



## Influence of the low-temperature storage mode on qualitative indicators of melon sorbet

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Running title: **Influence of the low-temperature storage on qualitative indicators of sorbet**

### Abstract

A number of research were carried out to determine the effect of three, six and nine months of storage in the range of minus 18 ÷ minus 25°C on qualitative indicators of melon sorbet with phytogetic enriching additives of various compositions: "Snowy temptation", "Frosty night", "Ice touch", "Winter sun", "Summer freshness". Researches of the effect of low-temperature storage modes on quality indicators were conducted in the accredited laboratory "Food safety" of Almaty Technological University in accordance with modern standard methods. According to the results of the organoleptic analysis, it has been established that sorbet is best kept for six months, since during this period the color, consistency and taste-aromatic properties are best preserved, whereas in nine-month storage sorbet taste is reduced.

In addition to the organoleptic analysis of melon sorbet, the influence of the low-temperature storage mode on the qualitative indicators of products such as the mass fraction of protein, fat, pectin substances, antioxidant activity, vitamin C, potassium, magnesium, sucrose, fructose, glucose, malic acid was studied.

During the three, six and nine months of storage, there is a tendency for pectin substances to decrease in all sorbet species, an average of 1.04; 1.12 and 1.28 times respectively. There is a slight decline in the content of antioxidant activity on average after three months of storage by 7.6%, in six months by 14.1% and in nine months by 26.3%. The loss of vitamin C is on average 15.4%, 29.5% and 36.2% after three, six and nine months of storage, respectively.

It is established that storage of sorbet within 6-9 months within minus 18 ÷ minus 25°C ensures the preservation of quality indicators, since longer storage reduces the level of biologically active substances, which in turn affects the flavor and aromatic properties of the products.

### Practical applications

As a result of the research, a patent of the Republic of Kazakhstan for invention No.32881 "Compositions for melon sorbet (variants)" was obtained.

Technological procedure regulation for production of melon sorbet with phytogetic enriching additives ATU-TR-4.2.3-2016-04-06-01-02 and the standard of organization ATU-ST-4.2.3-2016-04-06-01-02 "Melon sorbet with phytogetic enriching additives".

Melon sorbet with phytogetic enriching additives technology is approved and introduced in production conditions of "Smak Firm" LLP (Almaty, Alatau district, Algabas settlement).

**Key words:** melon, sorbet, low-temperature storage, organoleptic evaluation, quality indicators



## Introduction

Currently, most of the market in Kazakhstan is occupied by traditional milk-based ice cream, which has a high-calorie content and excessive consumption of which leads to obesity. Not the latest niche in the ice cream market on the territory of the Republic of Kazakhstan is occupied by fruit ice, mainly consisting of water, artificial colors and flavors, although some bona fide producers use fruit and berry concentrates (Yerenova et al. 2016).

Frozen desserts presented on the market do not contain important functional ingredients, they have high caloric content due to the presence of sugar, fats, synthetic dyes and flavors, which leads to metabolic disorders and concomitant diseases (Matseichik et al. 2017).

However, among the frozen desserts sorbet deserves special attention, which is a low-fat product made on the basis of fruits or fruit juices. In contrast to traditional ice cream, sorbets do not contain dairy components, which is especially important for people suffering from food allergies or intolerance to dairy products (Topolska et al. 2017).

In this connection, we developed a technology and carried out studies to determine the nutritional and biological value of melon sorbet enriched with phytogetic additives of various compositions: "Snowy temptation", "Frosty night", "Ice touch" "Winter sun", "Summer freshness". The developed assortment of melon sorbet enriched with phytogetic vegetable additives has competitive properties, since they are natural, low-calorie, polyvitaminic, which, with their regular use, will reduce the level of diseases associated with the negative effects of ecology and working conditions on the human body, adjust the daily diet of the population, in particular those suffering from obesity and other pathologies (Yerenova and Pronina 2016; Yerenova et al. 2016).

At this stage, studies have been conducted to determine the effect of the low-temperature storage mode within -18 to -25°C on qualitative indicators of melon sorbet enriched with phytogetic additives.

In order to achieve this goal, the main tasks have been solved: conducting melon sorbet hardening within -20 to -30°C for 24-36 h, determination of organoleptic evaluation, nutritional and biological value of sorbet after three, six and nine months of storage within -18 to -25°C.

## Materials and Methods

### *Materials*

For the production of sorbets were used melons of late ripening varieties, enriching phytogetic additives: apples, cranberries, red bilberry, raspberries, sea buckthorn, lemons, spinach, cherry, black currant and tayberry.

### *Methods of assessment of quality indicators of sorbet*

Studies to identify the effect of low-temperature storage modes on quality indicators of melon-based sorbet were conducted in the accredited laboratory "Food safety" of the Almaty Technological University.

Taste aromatic properties of frozen desserts sorbet on the basis of melon are determined on the basis of the standard of the organization ATU-ST-4.2.3-2016-04-06-01-02 "Sorbet with melon on the basis of enriching herbal supplements".

The main quality indicators of melon-based sorbet are set according to modern standard methods.

The protein mass fraction was determined using the "Kjeldahl IDK-129" analyzer. Mass fraction of fat measured on the device "Solvent extractorser 148". The mass fraction of potassium and magnesium was determined on a spectrometer with electric atomization "QUANTUM-Z. ETA-T" with software and using the method of atomic absorption spectroscopy (AAS). Organic acids are determined on the basis of the method of measuring the mass concentration of organic acids and their salts by capillary electrophoresis "Kapel 105". The total antioxidant activity determination was performed on "Tsvet yauza 01-AA".

## Results and Discussion

### *Determination of sorbet quality indicators*

Before low-temperature storage, hardening of five compositions of melon sorbet in the range of -20 to -30°C was conducted for 24-36 h for further investigation of their qualitative indicators.

The results of organoleptic analysis of sorbet enriched with phytogetic additives after three, six, nine months of storage are shown in Fig. 1.

As shown in Fig. 1, all kinds of sorbet after three months of storage had high organoleptic characteristics.

After six months of storage in the "Snowy temptation" sorbet no visible changes were observed.



Color of sorbet remained saturated burgundy (crimson), in the aroma there was a delicate shade of raspberry with notes of melon and viburnum, there was a slight decrease in sweetness, no foreign taste and aroma was found, the consistency was homogeneous, unchanged.

After six months of storage the "Winter sun" sorbet had an attractive appearance, the color remained saturated – warm orange, the aroma had sea-buckthorn notes with light hints of melon and vanilla, the taste was gentle and pleasant with a slight decrease in sweetness, homogeneous consistency, without extraneous inclusions.

During the six-month period, the "Frosty night" sorbet retained its taste and aromatic qualities, the color remained saturated – dark purple with a slight reddish tinge, the melon notes predominated in the aroma, the taste was pleasant, refreshing, sweetish-acidic, a slight decrease in sweetness was observed, the consistency was homogenous, unchanged.

After six months of storing noticeable changes in taste and aroma in the "Ice Touch" sorbet did not occur, except for an easy decrease in sweetness, the color of the sorbet had a pleasant bright pink hue, the melon predominated in the aroma with light notes of red bilberry, the consistency is homogeneous, without extraneous inclusions.

In the "Summer freshness" sorbet after six months no significant changes in taste, consistency and aroma did not occur, the color remained light green with a slight yellowish tinge, aromatic melon-lemon notes were present, a slight decrease in sweetness and acidity was observed in the taste, the consistency was uniform, without extraneous inclusions.

In all kinds of sorbet, after nine months of storage, a significant decrease in sweetness and acidity was observed, the taste became more insipid, no noticeable changes occurred in the consistency, color and aroma. On the basis of the data obtained, it should be noted that the sorbet is best kept for six-nine months, since during this period the color, consistency and taste-aromatic properties are best preserved, while with longer storage the taste of the products is reduced. In addition to the organoleptic analysis of the melon sorbet, the influence of the low-temperature storage mode on the qualitative indicators of the products was studied (Table 1). It follows from Table 1 that the level of the mass fraction of protein is approximately the same in all samples of the sorbet and during storage decreases insignificantly, on average three months of

storage it is reduced by 1.07 times, six months by 1.13 times and nine months by 1.25 times.

Mass fraction of fat in the presented sorbet samples varies in the range from 69 to 112.1 mg / 100g and during the storage period on the average it decreases by 1.06 times after three months, by 1.16 times in six months and after nine months of storage by 1.28 times. As shown in Table 1, the mass fraction of pectin substances is most abundant in "Snow temptation", "Frosty night", "Winter sun", "Summer freshness" sorbets and less in sorbet "Ice touch". During the three, six and nine months of storage there is a tendency for a slight decrease in the level of pectin substances in all sorbet species, an average of 1.04; 1.12 and 1.28 times, respectively, indicating a good binding ability and preservation of the consistency of products. After hardening of sorbet the test samples, the content of antioxidant activity varies from 3.16 to 3.73 mg / l. After the expiration of low-temperature storage, there is a slight decrease in antioxidant activity on average by 7.6% (after three months), by 14.1% (six months) and by 26.3% (nine months), which does not reduce its main protective effects in sorbet, since it plays an important role in prevention of cancer and cardiovascular diseases and promotes the neutralization of free radicals in the human body.

Losses of vitamin C make after an expiration of three months of storage an average of 15.4%, six months – 29.5% and nine months – 36.2%. The decrease in potassium content in all samples of sorbet averaged after three, six and nine months of storage, respectively 1.6%, 2.6% and 3.6%. Insignificant losses of magnesium in samples of sorbet averaged in three, six and nine months of storage accordingly – 2.1%, 4.0% and 6.1%.

As shown in Table 1, in the types of sorbet tested after hardening, carbohydrates such as sucrose, fructose and glucose are found. At the same time, in all sorbet compositions fructose predominates, which gives them a dietary effect and has sparing effects on the cells of the human body during decomposition. Compared with fructose, the glucose content of the sorbet is on average twice less, and sucrose - six times less.

At low-temperature storage for three, six and nine months in all investigated samples of sorbet there was a noticeable non-uniform decrease in the level of sucrose, glucose, fructose. After nine months of storage, the least loss of carbohydrates occurred in the "Winter sun" sorbet, on average, by 32.3%, and the largest losses (39.3%) were found in the "Snow



temptation” sorbet. In our opinion, such a noticeable decrease in the level of carbohydrates in sorbet is due to the sensitivity of sugars to low temperature storage. As of malic acid, then at three, six, nine months of storage there is a tendency of its insignificant decrease in sorbet samples, on average, by 5.13%, 9.38% and 15.75%, respectively.

### Conclusions

The obtained data shows that storage of sorbet within 6-9 months within -18 to -25°C ensures the preservation of quality indicators, since longer storage reduces the level of biologically active substances, which in turn affects the flavor and aromatic properties of the products.

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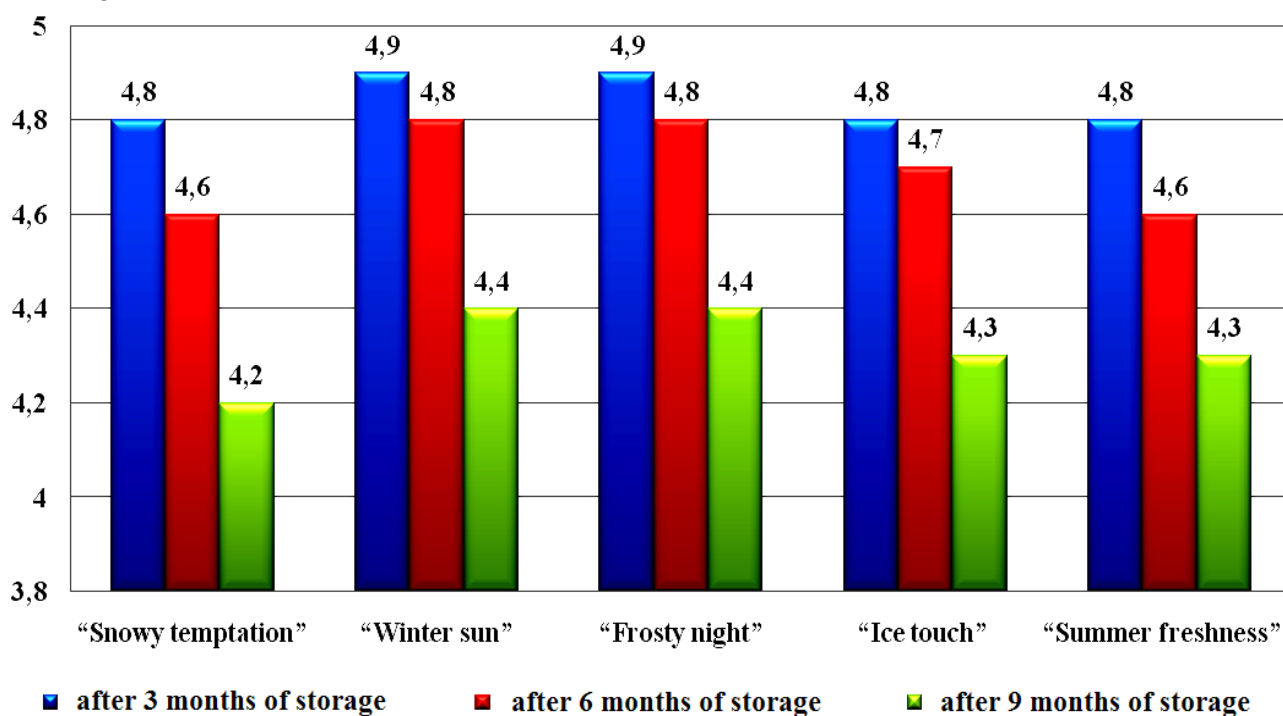
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**Table 1.** Influence of the low-temperature storage mode within -18 to -25°C on qualitative indicators of melon sorbet

Indicators		Mass fraction of protein, mg /100g	Mass fraction of fat, mg / 100g	Mass fraction of pectin substances,	Antioxidant activity, mg / l	Vitamin C, mg / 100g	Potassium, mg / 100 g	Magnesium, mg / 100 g	Sucrose, g/l	Fructose, g/l	Glucose, g/l	Malic acid, mg /l
“Winter sun” sorbet	after hardening	48	69	262	3.17	0.35	142.1	16.52	0.010	5.014	2.145	18.5
	after 3months of storage	44	66	246	2.92	0.3	139.3	16.3	0.009	4.56	1.93	17.3
	after 6 months of storage	42	63	231	2.79	0.24	137.8	16.0	0.008	4.21	1.71	16.7
	after 9 months of storage	38	57	204	2.25	0.21	136.4	15.8	0.008	3.24	1.34	15.4
“Ice touch” sorbet	after hardening	49	89.7	206	3.51	0.98	164.2	17.61	0.013	8.001	2.623	195
	after 3months of storage	46	85.2	192	3.19	0.74	162.5	17.3	0.012	6.72	2.33	188
	after 6 months of storage	44	79.8	175	2.95	0.7	160.8	16.9	0.011	6.08	2.06	179
	after 9 months of storage	41	72.6	160	2.53	0.6	159.1	16.4	0.009	5.04	1.84	167
“Frosty night” sorbet	after hardening	45	110.4	286	3.16	0.93	183.2	14.09	0.008	6.525	4.104	195
	after 3months of storage	43	106	274	2.84	0.79	179.5	13.8	0.007	5.48	3.6	187
	after 6 months of storage	40	92	257	2.65	0.69	177.7	13.5	0.006	4.89	3.2	177
	after 9 months of storage	36	86	228	2.3	0.6	175.8	13.3	0.005	4.11	2.7	165
“Summer freshness” sorbet	after hardening	44	112.1	234	3.73	0.101	405.4	31.83	0.007	5.709	3.893	165
	after 3months of storage	41	101	224	3.54	0.89	397.5	31.1	0.006	4.89	3.34	152
	after 6 months of storage	39	95	210	3.31	0.7	393.3	30.5	0.005	4.61	2.95	148
	after 9 months of storage	34	84	180	2.94	0.65	389.3	29.7	0.004	3.88	2.43	131
“Snowy temptation” sorbet	after hardening	46	111.8	326	3.23	1.0	126.5	12.58	0.001	6.242	3.765	170
	after 3months of storage	42	102	312	3.03	0.89	125.2	12.2	0.001	5.24	3.31	161
	after 6 months of storage	39	94	290	2.74	0.81	123.9	12.0	0.001	4.61	2.93	153
	after 9 months of storage	36	85	247	2.39	0.69	122.7	11.7	0.001	3.44	2.52	148

Technological losses, %



**Figure 1.** Organoleptic evaluation of melon sorbet with enriching phytogetic additives after low-temperature storage within -18 to -25°C