Obtention of menthol and luteolin powders using spray-drying for the formulation of instant aromatic beverages

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INTRODUCTION

Aromatic plants represent about 0.7% of all medicinal plants. The most common are spearmint (main active ingredient: menthol) and chamomile (main active ingredient: flavonoids such as luteolin), which are usually consumed in "tea bags" to make infusions or herbal teas (Castro M., *et al*., 2005). However, the use of these bags means that their preparation time is relatively long, waste is generated and there is a high proability of ingesting microplastics and nanoplastics (Hernandez, *et al*., 2019).

OBJECTIVE

To obtain powders encapsulating menthol and luteolin as instant aromatic beverages, and to evaluate their potential to replace the conventional preparation of this type of beverages by analyzing their intrinsic, imaging and *in vitro* digestion properties.

MATERIALS AND METHODS

Four powder formulations were made. *In vitro* digestion fluids (salivary, gastric and intestinal) were simulated with Minekus *et al*. (2014) methodology. Figure 1 shows the methods used along the study.

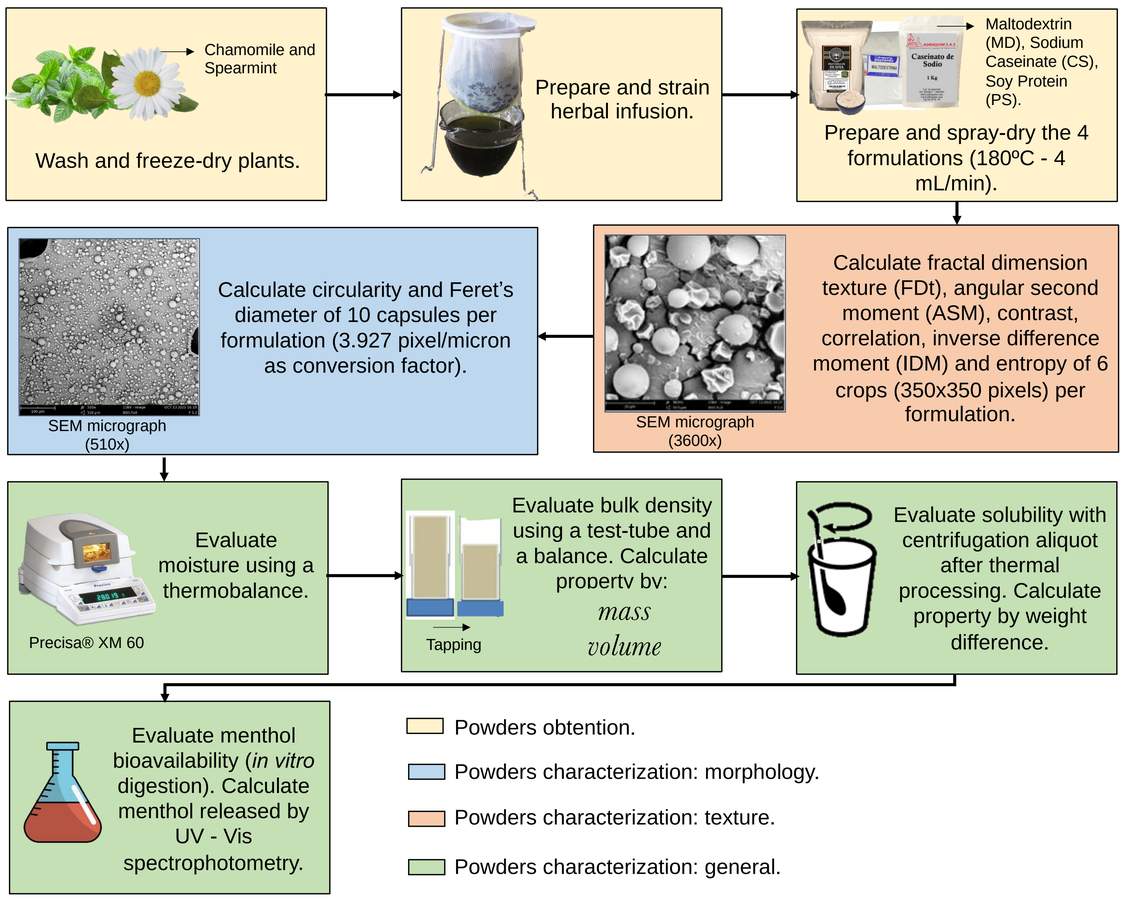

Figure 1. Methodology followed for the menthol-luteolin powders.

RESULTS AND DISCUSSION

The satistical analysis used for all the collected data was Tukey's test in Minitab® for factorial DOE. The formulations obtained are presented in Figure 2.

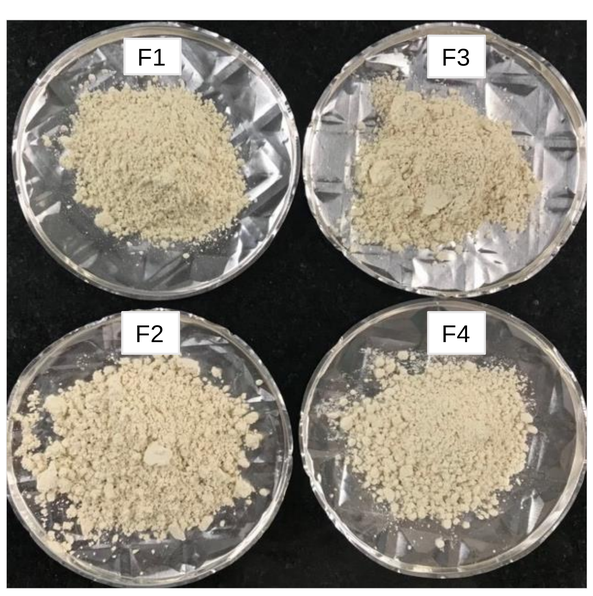

Figure 2. Powder formulations obtained.

Image analysis showed (Table 1 and 2):

- F1 presented better values of circularity → Higher values = more regular shape, and moisture → Lower values have special interest for food safety.
- F2 presented better values of ASM, correlation, IDM and entropy → More homogeneous texture.
- F1 and F2 → High adequate solubillity values → Important to reconstitute the powders.

Table 1. Tukey results for the I characterization tests of powders.

Formulation	Material No.2	%w/w	Solubility (%)	Moisture (%)	Bulk Density (g/mL)	Circularity	Feret's diameter (micron)
F1	MD + CS	10	97.73^{b*} (0.76)	2.69^{a} (0.53)	0.250^{b} (0.020)	0.927^{a} (0.012)	13.87^{c} (0.68)
F2	MD + PS	10	$98.07^{a,b}$ (0.50)	2.71^{a} (0.21)	0.302^{a} (0.046)	0.926^{a} (0.011)	$15.89^{b,c}$ (0.79)
F3	MD + CS	15	$97.99^{a,b}$ (0.20)	3.11^{a} (1.42)	0.248^{b} (0.07)	0.878^{b} (0.024)	19.23^{a} (2.003)
F4	MD + PS	15	98.29^{a} (0.29)	2.78^{a} (1.28)	$0.291^{a,b}$ (0.038)	0.895^{b} (0.012)	$17.88^{a,b}$ (1.16)

The values in parentheses represent the standard deviation.
*For the same column, different letters indicate the existence of statistically significant differences according to the Tukey test (p<0,05)

Table 2. Tukey results for the II characterization tests of powders.

Formulation	Material No.2	%w/w	Entropy	IDM	FDt	Correlation	Contrast	ASM
F1	MD+CS	10	$7.60^{a,b*}$ (0.35)	$0.156^{a,b}$ (0.022)	2.52^{a} (0.03)	2.00×10^{-3} ^{a} (9.4×10^{-4})	182.385^{a} (18.78)	6.83×10^{-4} ^{a,b} (2.05×10^{-4})
F2	MD+PS	10	7.33^{b} (0.41)	0.172^{a} (0.027)	2.53^{a} (0.14)	2.33×10^{-3} ^{a} (8.6×10^{-4})	$158.923^{a,b}$ (30.69)	8.51×10^{-4} ^{a} (2.49×10^{-4})
F3	MD+CS	15	7.87^{a} (0.28)	$0.151^{a,b}$ (0.031)	2.50^{a} (0.06)	1.67×10^{-3} ^{a} (5.4×10^{-4})	136.645^{b}(33.26)	5.21×10^{-4} ^{b} (1.55×10^{-4})
F4	MD+PS	15	$7.84^{a,b}$ (0.26)	0.133^{b} (0.015)	2.50^{a} (0.02)	1.99×10^{-3} ^{a} (6.8×10^{-4})	193.148^{a} (13.25)	5.44×10^{-4} ^{b} (1.68×10^{-4})

The values in parentheses represent the standard deviation.
*For the same column, different letters indicate the existence of statistically significant differences according to the Tukey test (p<0,05)

Bioavailability analysis showed:

- F1 was the best formulation → allowed 9.36% of menthol to be released into the simulated intestinal fluid (SIF).
- F2 allowed 4.37% of menthol to be released into the SIF.
- Only difference between F1 and F2 is wall material No. 2 → Possibility: CS present in F1 retained menthol better than PS during gastric phase (SGF) → Main reason: pH in SGF is below the isoelectric point of CS producing its denaturation, becoming it insoluble (Sobel, *et al*., 2014).

CONCLUSION

It was possible to encapsulate the spearmint and chamomile infusion by spray-drying for the 4 formulations evaluated. F1 and F2 presented the best performance in the properties analyses (image analysis, moisture, *in vitro* digestion). This data suggest the potential of these powders not only as an easy-to-consume and eco-friendly instant aromatic beverage, but also as a functional one.

REFERENCES

Castro M., M.J., Ricaurte C., C.E., & Quijano Parra, A. (2005). Determinación de metales en las estructuras del diente de león (*Taraxacum officinalis weber*), hierbabuena (*Mentha piperita*) y manzanilla (*Matricaria chamomilla*). *Bistua: Revista de la Facultad de Ciencias Básicas, 3*(1), 38-44.

Hernandez, L.M., Xu, E.G, Larsson, H.C.E, Tahara, R., Maisuria, V.B., & Tufenkji, N. (2019). Plastic Teabags Release Billions of Microparticles and Nanoparticles into Tea. *Environmental Science & Technology, 53*(21), 12300-12310.

Minekus, M., Alminger, M., Alvito, P., Ballance, S., Bohn, T., Bourlieu, C., Carrière, F., Boutrou, R., Corredig, M., Dupont, D., Dufour, C., Egger, L., Golding, M., Karakaya, S., Kirkhus, B., le Feunteun, S., Lesmes, U., Macierzanka, A., Mackie, A., . . . Brodkorb, A. (2014). A standardised static in vitro digestion method suitable for food – an international consensus. *Food Funct.*, *5*(6), 1113–1124.

Sobel, R., Versic, R., & Gaonkar, A. G. (2014). Introduction to Microencapsulation and Controlled Delivery in Foods. *Microencapsulation in the Food Industry*, 3–12.