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Study of applying Melon from South Kazakhstan for Producing Melon and Fruit-Melon Concentrates

Balabekov OS*, Khanzharov NS and Telkhozhaevna B

M.Auezov South Kazakhstan State University, Kazakhstan

Abstract

The article is devoted to the issue of increasing of efficiency of using of local cucurbits crops. The statistical data of cultivation of cucurbits crops in South Kazakhstan region are analyzed in the article. According to the given data there is growth of cultivation areas and productivity of cucurbits crops observed. Since 1994 the cultivated area for cucurbits crops has increased 5.9 times, the whole yield–19.08 times, the productivity – 3.2 times. In 2014 year in South Kazakhstan region the whole yield of cucurbits crops composed 64% from total volume. Useful properties of cucurbits crops are described. The problem of absence of industrial processing of cucurbits crops is pointed out. Recommendations to process cucurbits crop into plant honey which is possible to use for obtaining wide assortment of food products are described. The problem of processing of cucurbits crops is offered by creation of concentrated jelly-like melon product technology and using this product in confectionery industry. Flash-free melon concentrate and melon and fruit-melon concentrates with flash are developed. The formulations of melon-fruit concentrates are developed. Their sensory characteristics, physical-chemical indicators are determined, energetic value and specific heat capacity is calculated. The review of scientific researches on melon is given; the review includes investigation of chemical composition of melon, development of methods and devices for storage and treatment melon and creation of new melon products. Investigation object of scientists in the field of melon employment is not only its flesh but seeds rich by proteins and fats as well.

Keywords: Melon; Concentrate; Technology; Formulation; Apricot; Plum; Apple peel; South Kazakhstan region; Cucurbits crops

Introduction

Cucurbits crops have high food value and complex of biological active substances varying by chemical composition and, consequently, by therapeutic action on human organism. It is found out, that pectin substances of cucurbits crops are able to bond ions of the heavy metals and remove them from human organism [1]. Furthermore, cucurbits crops are reach by macro-, micronutrients and vitamins necessary for a productive life. For example, a half of daily need in vitamin E and ascorbic acid is satisfied factually at including in a daily ration 500 g of melon. Microelements and vitamins presented in watermelon stipulate metabolic processes in a liver, improve fel composition, prevent stone formation in a gall bladder and ducts, possess by antisclerotic action. Therefore a watermelon is used as an effective remedy for chronic hepatitis, cholecystitis etc.

Melon (Cucumis melo) is one of the most distributed and cultivated kinds of cucurbits crops in Kazakhstan. South Kazakhstan is a basic region for cultivation cucurbits crops in the country because a lot of heat and sun light are needed for growing cucurbits crops and the weather should be hot and dry in their mature stage. Thus, according to data of Committee in statistics of Ministry of national economics of the Republic of Kazakhstan , bulk yield of cucurbits crops in South Kazakhstan region composes 64% (12366215,4 centers) from total value (Figure 1).

In turn, according to data of Department in statistics of South Kazakhstan region, the growth of cultivation area for cucurbits crops is observed annually that involves the growth of bulk yield. Thus, for the period from 1995 from 2014 years cultivation area for cucurbits crops has been increased from 9727 to 57580 hectares (Figure 2), i.e., in 5,9 times. Bulk yield has been grown from 64815 to 1236622 tons, i.e., 19,08 times (Figure 3) for mentioned period. At that productivity of land has grown from 66,5 to 215,3 centers per hectare since 1995, i.e., in 3,2 times (Figure 4). These Figures show evidence about interest of farms of the region in cultivation of cucurbits crops.

Mostly newly-grown cucurbits crops are used only. A sun-dried product, honey, jam, compotes etc. are made from melon in home conditions. Industrial processing of melon has not used widely yet but scientific interest in the field of melon investigation is increased significantly last years. Issues in this field of study are devoted to researching of chemical composition, developing of methods and devices for storage and processing of melon, creation of new melon products.

Franko [2] investigated chemical composition of melon of grades Uzhanka and Kolkhozniza 74a/753 and their seeds. The analysis of results shows that melon flesh contains a complex of biologically active substances and nutrients. Amino acid composition of melon is represented by irreplaceable acids. There till 60% of proteins, from 23 to 30% of fats in melon seeds.

Hui [3] investigated influence of such disinfecting substances as hydric dioxide, chlorine dioxide and organic acids. As a part of the study it is found that processing of melons by hydric dioxide elongates shelf life of field-fresh yield on 4-5 days compare to processing by chlorine dioxide.

***Corresponding author:** Balabekov OS, M.Auezov South-Kazakhstan State University, Tauke-khan avenue 5, 160012 Shymkent City, Republic of Kazakhstan, Tel: 87014991034; E-mail: ortaev@mail.ru

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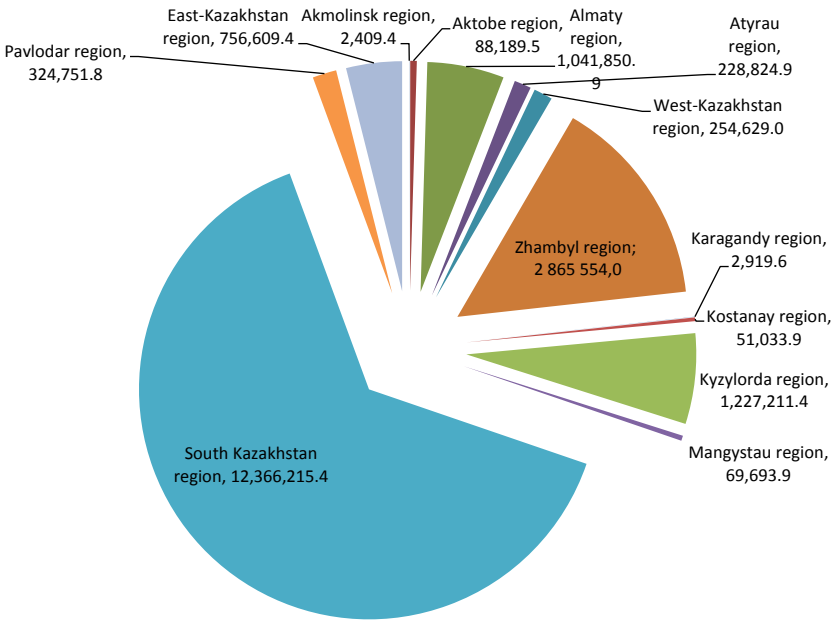

Figure 1: Bulk yield of cucurbits crops in Kazakhstan in 2014 (centers).

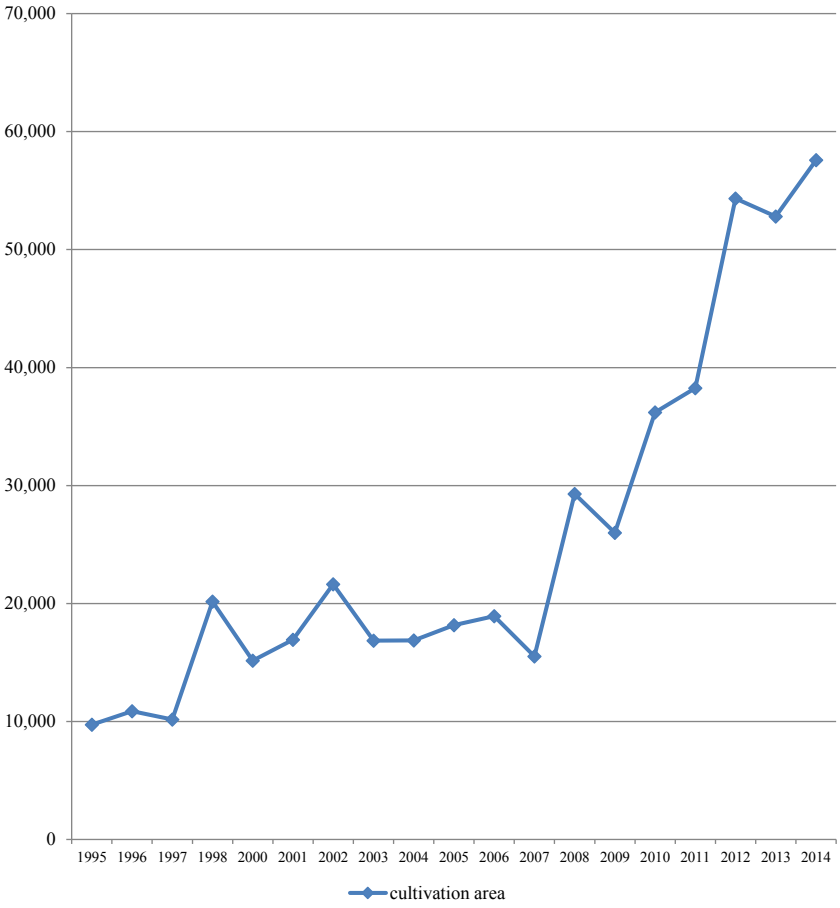

Figure 2: Cultivation area for cucurbits crops in South Kazakhstan region.

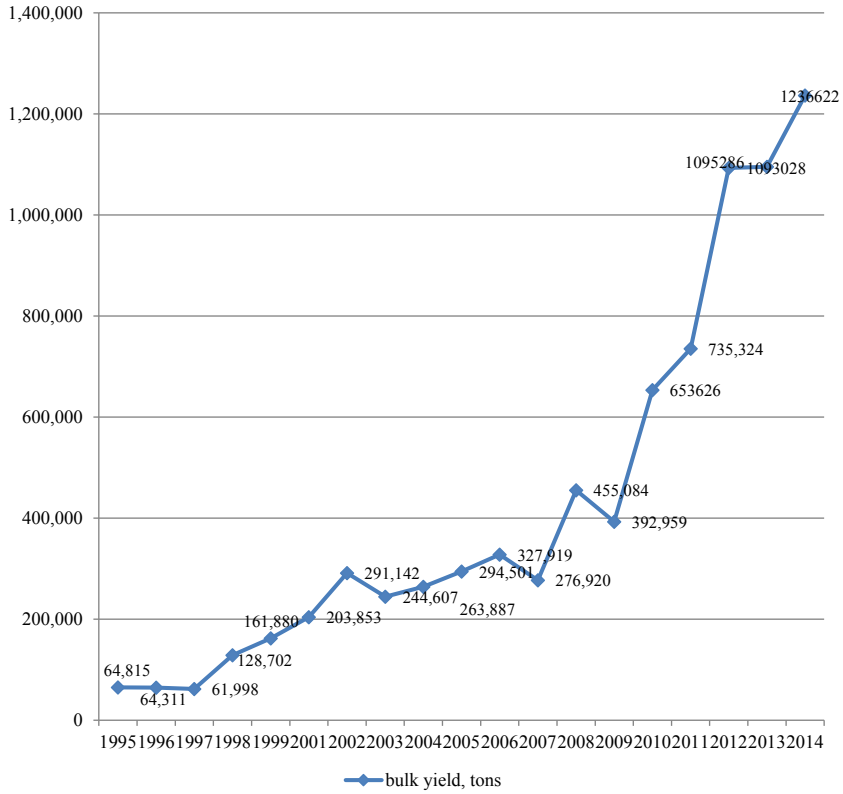

Figure 3: Bulk yield of cucurbits crops in farms of South Kazakhstan region.

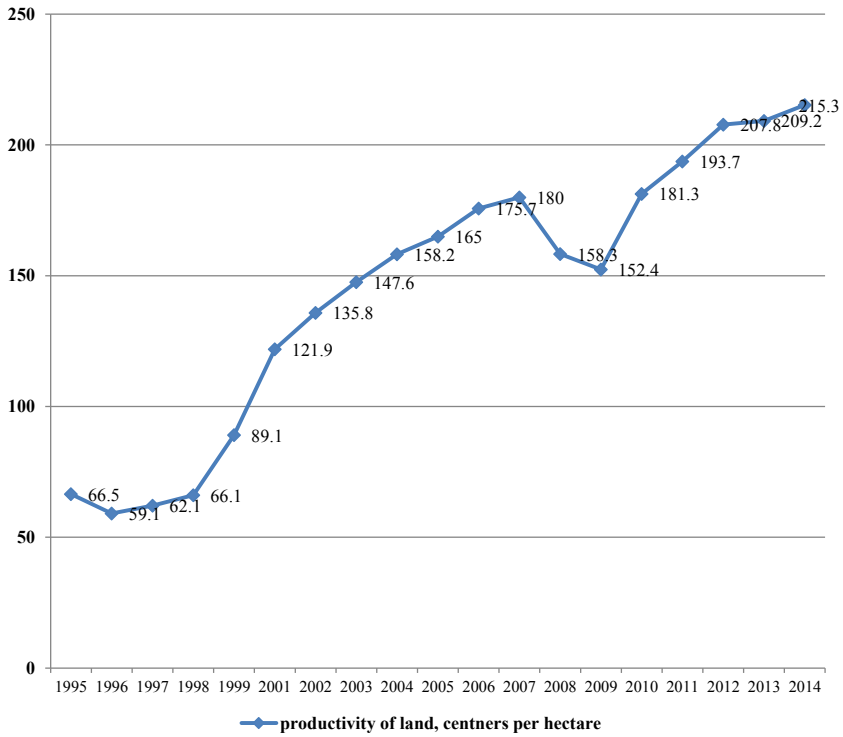

Figure 4: Productivity of cucurbits crops in farms of South Kazakhstan region.

Thompson [4] offered applying of differential colorimeter for measuring melon peel colour. Peel colour depends on content of chlorophyll in it, which quantity is changed during fruit maturating process. Therefore, it is possible to determine degree of melon maturity by peel colour.

Yerkebayev et al. [5] created a device for peeling pieces of melon which has simple and reliable construction.

Ali Mohamadi Sani et al. [6] studied effect of temperature and concentration on density and rheological properties of melon. Results showed that the four-term polynomial model is the best model for computing density values from temperature and concentration. The measured shear stress was within 1.69-780 Pa, corresponding to viscosity range of 0.016-0.237 Pa•s. Within the tested conditions, the concentrate exhibited a pseudo plastic behavior. Temperature had an inverse effect on shear stress and apparent viscosity.

Karina G Angilelli et al. [7] studied multicomponent diffusion during osmotic dehydration process in melon pieces. The transfer of sucrose and fructooligosaccharides (FOSs) to melon and water to solution was modeled based on generalized form of Fick's second law for simultaneous diffusion and resolved by the finite element method using the software package COMSOL Multiphysics 3.2. The developed system for diffusion simulating water and solutes will enable control and modulation of the sucrose and FOS content in melon pieces.

Makanjuola [8] designed a machine for shelling the seeds. Based on a large number of measurements, empirical equations are proposed to express the correlation between the 3 principal dimensions for the 2 most common types of melon seed produced in the Western State of Nigeria. Another set of equations are suggested to estimate the surface area of the flat side with reasonable degree of accuracy from the measurement of either the length or the breadth of the seed. The biggest range of researches is devoted to developing various melon products.

Admaeva et al. [9,10] worked out nectars and soft drinks on the base of melon juice. Composition of these products includes juices of fruit and berries, honey and dogrose extract as well that gives increased food and biological value.

The method of preparation dessert includes grading, inspection, washing and removing of inedible parts [11]. Melon is cut on pieces, plum is cut in half and bones are removed. Then melon and plum are mixed, cooled at the temperature 3...5°C during 8-24 hours and frozen at the temperature -350°C. The frozen dessert is stored at the temperature -180°C during 12 months.

Another method of the same name involves grading, inspection and washing of melon, removing of inedible parts, cutting on cubes (30×30 mm) or plates (15×50 mm). Simultaneously puree is prepared from melon and other raw materials, mixed with pectin solution till achieving mass with uniform consistency [11]. Prepared melon pieces are packed according to a formulation in polyethylene packets which are moisture-proof and stable to low temperatures. Then mixture of melon and/or plum puree and pectin solution is added. Filled packets are closed, cooled and frozen.

Pento et al. [12] developed a method for production food from melon provided its preparation, cutting, convective drying till intermediate humidity, holding under pressure at heating till temperature not low than 100°C, releasing of a pressure till atmospheric one, completion of drying in the field of microwave frequencies till content of dry substances not low than 85%, adding taste agents and filling in polymer or composite material packages. Alteration of pressure leads to evaporation of part of residual moisture and swelling of melon and absence of contact with oxygen decelerates nonenzymatic oxidizing and elongates shelf life of the food. A number of investigations pursuit applying melon seeds.

Thus, Vlasova et al. [13] developed a method of making a sweet dairy sauce with flour from melon seeds and mustard dressing with flour from watermelon seed. The authors researched emulsifying characteristics of pumpkin, vegetable marrow, scallop, watermelon and melon seeds. Franko and Kasyanov [14] confirmed that proteins of melon seeds possess by high ability to form emulsion and stabilize it. Furthermore, the authors offered a scheme of melon processing and obtaining protein-lipid preparation from it recommended using at developing functional food.

Franko and Kasyanov [14] researched CO_2-extraction of melon seeds as well. Applying of extraction by condensed gas promotes disinfection of raw material and allows obtain high-quality product. Described above investigation results allow to make next conclusion. Melon owing to wealthy composition by essential macro-, micronutrients and vitamins became an object of many researches. It is efficiently to produce concentrated melon product that may be applied independently or included into composition of floury confectionery products, drinks, desserts, sweets etc.

For these purposes technology of melon concentrate was developed. In order to expand food assortment and increase food and biological value of the concentrate the possibility of using fruit additives from plum and apricots is investigated. At correct balance of melon and fruit it is possible to obtain fruit-melon concentrate with good sensory indicators.

Methods

Melon of grade Myrzashol is used as a basic object of research. Apricot and plum are investigated as well. Flash-free concentrate and concentrate with flesh were developed. At making flesh-free concentrate crushed melon was filtered; flash was removed at filtering. Obtained juice was boiled down till dense consistency. In order to give to the concentrate a jelly-like consistency an apple peel reach by pectin was added. Medium-size melons were washed thoroughly, bisected with removing seeds, cut on pieces, peeled. Peeled pieces were crushed; obtained mass was filtered. Obtained juice was boiled down at atmospheric pressure during 120 minutes, then washed apple peel was entered and the mass was boiled down for 60 minutes more. In the end of boiling the apple peel was removed. A hot ready product was filled in glass containers and closed. The containers were cooled till 18-20°C and stored at the air temperature 20°C and relative humidity of air not above 75%. A melon consumption rate to produce concentrate was determined empirically.

At making melon concentrate with flash filtration was excluded. Obtained melon concentrate had dense and spread consistency which is good for using concentrate as a biscuit stuffing. According to the developed technology apricots and plums were inspected, sorted, washed, peeled and crushed. Washed melons were bisected, peeled, cut on the pieces by size 30×50 mm and crushed. A melon puree is boiled down during 80 minutes, then apricot or plum puree were entered; a mass was boiled down for 40 minutes more till achievement dense spreading consistency. A hot ready product was filled in glass containers, closed and cooled till 18-20°C.

Content of macro- and microelements in melon and fruit-melon concentrates was determined on mass-spectrometer by method of

dry mineralization. Chemical composition and sensory indicators of the concentrates were determined by standard physical-chemical and organoleptic analysis. A heating capacity and an energetic value were calculated on the base of experimental data.

Results and Discussion

Flash-free melon concentrate results

Flash-free melon concentrate possesses by following sensory (Table 1) and physical-chemical indicators (Table 2). A melon consumption rate to produce flash-free concentrate is shown in the Table 3. Runny consistency is not appropriable for its applying as a biscuit stuffing because it deteriorates appearance of a ready product.

As it is seen from Table 3, it is need very high consumption of melon to produce flash-free concentrate. It is connected with removing of flash. Furthermore, duration of boiling for achieving dense consistency is higher compare to process of making concentrate with flash that stipulates high energy consumption.

Fruit-melon and melon concentrate with flash results

In order to develop melon concentrate with flash possessed by good harmonic taste and aroma fruits were added according to formulation worked out during a number of experiments (Table 4). For the purposes balance of melon and fruit was varied from 95:5 to 60:40%. Variation step was equal to 5%. Characteristics of sensory indicators of melon concentrate with flash are shown in the Table 5. Physical-chemical indicators are shown in the Table 6.

10% of plum and 90% of melon is best balance in order to obtain well-balanced by taste product. Otherwise, at increasing of content of plum puree, a taste of concentrate gets sour. Level of active acidity of all concentrates allows ranging them (excluding concentrate from melon and apricot) to the groups of products with low acidity [15].

Melon and fruit consumption rates to produce melon and fruit-melon concentrates with flash is shown in the Table 7. As it is shown from the Table 8, energetic value of flash-free melon concentrate is higher, that explains by high content of dry substances (47,1%) compare to concentrates with flash (Table 6). And vice versa, the meaning of specific heat capacity of flash-free melon concentrate is the lowest that depends on content of dry substances as well.

After analyzing of sensory indicators of flash-free melon concentrates, melon and fruit-melon concentrates with flash, it is decided to apply last two concentrates as biscuit stuffing because of their spread state. Runny consistency will deteriorate an appearance of ready product.

From the Table 9 it is clear that melon and fruit-melon concentrates with flash contain a widely number of macro-and microelements.

Kind of product	Sensory indicators			
	colour	smell	taste	consistency
Flash-free melon concentrate	light-brown	peculiar to melon	very sweet	dense and runny

Table 1: Sensory indicators of flash-free concentrate.

Kind of Product	Proteins, %	Dry substances, %	Carbohydrates, %	Ash, %	titrable acidity, %	Active acidity, pH
Flash-free melon concentrate	1,5	47,1	40,2	3,8	1,34	4,7

Table 2: Physical-chemical indicators of flash-free concentrate.

Kind of raw material	Consumption rate for 1 ton of ready product, kg
melon	23055
apple peel	403,5

Table 3: A melon consumption rate to produce flash-free melon concentrate.

Concentrate, composition	Balance of components, %
Concentrate from apricot and melon:	
- melon puree	75
- apricot puree	25
Concentrate from plum and melon:	
- melon puree	90
- plum puree	10

Table 4: Formulations of fruit-melon concentrates.

Indicator	Experimental data		
	Melon Concentrate	Concentrate from melon and apricot	Concentrate from melon and plum
Dry substances, %	27,21	27,9	33,56
Ash, %	1,52	1,53	1,83
Carbohydrates, %	24,38	24,85	30,70
Titratable acidity, %	4,52	12,9	7,47
Active acidity, pH	5,53	4,47	4,79
Proteins, %	0,810	0,94	0,62
β-carotin, %	0,38	0,52	0,36

Table 6: Physical-chemical indicators of melon and melon-fruit concentrates.

Raw material	A consumption rate for 1 ton of ready product, kg		
	Melon concentrate	Concentrate from apricot and melon	Concentrate from melon and plum
melon	3120,0	2025,0	2430,0
apricot	-	517,25	-
plum	-	-	255,1

Table 7: Melon and fruit consumption rates to produce melon and fruit-melon concentrates with flash.

Kind of product	Energetic value, kJ	Specific heat capacity, kJ/(kg•K)
Flash-free melon concentrate	7,15,140	2,886
Melon concentrate with flash	4,21,882	3,435
Concentrate from apricot and melon	4,24,059	3,416
Concentrate from plum and melon	5,24,547	3,259

Table 8: Heating capacity and energetic value of melon and fruit-melon concentrates.

Kind of product	Sensory indicators			
	Appearance	Taste	consistency	smell
Concentrate from apricot and melon	Uniform mass of light-orange colour	Sweet, balanced taste of melon and apricot	dense, spread	peculiar to melon, melon aroma is expressed clearly, apricot aroma is sensible
Concentrate from plum and melon	Uniform mass of light-brown colour	Sweetish, with easy sour smack	dense, spread	peculiar to melon, melon aroma expressed clearly

Table 5: Sensory indicators of fruit-melon concentrates.

Name of micro/ macro elements	Content of micro/macro element, mkg/l		
	Melon concentrate with flash	Concentrate from apricot and melon	Concentrate from plum and melon
Na	18,27,84,500	20,04,52,400	16,87,05,200
Mg	2,38,15,080	2,41,11,610	2,15,00,340
Al	5,00,282	5,83,276	5,08,423
P	12,74,69,900	14,20,28,400	12,48,38,600
K	21,15,33,700	22,65,66,900	2,03,87,000
Ca	4,28,73,490	4,80,97,530	4,01,98,740
Ti	1,40,403	1,54,494	1,42,312
V	2,458	3,189	4,837
Cr	2,49,284	2,60,329	2,27,932
Mn	2,60,849	3,19,939	2,77,479
Fe	16,80,835	18,78,113	16,02,078
Co	0,856	0,948	0,818
Ni	14,411	94,544	51,457
Cu	1,40,976	1,43,746	1,17,990
Zn	7,89,965	6,45,824	5,92,976
Ge	0,536	0,501	0,574
As	3,626	4,258	0,357
Rb	61,294	73,916	55,612
Sr	2,54,979	2,75,583	2,64,372
Zr	0,482	0,593	0,416
Nb	0,209	0,193	0,135
Mo	15,325	16,979	13,512
Ag	34,085	5,615	19,201
Cd	0,439	0,322	0,329
Sn	1,447	1,421	0,686
Sb	0,427	0,422	0,464
Te	0,386	0,350	0,213
Cs	0,230	0,254	0,131
Ba	81,432	95,873	90,002
La	0,140	1,022	0,487
Ce	0,383	1,092	0,924
Nd	0,105	0,119	0,359
Ta	0,042	0,068	0,033
W	0,349	0,317	0,146
Pb	13,327	11,079	8,255
U	0,281	0,264	0,269

Table 9: Content of macro- and microelements in melon and fruit-melon concentrates with flash.

Thus, there is manganese, copper, zinc, strontium etc. elements revised [16].

Conclusion

On the base of investigation of perspective ways of processing of cucurbits crops an effective technology of obtaining concentrated jelly-like melon product with fruit additives is created. Optimal formulations of melon-apricot and melon-plum concentrates are developed. In a laboratory conditions physical-chemical indicators of melon and fruit-melon concentrates are determined, their specific capacities and energetic values are calculated. It is possible to apply developed concentrate not only as a biscuit stuffing but at production of other confectionery products, sweet dishes etc.

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