

## **OLIVE RESIDUES - RENEWABLE SOURCE OF ENERGY**

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### **ABSTRACT**

*Olive oil production is important economical activity in all Mediterranean countries of European Union. The EU is the largest world producer of olive oil with more than 2 million tons produced in 2007 with about 12.000 olive-mills, most of which are small and medium enterprises (SMEs). Residues after olive oil production represent serious environmental problem, still not properly regulated in most countries. SWOT analysis of potential regional olive residues market for energy was presented in this paper. Results revealed that the creation of supply olive-residues-to-energy chains could be the optimal solution for olive residues management in Istria (Croatia).*

*Keywords: olive residues, renewable energy*

### **1. INTRODUCTION**

Olive oil production is wide spread throughout the Istria, costal area of Kvarner and Dalmatia region and it's very important in Croatia. Role of olive cultivation is important mainly for rural economy, local heritage and becomes important as specific landscapes interesting for tourism activity ("olive oil roads"). Because of that, olive oil production is more and more important as a source of employment. Most of olive oil producers are SMEs and can be distinguished as traditional groves. There are only few intensive and more mechanised plantations. The EU is the biggest world producer of olive oil (80% of total) with about 12.000 olive mills and EU globally accounts for 71% of world consumption [1].

In Istria there were 411.146 bearing olive trees or 608.120 total olive trees in 2006. (personal communication: Central Bureau of Statistics, Agricultural department), but regional plantation program has increased this number with 106.186 in 2007. and 111.694 new olive trees in 2008 [2]. Positive trend in Istrian olive production will affect on currently negative solid olive residues treatment. Istrian region plantation plan anticipate to have 12.026 ha under fruit orchards, mainly olives, till 2020 [2] that implicates also much higher quantities of solid olive residues in next years when the new plantations will come into bearing stage.

Changes in consumer's attitude towards the environmental effects of food production [3], the stricter policy rules on environmental issues and even stricter regulations in European Union towards reduction of the use of natural resources initiated a great amount of research towards improving of waste management [4]).

## **2. METHODOLOGY**

The information for the paper was gathered in the framework of IEE project M.O.R.E. “Market of Olive Residues for Energy”. In the paper were presented current situation of olive residues production and its prospects for energy use, in Croatia and especially in Istria, through SWOT analysis. The aim of the paper is to present complete picture of olive residues used, namely for energy.

## **3. BIOMASS AS ENERGY**

Increased interest for development of technologies using new renewable sources of energy like biomass and others starts since 1970's after oil price crisis [5]. Bioenergy is interesting for many reasons and one of them is that does not affect the climate change through emissions of carbon dioxide or other ‘green house gases’ to the atmosphere [6,7,8].

Olive oil industry has great environmental impact because of the production of a highly polluted wastewater and/or a solid residue, olive skin and stone (olive husk), depending on the olive oil extraction process [9]. In EU three broad types of production can be distinguished: 1) traditional groves, 2) more managed traditional plantations and 3) intensive, generally recent, more mechanised. The three use different industrial processing methods which besides olive oil, generate solid (olive pomace) and liquid (wastewater) residues in different quantities. In generally, of 100 kg of olives, we get 35 kg of pomace and 100 liters of liquid residues (these numbers can change according to the technology used). Pomace is the solid residual (a little of olive, pieces of nut, etc.) [1].

Almost every part of olive residues can be use as biomass for energy like olive fruit, olive oil and vegetable water and olive cake, which consists of pit and pulp of the, can be used as an excellent source of renewable energy (average calorific value:  $31,2 \text{ kJ g}^{-1}$ ). The combustion efficiency of olive cake ranged between 82,3 % and 98,7 %, while maximum combustion efficiency of coal reached 98,3 % [4].

Crude residues from olive oil production are big ecological problem in Republic of Croatia. Usual procedures with those residues are treatment as a waste and disposal directly on the ground near the olive mill. Because of limestone bedrock which is very porous, toxic elements from olive residues penetrate through the soil into the aquifers and pollute water and soil while volatile compounds have influence on air pollution and cause the unpleasant smell near to the landfill place. Using these residues as raw material for energy production, instead can be a good solution for aforementioned environmental problems.

## **4. RESULTS**

Our research revealed following: Olive producers use services of olive mills that are responsible for olive mill waste management. Regulations and state authorities are currently indefinite concerning olive residues management. Olive millers should alone make a choice, organize themselves and solve technological problems. In practice, residues after olive oil production are not used for some new useful product. Most commonly usage is as a fertilizer or as a waste. There is existing knowledge of other possibilities of pomace usage (animal feed etc.) – but up to now no concrete actions were taken. Istrian olive mills have processed 6.336 t of olive fruit and have produced 4.066 t of olive pomace in 2008 (approximation according to olive yield).

Results from survey carried out by questionnaires on a sample of 16 olive-mills in Istrian Region during 2008 [10], related to quantities and treatment of olive pomace are presented on Figure 1.

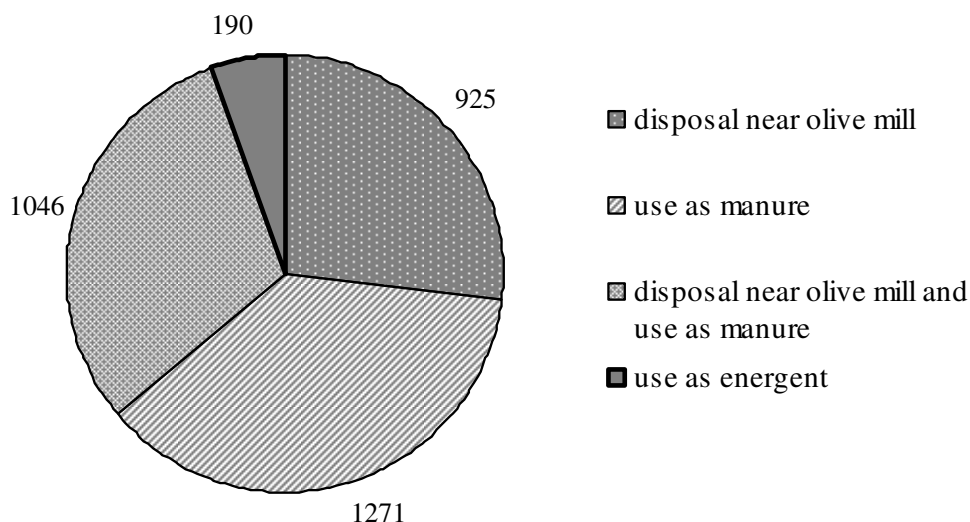


Fig. 1. Use and quantities (t) of virgin olive pomace in Istria (2008.)

In Figure 2. market player’s motivation for using pomace as energy-generating product through the distribution of answers on the question “In what circumstances will you use pomace as energy-generating product?” was presented (Figure 2.).

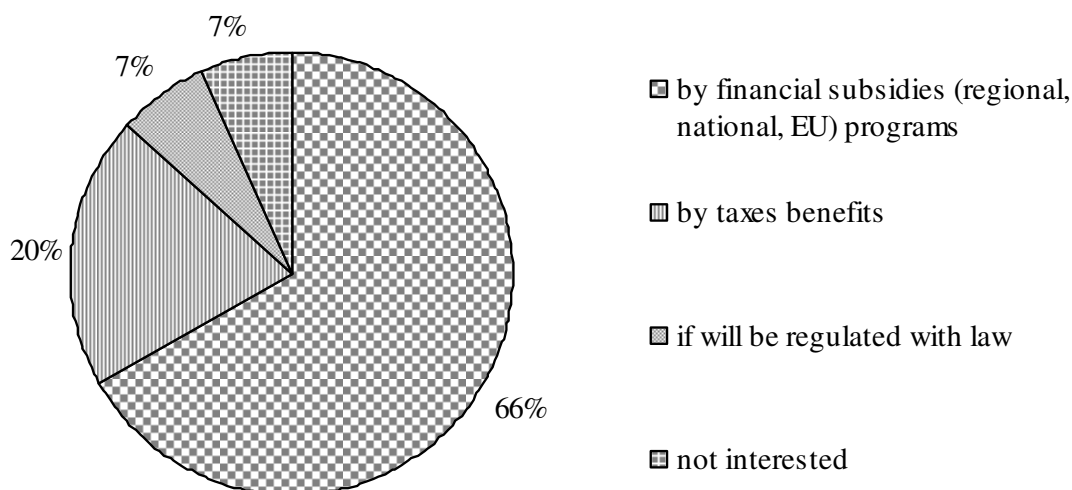


Fig. 2. Circumstances of use pomace as energy-generating product

At the moment, olive millers have unsolved problems with residues. Most of problems are caused by the lack of information needed for regular waste management and they will be soon faced with increasingly restrictive environmental legislations in Croatia and the EU.

All obtained data in Istrian Region were used for SWOT analysis.

### SWOT analysis - The use of solid olive oil residues in Istria, Croatia

#### Strengths

- Olive-milling residues are not fully exploited renewable energy sources
- Increased exploitation of renewable energy sources is one of the main goals of Croatian energy development sector
- Increasing trend of olive growing in the Istria and Croatia
- Positive attitude of key market actors towards adequate olive residues management
- Local authorities are ready to support positive initiatives in the sector

### **Weaknesses**

- Lack of organization of olive milling residues management
- In Istria (and Croatia) there is no olive cake collecting centers or facilities for their drying and energy producing
- Olive milling residues are not used for energy purpose at the moment
- High percentage of olive oil in pomace in Croatia (no pomace oil extraction) requires a special approach in energy production
- Undefined legislation concerning olive residues management
- Limited access to information on regular and appropriate waste management

### **Opportunities**

- Creation of supply olive-residues-to-energy chains could be the optimal solution for olive residues management in the region
- Istria as a tourist region could implement known technology and solutions in tourist facilities (hotels, swimming pools, etc.)
- Existing trend of waste repositories reconstruction in Istria could create additional possibilities for treatment and energy use of olive milling waste

### **Threats**

- Production seasonality and variability of residues quantities for energy production
- Existing producer's attitude of non profitability on pomace use in energy purposes

Evident problem in Croatia is undefined legislation concerning olive residues management. Olive residues are mostly treated as a waste, in a very few cases olive residues were used as raw material for energy production (domestic purposes). This is a big problem for olive millers because disposal of waste with more than 35% of biomass content at the waste repositories is forbidden [11].

Creation of supply olive-residues-to-energy chains could be the optimal solution for olive residues management in the region but some problems for the energy exploitation could arise. A few main could be caused by the lack of olive cake collecting centres or drying facilities, dispersion and seasonality of olive residues production and presence of different milling systems with different residues content.

## **5. CONCLUSION**

At the moment in Croatia there is a lack of successful energy exploitation of olive residues. Quantities of residues are relatively low in Croatia but in the following period significant increasing could be foreseen. On the national level it is necessary to initiate the changes in national policy for treating olive residues as by-product. The main stakeholders that should be involved in these activities are Istrian olive business cluster, local and regional Government together with National Association of olive growers and olive oil producers, supported by RSC (Regional Steering Committee) members. RSC gather key regional stakeholders, in the framework of project M.O.R.E., which were encouraged to take concrete action. Raising public awareness through education and promotion on local and national level is a key element for the successful use of olive oil production residues for renewable energy purposes in the Region. Expected impacts were increased interest for olive residues as raw material and better handle with olive residues-to-energy market development.

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