

Extraction of Oil from Spent Grounds Coffee using Ultrasound as Pre-Extraction Method

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Abstract

The treatment and processing of coffee annually produces a large volume of biological waste, which contributes to environmental pollution, it is estimated that coffee production generates approx. 6 million tonnes of spent coffee grounds per year in the world (GETACHEW and CHUN, 2017). Thus, the sludge becomes a residue equivalent to approximately 50% of the roasted coffee in the soluble coffee industry (PUJOL D. et al. 2013). The major problem of the discharge of spent ground coffee in the environment is the presence of caffeine and phenolic compounds when in concentration above 2.5% due to toxicity to plants and soil microorganisms. Therefore, this project proposed to extract the oil from the coffee grounds using the ultrasound method as a pre-extraction method to the soxhlet extractor, aiming at eliminating the environmental contamination of the residue and at the same time adding value through the study of the oil for use in cosmetics due to the high amounts of phenolic compounds and antioxidants. The results showed that the application of the ultrasound as a pre-extractive method during 30 min allowed to increase the oil quantity by 70% in relation to the use of the soxhlet extractor only, maintaining the quality of the composition.

Keywords: Spent ground coffee; biological waste; ultrasound method; oil from coffee.

1. Introduction

The extraction techniques used to obtain extracts of natural products directly influence its quality and final composition. Several extraction technologies have been applied mainly to increase the quantity and quality of extracted oil, decrease solvent use and shorter operating time. According to (Shang et al., 2017) coffee grounds contain many bioactive components and techniques such as pressurized liquid extraction with water and ethanol, extraction with super critical fluids (Marto et al., 2016) followed by concentration in a rotary evaporator, drying in an oven and weighting.

have been considered as efficient extraction methods and processing due to the decrease in the use of solvents, light and oxygen free environment, and short operation time, however it presents the disadvantage of the high cost of energy in industrial scale besides the presence of mixtures of difficult characterization. The use of ultrasound as an oil extraction method has presented interesting results, since the ultrasonic waves rupture the cellular walls present in the vegetal matrix, increasing the penetration of the solvent and the contact between the phases solute / solvent and thus, facilitating the release of extracts. The use of ultrasound in extraction processes has attracted increasing attention due to its higher efficiency and reduced extraction time, compared to conventional extractions such as Soxhlet and maceration, however studies have shown that the use of ultrasonic technology associated with Soxhlet technology used as pre-extraction technology, has presented excellent results due to improved quality of extracted oil. This paper aims to study the application of ultrasonic technology in the pre-extraction of the oil from the coffee grounds.

2. Experimental conditions

Ultrasound equipment (figure 1) was placed 5g of coffee grounds in a flat bottom flask with 25mL of distilled water, the frequency used was 40kHz for 10 minutes of vibration, after which time the sample was transferred to a capsule and placed in a 50 ° C oven for 48 h for complete drying of the samples, and then transferred to the filter paper cartridge for extracting oil in the Soxhlet extractor. The coffee sludge samples after passing through the pre-extractive processes were subjected to extraction of the oil with the solvent n-hexane in the Soxhlet Total lipid apparatus were extracted by the Soxhlet method with n-hexane for 4 h,

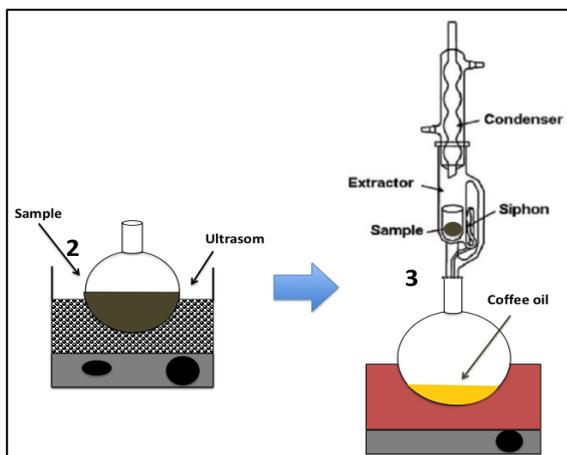


Figure 1. Ultrasonic extraction system and Soxhlet

3. Results

The first item evaluated was the yield of the extracted oil, Table 1 shows the oil content obtained from the coffee grounds: control - oil extracted from the raw sludge, without pre-extraction and ultrasound - sample that underwent the pre-extraction process with ultrasound.

Sample	% oil
Control	9.41 ± 0.6
Ultrasonic	14.38 ± 1.19

Table 1. Percentage of oil extracted from spent coffee grounds

Data are means ± SD (n = 3).

With such a high yield, the concern becomes the quality of the extracted oil, for which the characterization of the fatty acids obtained in the oil samples was carried out. Table 2 shows the fatty acids identified in the chromatographic analysis - palmitic acid; linoleic acid; oleic acid; stearic acid and eicosanoic acid and the mean values of concentrations of substances with their extraction method and sample standard deviation.

4. Conclusion

From the analysis of the acids present in the extracted oil samples it is observed that the use of ultrasound increases the extraction yield by approximately 50%. The ratio between the acids obtained in the samples is similar. In the control sample palmitic acid is much larger, the ultrasonic method presented the highest concentration of linoleic acid in comparison to control sample, whereas the other acids (oleic, stearic and eicosanoic) the concentrations were similar. Linoleic acid is a polyunsaturated acid that has advantages for human consumption, due to the great amount of nutraceutical compounds besides being used

Fatty acids (% TFAs) according the treatment					
	Ácido palmitico	Ácido linoleico	Ácido oleico	Ácido esteárico	Ácido eicosanoico
control	0,5±0,05	0,16±0,05	0,11±0,01	0,11±0,01	0,03±0,002
ultrasonic	0,43±0,01	0,38±0,10	0,11±0,006	0,08±0,01	0,01±0,01

Table 2. Averages of concentration of Acids identified by CG-MS in oil extracted from control and ultrasonic.

successfully in the cosmetics industry due to its emollient capacity.

The results confirm the high potential of the use of ultrasound in the pre-extraction of oil from spent coffee grounds.

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