Анотація. Досліджено показники безпечності швидкозаморожених соків із м'якоттю: вміст токсичних елементів, радіонуклідів, нітратів, показники мікробіологічної стабільності протягом тривалого низькотемпературного зберігання. За результатами досліджень підтверджено позитивний вплив швидкого заморожування на мікробіологічні показники та відсутність впливу на вміст токсичних елементів і нітратів.

Ключові слова: безпечність, швидкозаморожені соки з м'якоттю, БГКП, МАФАнМ, плісневі гриби, дріжджі, токсичні елементи, нітрати, радіонукліди.

Аннотация. Исследованы показатели безопасности быстрозамороженных соков с мякотью: содержание токсичных элементов, радионуклидов, нитратов, показатели микробиологической стабильности в течении длительного низкотемпературного хранения. По результатам исследований подтверждено положительное влияние быстрого замораживания на микробиологические показатели и отсутствие влияния на содержание токсичных элементов и нитратов.

Ключевые термины: безопасность, быстрозамороженные соки с мякотью, БГКП, МАФАнМ, плесневые грибы, дрожжи, токсичные элементы, нитраты, радионуклиды.

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SAFETY OF QUICK-FROZEN JUICES WITH PULP

O. V. Diakov
Postgraduate*
E-mail: fisch-sd-fisch@ukr.net
S.O. Belinska
Doctor of Engineering Science, professor*
E-mail: belinska.s.o@voliacable.com
*Department of Commodity Research and Examination of Food Products
Kyiv National University of Trade and Economics
19 Kioto Street, Kyiv, Ukraine, 02156

Introduction

Safety of food products, as the main quality index, assumes absence of toxic, cancerogenic, mutafacient and other negative influence on human's organism while consumption in conventional amounts. It is provided by measurement and observance of regulated concentration grade of contaminants of chemical and biological nature, and also of natural toxic substances, which are true to type for these products and are dangerous for health [1].

Problem definition

Fresh fruits and vegetables are known as essential and indispensable source of biologically and physiologically active substances. However, during the cultivation plant raw materials collect contaminants of chemical nature, because of more intensive farming techniques and environmental disasters. At the same time, during storage fresh fruits and vegetables can be exposed to bacteriological damage, what causes quantitative and qualitative losses and accumulation of mycotoxins.

Literature review

Researches of A.A. Dubinina [2], N.Y. Orlova [3], P.K. Ponomariov, I.V. Syrokhman [4] El Gizawy S.A., Daw Z.Y., Said AMB [5], Sapers G.M., Miller R.L., Mattrazzo A.M 6], Ewa Hajduk, Krzysztof Surówka [7], M. Houska, J. Strohalm, J. Totusek [8] are devoted to foodstuffs safety examinations, particularly to fresh and processed fruits and vegetables. Special aspects of contaminant accumulation by different types and parts of fruits and vegetables were discovered, and practicability of using of various preparative treatment methods in manufacturing of safe fruit and vegetable products was proved.

Quick-frozen fruit and vegetable products have stable demand among Ukrainian people. This is due to its high organoleptic qualities, stable chemical composition, particularly, high preservation ability for vitamins, mineral elements, and absence of synthetic nutrient additives in it. But at the same time, high-temperature processing is not used during manufacturing of the vast number of frozen fruits and vegetables. The main aim of high-temperature processing is to reduce the microbiological contaminant and to slow down the enzymatic processes. That is why it is necessary to concentrate attention on safety of frozen fruit and vegetable products.

The influence of rapid freezing on safety juices with pulpBASIC PART

Goal of research is to study the safety of quick-frozen juices with pulp.

Methods and materials. Objects of research – quick-frozen juices with pulp received from variety of melon Amal, watermelon Khersonskyi, apples Golden Delicious, carrot Canada, celery Giant, and beetroot Bordeaux.

To increase consumption value, improve organoleptic qualities, to stabilize color and consistency of quick-frozen juices we proposed to blend apple, carrot and celery juices in a ratio of 60, 30 and 10 %, apple and beetroot juice - 80 and 20 % accordingly [9] and to add solutions of natural polysaccharide xanthan gum and ascorbic acid. Content of admixtures in experimental samples of juices are represented in Table 1.

Table 1– Content of admixtures in experimental samples of juices

Juice	Content of admixtures, g/100 g		
	xanthan gum	white sugar due to SSTU 4623:2006	ascorbic acid
Apple-carrot-celery	0,040	3,0	0,005
Apple-beetroot	0,050		
Melon	0,025		
Watermelon	0,020	5,0	

Notes: SSTU – State Standard of Ukraine.

Table 2 – Microbiological indicators of juices with pulp $p \geq 0.95$; $n = 5$

Juice	Sample	Stage of research	Storage term. months	Microbiological indicators, CFO / 1 gram		
				qMAFAnM	mold fungi	yeasts
Melon	C	Before freezing	–	$1{,}2\times10^{4}$	$6{,}0\times10^{1}$	$4{,}2\times10^{1}$
		After freezing	0*	$2{,}3\times10^{3}$	$2{,}0\times10^{1}$	$2{,}2\times10^{1}$
			3	$1{,}7\times10^{3}$	$1{,}6\times10^{1}$	$1{,}5\times10^{1}$
			6	$1{,}5\times10^{3}$	was not determined	was not determined
			9	$1{,}6\times10^{3}$		
			12	$1{,}8\times10^{3}$		
	E	Before freezing	–	$1{,}3\times10^{1}$	$6{,}2\times10^{1}$	$4{,}4\times10^{1}$
		After freezing	0*	$2{,}4\times10^{3}$	$2{,}4\times10^{1}$	$2{,}0\times10^{1}$
			3	$1{,}4\times10^{3}$	$1{,}5\times10^{1}$	$2{,}0\times10^{1}$
			6	$1{,}2\times10^{3}$	was not determined	was not determined
			9	$1{,}2\times10^{3}$		
			12	$1{,}3\times10^{3}$		
Watermelon	C	Before freezing	-	$1{,}0\times10^{1}$	$5{,}2\times10^{1}$	$4{,}6\times10^{1}$
		After freezing	0*	$1{,}2\times10^{4}$	$1{,}4\times10^{1}$	$1{,}4\times10^{1}$
			3	$7{,}6\times10^{3}$	$0{,}8\times10^{1}$	$1{,}0\times10^{1}$
			6	$5{,}9\times10^{3}$	was not determined	was not determined
			9	$5{,}4\times10^{3}$		
			12	$5{,}8\times10^{3}$		
	E	Before freezing	–	$1{,}0\times10^{1}$	$5{,}5\times10^{1}$	$4{,}8\times10^{1}$
		After freezing	0*	$1{,}5\times10^{4}$	$1{,}8\times10^{1}$	$1{,}3\times10^{1}$
			3	$6{,}4\times10^{3}$	$1{,}2\times10^{1}$	$0{,}6\times10^{1}$
			6	$5{,}8\times10^{3}$	was not determined	was not determined
			9	$5{,}7\times10^{3}$		
			12	$5{,}9\times10^{3}$		
Apple-carrot-celery	C	Before freezing	–	$1{,}3\times10^{1}$	$5{,}0\times10^{1}$	$5{,}2\times10^{1}$
		After freezing	0*	$2{,}5\times10^{3}$	$1{,}1\times10^{1}$	$1{,}8\times10^{1}$
			3	$2{,}0\times10^{3}$	$0{,}6\times10^{1}$	$1{,}2\times10^{1}$
			6	$1{,}8\times10^{3}$	was not determined	was not determined
			9	$1{,}8\times10^{3}$		
			12	$1{,}9\times10^{3}$		
	E	Before freezing	–	$1{,}6\times10^{1}$	$5{,}4\times10^{1}$	$5{,}5\times10^{1}$
		After freezing	0*	$2{,}8\times10^{3}$	$1{,}5\times10^{1}$	$1{,}6\times10^{1}$
			3	$1{,}5\times10^{3}$	$0{,}9\times10^{1}$	$0{,}9\times10^{1}$
			6	$1{,}5\times10^{3}$	was not determined	was not determined
			9	$1{,}7\times10^{3}$		
			12	$1{,}9\times10^{3}$		
Apple-beetroot	C	Before freezing	–	$1{,}5\times10^{1}$	$5{,}9\times10^{1}$	$4{,}7\times10^{1}$
		After freezing	0*	$2{,}1\times10^{3}$	$1{,}9\times10^{1}$	$1{,}3\times10^{1}$
			3	$1{,}6\times10^{3}$	$1{,}4\times10^{1}$	$0{,}6\times10^{1}$
			6	$1{,}5\times10^{3}$	was not determined	was not determined
			9	$1{,}8\times10^{3}$		
			12	$1{,}9\times10^{3}$		
	E	Before freezing	–	$2{,}0\times10^{1}$	$6{,}3\times10^{1}$	$5{,}0\times10^{1}$
		After freezing	0*	$2{,}4\times10^{3}$	$2{,}1\times10^{1}$	$1{,}1\times10^{1}$
			3	$1{,}3\times10^{3}$	$1{,}1\times10^{1}$	$0{,}5\times10^{1}$
			6	$1{,}5\times10^{3}$	was not determined	was not determined
			9	$1{,}6\times10^{3}$		
			12	$1{,}8\times10^{3}$		

Notes: 0* – fresh-frozen.
CFO – colony-forming organisms

Juices without admixtures were used as control samples.

Content of nitrates in experimental (E) and control (C) samples of juices was determined by photocolorimetric method of K. N. Pochynok [10, page 96]; content of radioactive nuclides – by spectrometric method [2]; content of toxic elements – by spectrometric method of flameless atomic absorption [11-16]; indicators of microbiological safety (coliform bacteria, qMAFAnM, pathogenic microorganisms, mold fungi, yeasts) – according to conventional methods [17-20]. Samples were examined before freezing and during 12 months storage at the temperature minus (20±2) ºC at intervals of 3 months.

Results of research. The results of studies of microbiological indicators of experimental and control samples are shown in Table 2. Coliform bacteria and pathogenic microorganisms, including Salmonella, were not found.

Data in Table 2 confirm microbiological safety of experimental and control samples. Not significant differences in experimental samples are caused by presence of admixtures. It was discovered that the freezing process is a determining factor for reducing the number of mold fungi and yeasts, which are non-persistent to low temperatures. During freezing and next low-temperature storage qMAFAnM gets reduced, and only after 3, 6 months of storage it starts to grow slightly. This fact can be connected with development of psychrophiles, which are able to grow in temperatures ranging from plus (25 – 30) ºC to minus (5 – 10) ºC and to adapt to low temperatures. Significant difference between experimental and control samples of juices was not ascertained.

Radioactive nuclides ^{137}Cs i ^{90}Sr in the juices were not detected.

Table 3 – Safety indexes of juices with pulp before freezing

***p* ≥ 0.95; *n* = 5**

Juice	Sample	Toxic elements, mg/kg						Nitrates, mg/kg
		Pb	Cd	Hg	Cu	Zn	As	
Melon	C	0,1	wnd	wnd	1,5	1,6	wnd	11
	E	0,1	wnd	wnd	1,5	1,6	wnd	11
Water-melon	C	0,2	wnd	wnd	1,4	1,8	wnd	17
	E	0,2	wnd	wnd	1,4	1,8	wnd	17
Apple-carrot-celery	C	0,1	wnd	wnd	1,2	1,7	wnd	45
	E	0,1	wnd	wnd	1,2	1,7	wnd	45
Apple-beetroot	C	0,1	wnd	wnd	1,6	2,1	wnd	33
	E	0,1	wnd	wnd	1,6	2,1	wnd	33

Notes: wnd – was not determined

Table 3 shows the results of determination of toxic elements and nitrates.

The level of nitrate contamination for the control and experimental samples of juice before and after freezing was not changed, and it proves that low temperatures had no influence on their content in juices. However, it is slightly higher for apple-carrot-celery and apple-beetroot juices comparing with melon and watermelon juices. This fact can be explained with structural features of roots of beet, carrot and celery and differences in the ability to collect nitrates.

Toxic elements, such as cadmium, mercury and arsenic were not detected. The levels of lead, cuprum and zinc were within the limits of the permissible concentrations [21] and correlated with researching results of foreign authors [22-23]. Freezing and low Table 3.-temperature storage had no influence on changes in content of toxic elements.

Conclusions.

The results of researches confirm the safety of quick-frozen juices with pulp and absence of influence of quick-freezing on contents of toxic elements and nitrates. Regarding to indexes of microbiological safety, usage of high quality raw materials and compliance with sanitary standards of manufacturing ensure microbiological safety of frozen juices.

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