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Integrated Waste Management for the Olive Oil Pressing Industries in Lebanon, Syria & Jordan (IMOOPW)

# Olive Oil Production in Lebanon

Agriculture contributes to 5.8% of GDP in Lebanon (MOET, 2002) and employs about 6.7% of the total labor force (Casparian, 2003), 57% of which are olive growers. Olive trees cover 57.6 thousand hectares of the Lebanese territory producing 83.2 thousand tons of olives per year (MoAg, 2003). The olive cultivated area is sustaining a growth rate of 3% annually (SRI, 2004).

The Ministry of Agriculture estimates that around 70% of the total olive production is transformed into olive oil. Olive oil production represents a common and traditional business that is mostly run by families in rural areas.

The average yearly per capita consumption of olive oil in Lebanon is about 2.5 kg (3.12 liters) and the total yearly consumption of olive oil reaches 9,500 tons. During low production years, the local market demand for olive oil exceeds local production and Lebanon reverts to olive oil import. During high production years Lebanon becomes a small net exporter of olive oil. For example, in 2002 (a high production year), Lebanon only exported about 3% of its total olive oil production (SRI, 2004).

Following international market trends, the FAO forecasts that local demand for olive oil in Lebanon will increase by a pace of 1.5% per year so that local demand should reach 19,000 tons by 2010.

Olive oil production is a polluting industry generating two types of wastes: vegetable water (liquid waste) and spent olives or pomace (solid waste). The improper disposal of these wastes causes negative environmental impacts to soil, water and air.

## Olive Mills' Distribution & Status

The IMOOPW project conducted a survey for olive mills and their complementary industries. The results of the survey showed that Lebanon has 492 olive mills and around 36 complementary industries including soap, coal, packaging and composting. The majority of the olive mills (45.73%) are located in North Lebanon, followed by Mount Lebanon (17.48%), South Lebanon (16.67%), Nabatieh (15.45%) and Bekaa (4.67 %). Complementary industries are more densely distributed in North Lebanon (40.38%) and South Lebanon (36.54%). 87% of olive mills use the traditional oil extraction method, while 10% use 3-phase decanters and 3% use 2-phase decanters. 80% of mills are owned by individuals while only 5% are owned by cooperatives. The average maximum production capacity of olive oil mills is 657 kg/hr.

Around 48% of olive mills do not have a license.

In a high season, around 120,000 l. of vegetable water is being produced annually and is being disposed of improperly and around 79,000 tons of pomace are produced and mainly used for heating and coal production.

**Inside this issue:**


| | |
|---|---|
| Olive Oil Production in Lebanon | 1 |
| Olive Mills' Distribution & Status | 1 |
| Olive Oil Extraction Methods | 2 |
| OMW: A Blessing or a Curse? | 2 |
| Health Effects of Polyphenols in Olive Oil | 3 |
| OMW: From Env. Problem to Source of Wellness | 3 |
| Olive Pomace in a Fight Against HIV | 3 |
| Effects of July War On the Olive Oil Sector | 4 |


# Olive Oil Extraction Methods

There are mainly 2 methods for oil extraction: the traditional system and the continuous system.

The traditional system is a discontinuous system consisting of pressing the paste by means of hydraulic presses. The continuous 3-phase system uses horizontal centrifugation (decanter) to separate the oil from the mass. The result of the process is the oil, vegetable water and spent olives. The continuous 2-phase system uses a decanter that separates the oil and mixes the spent olives and the vegetable water in one phase called humid olive kernel or moist spent olives. The table below shows the different steps in the 2 extraction methods.

| Olive oil extraction | Reception | Milling | Malaxation / Mixing | Oil extraction | Centrifugation | Storage |
|---|---|---|---|---|---|---|
| **Traditional** |  |  |  |  |  |  |
| **Continuous** |  |  |  |  |  |  |

# Olive Mill Wastewater: A Blessing or a Curse?

The demand of olive oil is highly increasing worldwide, and environmental pollution caused by olive mill wastes (OMW) is increasing especially in the Mediterranean region. OMW contain high amounts of organic materials and polyphenols. Olive mills are usually associated with emissions of odorous volatile compounds. OMW cause deterioration of water bodies reflected as reflected by coloring, appearance of an oily shine, and increased oxygen demand. They also affect the soil quality, are toxic to plant life, and create odor nuisance when disposed into the soil. The main problem regarding the disposal of OMW is to find an environmentally friendly and economically viable solution. Due to the presence of toxic organics these wastes are toxic to bacteria and direct biological treatment is not possible. In addition, these wastes are mostly generated from small enterprises having limited financial resources and usually distant, which creates difficulty in establishing central treatment and disposal facilities. On the other hand, there are studies indicating that OMW may also be regarded as an economic resource such as the use of OMW as soil conditioner, biomass fuel, compost, or as starting material to obtain valuable products such as antioxidants, enzymes and biogas fuel . In order to avoid the economic and social chaos leading to potential crisis in olive production due to the requirements of very expensive OMW treatment investments, several provisory legislation and ministerial decrees were promulgated and strategic plans were applied in some countries. One of them has foreseen spreading of wastewaters on land, such as in Italy.

Spain, for example, almost totally changed the production techniques from press and three-phase (oil-water-paste) continuous systems to two-phase systems to produce less waste. Extensive field studies and research indicating the high fertilizing and soil conditioning value of OMW were carried out in Spain and Italy. (Azbar, N., 2004).

> *"...OMW may also be regarded as an economic resource such as the use of OMW as soil conditioner, biomass fuel, compost, or as starting material to obtain valuable products such as antioxidants, enzymes and biogas fuel".*

***Hasbani river, South Lebanon, becomes black during the olive pressing season because of OMW discharge.***

# Health Effects of Polyphenols in Olive Oil

An article by Covas, M. I. et al. published in the Annals of Internal Medicine volume 145, issue 5, September 2006, studied the effect of the phenolic content in olive oil on plasma lipid levels and lipid oxidative damage. In a crossover study, participants were randomly assigned to 3 sequences of daily administration of 25 ml of 3 olive oils. Olive oils had low (2.7 mg/kg of olive oil), medium (164 mg/kg), or high (366 mg/kg) phenolic content but were otherwise similar. Intervention periods were 3 weeks preceded by 2-week washout periods. The results showed that the higher the phenol content of the oil, the higher the HDL "good" cholesterol and the higher the level of antioxidants in the blood. The antioxidants prevent damage to LDL . Olive oil's phenolic content can also provide benefits for plasma lipid levels and oxidative damage.

***Which Olive Oils have higher polyphenols?***

Phenol content in olives depends on several factors:

**Variety:** Specific types of olives, such as the Tuscan varieties (Frantoio, Coratina, Lucca, Pendolino), will have higher polyphenol values.

**Time of picking**: Most olives picked earlier in the year will have more polyphenols. Polyphenol concentrations increase with fruit growth until the olives begin to turn purple then begins to decrease.

**Processing method**: Mixing the olive paste in the presence of the oxygen in air will lower the polyphenols. Refined oil is low in polyphenols.

**Storage:** As oil sits in storage tanks or the bottle, the polyphenols will slowly be oxidized and used up. This process speeds up when the oil is heated or exposed to light.

# OMW: From Environmental Problem to Source of Wellness

Lachifarma, a pharmaceutical industry in Lecce, Italy has developed a new technology that allows the treatment and valorization of olive mill wastewaters.

The technology consists of using a series of membrane filtration starting by micro-filtration, followed by ultra-filtration, nano-filtration and ending by reverse osmosis. The treatment generates valuable by-products as follows:

Out of 100 L. of OMW

- 68% water suitable for agricultural uses.
- 26% of low molecular weight products that can be used for animal feed.
- 6% of hydroxytyrosol, a powerful antioxidant used in the pharmaceutical and cosmetics industries.

*"When competent companies adopt the principle of eco-efficiency they turn out important innovations. . . It will not just be about technology and economics but also about framing the market and about creating new partnerships across the traditional boundaries of business and politics." Claude Fussler , WBCSD, 2002.*

The company holds an international patent on this clean-up process of OMW and production of Hydroxytyrosol and other phenolic compounds (Pat. No. EP1623960A1).

# Olive Pomace in a fight against HIV

The Bionat team, from the University of Granada, headed by Prof. Andrés García-Granados, senior lecturer in Organic Chemistry, have been working on the extraction of maslinic acid from dry pomace produced in olive oil mills.
Maslinic acid inhibits serin-protease, an enzyme used by HIV, to release itself from the infected cell into the extracellular environment and, consequently, to spread the infection into the whole body.

These scientists from Granada determined that the use of olive-pomace can slow down AIDS spread in the body by 80%.
Maslinic or crataegolic acid is a pentacyclic terpene with antioxidant and anticancer effects found in olive skin, alongside oleanolic acid. Maslinic acid innovative properties stem from its powerful protease-inhibition activity, it is also a very active compound in opportunistic parasitic infections seriously affecting HIV patients.
(Medical News Today, 23 Dec. 2006, *A Compound From Olive-pomace Oil Gets 80% Slowing Down Of HIV Spread*).

**Pomace produced in a traditional olive mill.**

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***Conserve resources to boost business!!***

**Access IMOOPW databases on the web!**

*The project entitled "integrated waste management for the olive oil pressing industries in Lebanon, Syria & Jordan" is within the context of the Euro-Mediterranean Partnership and is implemented under the Short and Medium Term Priority Environmental Action Programme II (SMAP II). It is funded by the EU, managed by UNDP and implemented by the Ministries of Environment in the 3 countries.*

*The overall objective of the project is to introduce the elements of an integrated olive oil waste management system through:*

- *Establishing an industrial database relating to the oil production sector and its complimentary industries.*
- *Introducing cleaner production options, prevention, control & treatment measures to the olive oil industry in the project area.*
- *Training and technical assistance for concerned stakeholders to maintain principles of "green" processing of olive oil.*
- *Setting standards and limits relevant to the olive oil industry effluents.*
- *Setting of a monitoring strategy to be adopted by the relevant ministries and/ or local authorities in controlling/ regulating olive oil production and associated in-line industries.*
- *Developing financial as well as technical incentives to promote the mandates of previously agreed Memorandums of Understanding (MOUs) relating to the proposed environmental quality standards and compliance strategy.*
- *Undertake awareness activities.*

# Effect of July War on the Olive Oil Sector

The Israeli war on Lebanon in July 2006 caused tremendous effects on the olive oil sector.

This year was supposed to be one of the best season in terms of olive yields especially in South Lebanon. However, at the agricultural level, large areas of olive fields in South Lebanon were either directly destroyed or burnt by Israeli attacks or indirectly affected through the presence of unexploded ordinances which made it impossible to farmers to pick the olives. Data collected by UNDP and NDO showed that the area of olive fields affected by unexploded ordinance was 4,729,000 $m^2$. Olive harvesting was also affected by the unavailability of workers for olive picking especially that the majority of these workers were usually of Syrian nationality. The political situation caused a scarcity in olive pickers which lead to an increase in the wages of the available pickers. In some areas in North and South Lebanon, the wages increased from 10$ per day to 30$ per day. This of course lead to the increase in the price of olive products especially olive oil.

*Olive picking by hand.*

At the industrial level, a number of olive mills were either partially or totally destroyed because of the war. The IMOOPW project conducted a rapid phone survey to try to assess the number of mills affected and it turned out that around 20 mills were slightly affected and were able to operate during the pressing season, and around 10 mills were highly affected or completely destroyed.

In addition, olive oil mills were also suffering from the unavailability of workers and the high wages requested by the present ones.

These are some general impacts from the war, however, there are more that need further investigations in the field.