CORRELATION ANALYSIS BETWEEN SOME PHYSICO-CHEMICAL PARAMETERS OF SOME FRUIT JUICES

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Abstract: The purpose of this study is to analyze the changes of pH values, vitamin C, acidity, density, water activity of fruit juices during storage. The manufacture of pulp and clear juice must ensure that the vitamin and mineral content of fruits and vegetables used is found in the finished product.

Of citrus juices, orange juice is the most appreciated and used because of its flavor and high content of vitamin C. Evaluation of the quality and determination of life (shelf life) it is based mainly on the progress of vitamin C during storage.

Fruit juices were prepared using a robot type fruit squeezer. Were prepared orange juice, kiwi, apple, the flesh and clear and mixed fruit in different proportions. Physico-chemical characteristics were determined from fresh juice as well as from juice kept in refrigerator, at certain time intervals (one day, two days, five and seven days). The storage of these juices under refrigeration conditions has determined percentage reductions of vitamin C content of these ones. Kiwi fruit and oranges are high in vitamin C, the results confirm that mixtures containing two fruits have a higher ascorbic acid than the other.

Keywords: clear juice, vitamin C, kivi fruit, orange, apples.

Introduction

Due to their potential nutritional and biological fruit juices are foods with multiple implications for body balance. The richest sources of vitamin C are citrus fruits, kiwi fruits, but also local fruits underbrush, sweet briar, apples etc.

Apples *Mallus pumilla Fam. Rosaceae*, are some of the most important fruit grown in the region of Suceava. Apple fruits are directly consumed in the form of fresh juice which can also be used in soft drinks for jellies and jams, for flavouring paste, dried fruit, etc.

In terms of chemical composition fruits consist of water and dry matter. The dry matter contains considerable amounts of dry vitamins, acids, sugars, polysaccharides, pectin, cellulose, polyphenols and minerals.

Non-enzymatic antioxidants, subjects on a growing list, are a large group of compounds coming from food. These include glutathione and vitamine E (Tocopherols), vitamin C (ascorbic acid), carotenoids and bioflavonoids. Vitamin C is a common natural substance, especially in plants.

A study by Steinberg (1993) cited by [1] indicate their particular importance. Antioxidant vitamins (A, C, E and bioflavonoids) have the strongest effect, preventing membrane lipid peroxidation and accumulation of atherogenic compounds that affect the integrity of the vascular wall.

Studying a range of fruit and vegetables, Adrian A. Franke and others have shown that vitamin C and flavonoid levels vary widely not only by species and variety, place of growth, harvesting period and storage, but they also vary depending on processing methods.

The authors determined the concentrations of ascorbic acid and flavonoids and found significant losses during storage and especially during thermal processing. [2].

Vitamin C becomes unstable in the presence of oxygen, oxidation depending on pH (at pH 4.3 it is very fast), temperature (oxidation rises with increasing temperature to 60 ° C), the presence of heavy metals (particularly Cu at mg / kg). Anthocyanins, sugars and starches [3] have a protective effect on vitamin C.

Storage temperature was the prime limiting factor for shelf life of orange juice [4].

Consumption of fruit juices with pulp is recommended, being used in the treatment and prevention of cardiovascular diseases, liver disease, etc., natural juices providing a high percentage of vitamins and minerals in daily dose.

The purpose of the given work was to determine the physico-chemical and organoleptic properties of the juice samples obtained from apples, kiwi and orange fruits.

Materials and methods

Plant material:

Mature fruit samples (table 1), approximately 1 kg each were purchased from a local market in may 2012.

Fruit juices were prepared using a robot type fruit squeezer. Orange, kiwi and apple juices were prepared fresh and clear and the fruit were mixed in different proportions.

Each type of juice clear samples was filtered to remove pulp and seeds and stored in already labeled plastic containers were stored at refrigerated at 4°C for seven days after processing.

Table 1 Botanical and common names of fruits used for the analysis

Botanical name	***Common name***
Actinidia chinensis	Kiwi fruit
Citrus sinensis	orange
Mallus pumilla	Apples Golden delicious

Chemical analyses:

Vitamin C was determined using 2,6-dichlorophenolindophenol titration. The pH of the juices was evaluated using a digital pH meter at 27ºC. Titratable acidity was determined by titrating samples with 0.1M NaOH and was expressed as percentage citric acid. Soluble solids were determined using an Abbe refractometer and corrected to the equivalent reading at 20^0 C (AOAC, 1995), density (d20) – using the densimetric method.

Statistical analysis:

The PCA was performed using Unscrambler X 10.1 (CAMO Process AS, Oslo, Norway), all the physicochemical parameters were weighted and normalized for performing the PCA. The PCA was applied to describe the relationship among the physicochemical parameters.

Results and discussion

12 samples were formed, and Table 1 shows the values obtained for physico-chemical characteristics.

Table 2 Physico-chemical parameters of juice samples

	Samples		***pH***	***Vit C mg/100 g***	***Acidity g/l***	***a_w***	***Total soluble solids %***	***Density g/cm³***
P1	Orange	Juice pulp	3.23	30.8	4.02	0.928	12.2	1.047
P2		Clear juice	3.90	13.2	3.92	0.915	12.1	1.047
P3	Kiwi fruit	Juice pulp	3.20	83.6	3.97	0.931	12.2	1.047
P4		Clear juice	3.83	74.8	3.70	0.930	12.2	1.047
P5	Mixture 50 orange: 50 kiwi	Juice pulp	3.62	75.68	3.85	0.948	12.2	1.047
P6		Clear juice	4.22	48.4	3.47	0.944	12.0	1.047
P7	Mixture 70 orange: 30 kiwi	Juice pulp	3.58	52.8	3.78	0.947	12.1	1.047
P8		Clear juice	4.19	68	3.44	0.945	12.1	1.047
P9	Mixture 30 orange: 70 kiwi	Juice pulp	3.50	96.8	3.91	0.938	12.2	1.047
P10		Clear juice	3.92	44	3.55	0.935	12.1	1.047
P11	Apple	Juice pulp	3.51	29.8	3.95	0.945	12.9	1.046
P12		Clear juice	3.9	22.5	3.72	0.935	12.7	1.046

The pH analysis of the juice shows significant differences depending on the fruit used, and it shows higher values for clear juice as compared to juices with pulp. pH is the main factor affecting the stability of vitamin C, thus high values of pH favouring the oxidation processes of vitamin C.

The total soluble solids of the sample juice analyzed remained almost constant in the initial weeks. According to [5] the total soluble solids started to decrease after 7 weeks storage time. They reported that the change in total soluble solids is due to the presence of the microorganisms that cause the fruit juice to deteriorate as a result of sugar fermentation.

Table 3 Pearson correlation of physicochemical parameters of juice samples

	pH	Vitamin C	Acidity	a_w	Total soluble solids, %	Density
pH	1					
Vitamin C	-0.199ns	1				
Acidity	-0.880***	-0.056ns	1			
a_w	0.136ns	0.355ns	-0.367ns	1		
Total soluble solids, %	-0.230ns	-0.351ns	0.337ns	0.137ns	1	
Density	0.16ns	0.480ns	-0.144	-0.155ns	-0.959***	1

ns - not-significant, P<0.001 ***

Table 3 shows the correlation matrix obtained for each pair of variables. The highest negatively correlation have been observed in the case of density with total soluble solids (r=-0.959), followed by acidity with pH (r=-0.880), while the highest positively correlation have been observed in the case of density with vitamin C content (r = 0.480). All the rest correlation is negligible.

A PCA was conducted to evaluate the global effect of physicochemical properties on the juice type, from a descriptive point of view. Figures 1 and 2 show the sample scores and compound loadings of the PCA analysis performed. It was found, that two principal components (PCs) expalined 97% of the variations in the data set. The PC1 explains 72% of the variability, and the PC2 explains 25%. The PC-2 allows dividing the juice in two major groups: in the left part the juice which have in composition kiwi, while in the right part the juice without kiwi. The right group is formed by the apple juice (clear and with pulp) and orange juice (clear and with pulp).

In the figure 2 is presented the parameters loadings; it can be observed that the major influence on the descriptive view is represented by vitamic C content, pH and acidity, while a_w, TSS and density do not influence in the same amount like the formers.

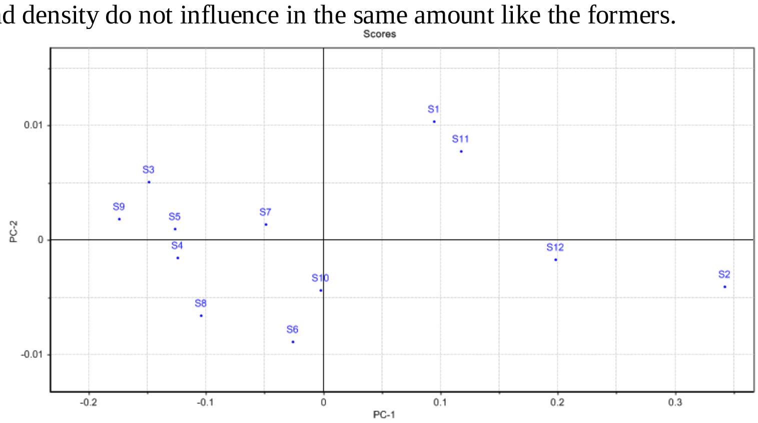

Fig. 1. PCA of the physicochemical parameters scores of juice samples

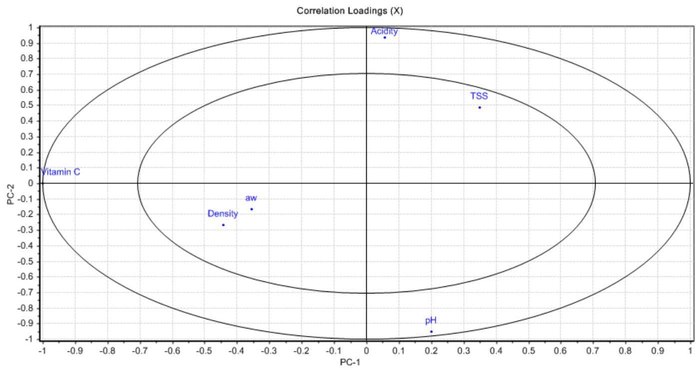

Fig. 2. PCA analysis of the physicochemical parameters loadings of juice samples

The content of vitamin C is an important parameter for assessing the nutritional value of the food as it degrades during storage [6, 7, 8].

The results show that fresh kiwi juice and juice mixture Kivi: 70:30 orange has the highest content of vitamin C, 83.6 mg or 96.8mg per 100g of product.

Vitamin C is an important anti-oxidant, helps protect against cancers, heart disease, stress, it is part of the cellular chemistry that provides energy, it is essential for sperm production, and for making the collagen protein involved in the building and health of cartilage, joints, skin, and blood vessels[9].

Table 4. Evolution of vitamin C during storage

Variant	***Samples***		***Vit C mg/100 g***			
			Day 1	***Day 2***	***Day 5***	***Day 7***
P1	Orange	Juice pulp	30.8	30.2	28.6	25.9
P2		Clear juice	13.2	13.0	12.2	10.8
P3	Kiwi fruit	Juice pulp	83.6	83.1	77.6	72.1
P4		Clear juice	74.8	74.6	70.5	67.8
P5	Mixture 50 orange: 50 kiwi	Juice pulp	75.68	74.1	72.9	63.5
P6		Clear juice	48.4	48.1	45.1	39.7
P7	Mixture 70 orange: 30 kiwi	Juice pulp	52.8	51.5	48.7	42.1
P8		Clear juice	68	67.5	65.2	52.5
P9	Mixture 30 orange: 70 kiwi	Juice pulp	96.8	95.8	90.2	86.2
P10		Clear juice	44	43.5	40.1	35.7
P11	Apple	Juice pulp	29.8	29.6	28.2	25.6
P12		Clear juice	22.5	21.6	19.8	18.7

Decreasing the amount of ascorbic acid per 100 g of product is evident in orange juice and mixture juice, compared to 100 g product;

Results show that minimum percent maximum decrease in ascorbic acid content was recorded in sample minimum in P8 (22.8%) (Table 4), and minimum in P12 (16.8%).

As long as the juice will be consumed fresh, it will keep its properties and nutrients. Fresh juice, squeezed and consumed immediately only has a higher content of vitamins than the pasteurized one (although there is a loss of vitamins and spinning) [10].

Conclusions

Some physico-chemical indices of juice fruit refrigerated at 4°C for seven days after processing were analyzed. During fruit juice storage important quality losses occur.

Duration and storage temperature significantly affect the vitamin C content of juices analyzed.

Among the analyzed juices the product with higher content of vitamin C is kiwi fresh juice and juice mixture Kiwi: 70:30 orange has the highest content of vitamin C, 83.6 mg or 96.8mg per 100g of product.

The analysis of our data showed that storage period and treatments had a significant overall acceptability (obtained from color, flavor and odor) of the twelve sample juices.

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