Optimization of ultrasound assisted extraction as enhanced method for maceration of olive oil with rosemary essential oil

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Abstract

Ultrasound assisted maceration was developed as a new and cleaner procedure for a green enrichment of an olive oil with rosemary essential oil. Ultrasound assisted maceration has been compared with conventional maceration. Ultrasound was then applied in order to accelerate diffusion of the rosemary volatile compounds into the olive oil. Then the enriched olive oil obtained by Ultrasound assisted maceration was qualitatively similar to those obtained by conventional maceration. However, the processing time is reduced from hours or days to few minutes when comparing traditional maceration and Ultrasound assisted maceration.

Keywords: *Maceration, Ultrasound, Olive Oil, Essential oil, Rosemary.*

I. Introduction

Virgin olive oil is highly appreciated for its sensory and nutritional properties. Therefore, it confers healthy benefits to the Mediterranean diet [1], it represents the excellent source of fats 98% of total oil weight and phenolic compounds 2% of total oil weight [2].

Aromatic plants have also been used since ancient times in food flavors, it is well known for its antioxidant activity and nutritional value due to its riches with essential oil [3, 4].

The present work proposes a practice of ultrasound to extract the rosemary essential oil from their glands to the olive oil. In order to reduce the extraction time, CO_2 emissions and energy cost. This new technique, fortify nutritional value of oil and increase its shelf life and consequently, create a health-beneficial traditional foods.

2. Materials and methods

2.1. Materials

Rosemary leaves were collected from the north area of Tunisia. Extra virgin olive oil (EVOO) used in this study was produced in 2016.

2.2. Conventional maceration

Rosemary leaves were added directly to the samples of EVOO at a rate of 10% at room temperature for several days to follow the kinetics of maceration.

2.3. Ultrasound assisted maceration

Identical amounts of plant material supplied to EVOO. However, the ultrasound was applied for different powers and periods to optimize the maceration of olive oil. The final aromatized mixture subjected to the same analyses as the previous simples.

2.4 *Extraction of essential oil with hydrodistillation*

One hundred grams of rosemary seeds were subjected to hydrodistillation using a Clevenger apparatus. The hydrodistillation was performed at a rosemary seeds to distilled water ratio of 1:10. The digital Wattmeter LCD was placed in the electrical heater entrance monitored the consumptions of the power during the extraction of essential oil, which was read directly from the digital affichor in kWh. 180 min was enough to extract all quantities of essential oil contained in rosemary seeds. The

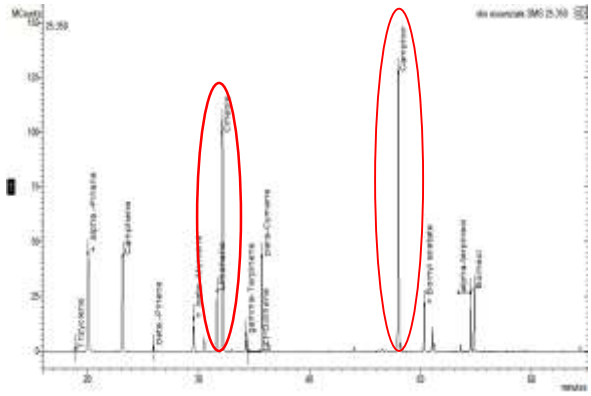
extraction was performed in triplicated, and the mean values were given herein.

3. Results and discussion

3.1 Comparison of ultrasounda ssisted maceration and conventional maceration.

The yield of the essential oil extracted from rosemary leaves was 2,45%. 17 volatile compounds were identified by the HS-SPME/GC-MS chromatograph mainly composed of camphore 25% and cineole 23%, which are not found in EVOO before maceration (Figure 1), thus these two compounds were used like keys to estimate the level of maceration of the olive oil.

a



b

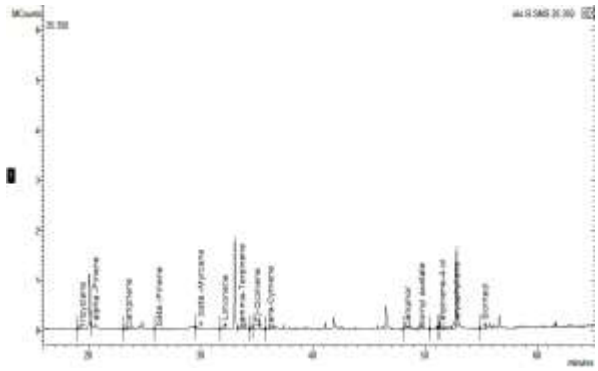


Figure 1: (a) GC/MS chromatogram of rosemary essential oil; (b) chromatogram of no macerated olive oil.

We analyzed different samples of enriched olive oil that were taken at different moment by GC-MS to fellow the kinetic of enrichment (Figure 2).

After 9 min of ultrasound assisted maceration, we estimated an increasing yield of cineole and camphore 3,16% and 1,21%, respectively, but with traditional maceration only 1,05% of cineole and 0,45% of camphor were found in the oil after 12h of natural maceration.

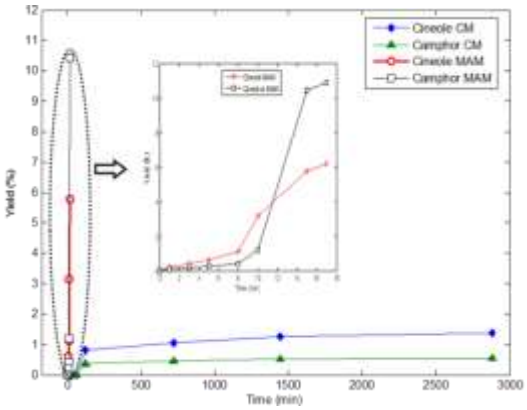


Figure 2: Kinetic of maceration by ultrasound assisted maceration and conventional maceration (10% of rosemary leaves in EVOO).

Ultrasound increased the kinetic of enrichment, 9 min of experiment with ultrasound is enough to produce aromatized olive oil with high quality controlled by several tests of free fatty acid FFA ≤ 0,8% and peroxide value PV≤ 20 m Eq O_2/kg.

4. Conclusions

Ultrasound assisted maceration has been demonstrating its ability to enrich the EVOO by rosemary volatile compounds with various advantages in term of time, yield and energy cost.

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