the improvement of hive management techniques and productivity, with the overarching goal of conserving our exceptional apicultural livestock.

P023 POTENTIAL ROLE OF KISSPEPTIN IN INFERTILITY DISORDERS.

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Kisspeptin is a neuropeptide that plays a central role in fertility and neuroendocrine regulation of the hypothalamic-pituitary-gonadal axis. It has also been shown to act at the peripheral level in both men and women. Numerous studies have shown a correlation between blood kisspeptin levels and fertility in men. It is also involved in sperm maturation and even pregnancy implantation in women. In men, dysregulation of kisspeptin signaling can lead to hypogonadotropic hypogonadism. Recent studies have shown that kisspeptin could be a new therapeutic target in treating fertility disorders. Others have shown that the administration of exogenous kisspeptin stimulates gonadotropin release in patients with fertility problems and even in healthy subjects. In addition, it plays a vital role in improving sperm quality in medically assisted reproduction and even in oocyte maturation. In this literature review, we aim to examine the primary functions of kisspeptins in male and female infertility.

P024 SEASONAL ACTIVITY PATTERNS AND HABITAT USE BY KUHLL'S PIPISTRELL (PIPISTRELLUS KUHLLII) AND THE ISABELLINE SEROTINE BAT (EPTESICUS ISABELLINUS) IN SAFI CITY, CENTRAL WEST OF MOROCCO.

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The seasonal activity patterns of two common species of bats widely distributed through the Moroccan country, Kuhl's pipistrell (*Pipistrellus kuhllii*) and the Isabelline Serotine Bat (*Eptesicus isabellinus*) in four-urban habitat at Safi city. From July 2021 to June 2022, we monitored selected habitat using echolocation calls detection during three hours beginning 15 minutes before sunset. We used a Song Meter 4 FS Ultrasonic Recorder (Wildlife-Acoustics, USA), coupled with a 5-meter microphone (SMM-U2 Ultrasonic Microphone) at fixed points in each habitat of surveillance. In total, we recorded 11,508 sequences, from which 8915 belonged to *P. kuhllii* and 2593 sequences emitted by *E. isabellinus*. During spring and summer, activity peaked for both species with 2,219 and 2,864 passes respectively for *P. kuhllii*, while *E. isabellinus* totaled 519 and 1,227 passes. Whereas, activity decreased in autumn and winter, during which the number of passes was 2210 and 1622 respectively for *P. kuhllii*, compared with 813 and 34 passes for *E. isabellinus*. The two species were recorded in the four green spaces and during the four seasons, suggesting a brief hibernation period. These results showcased the first findings on phenological patterns of bats in the urban areas of Morocco, accordingly signaling the importance of maintaining the integration of urban habitats as foraging sources for bats.

P025 TIMING OF MIGRATION DATES AND DETECTION OF FIRST WINTERING SITES FOR THE TURTLE DOVE IN NORTHWEST AFRICA.

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The identification of migration dates and wintering zones for migratory birds are key elements for the understanding of the Afro-Palaearctic migration system. In this study, we monitored the migration dates and we investigated the new wintering sites in the migratory Turtle Doves *Streptopelia turtur* in the Maghreb. Field visits were realized with the transect method from 2015 to 2022 in different ecosystems of Morocco, Algeria, and Tunisia. We recorded that Turtle Doves entered the North African region in the final week of March and left in the middle of October. Doves arrived in Algeria and Tunisia much

sooner than they did in Morocco. Additionally, from October to February, Doves were found to winter at nine locations in Northwest Africa where they graze in flocks. We discovered that as temperature and rainfall increased, the likelihood of seeing turtle doves during the wintertime reduced dramatically. Since the likelihood of overwintering decreased with increasing distance from the recording location to the next water body, birds wintered most frequently adjacent to wetlands. These are the first and only comprehensive findings on the phenology of the globally endangered Turtle Dove's migratory in northwestern Africa.

P026 ETUDE DES TRAITs FAVORISANT LA CROISSANCE DES PLANTES ET DE LA RESISTANCE AU STRESS HYDRIQUE DES ISOLATS RHIZOSPHERIQUES DE CACTUS.

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Les chercheurs ont prévu que les sécheresses deviendraient plus graves et plus fréquentes dans le monde entier en raison du réchauffement climatique. Ce problème constitue un facteur limitant pour la production agricole. Une nouvelle technique pour gérer le stress abiotique consiste à inoculer les plantes avec des rhizobactéries favorisant la croissance des plantes. (PGPR). L'objectif principal de ce travail est de trouver des bactéries capables de stimuler la croissance des plantes dans des conditions normales et de stress ayant un potentiel PGP et étant résistantes au stress hydrique. Ainsi, 77 bactéries ont été isolées de la rhizosphère de cactus. Ces isolats ont été testés pour leurs caractéristiques PGP ainsi que pour leur résistance à différents niveaux de stress hydrique causé par le polyéthylène glycol. Les résultats ont montré que les isolats bactériens présentaient des traits PGP différents. 21,33% des isolats présentaient une solubilisation du phosphate inorganique, 60% étaient capables de fixer l'azote atmosphérique, 62,66% produisaient de l'ammoniac et démontraient une activité antagoniste contre le champignon phytopathogène *Fusarium solani*, et 73,33% produisaient des sidérophores. D'autres traits ont été étudiés dont la capacité à produire de l'acide cyanhydrique (22,66 %), de l'acide indole acétique (45,33 %) et des exo-polysaccharides (52%). Les résultats ont également révélé des différents niveaux de résistance au stress hydrique (30,67% des isolats étaient sensibles au stress hydrique, tandis que 69,33% présentaient une résistance à des pressions osmotiques allant de -0,05 jusqu'au -1,76 MPa). Ces résultats ont été analysés statistiquement et 22 isolats potentiellement efficaces ont été sélectionnés. Les bactéries rhizosphériques sélectionnées dans cette étude montrent un intérêt pour une application en tant qu'inoculants afin d'améliorer la croissance, la qualité et le rendement des plantes, y compris le cactus dans diverses conditions environnementales.

Mots clés : Rhizobactéries favorisant la croissance des plantes (PGPR), cactus, stress hydrique.

Theme 6: Soil management and biodiversity protection.

P027 EFFECT OF LEGUME INTERCROPPING AND COW MANURE ON GOWTH AND

YIELD PARAMETERS OF MAIZE (*ZEA MAYS L.*) IN MEKNES REGION, MOROCCO.Khalid SETTINI ^{1,2}, Karima MIKOU ¹, Saadia BELMALHA ¹.

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The agricultural sector grapples with a plethora of challenges that imperil its stability and ongoing viability, particularly with fertilizer applications as current chemical fertilizers are known to pose a great danger to the ecosystem necessitating the development of an alternative eco-friendly fertilization technique. The objective of this study is to investigate diverse fertilization approaches, specifically, legume intercropping and cow manure, applied to maize cultivation, and compare them against chemical fertilizers. This study spanned two consecutive agricultural seasons (2021-2022 and 2022-2023) in the Meknes region of Morocco. A randomized complete block design was adopted, with four replications, and encompassing four treatments: a sole maize plot devoid of fertilization (the control), maize intercropped with common bean, maize fertilized with cow manure, and maize treated with an N-P-K fertilizer. Across the various growth stages of the maize crop, an array of parameters, including plant length, leaf count, and stem diameter, as well as yield-related metrics such as ear length, ear diameter, seed count per ear, and the weight of 100 seeds, were meticulously assessed. The Results showed that all alternative fertilization methods exhibited statistically significant improvements compared to the control group ($P < 0.05$). The N-P-K fertilizer exhibited the most favorable outcomes across all growth parameters, with notable enhancements of 37.9%, 12.5%, and 43.4% observed in plant length, leaf count, and stem diameter, respectively. Subsequently, cow manure demonstrated respectable progress, registering increases of 23.7%, 2.9%, and 30.4% in the aforementioned parameters. In the case of intercropping, it yielded advancements of 19.2%, 5.4%, and 17.6%, respectively. As for yield-related aspects, the N-P-K fertilizer yielded the most compelling results, manifesting a remarkable 69.2% boost in seed count per ear and a 15.8% enhancement in the weight of 100 seeds compared to the control treatment. Following closely, cow manure delivered impressive gains of 69.08% and 11.06% in these two respective metrics. Intercropping, on the other hand, yielded a commendable 68.6% improvement in seed count per ear and an 8.6% increase in the weight of 100 seeds. Notably, cow manure excelled in ear diameter, exhibiting a substantial 23.5% enhancement over the control treatment, while intercropping and the N-P-K fertilizer displayed improvements of 11.6% and 9.8%, respectively. Finally, intercropping excelled in ear length, demonstrating a substantial 23.08% improvement over the control, with the N-P-K fertilizer and cow manure yielding increases of 18.9% and 9.5%, respectively. These findings highlight the potential of these alternative techniques to replace traditional chemical fertilizers while also preserving the ecosystem well-being.

P28 EFFECTIVENESS OF AERATION FOLLOWED BY STATISTICAL OPTIMIZATION OF AOP'S (ULTRAVIOLET/ULTRASONIC ACTIVE PERSULFATE/HYDROGEN PEROXIDE) PROCESS PARAMETERS FOR THE TREATMENT OF YOUNG LANDFILL LEACHATE.Hamza BELLOUK ¹, Ilham ZOUTANE ², Imane EL MRABET ³, Naima EL GHACHTOULI ², Hicham ZAITAN ¹

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The high level of pollutants in leachate leads to global pollution and significant risks for the ecosystem. The challenge is to develop an efficient, feasible, cost-effective and environmentally sound approach to leachate treatment, as these pollutants are biologically and chemically very resistant.

In this study, the young leachate from the Fez city landfill was subjected to biological pretreatment by aeration and treatment by a new advanced oxidation process (AOP) using a combination of two inorganic oxidation systems (potassium persulfate (K₂S₂O₈) and hydrogen peroxide (H₂O₂)) applied simultaneously with UV-A irradiation and ultrasonic (US).

Initial treatment by aeration resulted in COD, ABS₂₅₄, and CN removal efficiencies of 53%, 55%, and 78%, respectively. For the treatment, the efficiency of the advanced oxidation process (AOP) was statistically evaluated and the optimal operating conditions were determined. Then, the process conditions were optimized by Box-Behnken Design (BBD) combined with a surface response method to investigate the effects of three operating variables (pH, S₂O₈²⁻ and H₂O₂) on three target responses: COD, ABS₂₅₄ and color removal.

The statistical and graphical analyses show that the sequential process with aeration as pretreatment and subsequent application of the H₂O₂-PS-US-UV-A system achieves maximum efficiencies of 77%, 89%, and 99.4% in terms of COD, Abs₂₅₄, and color removal, respectively.

From a microbiological point of view, the sequential application of AOPs after pretreatment by aeration is a promising technique for the removal of high concentrations of pathogenic microorganisms in young leachates. Complete removal of total coliforms, fecal coliforms, and total mesophilic flora was achieved.

P029 TOWARDS SUSTAINABLE VEGETABLE FARMING: EXPLORING AGROECOLOGICAL ALTERNATIVES TO CHEMICAL PRODUCTS IN THE FEZ-MEKNES REGION OF MOROCCO.

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The use of excessive chemicals in agriculture can cause harm to the environment and human health. Sustainable agriculture systems promote agroecological practices to reduce chemical use and promote environmental and human health. However, there is a lack of data on the status of chemical use and the adoption of agroecological practices in the Fez-Meknes region, which is a significant national vegetable production area. To address this gap, we conducted cross-sectional surveys with 603 farmers to analyze their practices, behaviors, and knowledge regarding chemical and bio-product use, as well as the risks to crops, health, and the environment. Additionally, we aimed to diagnose the diffusion of agroecological practices and identify the most relevant obstacles and motivations for adoption. Our results indicate that a majority of farmers (95%) use chemicals throughout the production process but lack a good understanding of their use and associated risks. However, farmers do have access to alternative practices such as crop rotation (99.67%), manure (96.35%), drip irrigation (74.46%), and intercropping (69%). The success of these practices among farmers was a significant motivation for their adoption (50%), whereas the difficulties of managing pests and diseases without pesticides (73.2%) and the lack of technical advice and support (70.8%) were the main barriers to adoption. In conclusion, our study highlights the need for training and financial encouragement from the state to promote healthy and eco-friendly farming practices. This research provides valuable insights into the current status of chemical use and the adoption of agroecological practices in the Fez-Meknes region, which can inform policy decisions and promote sustainable agriculture practices for the future.

Theme 7: Protection and valorization of plants.

P30 CHARDON-MARIE (*SILYBUM MARIANUM L. GAERTN*) : UNE PLANTE MÉDICINALE PRÉCIEUSE AUX PLUSIEURS EFFETS THÉRAPEUTIQUES –REVIEW.

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Silybum marianum L. Gaertn (Chardon-Marie) est une plante médicinale largement utilisée pour ses propriétés thérapeutiques : Le Chardon-Marie est une plante originaire de la région méditerranéenne, utilisée depuis des siècles en phytothérapie pour traiter diverses affections hépatiques. Ses graines contiennent une combinaison de composés bioactifs, dont la silymarine, qui est considérée comme l'ingrédient actif principal responsable de ses effets bénéfiques. Cette revue vise à explorer les composés actifs, les bienfaits potentiels pour la santé, les mécanismes d'action et les applications cliniques du Chardon-Marie et de discute les études récents concernant les effets thérapeutiques de *Silybum marianum* et de la silymarine. Ces données ont été recueillies au moyen d'une analyse documentaire exhaustive. Le chardon- marie et la silymarine ont été utilisés dans divers domaines médicaux, thérapeutiques et pharmaceutiques, d'après un grand nombre de documents et des études scientifiques. Le chardon-Marie et la silymarine ont été utilisés comme thérapies complémentaires contre des cancers tels que la peau, la prostate et les cancers colorectaux, ainsi que des agents hépato-protecteurs. La silymarine exerce un effet chimiopréventif en réactivant les voies de mort cellulaire par la modulation des protéines antiapoptotiques et en synergie avec les agonistes des récepteurs du domaine de la mort. Sur la base des résultats de ces études, la silymarine pourrait être bénéfique pour les patients en oncologie, en particulier pour le traitement des effets secondaires des chimiothérapies anticancéreuses. Compte tenu de la propension humaine à utiliser des phyto-composés plutôt que des médicaments basés sur des constituants chimiques, il convient d'accorder une attention particulière au lien entre la valeur du chardon-marie et de la silymarine, de la science fondamentale aux applications cliniques.

P31 ETHNOBOTANICAL SURVEY: MOROCCAN MEDICINAL AND AROMATIC PLANTS, A STRONG ALTERNATIVE FOR A BETTER STRAWBERRY AND TOMATO CONSERVATION.

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Medicinal and Aromatic Plants are used in different sectors, namely the medical, agricultural, cosmetics etc... due to their richness in bioactive components. These secondary metabolites have very interesting biological activities, such as antioxidant, antimicrobial, anti-inflammatory activities.

This present work was carried out in 15 different locations (Fez, Meknes, Taounate, Karya Ba Mohamed, Khlalfa, Sidi El Mokhfi, Sefrou, Tafrant, Ghafssay, Tahar Souk, Zrizer, Kenitra, Moulay Bousselham, Larache, El Hajeb). 250 individuals (Farmers and Herbalists) have been interrogated using a form of predefined questions, concerning information about different MAPs used for conserving Tomatoes and Strawberries post-harvest. This inquiry allowed us to acquire important data about this matter.

The results obtained show an important use of Rosemary, Lavender, Thyme and Eucalyptus, four medicinal plants widely distributed and used in Morocco, which may have interesting preservative effects for Strawberries and Tomatoes in Post-Harvest.

P32 EVALUATING THE EFFECTS OF PESTICIDE APPLICATION IN MOROCCAN VINEYARDS USING ENVIRONMENTAL STRESS INDICATORS.

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The Sebou River Basin (SRB) is a crucial area for Moroccan agriculture, being a centre for the production of industrial crops, fruit and vegetables, and olive oil. The prevalence of a wide range of diseases and pests requires extensive use of pesticides. The Sebou Basin is one of the most important wine-growing areas in the country, accounting for 80% and 60% of the national area devoted to wine and grapes respectively. Unfortunately, heavy reliance on chemical inputs such as pesticides is a common practice in this area. However, this excessive use of pesticides poses significant risks to both human health and the environment. The aim of this study is to assess the impact of pesticide use on vineyards and its effects on the environment and human health. The evaluation is carried out by determining agro-environmental indicators (NT, QASI, TFI and EIQ) through field surveys. The surveys were carried out on a sample of 30 winegrowers with a total area of 1197 hectares. The results showed that grapevine cultivation is highly dependent on pesticides, with an average treatment frequency of 24.63 treatments per growing cycle. Fungicides were found to be the main type of treatment used and a wide range of 141 commercial products from 31 chemical families were used for vineyard protection. Of the total range of products, 69.5% were fungicides, 20.08% were insecticides and 1.42% were herbicides. The calculated average total TFI for pesticide use is 23.59. In addition, this study introduced the Quantity of Active Substances Indicator (QASI), which indicated an elevated pesticide application rate of 100.00 kg/ha. These findings highlight the extensive use of pesticides, which may pose significant challenges to long-term sustainable development due to the associated environmental and health hazards.

P33 OPTIMISATION SYNERGETIQUE DES SOLVANTS D'EXTRACTION DE L'INULA VISCOSA POUR UNE AMELIORATION DE L'EXTRACTION DES COMPOSES PHENOLIQUES ET DE L'ACTIVITE ANTIOXYDANTE.

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La présente étude se concentre sur l'optimisation du processus d'extraction des composés phénoliques de l'*Inula Visoca* en utilisant une approche de mélange de solvants. Les composés phénoliques sont des métabolites végétaux connus pour leurs propriétés antioxydantes et leurs avantages pour la santé. L'objectif de l'étude était d'améliorer l'efficacité de l'extraction de ces composés en modifiant les solvants utilisés. Les solvants choisis sont le méthanol, l'éthanol et l'eau vu qu'ils sont les plus utilisés dans l'extraction des métabolites des plantes. Pour atteindre notre objectif, différentes combinaisons de solvants ont été évalué par leurs effets sur deux paramètres clés : la teneur en composés phénoliques (TPC) et l'IC50 et cela en se basant sur un modèle centré augmenté qui a résulté en une matrice à 12 essais et trois point centraux.

Les résultats de l'étude ont été analyser statistiquement à partir de leur profil d'iso réponse et de leur fonction désirabilité, résultant en un mélange optimal qui conduit à une augmentation significative de la teneur total en composés phénoliques avec des valeurs de +16,32% ; +30,86% et +147,73%, de plus, l'IC50 a été réduit de -16,5% ; -26,95% et -49,15% en comparaison avec les extractions à solvants unique respectivement l'éthanol, le méthanol et l'eau. Les extraits obtenus à partir du mélange de solvants optimisé démontrant ainsi une augmentation de l'activité biologique des extraits.

P34 UNLOCKING THE POTENTIAL OF ENDOPHYTIC FUNGUS STRAINS AS BIOCONTROL AGENTS AGAINST OLIVE TREES (OLEA EUROPAEA L.) DIEBACK IN MOROCCO.

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The olive tree (*Olea europaea* L.) represents the main fruit crop in Morocco, where it occupies more than 50% of the national arboricultural area, with an annual production of 1,912,238 tonnes. However, with the intensification of olive cultivation, this plant is susceptible to attack by numerous pests and fungal diseases. This phytosanitary problem poses significant issues to increasing olive productivity, as these pathogens not only affect the quantity but also the quality of the harvest. Among these diseases is root rot caused by *Pythium schmitthenneri*, which is destructive in plantations subjected to biotic and/or abiotic stress. To address this pathology, we isolated and identified seven strains of endophytic fungus *Trichoderma* as biocontrol agents. Therefore, we studied the antagonistic effect of *Trichoderma* strains for the biocontrol of the mentioned fungus by conducting in vitro confrontation tests. The results from the direct confrontation between the pathogen and *Trichoderma* spp. showed that all seven strains of *Trichoderma* studied exhibited an inhibition rate exceeding 60% after five days of incubation at 25°C. Similarly, for the volatile organic compound (VOC) confrontation test and the acellular filtrate, the results confirmed that these strains have a significant ability to inhibit the mycelial growth of *Pythium schmitthenneri*. These effects suggest that the evaluated strains of *Trichoderma* may be potential candidates for the biocontrol of olive root rot.

Theme 8: Plant Biotechnology at the service of the Improvement and enhancement of plant resources

P35 MORPHOLOGICAL CHARACTERIZATION OF THE YLANG-YLANG PLANT FROM THE COMOROS ISLANDS.

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Cananga odorata (Lam.) Hook et Thoms is a tropical tree in the Annonaceae family, native to Indonesia. Only the genuina form can be called Ylang-Ylang proper. *Ylang-ylang* is mainly grown on the islands of Comoros, Madagascar and Mayotte to extract its essential oils. These essences are widely used in various fields, including the perfume, cosmetics and soap industries. These essential oils are also used in culinary preparations and have medicinal properties.

The tree, naturally large, is brought down to human height to make it easier to pick the flowers. Its leaves are long and dark, the flowers are light-green to dark-yellow flowers are light-green to dark yellow, highly fragrant and the fruit berries. This species thrives on many types of soil high temperatures and average annual rainfall of average annual rainfall of 1,500 mm.

Under cultivation conditions, to ensure a good flower yield, plots must be topped, pruned, deseeded and weeded. Flowers can be picked all year round, but yields, in terms of both flowers and essential oil, are highest during the dry season.

In the present work, we have tried to characterize the Ylang-Ylang plant, providing a well-detailed description of all the different aerial parts. This will enable us to highlight the distinctive characteristics of this species, widely known for its high socio-economic value.

Theme 9: Aquatic ecosystems: resources and development

P36 ANTIBIOTIC RESISTANCE IN AQUACULTURE AND AQUATIC ORGANISMS.

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Aquaculture is the fastest growing and the most promising activity to meet global food demands. Nevertheless, aquaculture growth is often linked to culture intensification, leading to stress induction in aquatic species through overcrowding and poor water quality, and simultaneously facilitating the spread of pathogens and increasing disease outbreaks such as bacterial, viral and parasitic epizootics and therefore high mortality. Antibiotics and chemicals are commonly applied to combat these diseases.

however, these treatments have been widely criticized since they represent a potential risk to aquatic species, consumer and environment.

Intensive use of synthetic drugs has resulted in the development of bacterial resistance, the emergence of antibiotic residues in the host, reduced immunity, changes in gut microbiota of the host and water pollution.

Hence, the objective of this bibliographic work is to highlight the major problems caused by the massive use or misuse of these chemicals and how they impact the aquaculture industry and simultaneously direct attention to some ecofriendly alternatives that might be used to cope with these challenges.

P37 DEEP EUTECTIC SOLVENTS AS AN INNOVATIVE TECHNIQUE FOR EXTRACTION OF BIOACTIVE COMPOUNDS FROM MICROALGAE BIOMASS.

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In response to the growing demand for natural bioactive molecules in various industries, the extraction of metabolites from natural resources has received increasing attention. Microalgae species, due to their high biotechnological potential for producing a diverse array of biomolecules, have emerged as a valuable resource for various industrial sectors. However, the economic viability of biotechnological processes remains a central challenge, given that many valuable compounds accumulate within microalgal cells, necessitating efficient extraction, recovery, and purification technologies. Recent advancements in solvent-free physicochemical processes and treatments aim to establish adaptable and sustainable methods for obtaining high-quality, pure target products from microalgae. In this study, we explored the potential of renewable deep eutectic solvents (DES) in conjunction with various solvents as environmentally friendly alternatives to conventional solvents for the efficient extraction of bioactive compounds from microalgal biomass. Our study focused on four distinct choline chloride based DES formulations: glycerol, citric acid, urea, and glucose, as well as three organic solvents: hydro-ethanol extract, methanol extract and aqueous extract. We further optimized the extraction process through the application of ultrasound and microwave treatments. Quantitative analysis of the extracts revealed that polyphenol concentrations ranged from 3.8 to 8.31 mg EAG/g DM, with the highest concentrations observed in DES-type extracts. Notably, the DES3 (urea-based) extract exhibited the highest polyphenol content, while the aqueous extract displayed the lowest. In parallel, flavonoid analysis demonstrated that the DES2 (Citric acid-based) extract possessed the highest concentration at 199.68 mg EQ/g DM, followed by the methanolic extract at 110.33 mg EQ/g DM, with the aqueous extract yielding the lowest flavonoid content. These results underscore the efficacy of specific DES formulations, with DES3 and DES2 showing promise for polyphenol and flavonoid extraction, respectively. Our findings contribute valuable insights into sustainable and economically viable extraction methods for microalgal metabolites, holding significant potential for applications in various biotechnological fields.

P38 PHYSICOCHEMICAL AND BACTERIOLOGICAL QUALITY ASSESSMENT OF WATER DOWNSTREAM OF THE KADDOUSSA DAM IN BOUDNIB, MOROCCO.

El Mostapha AL BOU

FST– Errachidia.

This study aimed to assess the physicochemical and bacteriological quality of surface water and groundwater along the Oued Guir downstream of the Kaddoussa Dam. Additionally, the study aimed to

characterize the liquid effluent discharged from the Boudnib wastewater treatment plant in Oued Guir. Therefore, 15 measuring points were selected and a sampling campaign was organized in November 2022. For the assessment of groundwater and surface water quality, 10 physicochemical parameters were examined. While for the bacteriological analysis, two indicators were studied: fecal coliforms and *Escherichia coli*. Whereas, to characterize wastewater, 38 parameters were studied. Water samples were collected and analyzed for their physicochemical and bacteriological quality using standard methods. The results found were compared with Moroccan and World Health Organization (WHO) standards. The results of this study indicate that the mineralization of surface water and groundwater is relatively strong at all sites. Electrical conductivity (EC) measurements in groundwater were in excess of 1400 $\mu\text{S}/\text{cm}$. While, Nitrogen quality of groundwater in terms of Nitrates (NO_3^-) is average at all sampling points. Moreover, the nitrogen quality in terms of Ammonium (NH_4^+) is excellent for all the stations. The physicochemical indicators measured for surface waters show that the quality of these waters is excellent. According to the analysis of the results of the bacteriological examination of fecal coliforms and *Escherichia coli*, it turns out that the contamination of the waters analyzed is very low, and it can be considered negligible. In contrast, the physicochemical analysis of the liquid effluent discharged by the Boudnib wastewater treatment plant shows that the organic load exceeds the Moroccan standards for liquid discharges, which threatens the receiving environment.

Theme 10: Blue biotechnologies: Economic and environmental valorization of natural and bioactive substances.

P39 ACTIVITE ANTIBACTERIENNE DES BACTERIES LACTIQUES ISOLEES DES ALGUES MARINES CONTRE LES BACTERIES RESPONSABLES DE MALADIES NOSOCOMIALES.

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L'émergence du phénomène d'antibiorésistance et des maladies nosocomiales a incité la communauté scientifique à lancer des investigations pour surpasser ce dilemme. Les scientifiques d'aujourd'hui s'intéressent de plus en plus à la recherche de nouvelles molécules biologiques alternatives produites par des microorganismes qui vivent et survivent dans des niches écologiques hostiles caractérisés par des paramètres physicochimiques extrêmes en termes de température, salinité et/ou acidité.

Cette étude vise à isoler, caractériser et identifier des souches de bactéries lactiques compétentes à partir du milieu marin pour traiter certaines problématiques ayant une priorité nationale et internationale. Dans cet objectif nous avons testé l'activité antibactérienne *in vitro* de 14 souches de bactéries lactiques (BL) marines contre des souches isolées des milieux hospitaliers notamment les souches *Escherichia coli*, *Salmonella spp.*, *Staphylococcus aureus*, *Bacillus subtilus*, *Bacillus cereus* et *Bacillus sp.* La capacité inhibitrice des BL a été testée en utilisant la méthode de diffusion en puits sur gélose, et les moyennes ont été calculées à partir des mesures issues de 3 essais distincts. Les résultats obtenus démontrent un potentiel inhibiteur des BL marines étudiées envers les souches pathogènes testées, avec un diamètre d'inhibition moyen de 30,3 mm, comparé à celui de l'antibiotique tétracycline et streptomycine qui était de 25 mm. Ces résultats ouvrent des perspectives pour identifier les substances antibactériennes inhibitrices produites par les BL marines, et suggèrent leur utilisation potentielle dans des procédés biotechnologiques contre les germes d'altération alimentaire et infections humaines.

Mots-clés : Bactéries lactiques, algues marines, activité antibactérienne, applications biotechnologiques.

P40 ANTIFUNGAL ACTIVITY OF LACTIC ACID BACTERIA ISOLATED FROM MARINE ALGAE AND ALGAE EXTRACTS AGAINST SPOILAGE MICROORGANISMS AND TOXIGENIC MOLDS.

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Toxigenic molds (*Aspergillus flavus* and *A. niger*) and spoilage fungi are responsible for the deterioration of the quality of various foodstuffs, leading to adverse health consequences and significant economic losses. They are also capable of producing several mycotoxins on infected plants and fruits, posing a serious risk to human and animal health. Lactic acid bacteria (LAB) and marine algae are considered as natural antagonists of these microorganisms through the production of a large number of bioactive compounds with antifungal properties.

In the present study, selected strains of LAB isolated from several marine algal species collected on the coast of Sidi Bouzid in El Jadida, as well as the extracts of collected marine algae, were tested for their antifungal power against yeast strains (*Candida* spp.) and toxigenic strains of *A. flavus* and *A. niger*. The antifungal capacity of LAB and marine algae extracts was evaluated using the agar inoculation method, and means were calculated from measurements from 3 separate assays. The obtained results demonstrated an inhibitory potential of algae extracts and LAB against all studied fungal species of up to 90%. These results suggest a potential application of the studied algae extracts and isolated LAB in food industry as biopreservatives against toxigenic molds and food spoilage microorganisms.

Keywords: Antifungal activity, Lactic acid bacteria, Marine algae, Biotechnological application.

Theme 11: Natural resource compounds: chemical composition, biological activity and toxicity assessment

P41 AMELIORATION DE L'EFFICACITE ANTIMICROBIENNE DU CAMPHRE PAR SA TRANSFORMATION EN BORNEOL-O-ALKYL.

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Cette étude met en évidence la synthèse et la caractérisation de molécules bioactives innovantes dérivées du camphre (terpène cétone bicyclique). L'exploration de leurs propriétés et de leurs applications potentielles est au cœur de cette recherche. Notre étude a conduit à la synthèse d'une nouvelle molécule, le bornéol-o-alkyl, dérivée du camphre, le principal composé du romarin. Les techniques de spectroscopie RMN et carbone-13 révèlent ses caractéristiques structurales. Les activités antimicrobiennes ont révélé une toxicité accrue du bornéol-o-alkyl envers lune bactérie à Gram positif (*Escherichia coli*) et une bactérie à Gram positif (*Staphylococcus aureus*) par rapport au camphre

original. Cette molécule plus hydrophobe pénètre facilement dans les membranes des bactéries grâce à l'alkylation propargyle, ce qui renforce son activité antibactérienne. La synthèse du bornéol-o-alkyle à partir du camphre a produit une molécule bioactive plus efficace, présentant une activité antimicrobienne ciblée contre certaines souches bactériennes. Ces résultats ouvrent de nouvelles voies dans le domaine du contrôle antimicrobien et de la conception de composés bioactifs améliorés, offrant des perspectives prometteuses pour de futures applications.

Mots-clés : Synthèse chimique, Bornéol-o-alkyl, Camphre, Spectroscopie RMN, Carbone-13, Activité antimicrobienne, Alkylation propargyle.

P42 ANALYSE QUALITATIVE ET QUANTITATIVE DES GLYCOSIDES DE STEVIOL A PARTIR DES FEUILLES DE *STEVIA REBAUDIANA BERTONI* CULTIVEE AU MAROC : UNE ETUDE EXPERIMENTALE A TROIS FACTEURS.

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Cette étude se focalise sur l'analyse qualitative et quantitative de trois glycosides de stéviol (Stevioside, Steviolbioside, et Rebaudioside-A) extraits des feuilles de *Stevia Rebaudiana Bertoni* cultivées au Maroc. L'analyse qualitative a été réalisée par chromatographie sur colonne, avec ces glycosides servant de normes de référence. L'analyse quantitative a suivi un plan d'expérience à trois facteurs, incluant la température (45 – 70 °C), le temps d'extraction (15 – 60 minutes), et la combinaison de solvants (20/80 – 70/30), avec huit essais distincts. Les échantillons ont été mesurés par spectrophotométrie à 510 nm après identification par chromatographie sur couche mince. Les résultats montrent que les conditions d'extraction optimales sont 70 °C pendant 15 minutes, avec une combinaison de 20/80 éthanol/eau. Ces résultats suggèrent un fort potentiel d'utilisation des glycosides de stéviol dans les industries alimentaires et pharmaceutiques.

P43 BIOLOGICAL ACTIVITIES OF NATURAL BIOACTIVE MOLECULES IN MEDICINAL PLANTS.

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The use of medicinal plants is increasing day by day, due to their benefits for human health. Synthetic antioxidants and antibiotics only increase the incidence of disease due to their undesirable side-effects, bacterial multi-resistance and other illnesses. To address this problem, scientists are turning to medicinal plants. These are a potential source of bioactive molecules used as an alternative to protect against and treat disease. Bioactive molecules such as flavonoids, terpenes, phenolic acids, coumarins, alkaloids, glucosides and saponins are at the origin of the biological activities exerted by these plants: antibacterial, antifungal, antioxidant, anti-inflammatory, antidiabetic.

The present work illustrates some of the biological activities exerted by the natural bioactive molecules of medicinal plants.

P44 CONTRIBUTION A L'ETUDE DE LA VARIABILITE DE LA COMPOSITION CHIMIQUE DE L'HUILE ESSENTIELLE D'ARTEMISIA : ESPECE ENDEMIQUE AU MAROC.

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Cette étude est basée sur la collecte du genre *Artemisia* de 6 provenances appartenant à des régions distinctes afin d'étudier la variabilité de cette plante en relation avec le profil chimique de son huile essentielle (HE). L'extraction de l'huile essentielle (HE) de la partie aérienne de cette plante a été réalisée par hydrodistillation et analysée par GC/MS. Le rendement en HE d'*Artemisia herba alba* des 6 provenances est autour de 1 %. L'HE de la provenance P1 est dominée par le Camphre, Thujone et Camphène. Les HE des provenances P2, P3, sont caractérisées par la prédominance de 3 monoterpènes oxygénés : le Camphre, la Thujone et l'Eucalyptol Enfin, l'HE de P4, P5 et P6 sont caractérisée par la prédominance de trois monoterpènes oxygénés : le Camphre, l'Eucalyptol, et Camphène, on constate ainsi la présence d'une faible teneur en thujone au niveau de P4, P5 et P6. Ce travail a permis d'identifier deux chémotypes : l'un au Camphre et Thujone (P1, P2 et P3) ; l'autre au camphre et Eucalyptol (P4, P5, P6).

P45 CURRENT PROGRESS IN PRODUCTION OF BIOPOLYMERIC MATERIALS BASED ON CELLULOSE.

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Cellulose is one of the main natural polymers existing in plant biomass and having great economic potential. In this study, cellulose fibers were extracted from flax stalks of three varieties (LK, LE, LF) and analyzed to understand the crystalline, functional and morphological properties by using X-ray diffraction (X-RD) and scanning electron microscopy (SEM). Plant biomass was characterized on a phytochemical and biochemical level to select which constitutes a recoverable and exploitable economic source. The lignin contents were determined to find the most suitable varieties for the manufacture of bio-materials. Cellulose fibers were treated with sulfuric acid to obtain cellulose nanospheres. The Kazakhstan (LK) variety contains the greatest amount of cellulose (73.5%) and hemicellulose (14.3%). Biochemical analyzes show that the Moroccan variety can be exploited for the production of high added value lipids and fibers. Their rheological characterization seems to be a priority for moving to industrial exploitation. In perspective, three parameters will be determined: density, water absorption capacity and compressive strength to better understand the behavior of cellulosic composites and allow their wide implementation in sustainable construction materials such as non-load-bearing construction products, so that we can market our own ecological composites.

P46 DESIGN, SYNTHESIS AND CHARACTERIZATION OF NEW QUINOXALINE-2,3-DIONE DERIVATIVES FOR APPLICATIONS IN MEDICINAL CHEMISTRY.

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Heterocyclic compound are one of the vast areas of research in medicinal chemistry. Several nitrogenous heterocycles have been synthesized or discovered in natural compound, including indole, triazole, quinoline, and quinoxaline [1]. Quinoxaline is a member of family of benzodiazine with its 1,4-nitrogens as heteroatoms; it is formed by the fusion of two aromatic rings, benzene and pyrazine. For this reason is also called benzopyrazine, and is described as a bioisoster of quinoline, naphthalene and benzothiophene [2]. These are pharmacologically important compounds possessing a wide variety of pharmacological effects and a low toxicity profile. Quinoxaline core is an attractive nucleus for Medicinal Chemists to achieve various biologically active compounds. Echinomycin [3] a natural antibiotic that possesses two terminals quinoxaline-2-carboxylic.

In particular, quinoxaline-2, 3-dione derivatives are important classes of nitrogen-containing heterocycles, as they constitute useful intermediates in organic synthesis [4]. Introduction of different groups to the core structure can produce a series of compounds with multiple activities. Our work describes various aspects different reactions used to create novel quinoxalines-2, 3-dione derivatives. Reports on physicochemical characteristics and chemical structure characterization will be presented alongside with some biological applications.

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P47 ETUDE CHROMATOGRAPHIQUE DES COMPOSES PHENOLIQUES LA CITRONNELLE (CYMBOPOGON CITRATUS) PLANTEE AU MAROC.

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Les feuilles et autres parties de la plante *Cymbopogon citratus* sont utilisées en industrie agroalimentaire, en cosmétologie et en industrie pharmaceutiques. Ainsi, elle peut être utilisée pour traiter les effets secondaires du VIH, y compris les infections bactériennes secondaires. En raison de la présence de différents métabolites secondaires, la citronnelle a été utilisée pour traiter une variété de maladies (la toux, la fièvre, l'éléphantiasis, la malaria, la lèpre et d'autres difficultés digestives). Dans cette étude, nous avons utilisé des feuilles de citronnelle, plantée dans le jardin botanique relevant de la FST de Fès, pour préparer une poudre fine (\varnothing 0.1mm) qui est extraite par trois solvants polaires (eau, méthanol et éthanol). Les extraits solides obtenus après élimination des solvants on fait l'objet d'une chromatographie d'exclusion sur gel Sephadex (G-50) afin de suivre la distribution des poids moléculaires des composés phénoliques suivi quantitativement par le réactif *Folin-Ciocalteu*. Globalement, l'affinité des solvants utilisés pour l'extraction de *Cymbopogon citratus*, en raison de leur poids moléculaire élevé, augmente proportionnellement avec le degré de polarité. Les quantités de composés phénoliques totaux dans *Cymbopogon citratus* étaient variables en fonction du type

d'extrait et de la fraction. L'éthanol est le meilleur solvant pour extraire les molécules ayant plusieurs activités biologiques.

P48 ETUDE COMPARATIVE DES PROFILS PHENOLIQUES DES VARIETES DES CUMIN (*CUMINUM CYMINUM L.*) PLANTEES AU MAROC.

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Au Maroc nous avons des plantations de cumin qui sont adaptées aux conditions écologiques locales. Ce secteur souffre de plusieurs problématiques qui entravent son développement et sa compétitivité sur le plan national et international. Au Maroc cette plante est moins étudiée sur le plan phytochimique car la majorité des études sont concentrées uniquement sur les huiles essentielles.

Dans cette étude nous avons visé les composées phénoliques comme indicateurs qualitatifs et quantitatifs pour les épices comme objectif la comparaison des variétés du cumin locale et importes dans différentes plantations.

L'analyse chromatographique laquelle a montré que les extraits aqueux qui correspond théoriquement à la forme culinaire sont pauvres en composés phénoliques polymères et riches en composés phénoliques monomères.

L'analyse de l'activité antioxydante évaluée par deux méthodes (DPPH et CAT) a montré que le DPPH est bien corrélé avec les contenus phénoliques alors que la méthode CAT est corrélée avec les polymères glucidiques et l'activité antimicrobienne des composés phénoliques est corrélés avec la forme monomère.

P49 ETUDE COMPARATIVE DU COMPORTEMENT DES GRAINES DE CINQ VARIETES DE LIN (*LINUM USITATISSIMUM*) VIS-A-VIS DU STRESS SALIN.

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Les graines de lin sont largement reconnues pour leurs propriétés nutritionnelles et leurs multiples applications industrielles. Cependant, la culture du lin peut être confrontée à diverses contraintes environnementales telles que le stress salin qui peut avoir un impact négatif sur la germination et la performance globale des plantes. Il est donc crucial de rechercher des variétés qui présentent une tolérance accrue à la salinité. La présente étude vise à examiner l'effet de différentes concentrations de NaCl sur la germination et la croissance de 5 variétés de lin (LM, LC, LE, LF et LK). Outre l'étude des paramètres de la germination, des études morphométriques (longueur, largeur et épaisseur des graines), biochimiques (Protéines solubles et sucres totaux des plantules) et de croissance (hauteur de la plante, nombre de feuilles et teneur en chlorophylles) sont réalisées par des méthodes standardisées. Les résultats ont montré que les variétés LM et LC présentent le pourcentage de germination le plus élevé, (93,33 %) suivi de celui des variétés LE et LF (86,66 %) et de LK (73,33 %). Sous un stress modéré (50 mM), le taux de germination des différentes variétés testées ne diffère pas significativement de celui du témoin. Cependant, lorsque l'intensité du stress est élevée (100 mM et 200 mM), toutes les variétés sont affectées avec un taux de germination inférieur à celui du témoin. Néanmoins, LM et LC sont les variétés les plus résistantes au stress salin avec un taux de germination moyen de 40 % dans les conditions de stress sévères (200 mM). Ces variétés tolérantes ont montré une augmentation de la concentration en protéines solubles (16% contre 10% pour le témoin) et en sucres totaux (6,2% contre 3% pour le témoin). C'est également ces deux variétés qui sont caractérisées par une teneur en chlorophylle a élevée

(18,9 mg/gMF), une plus grande longueur de tige et un nombre de feuilles élevé. Cette étude contribuera à identifier les variétés les plus adaptées à la culture du lin dans des régions où la salinité du sol constitue une contrainte majeure Elle met également en évidence la stratégie adaptative de la plante vis-à-vis du stress salin.

P50 EVALUATION DE CERTAINS PARAMETRES ORGANOLEPTIQUES DE LA VIANDE DES POULETS DE CHAIR NOURRIS AUX POUDRES DE ROMARIN (ROSMARINUS OFFICINALIS) ET LA CHITINE.

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Cette étude vise l'amélioration de la qualité de viande poulet de chair par la poudre de romarin et la chitine utilisées comme substituants des antibiotiques dans quatre formulations formées de deux témoins et deux traitements avec deux doses de 20 et 50 g/kg. Quatre lots de 12 poussins (Hubbard F37) âgés de 1 jour ont été nourris à l'aide des 4 formulations durant 37 jours. Les qualités organoleptiques de la viande des poulets ont été jury de dégustation. Le test de dégustation a été réalisé sur 8 poulets à raison de 2 poulets pour chaque groupe. Par conséquent, les dégustateurs devaient juger un morceau de peau, un morceau de blanc et un morceau de cuisse. Les résultats de l'analyse organoleptique de la viande des poulets de chair ont montré que la poudre formulée améliore le goût, la texture et la tendreté des viandes. Ces paramètres augmentent avec le taux d'incorporation de poudre de romarin et la chitine dans l'aliment des poulets de chair. La saveur et la jutosité sont presque similaires avec les quatre lots. De façon générale, l'utilisation de la poudre du romarin et la chitine à un effet positive sur la qualité organoleptique.

P51 EVALUATION DE L'EFFET DE BIOMOLECULE SYNTHETIQUE SUR L'INFLAMMATION INTESTINALE INDUITE CHEZ LE RAT.

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Introduction : Les maladies inflammatoires de l'intestin (MICI) sont des affections chroniques, rémittentes et récurrentes, avec une prévalence élevée dans les pays développés et une incidence en augmentation rapide dans les pays nouvellement industrialisés. Actuellement, les MICI sont devenues presque mondiales affectant des masses de presque tous les âges, y compris la population pédiatrique. Ainsi, la prévalence mondiale devrait toucher jusqu'à 30 millions de personnes d'ici 2025. De plus l'étiologie des MICI n'est pas encore entièrement clarifiée. Alors pour étudier la pathogénéicité et la complexité des MICI, il est nécessaire de développer une variété de modèles animaux et de s'intéresser de plus en plus à utiliser des produits naturels ou bien synthétiques qui préservent la nature.

Les pyrano[2,3- c]pyrazoles ont des activités importantes, telles que des propriétés antitumorales, analgésique, anti-inflammatoires, antimicrobiennes, antioxydantes et molluscicides. De plus, ces composés sont des précurseurs importants de médicaments prometteurs dans le domaine de la chimie médicinale. Ces composés dérivent de la synthèse par les réactions multicomposantes (MCRs).

Méthodes : A cet égard dans un premier temps nous avons développé un modèle animal et avons évalué l'effet curatif et préventif des pyrano[2,3- c]pyrazoles sur le colon en faisant une étude macroscopique, histologique et en dosant le MDA, marqueur de la peroxydation lipidique.

Résultats : En s'appuyant sur les différents résultats obtenus, nous avons constaté que la molécule a un effet curatif plutôt que préventif.

Conclusion : Enfin cette étude suggère l'utilisation des pyrano[2,3- c]pyrazoles en tant que traitement, mais pour confirmer cela, l'analyse d'autres paramètres biochimiques et inflammatoires est nécessaire.

P51 EVALUATION DES EFFETS D'UNE HUILE ESSENTIELLE SUR L'INFLAMMATION INTESTINALE IN-VIVO.

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L'inflammation est un phénomène naturel qui fait partie de notre système immunitaire, elle joue un rôle crucial dans la défense que dans le processus de guérison. Cependant, la réponse inflammatoire incontrôlée est la principale cause de nombreuses pathologies y compris les maladies inflammatoires chroniques de l'intestin. Explorer des alternatives naturelles pour traiter ces maladies constitue une préoccupation primordiale particulièrement en présence du risque d'événements indésirables liés aux médicaments anti-inflammatoires. Dans ce contexte, nous nous sommes intéressés dans le présent travail à évaluer l'effet curatif d'une huile essentielle d'une plante marocaine (HETA) extraite par hydrodistillation sur un modèle d'inflammation intestinale induite par l'acide acétique chez le rat. Les tissus du côlon ont été examinés pour les paramètres macroscopiques, histologiques et les niveaux de malondialdéhyde (MDA), Catalase (CAT) et la Superoxyde dismutase (SOD). Les résultats préliminaires de cette étude suggèrent que cette huile possède une activité antioxydante et anti-inflammatoire intéressantes reflétées par une amélioration des caractères physiopathologiques macroscopiques et histopathologiques associés à l'inflammation, une réduction de la peroxydation lipidique ainsi qu'une augmentation des activités spécifiques de la SOD et CAT.

P52 EXPLORING MICROBIAL INULINASE: SELECTION, CHARACTERIZATION, AND PURIFICATION OF STREPTOMYCES ANULATUS FOR ENHANCED INDUSTRIAL APPLICATIONS.

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Inulinase is an essential enzyme that facilitates the conversion of inulin into D-fructose. While this enzyme can be derived from plants, obtaining it in significant quantities presents a challenge, resulting in high production costs. As a result, microbial inulinase has emerged as a promising alternative to meet industrial demands more efficiently. Unfortunately, there has been a noticeable dearth of research in the past decade concerning actinobacterial inulinases, particularly in terms of their purification and characterization during the extraction process. This study aims to address this research gap by selecting actinomycetes with substantial inulinase activity from soil samples. To screen for inulinase-producing bacteria, a modified Czapek Dox agar supplemented with 1% inulin powder was employed. Among the tested isolates, *Streptomyces* sp. EFBO8 exhibited remarkable efficacy. Through morphological and genotypic identification methods, it was confirmed that the strain is specifically identified as *Streptomyces anulatus*, with its nucleotide sequence being deposited in Genbank under the accession number QO73700. In order to optimize the production of inulinase, kinetic studies were conducted using the highly productive *Streptomyces anulatus* strain, which yielded a value of 24,024 EU/ml. The enzyme was subsequently purified from the culture filtrate by precipitation with ammonium sulfate

(NH₄)₂SO₄), followed by column chromatography using Sephadex (G50) for separation. The purified protein exhibited a molecular mass of 3331.83Da.

P53 L'ACTIVITE ANTIOXYDANTE DES POLYPHENOLS EXTRAITS DES FRUITS D'OPUNTIA STRICTA COLLECTE AU MAROC.

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Opuntia stricta appartient à la famille des *Cactaceae* et produit un fruit que l'on appelle figue de Barbarie. Cette plante est originaire du Mexique mais en raison de sa capacité à pousser dans des climats désertiques, elle s'est répandue dans différentes régions telles que le Maroc. Cette étude s'intéresse à l'évaluation de l'activité antioxydante des polyphénols extraits des fruits la plante *Opuntia Stricta*. Les polyphénols ont été extraits par deux méthodes, macération et appareil soxhlet. L'activité antioxydante a été réalisée avec deux méthodes : Pouvoir ferrique réducteur antioxydant FRAP et Phosphomolybdène PPM. Les deux méthodes présentent un rendement en polyphénols totales égal à 3,78±0.23% et 4,45±0.15% pour appareil soxhlet et macération respectivement. Le test FRAP a montré une capacité antioxydante significative. Surtout dans l'extrait obtenu par macération qui occupe la première place avec une valeur de 2908.6 EAA/1g MS, en comparaison avec l'acide ascorbique, de 1086.5 EAA/1g DM pour la concentration de 0.5mg/ml. Cette étude a montré l'intérêt des fruits d'*Opuntia Stricta* comme source potentielle de nouvelles substances biologiques naturelles.

P54 L'HUILE ESSENTIELLE DES FEUILLES DE CITRONNELLE, MISE AU POINT ET VALORISATION.

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Cymbopogon citratus est connue comme l'une des plantes aromatiques cultivées principalement pour son huile essentielle dans les régions tropicales et subtropicales régions d'Asie, d'Amérique du Sud et d'Afrique. Cette huile essentielle est traditionnellement utilisée pour traiter diverses maladies microbiennes. Ce travail vise à étudier les huiles essentielles de *cymbopogon citratus* introduite au Maroc pour s'enquérir de la composition de son huile essentielle ainsi que son activité antioxydante. Les feuilles de *Cymbopogon citratus* sont récoltées puis séchées à l'étuve à une température de 45°C. L'extraction des huiles essentielles a été réalisée pendant 3 heures par hydrodistillation à l'aide d'un appareil type Clevenger. L'identification des constituants de l'huile essentielle a été réalisée sur chromatographe en phase gazeuse couplée à la spectrométrie de masse. L'activité antioxydante totale a été évaluée par la méthode de capacité antioxydant totale dont le principe est basé sur la réduction du molybdène.

Les résultats obtenus ont permis d'identifier 19 constituants représentant environ 95,81 % de cette essence. L'échantillon de *Cymbopogon Citratus* est riche en Geranial (50, 3 %), le Neral (31,2 %) ensemble souvent dénommé citral. Le Neral et le Geranial restent les 2 composés majoritaires

constituant le *C. citratus* des différents échantillons du Maroc, Togo, l'inde, le Brésil, l'Égypte, l'Éthiopie et le Burkina Faso avec des pourcentages très proches l'un à l'autre. Les résultats obtenus montrent que l'HE de *C. citratus* présente une capacité antioxydante très importante.

L'activité antioxydante est modérée à importante selon la méthode d'évaluation utilisée. De ce fait, grâce aux vertus antioxydantes, la citronnelle peut être considérée comme une alternative naturelle dans les domaines d'industries alimentaires et pharmaceutiques pouvant remplacer les composés chimiques.

P55 LAVANDULA MAROCCANA ESSENTIAL OIL: CHEMICAL PROFILING AND ANTIMICROBIAL POTENTIAL.

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Essential oils, derived from aromatic plants, provide a diverse array of bioactive compounds that effectively combat bacterial infections, including drug-resistant strains, offering a valuable resource in the fight against antibiotic resistance. Lavandula maroccana, a native Moroccan plant thriving in the high-altitude regions of the Atlas Mountains, is renowned for its aromatic and medicinal properties deeply rooted in traditional medicine. Despite its significance, the chemical composition and the antimicrobial activity of *L. maroccana* essential oil (LMEOs) remain largely unexplored.

This research explores the antimicrobial potential of LMEOs obtained using the Clevenger apparatus. Chemical identification was performed using gas chromatography coupled to a mass spectrometer (GC-MS). Antimicrobial properties were assessed through measurements of inhibition halos and determination of minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) using assays. The study targeted bacterial strains including *Bacillus cereus*, *Staphylococcus aureus*, *Listeria innocua*, *Pseudomonas savastanoi*, and *Escherichia coli*, alongside the fungus *Candida albicans*.

In terms of the chemical composition, Camphor emerged as the predominant bioactive compound in the essential oil among the 43 identified compounds. It was followed by Octadecane, beta-eudesmol, borneol, and piperitenone oxide. Regarding the antibacterial activity, the most substantial inhibition zone was observed against *B. cereus*, which was equivalent to the inhibition observed with the positive control gentamicin. Additionally, the essential oil exhibited the second-highest inhibition zone against the fungus, and this was comparable to the inhibition achieved by the positive control amphotericin B. The lowest MIC value was recorded for *E. coli*, underscoring its potent growth inhibition, and revealing its high susceptibility for the essential oil. This pattern was followed by the MIC values for the remaining bacterial strains and the fungus, all showing similar susceptibility. Remarkably, the MBC value remained consistent for bacterial strains and the fungus.

In conclusion, this study sheds light on the previously unexplored chemical composition of *Lavandula maroccana* essential oil, revealing its promising potential for applications in the field of antimicrobial research.

P56 NEW EXTRACTS FROM POMEGRANATE BY-PRODUCTS AS A POTENTIAL BIOHERBICIDAL TANNIN: PRELIMINARY CHARACTERIZATION AND GROWTH CONTROL ON *MEDICAGO SATIVA L.* AS A MODEL.

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Many plant species have recently developed resistance to herbicides that are commercially available. As a result, there is increased interest in the study and development of approaches based on alternative materials to regulate these plants, with the purpose of reducing the environmental hazards of their uncontrolled use. Pomegranate (*Punica granatum L.*) by-products (PR) are rich in phenolic compounds which are classified as allelochemicals having inhibitory effect on the growth of plants. This study aims to verify the biological effects of PR phenolic compounds, by studying the germination characteristics and initial seedling development, in order to reveal potential phytotoxic effects on plant species' morphophysiology. The phytotoxicity tests were carried out to demonstrate the existence of inhibitory effects of PR crude extracts as well as their fractions on plant growth. Dried Alfalfa seeds (*Medicago sativa L.*) were used as a model for this study. The phytotoxicity of PR crude extracts and their fractions, on alfalfa seed germination show that all extracts significantly inhibit germination and slow down germination kinetics, with inhibition rates ranging from 3.72% for the aqueous extract to 61.1% for the n-butanolic fraction.

For all PR extracts tested, a delayed phytotoxicity effect was observed, stabilizing from the 4th day of incubation. However, a rapid and unstable inhibition is observed, followed by a decrease in control and regulation of seed dormancy, after increasing the extract concentration. Correlating these phytotoxicity studies with phenolic, flavonoids and tannins contents results in a deeper understanding of the biological effect of these substances which could be the result of the whole extracts, their pure isolated bioactive compound or a synergism between many components.

P57 NOUVEAUX COMPOSES TRIAZOLIQUES DERIVES DE LA CYTOSINE : SYNTHÈSE, CARACTERISATION ET ACTIVITE BIOLOGIQUE.

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La cytosine est une base nucléique, et plus exactement une base pyrimidique. On la trouve sous forme de nucléotide dans l'ADN, dans l'ARN, ainsi que sous forme de nucléoside avec la désoxycytidine et la cytidine. Les triazoles font partie de la famille chimique des azoles qui sont largement rencontrés en chimie industrielle et représentés dans l'industrie pharmaceutique, l'agrochimie, l'environnement, les colorants, les plastiques, le traitement de surface, les cosmétiques, les tensioactifs...

Les molécules comportant des unités 1, 2,3-triazole ou 1, 2,4-triazole sont utilisées comme intermédiaires de synthèse dans la préparation de nombreux principes actifs médicamenteux. Elles sont en effet associées à diverses propriétés pharmacologiques, telles que des propriétés antivirales, antitumorales, antimicrobiennes, antiépileptiques, antihistaminiques, antiprolifératives, antibactériennes, antiallergiques, anti-inflammatoires ou antifongiques.

Les sucres jouent un rôle essentiel dans les communications entre les cellules et dans le fonctionnement du système immunitaire. Ils représentent une nouvelle génération de médicaments, destinés à lutter contre les maladies infectieuses et contre le cancer.

Dans ce travail, nous nous intéressons à la synthèse de triazoles à partir de la cytosine avec différents sucres.

P58 OPTIMISATION D'EXTRACTION DES BÉTALAÏNES D'*OPUNTIA STRICTA* COLLECTE AU MAROC.

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Les fruits d'*Opuntia stricta* ont un couleur violet intense, dont l'écorce et la pulpe poussent à l'état sauvage, qui constitue une source importante de bétalaïnes principalement des bétacyanines et de composés, qui pourraient jouer un rôle important dans la promotion de la santé humain. La présente étude a été réalisé dans le but d'optimisé l'extraction par macération des bétalaïnes d'*Opuntia Stricta*. L'influence de la quantité de la matière sèche dans le solvant (0,1%, 0,2%, 0,3%, 0,4%, 0,5% et 1%), de solvant d'extraction avec un rapport de (0%,20%,40%,60%,80% et 100%) d'eau dans l'éthanol et du temps d'extraction (10, 20, 30 et 60 min) sur les bétalaïnes totales. Tous ces échantillons ont été mesurés par spectrophotométrie UV-visible. Cette étude propose une méthode simple et efficace pour obtenir un bon rendement des bétalaïnes, qui peuvent être utilisés dans plusieurs applications.

P59 PEDAGOGIE ET CONCEPTUALISATION AFIN D'ACCEDER A L'EDUCATION POUR LA DURABILITE A L'UNIVERSITE MAROCAINE : L'USMBA COMME MODEL.

Nabila DIOURI, Driss BENTIR, Faouzi ERRACHIDI.

Dans ce travail, nous conceptualisons l'éducation pour la durabilité (EPD) comme un problème socio-économique déréglé qui nécessite la mise en œuvre d'une perspective corrective si elle doit être abordée de manière systémique et durable au Maroc. La prise en compte de l'EPD à travers un kaléidoscope socio-économique complexe prendre en considération des perspectives que nous nommons dans ce travail la pensée rationnelle et objective doit interagir avec plus de structures de connaissances particulières et subjectives. Cela nous permet d'aborder les concepts de de base liés à l'EPD que nous identifions comme problématique de première nécessité. Par analogie avec l'exploration d'un terrain inconnu, nous considérons l'importance de la pédagogie en tant qu'idée fondamentale dans la construction d'approches interdisciplinaires de l'EPD à l'université marocaine.

Pour atteindre ces objectives nous avons élaboré une analyse documentaire par la méthode d'analyse des contenus et des enquêtes auprès des étudiants et des professeurs.

Les résultats obtenus été utilisé pour élaborer des stratégies avec une représentation graphique « résumant » des problématiques et des solutions proposées.

L'étude de cas (USMBA) nous a permis de repérer les dysfonctionnements dans les facultés relevant de cette structure universitaire. Des variables qualitatives et quantitatives ont été identifiés pour mieux gérer l'éducation pour la durabilité.

P60 PROPRIETES ANTIOXYDANTES IN VITRO DES GLYCOSIDES DE STEVIOL ISOLES A PARTIR DE FEUILLES DE *STEVIA REBAUDIANA BERTONI* ACCLIMATEES AU MAROC.

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Stevia Rebaudiana Bertoni, communément appelée Stevia, est un arbuste naturel originaire d'Amérique du Sud, apprécié pour ses propriétés édulcorantes. Elle contient des glycosides qui sont intensément sucrés mais pauvres en calories. La stévia a attiré l'attention pour son potentiel en tant que substitut du sucre, en particulier pour les personnes souffrant de diabète. La stévia possède également des propriétés antioxydantes qui peuvent s'avérer bénéfiques pour lutter contre les maladies liées au stress oxydatif. Cette étude explore le potentiel antioxydant des glycosides de stéviol isolés à partir de feuilles de *Stevia Rebaudiana Bertoni* acclimatées au Maroc, et met en lumière ses éventuels bienfaits pour la santé. Les composés purs ont été isolés et caractérisés par chromatographie sur colonne, et leurs activités antioxydantes ont été évaluées à l'aide des tests du Pouvoir Antioxydant Réducteur Ferrique (FRAP) et de l'Activité Antioxydante Totale (TAC). Le processus de séparation et de purification sur colonne a permis d'identifier trois glycosides de stéviol : Stéviolside, Stéviolbioside, et Rebaudioside-A, provenant de l'extrait brut. Ces composés présentent des propriétés antioxydantes nettement supérieures à celles de l'acide ascorbique, avec des résultats optimaux, en particulier dans le test TAC. Les résultats suggèrent que les glycosides de stéviol sont prometteurs pour atténuer la progression de diverses maladies liées au stress oxydatif et démontrent un potentiel pour d'autres activités biologiques.

P61 QSAR MODELING, MOLECULAR DOCKING AND MOLECULAR DYNAMIC SIMULATION OF PHOSPHORUS-SUBSTITUTED QUINOLINE DERIVATIVES AS TOPOISOMERASE I INHIBITORS.

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As they facilitate the cleavage of single and double stranded DNA to relax supercoils, unwind catenanes, and condense chromosomes in eukaryotic cells, Topoisomerase plays crucial roles in cellular reproduction and DNA organization. Because the unrepaired single and double stranded DNA breaks these complexes generate might result in apoptosis and cell death, they are cytotoxic agents.

In this study, 28 compounds derived from phosphorus-substituted quinoline are subjected to a quantitative structure-activity relationship (QSAR) using partial least squares, principal component regression, and multiple linear regression. The Gaussian 09 software and the Molecular Operating Environment program were used to calculate molecular descriptors. The anti-proliferative activity was correlated with a variety of electronic and structural characteristics of the molecules, such as EHOMO (energy of the highest occupied molecular orbital) and ELUMO (energy of the lowest unoccupied molecular orbital), which provided evidence for the modeling. The B3LYP/6-31G (d, p) level of theory's Density Functional Theory (DFT) approach was used to compute these electronic properties, and Principal Component Analysis (PCA) was used to test for collinearity between the descriptors. In fact, three alternative prediction models were created using various 2D and 3D descriptor counts, and they were each assessed using the statistical metrics of coefficient of determination (R²) and root mean squared error (RMSE). A MLR model had the best predictive performance of all the constructed models, as indicated by R² and RMSE of 0.865 and 0.316, respectively.

Three proteins (6G77, 2NS2, and 5K47) for lung, ovarian, and kidney malignancies showed strong binding affinities via hydrophobic interactions and H-bonds with the pertinent chemicals by crystal structure modeling. Compounds C11, C19 and C26, respectively, showed the highest binding energy for ovarian, kidney and lung cancer. The outcomes of the molecular dynamic MD simulation diagram were produced to support the molecular docking findings from earlier research, which demonstrated that inhibitors were stable in the active sites of the selected proteins for 10 ns. This raises the possibility that these chemicals could serve as a valuable model for the development and synthesis of more effective anticancer prospects.

P62 QUINOLONES AS POTENTIAL DRUGS: THEIR SYNTHESIS AND BIOLOGICAL APPLICATIONS.

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Quinolones are a class of synthetic antibiotics used to treat a wide range of bacterial infections. They are known for their broad-spectrum activity, which means they can effectively target and kill a wide range of bacteria. Quinolones work by inhibiting the action of bacterial enzymes called DNA gyrase and topoisomerase IV, which are essential for DNA replication, repair and recombination in bacteria. Quinolones continue to receive significant attention owing to their diverse range of biological activities. They provide an important scaffold in anticancer, antibacterial and antiviral drug research. Some chemical syntheses, and biological activities of quinolone derivatives are reviewed.

Keywords: Quinolones, Antibacterial, Anticancer, Antioxidant, Antiviral, Antifungal, Fluorescent, Anticonvulsant.

P63 STUDY OF SWEET POTATO PHENOLIC COMPOUNDS AND EVALUATION OF THEIR ANTI-INFLAMMATORY ACTIVITY.

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Increasing evidence indicates that oxidative stress (OS) and inflammation are key players in many diseases, such as neurodegenerative disorders diabetes (types 1&2), and cardiovascular diseases. Free radicals, as highly reactive compounds, are produced as a result of cells metabolic activity. At a certain level, these oxidative compounds apply positive effects on the immune system; however, oxidative stress associated with inappropriate dietary habits and lifestyles can cause an inequality between free radicals' production and the body's antioxidant defense mechanisms, through different biomarkers of molecular damage. This is the reason why free radicals can lead to undesirable health effects and subsequently, there is a growing social concern to adhere the newest healthy consumption habits that include bioactive antioxidant compounds consumption.

Sweet potato as a foodstuff rich in bioactive molecules, has very high levels of phenolic compounds (130.11mg GAE/100g DW) when compared to potato (47.55 mg GAE/100g DW). Flavonoids represent

65% of sweet potato phenolics and 1% of potato phenolics. Exclusion chromatographic analysis (Sephadex G50) showed the existence of two major peaks identified as mono- and poly-phenolic. The latter were tested for their biological activity, notably antioxidant activity in-vitro and anti-inflammatory activity in-vivo on rats used as an animal model. Obtained analysis show that monophenols and polyphenols are largely involved in the two biological activities evaluated.

P64 SYNTHESIS OF NEW HETEROCYCLIC SYSTEMS DERIVED FROM 5,5-DIPHENYLHYDANTOIN FOR THERAPEUTIC PURPOSES.

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Heterocycles are a class of chemical compounds in which one atom or more than one carboxyl group replaced by a heteroatom such as oxygen, nitrogen, phosphorus or sulfur. They are very interesting chemical compounds because of their potential applications in different fields. The most common heterocycles contain nitrogen and oxygen [1].

Compounds with a hydantoin moiety have been a source of interest in the search for new drugs due to their cyclic analogy with naturally occurring amino acids [2]. When appropriately substituted, derivatives of hydantoin exhibit various pharmacological activities, including antibacterial [3], anticonvulsant [4], antidiabetic [5], antitumor [6]. Phenytoin (5,5-diphenylhydantoin) is one of the most important hydantoin pharmaceutical drugs, used in the treatment of epilepsy and cardiac arrhythmias for over seven decades [2].

Introduction of different groups to the core structure can produce a series of compounds with multiple activities. The current work describes various aspects of the phase transfer catalyzed alkylation reactions used to create some new 5,5-diphenylhydantoin derivatives. The structures of the newly synthesized compounds were determined using ¹H NMR and ¹³C NMR spectroscopic methods.

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P65 THE USE OF PHYTOCOMPOUNDS FOR COMBATING MULTI-DRUG RESISTANCE

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The emergence of multi-drug-resistant bacteria, coupled with limited success in discovering new and effective antimicrobial chemotherapeutics, presents a significant challenge for both human and animal health. These issues have raised concerns within the scientific community, sparking interest in the development of bio-based therapeutic compounds with limited resistance potential namely, phytochemicals or biomolecules. These substances could offer an effective approach to drug delivery and development against infections caused by multi-drug-resistant bacteria. Phytochemicals, also known as natural compounds derived from plants, have shown promise in combating antibiotic resistance and offer several advantages in the fight against these resilient pathogens. Consequently, numerous phytochemicals have demonstrated significant effectiveness against the molecular determinants responsible for the development of drug resistance in pathogens, such as membrane proteins, biofilms, efflux pumps, and bacterial cell communication.

In this discussion, we explore the use of phytochemicals against multi-drug-resistant bacteria, which hold substantial potential in the context of antimicrobial resistance. Their diverse range of compounds, natural origins, and lower likelihood of resistance development make them a promising avenue for further investigation and development. However, challenges related to bioavailability and the necessity for extensive clinical testing must be addressed before phyto-molecules can become a mainstream solution for combating multi-drug resistance.

Theme 12: Biotechnology and Natural Resources Development.

P66 ACUTE TOXICITY EVALUATION AND ANTIDYSLIPIDEMIC POTENTIAL OF THE AQUEOUS EXTRACT OF *RETAMA SPHAEROCARPA* L. IN TRITON WR-1339-INDUCED HYPERLIPIDEMIC RATS.

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Objectives: The study was designed to evaluate the acute oral toxicity and the antidyslipidemic ability of the aqueous extract of *Retama sphaerocarpa* (RSAE) in Triton WR-1339-induced hyperlipidemic rats.

Methods: The acute toxicity of RSAE was assessed according to OCED Guideline 423. RSAE was administered orally as a single dose of 2000 mg/kg and the rats were monitored for any signs of toxicity or mortality, in addition, their hematological and biochemical parameters were evaluated after 24 hours of the administration. The antidyslipidemic effect of RSAE (400 mg/kg) was carried out in Triton WR-1339-induced dyslipidemia in Wistar albino rats.

Results: Pretreatment of rats for 7 consecutive days with aqueous extract of RSAE (400 mg/kg) prior to Triton WR-1339 injection, prevented increases in plasma levels of total cholesterol, triglycerides and LDL-c, while it increased serum HDL-c. The single oral administration of 2000 mg/kg of RSAE did not produce any mortality or toxic effects during acute toxicity study in rats. Moreover, there were no observed changes in haematological and biochemical parameters after 24 hours of administration of RSAE, when compared to the control group.

Conclusion: The study demonstrates that RSAE exhibits a significant antidyplipidemic effect. Additionally, the acute toxicity evaluation revealed that RSAE is safe up to a dose of 2000 mg/kg in rats.

P67 ANTIHYPERTENSIVE AND VASORELAXANT EFFECTS OF DAPHNE GNIDIUM (L.) THROUGH RECEPTOR-OPERATED CALCIUM CHANNELS IN HYPERTENSIVE RATS AND ITS EFFECT ON ANGIOTENSIN-CONVERTING ENZYME 2 (ACE-2).

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Aims: The aim of the study was to assess the antihypertensive activity of *Daphne gnidium* and its effect on angiotensin-converting enzyme 2 (ACE-2). It belongs to the family of *Thymelaeaceae* widely distributed around the Mediterranean basin, and it is present in the Southern Europe, North Africa and the Middle East. *Daphne gnidium* is used in folk medicine against nervous breakdowns, diabetes, rheumatic and muscular pains, and as an anti-inflammatory agent.

Materials and methods: In the in vivo examination, N-omega-Nitro-L-arginine methyl ester hydrochloride(L-NAME)-induced hypertensive and normotensive rats have received orally the *Daphne gnidium* aqueous extract (DGAE, 180 and 100 mg/kg) during six hours for the acute experiment and during seven days for the sub-chronic treatment and blood pressure parameters were evaluated. In the ex-vivo experiment, isolated intact thoracic aortic rings were precontracted with epinephrine (EP) (10 μ M) and KCl (80 mM) and vascular dilatation was assessed.

Results: DGAE lowered blood pressure parameters in L-NAME-induced hypertensive, without affecting normotensive rats following oral administration, suggesting that DGAE possesses an antihypertensive effect. In addition, cumulative concentrations of DGAE (0.25-1 mg/mL) revealed a vasorelaxant effect in thoracic aortic rings precontracted by EP (10 μ M), however these cumulative concentrations of DGAE (0.25-1 mg/mL) had only a minimal vasorelaxant effect on thoracic aortic rings precontracted by KCl (80 mM). The extract induced a vasorelaxant effect on the aorta precontracted with epinephrine by inhibiting the entry of extracellular Ca²⁺ through receptor-activated calcium channels (ROCCs); while DGAE extract has no effect on either stimulating or inhibiting ACE-2.

Conclusion: The study demonstrates that *Daphne gnidium* aqueous extract exhibits a potent antihypertensive and vasorelaxant activities via the inhibition of Ca²⁺ entry.

P68 CHEMICAL COMPOSITION, ANTI-OXIDANT ACTIVITY, AND ANTI-MICROBIAL EFFECTS OF ESSENTIAL OILS FROM WILD SALVIA LAVANDULIFOLIA SUBSP. MESATLANTICA.

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Herbal remedies have been and continue to be the mainstay of medical care in underdeveloped nations for many years. Medicinal uses for plants stem from their naturally occurring active biomolecules. In Morocco, many wild plants were investigated for their biological activities including antimicrobial activities. However other native plants are not yet examined. In this study, we aimed to investigate the

chemical composition, antioxidant activity (DPPH, TAC, and FRAP) and anti-microbial effects of essential oils from wild *Salvia lavandulifolia* subsp. *mesatlantica*. The chemical screening was realised via G-C, while the antimicrobial activity was tested against three bacteria and one yeast species via disc method. Obtained results showed that 10 chemical constituents were recorded in the Essential oils of *Salvia lavandulifolia*. The major constituents were 1,7,7-trimethylbicyclo [2.2.1] heptan-2-one with 39.24%, followed by Eucalyptol with 22.01%, and Camphene with 9.71%. The highest value of FRAP was 64.61%, while recorded Scavenging of the Free Radical DPPH was at 92.97%. The IC50 of *Salvia lavandulifolia* was estimated at 34.55mg EqAA/gDW, while the Total Antioxidant Capacity (TAC) was at 49.941 mg/g. Essential oils of the tested plant showed important inhibitory effects against all tested microorganisms. The highest value of MCI was recorded against *Staphylococcus aureus* and *Candida albicans* with 3.75 mg/ml each, while the lowest values were recorded against *Proteus mirabilis* and *Bacillus subtilis* with 1.87 mg/ml each. Similarly, the highest MBC values were recorded against *Staphylococcus aureus* and *Candida albicans* with 7.5 mg/ml each, while the lowest values were recorded against *Proteus mirabilis* and *Bacillus subtilis* with 3.75 mg/ml each.

P69 EFFET DU RAFFINAGE PHYSIQUE SUR LA QUALITE ET LA STABILITE OXYDATIVE DE L'HUILE D'ARGANE EXTRAITE A PARTIR DES NOIX REGURGITEES PAR LES CHEVRES.

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Les amandons d'argane régurgités par les chèvres ne sont pas utilisés pour préparer l'huile d'argane car ils fournissent une huile avec des propriétés organoleptiques désagréables. Par conséquent, un raffinage physique de cette huile semble une voie importante et intéressante à explorer. En effet, ce procédé permet d'obtenir une huile de qualité optimale à l'échelle industrielle, notamment dans le domaine cosmétique. Elle correspondrait à une huile présentant un même profil pharmacologique complet et similaire à l'huile d'argane cosmétique vierge. Ainsi, l'objectif de notre travail est d'évaluer l'effet du raffinage physique, sur la qualité physicochimique et la stabilité oxydative de l'huile d'argane extraite à partir des noix régurgitées par les chèvres.

Pour ce faire, nous avons évalué l'effet du raffinage sur l'ensemble des caractéristiques physico-chimiques initiales des huiles d'argane et nous avons étudié leur effet sur la stabilité de ces huiles stockées dans l'étuve à 60°C pendant trois mois. Nos résultats montrent que le raffinage de l'huile d'argane préparée à partir de noix régurgitées conduira à une huile cosmétique similaire à celle de l'huile d'argane cosmétique de qualité certifiée. Cependant, elle est particulièrement sensible à l'oxydation. Par conséquent, des conditions particulières, telles que le froid et la protection contre la lumière, doivent être envisagées pour un stockage prolongé de cette huile.

P70 ETUDE POPULATIONNELLE PAR LA NOUVELLE TECHNIQUE NGS.

Lamiaa MEKHFI

Cette thèse s'intéresse à l'étude de l'ascendance biogéographique de la population marocaine utilisant le panneau Precision ID Ancestry. En raison de la recombinaison et de la migration humaine continue, les marqueurs autosomiques peuvent fournir des informations supplémentaires sur la nature mélangée d'un individu. Les tests ADN pour prédire l'ascendance sont souvent référés à l'évaluation de l'ascendance biogéographique (BGA). Le plus Généralement, cela est réalisé en testant un certain nombre de régions

d'ADN spécifiques appelées Ancestry Informative Marqueurs (AIM). Les AIM sont sélectionnés parce qu'ils exposent des fréquences sensiblement différentes entre les différentes populations de différentes régions géographiques dans le monde. Les panels de ces AIM peuvent être testés en utilisant le séquençage de nouvelle génération (NGS) pour prédire les origines géographiques des ancêtres d'une personne d'intérêt typiquement en termes de continent d'origine (par exemple en Afrique, en Asie ou en Europe), mais dans certains cas par régions géographiques plus petites (p. ex. Afrique de l'Est ou Afrique du Sud) Asie (Inde/Pakistan/Bangladesh). En plus des panels AIM, les informations génétiques de séquençage mitochondrial et de L'analyse Y-STR peut être utilisée pour affiner l'ascendance prédiction. Ces tests peuvent fournir des informations sur L'ascendance des lignées maternelles et paternelles spécifiquement. Les allèles AIM sont partagés entre tous les groupes humains. Par conséquent, ce n'est pas la présence/absence absolue d'un allèle, mais plutôt sa fréquence dans la population qui est habituellement analysé lors de la déduction de l'ascendance.

P71 INVOLVEMENT OF NITRIC OXIDE PATHWAYS AND CALCIUM CHANNELS IN VASORELAXANT EFFECT INDUCED BY LAGUNARIA PATERSONII G.DON IN RAT AORTIC RINGS.

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The purpose of this study was to investigate the antihypertensive activity, the vasorelaxant activity, and the mechanism of action of an aqueous extract of the *Lagunaria patersonii* (AELP). *Lagunaria patersonii* is an ornamental plant native to Australia and belonging to the Malvaceae family. In the current study, AELP was prepared, and its antihypertensive activity was evaluated in L-NG-Nitro arginine methyl ester (L-NAME) hypertensive and normal rats. Blood pressure parameters and heart rate were registered for 6 hours (acute test) and seven days (sub-chronic treatment). In addition, we used isolated rat aortic rings to assess the effect of AELP on vasorelaxant or to define the mechanism of action involved in this activity. The data revealed that AELP reduced the systolic, diastolic, and mean arterial blood pressure parameters in L-NAME- induced hypertensive rats. In addition, we found that AELP extract exerts an antihypertensive effect through its vasodilatory properties. More interestingly, the study demonstrated here that the vasorelaxant ability of AELP is exerted through both Nitric Oxide pathways and calcium channels. The data presented indicate that AESA leaves have a relaxing effect on rat aorta, which shows the beneficial action of AESA in the management of hypertension.

P72 VITAMIN C INHIBITS ANGIOTENSIN-CONVERTING ENZYME-2 IN ISOLATED RAT AORTIC RING.

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Coronavirus disease 2019 (COVID-19) is a disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which uses angiotensin-converting enzyme 2 (ACE2) as the first route to infect human cells. Accordingly, agents with potential inhibition of ACE2 receptors might be effective in the prevention and management of COVID-19. The goal of this work was to assess the possible inhibitory effect of ascorbic acid on ACE2 using an *ex vivo* approach based on the inhibition of diminazene-induced vasorelaxation. In the present study, diminazene was used as a known specific

inhibitor of ACE2. Then, the vasorelaxant effect of ascorbic acid on diminazene-induced relaxation was examined using isolated aortic rings. All experiments of this study were evaluated on isolated aortic rings precontracted by epinephrine. The results confirmed that diminazene induced vasorelaxation in a dose-dependent manner. More interestingly, ascorbic acid inhibited diminazene-induced vasorelaxation in a dose-dependent manner. In conclusion, this investigation provides valuable experimental proof of the efficacy of ascorbic acid (Vitamin C) on inhibiting *ex vivo* vascular angiotensin-converting enzyme 2, which is known among the pharmacological targets of anti-COVID-19 drugs.

Funding: This research was funded by the Hassan II Academy of Science and Technology, Morocco.

Theme 13: Climate Change and Natural Resources Management.

P73 ASSESSMENT OF COPPER (CU) AND MANGANESE (MN) CONTAMINATION IN WASTEWATER-IRRIGATED AGRICULTURAL AREAS OF MEKNES (MOROCCO).

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Wastewater is widely used for irrigation in urban and peri-urban areas of Meknes, helping farmers cope with drought. This wastewater may contain many toxic chemicals, posing significant health risks to the population. Copper (Cu) and manganese (Mn) are heavy metals that contribute to various health issues, affecting the nervous, renal, immune, reproductive, and cardiovascular systems. The aim of the study is to determine the concentrations of copper (Cu) and manganese (Mn) in irrigation water, soil, and various vegetables from urban and periurban agricultural areas in the city of Meknes. The analysis employed atomic absorption spectroscopy to measure metal concentrations. The study found that Cu and Mn concentrations varied across sample types, with soil having the highest level (0.4567 mg/l) for Cu and (6.2269 mg/l) for Mn, while irrigation water displayed the lowest concentrations, both at (0.01 mg/l). Among the vegetables, courgettes displayed the highest Cu concentration, whereas beets exhibited the highest Mn levels. These findings reveal significant Cu and Mn contamination variations among sample types in wastewater-irrigated farms. Developing necessary measures before utilizing it for irrigation and establishing regular monitoring protocols is highly recommended.

P74 ETUDE DU BILAN HYDRIQUE DES NAPPES de SOUSS, de TIZNIT ET de CHTOUKA) AU NIVEAU DE LA REGION DE SOUSS-MASSA, (SUD DU MAROC).

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Le bassin versant de Souss-Massa est situé entre le Haut Atlas au Nord et les massifs de l'Anti-Atlas au Sud. Il comprend une superficie de 27 800 km². Dans cette étude nous nous sommes appuyés sur une méthode statistique pour calculer et analyser l'évolution du bilan hydrique au niveau de trois nappes (Souss, Tiznit et Chtouka) au cours d'une période allant de 1972 à 2007 selon la nappe.

La nappe de Souss est une nappe phréatique dans des formations d'âge Plio-Quaternaire, perméables et hétérogènes, à faciès détritiques et des formations calcaires d'âge Turonien. Les transmissivités sont relativement élevées : 90 % des valeurs sont supérieures à 10-3 m²/s, 75 % à 5 10-3 m²/s et 60 % à 10-2 m²/s et les perméabilités fictives calculées varient entre 10-2 m/s et 10-5 m/s : 80 % sont supérieures à 10-4 m/s et 30 % à 10-3 m/s. Le bilan de la recharge de la nappe de Souss est évalué à près de 267.5 Mm³/an et les sorties sont estimées à près de 551 Mm³/an.

La nappe libre de Chtouka est constituée principalement des formations d'âge Plio- Quaternaire, perméables et hétérogènes, à faciès détritiques, des formations d'âge Miocène et Eocène et des formations schisteuses d'âge Acadien. Ces formations présentent d'importantes perméabilités qui sont dues à l'altération et la fissuration des schistes. La valeur moyenne de transmissivité de la nappe est de 6.7 10-3 m²/s et la perméabilité oscille entre 8 10-6 et 3 10-5 m/s. L'alimentation de la nappe de Chtouka est évaluée à près de 33 Mm³/an et les sorties sont estimées à près de 90,5 Mm³/an.

La nappe de Tiznit est une nappe phréatique qui circule dans des formations d'âge Plio- Quaternaire, perméables et hétérogènes, à faciès détritiques ou carbonatés et des formations schisteuses d'âge Acadien avec une grande perméabilité par endroits. La transmissivité de la nappe varie entre 3.5 10-4 m² /s et 1.1 10-2 m² /s et la profondeur augmente généralement de l'Est (10 à 20 m) vers l'Ouest (20 à 40 m).

L'alimentation de ces nappes est basée généralement sur l'infiltration des eaux de pluie, dans les lits des oueds, le retour des eaux d'irrigation superficielles, la drainance ascendante à partir des nappes profondes et l'apport d'eau par l'abouchement souterrain.

Les analyses des résultats, montrent que l'année 1996 a occasionné une recharge importante dont les apports hydrologiques d'entrées ont atteint un maximum de 870 Mm³ pour Sous 43 Mm³ pour Chtouka et 27 Mm³ Pour Tiznit permettant une amélioration de l'état des ressources en eau mais après les années 1970, les trois nappes sont entrées en déficit hydraulique.

Pour les recharges et les sorties des trois nappes, les tendances montrent un penchant à la baisse pour les entrées et un penchant à la hausse pour les sorties c'est-à-dire un déficit hydraulique au niveau de trois nappes. Ce déficit s'est accentué durant les dernières années. Ceci s'explique par les effets conjugués des années successives de sécheresse qu'a connues la région la dernière décennie, due aux changements climatiques et l'exploitation intensive des nappes par les activités agricoles.

P75 INVESTIGATION OF SPATIO-TEMPORAL VARIABILITY OF PHYSICO-CHEMICAL PARAMETERS AND ALGAL DISTRIBUTION AS INDICATORS OF LAGOON QUALITY IN OUALIDIA.

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The Oualidia lagoon, characterized as a partially enclosed ecosystem, faces multiple pollution sources (agriculture, oyster farming, tourism, etc.) that detrimentally affect the trophic quality of its water. Over the past few years, a significant increase in algal biomass has been clearly observed. The aim of this study is to investigate the spatio-temporal variation in physico-chemical parameters and to establish an up-to-date inventory of the algae present in the lagoon, as well as their spatio-temporal distribution. To this end, monthly surveys were carried out between March 2019 and February 2020 to determine the physico-chemical variables (temperature, pH, salinity, dissolved oxygen, NO₃ and PO₄) and identify the algae present in the lagoon. The results reveal significant spatial and seasonal variation in the physicochemical parameters studied, with upstream-downstream gradients for most parameters. A total of 39 species of algae were recorded throughout the lagoon over the study period. The distribution of algae is strongly affected by the concentration of nutrients along the lagoon and also by variations in physical factors.

P76 LA VARIABILITÉ SPATIO-TEMPORELLE DES PLUIES DANS LE BASSIN VERSANT

D'INAOUÈNE (MAROC) ENTRE LA PÉRIODE 1970-71 / 2017-18 DANS UN CONTEXTE DU CHANGEMENT CLIMATIQUE.

Saddik ELYADARI

Géographie.

Cette étude vise à analyser la variabilité spatio-temporelle qui a affecté les précipitations totales annuelles et mensuelles enregistrées dans le bassin d'Inaouène entre la période allant de 1970-71 à 2017-19. À cet égard, nous nous sommes appuyés sur une méthodologie statistique spécifique pour détecter l'indice de rupture ou la tendance à la diminution ou à la hausse des précipitations de pluie aux différents niveaux de temps mentionnés, et dans une phase ultérieure, nous avons travaillé sur le diagnostic de l'impact de ce changement sur les pluies dans le domaine d'étude. La présente étude a conclu qu'il y avait une diminution significative des précipitations annuelles après la rupture enregistrée à la fin des années soixante-dix du dernier siècle, et son pourcentage a atteint -20.32 % à la station de Taza comme exemple, en raison de la diminution des précipitations mensuelles notamment en mars et avril, parmi les résultats de cette étude on trouve également le rétrécissement de la lame d'eau tombée dans le Bassin d'Inaouene d'environ -3,1%.

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