

Antioxidant properties evaluation of some red beet based fresh juices

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Abstract

Consumption of fresh juices obtained from fruits and vegetables is known as a factor that increases vitality and causes beneficial detoxification processes. Another result of consuming fresh juices is rapid healing of damaged body tissues. Among natural juices, a special attention, due to multiple health benefits, is given to red beet juice simply or combined with other vegetable and fruit juices. This paper aimed to analyze content of ascorbic acid, total polyphenols, antioxidant activity of three varieties red beet based fresh juices, compared to raw materials. Fresh juices assortments were obtained as follows: first (FJ1) of red beet, apple, carrot juices (5:3:2; v:v:v), second (FJ2) of red beet, apple, ginger juices (7.8:2:0.2; v:v:v) and third (FJ3), from red beet, apple, carrot and ginger juices (5:2.8:2:0.2; v:v:v:v). All juices were obtained in laboratory from fresh raw materials and no additives were used. Among raw materials used, apples (Jonathan variety) had highest content of vitamin C 12.85 ± 0.32 mg/100g FW, followed by red beet (7.82 ± 0.18 mg/100g FW) while red beet had highest total polyphenol content (8.83 ± 0.18 mg gallic acid/g FW), followed by ginger root (2.81 ± 0.07 mg gallic acid/g FW). In terms of antioxidant activity, red beet stood out with a much higher antioxidant activity than other raw materials: 69.97 ± 0.84 mg Trolox/g FW, followed by carrots with 7.14 ± 0.18 mg Trolox/g FW. Of the three fresh juice assortments, although FJ1 and FJ3 had the highest ascorbic acid content (19.36 ± 0.41 mg/100g and respectively 19.08 ± 0.36 mg/100g), FJ2 variant had the best antioxidant activity (46.43 ± 0.54 mg Trolox/g), being also the richer in polyphenolic compounds (4.23 ± 0.11 mg gallic acid/g).

Keywords: natural juices, antioxidant activity, ascorbic acid, polyphenols, red beet.

1. Introduction

Natural juices from various fruits and vegetables play an important role in human nutrition because they have a high nutritional value, a pleasant taste and aroma, a favorable effect on the exchange of substances in the body, reduce appetite and favor the food assimilation. Fruit and vegetable juices is an important source of energy that ensures the normal performance of daily activities and maintaining health [1,2]. The consumption of juice obtained from fresh fruits and vegetables is known as a factor that increases vitality and causes beneficial detoxification processes. Another result of fresh juices consumption is the rapid healing of damaged body tissues [3].

Red beet (*Beta vulgaris*) is part of the *Chenopodiaceae* family, being a biennial plant, cultivated for its fleshy root used as a vegetable in human nutrition and as a fodder plant [4]. The red beet is the main source of natural red dye, the extract obtained from it being cataloged as beet red and indexed as E162. The main component of this extract is betanin [5]. The beetroot is native to the Mediterranean region and widely cultivated in America, Europe and throughout India. Ferrara [6] reported for red beet a content of: 91% water, 1.10% protein, 4% sugars, 2.60% dietary fiber, 300 mg of potassium, 84 mg sodium, 20 mg calcium, 0.40 mg iron, 21 mg phosphorus, 23 mg magnesium, 0.4 mg zinc, 0.7 μ g selenium, 400-600 mg nitrates, 109 μ g folic acid, 10.5 μ g biotin, 7mg vitamin C, 0.03 mg vitamin B1, 0.02 mg vitamin B2, 0.20 mg vitamin B3, 33 IU vitamin A.

Also, red beet is an important source of polyphenols and carotenoids with very good antioxidant activity [6].

Beetroot juice plays an important role in human nutrition and is widely used. This juice is not only blessed with a beautiful color, but also with nutrients, antioxidants, vitamins and soluble fibers. It has a pleasant taste, quenches thirst and is also used as a natural remedy for the treatment of cancer and to remove stones from the kidneys and gall bladder. Recent studies have proven that the ingestion of beetroot juice offers beneficial effects in the case of high blood pressure, atherosclerosis and type 2 diabetes. The high content of iron in beetroot juice regenerates and reactivates the red blood cells and the copper content makes the iron better assimilated by the body. Also, beetroot juice is indicated in the case of: gastric ulcer, kidney diseases, skin diseases, high cholesterol [7-10].

Ginger (*Zingiber officinale*) is part of the *Zingiberaceae* family and is one of the most important and ancient spices. It has a history of medicinal use dating back 2,500 years in China and India. Ginger has the following chemical composition: starch 60%; protein 10%; fat 10%; fiber 5%; inorganic material 6%; residual humidity 10%; essential oil 1%. Phenolic and terpene compounds were also identified in ginger. Recent studies have highlighted multiple biological actions of ginger: antioxidant, anticancer, anti-inflammatory and antimicrobial properties associated with the potential to prevent and treat conditions such as: cardiovascular diseases, obesity, neurodegenerative diseases, diabetes, respiratory problems [11-14].

Carrots (*Daucus carota*), part of the *Apiaceae* family, were used in the past for medicinal purposes and gradually used as food [15]. Carrot juice is also often called the "miracle juice" due to its numerous health benefits. Carrot juice is rich in carotenoids (especially β - carotene), calcium, potassium and is easier to digest than the raw vegetable. It is among the most popular non-alcoholic beverages. Carrot juice has beneficial effects on health, having anti-carcinogenic, antioxidant and immunosuppressive properties, as well as pro-vitaminic A activity assured by some carotenoids. Due to the high carotenoids content, carrot juice improves vision, protects against cataracts and glaucoma.

Carotenoids are also known to fight cancer and cleanse toxins from the liver and digestive tract. Carrot juice prevents the formation of kidney stones and cleans cholesterol plaque from the walls of the coronary arteries. The juice also helps the body build resistance to germs, viruses, bacteria and infections, which makes it a good ally of the immune system [16-18].

The apple is a widely consumed fruit all over the world, due to its very pleasant taste, texture and aroma, as well as due to the multiple health benefits it brings. A lot of biologically active substances were found in apples, such as: vitamin C, phenolic compounds, flavonoids, minerals, pectic substances, which are also found in apple juice. More and more recent studies highlight the fact that natural apple juice possesses anti-inflammatory, anti-cancer, antioxidant, neuroprotective properties, as well as prevention of diabetes, cardiovascular diseases, obesity and gastrointestinal disorders [19-22].

The purpose of this work was to obtain and characterize in terms of vitamin C content, total polyphenols, antioxidant activity, nutritional characteristics, three blends of natural fresh juices based on beetroot with different additions of apple, carrot and ginger juice.

2. Materials and method

To obtain the three assortments of natural juices (FJ1, FJ2 and FJ3), fresh raw materials obtained from the Romanian market were used as follow: red beet: "Rubiniu" variety, apples: "Idared" variety, carrots: "Assol" variety and ginger roots.

Fresh juices obtaining method

The raw materials were washed and in the case of carrots and red beets, the peeling operation was also performed. The fresh juices from each type of raw material were obtained in the laboratory, using a Tefal ZE 585H38 Easy Fruit juicer and then the quantities of juices necessary to obtain the three types of mixtures were weighed and mixed, according to the recipes presented in Table 1.

Table 1. Recipes used to obtain the three assortments of fresh juices

Raw and auxiliary materials	FJ1	FJ2	FJ3
Red beet juice (ml)	500	780	580
Apple juice (ml)	300	200	280
Carrot juice (ml)	200	-	200
Ginger juice (ml)	-	20	20

Assessment of vitamin C, total polyphenol content and antioxidant activity

The ascorbic acid content (iodometric assay), total polyphenols (Folin-Ciocalteu method) and antioxidant activity (Cupric Reducing Antioxidant Capacity - CUPRAC assay) were determined for the raw materials and for the juice mixtures using the same work methods described by Dumbrava *et al.*, (2020) [23].

Statistical analysis

For ascorbic acid content, total polyphenols content and antioxidant activity the mean values and standard deviations of all replicates were calculated using Excel software (Microsoft Office 2010).

3.Results and discussion

Ascorbic acid content

For the raw materials and for the juice mixtures, the vitamin C content analysis, using iodometric method, led to the results presented in Table 2.

Table 2. Vitamin C content in the raw materials and in the three juice mixtures

Sample	Ascorbic acid content (mg/100g)
Apple	12.85±0.32
Red beet	7.82±0.18
Carrot	6.20±0.15
Ginger root	7.52±0.16
FJ1	19.36±0.41
FJ2	18.20±0.30
FJ3	19.08±0.36

From Table 2, it can be seen that among the raw materials used, the highest concentration of ascorbic acid was present in apples (12.85±0.32 mg/100g), followed by beetroot (7.82±0.18 mg/100g) and ginger (7.52±0.16 mg/100g). The lowest content of vitamin C was reported in carrots (6.20±0.15 mg/100g).

From the literature data analysis, Rasanu *et al.*, [24] reported 12.68 mg ascorbic acid/100g for fresh apple, very close to those found in this research, also Hussain *et al.*, [25] determined for carrots: 5.8 mg/100g. For red beet Barbarykin *et al.*, [26] found a somewhat higher vitamin C content: 10 mg/100g, also for ginger root Shirin and Jamuna [27] reported 9.33 mg/100g.

From the experimental data it can be seen that the finished products, respectively the three types of juice mixtures obtained have a higher ascorbic acid concentration than that of each raw material used separately, the FJ1 juice being slightly more concentrated in vitamin C (19.36±0.41 g/100g), than FJ3 (19.08±0.36 mg/100g) and this one than FJ2 (18.20±0.30 mg/100g).

Total polyphenol content

The polyphenol content determined by the Folin-Ciocalteu assay, for the raw materials and juice mixtures, is showed in Table 3.

Table 3. Total polyphenol content in raw materials and juice mixtures

Sample	Total polyphenol content (mg gallic acid/g)
Apple	2.36±0.05
Red beet	8.83±0.18
Carrot	2.14±0.02
Ginger root	2.81±0.07
FJ1	3.10±0.09
FJ2	4.23±0.11
FJ3	3.34±0.08

Among the raw materials, beetroot stands out for the highest content of total polyphenols (8.83±0.18 mg gallic acid/g), while apple, carrot and ginger had very similar concentrations of these compounds (2.36±0.05, 2.14±0.02, respectively 2.81±0.07 mg gallic acid/g). Ninfali and Angelino [28] found for beetroot lower contents of total polyphenols, between 0.72 and 1.28 mg gallic acid/g, and also Preti and Tarola [29], for different apple varieties reported a range of concentrations between 0.22 and 1.75 mg gallic acid/g. Shirin and Jamuna [27] found for ginger root higher values of total polyphenols: 5.65 mg gallic acid/g. Concerning the juice mixtures, FJ2, with the highest content of red beet juice, had the highest total polyphenols content (4.23±0.11 mg gallic acid/g), and for FJ1 and FJ3, very close values were determined (3.10±0.09, respectively 3.34±0.08 mg gallic acid/g).

Antioxidant activity analysis

The results regarding the antioxidant activity of the three types of juice mixtures, as well as of the raw materials, determined by the CUPRAC method, are presented in Table 4.

Table 4. Antioxidant activity of raw materials and juice mixtures

Sample	Antioxidant activity (mg Trolox/g)
Apple	5,54±0,12
Red beet	69,97±0,84
Carrot	7,14±0,18
Ginger root	5,72±0,14
FJ1	34,73±0,42
FJ2	46,43±0,54
FJ3	36,25±0,45

The strongest antioxidant activity, in the case of raw materials, was registered for red beetroot (69.97±0,84 mg Trolox/g), followed by carrots (7.14±0,18 mg Trolox/g). Ginger and apples had very close antioxidant activity values (5.72±0,14 mg Trolox/g for ginger, respectively 5.54±0,12 mg Trolox/g for apples). Slavov *et al.* [30] reported for the red beet an antioxidant activity value (69.5 mg Trolox/g) very close to the one in this work, also, Duda-Chodak *et al.* [31] for cold stored apples, values between 4.24 and 6.21 mg Trolox/g. Regarding the juice mixtures, it is found that the FJ2 variant (46,43±0,54 mg Trolox/g), which contains the highest proportion of red beet juice, had the strongest antioxidant activity. The FJ1 and FJ 3 juice mixtures had a very similar antioxidant activity (34.73±0,42 mg Trolox/g, respectively 36,25±0,45 mg Trolox/g).

Conclusions

As part of this work, three variants of natural fruit juice mixtures obtained from red beet, apples, carrots and ginger were made: FJ1 (red beet, apple and carrot juices 5:3:2, v:v:v), FJ2 (red beet, apple, ginger juices 7.8:2:0.2, v:v:v) and FJ3 (red beet, apple, carrot and ginger juices 5:2.8:2:0.2, v:v:v:v). Juice mixtures and raw materials were analyzed in terms of ascorbic acid, total polyphenols and antioxidant activity. Among the raw materials used, apples were the richest in vitamin C, followed by red beet and ginger. All three types of juice mixtures had a higher ascorbic acid content than each raw material separately, FJ1 being the richest, followed at a very close value by FJ3. The highest content of total polyphenols was recorded in red beets, and the lowest in carrots. Among the juice mixtures, the FJ2 variant, with the highest proportion of beetroot juice, had the highest concentration of polyphenols and the strongest antioxidant activity. Beetroot had almost 10 times the antioxidant activity of carrots and more than 12

times that of ginger and apple. The three variants of natural juice mixtures stood out for their high content of vitamin C, total polyphenols and a remarkable antioxidant activity. FJ1 and FJ3 were richer in ascorbic acid, while FJ2 had more polyphenols and a higher antioxidant activity.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human or animal subjects (if exist) respect the specific regulation and standards.

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