Application of the calorimetric methods to the characteristics of seeds from olives

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Biomass from olive seeds

Olive oil is one of the most traditional agricultural products of Mediterranean countries. In the last few decades, the interest in olive oil, due to its health properties, has increased significantly, and the cultivation of olive trees has spread throughout the world.

According to the Food and Agriculture Organization of the United Nations, in 2018, 10.7 million hectares of olive trees were grown in 41 different countries. The total global olive production in 2018 was 21.6 million tonnes.

Depending on the climate, 15-40 kg of olives can be obtained from one olive tree each year.

The industrial processing of olive fruits to obtain olive oil produces large amounts of by-products including flesh, skin and seed, so in addition to the main product - olive oil, the biomass is also produced. Biomass is the term used to describe all biologically produced matter.

Olive stone is an essential by-product generated in the olive oil extraction industries and it represents roughly 10% by weight of olive fruit.

Aim of the work

In the present study we have investigated the possibility of use of differential scanning calorimetry for thermal characterization of seeds from green and black pickled olives from Croatia.

Olive seeds extracted by hand from pickled green and dark olives from Croatia (OPG Bagić Zdravko) were analyzed.

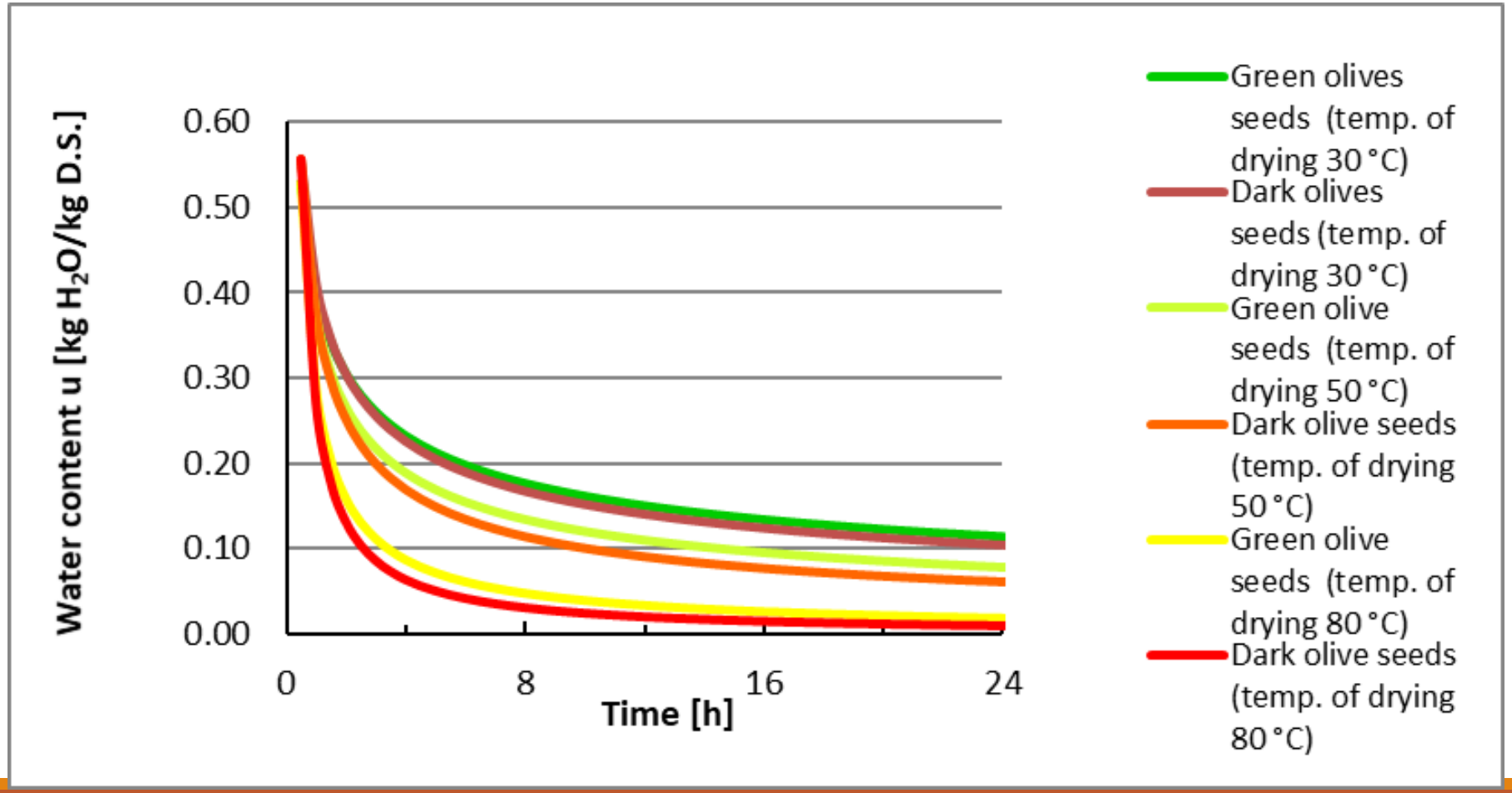
Methods

- Determination of initial water content (u) by oven-drying method and its change during drying process.
- The change of water content during entire drying process were determined of olive seeds in a convective dryer at the temperature of 30°C, 50°C and 80°C, without the flow of drying agent.
- Ash content in the olive seeds was determined by combusting the material in the muffle furnace.
- The heat of combustion (gross calorific value) was determined by using bomb calorimetry method.
- The differential scanning calorimeter with a normal pressure DSC cell equipped with a cooling system was used to determine thermal properties of olive seeds.

Results

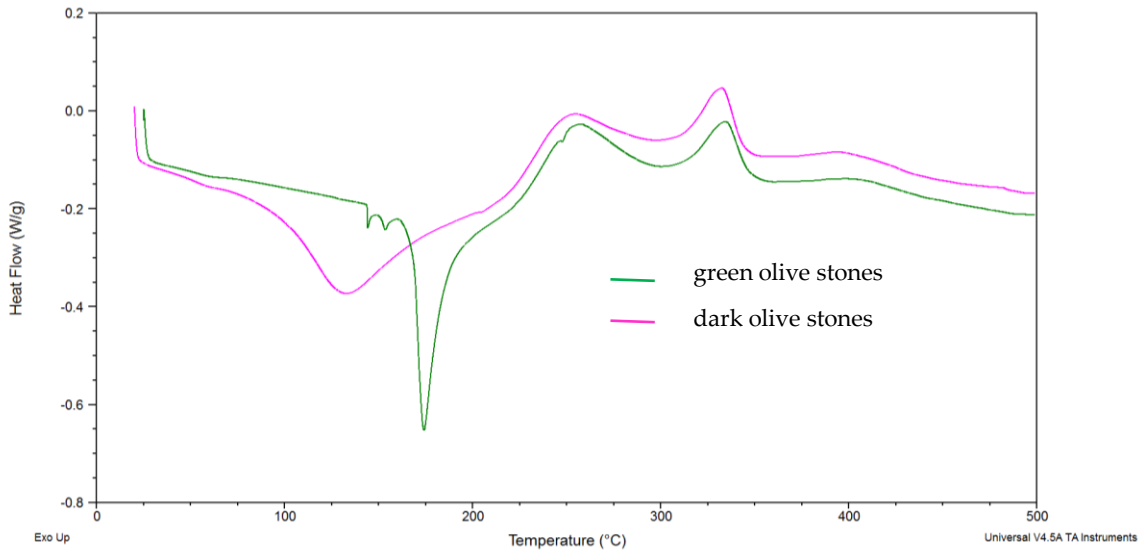
Kinde of olive stones	The seeds share in the total mass of the olives %	Water content u kg of H_2O /kg D.S.	Moisture %	Ash content %	Calorific value kJ/g
green olives seeds	17.1	0.53	34.7	2.18	20.64
dark olives seeds	16.5	0.55	35.4	2.69	20.07

Drying experiments



Thermal analysis

Thermal analysis is convenient, reproducible and useful method for characterizing heterogeneous organic materials. One of the promising thermal techniques for biomass characterization is Differential Scanning Calorimetry (DSC) because DSC is sensitive, cheaper and faster, which means that it does not require time-consuming processing of test samples.



Conclusion

- DSC curves are different depending on the type of olive seeds. These results suggest that the curves obtained by differential scanning calorimetry (DSC) can be used as a discriminant characteristic.
- In order to achieve the desired moisture content in the shortest time, the stones of the olives should be dried at a temperature of 80°C. Drying at this temperature to achieve the desired humidity (12%) took 4 hours.
- The heat of combustion of the tested olive seeds is comparable to other biological materials and was 20.64 kJ/g for green olive seeds and 20.07 kJ/g for dark olive seeds.
- Olive seeds are characterized by a relatively low water content, which is 0.53 kg of H_2O / kg D.S. for green olive stones and 0.55 kg of H_2O / kg D.S.
- The ash content of the green olive seeds under investigation was 2.18% and 2.69% of the black olive, which is a relatively high value.
- The olive stones show a good characteristics for being used as a fuel, with low ash content and high calorific value.