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Biophysical and nutritional characterization of some natural fruit and vegetable juices

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Abstract

Due to its nutritional and therapeutic qualities, natural juices of fruits and vegetables have attained an important place in the daily diet of people of different ages. Being appreciable sources of vitamins, minerals and fiber, natural juices from fruits and vegetables are increasingly appreciated and recommended being considered as functional foods. Fresh juices mixture made from celery (*Apium graveolens*), carrot (*Daccus carota*), red beet (*Beta vulgaris*), apple (*Malus domestica*) and oranges (*Citrus sinensis*) is considered nutritional juice on a commercial scale, being able be used both, as a source of antioxidants and as functional drinks. In the experimental part, six types of natural juices made by fresh fruits and vegetables were analyzed in terms of physicochemical and nutritional characteristics. The aim of this paper was to analyze and compare some biophysical characteristics from fresh and clearly juice prepared using a press robot: pH, electrical conductivity, dynamic viscosity, refractive index, surface tension and density, in case of natural juice samples obtained from celery, carrot, red beet, apples, and oranges each taken separately and in the mixture. From their analysis, for the natural juices considered (celery, carrot, red beet, apples, oranges and mixed one) it can be noticed that their values differ from one category to another, but results are comparable to the data from the literature.

Keywords: fresh juices of fruits and vegetables, biophysical characteristics

1.Introduction

Fruit juices are consumed worldwide, not only for their taste, flavour, and freshness, but also due to their beneficial health effects when are consumed regularly. Being rich in vitamins and minerals, enzymes, phytonutrients, fruit juices should not be lacking in daily nutrition. Due to the beneficial antioxidant qualities it possesses these products can improve and maintain human health, being considered as functional foods [1,2]. Moderately consumed, as part of a balanced diet, they offer properties that promote good health, reducing the risk of illness. Natural juice is a product obtained from various ripe fruit and vegetable species, fresh, frozen or refrigerated through a mechanical process (centrifugation, pressing or diffusion) being preserved by different ways (pasteurization, concentration, chemical preservation).

According to the legislation, natural juices may not contain preservatives, dyes or flavors other than those obtained from fruits and vegetables from which they come [3,4]. Based on healing effects in a range of acute and chronic diseases, the fruit juice diet is a successful technique used in modern medicine. It is recommended, prophylactic and curative, as an adjuvant, when the body accumulates significant amounts of acids; which has repercussions such as diabetes, aging, gout etc. [5,6].

Apple (*Malus domestica*) belongs to the Rosaceae family, occupies the first place in the temperate climate of fruit trees species, due to its fruit value. Apples are rich in sugars, organic acids, ascorbic acid, protein substances, pectic substances, minerals, vitamins (C, A, B_1, B_2, PP) and fibers.

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Apple fruit is appreciated an exceptional natural medicine with therapeutic properties in cardiovascular disease, atherosclerosis, hypertension, myocardial infarction, anemia and demineralization of the body, chronic hepatitis, constipation, insomnia, arthritis [7,8]. Apples can be served as such naturally or ripe in the form of compote, sauce or jelly or juice. Apple juice has a higher antioxidant effect if the peel is not removed, because the substances with this effect are found mainly in the peel of the fruit. Considered the most popular and available drinks, it retains many of the nutrients of apples such as vitamin C, various vitamins B as well as minerals such as iron, calcium, potassium, copper and manganese [9].

Compared to other fruits, orange is a superior nutritious and delicious fruit. Seasonal fruits measure about 8 cm in diameter and weigh around 100-150 g. Oranges contain plenty of water, 87.6%, protein 0.7%, fat 0.2%, fiber 0.3% calcium 26 mg, phosphorus 20 mg, iron 0.3 mg, carbohydrates 10.9%, minerals 0, 3% and vitamins B and C. The orange nutrients are diverse and numerous. The fruit has a poor content in calories, does not contain saturated fat or cholesterol, but is rich in food fiber and pectin. Like other citrus fruits, oranges, are an excellent source of vitamin C, which is a powerful natural antioxidant. The consumption of vitamin C-rich food helps the body develop resistance to infections and eliminate free inflammatory radicals from blood [10]. Consumption of orange juice helps to improve blood pressure because it contains magnesium, which has the ability to bring the blood pressure level to normal limits. The most important benefits of the orange juice are its curative properties [11].

Red beet contains many nutrients such as vitamin A, vitamins B1, B2, B6, Vitamin C, calcium, copper, sodium, sulfur, iron, potassium, iodine, folic acid and antioxidants. The red beet is easily digestible and is rich in water, fiber, sugars. The pigment that gives the characteristic red-violet color and which has an antioxidant action is called saponina. Trace elements found in beets helps to detoxify the body and strengthen immunity. Red beetroot juice is one of the richest foods in antioxidants [12].

Celery (*Apium graveolens)* is a plant of the family *Apiaceae* that can reach a height up to 1 m with large-lumbat leaves. Each part of the celery, including the stalk, seeds and leaves are edible and rich in nutrients.

An excellent source of of Vitamin B_1, B_2, B_6 vitamin and also vitamin C which is added potassium, calcium, magnesium, folic acid, phosphorus, iron, sodium and essential amino acids celery juice is recommended for consumption being essential for the body. Celery is known for its compounds, which fight cancer, with a role in stopping tumor cell development. The phenolic acids in the celery block the action of prostaglandins which stimulate the growth of tumor cells. Cumarines help prevent free radicals from tumor-affected cells. Due to the high potassium content, celery root juice increases the diuresis, with the effect of draining the kidneys, helping to eliminate urine acid, treating kidney publishing, non-critical colic, urinary retention and kidney litters. Celery leaves juice has diuretic, aphrodisiac, stimulatory, digestive, anti-rheumatic and depurators properties. It is also used in blood cleaning and hormonal regulation, as well as in youth acne and psoriasis [13, 14].

The carrot (*Daccus carota*) belong to the *Apiaceae family* is an orange plant root, the edible part of the plant being the root. The highly diverse biochemical content of the carrot explains the multiple effects in feeding the whole body and maintaining health. The roots of the carrots have a high content of carotenoids, mainly beta-carotene, which is transformed by the organism into A vitamin with direct effects on the skin, heart and immune system. The vitamins present in the carrots also include vitamins B_1, B_2, B_6, C, E, K, P and PP. Moreover, the wealth of mineral salts necessary to increase and maintain health should not be forgotten: Iron, phosphorus, calcium, potassium, magnesium. Carrot juice decreases the risk of heart disease, stroke, improves the body's defense against cardiac diseases and enhances the health of the heart by reducing oxidative stress. It also helps to lower cholesterol and increase biliary production, which increases the body's ability to digest fats. Not only helps the digestive system adequately absorb nutrients in food, but directly influences good cholesterol levels that protect the heart [15,16].

2.Materials and methods

In the experimental part, six types of natural juices made by fresh fruits and vegetables were analyzed in terms of physicochemical and nutritional characteristics.

Natural juices from fruits and vegetables presents great importance being appreciated both due to the aroma and also for the sweet-sour taste, providing the necessary of vital energy and nutrients.

The samples of natural juice were obtained in the laboratory, by squeezing each piece of fruit separately using an centrifugal power juicer. Also, natural juice samples were filtered to remove the pulp and seeds, making the juice clear and without impurities. The analyzed fruit and vegetable samples were purchased from a local market in May 2019. Five separate samples of juice were prepared by celery, carrot, beet, apples, and oranges each of about 200 ml as well as a mixed sample resulting from the mixture of this five components. The mixed juice obtained is a 100% natural product without additives or preservatives, made with the juicer by mastication that extracts, crushes and presses, contributing to the release of nutrients from fruits and vegetables used in the preparation.

The purpose of this study was to analyze and compare some biophysical characteristics from fresh and clearly juice prepared using a press robot: pH, electrical conductivity, dynamic viscosity, refractive index, surface tension and density, in case of natural juice samples obtained from celery, carrot, red beet, apples, and oranges each taken separately and in the mixture. The physicochemical characteristics were determined from fresh and clearly juice prepared using a fruit and vegetable press robot. In order to determine the analyzed parameters, were used the common and classical physico-chemical methods of analysis. The pH was measured using a pH meter mark OP-211/2 connected with combined electrode OP-0808P according to the AOAC methods. The total soluble solids (TSS) and the refractive index were obtained using the refractometry method, with the Abbe refractometer corrected to the equivalent reading at 20°C (AOAC, 1995). Electrical conductance was determined by conductometer OK 112 and viscosity using Ostwald-type viscometer [17].

3.Results and Discussion

In case of natural juices considered (celery, carrot, beet, apples, oranges, and mixed) from the determinations of physico-chemical analyzed parameters, it can be noticed that their values differ from one category to another. The assesement of the physico-chemical parameters (pH, G, n, η) are an important indicator in the investigation of the physico-chemical and nutritional properties of the natural juices analyzed in this study. Conductometric methods are physicochemical analysis methods based on the determination of conductivity of the elctrolyte solutions. The property of juices to drive the electric current is quantitatively evaluated by electrical conductivity, G. Electrical conductivity is one of the parameters that verifies the authenticity, freshness of a product.

The electrical conductivity of a food product is a function of product characteristics (composition, sugar content and salts, pH, etc.), and is also influenced by the heating process, especially temperature.

Minerals are present in the form of electrolytes, so they are easily absorbable by the human body. It is known that the solution's conductivity increases with its content in dissolved substances. Conductivity varies with concentration and it grows with increasing electrolyte concentration. This increase depends both on the nature of the electrolyte and on the temperature [18]. In terms of electrical conductivity, the highest value was obtained for natural celery juice (11,96 mS) and the smallest of natural apple juice (1,84mS). Natural juices contain a range of minerals, organic acids, fibers, salts and other bioactive substances.

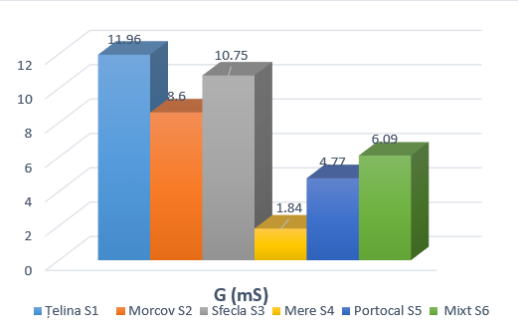

Figure 1. Determination of conductivity for different type of vegetable juice samples

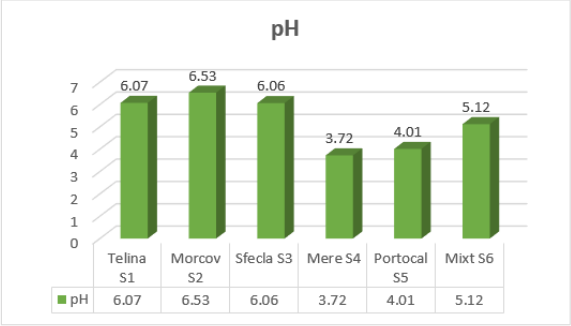

Figure 2. Determination of pH for different type of vegetable juice samples

The acidity or alkalinity of a solution is expressed by physical size, pH. Being a measure of the acidic or basic character of a solution, pH is an important factor in the processing of fruit and vegetable products.

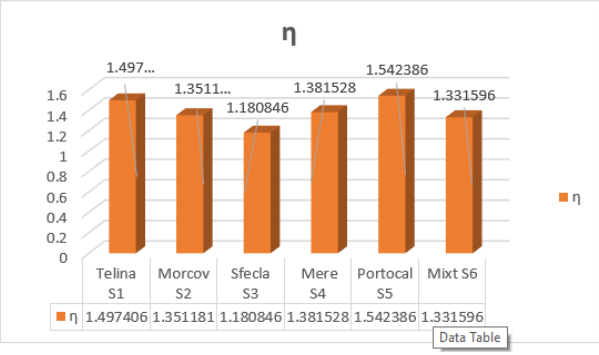

Figure 3. Determination of viscosity for different type of natural juice samples

In case of the pH determination it was observed that the lowest value was obtained for apple juice (3.72) and the highest value for the carrot juice (6.53). Higher acidity (low pH) of preserved juices than fresh ones, recommends natural, fresh daily intake as a benefit in the treatment and prevention of many diseases. For example, most commercial drinking water has pH 7, beer has a pH of about 5, and juices between 5 and 6. Water and natural juices from fruits and vegetables have the role of compensating for a too acidic diet that can disrupt our metabolism. From the comparative analysis of pH determination results, this parameter is within the permissible limits for all the samples analyzed in this study [19].

Viscosity is considered an important physical property for the quality of liquid foods. The increase in viscosity is the result of increased fiber, pectin and the amount of sugar present. From the graph analysis it can be observed the minimum values of dynamic viscosity of the studied juices is 1.18 cp for the red beet juice and the maximum dynamic viscosity values of the studied juices is 1.54 in the case of orange juice. Because natural vegetable juices contain minerals, considerable amounts of pulp, they may have additional flow resistance represented by a higher stretching request. It has been found that the fresh juice viscosity is higher than the pasteurized ones due to the increased fiber content, pectin. For this reason, it is recommended to use freshly squeezed natural juices instead of pasteurized [20].

4.Conclusions

Natural juices from fruits and vegetables are widely recommended and used in food, fresh or preserved due to the taste qualities, nutritional value, and high degree of assimilation by the human body.

Biophysical parameters (pH, electric conductivity, refractive index, viscosity, surface tension, density) are important indicators in investigating the physical and nutritional properties of natural fruit and vegetable juices analyzed in this study. For the natural juices considered it was observed that their values differ from one category to another, but the obtained results are comparable with the data from the specialized literature. From the comparative analysis of the obtained results it was found that these parameters are within the allowed limits, for all samples analyzed in this study.

Owing to beneficial, nutritional and antioxidant qualities, it is recommended to consume daily, succulent, freshly squeezed and immediately consumed over the pasteurized. Vegetable fruit juices acting as a functional food, is a simple affordable and effective alternative to cellular regeneration, health human body improvement, maintain the level of hydration in the body.

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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