Comprehensive evaluation of the hot sweet soufflé dessert quality

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Abstract

Introduction. The aim of the research is to evaluate the quality of innovative hot soufflé dessert from the standpoint of physiological needs of the child of preschool age by qualimetry methods.

Materials and methods. The basis of the research was established by the methods of theoretical generalization, scientific induction and deduction, methods of systematic, structural, qualimetric and mathematical analysis of the dish quality.

Results and discussion. Taking into consideration physiological needs norms of 4-6 years old child, the innovative hot sweet soufflé dessert was developed. The comprehensive evaluation was given to this dish, and it showed the benefits of an improved recipe in comparison with the traditional one. The hierarchical structure of quality indicators of the dish was improved and the scale of nodal values of quality indicators that characterize the critical point of the meal was created on its basis.

Basic qualitative indexes (m) innovative hot sweet dessert of macronutrients, mineral matters and vitamins are the following: for proteins – 0,20; fats – 0,40; carbohydrates – 0,40; sodium – 0,10; potassium – 0,10; calcium – 0,10; zinc – 0,40; iron – 0,30; thiamine – 0,20; β-carotene – 20; riboflavin – 0,20; pyridoxine – 0,20; ascorbic acid – 0,20.

The biggest value of the complex index (K_0) is for: fats and carbohydrates - 0,4; zinc – 0,4; The minimum value is typical of calcium, potassium, sodium

Conclusion. The benefits of innovative hot sweet soufflé dessert in comparison with the prototype were established by methods of qualimetric quality analysis. The expediency of β-glucan usage in the dish recipe is proved by these methods to enhance nutrition value and to reduce the food energy value.

Introduction

Cardiovascular diseases remain the main cause of mortality in many countries around the world. The highest mortal rate caused by cardiovascular diseases in 1990-2015 according to the statistics analysis conducted by professor Gregory Roth (Washington University «School of Medicine») is observed in Eastern Europe, Central Asia, Near East and South America. The lowest indexes are recorded in such countries as Japan, Andorra, Peru, France, Israel and Spain (Dean R. Owen, Rachel Fortunati, 2017) [1]. These diseases develop because of the increase of blood cholesterol level. The main reasons for cholesterol increase are:

- eating foods with high animal fat saturation;
- bad habits;
- heredity.

It is believed that only elderly people suffer from cholesterol affects, but nowadays not only they, but also children, pregnant women, adolescents are also in hazard because of the consumption increase of foods with a high glycemic index and food that contains a significant amount of saturated fatty acids and easily digested carbohydrates.

The scientific studies of scholars highlight the main researches of the excess cholesterol accumulation in the human's body and they point out essential ways to reduce it:

- restriction of eating products with high glycemic index;
- eating products, where animal raw materials are replaced with the plant;
- physical exercises;
- treatment with medecines (Negin Sharafbafia, Susan M.Toshb et al 2014; Butt M, 2014) (Table 1) [2–3].

Materials and methods

The basis of the research was established by methods of theoretical generalization, scientific induction and deduction, methods of systematic, structural, qualimetric and mathematical analysis of the dish quality.

According to the theoretical and methodological basis of qualimetry, the method of quality evaluation of innovative hot sweet soufflé dessert was developed. The absolute values of indicators of quality expressed in different units cannot be directly reduced to a general integrated index without transforming them into a common measurement scale (Topol'nik, Ratushnyj, 2008; Azgaldov et al., 2011; Koretska, 2013; Niemirich A., Novosad O. 2013) [11, 12, 13, 14].

According to the principles of qualimetry, the value of a single quality indicator and product quality as a whole should be evaluated by means of comparison with the basic or absolute value (Kuzmin et al, 2014–2016; Jean-Louis Sébédio, 2017) [15, 16, 17, 18] This valuation is a dimensionless quantity .

Numerous ways of determining the quality evaluation are currently being studied; the most common two methods are:

- comprehensive quality evaluation;
- quality determination with the help of desirability scale of Harrington method.

Table 1

Comparative chemical composition of cow milk and oat broth

Substance name	Content of components in 100 g of raw materials	
	Cow's milk	Oat broth
Water	88,1 [4]	-
Ash	0,7 [4]	3,2[4]
Mineral substances, mg		
Iron	0,1 [4]	5,5 [4]
Calcium	120 [4]	118 [5]
Potassium	146 [4]	421 [4]
Sodium	50 [4]	37 [4]
Iodine, μg(mcg)	0,0009 [4]	0,075 [4]
Zinc	0,4 [4]	3,61
Phosphorus	-	90 [5]
Proteins	2,9 [4]	3,0 [5]
Carbohydrates	4,7 [4]	4,4 [5]
Mono- and disaccharides	4,7 [4]	-
β-glucan	-	0,60 [5]
Starch	-	53,7
Dietary fibre	-	8,0 [4]
Fat	3,5 [4]	0,3 [5]
Cholesterol	10,0 [4]	-
Organic acids	0,1 [4]	-
Vitamins, mg		
Vitamin B_1	0,04 [4]	0,47 [4]
Vitamin B_2	0,15 [4]	0,12 [4]
Vitamin B_4	23,6 [4]	-
Vitamin B_5	0,4 [4]	1,0 [4]
Vitamin B_6	0,5 [4]	0,26 [4]
Vitamin C	1,3 [4]	-
Vitamin E	0,1 [4]	1,4 [4]
Vitamins, μg (mcg)		
Retinol	0,13 [4]	-
β-carotene	-	0,02 [4]

The most accurate method is considered to be the desirability scale of Harrington, which has more accurate attributes, such as monotony, continuity, adequacy, effectiveness and statistical sensitivity. (Topol'nik, Ratushnyj, 2008; Azgaldov et al., 2011; Koretska, 2013; Niemirich A., Novosad O. 2013) [11, 12, 13, 14]. To convert the absolute values of products quality into dimensionless ones, it is efficiently to use exponential dependence that is taken as the basis of desirability scale of Harrington:

$$D_i = \exp\left[-\exp(-Y_i)\right] \quad (1)$$

where Y_i is the code value of the quality indicator. Scale includes intervals from 1,00 to 0,00 (Figure 1):

- 1,00–0,80 – very good (excellent);
- 0,80–0,63 – good;
- 0,63–0,37 – satisfactory;
- 0,37–0,20 – bad;
- 0,20–0,00 – very bad.

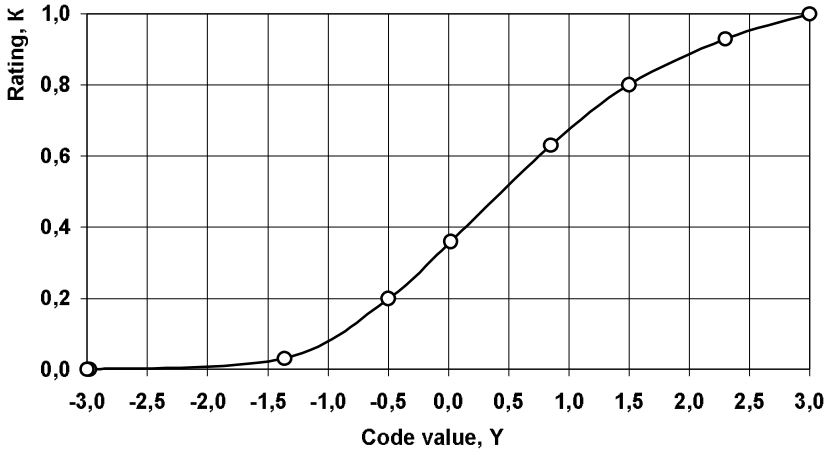

Figure 1. Schedule of estimates definition of the normed quality indicators of innovative hot sweet soufflé dessert

Results and discussion

It should be noted that at present in modern child's food allowance sweets prevail above other products, therefore flour, bakery and confectionery products are the main objects for improvement of recipe composition. Every year foreign market expands the range of sweet foods enriched with nutrients (J. Harrison, A. Bramlett et al, 2012; M, Marauska et al, 2013; Vilma Speiciene et al, 2015) [6,7,8]. The researches pay special attention is to the hot desserts because they are the most popular products among the guests of the restaurant industry. That is why the object of the improvement is the traditional recipe of "Chocolate soufflé"

Innovative product is enriched with β-glucan to enhance nutrition value and to reduce the food energy value. (Noora Mäkelä Ndegwa, H.Maina Päivi, et al, 2017;) [9, 10].

Recipe composition of control and innovative hot sweet soufflé dessert are given in tables 2 and 3.

Table 2

«Chocolate souffle»

No.	The name of the raw material	Mass of raw materials, g	
		Gross	Net
1	Egg	2,0	80,0
2	Sugar white crystalline	40,0	40,0
3	Cow's milk	40,0	40,0
4	Fancy white wheat flour	8,0	8,0
5	Butter	2,0	2,0
6	Vanilla	0,02	0,02
7	Dark chocolate	5,0	5,0

Table 3

The innovative dessert Soufflé

No.	The name of the raw material	Mass of raw materials, g	
		Gross	Net
1	Pumpkin	38,0	25,0
2	Grounded flax seeds	10,0	10,0
3	Tapioca starch	15,0	15,0
4	Banana	25,0	20,0
5	Oat broth	33,0	33,0
6	Cocoa powder	17,0	17,0
7	Fresh egg albumen	5,0	5,0

It was established that the addition of oat broth is quite pertinent, but it needs more detailed study. That is why in this case the quantitative evaluative method is selected for evaluation of innovative hot sweet soufflé dessert. Certain indicators of the product are determined for calculation of the quantitative evaluation of the quality of the dish. These indicators are categorized into: standard and original.

The standard indicators of soufflé quality include: the organoleptic, physical, chemical and microbiological indicators of safety (J.M. Regenstein CE Regenstein, 2017) [19].

The original indicators include contents of: protein, carbohydrates, fats, minerals and vitamins. (Azgaldov et al, 2015; Samantha Caesar et al, 2016; Jean-Louis Sébédio et al, 2017; Jean-Claude Moubarac et al, 2017; Kuzmin O., Ditrich I., et al 2017) [20-23].

At Figure 2 the hierarchical structure is represented by the standard and original indicators as the main components.

To calculate the comprehensive quality evaluation the arithmetic weighted average is used according to the formula 2:

$$K = \sum_{i=1}^{n} K_i \cdot m_i, \quad (2)$$

The justification of the nodal values is given in Table 4. The standardized values are presented in the form of a relative quality index - Ki = 0.37 and highlighted in bold. (Topol'nik, Ratushnyj, 2008;Azgaldov et al., 2011; Koretska, 2013; Niemirich A., Novosad O. 2013Topol'nik) [9, 10, 11, 12].

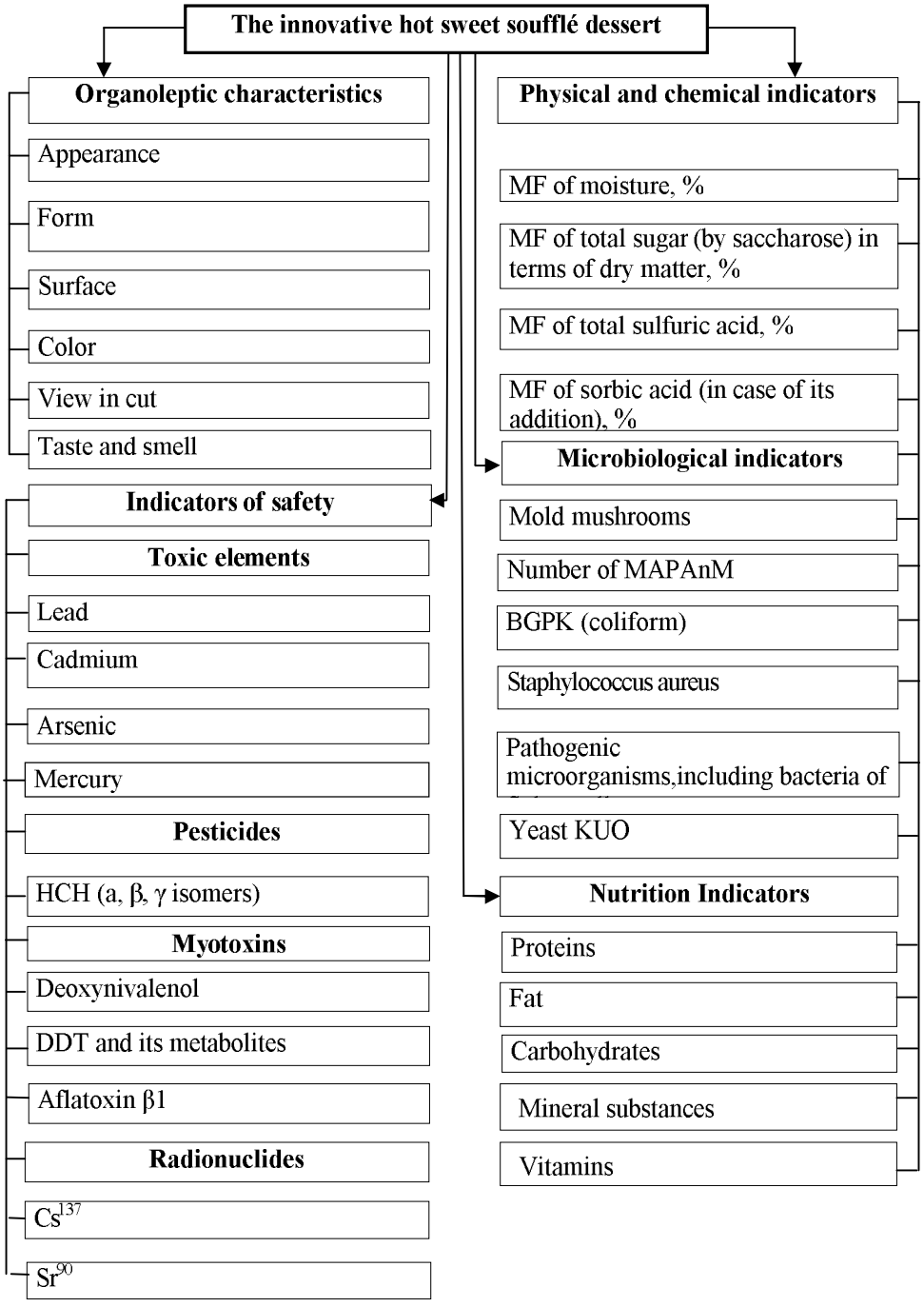

Figure 2. The hierarchical structure of innovative hot sweet dessert

Table 4

The scale of the nodal values of the quality indices of the innovative hot sweet soufflé dessert

Metric name, unit of measurement	Grade, K_i					
	1,00	0,80	0,65	0,37	0,20	0,00
	Coded values *in*					
	3,00	1,50	0,85	0,00	-0,50	-3,00
1	2	3	4	5	6	7
Organoleptic characteristics						
Appearance	5,0	4,0	3,0	2,0	1,5	1,0
Form	5,0	4,0	3,0	2,0	1,5	1,0
Surface	5,0	4,0	3,0	2,0	1,5	1,0
Color	5,0	4,0	3,0	2,0	1,5	1,0
View in cut	5,0	4,0	3,0	2,0	1,5	1,0
Taste and smell	5,0	4,0	3,0	2,0	1,5	1,0
Physical and chemical indicators						
MF of moisture, %	41,0	40,5	40,2	**40,0**	37,0	35,0
	41,0	42	43	**44,0**	46,0	50,0
MF of total sugar (by saccharose) in terms of dry matter, %	0,5	0,8	1,0	**1,5**	2,0	3,0
MF of total sulfuric acid, %	0,002	0,003	0,007	**0,04**	0,07	0,15
Indicators of safety						
Lead, mg / kg	0,01	0,05	0,1	**0,5**	1,4	3
Cadmium, mg / kg	0,005	0,01	0,05	**0,1**	0,7	1,5
Arsenic, mg / kg	0,001	0,005	0,01	**0,3**	1,0	1,6
Mercury, mg / kg	0,001	0,005	0,01	**0,02**	0,1	1,0
Myotoxins						
Deoxynivalenol	0,05	0,1	0,3	**0,7**	1,2	2,0
Aflatoxin β1	0,0005	0,001	0,002	**0,005**	0,01	0,02
Pesticides						
HCH (a, β, γ isomers)	0,007	0,05	0,1	**0,2**	0,7	1,2
DDT and its metabolites	0,001	0,005	0,01	**0,02**	0,09	0,2
Radionuclides						
Cs^{137}	1,0	20,0	50,0	**100,0**	200,0	300,0
Sr^{90}	15,0	80,0				
Microbiological indicators						
Number of MAPAnM	$1 \cdot 10^2$	$1 \cdot 10^3$	$1 \cdot 10^4$	$\mathbf{5 \cdot 10^4}$	$6 \cdot 10^4$	$8 \cdot 10^4$
BGPK (coliform)	0,001	0,005	0,008	**0,01**	0,07	0,2
Staphylococcus aureus in 1,0 g of product	0,001	0,005	0,01	**0,1**	0,7	1,3

continuation tab 4

1	2	3	4	5	6	7
Mold mushrooms in 1 g of product	2,0	20,0	50,0	**100,0**	200,0	300,0a
Pathogenic microorganisms,including bacteria of Salmonella genus	1,0	10,0	15,0	**25,0**	40,0	60,0
Yeast KUO, not more than 1 g of product	2,0	15,0	25,0	**50,0**	100,0	150,0
Macronutrients, g						
Proteins in 100 g of product	5,2	5,0	4,80	**4,60**	4,0	3,8
	5,2	5,40	5,60	**5,80**	6,0	6,2
Fat in 100 g of product	2,2	2,0	1,6	**1,20**	1,0	0,8
	2,2	2,40	2,60	**2,70**	2,80	3,00
Carbohydrates in100 g of product	26,0	27,0	34,0	**30,0**	10,0	5,0
	26,0	32,0	36,0	**38,0**	40,0	42,0
Mineral substances, mg						
Calcium in 100 g of product	820,0	815,0	810,0	**800,0**	780,0	770,0
	820,0	825,0	830,0	**840,0**	850,0	860,0
Potassium per 100 g of product	1380,0	1370,0	1360,0	**1350,0**	900,0	750,0
	1380,0	1400,0	1450,0	**1600,0**	1800,0	2100,0
Sodium in 100 g of product	330,0	325,0	320,0	**315,0**	260,0	200,0
	330,0	335,0	340,0	**350,0**	400,0	450,0
Mangan in 100 g of product	128,0	127,0	124,0	**130,0**	110,0	95,0
	128,0	133,0	137,0	**140,0**	155,0	170,0
Phosphorus in 100 g of product	810,0	806,0	802,0	**800,0**	780,0	770,0
	810,0	815,0	820,0	**825,0**	830,0	840,0
Iron in 100 g of product	11,5	11,0	10,5	**10,0**	75,0	64,0
	11,5	12,0	12,5	**13,0**	14,0	15,0
Iodine 100 g	100,0	95,0	94,0	**90,0**	75,0	70,0
	100,0	101,0	103,0	**104,0**	110,0	120,0
Vitamins, mg						
Vitamin B_1 100 g	0,96	0,94	0,90	**0,80**	0,4	0,3
	0,96	0,98	1,0	**1,20**	1,4	1,44
Vitamin B_2 100 g	1,08	1,06	1,04	**1,0**	0,7	0,65
	1,08	1,10	1,12	**1,14**	1,16	1,18
Vitamin B_5 per 100 g of product	3,6	3,40	3,20	**3,0**	2,8	2,7
	3,6	3,80	3,90	**4,0**	4,2	4,4
Vitamin C in 100 g of product	51,6	51,0	50,5	**50,0**	48,0	47,0
	51,5	52,0	52,5	**53,0**	54,0	55,0
Vitamins, µg						
β-carotene per 100 g of product	620,0	615,0	610,0	**600,0**	590,0	585,0
	620,0	625,0	630,0	**635,0**	640,0	645,0

Values of indicators with an estimate below 0,37 do not meet the requirements of foreign quality standards (Topol'nik, Ratushnyj, 2008; Azgaldov et al,, 2011; Koretska, 2013; Zinchenko, Niemirich A., Novosad O. 2013) [9, 10, 11, 12].

The normalized value is an indicator that has received an estimate of 0,37. To determine the weighting factors, the advantage method is used (Table 5).

Table 5

Determination of weight factor for innovative sweet soufflé dessert

Nutrition	Norm	Validity
Proteins	4,60	$m_{1\text{-}1} = 0,2$
Fat	1,20	$m_{1\text{-}2} = 0,4$
Carbohydrates	30,0	$m_{1\text{-}3} = 0,4$
Σ - energy substances	**149,2**	**Σ m = 1,0**
Ca	107,0	$m_{2\text{-}1} = 0,1$
K	380,0	$m_{2\text{-}2} = 0,1$
Na	32,0	$m_{2\text{-}3} = 0,1$
Zn	2,0	$m_{2\text{-}5} = 0,4$
Fe	6,0	$m_{2\text{-}6} = 0,3$
Σ-mineral substances	**527,0**	**Σ m = 1,0**
beta-carotene	0,66	$m_{3\text{-}1} = 0,2$
B_1	0,4	$m_{3\text{-}2} = 0,2$
B_2	0,2	$m_{3\text{-}3} = 0,2$
B_6	14,0	$m_{3\text{-}4} = 0,2$
C	12,0	$m_{3\text{-}5} = 0,2$
Σ- vitamins	**27,26**	**Σ m = 1,0**
Σ- all substances	**703,46**	

The Table shows that the highest value of the complex index (K0) is for: fats and carbohydrates – 0,4; zinc – 0,4; the minimum value is typical for calcium, potassium and sodium.

Conclusions

The benefits of innovative hot sweet soufflé dessert in comparison with the prototype were established by methods of qualimetric and mathematical quality analysis.

These methods have proved the expediency of using β-glucan in the recipe of dish to enhance nutrition value and to reduce the food energy value.Indicators of safety and microbiological indicators that are defined with the help of the Harrington's scale of desirability have confirmed the safety of a new type of soufflé.

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