ANALAYZING THE EXTRACTION DEVICE IN THE TECHNOLOGICAL SYSTEMS OF GETTING VEGETABLE OIL PRODUCTION

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Annotation. Recently, studies have been conducted to improve the traditional malaxation process and obtain positive effects on both oil production and consumption. With these aims, emerging technologies including microwave (MW), pulsed electric field (PEF), and ultrasound (US) have been applied to conventional virgin olive oil extraction process. In this chapter, most recent studies that focused on adaptation of emerging technologies to traditional extraction to increase the yield of olive oil or some minor compounds and bioactive components present in olive oil including tocopherols, chlorophyll, carotenoids. In recent years, novel technologies such as ultrasound, pulsed electric field, or microwave have been adopted in olive oil extraction [1] because of their positive effects including enhanced extraction efficiency, reduced extraction time, increased yield, and low energy consumption.

Key words: plant materials, diagnostics, separation, oil industry, theoretical studies, processing, conventional extraction.

Introduction. Ultrasound is one of the main emerging technologies widely used in various extraction processes of plant materials. In order to enhance oil extraction, ultrasound can be applied to the olive paste due to its mechanic effect on the cell membranes, which induces them to release oil easily from vacuoles with a considerably lower malaxation time and higher oil quality and yield. In addition to the extraction process, ultrasound was also investigated in numerous studies on food processing methods including emulsification, filtration, crystallization, inactivation of enzymes and microorganisms, thawing, and freezing on foods [2]. Over the last few decades, microwave treatments in food processing have gained popularity because of their low heat treatment times, operational simplicity, and high heating rates, which result in lower maintenance requirements.

Materials and methods. The microwaves obtained from household ovens and many industrial applications are produced efficiently by permanent wave magnetrons (Figure 2) [3]. The effect of heating with microwave and its comparison with conventional heating and ultrasound heating on crushed olives was investigated by Clodoveo and Hbaieb [4]. Results showed that the main quality parameters legally established (acidity, peroxide value, and specific extinction coefficients (K232 and K270)) to evaluate VOO were not affected by the microwave and ultrasound treatments. Moreover, the malaxation time was decreased and extraction yield was improved by Technological Innovation in the Olive Oil Production Chain.

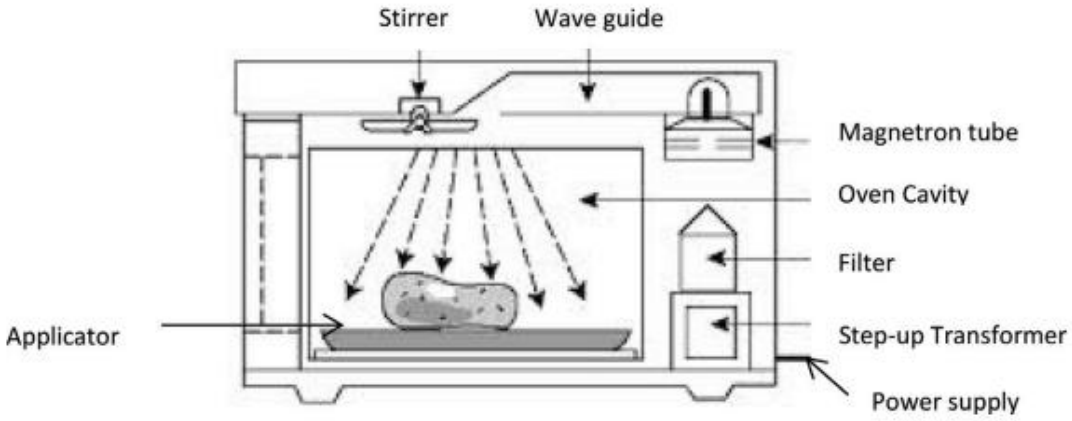

Figure 1. Microwave oven parts

The yield of oil obtained by conventional extraction was lower than that of oil obtained by microwave extraction from olive pomace. It demonstrated that microwave-extracted oils had higher total phenolic (985 mg caffeic acid/kg oil) and tocopherol compounds (278.07 mg/kg oil), also lower peroxide value (17.8 meq O2/kg oil) and polycyclic aromatic hydrocarbons (PAH) (0.44 µg benzo(α) pyrene/kg) compared to oils extracted by conventional industrial methods. The effect of microwave-assisted solvent extraction at two different radiation power values (170 and 510 W) combined with acetic acid on yield and physicochemical properties of olive oil was studied by Kadi et al. The UV absorbance values were highest in oils treated with 510-W microwave and 7.5% acetic acid content. Since microwave radiations accelerate the disruption of cells and oil release, they observed similar results to those of previous researchers who also achieved better oil extractability. The possibility of combining megasonic and microwave treatment in a continuous olive oil extraction system to enhance olive oil extractability was examined by Leone et al. The utilization of combined megasonic and microwave treatment to olive paste resulted in a consistent reduction of viscosity. In result, both microwave and megasonic technologies have improved the oil extractability performance by lowering the consistency of the olive paste. In recent years, infrared spectroscopy, computer vision, machine olfaction technology, electronic tongues, and dielectric spectroscopy are some of the main sensing technologies applied to the virgin olive oil production process. Infrared spectroscopy can also be used to evaluate the official quality parameters of olive fruits and oil.

The mass transfer stops when thermodynamic equilibrium between the two phases is reached. Equilibrium is characterized by an equal temperature, equal pressure and equal chemical potentials in both phases. In the second step the two phases are allowed to separate (settling process). Finally, after decanting one receives the raffinate and the extract.

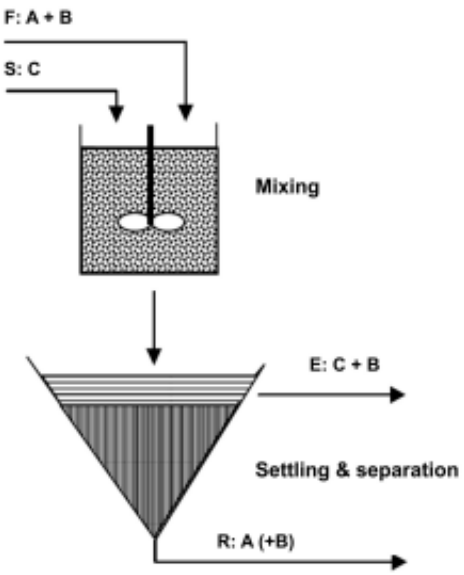

Figure 2. The one-stage extractor

However, in order to obtain the required separation several steps of mixing and phase separation are mostly needed. Therefore, in practical applications multi-stage extractors are usually used. As for many separation processes, a co-, a cross-, or a counter-flow concept can be applied [3]. Liquid-liquid extraction is most widely used and will be considered within this laboratory. It is applied e.g. to remove heavy metals or acids from waste water or for the production of aromatic compounds from mixtures of hydrocarbons. Another application is gas-liquid extraction which is also called absorption. The world's annual production of vegetable oils has exceeded 100 million tons, 86% of which are used for human consumption. Vegetable oils are mainly derived from the stored oils in the seeds of some oilseed crops. Vegetable oils are generally considered to be more beneficial to human health than animal oils. The fatty acids that make up the basic components of vegetable oils can generally be classified as saturated, monounsaturated, and polyunsaturated fatty acids. These fatty acids, like vitamins and amino acids, are also important nutrients for the human body. Among them, polyunsaturated fatty acids are essential fatty acids that cannot be synthesized by the body itself and must be taken in from food.

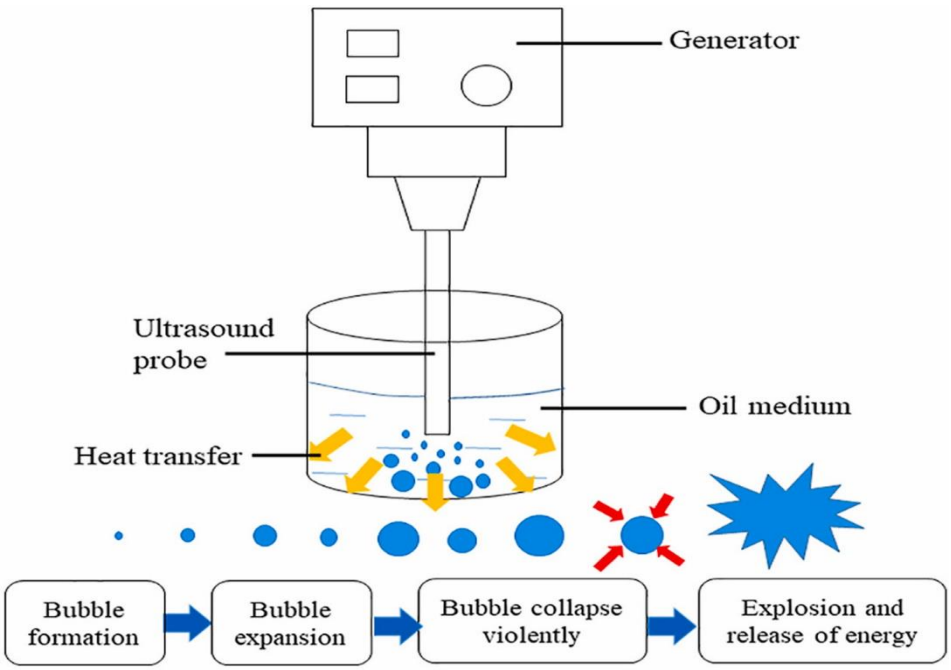

Figure 3. The system pf getting oil production

This ultrasound technology offers several advantages over conventional refining, such as improved oil yield, reduced dosage of materials, and saved cost. This article provides a better understanding of ultrasound mechanism on the oil quality and insightful information to stimulate impending applications in the oil industry. Edible oil represents an important component of human diets in our daily life to provide energy, essential fatty acids, and nutrients to human beings. The nutritional value of edible oils varies depending on the types of oilseeds, extraction techniques, processing methods, and storage conditions (Li et al., 2020). With a continuous increase in population and economic development, the demand for healthy and nutritious vegetable oils has been increasing due to the health benefits offered to human. The continuous search for functional and nutritious edible oils has gained world attention on the technology to process edible oils. The refining process exposes the vegetable oils to high temperature, alkali (sodium hydroxide) and acid (acid-activated bleaching earth, phosphoric acid or acetic acid) mediums, as well as metal processing equipment. These exposures can lead to numerous changes in the chemical composition of treated oils, which affect its oxidative stability. Thus, there is an ongoing effort to improve the oil refining process to preserve the nutritional quality of refined vegetable oils. The recent interest in exploring an environmentally sustainable refining process led to the application of ultrasound waves to generate a cavitation effect in the refining process of edible oils. High-intensity ultrasounds are sound waves with frequencies more than 20 kHz, which is the frequency end of human hearing (Wu et al., 2008). Previously, ultrasound technology used to extract oil with reduced time and better oil yields without changing the fatty acid composition.

Conclusion. The application of ultrasound technology in the refining process of vegetable oil has been concerning recently. Ultrasound technology can be applied in the degumming stage to enhance the degumming efficiency with the removal of phospholipids. Moreover, ultrasound technology reduces the usage of acid and water, the temperature, and the time during the degumming process. Furthermore, ultrasound enhances the extent of degumming in enzymatic degumming.

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