The Problem of Olive Mill Wastewater in Turkey and some Solution Alternatives

Renan TUNALIOĞLU 1 (✉)
Tolga BEKTAŞ 2

Summary

Olive, as a fruit, cannot be consumed directly due to the oleuropein substance it contains and needs to be processed into either table olives or olive oil through various production systems. The process of olive oil extraction results in olive oil as the main product, and two by-products, with olive pomace being one and brown-coloured Olive Mill Wastewater (OMWW) as the other. OMWW has no direct use and it is usually discharged directly to soil, small rivers, lakes or sea, resulting in potential contamination of the environment. Turkey is the fourth largest olive producing country in the world and fifth in olive oil production. Turkey produces approximately 891,393 tonnes of OMWW on average per two years using the current mill production technologies, and hence faces the problem of OMWW. This study proposes and discusses various solution alternatives to overcome the problem of OMWW in Turkey. The results of this study aim to contribute to the ongoing efforts in resolving this problem by the olive industry and to aid policy making to tackle this important issue.

Key words

olive mill wastewater, Turkey, solution alternatives

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Introduction

Olive is grown in nearly 40 countries in the Mediterranean or under the Mediterranean climate (FAO, 2011). EU countries such as Spain, Italy, Greece, Portugal and France are significant producers of olive oil, with their overall production constituting 60% of the world’s olive production, 40% of table olive production and 80% of olive oil production. Tunisia, Turkey and Syria are other important olive producer countries of oil (IOC, 2011). Adoption of healthier diets in many parts of the world has resulted in an increased interest in the adoption of the Mediterranean way of eating olives and consuming olive oil, and hence increased demand for this fruit.

There are several systems that could be used to extract olive oil. Whatever process is used, a dark brown-coloured substance named Olive Mill Wastewater (OMWW) is obtained as a by-product. Due to its environmental hazards, OMWW is a problem acknowledged by many olive-oil producing countries and the solution to this problem requires that political and economic measures are put in place (Tunalıoğlu et al., 2008). In this paper, the problem of OMWW in Turkey is described and some solution alternatives are discussed. In what follows, a brief background on OMWW is provided.

Olive Oil Production Systems and Olive Mill Wastewater (OMWW)

Olive cannot be consumed directly due to the oleuropein it contains. It therefore needs to be processed into table olives or olive oil through various production technologies. There are a number of ways of extracting olive oil, ranging from the more traditional (classical) press-based techniques to more modern two- and three-phase systems. Modern methods are based on principles of centrifugation, percolation and combinations thereof (Yemişçioglu et al., 2001). Table 1 presents a tabulated classification of these systems.

The process through which olive oil is produced results in a number of by-products that are potentially harmful to the environment. One of such by-products is pomace, which can be re-processed as oil and used as raw material in food, or in industrial and energy sectors. The other by-product is OMWW, re-processed as oil and used as raw material in food, or in environment. One of such by-products is pomace, which can be

Table 1. Olive oil extraction systems

<table>
<thead>
<tr>
<th>Classical Systems</th>
<th>Modern Systems</th>
<th>Combined Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Vice (Press)</td>
<td>1. 2 Phases Systems</td>
<td>1. Percolation-Pressing Combined</td>
</tr>
<tr>
<td>2. Pressing</td>
<td>2. 2½ Phases Systems</td>
<td>2. Percolation-Centrifugal Combined</td>
</tr>
</tbody>
</table>

Source. Adapted from Yemişçioglu et al., 2001.
The Problem of Olive Mill Wastewater in Turkey and some Solution Alternatives

The current practice with managing OMWW in Turkey is that it is either discharged into the environment (e.g., lakes, small rivers, sea or soil) or collected in lagoons that form part of many olive mills, left for natural evaporation. The discharge of OMWW into the environment is a major problem in the country. For this reason, the Ministry of Environment and Forestry has put strict policies in place to control and fine such hazardous practices (Tunalıoğlu, 2010). The olive mills themselves also acknowledge this problem but have little resources to deal with and properly dispose of OMWW. For this reason, more needs to be done to solve this problem in a collective manner, which requires financial support from the government. Although research and development activities are underway for the reuse of OMWW, as, for example, biofuel and animal feed (Tunalıoğlu and Armağan, 2008; TBMM, 2008), but these efforts are not yet at a level to tackle the problem fully and satisfactorily.

The next section discusses some possible solution alternatives for the problem of OMWW in Turkey.

Discussion

Several possible solution alternatives for disposal or treatment of OMWW in Turkey are detailed below:

1. A traditional and conventional method is the use of lagoons in which OMWW is kept until it naturally evaporates. This method is particularly applicable in countries where a sufficiently warm climate allows for natural evaporation, as in Turkey. Although lagoons only require minimal investment cost, they are not an efficient and a desirable way for OMWW disposal for several reasons. Apart from the obvious space requirements, OMWW kept in a reserve for prolonged periods of time would potentially lead to ground contamination unless the lagoon is properly fitted. A further problem issue would be the growing odour, which would provide for the European Union’s harmonization efforts, and the under the new regulations of the Turkish Environmental Law.

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<table>
<thead>
<tr>
<th>The Important Olive for Olive Producer Provinces</th>
<th>Olive for Olive Oil Production (t)</th>
<th>OMWW* (t/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aydın</td>
<td>159 985</td>
<td>159 985</td>
</tr>
<tr>
<td>Balıkesir</td>
<td>115 628</td>
<td>115 628</td>
</tr>
<tr>
<td>Çanakkale</td>
<td>54 772</td>
<td>54 772</td>
</tr>
<tr>
<td>Hatay</td>
<td>104 098</td>
<td>104 098</td>
</tr>
<tr>
<td>İzmir</td>
<td>165 125</td>
<td>165 125</td>
</tr>
<tr>
<td>Manisa</td>
<td>37 429</td>
<td>37 429</td>
</tr>
<tr>
<td>Mersin</td>
<td>47 372</td>
<td>47 372</td>
</tr>
<tr>
<td>Muğla</td>
<td>95 696</td>
<td>95 696</td>
</tr>
<tr>
<td>Gaziantep</td>
<td>31 854</td>
<td>31 854</td>
</tr>
<tr>
<td>Antalya</td>
<td>33 362</td>
<td>33 362</td>
</tr>
<tr>
<td>Kilis</td>
<td>9 640</td>
<td>9 640</td>
</tr>
<tr>
<td>Other Provinces</td>
<td>36 432</td>
<td>36 432</td>
</tr>
<tr>
<td>Total</td>
<td>891 393</td>
<td>891 393</td>
</tr>
</tbody>
</table>

Source: Extracted from TUIK (2011) using average statistics for 2008–2009; (*) Calculations in this table have been made on the assumption that all olive oil production facilities are assumed to be operating under the three-phase system and that the amount of OMWW is equal to the amount of production of olive for olive oil.
rapid breeding of flies around the lagoon and ultimately lead to an unhygienic environment (Azbar et al., 2004).

2. For facilities operating under a three-phase system, transition to a two-phase olive oil production system would lead to reduction in water requirements in various stages of the extraction process. This alternative, however, requires a substantial investment by the olive oil mills, as the switching cost from one technology to the other is significantly high. Furthermore, one must bear in mind that the resulting mixed solid-liquid waste would still need to be processed further to separate the pomace from water. Unless subsidised or partially funded by the government, small or medium sized olive oil mills in Turkey are unlikely to cover the costs of such transition on their own, despite the significant benefits.

3. Another possible option is to consider the use of integrated olive mills (Azbar et al., 2004) wherein facilities are built in which olive oil extraction and wastewater treatment can be done in an integrated and sequential manner. As with the second option, however, the cost of this option is also very significant and unlikely to be adopted unless subsidized by the government, private institutions or unions.

4. There are several ways in which OMWW can be treated, such as physico-chemical including flocculation, coagulation, filtration, incineration and biotechnological, including microbiological treatments, composting, anaerobic and extraction processes (Roig et al., 2006). Akdemir and Ozer (2008) state that the treatment of OMWW through such methods has not entirely been successful, and suggest ultrafiltration as a viable alternative to those already mentioned. The modern strategy for olive mill wastewater management is combining wastewater treatment and valorization. In other words, producing valuable products from wastewater and thus compensating the high costs of treatment. Designing centralized plants to collect wastewater from small olive mills within a regional radius offers a feasible economic solution. However, one should bear in mind that the high cost of building and running such facilities will require the financial support of private oil mills as well as the government, but this is not likely to be as expensive as technology switching as mentioned in (2) above.

In summary, OMWW is an increasingly growing problem in both Turkey and other olive producing countries in the world. The increasing number of olive trees planted as a result of continued government support will result in more olive production in the future, hence more olive oil and OMWW. We believe any solution adopted for the problem of OMWW in Turkey will need to be socially and economically feasible. Solution should also be acceptable to and supported by the government and other authorities.

References


