

Natural celery-based juice assortment - protective quality assessment

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Abstract

Natural juices, made from a variety of fruits and vegetables, are an important part of a healthy diet. These are appreciated for their high nutritional value, pleasant taste and flavour, their ability to reduce appetite and promote food assimilation, as well as their beneficial effects on metabolism. The aim of this work is to obtain a natural mixed juice from celery, pineapple and parsley leaves (CPPJ) and to determine its proximate composition, energy value, sensory properties, as well as to analyze the protective properties of this juice mixture by determining the content of vitamin C (iodometric method), total polyphenols (Folin-Ciocalteu assay), antioxidant activity analysis (2,2-diphenyl-1-picrylhydrazyl free radical method), compared to plain celery juice (CJ) and raw materials. Experimental results showed that among the raw materials, parsley leaves had the highest vitamin C content (135.26 ± 1.02 mg/100g), followed by pineapple, with celery having a much lower concentration. Consequently, CPPJ mixed juice was much richer in ascorbic (69.68 ± 0.56 mg/100g) acid than plain celery CJ juice (7.25 ± 0.11 mg/100g). The highest concentration of total polyphenolic compounds was reported in parsley leaves (20.38 ± 0.18 mg gallic acid/g), so that CPPJ was superior (23.94 ± 0.12 mg gallic acid/g) to CJ (16.84 ± 0.08 mg gallic acid/g) also in terms of the content of these particularly healthy antioxidant compounds for the consumer's body. Parsley leaves showed the strongest anti-radical activity, followed by pineapple, so CPPJ was superior to CJ in this respect as well. In terms of proximate composition, it was noted that the addition of pineapple and parsley leaves in CPPJ resulted in significant increases in total carbohydrates, sugars, protein and total lipids as well as energy value. Sensory analysis by a panel of 20 volunteer (inexperienced) tasters resulted in significantly higher scores for CPPJ than CJ on all organoleptic characteristics analysed.

Keywords: celery, natural juice, ascorbic acid, polyphenols, antioxidant activity.

1. Introduction

Vegetable and fruit juices have gained popularity because of the benefits they bring to the human body. These natural juices, made from a variety of fruits and vegetables, are an important component of a healthy diet [1-4]. According to research, vegetable and fruit juices are an essential source of energy for the body, ensuring the normal functioning of daily activities and maintaining health. Juice therapy has achieved phenomenal results in the body's recovery from various ailments and is widely recognized worldwide.

Today, well-informed individuals, specialists and non-specialists fully appreciate the nutritional and recuperative value of fresh fruit and vegetable juices. The key advantage of juices is that, by separating minerals and water from food from fiber, they are digested quickly. The digestive processes required to separate minerals from fiber require a significant amount of energy and vegetable and fruit juices are an efficient and easily assimilated source of nutrition. It is therefore essential to have a balanced diet that includes fresh fruit and vegetables as well as natural juices [5-8].

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Celery (*Apium graveolens*) has a long history and has been cultivated as a vegetable since ancient times. There is evidence that celery was consumed in ancient Egypt and was considered particularly valuable medicinally and culinarily. Over the centuries, celery has spread throughout the world and has become a popular vegetable in many cultures and cuisines [9]. Celery juice, obtained by squeezing celery (*Apium graveolens*), is recognized for its remarkable health benefits [10]. This popular beverage has gained great attention due to its rich nutrient content and therapeutic properties. Celery juice is known to contain antioxidant and anti-inflammatory compounds, such as flavonoids and polyacetylenes, which can help reduce inflammation and protect cells against oxidative stress. These properties may be beneficial for the prevention of inflammatory conditions and chronic diseases [11, 12]. Studies have also shown that regular consumption of celery juice can have positive effects on heart and blood vessel health. Certain compounds present in celery, such as flavonoids and potassium, can help lower blood pressure and reduce cholesterol levels, thus contributing to a healthy cardiovascular system [13]. As for the digestive system, celery juice can support its health by stimulating the secretion of digestive enzymes and improving intestinal transit. It can also help reduce inflammation in the digestive tract and soothe symptoms associated with digestive conditions such as heartburn and bloating. Celery juice also has beneficial effects in detoxification and supporting kidney function, as celery has natural diuretic properties. It can help remove toxins and excess fluids from the body, helping to cleanse the kidneys and maintain healthy kidney function. Celery juice is also a good source of vitamin C, which supports the immune system and helps the body fight infection [14]. Pineapple (*Ananas comosus*) is a tropical plant of the *Bromeliaceae* family. Nutritionally it is a rich source of vitamins, minerals and enzymes. In a fresh pineapple, about 86% of the caloric content is carbohydrates, mainly glucose and fructose, and the remaining 14% is protein and fat. Pineapple is a good source of vitamin C, containing about 78.9 mg/100g. Other important vitamins and minerals include vitamin B6, thiamin, riboflavin, pantothenic acid, magnesium and potassium. In addition, pineapple contains the enzyme bromelain, which is known for its digestive and anti-inflammatory properties [15].

Pineapple also contains a wide range of polyphenolic compounds, such as flavonoids and gallic acid, which have been associated with numerous health benefits, such as reducing inflammation and oxidative stress [16]. Pineapple juice, obtained by squeezing the pineapple fruit, is known for its tasty and health-promoting properties: anti-inflammatory and antioxidant properties, digestive benefits, improved immune system health [17]. Parsley (*Petroselinum crispum*) belongs to the *Apiaceae* family. Throughout history, parsley has been used both as a medicinal herb and as an aromatic herb. Nowadays is commonly used as an aromatic herb in cooking, especially in Mediterranean and Middle Eastern cuisine. It is also known for its high vitamin and mineral content, including vitamin C, vitamin K and iron [18]. According to research, parsley contains compounds with antioxidant properties, such as carotenoids and flavonoids, which can help protect against chronic diseases such as heart disease, diabetes and cancer [19].

The aim of this work was to obtain a natural mixed juice from celery, pineapple and parsley leaves and to determine its proximate composition, energy value, sensory properties, as well as to analyze the protective properties of this juice mixture by determining the content of vitamin C, total polyphenols, analysis of antioxidant activity, compared with simple celery juice and raw materials.

2. Materials and method

The following raw and auxiliary materials (purchased on the Romanian market) were used to obtain the natural juice: celery, pineapple, parsley fresh leaves.

Juice obtaining method

In the preparation of natural juice from celery, pineapple pulp and parsley leaves (CPPJ) the raw materials were used in the following proportions: celery 49.5%, pineapple pulp: 49.5%, fresh parsley leaves: 1%. Separately, a simple celery juice (CJ) was also made for comparison.

To obtain the juices the raw materials (celery, pineapple pulp, parsley leaves) were washed, celery was cut into pieces, pineapple was subjected to peeling and pulp cutting operations. The raw materials thus prepared were weighed and processed one by one in a Tefal ZE 585H38 Easy Fruit juicer.

The simple celery juice (CJ) was obtained separately and the juice thus prepared was then poured into bottles with screw caps.



Figure 1. The final product (CPPJ)

Assessment of vitamin C, total polyphenol content, antioxidant activity and sensory analysis

The iodometric titrimetric method presented by Dumbrava *et al.* (2016) [20] was used to determine vitamin C in juices and raw materials, The total polyphenol content (TPC) in juices and raw materials was determined by the Folin-Cicalteu method, and the organoleptic evaluation of juices was performed by 20 panelists using the 5-point hedonic scale assay, as presented by Dumbrava *et al.*, (2020) [21]. The antioxidant properties of juices and raw materials were determined by the analysis of 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity (RSA), following the same methodology as Dumbrava *et al.*, (2022) [22].

Assessment of proximate composition and energy value

The proximate composition and energy value of the juices was determined by calculation using the USDA Nutritional Database.

Statistical analysis

For total polyphenol content and DPPH free radical scavenging activity, the mean value and standard deviation of the replicates were determined using Excel software (Microsoft Office 2010).

3.Results and discussion

Vitamin C content

The concentration of vitamin C in the juices obtained, as well as in the raw materials, is shown in Table 1.

Table 1. Vitamin C content of raw materials and juice obtained

Sample	Ascorbic acid (mg/100g FW)
Celery	3.50±0.08
Pineapple pulp	77.83±0.82
Parsley leaves	135.26±1.02
CPPJ	69.68±0.56
CJ	7.25±0.11

It could be observed that of the raw materials parsley leaves had the highest ascorbic acid content (135.26±1.02 mg/100g FW), followed by pineapple (77.83±0.82 mg/100g), celery being rather poor in this vitamin (3.50±0.08 mg/100g). The mixed juice CPPJ had a vitamin C content of 69.68±0.56 mg/100g, 9.61 times higher than the plain celery juice. Thus, by the addition of pineapple pulp and parsley leaves to celery resulted in a natural juice with much more vitamin C than plain celery juice. Compared to the values determined by us, Zhang *et al.*, (2005) reported for celery a higher content of 7.3 - 4.5 mg vitamin C/100g which decreases with increasing storage period [23] and for fresh celery juice, Profir and Vizireanu (2013) found a higher ascorbic acid concentration of 9.57 mg/100g [24]. For parsley leaves, the value found in this paper is slightly higher than that reported by Caunii *et al.*, (2010): 133.0 mg ascorbic acid/100g [25], while for pineapple pulp, Huang *et al.*, (2021) determined a little higher content: 78.9 mg/100g [15].

Total polyphenol content

Content of total polyphenols (TPC) in raw materials and juices, determined by the Folin-Ciocalteu method, is shown in Table 2.

The highest TPC of the raw materials was recorded for parsley leaves (20.38±0.18 mg gallic acid/g), followed by celery (15.08±0.14 mg gallic acid/g). Of the two types of juice, the mixed CPPJ variant, had a 42.16% higher level of total polyphenols (23.94±0.12 mg gallic acid/g) than CJ (16.84±0.08 mg gallic acid/g FW). Thus, the addition of pineapple and parsley leaves to celery results in a significant increase in the total polyphenol content of the juice compared to plain celery juice. The values we found for TPC in celery were lower than those reported by Ud Din *et al.*, (2015) 36.60±12.28mg GAE/g [26], and for parsley leaves we found a value close to Derouich *et al.*, (2020) 21.63 ± 1.04 mg GAE/g [27].

For pineapple the values we found are higher than those reported by Valdés García *et al.*, (2021): 0.22-0.66 mg gallic acid/g [28].

Table 2. Total polyphenols content of juices and raw materials

Sample	TPC (mg gallic acid/g FW)
Celery	15.08±0.14
Pineapple pulp	0.86±0.04
Parsley leaves	20.38±0.18
CPPJ	23.94±0.12
CJ	16.84±0.08

Antioxidant properties analysis

Antioxidant characteristics of juices and raw materials determined by DPPH free radical scavenging activity (RSA) are shown in Table 3.

Table 3. RSA for juices and raw materials

Sample	Dilution	RSA (%)
Celery	1:1000	19.55±0.11
Pineapple pulp	1:1000	54.12±0.14
Parsley leaves	1:1000	64.13±0.15
CPPJ	1:1000	51.87±0.16
CJ	1:1000	23.60±0.08

Of the raw materials, parsley leaves showed the strongest RSA (64.13±0.15%), followed by pineapple (54.12±0.14%), and CPPJ had antiradical activity of 51.87±0.16%, more than 2 times higher than plain celery juice CJ.

Proximate composition and energy value

The results on proximate composition and energy value of juices are shown in Figure 2 and Figure 3.

In CPPJ combined juice, the addition of pineapple pulp and parsley leaves resulted in increases of nutrients concentration compared to CJ, thus:

- dietary fiber: from 1.6 to 1.8 g/100g,
- sugars: from 1.3 to 5.4 g/100g (4.15 times higher),
- total carbohydrates: from 3.0 to 9.5 g/100g, (3.17 times higher),
- total fat: from 0.2 to 0.5 g/100g (2.5 times higher),
- protein: from 0.7 to 1.7 g/100g (2.43 times higher).

The energy value of CPPJ combined juice was found to be 3.14 times higher than that of CJ (44 kcal/100g versus 14 kcal/100g).

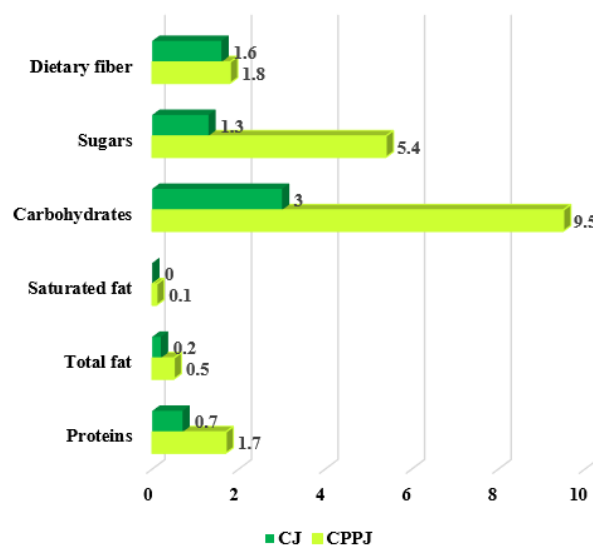


Figure 2. Proximate composition of juices (g/100g)

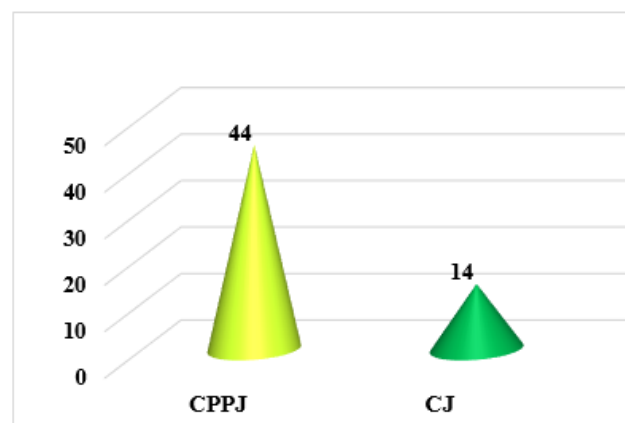


Figure 3. Energy values (kcal/100g) of finished products

Sensory analysis

Sensory analysis of the juices led to the results shown in Figures 4 and 5.

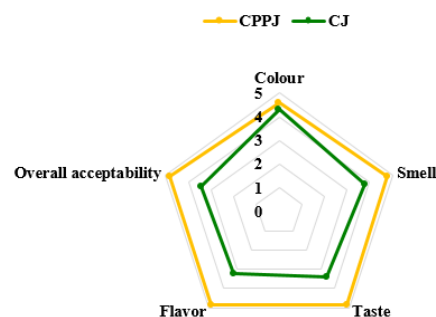


Figure 4. Overall organoleptic evaluations of CPPJ and CJ juices

CPPJ mixed juice was better organoleptically rated on all sensory characteristics analyzed by the panelists. Thus, this juice had a very good acceptability rating (between 4.6 and 4.85) on all sensory characteristics, while the plain CJ juice had only one characteristic (colour) with a good score (4.3) while taste, smell, flavor and overall acceptability were in the satisfactory acceptability category.

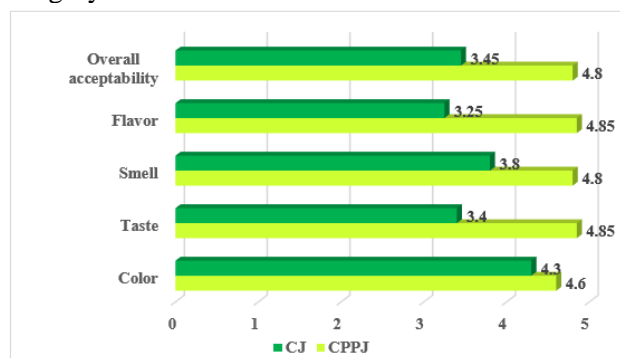


Figure 4. Organoleptic characteristics of juices

Conclusions

An innovative natural juice made from celery, pineapple and parsley leaves has been developed. It was analysed against raw materials and plain celery juice for ascorbic acid content, total polyphenols, antioxidant activity. At the same time, the obtained mixed juice (CPPJ) as well as the plain juice (CJ) were also analysed for proximate composition, nutritional value and sensory characteristics. Of the raw materials, parsley leaves had the highest vitamin C content, followed by pineapple, with celery having a much lower concentration. Thus, CPPJ was much richer in ascorbic acid than CJ. In terms of total polyphenols, the highest concentration was reported in parsley leaves, followed by celery, so that CPPJ was superior to CJ in these antioxidant compounds particularly healthy for the consumer's body. The strongest antiradical activity was reported in parsley leaves, followed by pineapple, respectively in CPPJ mixed juice. From a nutritional point of view, it was noted that the addition of pineapple and parsley leaves to CPPJ mixed juice resulted in significant increases in total carbohydrates, sugars, protein and total lipids as well as energy value. The sensory analysis carried out by a panel of 20 volunteer tasters (non-experienced) resulted in significantly higher scores for CPPJ than for CJ at all the organoleptic characteristics. Thus, while for CPPJ all the scores obtained were in the very good category, for CJ only the colour was evaluated with a good score, the

other characteristics being evaluated at the satisfactory level. Due to its richer content of vitamin C and total polyphenols, stronger antioxidant activity, higher nutritional value, and superior sensory characteristics, the addition of pineapple pulp and parsley leaves is recommended for an enriched celery juice.

Conflict of Interest. Author has declared that no competing interests exist.

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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