AVIS DE SOUTENANCE

THESE DE DOCTORAT

Présentée par

Mr : MOHAMED EL YAMANI

Discipline : Biologie

Spécialité : Science et Génie de l'Environnement

Sujet de la thèse : The olive (Olea europaea L.) sector in Taza Province (Morocco) : Ecophysiology, oil quality and Valorization of Wastewater.

Formation Doctorale : Sciences et Génie de la matière, de la Terre et de la Vie.

Thèse présentée et soutenue le mardi 10 septembre 2019 à 15h au Centre des conférences devant le jury composé de :

Nom Prénom	Titre	Etablissement	
Khalil HAMMANI	PES	Faculté Polydisciolinaire de Taza	Président
Azzouz BOUKROUTE	PES	Faculté des Sciences - Oujda	Rapporteur
Ali AMECHROUQ	PES	Faculté des Sciences - Meknès	Rapporteur
Ouafaa EL MAHDI	PES	Faculté Polydisciolinaire de Taza	Rapporteur
Khalid AMRANI JOUTEI	PES	Faculté des Sciences et Techniques – Fès	Examinateur
Mohamed HASSANI ZERROUK	PH	Faculté des Sciences et Techniques – Al Hoceima	Examinateur
Yahia RHARRABTI	PES	Faculté Polydisciolinaire de Taza	Directeur de thèse

Laboratoire d'accueil : Ressources Naturelles et Environnement.

Etablissement : Faculté Polydisciolinaire de Taza

كلية العلوم و التقنيات فاس
ⵜⴰⵖⵣⵓⵔⵜ ⵏ ⵜⵙⵓⵙⵏⴰⵏ ⴷ ⵜⵉⵏⵉⴳⵏⵉⵏ
Faculté des Sciences et Techniques de Fès

جامعة سيدي محمد بن عبد الله
Université Sidi Mohamed Ben Abdellah

Centre d'Etudes Doctorales : Sciences et Techniques de l'Ingénieur

Titre de la thèse : The olive (Olea europaea L.) sector in Taza Province (Morocco) : Ecophysiology, oil quality and Valorization of Wastewater.

Nom du candidat : Mohamed EL YAMANI

Spécialité : Science et Génie de l'Environnement

Résumé de la thèse

The socio-economic importance of the olive sector in Taza province is facing harsh environmental conditions, scarcity of water resources, competition of olive products from other regions, and the problematic issue of olive mill wastewaters (OMW). Therefore, the present doctoral thesis is devoted to highlighting the provincial olive sector and contributing to its development, dealing with three aspects:

Firstly, an outdoors experiment was carried out on three Moroccan varieties ('Moroccan Picholine', 'Menara' and 'Haouzia') of young olive trees (*Olea europaea* L.) grown in plastic pots under three water regimes (well-watering, moderate stress and severe stress). The water treatment was applied at different development stages during three growth seasons (2015, 2016 and 2017), in order to better understand the physiological and biochemical behavior of olive trees to limited water availability. Results showed that all parameters were found to be mainly under the impact of the water regime and growth stage. In fact, the severe stress led to significant reductions in transpiration rate (E), water potential (Ψw), and stomatal conductance (gs) by more than 24%, and also in relative water content (RWC), chlorophyll fluorescence (Fv/Fm) and chlorophyll content but with rates lower than 15%. However, it activated the accumulation of proline and soluble sugars of about 13%. Among growth stages, the bud development displayed the highest levels for RWC, Ψw, gs, E, and Fv/Fm, and the lowest ones for proline and soluble sugars, whilst, the opposite was observed during the fruiting stage. The impacts of plant variety, growing season and interactions were of minor extents. Principal component analysis allowed a great discrimination among the tree water regimes and the five growth stages. In addition, positive relationship was established between proline and soluble sugars, which are found negatively associated with the other parameters.

Secondly, we have investigated the composition and quality of the provincial olive oil 'Moroccan Picholine' with respect to: i) crop season, extraction system and production site, ii) ripening index and water regime, iii) time and storage conditions, and finally iv) the effect of natural additives to improve the oxidative stability of olive oil was evaluated. The characteristics of the studied olive oils were found to be closely related to the extraction system, of which the two phase centrifugation system provided the better quality of virgin olive oil with the lowest values of free fatty acids and oxidation indices and the highest amounts of oleic acid, carotenoids and total phenols therefore the greatest oxidative stability. The effect of environmental conditions (including production site and crop season) was also outstanding on some olive oil characteristics. The farming practices (ripening index and water regime) proved of great interest in order to improve the production and the quality of olive oil. In fact, the olive oil yield increased during ripening, and decreased when full irrigation was applied. Concerning the quality, lower values of peroxide value, K232, carotenoids, chlorophylls and total phenols and higher free fatty acids were registered at more advanced stages of maturity. Moreover, full irrigation reduced total phenols and increased free fatty acids. In addition, we observed a worthy deterioration of the quality and nutritional value of olive oil during storage, mainly due to oxidation and hydrolysis reactions, and losses of natural antioxidants, which are further favored by temperature and exposure to light. Then, olive oil enrichment with carotenoids and phenols, extracted from carrots and OMW respectively, had shown an appropriate oxidation prevention activity during storage, which could be optimized by storage conditions.

Finally, in an attempt to alleviate the environmental problem posed by olive oil industry, we first examined the physicochemical and microbiological composition of OMW produced in the province with respect to extraction system, crop season and production site. Our results confirmed the high polluting load and the toxicity of these effluents, mainly due to their content in total phenols, hence, their acidic character, which largely depended on the extraction system. Furthermore, significant relationships were shown especially among the traits expressing organic load, while microbiological counts were largely associated to total phenols and pH. Nevertheless, the OMW richness of valuable elements (especially, phenolic compounds), encourages their reuse in many purposes. Based on these findings, we have discussed OMW valorization through the recovery and the reuse of phenols, which are the main harmful elements, while having excellent biological activities. In fact, the OMW phenolic extracts have shown an interesting antibacterial and antioxidant potentials, either by in vitro tests or by their preventive effect against oxidation and olive oil deterioration.

Keywords: Olea europaea L., ecophysiology, olive oil quality, olive mill wastewater, Taza province