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Study on obtaining vegetables juices with high antioxidant potential, preserved by ohmic pasteurization

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Abstract

In recent years is growing the interest in healthy eating to help prevent diseases. Numerous scientific studies have demonstrated the importance to human health of consumption of raw vegetables and fruits. The natural juices of vegetables and fruits are a concentrated form of vitamins, minerals and antioxidants.

Our team proposes a healthy drink with a balanced nutrient content and low caloric value, which also constitutes an important source of vitamins, antioxidant compounds and dietary fiber needed for digestion. In the present study were used juices obtained from vegetables grown on Romania, namely pumpkin, carrot and celery, mixed with citrus fruits, oranges and grapefruits. It was analyzed the chemical composition and the content of antioxidant compounds of some variants of cocktails, only with vegetal juices. To ensure preservation of these cocktails it was used ohmic pasteurization, which can provide better nutritional properties and keeping sensory characteristics for a period of 14 days. From experimental data resulted that thermic effect of ohmic method is less harmful on flavonoids than conventional method. After this period of 14 days of storage, the highest amount of polyphenols was fined for sample P_3 of cocktails, with grapefruit juice. The lowest content of flavonoids was found for sample P_1, with the smallest amount of pumpkin juice. Finally, checking of acceptability of consumers by sensory analysis revealed that ohmic pasteurisation of juices have obtained a higher score than conventionally pasteurisation and had no negative influence on flavor of juices.

Keywords: vegetable juices, pumpkin, antioxidant activity, ohmic pasteurisation, sensory characteristics

1. Introduction

Numerous scientific studies have demonstrated the importance of consumption of fruits and vegetables raw. At the same time, the juices from fruits and vegetables represent a type of healthy drink, containing balanced nutrients and having a low caloric value. Eating fruits and vegetables brings to consumers multiple health benefits, being an important source of vitamins, minerals, trace elements and a factor for preventing obesity by reducing energy intake.

Juice consumption made from fresh fruits and vegetables is known as a factor that increases vitality and induce beneficial detox processes. Another result of the consumption of juices is rapid healing of damaged tissues of the body.

Fruits and vegetables contains the major parte of antioxidants and have low-calorie content [2] is recomanded to eat daily.

It was used pumpkin [3,7,10], who contains a large amount of carotenoids, which mince a source of pro-

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vitamin A: β-carotene, β-cryptoxanthin, α-carotene [11].

Others researchers found that the content of α and βcarotene in *Cucurbita moschata* pumpkin is aproximativ 100 µg/g [6].

Some studies indicated that consumption of carotenoids lowers the risk of degenerative and cardiovascular diseases, cataracts, macular degeneration, certain types of carcinomas [13]. Pumpkin pulp has low caloric value, 15–25 kcal/100 g, depending on variety [1], it is recommended in diets.

Carrots contain carotenoids as pro-vitamin A, easily assimilated. Dose for a person is between 700-700 µg/day. A serving of carrots provides a significant amount of fiber, protein and a significant percentage of the recommended daily dose of essential vitamins and minerals. A medium carrot provides 204% of the daily dose of vitamin A and 25 calories.

Celery has a high content of vitamin B 6 and fiber, vitamin C content helps build a strong immune system.

Cooking of juices can inactivate nutrients and enzymes, in order to increase the duration of preserving of natural juices, it was tried to find unconventional technological procedures, who did not affect its nutritional and organoleptic properties [5,9,12,14,17].

Some studies have shown the effect of thermal processing of the conventional technologies revel the organoleptic and nutritional degradation of the components [4,8,15,16].

It was elected heat treatment by ohmic heating, which is a processing method that uses power directly on food. Due to electrical and thermal conductivity, food is quickly and deeply heated. The heat generated in the food destroys pathogenic microflora and with potentially toxic in the same way as the classical heat treatment. This method of preserving food excludes the heat transfer surface, and the organoleptic characteristics of products are superior face the conventional heat treatment.

In this study it intent to obtain some varieties of fruit and vegetable juices, mixed in different proportions, to ensure intake of essential nutrients for the human body. Were tested some variants of mix of juice obtained from vegetables and fruits. After this, 4 variants were chosen and characterized physical and chemical, from the point of view of stability and sensory analysis. Thus we determined the contribution of each raw material properties of the final product.

We also analysed the influence of conservation processes, conventional and ohmic, the preservation challenge, physicochemical and sensory changes of juices.

2. Material and methods

2.1. Materials. Row material, mince vegetables, was purchased from farmers market and fruits were purchased from market. Juices obtained are part of category of juice with pulp. At preparation of mix juice was not used sweeteners and other additives, but only juice of fruit and vegetable obtained from a juicer. It was used juice obtained from two vegetables and one fruit for each of four variant of juice, in the proportion presented in the table 1. Proportions was establish by sensory tasting with the entire equip.

Table 1. Juices variants obtained from vegetables and fruits (%)

Compound	Samples			
	P1	P2	P3	P4
Pumpkin	20	30	30	30
Carrot	40	30	30	-
Celery	-	-	-	10
Orange	40	40	-	60
Grapefruits	-	-	40	-

For the comparative analysis of the effects of the classical method was used classical pasteurization of the juices on a water bath, dosed in glass containers, at 70°C for 10 minutes. Low temperature and short time, established as result of preparatory experiments, were conditions selected for pasteurised variants of cocktails, in order that this procedure affects in small measure the nutritional parameters. Conventional pasteurization was done on bain marie, juices were placed in sealed glass containers. Pasteurization temperature measurement was performed with thermometer with alcohol. Conventional pasteurization process is based on the gradual heating of the juice to a temperature of pasteurization, and maintaining the temperature a given time.

Like an alternative method was used ohmic pasteurization at 70°C. Ohmic pasteurisation is an efficient method for pasteurizing food who excludes heat transfer surface and organoleptic characteristics are superior to conventional thermal processes treated. Ohmic pasteurization of juice was based on the current passing through product, using stainless steel electrodes placed in a vat of ohmic heating, heat-resistant.

Characteristics of ohmic pasteurization installation: electrodes type - stainless cylindrical steel, distance between electrodes – 100 mm, electrodes diameter – 5 mm, heating surface area 2600 mm^2.

After pasteurisation the samples were slowly cooled at 4-5°C and kept in refrigerator.

All three types of juice (fresh, conventional pasteurized, ohmic pasteurized) were dosed in glass containers, from where samples were taken for analysis.

2.2. Methods

Chemical composition of fruit and vegetable juices was determined by the following methods:

- determination of dry matter was performed according to STAS 2213/4-86 thermo balance Precisa XM 60. For each sample were made two successive readings;
- determination of ash content was carried out by means of calcination at 550-600°C, according to STAS 90/1988;
- determination of total nitrogen content was performed according STAS 90/1988, SR ISO 1871/2002-Kjeldahl method. Protein content was calculated by multiplying total nitrogen content by the conversion factor 6.25;
- determination of lipids with Soxhlet method;
- determination of reducing sugars-Schoorl method - according STAS 6182/18-81.

Electrical conductivity was measured with a conductometer, model YK-2005 CD; temperature, current and voltage were determined with instruments included in ohmic pasteurization installation.

Total polyphenol content of the extracts was determined spectrophotometrically using gallic acid and tannic acid as standard, Folin-Ciocalteu method as described by the International Organization for Standardization (ISO 14502-1)[18].

Estimated *total content of flavonoids* has been made using a spectrophotometric method based on the formation of a yellow flavonoid-aluminum and its absorbance read at 430nm.

Sensory analysis was performed by a group of seven panelists of Sensory Analysis Laboratory, Department of Food Science, Food Engineering and Applied Biotechnology at the University "Dunarea de Jos" University of Galati. The panelists were appreciated appearance, color, taste, odor and mouthfeel for all four variants of juice, in form of fresh, conventional pasteurized and ohmic pasteurized juice. The tasting was done within an hour, with relaxing short breaks between samples for tasting. The samples were dosed into portions of 50 ml of each sample for each taster, in disposable cups. Evaluation of samples was based on a scale between 0-9 points (0 = totally inappropriate, 9 = very good). Finally, panelists were performed a preference test for each type of juice.

3.Results and Discussion

Ohmic pasteurisation. Were used two values of voltage in ohmic pasteurization, 20 V and 17.5 V, in order to choose the best method that is suitable for fruit and vegetable juices. It was chosen 17.5 V, because it was obtained a nonspecific color for samples pasteurized at 20 V. Initially there is a rapid

increase in temperature, after this, the increase is slow. Time for increasing of temperature is relatively low, about 3-4 minutes, compared to the conventional method, 10 minutes.

Physico-chemical characterization of raw materials and cocktails. Row material, means vegetables and fruits, were characterized in terms of physico-chemical, results of the determinations are shown in Table 2.

Table 2. Physico-chemical characterization of juices from raw materials (%)

Juice's name	Carbohydrates	Proteins	Lipids	Ash	Dry matter
Pumpkin	4,6	0,7	0,1	0,41	5,81
Carrot	7,8	0,6	0,4	0,58	9,38
Celery	7,2	1,4	0,3	0,66	9,56
Orange	8,6	0,7	0,1	0,42	9,82
Grapefruit	5,2	0,3	0,1	0,38	5,98

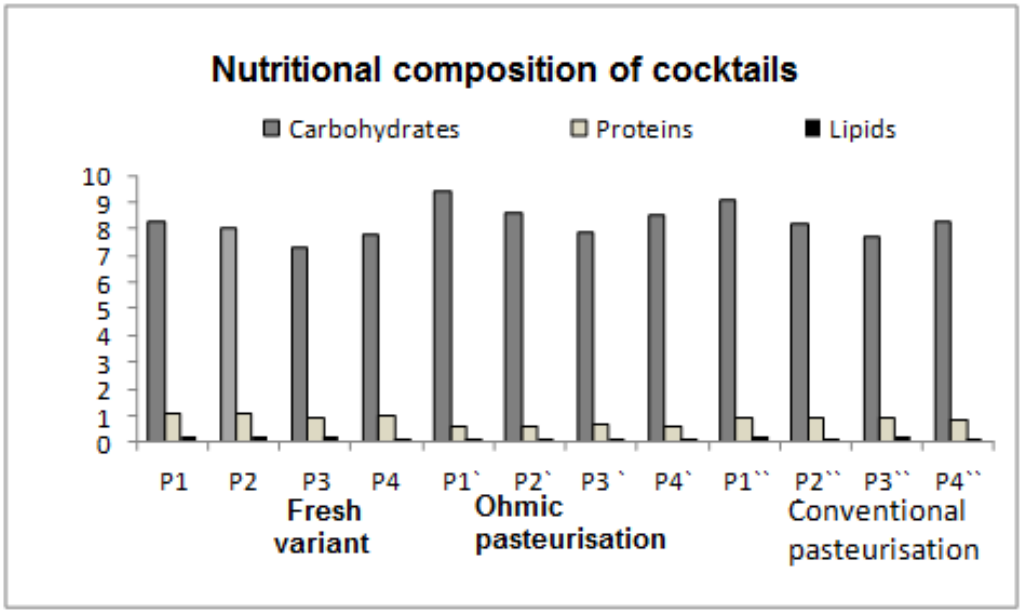

Figure 1. Nutritional composition of all variants of cocktails
Variants: fresh (P), ohmic (P') and conventional (P") pasteurized juices
P1 -20%pumpkin, 40% carrot, 40% orange juice, fresh;
P2 -30%pumpkin, 30% carrot, 40% orange juice, fresh;
P3 -30%pumpkin, 30% carrot, 40% grapefruit juice, fresh;
P4 -30%pumpkin, 10% celery, 60% orange juice, fresh;

Nutritional composition of cocktails is presented in Figure 1 and revel some differences between the tree variants, fresh, conventional and ohmic pasteurisation.

Proteins value was similar for ohmic and conventional pasteurized juices, but carbohydrates value was bigger with 3-4.25% for ohmic method than conventional method.

It can be seen that the highest values of carbohydrates were for variant P1 of cocktail, containing 40% carrot juice. Highest carbohydrate content it was find in carrot juice, and the lowest was in pumpkin, content was double for carrot and celery than pumpkin and grapefruit, similar with orange juice. The amount of protein was higher in celery juice, while the lower fat content was in pumpkin juice. Proteins and lipids content are very small for all fresh juices, between 0.5 -1%.

Determination of **antioxidants** (polyphenols and flavonoids), was done after standard curves, variation of content are presented in Figure 2 for all variants of juices.

It can see that, after 7 days, the most important quantity of antioxidants compound is registered for the variant P3 ohmic pasteurised juice, with 30% pumpkin and 40% grapefruit juice. After 14 days it was determined an antioxidant activity for the P3 and P4 samples, ohmic pasteurised variant. Only ohmic pasteurised juice was preserved some antioxidant activity after 21 days.

Sensory analysis. The panelists of our faculty were appreciated the appearance, color, taste, odor and mouthfeel for all four variants of juice, in form of fresh, conventional pasteurized and ohmic pasteurized juice.

In Figure 3 are presented the appreciation and the differences between the four cocktails. It can see that for P1, P3 and P4 variant there are no important differences between the two model of conservation, conventional and ohmic pasteurisation. Appearance and aroma was more appreciated than the others characteristics. Taste was bad appreciated for all samples. The most appreciated were pasteurized juices than the fresh one, but the differences between them were not large, up 0.53 points.

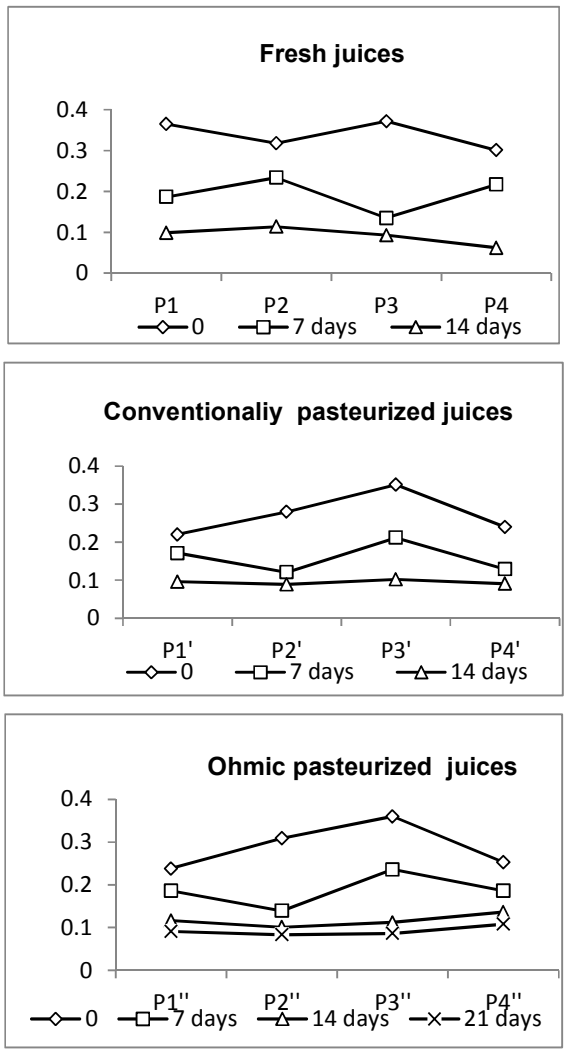

Figure 2. Antioxidants composition (gallic acid) of all variants of cocktails

a) fresh juices (P); b) ohmic pasteurized juices(P'); conventional pasteurized juices(P");

P1 - 20%pumpkin, 40% carrot, 40% orange juice, fresh;
P2 - 30%pumpkin, 30% carrot, 40% orange juice, fresh;
P3 - 30%pumpkin, 30% carrot, 40% grapefruit juice, fresh;
P4 - 30%pumpkin, 10% celery, 60% orange juice, fresh;

Lowest score was obtain for fresh juices - variant P1 (20% pumpkin juice) with a smaller amount of pumpkin juice than P2 (30% pumpkin juice). P2 variant was good appreciated for ohmic pasteurised samples. We conclude that pumpkin flavour did not influence panellists negatively.

For all samples, ohmic pasteurized juices obtained a higher score than conventionally pasteurized juices.

We conclude that ohmic pasteurization had no negative influence on flavour of juices.

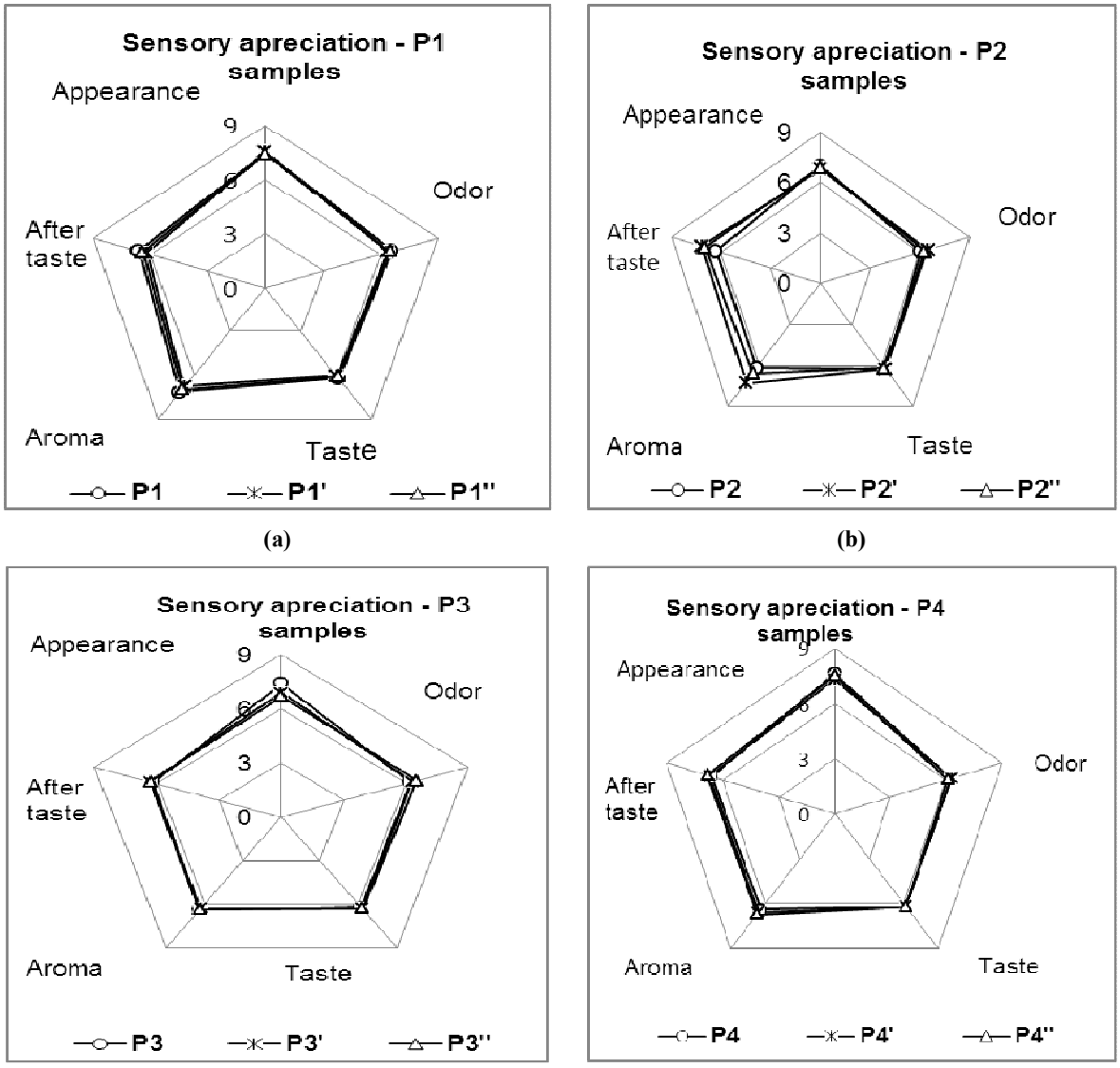

Figure 3. Sensory appreciation of all samples of cocktails
Variants: fresh (P), ohmic (P') and conventional (P") pasteurized juices
a) P1 - 20%pumpkin, 40% carrot, 40% orange juice, fresh;
b) P2 - 30%pumpkin, 30% carrot, 40% orange juice, fresh;
c) P3 - 30%pumpkin, 30% carrot, 40% grapefruit juice, fresh;
d) P4 - 30%pumpkin, 10% celery, 60% orange juice, fresh;

4. Conclusion

Due to nutrient content, low in carbohydrates and high in antioxidants, natural juices of fruits and vegetables can be served at breakfast. Through their consumption the organism procures the necessary elements for its proper development and functioning such as vitamin C, antioxidants and fiber. Pumpkin and celery are not normally consumed as juice, but combining them with other vegetables and citrus were appreciated by tasters.

For better conservation were used two methods of pasteurization, conventional and ohmic. Conservation was increasing with a period up to 5 days for conventional pasteurization and 8 days for ohmic pasteurisation.

No significant negative effects of pasteurised juices on the composition, nutritional and organoleptic, compared to fresh juices was found.

Ohmic pasteurization proved to have very little influence on nutrient content and sensory, juice was considered a good alternative to conventional pasteurization.

Optimal parameters for ohmic pasteurization of juice were choosing a voltage of 17.5 V and the temperature of 70°C. By using a higher current it was observed negative change for color and consistency of juices.

Sensory analyse of ohmic pasteurised juices obtained higher scores from tasters than conventional pasteurized juices with 0.53 point.

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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