

Comparative analysis of vitamin C content, total polyphenols and antioxidant activity of some apple juices

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Abstract

The purpose of this paper was to determine comparatively the content of ascorbic acid (by the iodometric method), total polyphenols (Folin -Ciocâlțeu method) and antioxidant activity (by DPPH free radical assay) of two apples juices, obtained from two apple varieties from the Romanian market: “Idared” and „Golden Delicious”. The “Idared” apple variety and the juice obtained from them, has a higher content of vitamin C (11.201 mg/100g and 33.804 mg/100g, respectively) than the “Golden Delicious” variety and juice obtained from this apples variety (5.021 mg/100g and 20.402 mg/100g, respectively). Regarding the total polyphenols content, the highest values were also recorded for “Idared” apples (1.216 mg gallic acid/g) and juice (0.518 mg gallic acid/g). The best antioxidant activity had the juice obtained from the “Idared” apples (DPPH's average speed of reaction: $v = 5,087 \mu\text{M/s}$), the juice obtained from the “Golden Delicious” variety, having a lower antioxidant activity (DPPH's average speed of reaction: $v = 3.140 \mu\text{M/s}$).

Keywords: apple, juices, antioxidant activity, ascorbic acid.

1. Introduction

Now, when mankind entered a new millennium, living conditions determine that the intake of biologically active substances in food is more important than energy intake. The multitude of diseases specific to the present civilization, the ever-lower immunity of the contemporary man, have led to the emergence and development of a new therapeutic concept consisting of the use of medicated foods in the prevention or the auxiliary and even the principal treatment of the various diseases [2,3,6,18]. Natural apple juice belongs to this category of food [12].

Apple (*Malus domestica*) is part of the *Rosaceae* family, *Maloideae* subfamily, *Malus* genus. There are over 10,000 apple varieties in the world, and in Romania there are almost 60 officially recognized apple varieties [13].

The apple comes from the Asian continent, where it was taken from ancient times by the peoples of China and India. Archaeological documents in Europe confirm the existence of the apple for over 7,000 years. In the current age, it is grown on both hemispheres throughout the temperate climate [10]. Apples are one of the basic components of modern human food. They can be eaten either fresh or as juice, compot, jam, cider, marmalade [1].

Apple juice is widely used because of the benefits it brings to the human body. It plays an important role in human nutrition because it has a relatively high nutritional value, possesses pleasant taste and aroma, improves appetite and favors food assimilation; acts favorably on the exchange of substances in the body. Apple juice is an important source of energy that ensures the normal development of daily activity and maintaining health.

100g of apple juice has an energy value of 46 kcal and contains water 88.24 g, protein 0.10 g, lipids 0.13 g, carbohydrates 11.30 g, calcium 8 mg, magnesium 5 mg, phosphorus 7 mg, potassium 101 mg, thiamine 0.021 mg, vitamin C 0.9 mg, vitamin B6 0.018 mg, zinc 0.02 mg, riboflavin 0.017 mg, vitamin E 0.01 mg [14]. Natural apple juice has a good antioxidant activity, especially due to the content of polyphenols and ascorbic acid [15]. Mahdavi *et al.*, (2011) analyzed the total polyphenol content of several types of fresh and processed (commercial) juices, and clearly established that processing causes a fairly significant decrease in the concentration of polyphenols [9]. Antioxidant activity of apple juice changes during storage due to oxidative and non-oxidative degradation of antioxidants. This is also dependent on the type of apple used and the juice-making technology [16, 17].

The purpose of this paper was to determine the content of vitamin C, total polyphenols, as well as the antioxidant activity for the juice obtained from two apple varieties on the Romanian market: Idared and Golden Delicious.

2. Materials and Methods

The apple juices were obtained in the laboratory using as raw materials apple varieties "Idared" and "Golden Delicious", purchased from the Romanian market. Apples washed and cut into pieces have been squeezed into a "Tefal ZE 585H38 Easy Fruit" brand juicer.

Both samples of the raw materials (the two apple varieties) and the juices obtained were analyzed.

For the quantitative determination of total polyphenols (Folin -Ciocâlțeu method) and ascorbic acid (iodometric assay) in the samples, the same working methodologies as those presented by Dumbrava *et al.*, (2016) were used [5].

Determination of the antioxidant activity of apple juices by the DPPH free radical method was performed according to the working method presented by Dumbrava *et al.* (2011) [4]. For the analysis, it was necessary that apple juices be diluted 1: 100.

3. Results and Discussion

Vitamin C content: Figure 1 shows the results of experimental determinations of vitamin C content for raw materials and apple juices obtained (reported to fresh weight-FW).

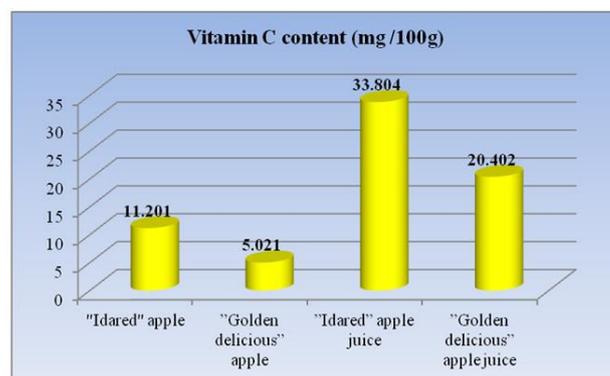


Figure 1. Ascorbic acid concentration of apple and juice samples

It can be noticed that the "Idared" apple or the juice obtained from them has a higher content of vitamin C (11.201 mg/100g, respectively 33.804 mg/100g) than the "Golden Delicious" variety, or the juice obtained from apples of this variety (5.021 mg/100g, respectively 20.402 mg/100g). The juices of both apple varieties are much more concentrated in vitamin C than the raw material from which they were obtained. Santini *et al.* (2014) have obtained concentrations of vitamin C in different apple juices between 11.92 mg/100ml and 30.32 mg/100ml [15]. Rupasinghe and Thilakarathna (2016) have found concentrations of ascorbic acid in different apple juices between 0.9 - 38.5 mg/100g [14]. Nweze *et al.* (2015) have determined mean values of vitamin C concentration in apples of $(7.94 \pm 0.13\text{mg}/100\text{g})$ [11].

Total polyphenols content: Determination of the total polyphenols content of raw materials and juices (reported to fresh weight-FW) led to the results presented in Figure 2.

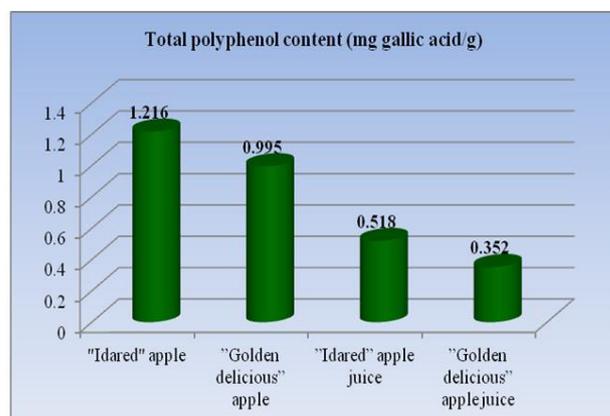


Figure 2. Total polyphenols content of apple and juice samples

From the experimental data obtained, it can be seen that the apple variety “Idared” is richer in total polyphenols (1.216 mg gallic acid/g) than the “Golden Delicious” variety (0.995 mg gallic acid/g). Also, in the case of the juice obtained from the two apple varieties, the one from “Idared” was more concentrated in total polyphenols (0.518 mg gallic acid/g) than the one from “Golden Delicious” (0.352 mg gallic acid/g). In both cases, the raw materials were more concentrated in total polyphenols than the juices. Lachman *et al.* (2006) studying several apple varieties found a total polyphenols content between 0.760 mg gallic acid/g FW - 1.343 mg gallic acid/g FW, and also for juices: 0.331 mg gallic acid/g FW – 0.697 mg gallic acid/g FW [8].

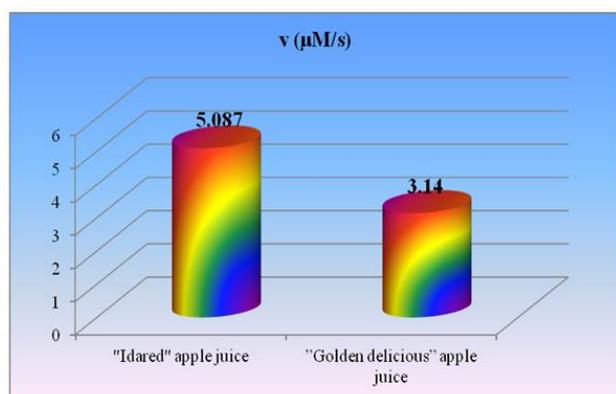


Figure 3. The average reaction speeds of DPPH in the presence of juice samples

Antioxidant activity: Analyzing the antioxidant activity of the apple juices obtained, by DPPH free radical method, the average reaction speeds shown in Figure 3 were recorded. Values were calculated using the calibration curve for DPPH and the Microsoft Excel program based on the spectrophotometric curves recorded for each analyzed sample (Figures 4 and 5).

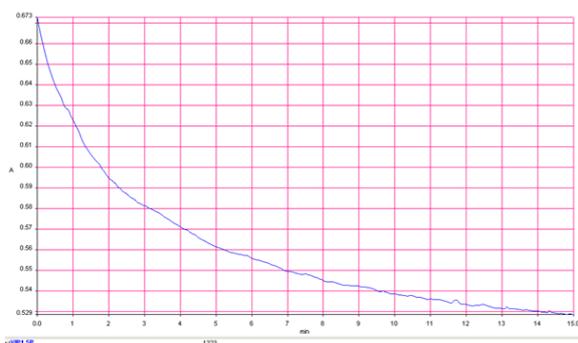


Figure 4. Time variation of the absorbance of the 1 mM DPPH solution in the presence of "Idared" apple juice diluted 1: 100

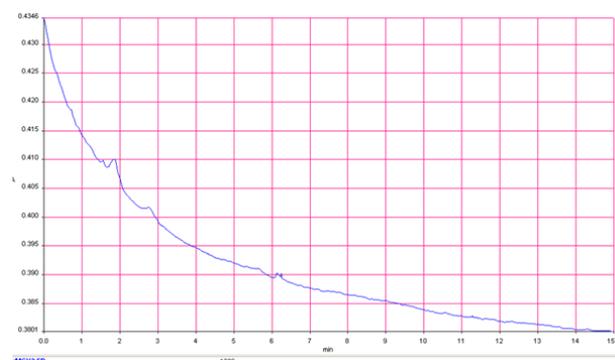


Figure 5. Time variation of the absorbance of the 1 mM DPPH solution in the presence of "Golden Delicious" apple juice diluted 1: 100

It is noted that the best antioxidant activity is expressed by the juice obtained from apples "Idared" (DPPH average reaction speed: $v = 5,087 \mu\text{M/s}$), this also having the highest content of ascorbic acid and total polyphenols, compounds with high antioxidant activity.

4. Conclusion

- Of the two varieties of apples (“Idared” and “Golden Delicious”) and apple juice studied, the highest vitamin C content was found in the case of the “Idared” variety. For both cases, the juices obtained were more concentrated in ascorbic acid than the raw material (relative to the fresh weight).
- The total polyphenols content was also higher for “Idared” apples and for the juice obtained from them, than for the "Golden Delicios" variety. Raw materials, in this case, showed a higher concentration of total polyphenols than the obtained juices.
- The best antioxidant activity was recorded for Idared apple juice, the result being directly proportional to the levels of vitamin C and total polyphenols, compounds with strong antioxidant action.

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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