Evaluation of antioxidant capacity and total polyphenol content of some coffees

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Abstract

Purpose of this work was to determine the antioxidant capacity and total polyphenol content for a few coffees on the Romanian market. We studied four types of coffee: Arabica instant - premium category, Arabica ground, vacuum packaging - economic category, Arabica ground, vacuum packaging - premium category, Arabica powder - bulk. Antioxidant capacity was evaluated by the CUPRAC method and polyphenols were determined by the Folin-Ciocâlteu method. The highest antioxidant capacity showed the sample of Arabica ground, vacuum packaging - premium category (0.434 mM Trolox/l). The lowest antioxidant activity presented the sample of Arabica ground, vacuum packaging - economic category (0.258 mM Trolox/l). In terms of total polyphenol content the sample with the highest concentration is also ground Arabica, vacuum packaging - premium category (0.196 mg gallic acid/l) and the lowest content of total polyphenols was found in coffee with the lowest antioxidant activity - ground Arabica, vacuum packaging - economic category (0.177 mg gallic acid/l).

Key words: coffee, antioxidant capacity, CUPRAC method, polyphenol, Folin-Ciocâlteu method.

1. Introduction

Coffee belongs to the genus *Coffea*, Rubiaceae family and includes a large number of species, most from African countries, only some of which shows the economic interest. Of all the only two shows greater interest and are grown most: *Coffea Arabica* (arabica) and *Coffea Canephora* (robusta) [1,2].

Arabica coffee is grown for a long time and is most prevalent. Production in Central America and South America, which represents 60% of the world is Arabica coffee. Robusta coffee is very much cultivated in tropical Africa and in Indonesia [2]. Coffee is grown in about 80 tropical and subtropical countries from grade 23 to grade 25 north latitude, the so-called cordon coffee [1]. Coffee is characterized by a very complex chemical composition. It contains: 2-3% water, 5% nitrogenous substances, fatty substances 8-15%, sugars: 6.50% sucrose, 0.70% glucose, 0.30% fructose, nicotinic acid 10 to 17%, 17.6% glutamic acid, caffeine from 0.9 to 20%, amino acids, organic acids, chlorogenic acids, sulfur compounds, minerals 162 mg, of which: 2.8 mg calcium, 1.8 mg iron, 9 mg phosphorus, 40 mg sodium, 10 mg K, 8 mg magnesium. Content and quantity of chemical compounds differ depending coffees species [3,4].

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Coffee is an excellent source of antioxidants, an excellent product and by its consumption can prevent some of the diseases of nowadays. Research has shown that antioxidants in coffee decreases the risk of some cancers, cardiovascular disease and cataracts. Furthermore, coffee has been correlated with reduced incidence of diseases such as type 2 diabetes or Parkinson's disease. Also in sport provide energy and improve endurance performance by sympathetic stimulation and coupling muscle excitation -contraction. Antioxidants in Coffee represents 30% of solid components; 5-7% of them are polyphenols, which act in the fight against skin aging [5-11].

Purpose of this work was to determine the antioxidant capacity of several types of coffee, by CUPRAC method and total polyphenol content (Folin/Ciocalteu method) of them to see which types of coffee is with the highest protective quality.

2. Materials and methods

We have analyzed four samples of coffee, as follows:

A. Arabica instant- premium category.
B. Arabica ground, vacuum packaging- economic category.
C. Arabica ground, vacuum packaging - premium category.
D. Arabica ground- bulk.

For these types of coffee were weighed 1-2 g, was added a volume of 20 ml ethanol 20% and, after 2 hours of extraction, the analyzes were performed.

2.1. Determination of antioxidant activity by CUPRAC method. Principle of CUPRAC method is similar to the FRAP method, except that ferric ion is replaced by cupric ion and ligand which forms colored complex is neocuprine [12]. The absorbance determination was done at 450 nm. The advantage of this method is the linearity in a broader range of concentrations, and that also determines the antioxidant action of the bioactive compounds that contain sulfhydryl group (-SH), such as, for example, proteins.

As a reference substance was used the Trolox (6-hydroxy - 2, 5, 7, 8 – tetramethylchroman - 2 - carboxylic acid), an antioxidant that mimics the structure of vitamin E, but is both fat-soluble and water-soluble (Figure 1.).

![Figure 1. Chemical structure of reagent Trolox](image)

The reagents used in the method of analysis were the following:

- 0.01 M CuCl$_2$ solution,
- Neocuprine alcoholic solution of 7.5 · 10$^{-3}$ M,
- Ammonium acetate buffer solution.

1 ml of cupric solution was mixed with 1 ml of alcoholic solution of ligand and 1 ml acetate buffer. Over this solution was added 1.1 ml solution containing the blank or sample and stirred well. After 30 minutes the absorbance was measured at 450 nm against the blank. The molar absorption coefficient of the Trolox in CUPRAC method is $\varepsilon = 1.67 \cdot 10^4$ l · mol$^{-1}$ · cm$^{-1}$. The results were expressed in mmol Trolox/g of dry matter.

Each coffee sample that was analyzed must be diluted 1:7 in order to determine the antioxidant activity by this method, due to the very high concentration of antioxidants.

2.2. Determination of total polyphenol content by Folin-Ciocalteu method. The method is based on the reducing properties of the polyphenols to the hexavalent molybdenum from the Folin/Ciocalteu reagent [13-14]. Hexavalent molybdenum is partially reduced to the polyphenols in strongly acidic medium to lower states (4, 5), which in an alkaline medium is colored blue and presents absorption bands at about 750 nm [15-16].

The reagents used were as follows:

- Folin-Ciocalteu reagent (FC) 2M, diluted 1:10;
- Solution of sodium carbonate7.5%.

Preparation of calibration curve and samples was done by mixing 2.5 ml FC reagent diluted 1:10 with 0.5 ml of sample or standard solution at concentration of 0.2-0.4-0.6-0.8-1.0-1.2 µM / ml gallic acid. After approx. 10 minutes (the time necessary for the completion of the reduction reaction) was added 2 mL of 7.5% sodium carbonate
solution to neutralize, and alkalinisation of the reaction medium and forming poly-phosphomolybdates reduced, colored in blue. After approx. 2 hours absorbance was read at 750nm. Polyphenol concentration was expressed as gallic acid.

3. Results and discussions

3.1. Antioxidant activity. The results on the antioxidant capacity of the analyzed samples coffee are shown in Figure 2.

The experimental results show that the highest antioxidant capacity presents sample C/ Arabica ground, vacuum packaging / premium category (0.434 mM Trolox/l) followed by sample A/ Arabica instant/ premium category (0.303 mM Trolox/l). The lowest antioxidant activity presents sample B/ Arabica ground, vacuum packaging/ economic category (0.258 mM Trolox/l), ascertaining a direct correlation price- antioxidant activity of coffee.

3.2. Minerals content. The results of the total polyphenol content in the examined samples are shown in Figure 3.

It was found that in terms of total polyphenol content (bioactive compounds with high antioxidant activity) sample with the highest concentration is also C- Arabica ground vacuum packaging - premium category (0.196 mg gallic acid/l), followed by sample A- Arabica instant-premium category (0.186 mg gallic acid/l).

4. Conclusions

Of this research paper the following conclusions can be drawn:

1. Highest antioxidant capacity presents sample C- Arabica ground, vacuum packaging - premium category (0.434 mM Trolox/l); the lowest antioxidant activity presents sample B- Arabica ground, vacuum packaging- economic category (0.258 mM Trolox/l), ascertaining a direct correlation price- antioxidant activity of coffee.

2. Sample with the highest concentration of polyphenols is also C- Arabica ground vacuum packaging - premium category (0.196 mg gallic acid/l); the lowest content of total polyphenols found in coffee with the lowest antioxidant activity/sample B/ Arabica ground, vacuum packaging- economic category (0.177 mg gallic acid/l), observing a directly proportional relationship between total polyphenol content and antioxidant activity of analyzed coffees;

3. Of all analyzed coffees, Arabica ground vacuum packaging - premium category has the highest protective quality, followed by the Arabica instant- premium category. Lowest protective quality had Arabica ground- bulk coffee, observing a relationship of direct proportionality with regard to the quality of food safety- the cost of the coffee;

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