Evaluation of bioactive compounds and antioxidant activity in functional Arabica coffee extract

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Introduction

Brazil is the world's largest producer of Arabica coffee beans and is the second largest market of coffee.[1] Brazilian coffee crops have exceptional flavors and aromas, but there is a gap in country in the development of specialties based on this beverage. Recent discoveries about the functional benefits of coffee are some of the factors that strengthen the need to search for processing alternatives and pave the way for new opportunities in exploring the potential of the beverage.[2] The coffee consumption, independent of caffeine intake, is associated lower risk of diabetes,[3] Alzheimer diseases.[4] In vitro and animal studies attributing these beneficial properties to antioxidant and chlorogenic acid compounds.[5] This work reports the bioactive compounds investigation (chlorogenic acids, caffeine, total phenolics) and the antioxidant activity of the fluid coffee extract produced under mild conditions and fortified with green coffee extract.

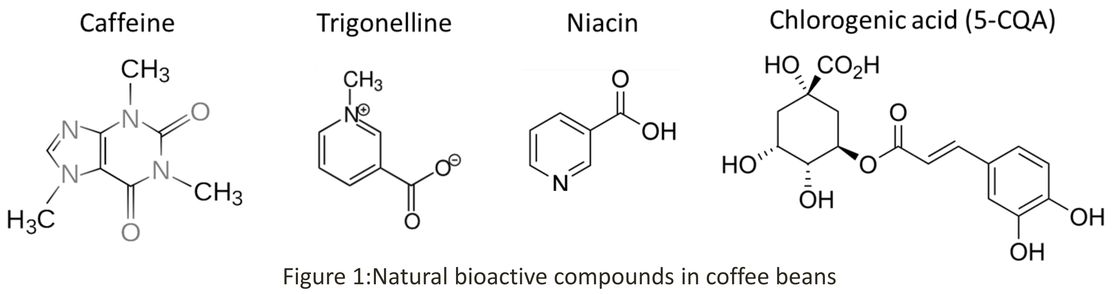


Figure 1:Natural bioactive compounds in coffee beans

Methodology

The extraction by maceration was made at room temperature and vegetal residue was separated by simple filtration. The pre-concentration was performed by microfiltration and reverse osmosis was performed to achieve the desired product concentration. The physical-chemical analysis (pH, brix, soluble solids content, total titratable acidity, centesimal composition) were performed in triplicate and the results were expressed by the mean and estimated standard deviation. The qualitative phytochemical profile were performed by thin layer chromatography. Bioactive compounds, chlorogenic acids and caffeine, were determined by HPLC, total phenolic content by Folin-Ciocalteu assay and the antioxidant activity by DPPH assay. Figure 2 shows an overview of the process used to produce the functional coffee extract.

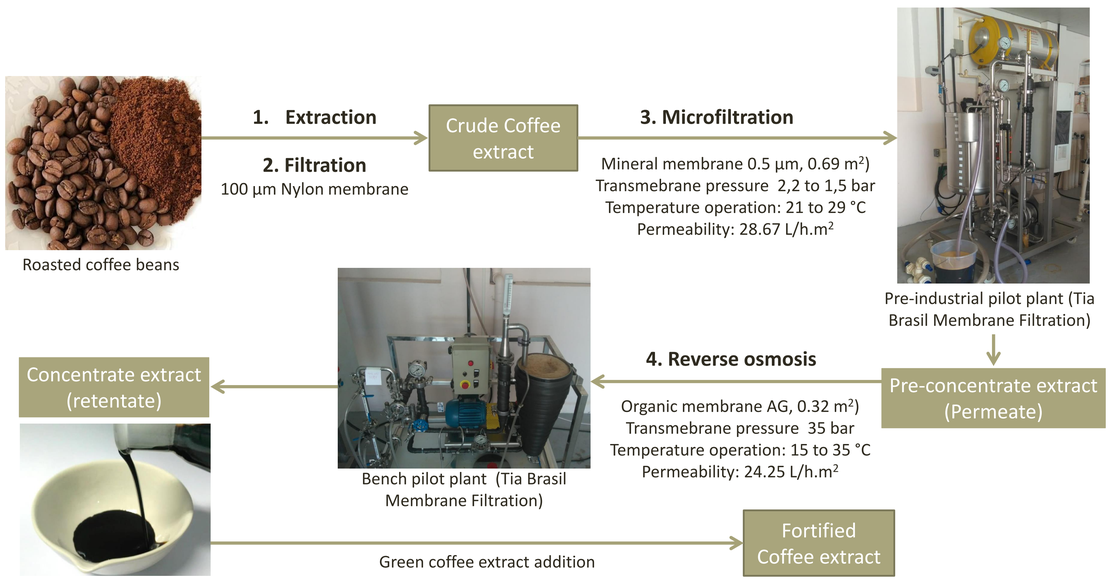


Figure 2: Overview of the process used to produce the functional coffee extract.

Results and Discussion

Physicochemical characteristics and bioactives contents were determined comparing obtained results for raw material (CB) crude extract (EB), concentrated extract (EC) and fortified extract (EE). The pre-concentration was performed at low pressure to remove large molecular weight suspended or colloidal compounds from dissolved solids by microfiltration, with volumetric concentration factor of 3.98. Reverse osmosis was performed at high pressure and with maximum of energy efficiency to concentrate low molecular weight compounds to produced fluid coffee extract from Arabica beans, with a volumetric concentration factor of 3.25. The extraction and concentration process at room temperature preserve coffee bioactive compounds (Figure 2).

Table 1: Centisimal composition resultos of roasted coffee beans (CB) , crude extract (EB) and conentrated extract (EC)

Centesimal composition (g/ 100 mL)	CB	EB	EC
Moisture and volative	0,75 ± 0,03	94,56 ± 0,01	85,95 ± 0,00
Total ash	5,43 ± 0,03	1,46 ± 0,00	3,97 ± 0,04
Proteins	17,52 ± 0,28	1,36 ± 0,03	4,06 ± 0,01
Carbohydrates[a]	65,32	5,62	15,02
Lipids	10,98 ± 0,28	< 0,10	< 0,10

[a] Calculated by difference: 100 - (g/100 g moisture + g/100 g ash + g/100 g lipids + g/100 g protein).

Table 2: Physical atributes of crude extract (EB) and conentrated extract (EC)

Physical atributes	EB	EC
Density (g/mL)	1,03 ± 0,01	1,09 ± 0,02
° Brix	7,6 ± 0,03	24,2 ± 0,01
pH (100 %)	5,95 ± 0,01	5,60 ± 0,01
Total soluble solids (g/ 100 mL)	5,44 ± 0,01	14,05 ± 0,00
Tritible acidity mL NaOH/g	4,22 ± 0,05	16,22 ± 0,01

Table 3: Chemical qualities of roasted coffee beans (CB) , crude extract (EB) , conentrated extract (EC) and fortified extract (EE)

Chemical qualities	CB	EB	EC	EE
Caffeine (g/100 mL)	0,78 ± 0,03	0,61 ± 0,01	0,51 ± 0,01	0,60 ± 0,01
Chlorogenic acid (g/ 100 mL)	0,02 ± 0,00	0,12 ± 0,00	0,29 ± 0,01	0,39 ± 0,01
Total phenolic (g/ 100 mL)	3,60 ± 0,56	0,77 ± 0,08	2,12 ± 0,02	2,67 ± 0,01
DPPH assay (g DPPH/ L)			549 ± 0,02	1095 ± 0,11

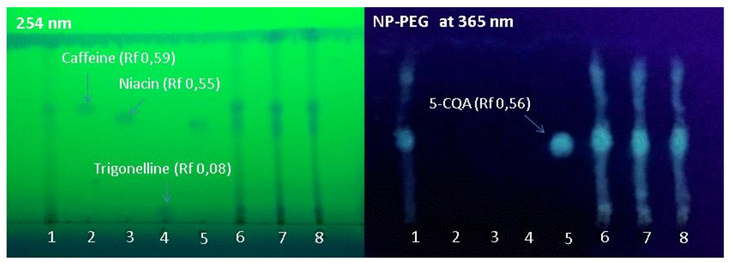


Figure 2: TLC profile of natural bioactive compounds in coffee extracts. 1 - Roasted coffee beans extracted with ethanol 50 % v/v (CB); 2 - Caffeine, 3 - Niacin; 4 – Trigonelline; 5 – 5-CQA; 6 - crude extract (EB) , 7 - conentrated extract (EC) and 8 - fortified extract (EE). Standards concentration are 10^{-3}M. Mobile fase ethyl acetate-acetic acid-formic acid-water 100:11:11:27 (v/v/v/v).

Conclusion

The extraction and concentration process carried out under mild temperature conditions, preserve natural coffee bioactive compounds and resulted in an extract with low acidity and less caffeine content. The fortified extract is three times richer in phenolic compounds and chlorogenic acid, resulting in an antioxidant activity two times higher than the concentrated extract. These results suggest that the fortified fluid extract of coffee have functional characteristics and thus may be an alternative for those who suffer from gastrointestinal symptoms.

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