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The Environmental Problem of Olive Mill Waste Water in Morocco: Data Analysis and Characterization

Rabia Benaddi[1], Abdelillah Bouriqi[2], Naaila Ouazzani[3]
[1,2,3] Laboratory of Water, Biodiversity and Climate Change Faculty of Sciences Semlalia, Cadi Ayyad University, BP 2390, Marrakech, Morocco

ABSTRACT: This work proposes a comparative study between several provinces in the region of Marrakech Safi concerning the pollution generated by the industrial units of crushing olives, in particular the volume of olive mill wate water (OMWW) and the polluting load. A physicochemical and bacteriological characterization of the OMWW issues from different industrial olive crushing units was also carried out, the result found showed a high polluting power of the OMWW that differs from one unit to another depending on the mode of crushing of the olive, Indeed, the OMWW are very loaded with polyphenols and organic matter. This effluent also has an acidic pH due to the presence of organic acids (phenolic acids, fatty acids). The high electrical conductivity of the OMWW is due to the presence of natural mineral salts and salts used to preserve olives until grinding such as Na^+, Cl^- and Ca^{2+} .... A physicochemical and bacteriological characterization of some wells downstream of the industrial units have also realized to study the impact of OMWW on ground water quality, it was found that most of the wells downstream of the oil mills concerned are of good quality.

KEYWORDS: OMWW; Organic matter; Phenol index; Pollution; Water.

I. INTRODUCTION

Olive oil is an iconic product of the Mediterranean basin, playing a fundamental role in socioeconomic and environmental terms in the majority of countries in this area of the world. This olive industry generates, in addition to oil as the main product, large quantities of liquid by-products (OMWW). This effluent pose serious problems for the environment. Their harmful effects derive largely from their content of polyphenols that are very difficult to biodegrade, their concentration varies from 0.1 to 17.5 g / L [1,2]. These plyphenols also inhibit the growth of microorganisms, especially bacteria. Phenols also affect human health by denaturing proteins and destroying cells [3], Various processes have been studied by several authors to eliminate phenols, namely oxidation [4], coagulation [5], ozonation [6], infiltration [7] and membrane technology [8] and adsorption [9,10], the comparison between different methods of treatment of OMWW has also been carried out by other authors 11]. In this work we will show the extent of this problem of OMWW in the region of Marrakech Safi in Morocco with data and figures as well as a physicochemical and bacteriological characterization of OMWW from different industrial units.

II. DATA AND ANALYSIS

The population of the provinces of the Marrakech Safi region is of the order of 4,268,626 habitants according to the general population census of 2014. This region is renowned for the great diversity of its vegetable productions, an important olive producer with 123,000 ha and 70% of national exports of canned olives. Oil mills are clearly the most threatening source of pollution, because it is a seasonal activity (December-January-February) and spread over almost the entire basin (with marked concentrations in Al Haouz and Marrakech). It therefore leads to a high concentration of organic matter, which consumes a lot of dissolved oxygen in water. The analysis of the data shows that the number of oil mills exceeds 800 units with 60% are traditional, which shows the extent of the problem in this region. The large number of units exists in the province of Essaouira. The overall volume of OMWW generated at the level of the Marrakech Safi region is of the order of 91070 m^3/companion. Modern oil mills alone generate 55% of this volume. This shows that the modern units more polluting even than their number does not exceed 130 units, this due to the large quantities of olives crushed by these units, the province of El Kelaa des Sraghna is the province most affected by this problem of discharge of the OMWW (Table 1). The oil mills discharge an annual pollutant load of 113,834 T/year in chemical oxygene demand

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(COD) at the study area. Indeed, traditional oil mills generate 22,238 T/year in COD and modern and semi-modern units generate 91,596 T/year.

Table 1. Volume of OMWW produced in the Marrakech Safi region (m^3)

Province	Traditional Units	Semi modern units	Modern units	Total
Chichaoua	2450	7210	0	9660
El Kelaa des Sraghna	209.98	866.75	27946.09	29022.82
Essaouira	12070.385	776.55	2543.25	15390.19
El Haouz	4169.145	9308.34	3984.5	17461.99
Marrakech	913.525	2037.8	5842.5	8793.825
Safi	79.2	1313.185	9327	10719.39
TOTAL	19914.235	21512.63	49643.34	91070.2

These OMWW are either stored in basins that do not comply with the standards in force or randomly discharged into the natural environment or join the sewerage network. Overall, OMWW are discharged directly into waterways or transported after storage to clandestine discharge points. These discharges constitute a major environmental constraint endangering water resources, through pollution discharged in its raw state into rivers, groundwater, soil and the public sewerage network.
Figure 1 above illustrate the methods adopted for the management of OMWW.

Figure 1. OMWW storage basin

III. CHARACTERIZATION OF OMWW

III.1. Materials and methods

OMWW sampling was carried out at several crushing units in the Marrakech Safi region during the 2021/2022 olive season. To avoid its degradation, the OMWW were kept in a dark place at a temperature of 4 ° C.
Measurements of pH and electrical conductivity (EC) are carried out respectively by a pH meter type 716 DMS Titrino and a conductivity meter type TWT. Suspended solids (SS) are determined by filtration on GF/C filter, according to afnor (1983) method T90-105. The determination of the residual concentration of each sample after filtration is carried out by a method based on the separation of phenols by distillation, then acidification with phosphoric acid with the presence of copper sulfate and sodium chloride

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then development of a staining with amino 4 antipyridine in alkaline medium with the presence of potasuim ferricyanide (AFNOR 76341). The chemical oxygen demand (COD) is estimated by oxidation, by excess of hot potassium dichromate in an acidic medium according to the standard method (APHA 1992). The biological oxygen demand (BOD_5) is determined according to the respirometric method T90-103 of AFNOR (1983). Kjeldahl nitrogen (NTK) is determined by the T90-110 method of AFNOR (1983). Ammoniacal nitrogen is dosed by the colorimetric method to indophenol blue, according to the standard T90-015 of AFNOR (1983).

III.2. Results and discussion

The chemical composition of the OMWW is highly variable. It depends on several factors such as the production area, the variety and degree of maturation of the crushed olives, the crushing process and practices and the settling time, Table 2 shows this variety based on the analysis of the different OMWW from several crushing units in the Marrakech Safi region. The OMWW are liquids of cloudy appearance, their PH varies from 5 to 6 This acidity is due to the presence of organic acids (phenolic acids, fatty acids ...) [5]. The electrical conductivity varies from 5 to 20ms/cm. This mineralization is due to the presence of Na^+ and Cl^- ca^{2+} ions... come from salts added for the preservation of olives before crushing. The richness of organic matter, expressed in COD and BOD_5, is generally high and far exceeds the general limit values for discharge into surface or groundwater.

It varie according to the method of extraction of the olive (it varies between 20 and 180 g / l). OMWW also contain large quantities of polyphenols, in fact, its concentration varies from 9 to 100 mg / l in terms of the phenol index according to the crushing method, these values are higher than that of the general limit value of discharge into surface or groundwater. Table 3 also shows that the OMWW contain mineral compounds such as nitrates and phosphates, these results are higher than the standard. For the enumeration of total and faecal coliforms (TC and FC), the results obtained show the total absence of these germs in studied OMWW.

Table 2. Analyses of OMWW issues from different industrial units in the Marrakech Safi region

Province	**Marrakech**	**Al Haouz**	**Essaouirra**	**El Kelaâ des Sraghna**	**Safi**	**Rhamna**
Commune	**Al ouidane**	**Ghmat**	**Ounagha**	**Tamellalt**	**Tnin Ghiat**	**Ras Elain**
T°	24,9	32	33,4	25,1	25,5	29,8
pH	**4,9**	**5,8**	**5,4**	**4,5**	**6**	**4,8**
CE (µS/cm)	10013	19933	15667	5000	20000	18697
Turbidité	**16917**	**2167**	**2760**	**283**	**3970**	**3850**
O2 dissous (mg/l)	1,2	0,4	0,6	3,5	0,7	3,7
MES (mg/l)	**49630**	**9819**	**2507**	**88911**	**7417**	**9721**
DCO (mg/l)	54836	92246	64935	167456	24846	78853
DBO5 (mg/l)	**27233**	**17567**	**16567**	**71367**	**9547**	**30200**
NH4+ (mg/l)	33,37	18	0,73	42	30,90	0,94
NTK (mg/l)	**1400**	**940**	**1960**	**1400**	**840**	**81**
PO43- (mg/l)	31,67	75	83,13	33	7,94	5,85
PT (mg/l)	**62,39**	**198**	**384,43**	**63**	**25,17**	**13**
Phenolic index (mg/l)	11	12	9,96	32	12,2	14
FC (UFC/100 ml)	**0**	**0**	**0**	**0**	**0**	**0**
TC(UFC/100 ml)	0	0	0	0	0	0

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Table 3 shows the results of the analyses of several water driving plants downstream of the oil mills studied. Based on the results found, it was found that most of the wells downstream of the oil mills concerned are of good quality.

Table 3. Water analysis of different wells downstream of industrial units in the Marrakech Safi region

Province	Marrakech	Al Haouz	El Kelaâ des Sraghna	Rhamna
Commune	Al ouidane	Ghmat	Tamellalt	Ras Elain
Depth (m)	110	60	96	50
T°	24,9	28,5	28,9	29,2
pH	7,9	6,9	9	8,4
CE (µS/cm)	236	1300	1650	970
O2 dissous (mg/l)	4,4	4,2	4,8	4,2
MES (mg/l)	69	27	43	173
MO (mg/l)	1,1	3,2	4,88	
NH4+ (mg/l)	0,03	0,03	0,01	0,01
NTK (mg/l)	4,2	4,1	3,1	3,6
PO43- (mg/l)	0,16	0,09	0,07	38,08
PT (mg/l)	0,52	0,27	0,15	0,27
Phenolic index (mg/l)	<0.05	<0,05	<0,05	<0,05
Cl (mg/l)	184	199	341	412
SO4 (mg/l)	83	18	61	54,5
CF (UFC/100 ml)	2	10	70	241
CT (UFC/100 ml)	5	23	118	325

CONCLUSION

At the end of this work relating to the physico-chemical and bacteriological characterization of OMWW in the Marrakech Safi region, we can retain that these are effluents with acidic pH, representing a high content of organic matter, suspended matter and polyphenols. These levels far exceed the limit values for discharges of industrial waste water. As a result, the direct discharge of OMWW into nature without any prior treatment can cause a lot of environmental problems.

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REFERENCES

1. N. Solomakou & A.M. Goula, Rev Environ Sci Biotechnol 20:839–863(2021),https://doi.org/10.1007/s11157-021-09585-x(0123456789().,-volV() 0123458697().,volV)
2. Davies, L. C., A. M. Vilhena, J. M. Novais & S. Martins-Dias. Grasas y aceites, 233-241 ,55(2004).
3. Lidija, J., 2015. Interactions of polyphenols with carbohydrates, lipids and proteins. Journal of Food Chemistry, 175, 556–567.
4. Celalettin, O¨., Hayrunnisa, T., Serkan, S. and Erkan, K., 2010. Pretreatment of Olive Oil Mill Wastewater by TwoDifferent Applications of Fenton Oxidation Processes. Journal of Clean – Soil, Air, Water, 38, 1152–1158.
5. Achak, M., 2010. Essais de traitement des rejets liquides issus d'une huilerie d'olive moderne (margines) par differents procedes : coagulation-floculation, adsorption, infiltration percolation, phyto-epuration. Thèse de doctorat, université cadi ayyad, Faculté des Sciences Semlalia, Marrakech
6. Ch. Olivier, D. Marie, P. Catherine. Desalination, 249, 865(2009). https://doi.org/10.1016/j.desal.2009.04.014.
7. M. Achak, N. Ouazzani, L. Mandi. Water Sci. Technol., 22,421 (2009). https://doi.org/10.7202/037780ar.
8. R. Waseem, L. Jechan, R. Nadeem, L. Yiwei, K. Ki-Hyun,Y. Jianhua. J. Ind. Eng. Chem., 71, 1 (2019). https://doi.org/10.1016/j.jiec.2018.11.024.
9. R. Benaddi, F. Aziz, KH. El harfi, F. Berrekhis and N. Ouazzani. J. Surface Sci. Technol. 36(1–2), 39(2020). https:// DOI: 10.18311/jsst/2020/23780.
10. R. Benaddi, F. Aziz, KH. El harfi and N. Ouazzani. 2021. Desalin. Water.Treat. 220, 297(2021). https:// doi: 10.5004/dwt.2021.26979.
11. N. Gholamzadeh, M. Peyravi and M. Jahanshahi. J.Water Environ. Nanotechnol., 1(2), 145(2016). https://dx.doi.org/10.7508/jwent.2016.02.008

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