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Abstract. Strawberries (*Fragaria x Ananassa Duch.*) as important part of our diet are known for their sensory and nutritional characteristics, because of high content of essential nutrients that are beneficial for biological activity in human health. A high consumption of plant foods, such as strawberries, appears to decrease the risk of obesity, diabetes, heart disease, and overall mortality. It can also promote a healthy complexion, increased energy, and overall lower weight. Nutritional quality was analyzed through by chemical parameter of fresh strawberry samples from plantation in Kosovo area at the ripe stage. The following quality parameters were determined in the strawberry's fruits: pH, dry matter, total soluble solids (TSS/◦Brix), total acidity (TA), TSS/TA ratio, Total sugars, reducing sugars, sucrose, vitamin C, protein, and lipids. Results can be used to inform potential strawberry farmers about the nutritional qualities and consumer preferences for strawberries. The rich nutritional composition of the studied fruits makes them a very special diet. All statistical analysis was performed using the MS Excel program and SPSS 22.0 statistics software.

Keywords: Strawberry, nutrient quality, fruits

Introduction

Strawberries fruit (*Fragaria x Ananassa Duch*.) are a nutritious fruit appreciated in our diet for their sensory and nutritional characteristics as well health benefits, because of their rich content of essential nutrients, with unique colour,flavour and delicious taste, and are considered the most popular fruit [1],[2]. They're a rich source of antioxidants known as polyphenols, that can prevent some of the damage caused by free radicals by neutralizing them [3].

Fruits and fruits products are a natural source of micronutrients such as of vitamins like vitamin C and minerals, carbohydrates, fibers, folates, and some phytonutrients, which are essential for human health [4]. Many epidemiological studies support that a diet rich in fruits and vegetables is associated with a lower incidence of many chronic diseases, including diabetes, infections, cardiovascular and neurological disorders and cancers [1].

Strawberry (*Fragaria x Ananassa Duch*.) fruits are consumed in large quantities, either fresh or in prepared foods such as preserves, desserts, fruit drinks, pies, ice creams, and milk shakes, jams, jellies [5]. Use of fruit desserts in nutrition is one of the ways how to consume vitamins and minerals. Berries, in general, and strawberries in particular are rich in sugars (glucose, fructose), but low in calories. They contain only small amounts of lipids and proteins, but a high content of dietary fiber and organic acids [6]. Dietary fiber and fructose contents may contribute in regulating blood sugar levels by slowing digestion, with its fiber content also contributing to control calorie intake by its satiating effect [2]. Ascorbic acid (vitamin C) is one of the most important organic acids in strawberry fruit and nutritional quality of strawberries comes mostly due to the large amount of containing vitamin C [7],[8] which makes them an important source of this vitamin for human nutrition. Together with vitamin C, folate plays a crucial role in emplacing the micronutrient content of the strawberry when considering that [2]. Sugars are the main soluble components in ripe strawberry fruit, with glucose, fructose, and sucrose accounting for 99% of total sugar content. Sugars also are implicated in fruit flavor and determine caloric value of strawberries. Organic acids are involved in flavor, texture, pH, and color of strawberries, altering the sensorial quality of this fruit [7]. Strawberry (*Fragaria x Ananassa Duch*.) are very popular fruit in Kosovo, cultivar of them is developed in Kosovo, where is commercially cultivated under several climatic conditions and cultivation modes. The average strawberry yield in Kosovo is 9.3 tons per hectare. However, quality parameters and nutritional value have not been determined in strawberries fruits during ripening, especially in fruit grown under organic cultivation. Literature regarding to this strawberry cultivar is scarce. This is the first research of this type in Kosovo and it should give us a novel result. This study has been designed to investigate the nutritional quality of strawberry fruits with ripening time by using some parameters (dry matter, total soluble solids (TSS), pH, total acidity (TA), TSS/TA ratio, sugars, total sugars, reducing sugars, sucrose, vitamin C, protein, lipids.

Materials and methods

Materials

Fruits of strawberry (*Fragaria x Ananassa Duch*.) from four strawberry cultivars, were grown at the different plantation located in the Kosovo and harvested at commercial maturity stage in the season 2019.Sampling was carried out on 3 trees growing in garden. Approximately 1 kg of fruits of uniform ripeness (red color) were harvested from each tree and transferred to laboratory at the day of harvest and stored overnight at +4◦C.Analyses were carried out next day. Fruits were washed with demineralized water, and after removing surface water, air dried and then mashed using a kitchen blender to prepared for further analysis. Three replicates were used for analysis.

Chemical analysis

Determination of nutritional properties of strawberry fruits were performed according the standard methods of the AOAC [9]. Total soluble solids content (TSS) measured using Abbe refractometer calibrate against sucrose and expressed in ◦Brix. Titratable acidity (TA) was measured according to AOAC Method and expressed as milligrams of citric acid. pH was measured using pH/mv meter, and dry matter (DM) was measured in triplicate by drying 5 g of the fresh fruits at 105◦C until constant weight (4-6 hours). Determination of lipids was done by Soxhlet extraction after digestion of the samples by hydrochloric acid hydrolysis, followed by extraction of the fats with petroleum ether. After the extraction, lipid content was determined by weighing. Protein was determined by the Bradford method with some modifications. Gelatin is commonly used to create the standard curve, and the absorption is measured at 545 nm. Reducing sugar was determined using the method of Lane and Eynon and Fehling's solution as described by AOAC [9]. Total sugars were determined by the phenol-sulfuric acid method (Nielsen, 2009). Glucose is commonly used to create the standard curve, and the absorption is measured at 490 nm. The sucrose mass fraction was determined by calculation from the difference between total and reduced sugars. Vitamin C content was estimated using spectrophotometric method with 2,4-dintrophenylhydrazine as an indicator [1],[9]. Freshly processed fruit (1 g) was homogenized in a mortar with a pestle with metaphosphoric acid (5% metaphosphoric acid in 10% acetic acid solution in water), filtered and treated with 85% sulphuric acid solution and 2,4-dintrophenylhydrazine, and then incubated at 60 ◦C for 60 min in a water bath. Absorbance was measured at 520 nm in a spectrophotometer (Genesys 10S UV-Visible,) for estimation of vitamin C in the fruits.

Statistical analysis

All data were expressed as the mean ± standard deviation of triplicate experiments. All statistical analysis performed using the MS Excel program and SPSS 22.0 statistics software Differences were tested for significance using the ANOVA procedure, with a significance level of $p < 0.05$.

Results and Discussion

The results of the chemical composition and nutritional components of the fresh strawberry fruits analyzed in period June 2019, in the four locations and cultivars are given in Tables 1-2 and figure 1.

Table 1. The chemical composition of the strawberry fruits

Sample	pH	W(DM)/%	TSS/◦Brix	TA/ %	TSS/TA ratio
S_1	4.10±0.2	3.03±0.1	9.00±0.1	0.95±0.1	9.47±0.1
S_2	3.80±0.2	1.47±0.1	9.00±0.1	0.76±0.1	11.84 0.2
S_3	3.85±0.1	1.96±0.1	8.00±0.1	0.72±0.2	11.11±0.2
S_4	4.30±0.1	3.04±0.1	5.00±0.1	0.90±0.2	5.55±0.2

Data are expressed as average value ± standard deviation of three replicates

Table 2. The Nutritional composition of the strawberry fruits

Sample	Vitamin C mg/100g	Total sugars g/100g	Reducing sugars g/100g	Sucrose g/100g	Lipids g/100g	Proteins g/100g
S_1	56.7±0.1	2.17±0.1	1.97±0.2	0.20±0.2	0.25 0.1	0.73±0.1
S_2	54.18±0.3	2.05±0.3	1.79±0.1	0.26±0.3	0.22±0.2	0.80±0.1
S_3	52.44±0.3	2.04±0.1	1.75±0.1	0.29±0.1	0.22±0.1	0.84±0.2
S_4	50.57±0.1	2.82±0.1	2.47±0.1	0.35±0.1	0.28±0.2	0.69±0.3

Data are expressed as average value ± standard deviation of three replicates

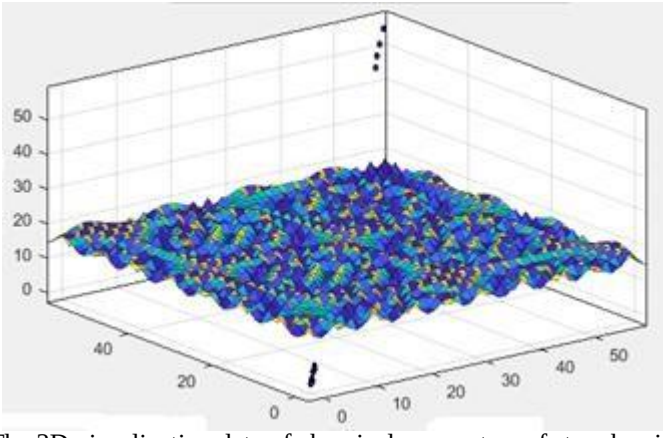

Fig.1. The 3D visualization data of chemical parameters of strawberries fruits

pH values tend to be lower, ranging from 3.80±0.2 to 4.30±0.1, where the higher pH has S_4 samples with 4.30 ± 0.1, these values are similar to many other authors studies, author reference [7]. The values for strawberry fruit of the total dry matter ranged from 1.47% ± 0.1 to 3.04% ± 0.1.

Soluble solids TSS/◦Brix content in fresh strawberries fruits ranged from 5.00 ± 0.1 ºBrix to 9.00 ± 0.1ºBrix, the values show very good amounts of soluble solids compared to the study of author reference [7]. Samples of strawberries contained about 0.72%± 0.2 to 0.95% ± 0.1 of citric acid.

Total acidity values for strawberries fruits were somewhat lower, which caused it's also lower TSS/TA ratio. The relationship between total soluble solids and total acidity is very important in determining fruit quality. In numerous researches conducted on different strawberry cultivars, the total soluble TSS/TA ratio was found to be very important, because it provides information on the balance of sugars and acids in the fruit. Strawberry fruits are a good source of vitamin C. Content of vitamin C in strawberries fresh fruit essentially different among the researched cultivars. Samples of strawberries contained more vitamin C 50.57 ± 0.1mg to the 56.70 ± 0.1mg/100g, where the highest amounts are samples S_1 and S_2.If we compare these results with other authors in most cases we will see that the strawberries we have

explored have average values compared to author reference [2]. From the above mentioned, the four strawberry varieties in our study might be considered as rich in vitamin C. The total number of sugars present in the strawberry fruit varied from 2.04 ± 0.1g to 2.82 ± 0.1g/100g. The comparing these fruits, we can infer that the strawberry fruit do not constitute itself as a good source of sugars, which are at a lower level than that reported by other authors on different cultivars from different parts of the world [1],[2].Protein values were estimated between 0.69 ± 0.1 g to 0.84 ± 0.2 g per 100 g strawberries fruits, which is consistent with the report of authors reference [1],[2]. Lipid contents is 0.22 ± 0.2g to 0.28 ± 0.2 g/100 g was also lower to those of authors reference [1],[2]. The obtained results can be useful in clarifyng the quality of fruits and traditional products in order to their promotion and application as food additive and nutraceutical.

Conclusion

The present study reveals that the strawberry (Fragaria x Ananassa Duch.) grown and developed at the Kosovo region were rich in vitamin C, sugars and minerals. Their nutritional value and quality attributes make them suitable for consumption. Tested fruit presented a considerably high content of vitamin C and moderate to high content of sugars and low content of lipids, giving nutritional and health relevance to this fruit, and these strawberries could be a promising dietary supplement to address the needs of vitamin C and nutrients.

References

1. Hossain,A.,Begum,P.,Zannat,S.M.,Rahman,H.,Ahsan, A.,Islam ,N.Sh.: Nutrient composition of strawberry genotypes cultivated in a horticulture farm. Food Chemistry 199 (2016) 648–652.

2. Giampieri,F., Tulipani,S., Suarez,A.M., Quiles,L.J.,Mezzetti,B.,Battino, M.:The strawberry:Composition, nutritional quality, and impact on human health. Nutrition 28 (2012) 9–19.

3. Scalbert,A., Johnson,T.I.,Saltmarsh, M.: Polyphenols: antioxidants and beyond. Am J Clin Nutr 81(suppl) (2005) 215S–7S.

4. Marinova, D.,Ribarova, F.: HPLC determination of carotenoids in Bulgarian berries. Journal of Food Composition and Analysis 20 (2007) 370–374.

5. Liu,L.,Ji,L.M., Chen,M., Sun,M.,Fu,X.,Li,L., Gao Sh.D.,Zhu,Y.C.: The flavor and nutritional characteristic of four strawberry varieties cultured in soilless system.Food Science & Nutrition 4(6),(2016) 858–868.

6. Skrovankova,S.,Sumczynski,D.,Mlcek,J.,Jurikova,T.,Sochor,J.:Bioactive Compounds and Antioxidant Activity in Different Types of Berries. Int. J. Mol. Sci.16 (2015) 24673-24706.

7.Paz,J.,Yahia,M.E.,Bustamante,R.N.,Martinez,P.D.J.,Minakata,E.P.M.,Junquera,I.V.,Muniz,A .C., Prieto,G.V., Reyes,O.E.: Physical attributes and chemical composition of organic strawberry fruit (Fragaria x Ananassa Duch, Cv. Albion) at six stages of ripening. Food Chemistry 138 (2013) 372–381.

8. Pavlovska,G.,Dukovska,E.,Knights,A.V.,Jankuloska,V.:Influence of temperature and time of storage on amount of vitamin C in strawberries.Journal of Hygienic Engineering and Design 11 (2014) 15-19.

9. AOAC : Official method of analysis. Maryland, USA: Publication by AOAC International (2016).
10.Nielsen,S.S.: Phenol-Sulfuric Acid Method for Total Carbohydrates.Food Analysis Laboratory Manual (2009) 47-53.