The changes of carotene in the process of obtaining food additives on the basis of carrots

Galyna Bandurenko, Oleksandr Bessarab, Tetiana Levkivska

National University of Food Technologies, Kyiv, Ukraine

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Corresponding author:

Tatiana Levkivska
E-mail:
talev_2111@mail.ru

Abstract

Introduction. The aim of the study was to develop new technological solutions to better utilization of the properties of carrot to obtain two multifunctional dietary supplements containing carotene in dry and liquid form.

Materials and methods. Carrot varieties Shantanu 2461, carrot juice, husks, powdery enrichment from carrot husks containing carotene and concentrated liquid filler containing carotene were used. The chemical composition of all samples was determined according to the international standards

Results. The work proposed a comprehensive resource-saving technology of processing of carrots with getting two basic products that contain carotene - dry and liquid. Dry enrichment "Carrotynka" obtained under production conditions by means of microwave drying of carrot husks, has a high content of β-carotene (148,0-154,0 mg/100 g) and fiber (11 g/100 g). Liquid filler "Carrot honey", obtained on the basis of carrot juice (70% of dry substance) - rich sugar (52-55 g/100 g), b-carotene (up to 11-12 mg/100 g) and pectin (up to 4 g/100 g).

Obtained products were subjected to various technological influences. As a result of these tests it can be noted a relatively high stability of obtained food additives to various modes of process and be recommend them for wide use in food technology as a multifunctional enriching additives.

We had tested a number of technologies of getting canned products from restored "Carrot honey", as well as development of confectionery and bakery products of new recipes, which gave a positive result.

Conclusion. The obtained products containing carotene, can be used in food technology as a multifunctional enriching additives.

Introduction

The growing worldwide trend towards healthy food led to the development of functional product. Functional foods, due to bioactive components presence in its composition are capable to support human health and increase the body's resistance to adverse environmental factors. To correct the nutritional value and food properties biologically active additives (BAA) are used, which allow to optimize the composition, improve the nutritional value of foods and form their functional properties. Food additives production is a perspective direction, which can significantly extend the range of functional foods and products for special purposes.

Due to the fact that in Ukraine biologically active additives are produced in limited quantities, current market is filled with imported goods. In this regard, development of domestic production of new types of supplements from plant material is relevant and promising. Among them vitamins-multifunctional additives are of greatest interest that are complex multicomponent systems with certain properties. The use of plant material for purposeful to receive specialized products or natural food additives is very specific. By itself, the technology of their processing is quite complex, due to many factors, including the low acidity of raw materials and the need for mandatory and complete cleaning. Thus. wastes can reach more than 40%. A positive factor is the low cost of raw materials and predictable quality characteristics of the finished product [1, 2, 3].

We are interested in processing of carrots that are fruitful vegetable, widespread in many countries with good Agrobiological indicators and the possibility of long-term storage. Numerous authors are engaged technologies on processing carrots in BAA. Some of them have shown the feasibility of using carrots for creating a carotenoid additives radioprotective action, developed a scientific basis for their use in food technology and proposed development of pasty carotenoid additives. Others investigated possibility of preserving carotenoids during drying of raw carrot were made [1, 2, 3, 4, 5, 6].

Historically, national cuisines of many countries use extensively carrots. The main reason of popularity is not so exprect color and strong taste, as its properties due to the presence of biologically active substances (BAS). Pectin, dietary fiber and natural carotenoid complexes are especially valuable, which have high stability, resistance to process and physiological activity. Of great importance β-carotene, which exept properties of provitamins has also an antioxidant, allows to improve the quality of the finished product and to continue its shelf life [7, 8, 9, 10, 11].

The aim of the study was to develop new technological solutions to better utilization of the properties of carrot to obtain two multifunctional dietary supplements containing carotene in dry and liquid form.

Materials and methods

The object of research is the technology supplements containing carotene from carrots.

The subject of the research is to change the content of β-carotene during the processing of raw carrot in various ways. Materials of research is carrot varieties Shantanu 2461, carrot juice, husks, powdery Enrichment from carrot husks containing carotene and concentrated liquid filler containing carotene.

Raw materials, materials, semi-finished and finished products were characterized using a range of modern physico-chemical, chemical, microbiological, organoleptic and mathematical methods.

Contents of dry substances, β-carotene, sugars, fiber and pectin were determined according to the international standards (ISO 751:1998(en), ISO 750:1998(en), ISO 6558-2:1992(en), ISO 2173:2003(en).

For the detection the characteristic absorption bands of β-carotene in the studied samples - carrots, natural carrot juice and concentrated, fresh carrot husks and dried in various ways, were recorded in the range of samples cyclohexane; as the comparing solution using cyclohexane, in the

wavelength range of 200-800 nm, thickness 1 cm; measurement error wavelengths on a spectrophotometer (Cary 100 Scan UV-visible spectrophotometer) according to the passport data is ± 1 nm value of a point was 0.0001.

Husks, received after pressing, drying sent by one of the methods were convection, infrared and microwave drying. Drying husks were carried out before the final moisture 6, 5% of the layer thickness of 0,9-1,1 cm.

During the convective drying temperature husks drying agent (air) was 70°S, speed was 2.0 m / s, the drying period was 160 min.

When infrared drying the duplex IR heating husks was carried. As generators of infrared radiation tubular electric heaters (TEHs) were used. Thus electric heaters warming up was carried out at a value of 'exposure (E) 3660 W / m^2 for 5-10 minutes. Then the value of E for 30 min, gradually decreased to 1600 W / m2, and left unchanged until the end of the drying process. Adjusting the value of E, in the dry husks, the change of voltage that is supplied to the heaters was performed. Thus the same voltage was changed as follows: from 220 to 120 on the lower TEH and 100 B was changed at the top. Drying time was 75 min.

Investigation of the process dry husks was conducted on at the semigenerating facility "Artemis" with a frequency of 2540 MHz. Drying of the samples occurred in the pulse-periodic mode with interval 1 to 2 minutes at a value of the heat flux of 300 W / cm2. Drying time is 14 minutes.

Results and discussion

To implement the project it was necessary to first analyze the distribution of carotenoids carrot in solid and liquid phase (fig. 1). To provide a semi-finished needed technological parameters was necessary to minimize sugar content in carrot husks Figure 1 shows the absorption spectra of molecules β-carotene in fresh carrots, carrot husks and natural carrot juice.

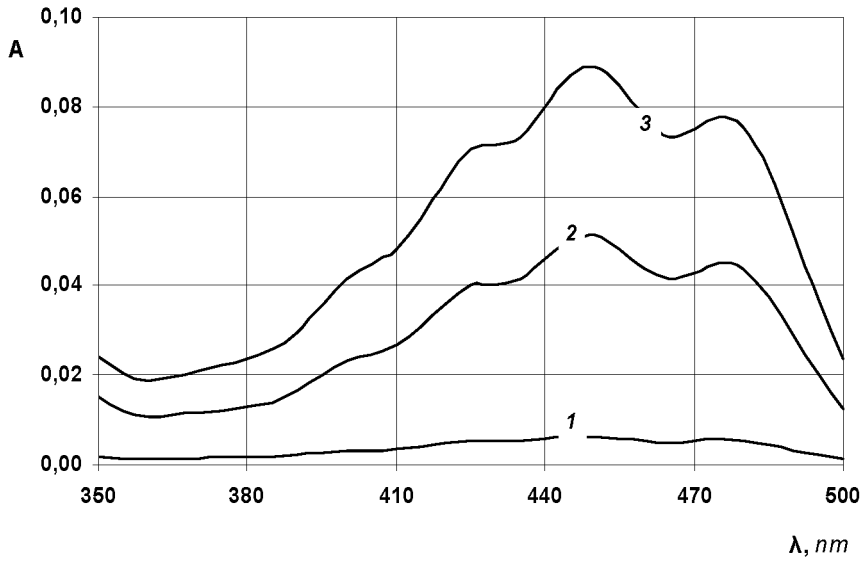

Fig. 1. Absorption spectra of molecules β-carotene:
1 – carrot, 2 – carrot husks, 3 – natural carrot juice

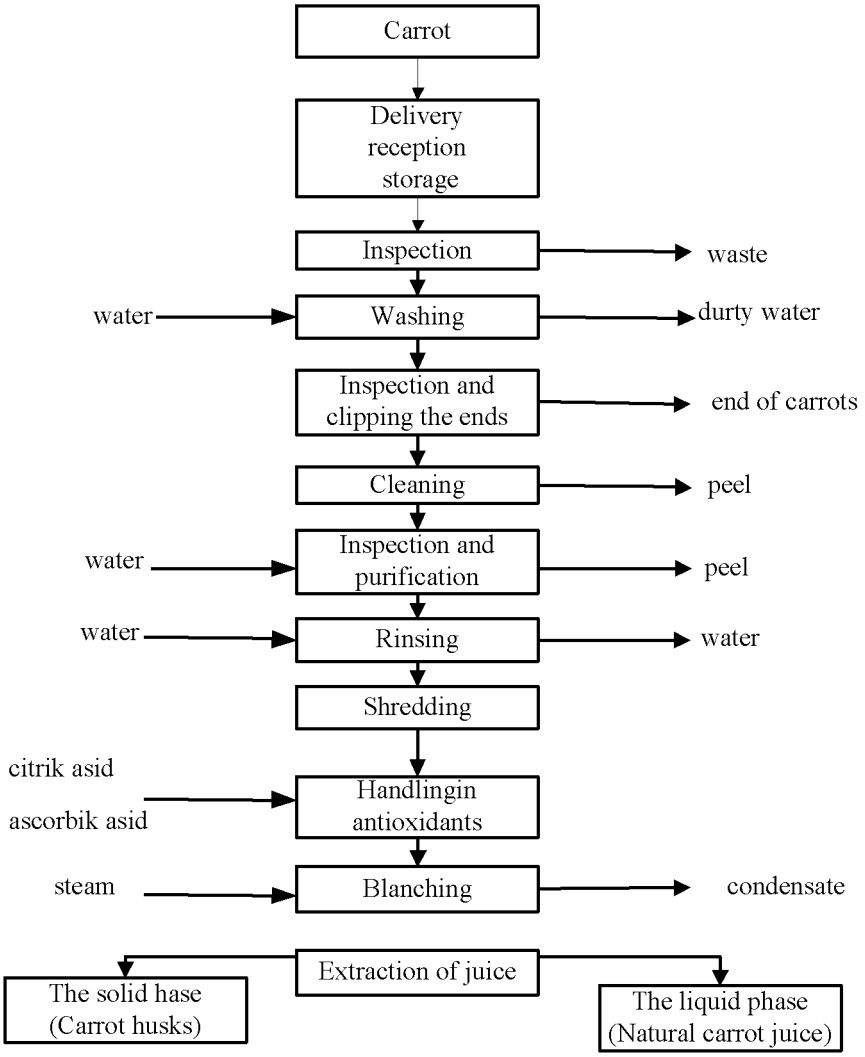

Fig. 2 The principal technological scheme of processing carrots

Figure 1 shows that the carotene content of husks, is 9,5 times greater than the natural carrot juice, which coincides with the research of many authors [10, 11].

Analysis of the known technologies of carrot allowed to reveal their "weak points" that adversely affect the quality of the finished product. Thus, the critical points in its processing is oxidation coloring substances and BAS during the grinding, pressing and drying. A key role in this complex is played by own enzymes carrots, the most active of which is peroxidase. Its inactivation is often a difficult task and requires special additional impacts on materials. Considering the fact that the enzyme activity is dependent on temperature, presence of atmospheric oxygen and pH, made a number of relevant research, that allowed to establish rational regimes of technological process of processing fresh

carrots, and its distribution on the solid and liquid phases. On the basis of research and optimization of individual technological modes it was suggested a complex resource saving processing technology of carrot for obtaining two basic products - dry enricher "Carrotynka" containing carotene obtained from carrot husks and liquid filler "Carrot honey", containing carotene obtained from carrots juice. The principal technological scheme of processing of carrots is shown in Figures 2.

The essence of this technology comes down to the fact that the prepared carrot (washed and peeled) are ground in the crusher treated with complex antioxidants, followed by 5-10 minutes sharp pair and sent for pressing. So, the distribution of the product on the solid and liquid phases is made. The solid phase with the initial dry matter content (15%) after additional processing dried in various ways (convection, infrared radiation, in the microwave field) to 6-7% moisture content, crushed and packed (Figure 3).

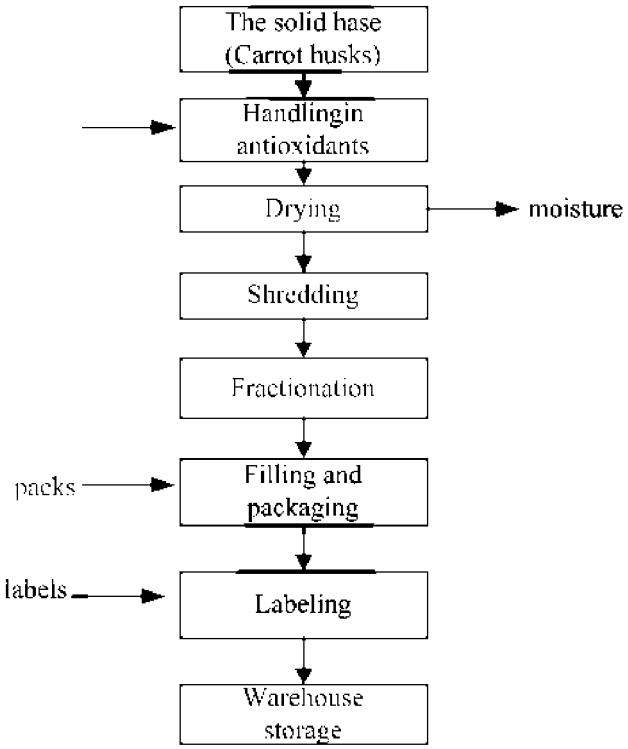

Fig. 3. The principal technological scheme production of dry carotene enricher "Carrotynka"

The study of different methods carrot pomace drying proved the microwave method feasibility (Figure 4).

Thus, during the field of microwave drying β-carotene content decreased to 5,1% and pectin 4,3% on their original content.

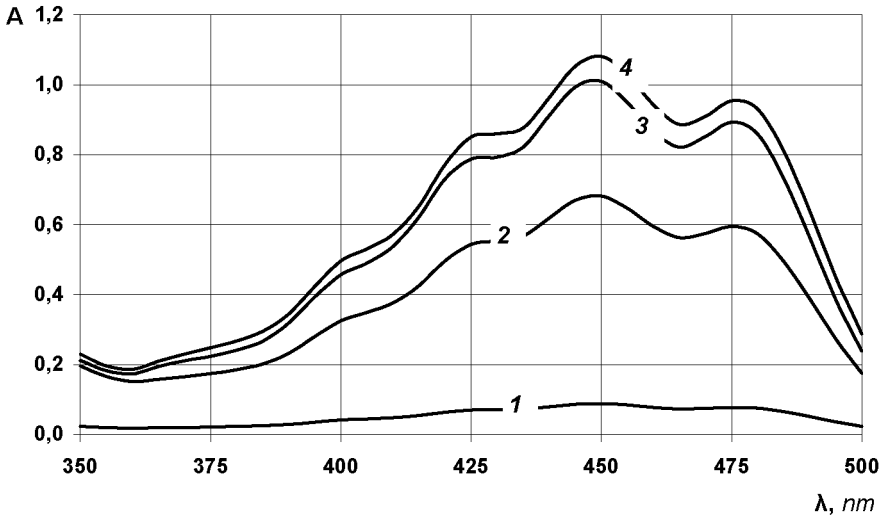

Fig. 4. Absorption spectra of molecules β-carotene in powders obtained by different methods:
1 - raw husks, 2 - dried convective way,
3 - dried IR radiation, 4 - in the microwave field.

The liquid phase (a natural carrot juice) after additional processing of enzyme preparation was concentrated to a solids content of 70% (Figure 5). The obtaining concentrated carrot juice differed strongly by strong orange color, high in β - carotene and pectin. During the concentration of carrot juice β-carotene content decreased to 7,6% and pectin – 8,5%, respectively.

Thus, in of the proposed technology it was got two products that can be used as multifunctional food additives. The comparative characteristic of some indicators of the chemical composition of carrot, semi-finished and finished products (derived food additives) are presented in Table 1.

Table 1

Organoleptic and physico-chemical parameters dry carotene enricher "Carrotynka" and concentrated filler containing carotene "Carrot honey"

Parameters	Carrotynka	Carrot honey
Organoleptic parameters		
Appearance	The powder is homogeneous on all bulk	Opaque the viscous liquid
Taste	A natural inherent carrots	Natural, close to natural carrot juice
Flavor	Orange	Dark orange
Physicochemical parameters		
Contents of dry substances,%	93,0-94,0	70,0-75,0
Contents of carotene,mg/100g	148,0-154,0	11,0-12,0
Content of pectin, g/100g	5,0-6,0	3,0-3,5
Content of sugars, g/100g	7,0-8,0	45,0-55,0
Content of fiber foods, mg/100g	20,0-24,0	–

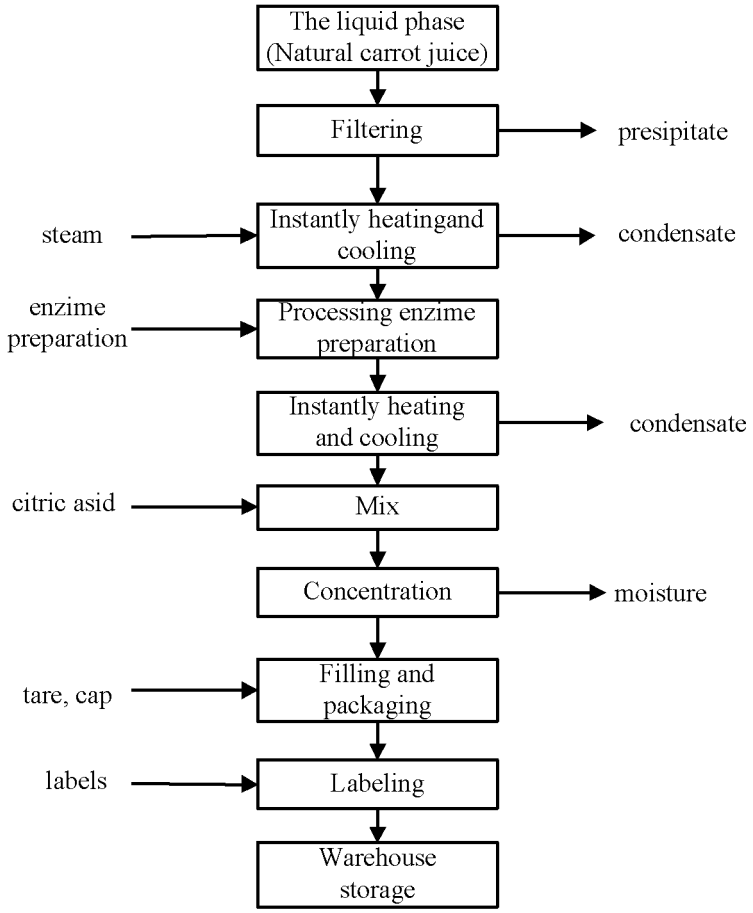

Fig. 5 The principal technological scheme production of concentrated filler containing carotene " Carrot honey "

An enrichment "Carrotynka" received in a production environment by microwave drying, has got a high content of β-carotene (148-154 mg/100 g) and fiber foods 20-24 (mg/100 g), and filler "Carrot honey" (70% solids) - rich in sugars (45-55 g/100 g), β-carotene (up to 11 mg/100 g) and pectin (up to 3,5 g/100 g).

Obtained additives should be stored in vacuum packaging avoid light at temperatures below 5°C. Loss carotene is 20-25%. The total number of microorganisms during storage is not increased.

Assessing quality index and technological properties of the obtained products, they were subjected to various technological influences. As a result of these tests it can be noted a relatively high stability of obtained food additives to various modes of process and be recommend them for wide use in food technology as a multifunctional enriching additives.

We had tested a number of technologies of getting canned products from restored carrot juice, as well as development of confectionery and bakery products of new recipes, which gave a positive result.

Conclusion

1. Developed the technology a complex processing carrots with production dry carotene enricher "Carrotynka" and concentrated filler containing carotene "Carrot honey".
2. Blanching carrot in the pair atmosphere and treatment with antioxidants, which provides peroxidase inactivation by 85%, saving β - carotene by 95%, Vitamin C - 75% and sugar - 93%.
3. To prevent the loss of β-carotene, coloring agents and sugars in the drying process after grinding carrots and carrot husks before drying, they are treated with antioxidants.
4. The highest content of β-carotene – 148-154 mg / 100 g can be obtained by drying the carrot husks in the field of microwave.
5. The optimal method of storage additives it is vacuum packing without light and temperature below 5 °C.
6. The obtained products containing carotene, can be used in food technology as a multifunctional enriching additives.

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