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Determination of characteristics of wastewater generated by the elaboration of olive oil and the possibility of their use as fertilizer on agricultural land.

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Abstract : *The aim of this study was the determination of the chemical composition of vegetable water derived from olive oil elaboration and evaluation of the main features modified through chemical-physical interactions (connection, inter effects) physical, chemical and biological between soil and effluent. The experiment was carried out in a field located near factory of olive oil production in Lunder Tirane during the years 2012-2014. The indicators that are analyzed are: pH, CE, L.O, Na, K, N, P. Based on the results, we found that the analyzed parameters have resulted in limits: pH 7.86-8.51, CE 22.4-290, L.O 9269.8-40216.09, rich in potassium (K) 4575.1-6627.5. High content of potassium and organic matter has a positive effect on the improvement of soil characteristics, because most of the olives plantations are planted in poor areas with organic matter and on the other hand olives needs land rich in potassium. Modification of characteristics of effluent on land during the 10, 100, 190 and 280 days could give us more accurate data on fertilisations of soils with a lower cost.*
Keywords: *Olive mill wastewater, agricultural land, soil properties, environmental pollution.*

I. Introduction

The cultivation of olives (Olea europaea L.) for olive oil production is among the most important industries in Mediterranean countries (including Albania) where approximately 94% of the world's commercial olive oil (over 3 million tons) was produced in 2010. This industrial waste water causes many environmental problems, including the following: deterioration of air quality, endangerment of aquatic life, pollution of surface and ground waters, degradation in soil quality, especially soil enzymatic activities, phytotoxicity and odor nuisance.(DellaGreca, M., Monaco, P., Pinto, G., Pollio, A., Previtera, L. and Temussi, F. 2001). During the olive oil production a large volumes of the waste are generated. The main olive processing method used in many countries is the continuous centrifugation system, called a three-phase system. This system is called three-phase because the centrifugal decanter allows for the separation of three flows of matter; the olive oil, solid waste and wastewater. During the elaboration of the olive oil the final components of the waste are 20% liquid oil, 30% solid waste and 50% olive mill waste water. The major environmental problem is caused in a short period of time during October - February. After the elaborating of olive oil the solid waste are about 50-60%.

Olive Mill Wastewater is acidic, and contains high concentration of total suspended solids (TSS), total dissolved solids (TDS), and other organic matter. The organic content is characterized by high levels of chemical oxygen demand (COD), biochemical oxygen demand (BOD), and very high concentration of fat, oil, and grease. The aim of this study was the determination of the chemical composition of vegetable water derived from olive oil elaboration and evaluation of the main features modified through chemical-physical interactions (connection, inter effects) physical, chemical and biological between soil and effluent.

Table1. Chemical composition of olive fruit (%)

Components	Olive-Pulp	Stone	Seed
Water	50-60	9.1	30
Oil	15-30	0.7	27.3
N	2-3	3.4	10.2
Sugar	3-7.5	41	26.6
Cellulose	3-6	38	1.9
Minerals	1-2	4.1	1.5
Poly Phenols	2.25-3	0.1	0.5-1
Other compounds	-	3.4	2.4

II. Materials and Methods

For the realization of the study we have taken materials from the elaboration of olive oil that is vegetable water (olive mill wastewater) located in Lunder Tirana. The factory that we are study is three-phase system. Vegetable water samples were taken in the exit of decanter which are analyzed for the following indicators: pH, temperature, COD, DBO5, EC, turbidity, density, NO3, oil and grease, total dissolved solids, salinity. Samples are stored in conditions that are defined by EPA in 2011, the Agricultural University of Tirana in the laboratory of soil and water. The following physicochemical characteristics of OMWWs were determined according to "Standard Methods for the Examination of Water and Wastewater 20th Edition, 1999".

For the realization of the experiment we took vegetable water at the exit of the decanter. The transfer of olive mill wastewater from the exit of the decanter to the soil profile is done through pumping (sistemi tuberive). Vegetable water (olive mill wastewater) in the soil profile was monitored in different periods of 10, 100, 190, 280 days to see the degradation of its characteristics. Also and this water was analyzed for the following indicators: pH, temperature, COD, DBO5, EC, turbidity, density, NO3, oil and grease, total dissolved solids, salinity. During this period the soil profile has been covered with a tent, the reason was that this vegetable water did not have any direct impact from atmospheric factors (rainfall).

For the second half of the study we took the land near the factory of olive oil productions. The place of experiment was constructed by neogenic deposits. On these rocks are located deposits deluvialo eluviale that have over 1-3m thick. In this land were planted olive trees.

Figure1. View of the place where the experiment is carried out

We have opened the profile soil in 80x140x110 sizes which we divided into five sampling horizons.

First Horizon T1 (0-25 cm)
Second Horizon T2 (26-50 cm)
Third Horizon T3 (51-75 cm)
Fourth Horizon T4 (76-100 cm)
Fifth Horizon T5 (110-120 cm)

For each horizon we take soil samples which are analyzed for the following indicators: pH CE, L.O, Na, K. Soil analyses are conducted at the laboratory of soil and water at the Agricultural University of Tirana. Soil samples are analyses before and after applications of olive mill wastewater. **Samples 1** are soil samples before application of vegetable water and **Samples 2** are soil samples after the applications of vegetable water. These analysis are conducted to see what happens to vegetable water and also how would have changed soil parameters during this application.

Figur2. Soil profile were the experiment was developed

III. Results and discussions

a. Olive mill wastewater characterization

Olive mill wastewater (OMW) contains an enormous supply of organic matter as was expected; untreated olive mill wastewater was an acidic effluent which had a high nutrient content that can be used to fertilize the soil. The indicators that are analyzed are: pH, CE, L.O, Na, K, N, P. Based on the results, we found that the analyzed parameters have resulted in limits: pH 7.86-8.51, CE 22.4-290, L.O 9269.8-40216.09, rich in potassium (K)4575.1-6627.5,poor in phosphorus (P), with intermediate levels of nitrogen (N). High content of potassium and organic matter has a positive effect on the improvement of soil characteristics, because most of the olives plantations are planted in poor areas with organic matter and on the other hand olives needs land rich in potassium.

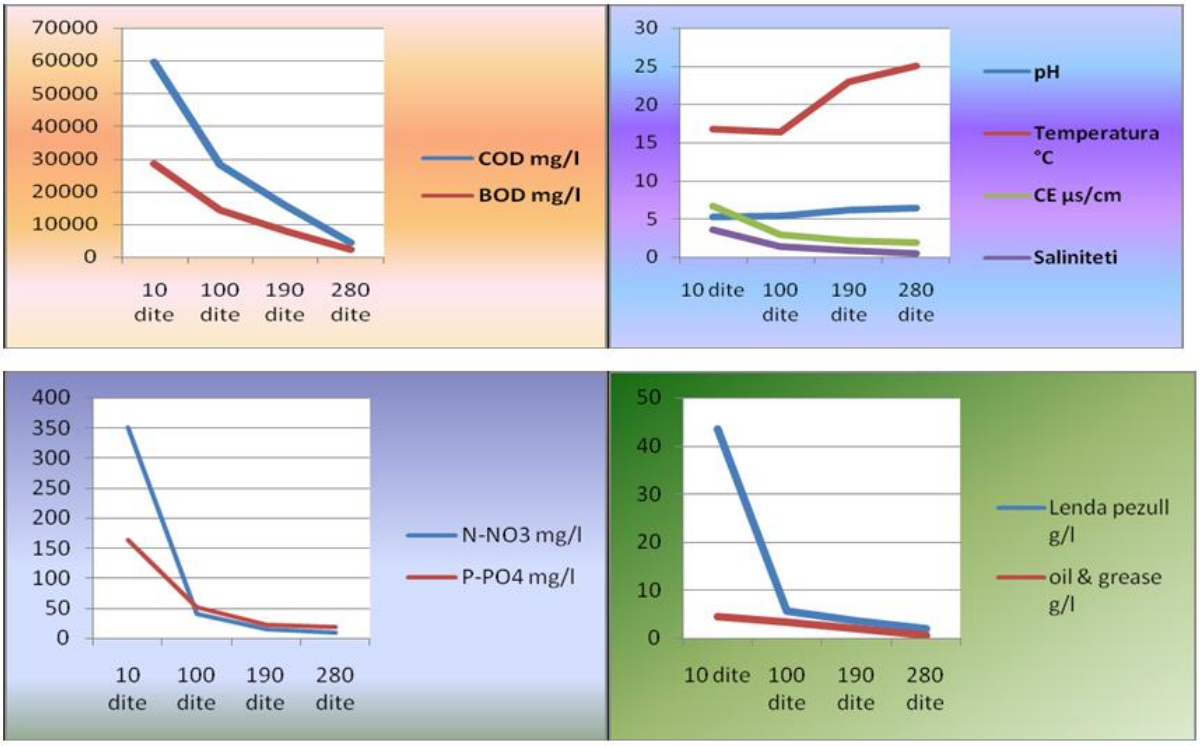


Figure3. Modification of physic-chemical parameters of olive mill wastewater during 280 days

From the results of the analyses we see that the olive mill wastewater has change during 280 days. So from the graphics we look that during 280 days of conservation all parameters have changed, they decreased during this period of time. Starting from pH values goes from acidic to neutralization.

Also we see and the value of COD (chemical oxygen demand) and BOD (biochemical oxygen demand) during this time these are reduced about 50%. But we cannot say that these values are acceptable from according emission norms. If we compare according to emission norms this values are very high.

According to emission norms VKM Nr 177 under Albanian legislation the values are: pH 6-9, BOD 50 mg/l, COD 250 mg/l, suspend solid 50 mg/l, oil and grease 10 mg/l, nitrates total 10 mg/l.

b. Soil characterization

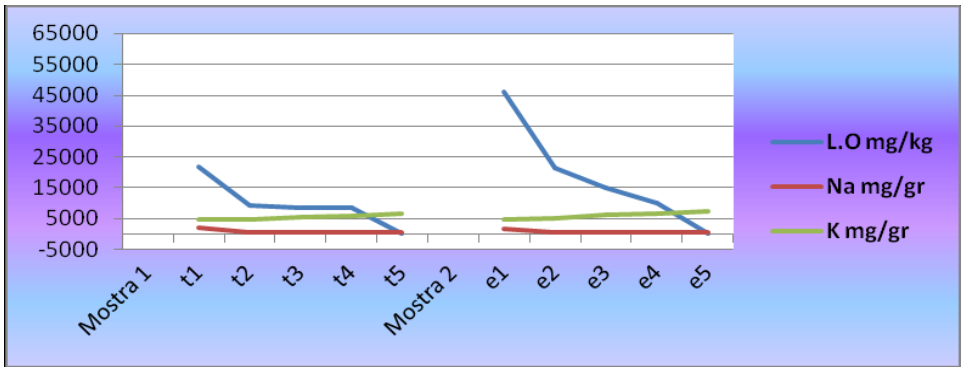
Soils were sampled for chemical and phytotoxicity examinations, before and after application of olive mill wastewater. Soil analysis was carried out using standard methodologies.

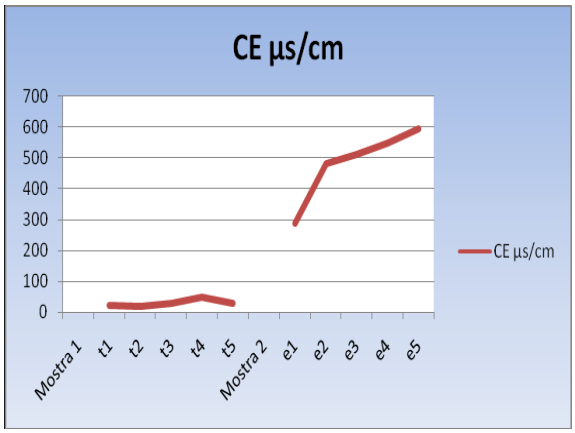
Soil parameters that we measured before application of are: pH, CE, L.O, Na, K, that resulted like in table below.

	Parametrat				
Horizontet	**pH**	**CE**	**L.O**	**Na**	**K**
t1	8.51	22.4	61630	1923.028	4767.65
t2	8.79	18.4	9269.8	622.29	4575.1
t3	8.01	29.9	8635.1	666.39	5557.825
t4	8.43	47.2	8574.5	622.51	5958.2
t5	8.52	29.7	69.1	608.33	6627.5

Table2. Soil parameters (Samples 1)

Many researchers have established that this wastewater have a high fertilizer value when applied to the soil. Soils in semi-arid and arid areas are known to have low organic matter levels, a low fertility and a high exposure to degradation, desertification and pollution. The high organic content of the olive mill wastewater makes it attractive for consideration as a source for agricultural irrigation.





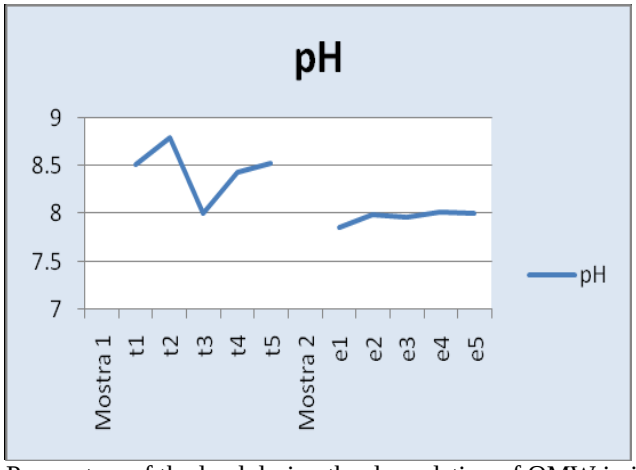


Figure4. Parameters of the land during the degradation of OMW in its profile

Looking the results of the experiment that we expressed in graphics we see that soil pH indicates that disposal of olive mill wastewater does not considerably affect soil acidity. According to Levi-Minzi et al. OMW application has a temporary acidifying effect just after application and after approximately fifteen days soil original acidity is restored. EC values in pond soils increased in general with depth, indicating thus infiltration of OMW from surface to deeper soil horizons. Differences in EC values were more evident in higher depths (110-120 cm) where the OMW flux is restrained due to the presence of compact sedimentary rocks. (Zharra. E.; Abazi.U., 2014). Therefore the increase in soil salinity can be a major concern if long-term application of OMW takes place on soils at high rates.

The content of organic matter at the active ponds was very high in upper soil layers (0–25 cm) but decreased sharply with depth. Moreover, a small increase in the content of organic matter was seen after the application of OMW.

Additional studies are required to assess the long-term effect of uncontrolled OMW disposal in evaporation ponds and agricultural land and assess the risk for soil and water contamination. Particular interest should be also paid to the fate of recalcitrant heavy metals present in soils.

IV. Conclusion

The indicators that are analyzed are: pH, CE, L.O, Na, K. Based on the results, we found that the analyzed parameters have resulted in limits: pH 7.86-8.51, CE 22.4-290, L.O 9269.8-40216.09, rich in potassium (K)4575.1-6627.5. High content of potassium and organic matter has a positive effect on the improvement of soil characteristics, because most of the olives plantations are planted in poor areas with organic matter and on the other hand olives needs land rich in potassium. During 280 day of storage, we observed about 50% reduction in BOD and COD.

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