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MODERN APPROACHES TO THE MODEL ANALYSIS OF THE CAPSULATE FUNCTIONAL PRODUCT BASED ON THE SEA BUCKTHORN OIL

Современные подходы к моделированию капсулированного функционального продукта на основе облепихового масла

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Abstract

The article is devoted to the challenging topic aimed at expanding the foodstuff range based on the sea buckthorn oil as a source of essential polyunsaturated fatty acids (ω -3, ω -6 and ω -7), phospholipids, and other biologically active substances and vitamins. As a research result the product recipes on the basis of the concentrated sea buckthorn oil, soft sugarplums "Sea Buckthorn Oil" were developed. The optimum ratio of the main raw, materials, to achieve high organoleptic indicators of sugarplums are the following: 51.23 g of sugar, 8.2 g of the concentrated sea buckthorn oil, 32.8 g of the refined sunflower oil per 100 g respectively. The conditions and storage periods of the developed sugarplums are determined: during the selected standard storage mode at the temperature $t=18\pm3$ °C and the saturation ratio less than 75% the sugarplums in a sealed package can be stored for 12 months from the date of production. As the fundamental quality indicators, the regulated quality indicators of the soft sugarplums as well as the biologically active substances amount that determines the functional properties of the developed sugarplums were developed. The results display that 6 soft sugarplums "Sea Buckthorn Oil" is able to meet 30 % of the daily needs in carotenoids. It allows to recommend the sugarplum as a tonic remedy for all consumer categories.

Реферат

Статья посвящена актуальной теме расширения ассортимента пищевых продуктов на основе использования облепихового масла как источника незаменимых полиненасыщенных жирных кислот (ω -3, ω -6 и ω -7), фосфолипидов и других биологически активных веществ и витаминов.

По результатам исследований разработаны рецептуры продуктов на основе концентрата масла облепихи крушиновидной – мягкое драже «Облепиховое масло». С целью достижения высоких органолептических показателей драже установлено оптимальное соотношение основного сырья, г/100 г: сахар-песок – 51,23; концентрат облепихового масла – 8,2; масло подсолнечное рафинированное – 32,8. Определены условия и сроки хранения разработанных драже: при выбранном стандартном режиме хранения ($t = 18\pm3$ °C; ОВВ – не более 75 %) драже в герметичной упаковке могут храниться в течение 12 месяцев с даты производства. За основополагающие приняты регламентируемые показатели качества мягкого драже, а также содержание биологически активных веществ (БАВ), обуславливающих функциональные свойства разработанных драже.

Полученные результаты показывают, что шесть мягких драже «Облепиховое масло» способны удовлетворять 30 % суточной потребности в каротиноидах, что позволяет рекомендовать их в качестве общеукрепляющего средства для всех категорий потребителей.

Relevance

The sea buckthorn oil is known to be a natural concentrate of carotenoids, tocopherols, phyloquinones, phytosterols, polyunsaturated fatty acids (ω -3, ω -6 and ω -7), phospholipids, and other biologically active substances and vitamins, it is manufactured remedy with the different therapeutic properties harmful side-effects devoid [1].

The research purpose is to develop the CPL soft sugarplums based on the sea buckthorn oil concentrate.

As the research results and run monitoring of the functional confectionery products based on sea buckthorn oil market [2, 3], an innovative product – CPL soft sugarplums “Sea Buckthorn Oil” that are based on the soft gelatin capsule filled with homogeneous oily liquid from the concentrate sea buckthorn oil with addition of refined sunflower oil and knurled powdered sugar – is offered. The advantage of the new sugarplums is the following: not all consumers, especially children, like tasteless capsules. In our opinion, developed sugarplums are the new method to deliver to the human body essential fatty acids of the sea buckthorn oil.

The CPL soft sugarplums “Sea Buckthorn Oil” is intended for the realization through the retail network for all population groups. It has the high taste properties and contains essential fatty acids of the sea buckthorn oil as an ingredient.

The Objects and Methods of the Research

The study objects in this project were the laboratory and production samples: the CPL soft sugarplums “Sea Buckthorn oil” produced on the “Altaivitaminy” base, Biysk.

Organoleptic characteristics of the sugarplums samples (shape, appearance, color, taste, flavor, quantity of agglomerated and deformed sugarplums, the number of sugarplums on 1 kg) were determined by the visual inspection, tasting and counting according to the GOST 5897-90 [4].

Moisture content of the sugarplums samples were determined by drying to the constant weight according to the GOST 5900-73 [5].

The total acidity was determined by the titration according to the GOST 5898-87[6]. The method is based on the neutralization of the acids contained in the samples, and the sodium hydroxide solution in the presence of phenolphthalein until the pink color appeared. The acidity is expressed in degrees. By the acidity degrees is meant the cm³ number of the sodium hydroxide N-solution used for the neutralization of acids contained in 100 g of the sugarplums.

The vitamin C determination was performed by the iodate titration method according to the GOST 7047-55 [7].

Discussion of the Results

The ingredients for the sugarplums recipe were selected on the basis of the chemical sea buckthorn oil concentrate analysis, as well as through the introduction of the necessary for this product form technological additives taking into account quality and safety requirements. For the basic recipe of the soft sugarplums, two variants with different contents of major flavor components (sea buckthorn oil concentrate and sugar) were further prepared. The taste of the three sugarplums formulations is estimated by the 30 point scale [8] (table 1).

The technological process of the CPL soft sugarplums “Sea Buckthorn Oil” production consisting of the steps shown on the figure 1 was developed.

An oily mixture was prepared from the sea buckthorn oil concentrate by diluting it with the sunflower oil and blending (averaging) it in blending reservoir.

On the first stage, the assessment of organoleptic characteristics was carried (table 2).

According to the table 2, the obtained prototypes meet the requirements of the GOST 7060-79 by

*Table 1
Formulation Value for the Production of the CPL Soft Sugarplums “Sea Buckthorn Oil”*

Index/ Dough Type		Ingredient Amount, gr per100 gr		
		Variant 1	Variant 2	Variant 3
1	Sea Buckthorn Oil Concentrate	8,200	8,932	9,932
2	Refined Oil	32,800	31,800	35,300
3	Gelatin	4,560	4,560	4,560
4	Sand Sugar	51,232	49,500	47,000
5	Additives	Commercial Secret		
	Weight of one sugarplum, gr	0,5	0,5	0,5

Figure 1. Block diagram of the CPL soft sugarplums production

Table 2

Formulation Value for the Production of the CPL Soft Sugarplums "Sea Buckthorn Oil"

Exponent	Reference Sample	Variant 1	Variant 2	Variant 3
Mode	Regular, spherical			
Layout	The sugarplums are soft filled with homogeneous syrupy oily moisture	The sugarplums are soft with regular sugar powder coating filled with homogeneous syrupy oily moisture		
Color	Light-orange	White		
Taste	Pronounced fruit (sea buckthorn), sour enough, short and sour aftertaste without flavors-off	Enjoyable, moderately sweet, slightly sour, pronounced fruit (sea buckthorn), without flavors-off	Pronounced fruit (sea buckthorn), too sour long-lasting and sour aftertaste without flavors-off	Pronounced fruit (sea buckthorn), sour enough, short and sour aftertaste without flavors-off
Flavour	Low fruit	Pronounced fruit, enjoyable, fresh		
Tasting Score	23,5	30	26	24
Number of Sticked and Strain Sugarplums, % (by Weight)	0			
Number of Sugarplums in 1 kg, PCS	2000			

Table 3
Physical and Chemical Characteristics of the CPL Soft Sugarplums "Sea Buckthorn Oil"

Index	Regulated Amount (by the GOST 7060-90)	Real Amount		
		Variant 1	Variant 2	Variant 3
Moisture, %	5,0–9,0	7,8±0,1	7,6±0,1	7,6±0,1
Acidity,	23,5	30	26	24
Degree, Less than	No applicable regulation	4,2±0,1	4,4±0,1	4,6±0,1

its organoleptic indicators. For the basic formulations, the most optimal ingredients combination (variant 1) giving the most advanced and harmonious taste – pleasant, moderate sweet, with slight acidity, pronounced fruit (sea buckthorn), without off-taste – was selected. The positive influence of the pearl sugar on the organoleptic quality of the CPL soft sugarplums "Sea Buckthorn Oil" is noticed. The degustation evaluation total score of the soft sugarplums "Sea Buckthorn Oil" quality is 8.5 points higher than in the control sample.

Only some of physical and chemical parameters regulated according to the GOST were determined, as developed sugarplums refer to a liqueur according to the type of coat [9] (table 3).

As developed soft sugarplums are positioned as a functional product, the amount of a number of biologically active substances in the sugarplums samples was determined (table 4).

As can be seen from the table 4, the number of glycerides and carotenoids in the soft sugarplums varies insignificantly, whereas sugarplums prepared according to the formulation № 1 are recognized the best by the taste.

By the microbiological and safety indicators, sugarplums should meet the requirements of the TR CU 021/2011 "About the food safety" [10], that is confirmed by the study (tables 5 and 6).

The expiry date was carried out by controlling the sugarplums samples embedded for the storage in accordance with the main directives of the MUK 4.2.1847-04 [11]. The products were stored for 14 months at a temperature of 18±3 °C and the saturation ratio of 70±5 %, in the consumers hermetically sealed containers – polyethylene food jars with a screw cap weighing 50,0±3,0 g. During the storage, organoleptic, physical, chemical and microbiological parameters were defined every 3 months.

Table 4
The Amount of Biologically Active Substances in the CPL soft sugarplums "Sea Buckthorn Oil"

Index	Amount in 100 gr of Sugarplums		
	Variant 1	Variant 2	Variant 3
Glyceryl Content, %	17,46±1,13	17,38±1,13	17,40±1,13
Triolein Content, %	60,89,03	60,29,03	60,05,03
Tripalmitin Content, %	8,99±0,05	8,76±0,05	8,60±0,05
Carotenoids Content (calculated as β -carotin), mg %	69,00±2,60	68,50±2,60	68,20±2,60

Table 5
Microbiological Indicators of the CPL Soft Sugarplums "Sea Buckthorn Oil"

Index	Variant 1	Variant 2
QMA&OAMO, c.f.u. in 1 gr of the Product	Not more than 2,5x10 ³	Less than 10,0
Product Weight, gr, in which the Following Is Prohibited:		
Coliforms (Poliforms) in 0,1 gr	Not permitted	Not Detected
Pathogenic Bacterium Including Salmonella, in 25 gr	Not permitted	Not Detected
Yeast, c.f.u. per 1 gr	Not more than 50,0	Less than 10
Penicillium, c.f.u. per 1 gr	Not more than 50,0	Less than 10

Table 6

Safety Indicators of the CPL soft sugarplums "Sea Buckthorn Oil"

Ingredient (Element) Name		Allowable Content Level (by the TR CU 021/2011), mg per kg, Not More Than	Real Amount
Toxic Component	Plumb	1,0	0,09
	Arsenic	1,0	Less than 0,02
	Cadmium	0,1	0,003
	Mercuric	0,01	Less than 0,002
Pesticide	HCH (α , β , γ -isomere)	0,005	Not Detected
	DDD and Its Metabolites	0,005	Not Detected

During the storage period the sugarplums organoleptic and, physical and chemical characteristics are determined not to be changed. Minor changes took place in the physiological value indicators (figure 2): decreased carotenoid number (calculated as β -carotene) to 55.40 mg%, which is about 80 % of the original. The glycerides number has not practically changed, that indicates the optimal conditions for the extraction solvent removal from the sea buckthorn oil concentrate providing the product with increased expiry period.

Summarizing obtained in the process of storing results by organoleptic, physical and chemical, toxicological and microbiological indicators, the biologically active substances amount in the CPL soft sugarplums "Sea Buckthorn Oil" the expiry date is possibly being determined. Under the selected standard storage mode – $t=18\pm3$ °C and the saturation ratio not more than 75 % – sugarplums in a sealed aseptic package can be stored for 12 months from the date of production.

So, sugarplums are able to satisfy 30% of the daily needs in carotenoids allowing to recommend it as a tonic remedy for all consumer categories.

By the results of the research of the CPL soft sugarplums "Sea Buckthorn Oil" the regulated quality indicators for conducting comprehensive trade analysis of the sugarplums were determined (tables 7, 8, 9 and 10).

The serial production of the CPL soft sugarplums "Sea Buckthorn Oil" is arranged on the base of the LC "Altaivitaminy" (Biysk, the Altai territory).

Thus, in the final part of the work according to the research results the functional orientation sugarplums – the CPL soft sugarplums "Sea Buckthorn Oil" based on the sea buckthorn oil concentrate were developed. It implemented at LC "Altaivitaminy". Its mass production continues that will allow to expand the product range at the regional level, which will differ by lower price compared to imported products due to the transport costs reduction and the use of local raw materials.

Figure 2. Dynamics of Reducing the Amount of Glyceryl, Triolein, Tripalmitin and Carotenoids in the Soft Sugarplums "Sea Buckthorn Oil"

Table 7
Regulated organoleptic and physical and chemical indicators of the soft sugarplums "Sea Buckthorn Oil"

Exponent	Amount
Mode	Regular, spherical
Layout	The sugarplums are soft with regular sugar powder coating filled with homogeneous syrupy oily moisture
Color	White
Taste	Enjoyable, moderately sweet, slightly sour, pronounced fruit (sea buckthorn), without flavors-off
Flavour	Pronounced fruit, enjoyable, fresh
Number of Sticked and Strain Sugarplums, % (by Weight)	0
Number of Sugarplums in 1 kg, PCS	2000
Moisture, %	5,0–9,0

Table 8
The Amount of Biologically Active Substances in the CPL soft sugarplums "Sea Buckthorn Oil"

Index	Amount in 100 gr of Sugarplums, %
Glyceryl Content, %	15±15
Triolein Content, %	55±15
Tripalmitin Content, %	8±15
Carotenoids Content (calculated as β -carotin), mg %	60±15

Table 9
Regulated Microbiological Indicators of the CPL Soft Sugarplums "Sea Buckthorn Oil"

Index	Regulated Amount
QMA&OAMO, c.f.u. in 1 gr of the Product	Not more than $2,5 \times 10^3$
Product Weight, gr, in which the Following Is Prohibited:	
Coliforms (Poliforms) in 0,1 gr	Not permitted
Pathogenic Bacterium Including Salmonella, in 25 gr	Not permitted
Yeast, c.f.u. per 1 gr	Not more than 50,0
Penicillium, c.f.u. per 1 gr	Not more than 50,0

Table 10
Regulated Safety Indicators of the CPL soft sugarplums "Sea Buckthorn Oil"

Ingredient (Element) Name		Allowable Content Level, mg per kg, Not More Than
Toxic Component	Plumb	1,0
	Arsenic	1,0
	Cadmium	0,1
	Mercuric	0,01
Pesticide	HCH (α , β , γ -isomere)	0,005
	DDD and Its Metabolites	0,005

Bibliography

- Galieva A.I. Razrabotka i issledovanie potrebitel'skikh svoystv obogashchennogo drazhe: avtoref. diss. ... kand. tehn. nauk: 05.18.15. Kemerovo, 2014. 16 s.
- GOST 5897-90. Izdelija konditerskie. Metody opredelenija organolepticheskikh pokazatelej kachestva, razmerov, massy netto i sostavnykh chastej. M.: Standartinform, 2012. S. 11-16.
- GOST 5898-87. Izdelija konditerskie. Metody opredelenija kislotsnosti i shhelochnosti. M.: Standartinform, 2012. S. 18-26.
- GOST 5900-73. Izdelija konditerskie. Metody opredelenija vlagi i suhih veshhestv. M.: Standartinform, 2012. S. 47-54.
- GOST 7047-55. Vitaminy A, S, D, V1, V2 i RR. Otbor prob, metody opredelenija vitaminov i ispytaniya kachestva vitaminnykh preparatov. M.: Izdatel'stvo standartov, 1994. 48 s.
- GOST 7060-79. Drazhe. Tehnicheskie usloviya. M.: Standartinform, 2004. S. 51-58.
- Gur'janov Ju.G., Lobach E.Ju., Reznichenko I.Ju. Ocenka potrebitel'skikh predpochtenij k novym produktam funkcional'nogo naznacheniya // Polzunovskij vestnik. 2012. № 2/2. S. 187-190.
- MUK 4.2.1847-04. 4.2. Metody kontrolja. Biologicheskie i mikrobiologicheskie faktory. Sanitarно-jepidemiologicheskaja ocenka obosnovaniya srokov godnosti i uslovij hraneniya pishhevyyh produktov: metod. ukazaniya (utv. Glavnym gosudarstvennym sanitarnym vrachom RF 06.03.2004). M., 2004. 18 s.
- O bezopasnosti pishhevoj produkcii: Tehnicheskij reglament Tamozhennogo sojuza 021/2011 (utv. 09.12.2011 g. resheniem komissii Tamozhennogo sojuza). M., 2011. 242 s.
- Poznjakovskij V.M., Reznichenko I.Ju., Guseva I.Ju. Konditerskie izdelija: prakticheskoe i uchebnoe posobie. Kemerovo: KemTIPP, 1999. 51 s.
- Sea buckthorn: monograph / Yu.A. Koshelev, L.D. Ageeva, E.S. Batashov, V.P. Sevodin, E.D. Rozhnov, N.I. Kuleshova. Biysk: Publishing house of Polzunov Altai State Technical, 2015. 401 p.

Библиографический список

- Галиева А.И. Разработка и исследование потребительских свойств обогащенного драже: автореф. дис. ... канд. техн. наук: 05.18.15. Кемерово, 2014. 16 с.
- ГОСТ 5897-90. Изделия кондитерские. Методы определения органолептических показателей качества, размеров, массы нетто и составных частей. М.: Стандартинформ, 2012. С. 11-16.
- ГОСТ 5898-87. Изделия кондитерские. Методы определения кислотности и щелочности. М.: Стандартинформ, 2012. С. 18-26.
- ГОСТ 5900-73. Изделия кондитерские. Методы определения влаги и сухих веществ. М.: Стандартинформ, 2012. С. 47-54.
- ГОСТ 7047-55. Витамины А, С, Д, В1, В2 и РР. Отбор проб, методы определения витаминов и испытания качества витаминных препаратов. М.: Изд-во стандартов, 1994. 48 с.
- ГОСТ 7060-79. Драже. Технические условия. М.: Стандартинформ, 2004. С. 51-58.
- Гурьянов Ю.Г., Лобач Е.Ю., Резниченко И.Ю. Оценка потребительских предпочтений к новым продуктам функционального назначения // Ползуновский вестник. 2012. № 2/2. С. 187-190.
- МУК 4.2.1847-04. 4.2. Методы контроля. Биологические и микробиологические факторы. Санитарно-эпидемиологическая оценка обоснования сроков годности и условий хранения пищевых продуктов: метод. указания (утв. Главным государственным санитарным врачом РФ 06.03.2004). М., 2004. 18 с.
- О безопасности пищевой продукции: Технический регламент Таможенного союза 021/2011 (утв. 09.12.2011 г. решением комиссии Таможенного союза). М., 2011. 242 с.
- Позняковский В.М., Резниченко И.Ю., Гусева И.Ю. Кондитерские изделия: практическое и учебное пособие. Кемерово: КемТИПП, 1999. 51 с.
- Sea buckthorn: monograph / Yu.A. Koshelev, L.D. Ageeva, E.S. Batashov, V.P. Sevodin, E.D. Rozhnov, N.I. Kuleshova. Biysk: Publishing house of Polzunov Altai State Technical, 2015. 401 p.

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