NUTRITIONAL AND SENSORY CHARACTERIZATION OF FROZEN PEAS DURING CULINARY PROCESSING

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Abstract: Food grains are nominated as the main sources of soluble fiber, vegetables are very important to produce insoluble fiber, like peas [6]. The market of our country has been flooded with a wide range of plant products frozen or preserved by sterilization, whose culinary use is growing. But the quality of these products has decreased; the material may be affected by the frozen storage. Study has analyses the evolution of the nutritional characteristics of three varieties of peas grown in the region Galati, subject to freezing or sterilization, and their behavior during cooking.
Keywords: pea, storage, nutrients, technological losses during heat treatment, sensory analysis of pea and food.

Introduction

Pea is one of the most versatile foods. We can make pea soup, risotto with peas, combined with pasta, can use on pizza and salad, can made peas and curry. In Romania, the peas are mainly used for foods with meat sauce. Leguminous are characterized by a high content of compounds of carbohydrates, proteins and vitamins B groups. Under the climatic conditions of Eastern Europe, leguminous more popularly grown and consumed are peas and beans. But the consumption of these vegetables is too low compared with dietary recommendations. This may be due to eating a bad habit, but also because of the insufficient supply of ready-to-eat products that are easy to prepare by the consumer. When food products are subjected to a heat treatment, pathogenic and putrefying microorganisms are eliminated and the endogenous enzymes can be inactivated, but the organoleptic and nutritional quality are also affected. Pea consumption requires pretreatments such as dulling, heat treatment and rehydration. Although these treatments provide some nutritional benefits, they are reported to alter the content and physico-chemical properties of components [11, 14].

Domestic cooking methods are known to reduce levels of anti-nutrients and thus improve the nutritional value [13] and to improve the digestibility of pea starch [12]. Cooking whole or split peas in boiling water is the most common method used to obtain a palatable product with enhanced nutritional value.

Although studies have been done on the chemical composition of raw pea, little information is available on the composition of processed peas. Changes in the composition and nutritional pea varieties that are grown in SE Romania formed the basis of our research; the biological material has been obtained from SC Contec Tecumseh SA, in Galati County and later transferred to study in the laboratories of the Faculty of Food Science and Engineering Galati.

Materials and Methods

Pea varieties used in the experiments of our team are:

- ***Apor*** variety - it's like a half early, about 86-87 days after emergence. It is resistant to *Fusarium* wilt. The pod contains 7-8 seeds. Their size is medium to large, 90% of them have a diameter between 8-9mm.

- ***Villio*** variety - is a late variety of pea, resistant to mildew and *Fusarium*. The pods are slightly curved, pointed, with 7-8 beans inside. The percentage of grains larger than 10 mm was 60%. This variety is very resistant.
- ***Omega*** variety - is approved in Moldova in 2000. Has an average size of 65-90 cm, leaf consists of 2-3 pairs of leaflet finished with 5-7 cases. Omega variety ripens evenly, half early is kind, and has a growing period of 83-102 days. It is shock resistant beans. The pressure drop and the main condition are identical to the control.

Determinations made to establish the composition for each type separately, so that the beginning and throughout the storage period, monthly for 12 months, as follows:

- protein content: Kjeldahl method;
- fat: gravimetric method (Soxhlet method);
- carbohydrates: Total Carbohydrate: Schoorl method; starch: hydrolysis process heat;
- vitamin C: iodometric method;
- antioxidant capacity: DPPH method.
- chlorophyll: Spectrophotometric method with acetone, using a spectrophotometer (T80 + UV / VIS SPECTROMETER PG - Instruments LTD);
- technological losses during heat treatment: after 12 months of storage;
- sensory analysis of pea samples: samples of 500 g of peas were boiled for 10 minutes in the hot or cold water. A team of eight specialists tested the five characteristics considered important for peas: general appearance, taste, color, smell and texture;
- sensory analysis of food culinary was performed by a team of 12 panelists specialized in the analysis of food using a 9-point scale (1 = unacceptable, 9 = acceptable). The team performed two parallel samples for all three varieties and four tests each time, then averaged the dates that was used in the tables and figures presented.

Results and discussions

Because are very perishable, legumes suffer preservations processes to maintain nutritional qualities of components, such as freezing, drying or sterilization. [7] In our study we followed the behavior for three varieties of peas used in the region Galati: Apor (A), Villio (V), Omega (O), during storage in frozen state for a period of 12 months. In parallel, we studied the behavior of a sterilization of the three varieties of peas for 12 months, range Omega.

We had source documents certified seed for these varieties released by Laboratory Central Agricultural Office HU01, Budapest II, who issued the analysis reports.

Half of the fresh samples were blanched 4 minutes at 95ºC. Blanching produced the inactivation of peroxidase and allowed better maintenance of colour and chlorophyll, reducing the microbial load on the surface of vegetables [5, 10]. After blanching it has verified the degree of inactivation of the enzyme by the reaction of peroxidase. Control of the inactivation of peroxidase gives a negative result for all lots of blanched peas.

Then all the samples, blanched and control were frozen. It was monitored the behavior of the product during frozen storage, monthly, a period of 12 months, the team has made determinations on control samples and blanching product. The temperature varies a little during storage in frozen state, within the limits of -22.5-24ºC.

After the package we used peas blanched and control for to cooking. Others samples was sterilized at a temperature of 120ºC for 20 minutes to 1.6 at. in glass containers and were deposited for 12 months.

The major nutritional components peas for food are proteins, carbohydrates and lipids [1]. Antinutritional factor that exists in peas and other legumes reduces the availability of nutrients such as proteins and starch, but the blanching significantly reduces this inconvenience. During the frozen storage between the control samples and blanched were observed differences between the three varieties, presented in Table 1.

Table 1. Characterization of nutrients of three varieties of peas (g/100 g dry)

Compound of nutrients	Variety	Control			Blanched		
		Fresh	6 months	12 months	Fresh	6 months	12 months
Proteins	*APOR*	25.32±0.06	24.14±0.02	23.32±0.05	22.41±0.07	22.25±0.05	21.91±0.03
	VILLIO	24.66±0.10	23.69±0.02	23.08±0.04	22.35±0.04	22.36±0.02	22.28±0.04
	OMEGA	25.61±0.03	23.53±0.04	23.53±0.02	22.04±0.03	22.04±0.06	22.10±0.02
Carbon's Hydrates	*APOR*	63.75±0.21	60.89±0.14	58.37±0.13	56.25±0.09	55.42±0.11	54.60±0.17
	VILLIO	71.19±0.18	67.42±0.08	65.49±0.11	63.85±0.10	61.54±0.07	62.03±0.12
	OMEGA	56.93±0.09	53.49±0.06	53.02±0.10	50.71±0.16	50.07±0.15	49.67±0.13
Lipids	*APOR*	1.56±0.01	1.48±0.00	1.40±0.02	1.37±0.01	1.33±0.01	1.32±0.01
	VILLIO	1.96±0.01	1.84±0.01	1.81±0.02	1.76±0.01	1.67±0.00	1.69±0.00
	OMEGA	1.73±0.02	1.60±0.02	1.60±0.01	1.52±0.00	1.78±0.01	1.49±0.02
Starch	*APOR*	35.42±0.04	33.82±0.09	32.43±0.05	31.25±0.10	30.79±0.04	30.34±0.09
	VILLIO	33.11±0.08	31.36±0.07	30.46±0.06	29.70±0.08	28.62±0.06	28.85±0.08
	OMEGA	38.97±0.12	36.64±0.11	36.32±0.13	37.73±0.07	34.30±0.07	34.02±0.14

For the sterilized product, determinations about the variety Omega gave us values for nutrient components very different face samples preserved by freezing (Table 2).

Table 2.Samples sterilized nutrient components-Omega variety (g/100 g dry)

Compound of nutrients		Echantillons stérilisés	
	Fresh	6 months	12 months
Proteins	18.39±0.01	14.77±0.02	14.12±0.00
Carbon's Hydrates	40.87±0.03	39.42±0.06	39.61±0.11
Lipids	27.98±0.03	29.95±0.04	35.20±0.10
Starch	1.24±0.06	1.30±0.01	1.32±0.00

The largest initial amount of vitamin C was determined in the variety *Villio*. Our determinations showed an average content of vitamin C between 23.75-26.39 mg/100g for fresh produce. After blanching, the samples showed a decrease in vitamin C, but during freezing peas do not suffer significant losses of vitamin C (Figure 1).

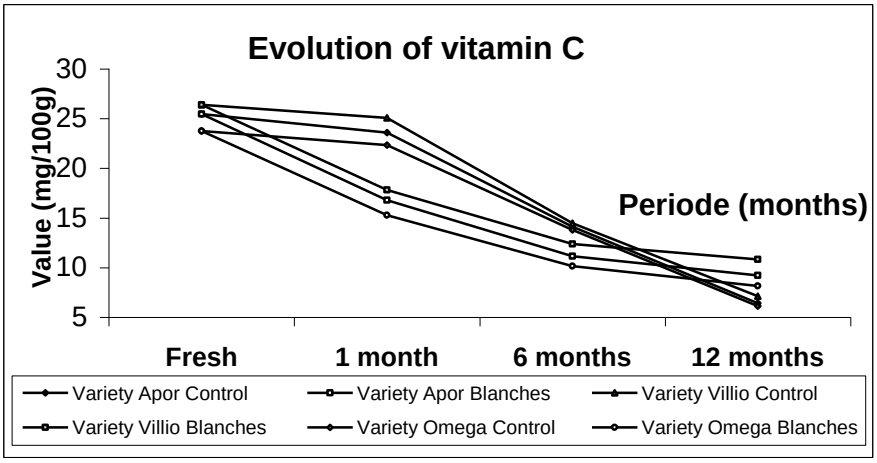

Fig. 1. Vitamin C - annual change during storage

Analysis of the antioxidant capacity in the soluble fraction in water gave us a significant correlation between this feature and the content of vitamin C [3], so that the variety Villio is the most important.

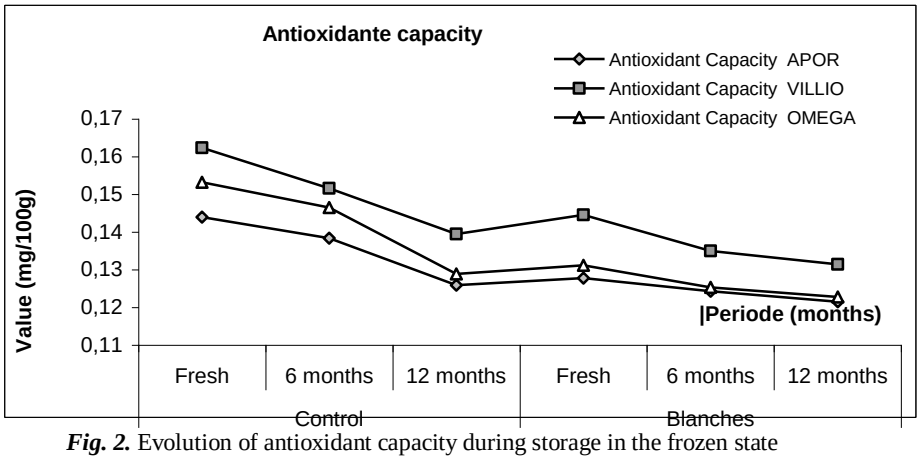

Fig. 2. Evolution of antioxidant capacity during storage in the frozen state

We can observe that the values for antioxidant capacity have ranged between 0.88-0.93 from Apor, between 0.90-0.94 from Omega face to Villio, so a difference between maxims 5-12% (Figure 2). These are important results, it is necessary to valorize this characteristic of the variety Villio.

Research on determining the fading vegetables during processing are based on quantitative analysis of chlorophyll pigments. The amount of total chlorophyll was determined taking into account that the stability of the chlorophyll is influenced by negative laundering and storing frozen state. Storage conditions of frozen peas can cause a significant loss of chlorophyll a and b under the action of chlorophyllase, which produces components gray (chlorophilides).

The total chlorophyll content decreased due to significant blanching and freezing up about 16.20%. After six months of frozen storage at -22 ...-25oC, the value of total chlorophyll attend 68.28% from the beginning, but at the end of the storage period the content represented 58.92% of the initial to variety Villio (Table 3). For other varieties values were smaller.

Table 3. Variation of chlorophyll *a* and *b* during storage for 12 months in a frozen state

Variety	Échantillons	Chlorophyll *a* (mg/kg)			Chlorophyll *b* (mg/kg)		
		Fresh	6 months	12 months	Fresh	6 months	12 months
Apor	Control	145.33±0.12	80.67±0.04	72.81±0.02	72.67±0.06	40.33±0.01	37.30±0.01
	Blanches	130.09±0.09	74.67±0.02	64.90±0.01	65.05±0.03	37.33±0.04	33.00±0.00
Villio	Control	150.11±0.06	102.67±0.00	82.78±0.12	75.05±0.02	51.33±0.02	47.00±0.01
	Blanches	138.00±0.04	89.33±0.13	74.67±0.07	69.00±0.01	44.67±0.03	41.60±0.03
Omega	Control	133.33±0.11	68.67±0.06	64.90±0.02	60.00±0.00	34.33±0.02	34.67±0.02
	Blanches	117.30±0.09	64.00±0.08	56.00±0.02	51.40±0.04	32.00±0.02	28.00±0.01

Losses were between 2.22-7.11% from the determinations of peas storied 12 months; the samples of pea were introduced 10 minutes in boiling water. The biggest losses were recorded at samples *Apor* and *Villio* blanched, respectively 7.11% and 5.84% and smaller for *Villio* control and *Omega* blanched, approximately 2%. Omega fresh had losses in value of 4.16%.

The heat treatment in 1% salt in water showed increasing weight of maximum 6.42% for *Villio* control face the beginning and minimum 0.68% for *Apor* control. *Omega* fresh recorded an increase of 4.65% against the beginning.

Cooking food. With these three peas varieties we made two products: salad of peas and pea paste. To check how the cooking preserves the nutritional qualities of the original pea, we have determinate vitamin C and dry. The results show that the cooking with peas from the last months of storage preserve largely the vitamin C, between 91-94% against the raw material, control and blanched peas. Boil peas retain between 0.61-0.84 facing the raw material, so an acceptable percentage (Table 4).

Table 4.Variation of vitamin C in boiled food - relative values

Varieties	Samples	Salad of peas boile	Pate of peas boiled
Apor	Control	0.73	0.81
	Blanches	0.73	0.83
Villio	Control	0.78	0.84
	Blanches	0.80	0.76
Omega	Control	0.73	0.84
	Blanches	0.61	0.79

Sensory analysis of samples blanched and control assumed boiling from the hot and cold water, to study them in the cooking process conditions. Colour and colour intensity means acceptability of the frozen product and to verify the acceptance of the finished product. It was performed the sensory appreciation of the main features: overall appearance, colour, smell, texture and taste.

Characteristics were evaluated by a team of 8 people, specialists in food industries. The assessment was carried out 12 months, monthly for all varieties. Each time we collected samples, which were rapidly thawed by exposure to ambient temperature, and then the packet was divided into samples of 50 g. After the sensory evaluation test was performed boil.

The evaluation of quality by sensory analysis was carried out using a scale of 1 to 10 (10 = very good, 1 = unsuitable), then the team calculated an average score for each evaluation on the basis of the scores given by the experts. It was found that during the first six months of storage frozen peas have not experienced a significant change in sensory characteristics, but after 12 months the main sensory characteristics were influenced in particular by the storage values assessments declined.

Green peas for control and blanched peas presented a diameter of 7.8 - 10.3 mm, green, with varying intensity, taste and smell good after thawing, with a soft consistency. The appearance and colour of the control were better appreciated, but after six months of storage the blanched samples were received top marks against control.

Figure 3 shows that the acceptance of salad of peas-variant without heat treatment, in terms of texture, variety is better for Villio control and blanched (cohesion, humidity) and Omega blanched (manual traction), variety Apor control was classified unacceptable (hardness).

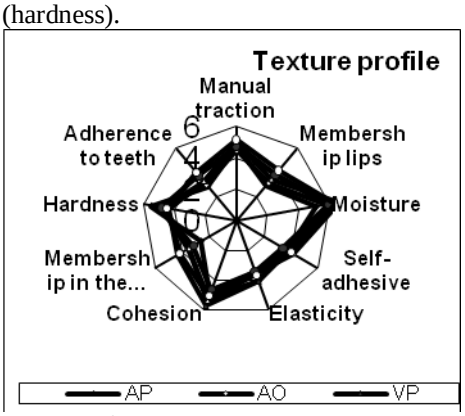

Fig. 3. Profile texture-pea salad-without heat treatment

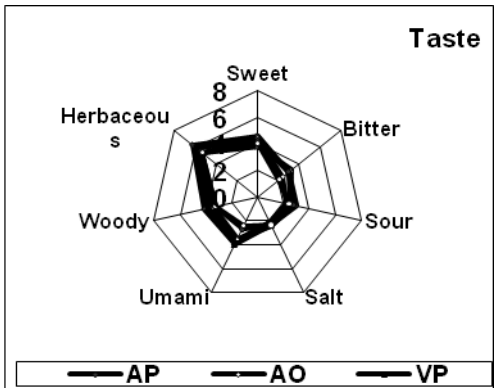

Fig. 4. Taste-pea salad-without heat treatment

Pea salads taste was assessed as acceptable for variety Apor - blanched (herbaceous, sweet), the most unacceptable was classified Villio - control (sour, bitter) and medium to Omega blanched (Figure 4).

The analysis of the texture of pea paste – fresh variant showed that variety Apor - blanched was best appreciated (elasticity, manual traction), Apor variety control and variety Apor-control was classified as unacceptable.

The taste revealed that variety Apor - blanched was most acceptable (sweet, umami) and Apor - control most unacceptable (bitter), variety Apor has the best qualities of taste for pasta, after long-term storage in frozen state.

The low score for taste and flavour can be explained due to the eating habits of the team tasting, which do not practice a vegetarian diet and are not familiar with the requirements for these products. From our perspective, pea paste can be consumed in this form or in snacks tip sandwiches, veggie or stuffed vegetables.

Conclusions

Content of nutritional components, proteins, carbohydrates, lipids and starch recommend peas to be used extensively in the diet. From a nutritional standpoint, the three pea varieties studied had good nutritional value, with a protein content of about 22-23% against the dried [1].But the results indicate that there are significant differences between the three varieties analyzed regarding the values of protein, carbohydrates and starch. Frozen peas have presented significant amounts of vitamin C, even after a storage period of 12 months; of course they are differences between varieties whose Business is exploited. The content of vitamin C seems to be the best indicator during the storage of frozen peas, so the loss of vitamin C is a barometer of the quality. After our results, the antioxidant capacity can be correlated with the content of vitamin C. The three types of peas showed different characteristics of composition and properties, which induce different technological behavior.

The results obtained in this study are compatible with the existing dates in the literature and show that, in the absence of fresh food, frozen vegetable products are an alternative to a healthy diet, even if they have been stored for a long period (up to 1 year).

Under the reserve of cold chain during storage, physico-chemical parameters vary indistinguishable in the first three months of storage, resulting in the preservation of nutritional value as a percentage of approximately 80%.

During the storage period, it have started chemical reactions that cause changes in chlorophyll pigments, changes in dry matter content of nutrients such as vitamins soluble in water - in especially vitamin C, carbohydrates and proteins. These changes depend on the variety of peas processed, grain maturity, storage temperature and storage time. Dependent on time, temperature and temperature stability of frozen storage can continue to lose nutrients (vitamin C), but lower than the initial loss treatment.

The total chlorophyll content decreased due to significant technological operations applied, at the end of the storage period the content represented 58.92% of the initial, variety Villio the most good.

To highlight the nutritional quality of pea varieties studied compared to a sterilized canned pea, we conducted two products that meet both those who practice eating vegetarian and vegan.

Treatment of cooking in boiling water or salt water influences the nutritional qualities by increasing the digestibility of proteins and reduction antitrypsin inhibitor and oligosaccharides.

Sensory analysis of samples blanched and control samples showed that boiled samples in hot water are the most good for the variety Villio.

At the same time, for culinary cooking executed, Omega and Villio varieties were the most accepted variety; Apor shows a pronounced bitter taste.

In conclusion, we can say that, out of time and storage temperature, variety and type of culinary treatment of pea influences in equal measure the nutritional and sensory characteristics of food products.

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