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COMPARATIVE QUANTITATIVE ANALYSIS OF SOME CLASSES OF BIOACTIVE COMPOUNDS IN SOME COFFEE SORTIMENTS AVAILABLE ON THE ROMANIAN MARKET

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ABSTRACT

Five import coffee sortiments (Brazil & Vietnam mix, Cuba Serrano Lavado, Kenya AA, Panama Boquete SHB, Peru Perhusa HB) available on the local market were studied for determining the concentrations of, carotenoid, total phenolic and polyphenolic compounds, flavonoids and oil contents in ground roasted coffee and pH of the resulting infusions.
Among the five coffee sortiments, Kenya AA and Cuba Serrano Lavado had the highest amount of carotenoids (288, respectively 259 mg/kg).
Total phenolic compounds had the highest concentrations in Cuba Serrano Lavado (15,274 mg/kg), followed by Kenya AA and Peru HB, with over 14,000 mg/kg. Of these, flavonoids constituted only a small fraction, with the maximum value in Peru HB (1,374 mg/kg). Total oil concentrations were highly variable, with a maximum in Panama SHB (98,400 mg/kg) and minimum in Kenya AA (26,400 mg/kg).
pH values were similar, acidic, for all coffees, ranging between 4.28-4.75.

INTRODUCTION

Coffee is one of the most sold commodities worldwide. Coffee exports in 2017, for instance, reached a total value of $19 billion, while the retail market value was $83 billion. Coffee trees are grown on over 12 million farms and coffee industry provides around 125 million jobs. The most popular usage is in hot and cold drinks, due to their energizing and aromatic properties (Voora et al., 2019).

Coffee is produced from the roasted and ground seeds of the coffee tree. Native of East Africa and South Arabia, the *Coffea* genus (Fam. Rubiaceae) has two main cultivated species, *C. arabica* L. and *C. canephora* Pierre ex A. Froehner (syn. *C. robusta*). While arabica coffee is considered more flavoured, robusta has an average caffeine content almost two times higher. Today, there are numerous different cultivars of the two species, as well as hybrid cultivars. Most coffees consumed are produced from blends of seed material from (DAFF 2012).

Coffee is known for high contents of bioactive compounds, apart from caffeine.

Carotenoids (including carotenes, lutein, lycopene, zeaxanthin) are accessory photosynthetic pigments. They are key to biosynthesising retinol and melanin, essential for human eye and skin health. They are also effective antioxidant and antiproliferative compounds (Eldahshan & Singab 2013).

Phenolic compounds are a wide group of chemicals, working as pigments, antimicrobial and antifungal agents in plants. Flavonoids, phenolic acids and tannins are included in this class (Kivrak & Kivrak 2014). For human consumers, they are the most important class of antioxidants, redicung agents, radical scavengers and lipid oxidation inhibitors (Zymonė et al. 2018).

Flavonoids (a class of low-mass polyphenols) are among the most valuable phenolic compounds, having antibacterial, antifungal, antiviral, antioxidant, anti-inflammatory and antiproliferative properties (Kivrak & Kivrak, 2014).

Coffee seeds are known to be rich in oils. Coffee oil is a complex mixture, which, like in many oleaginous seeds, is dominated by triglycerides (75%), based mostly on linoleic and palmitic fatty acids. Besides triglycerides, free fatty acids, sterols, waxes, ceramides, tocopherols (vitamin E), and aromatic volatile oils make up the remaining fraction. Among aromatic oils, two diterpenes are dominant: kahweol and canestol, known to protect human organism against certain carcinogens (however, they also increase blood cholesterol; Al-Asmari et al., 2020).

The objective of this paper was to assess and compare the content of the above-mentioned classes of compounds in some blends of imported coffee available to Romanian consumers.

MATERIAL AND METHODS

Five types of coffee blends were acquired from local commerce.

Brazil and Vietnam mix was composed of a mixture of arabica coffee from Brazil (Bourbon, Typica and Caturra cultivars) and robusta from Vietnam.

Cuba Serrano Lavado was a blend of arabica coffee produced in the Sierra Maestra mountain range in Cuba.

Kenya AA is the top quality coffee according to the Kenyan grading system. It is mostly produced from three arabica varieties, SL 28, SL 34 and Bourbon.

Panama Boquete SHB derives from a mix of two arabica cultivars, Typica and Caturra, grown in the Boquete region, Panama.

Peru Perhusa HB is also a blend of arabica coffee produced from three cultivars, namely Caturra, Typica and Bourbon.

Carotenoids were determined by extracting ground coffee in 80% acetone, filtration and reading spectrophotometric absorption (S106 WPA spectrophotometer) at 470 (Popoviciu et al., 2020). Concentrations were calculated according to Lichtenthaler & Buschmann (2001).

Flavonoids were assessed by water: methanol (4:8) extraction and reading spectrophotometric absorption at 340 nm (Szabo et al. 2012, Popoviciu et al. 2020).

The total concentration of phenolic compounds was determined by extracting ground coffee in methanol and reaction with Folin-Ciocâlteu reagent (10%) and sodium bicarbonate (7.5%) for 30 minutes. Absorbance was read at 765 nm. Standard gallic acid concentrations were used for the calibration curve (Stanković 2011, Siddiqui et al. 2017, Popoviciu et al. 2020).

Flavonoids were determined by extraction in water : methanol (4:8) mixture and reading spectrophotometric absorption at 340 nm (Szabo et al. 2012, Popoviciu et al. 2020).

Essential oils were determined by gravimetry. Ground coffee was extracted in petroleum ether (25 g per 5 g tissue). Solvent was evaporated at 35°C and the remaining residue weighed (Orphanides et al. 2011).

pH of infusions was determined by brewing of 5 g ground coffee in 50 mL boiling water for 10 minutes (Rao & Fuller 2018). The pH values were determined by using a HI98103 pH tester (Hanna Instruments).

RESULTS AND DISCUSSIONS

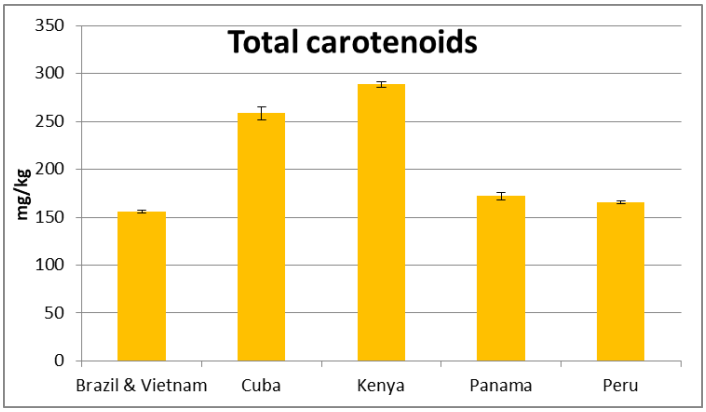

Figure 1. Concentrations of total carotenoids in selected coffee types (average values; mg/kg DW).

Among the five coffee blends Kenya AA had the highest carotenoid levels (288 mg/kg), followed by Cuba Serrano Lavado (259 mg/kg) types, while the remaining ones had below 200 mg/kg (minimum, Brazila and Vietnam mix, 156 mg/kg; Fig. 1).

Carotenoid concentrations are highly dependent on species and cultivar. While values around 200 mg/kg are common in arabica coffee, some robusta cultivars can reach up to 1,500 mg/kg. Lutein and zeaxanthin are known to be the dominant carotenoids; through roasting, they produce ionols, compounds important for coffee flavour (Degenhardt et al., 2006).

Total phenolics varied between 10,141 (Panama) and 15,274 (Cuba) mg/kg (Fig. 2). Kenya AA and Peru HB also had high values (over 14,000 mg/kg). Of these polyphenols, only a small fraction was made up of flavonoids, ranging from below detection limit (Kenya) to 1,374 mg/kg (Peru). The phenolic inventory of coffee is also highly variable and dependent on variety and processing. A study on several arabica cultivars, for instance, found 28,000-40,000 mg/kg total soluble phenolics (4,000-6,200 mg/kg flavonoids; Mehari et al., 2020). However, various processing stages, such as roasting are known to significantly lower these concentrations (Asfaw & Tefera, 2020).

Total oil concentrations showed a major variation, between 26,400 (Kenya AA) and 98,400 mg/kg (Panama Boquete SHB; Fig. 3). Processing also leads to a drop in oil content, which in green coffee beans usually reaches 70,000-170,000 mg/kg (Speer & Kölling-Speer 2006).

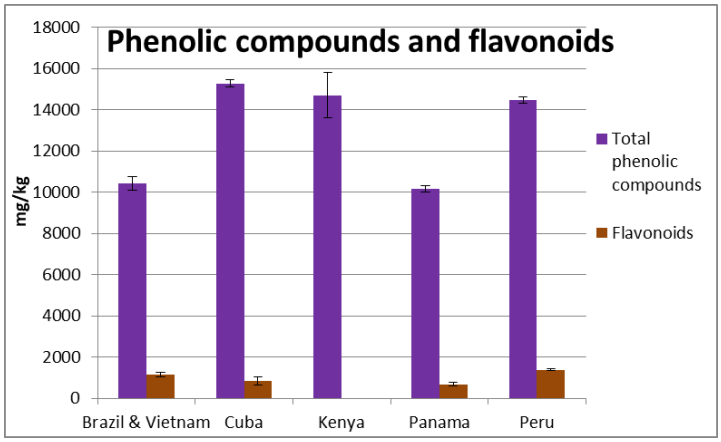

Figure 2. Concentrations of total phenolic and polyphenolic compounds and of flavonoids in selected coffee types (average values; mg/kg)

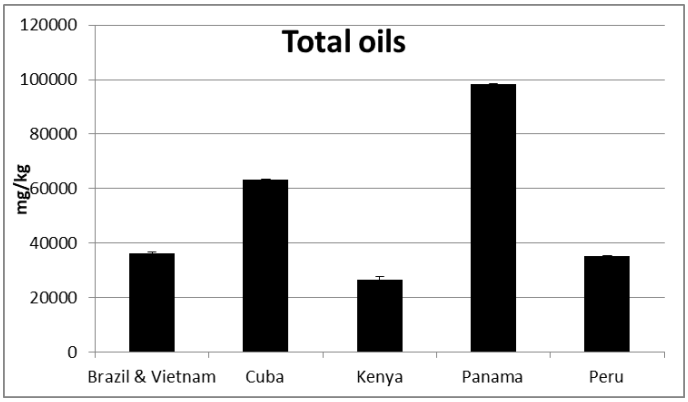

Figure 3. Concentrations of total oils in selected coffee types (average values; mg/kg).

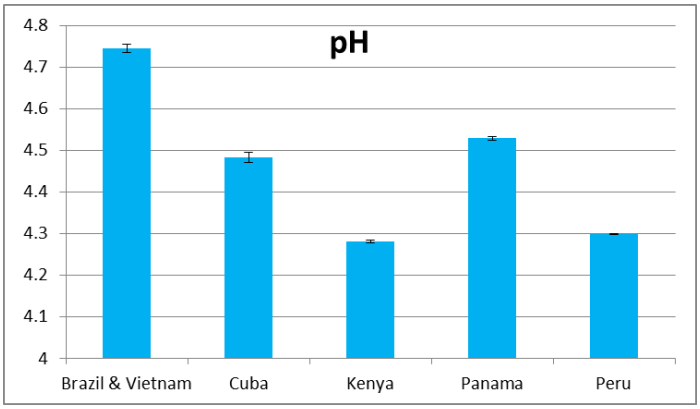

Figure 4. pH values for selected coffee types (average values).

pH values were acidic for all types of coffee (4.28 Kenya AA-4.75 Brazil and Vietnam mix; Fig. 4). Acidity is relevant, among other reasons, because long term consumption of acidic drinks can lead to gastrointestinal disorders and the corrosion of dental enamel. While any drink with a pH lower than 7 can aggravate heartburn symptoms in some people, the critical value for enamel demineralization is 5.5 (Akyuz & Yarat 2010, Rao & Fuller 2018). All analyzed coffees were below this threshold, thus requiring attention in consumption.

CONCLUSIONS

Among the five coffee sortiments, Kenya AA and Cuba Serrano Lavado had the highest amount of carotenoids (288, respectively 259 mg/kg).

Total phenolic compounds had the highest concentrations in Cuba Serrano Lavado (15,274 mg/kg), followed by Kenya AA and Peru HB, with over 14,000 mg/kg. Of these, flavonoids constituted only a small fraction, with the maximum value in Peru HB (1,374 mg/kg). Total oil concentrations were highly variable, with a maximum in Panama SHB (98,400 mg/kg) and minimum in Kenya AA (26,400 mg/kg).

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REFERENCES

Akyuz S., Yarat A. 2010. The pH and neutralisable acidity of the most-consumed Turkish fruit and herbal teas. Oral Health and Dental Management in the Black Sea Countries, 9(2): 75-78.

Al-Asmari K.M., Abu Zeid I.M., Al-Attar A.M. 2020. Medicinal properties of Arabica coffee (Coffea arabica) oil: An overview. Adv. Life Sci., 8(1): 20-29.

Asfaw G., Tefera M. 2020. Total polyphenol content of green, roasted and cooked Harar and Yirgacheffee coffee, Ethiopia. J. Appl. Sci. Environ. Manage., 24(1): 187-192.

Department of Agriculture, Forestry and Fisheries 2012, Production guideline: Coffee. Department of Agriculture, Forestry and Fisheries, Republic of South Africa, Pretoria, pp. 28.

Degenhardt A., Preininger M., Ullrich F. 2006. Carotenoids as flavour precursors in coffee. Dev. Food. Sci., 43: 379-382.

Eldahshan O.A., Singab A.N.B. 2013. Carotenoids. J. Pharmacogn. Phytochem., 2(1), 225-234.

Kivrak I., Kivrak S. 2014. Antioxidant properties, phenolic profile and nutritional value for Sorbus umbellata fruits from Turkey. Austin J. Nutr. Food Sci., 2(8), 1043-1048.

Lichtenthaler H.K., Buschmann C. 2001. Chlorophylls and carotenoids: Measurement and characterization by UV-VIS spectroscopy. In Wrolstad R.E. (ed.), Current Protocols in Food Analytical Chemistry, John Wiley & Sons Inc., Hoboken, F4.3: 1-8.

Mehari B., Chandravanshi B.S., Redi-Abshiro M., Combrinck S., McCrindle R., Atlabachew M. 2020. Polyphenol contents of green coffee beans from different regions of Ethiopia. Int. J. Food Prop., 24(1): 17-27.

Orphanides A., Goulas V., Chrysostomou M., Gekas V. 2011. Recovery of essential oils from carobs through various extraction methods. In Mastorakis N., Mladenov V., Lepădătescu B., Karimi H.R., Helmis C.G. (eds.), Recent Advances in Environment, Energy Systems and Naval Science, WSEAS Press, Athens, 219-224.

Popoviciu D.R., Ionașcu D.C., Bercu, R., 2020. Comparative quantitative analysis of some classes of bioactive compounds in six green tea types available on the Romanian market. Ann. Univ. Craiova, Ser. Biol. Hortic. Food Prod. Process. Environ. Eng., 25(61): 167-172.

Rao N.Z., Fuller M. 2018. Acidity and antioxidant activity of cold brew coffee. Scientific Reports, 8, doi: 10.1038/s41598-018-34392-w.

Siddiqui N., Rauf A., Latif A., Mahmood Z. 2017. Spectrophotometric determination of the total phenolic content, spectral and fluorescence study of the herbal Unani drug Gul-e-Zoofa (Nepeta bracteata Benth). J. Taibah Univ. Med. Sci., 12(4), 360-363.

Speer K., Kölling-Speer I. 2006. The lipid fraction of the coffee bean. Braz. J. Plant Physiol., 18(1): 201-216.

Stanković M.S. 2011. Total phenolic content, flavonoid concentration and antioxidant activity of Marrubium peregrinum L. extracts. Kragujevac J. Sci., 33, 63-72.

Szabo I., Vonhaz G., Fodor A., Bungău S., Țiț D.M. 2012. The quantitative analysis through spectrophotometry of flavonoids and polyphenols from vegetable products Hibisci trioni herba, radix and fructus. Analele Univ. Oradea, Fasc. Protecția Mediului, 18, 73-80.

Voora V., Bermúdez S., Larrea C., Baliño S. 2019. Global market report: Coffee. International Institute for Sustainable Development, Winnipeg, pp. 6.

Zymonė K., Raudonė L., Raudonis R., Marksa M., Ivanauskas L., Janulis V. 2018. Phytochemical profiling of fruit powders of twenty Sorbus L. cultivars. Molecules, 23, 2593-2609.