VALORIZATION OF A BY-PRODUCT FROM THE PROCESSING OF RED AND YELLOW CATURRA VARIETY ARABICA COFFEE: PROXIMAL CHARACTERIZATION, CAROTENOID EXTRACTION AND APPLICATION IN A FUNCTIONAL FOOD

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INTRODUCTION

Most benefits of coffee have been found in its beverage; however, processing by-products have been reported as source of compounds of high value. Some or those compounds are phenolic compounds, alkaloids as caffeine, and carotenoids as β-carotene and lutein. This group of molecules find diverse applications in the food and cosmetic industry due to their antioxidant and pro-vitamin A properties (Shete & Quadro, 2013).

Ultrasound-assisted extraction (UAE) is a non-conventional method that uses acoustic cavitation, to break the cell wall of the biomass, and improve the contact between the solvent and the pigments (Ordóñez-Santos et al., 2015). The incorporation of carotenoids into a food is limited by their chemical instability. One way to decrease these potential effects is through microencapsulation (Savic et al., 2022).

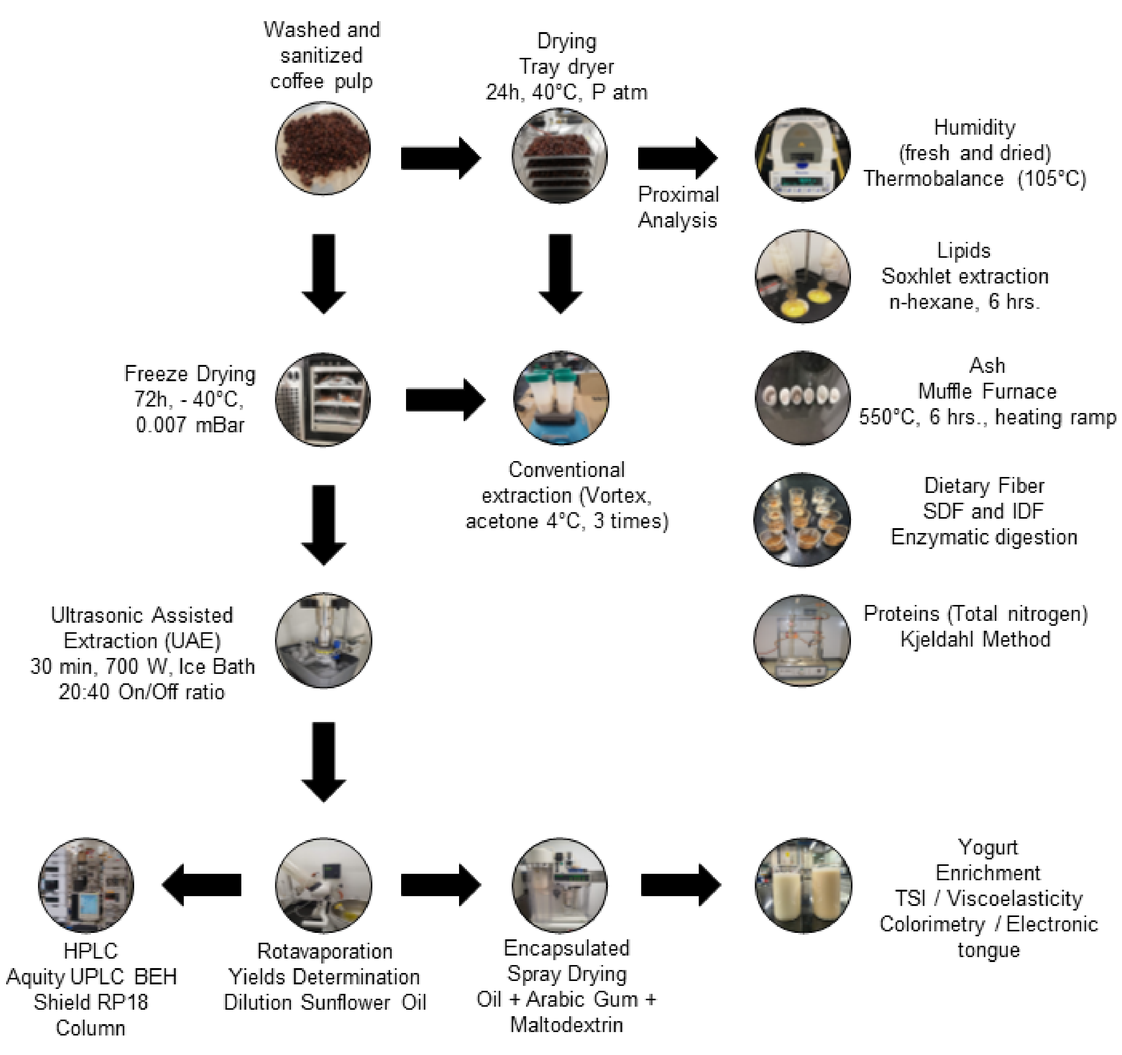
One of the ways to take advantage of this encapsulated extract is by adding it in the formulation of a functional food. This makes it possible to add beneficial health properties to some foods that are widely consumed by people.

OBJECTIVE

In this study, the proximal analyses of red and yellow coffee pulp, as well as the determination of the total carotenoids content, comparing two drying methods (dehydration vs. freeze-drying) were carried out. For carotenoid extraction, a 2^3 factorial design using ultrasound assisted extraction was assessed.

MATERIALS AND METHODS

The proximal characterization of coffee pulp was carried out and the extraction conditions that maximized the content of carotenoids extracted from the pulp were determined using a three-factor factorial experimental design: i) pulp color, ii) biomass:solvent ratio (BM:S) and composition of the ethanol:ethyl acetate (E:A) solvent mixture. The extractions were performed by Ultrasound Assisted Extraction (UAE) and the condition with the highest carotenoid extraction was microencapsulated using the spray drying technique and included in the formulation of a yogurt with potential functional properties. This was characterized in terms of flow behavior, stability, color and sensory profile with electronic tongue.



RESULTS AND DISCUSSION

Table 1. Results of the experimental design using ultrasound-assisted extraction: carotenoid concentration in the extracts and extraction yield. .

Color	Ratio BM:S (g/mL)	Ratio E: EA (v/v)	Content of carotenoids (mg β-carotene eq./g DB)	Yield (%)
Yellow	1:20	20:80	2.30^{ab} (0.14)	4.97^{d} (0.44)
	1:20	80:20	2.15^{b} (0.15)	7.52^{bc} (0.03)
	1:40	20:80	2.54^{a} (0.10)	6.85^{cd} (0.48)
	1:40	80:20	2.51^{a} (0.14)	10.85^{a} (0.99)
Red	1:20	20:80	1.53^{c} (0.07)	5.07^{d} (0.44)
	1:20	80:20	1.73^{c} (0.07)	7.89^{bc} (0.67)
	1:40	20:80	1.44^{c} (0.11)	6.68^{cd} (0.47)
	1:40	80:20	1.42^{c} (0.11)	9.56^{ab} (0.50)

Values in parentheses are standard deviations. DB: Dry Base. For the same column, values with different letters indicate statistically significant differences ($p<0.05$) according to Tukey's test. n=3 for carotenoid content. n=2 for yield.

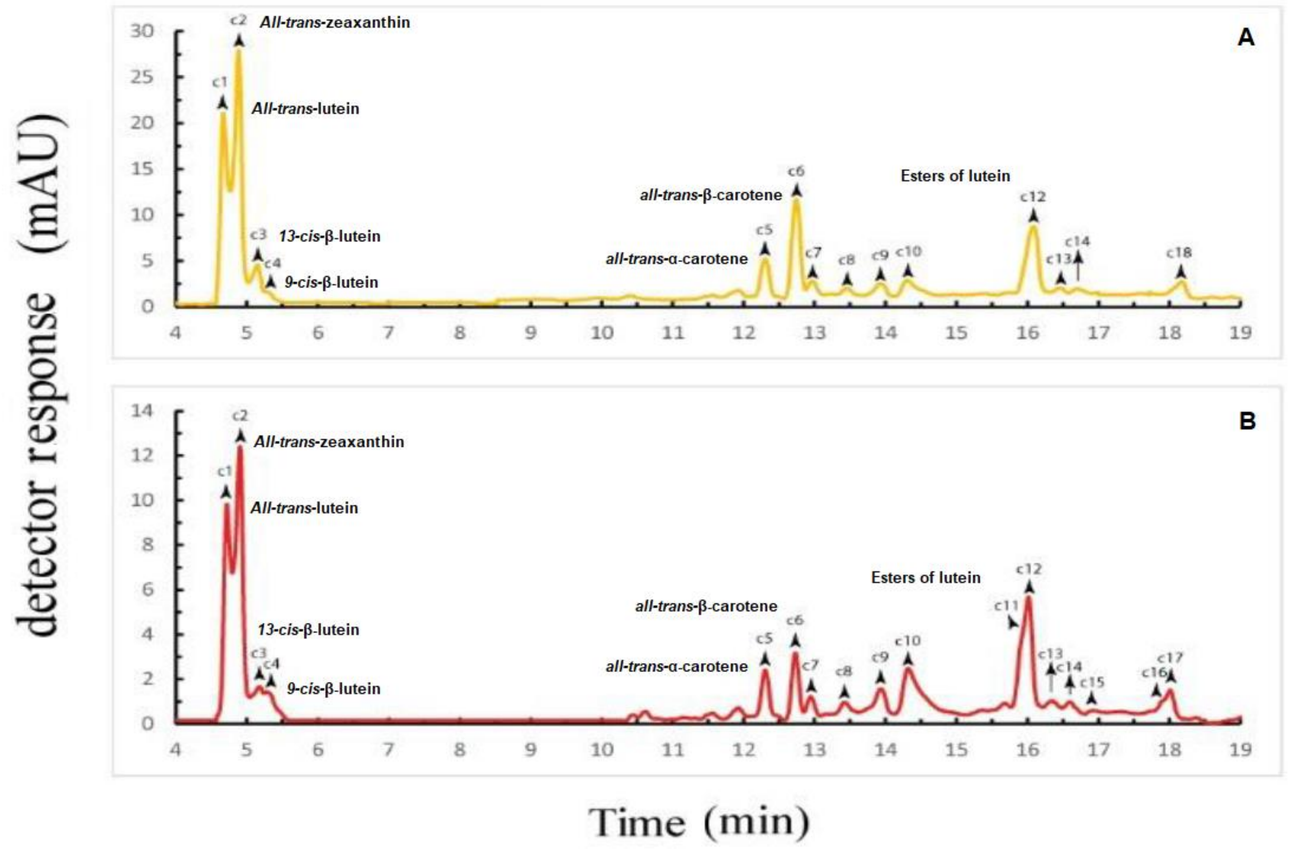


Figure 1. Chromatograms obtained by RP-UHPLC-DAD of carotenoids extracted from agro-industrial wastes at 450 nm. (a) Yellow coffee pulp; (b) Red coffee pulp.

CONCLUSION

The highest concentration of carotenoids extracted by the non-conventional method was 2.54 ± 0.1 mg β-carotene eq./g dry matter, being 76.37% higher with respect to conventional extraction. The encapsulation process allowed 66.96 ± 1.33% of the carotenoids in the emulsion to remain in the powder, demonstrating the feasibility of encapsulation using spray drying. The results obtained in this study present an alternative solution for the use of coffee agroindustry by-products in Colombia and the world.

REFERENCES

Ordóñez-Santos, L. E., Pinzón-Zarate, L. X., & González-Salcedo, L. O. (2015). Optimization of ultrasonic-assisted extraction of total carotenoids from peach palm fruit (Bactris gasipaes) by-products with sunflower oil using response surface methodology. Ultrasonics Sonochemistry, 27, 560–566. https://doi.org/10.1016/j.ultsonch.2015.04.010

Savic, I. M., Savic Gajic, I. M., Milovanovic, M. G., Zerajic, S., & Gajic, D. G. (2022). Optimization of Ultrasound-Assisted Extraction and Encapsulation of Antioxidants from Orange Peels in Alginate-Chitosan Microparticles. Antioxidants, 11(2), 297. https://doi.org/10.3390/antiox11020297

Shete, V., & Quadro, L. (2013). Mammalian Metabolism of β-Carotene: Gaps in Knowledge. Nutrients, 5(12), Art. 12. https://doi.org/10.3390/nu5124849