Qualimetric assessment of diets

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Abstract

Introduction. The work's objective is to analyze quality rating of diets from the standpoint of physiological need norms of a person and a daily ration, to further determine the balance of nutrition.

Materials and methods. The daily ration of human nutrition (breakfast, lunch, dinner) and the norms of the physiological needs of the average person – to determine the complex quantitative assessment of the quality of diets. An additive mathematical model as most widespread in a qualimetry is used for joining the quality rating into the generalized (complex) index. Methods – qualimetric.

Results and discussion. Taking into account the norms of physiological needs of a common person, the complex-quantitative estimation of quality of one meal is calculated, the three-level hierarchical structure of the system of qualitative indexes is developed: the third level simple indexes are grouped in the qualitative indexes, which form the second level of structure systems hierarchy, which, in turn, form the first level, and then - in the complex index of zero level, which characterizes quality rating of diets.

Basic qualitative indexes (P^{basic}) of macronutrients, mineral matters and vitamins are the following: for proteins – 0,15; fats – 0,17; carbohydrates – 0,68; sodium – 0,45; potassium – 0,34; calcium – 0,07; magnesium – 0,03; phosphorus – 0,11; thiamine – 0,02; ribofflavinum – 0,02; perydoxine – 0,02; cevitamic acid – 0,94. Weight coefficients (m) are the following: proteins – 0,50; fats – 0,40; carbohydrates – 0,10; sodium – 0,03; potassium – 0,05; calcium – 0,25; magnesium – 0,50; phosphorus – 0,17; thiamine – 0,36; ribofflavinum – 0,32; perydoxine – 0,31; cevitamic acid – 0,01.

The biggest value of the complex index (K_0) is obtained in breakfast – 1,60, the lowest value is typical for supper – 1,09.

Conclusion. For the set daily ration, the complex qualitative indexes for the group of macronutrients, mineral matters and vitamins are determined. The most balanced values of qualitative index are set, that is typical for a supper №2 with the estimation – 1,09.

Introduction

A qualitative index of a product is a quantitative characteristic of one or several properties of a product, which characterize its quality, and is considered in terms of certain conditions of its creation, exploitation or consuming (Azgaldov et al, 2011, 2015; Topol'nik, Ratushnyj, 2008; Zinchenko, Koretska, 2013) [1, 2, 4, 11].

According to the amount of characterized properties the indexes are divided into simple and complex (Topol'nik, Ratushnyj, 2008; Koval, Guts, 2013) [4, 9]. Simple qualitative index identifies one of its properties, for example contents of water, sugar, fat etc (Sébédio, 2017; Kuzmin et al, 2014-2016) [3, 5-8]. They are determined by the industry regulatory document.

Complex index identifies several properties of a product. It can be related to both set of properties, which determine quality, and certain group of properties (Topol'nik, Ratushnyj, 2008) [4]. If ever one index is equal to zero, complex index is also equal to zero (Azgaldov et al, 2011; Topol'nik, Ratushnyj, 2008) [1, 4].

There are two methods of a product quantitative estimation - differential and complex. A product quantitative estimation is a set of operations, which includes: qualitative indexes' nomenclature selection of a product, value determination of these indexes and their comparison with basic indexes (Koval, Guts, 2013; Niemirich, Novosad, 2013; Zinchenko, Koretska, 2013) [9-11].

Qualimetric methods can be used in any food as well as the results of their research. Method of a product quantitative estimation is based on comparison of the set of simple indexes' values of an estimated product with a certain set of base indexes' values, called differential (Topol'nik, Ratushnyj, 2008) [4].

Complex method of a product quantitative estimation is based on expressing of the estimation rate by one number, which is a result of grouping of selected simple indexes to one complex index (Azgaldov et al, 2011, 2015; Topol'nik, Ratushnyj, 2008) [1, 2, 4].

Complex method of a product quantitative estimation is prevailing (Wang et al, 2016; Rodgers, 2017; Perng, Oken, 2017; Grassi et al, 2017; Kim et al, 2017; Carbonneau et al, 2017; Kufley et al, 2017) [12-18]. But, a complex estimation of food products is not exclusive of differential estimation, because in some cases high value of complex qualitative index can disguise the low level of product's quality according to some simple indexes.

Each qualitative index, being a quantitative characteristic (extent) of one of object's quality model (fact) should reflect (to greater or lesser extent) the ability (property) of the object (fact), meet public demands (interests, values) in certain conditions. Therefore, in order to form a qualitative index we should take into account following qualitative components: public demand, certain conditions, object and extent of its meeting. Qualitative index should provide an answer to the question: to what extent is this object (fact) able to meet public demand (interest, value) (Topol'nik, Ratushnyj, 2008) [4].

It is better to represent the properties of food in a form of an hierarchical tree. Hierarchical structure of qualitative indexes of a product, manufactured by the industry regulatory document, is represented on the figure 1.

During the modeling of a product quality in the form of properties' hierarchical structure we decide that a quality, as the most generalized complex product property, is considered on the highest, null rate of an hierarchical set of properties (complex qualitative index), and its components – less generalized properties – are considered on the lowest, first hierarchical level (nutritive index). Nutritive indexes, in their turn, consist of an amount of even less generalized properties, situated on the even lower level – second

level (macronutrients, vitamins, mineral matters) (Tsapanou et al, 2017; Ramsay et al, 2017; Nguyen et al, 2017; Roy et al, 2017; Bruce et al, 2017; Hoerster et al, 2016) [19-24].

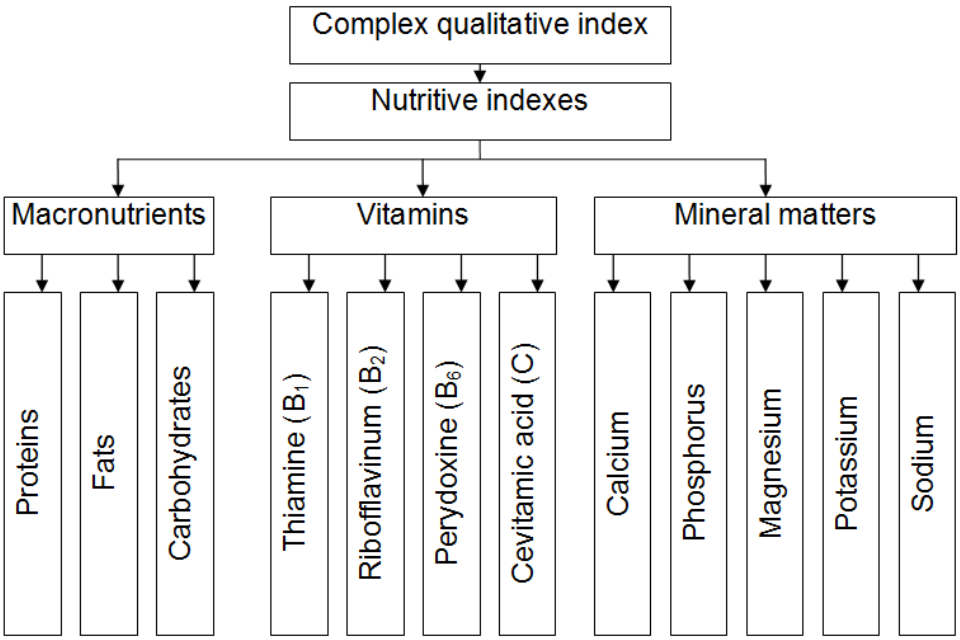

Fig. 1. Hierarchical structure of qualitative indexes of a diet

On the third level each group of properties also consists of several indexes: macronutrients (proteins, fats, carbohydrates); vitamins (thiamine, ribofflavinum, perydoxine, cevitamic acid); mineral matters (calcium, phosphorus, magnesium, potassium, sodium) (Moubarac et al, 2017; Zuniga et al, 2017; Andrade et al, 2016; Pham-Short et al. 2016; Nansel et al, 2016; Hu et al, 2016) [25-30].

Subordinate, so-called hierarchical, structure of properties appears which can be considered from increasing amount of levels (Kim et al, 2017; Nansel et al, 2016) [16, 29]. Building the hierarchical structure of properties we have gone down to the low level, where there are so-called simple properties. These simple properties can be measured by the certain method, and then, used as simple qualitative indexes.

Well grounded choice of production indexes in estimating its qualitative rate has high priority. In order to make this choice, we should have at hand the nomenclature of qualitative indexes' groups which meets demands of need and sufficiency.

Materials and methods

The daily ration of human nutrition (breakfast, lunch, dinner) and the norms of the physiological needs of the average person – to determine the complex quantitative

assessment of the quality of diets. An additive mathematical model as most widespread in a qualimetry is used for joining the quality rating into the generalized (complex) index. Methods – qualimetric (Azgaldov et al, 2011, 2015; Topol'nik, Ratushnyj, 2008) [1, 2, 4].

Method of a diet complex quantitative estimation (Topol'nik, Ratushnyj, 2008) [4]:

1. Index values for set diets are determined from the formula:

$$P_{ij} = \frac{M_{ij}}{\sum M_{ij}}, \tag{1}$$

M_{ij} – content of nutrient materials in group j in nutrition products included in the diet.

2. Analogously, due to recommended norm, basic indexes are determined;

$$P_{ij}^{basic} = \frac{M_{ij}}{\sum M_{ij}}, \tag{2}$$

M_{ij} – regulatory i nutrient material in group j of daily ration material.

3. Simple indexes'estimation of proteins, fats, carbohydrates is calculated by the formula:

$$K_{ij} = \left(\frac{P_{ij}}{P_{ij}^{basic}} \right)^{z}, \tag{3}$$

P_{ij} – index of a nutrient material in daily ration;
Pij^{basic} – basic (balanced) value of index of a nutrient material in daily ration (according to norms of physiological needs);
z – index, that considers the influence of changing index value on qualitative rate of an object, that is equal to plus 1 in proteins and carbohydrates content estimating and minus 1 in fats content estimating.

4. Weight coefficient value of nutrient materials m_{ij} is calculated by the formula:

$$m_{ij} = \frac{\frac{\sum P_{ij}^{basic}}{P_{ij}^{basic}}}{\sum \left(\frac{\sum P_{ij}^{basic}}{P_{ij}^{basic}} \right)}. \tag{4}$$

Complex qualitative index of meal due to nutrient materials equation for two-level structure is determined from the adaptive model:

$$K_o = \sum_{i=1}^{t} M_j \cdot \sum_{j=1}^{n_i} m_{ij} \cdot K_{ij}, \tag{5}$$

M_j – weight coefficient value of nutrients.

Results and discussions

According to norms of physiological needs of a common person we have developed complex qualitative index of meal (Table 1).

1. Complex quality rating of breakfast

Due to norms of macronutrients, mineral matters and vitamins content, included in breakfast dishes, the calculation of nutrient materials found in canteen menu is provided (Table 2).

Table 1

Norms of physiological needs of a common person at the age from 18 to 59

Nutrient material	Norm
Proteins, g	88,00
Fats, g	107,00
Carbohydrates, g	422,00
Total amount of nutrient materials, g:	**617,00**
Sodium (Na), mg	5000,00
Potassium (K), mg	3750,00
Calcium (Ca), mg	800,00
Magnesium(Mg), mg	400,00
Phosphorus (P), mg	1200,00
Total amount of mineral matters, mg	**11150,00**
Thiamine (B_1), mg	1,60
Ribofflavinum (B_2), mg	1,80
Perydoxine (B_6), mg	1,90
Cevitamic acid (C), mg	85,00
Total amount of vitamins, mg	**90,30**

Absolute values of qualitative indexes of macronutrients, mineral matters and vitamins calculated by the formula (1) are the following: for proteins – P_p= 0,20; fats – P_f = 0,15; carbohydrates – P_c =0,65; sodium – P_{Na} = 0,48; potassium – P_K = 0,20; calcium – P_{Ca} = 0,09; magnesium – P_{Mg} = 0,03; phosphorus– P_P = 0,20; thiamine – P_{B1} = 0,02; ribofflavinum – P_{B2} = 0,08; perydoxine – P_{B6} = 0,07; cevitamic acid– P_c = 0,83. Obtained results are brought in the Table 3.

Analogously to the recommended norms of physiological needs (Table 1) basic values have been determined from the formula (2). Basic qualitative indexes of macronutrients, mineral matters and vitamins are the following: for proteins – P_p^{basic} = 0,15; fats – P_f^{basic} = 0,17; carbohydrates– P_c^{basic} = 0,68; sodium– P_{Na}^{basic} = 0,45; potassium – P_K^{basic} = 0,34; calcium– P_{Ca}^{basic} = 0,07; magnesium– P_{Mg}^{basic} = 0,03; phosphorus– P_P^{basic}= 0,11; thiamine – P_{B1}^{basic}= 0,02; ribofflavinum – P_{B2}^{basic} = 0,02; perydoxine – P_{B6}^{basic} = 0,02; cevitamic acid – P_c^{basic}= 0,94. Obtained results are brought in the Table 3.

Table 2

Calculation of macronutrients, mineral matters and vitamins content included in breakfast dishes

Nutrient materials	Name of the dish							Total
	Diary butter	Fried liver	Dutch cheese	Buckwheat porridge	Wheat bread from first grade flour	Tea with sugar	Tomato	
Weight, g	20	75	30	150	100	200	100	675
Macronutrients, g:								
proteins	0,12	17,40	8,04	14,81	7,60	0,20	1,10	49,27
fats	16,50	7,65	8,19	3,90	0,90	0,00	0,20	37,34
carbohydrates	0,18	10,35	0,00	76,35	49,70	16,00	3,80	156,38
Mineral matters, mg:								
Na	14,80	456,00	330,00	988,50	488,00	0,00	40,00	2317,30
K	4,60	199,50	39,00	256,50	127,00	6,00	290,00	922,60
Ca	4,40	13,50	312,00	81,00	26,00	1,00	14,00	451,90
Mg	0,60	16,50	0,00	94,50	35,00	1,00	20,00	167,60
P	3,80	319,50	163,20	351,00	83,00	0,00	26,00	946,50
Vitamins, mg:								
B1	0,00	0,24	0,01	0,36	0,16	0,00	0,06	0,83
B2	0,02	1,97	0,11	0,20	0,08	0,00	0,04	2,41
B6	0,00	1,19	0,06	0,29	0,06	0,00	0,53	2,12
C	0,00	0,00	0,84	0,00	0,00	0,00	25,0	25,84

Table 3

Calculation of absolute values, basic values, weight coefficients and simple qualitative indexes

Absolute values		Basic values		Weight coefficients		Simple qualitative indexes	
Macronutrients							
P_p	0,20	P_p^{basic}	0,15	m_p	0,50	K_p	1,42
P_f	0,15	P_f^{basic}	0,17	m_f	0,40	K_f	1,13
P_c	0,65	P_c^{basic}	0,68	m_c	0,10	K_c	0,94
Mineral matters							
P_{Na}	0,48	P_{Na}^{basic}	0,45	m_{Na}	0,03	K_{Na}	1,08
P_K	0,20	P_K^{basic}	0,34	m_K	0,05	K_K	0,57
P_{Ca}	0,09	P_{Ca}^{basic}	0,07	m_{Ca}	0,25	K_{Ca}	1,31
P_{Mg}	0,03	P_{Mg}^{basic}	0,03	m_{Mg}	0,50	K_{Mg}	0,97
P_P	0,20	P_P^{basic}	0,11	m_P	0,17	K_P	1,83
Vitamins							
P_{B1}	0,02	P_{B1}^{basic}	0,02	m_{B1}	0,36	K_{B1}	1,50
P_{B2}	0,08	P_{B2}^{basic}	0,02	m_{B2}	0,32	K_{B2}	3,88
P_{B6}	0,07	P_{B6}^{basic}	0,02	m_{B6}	0,31	K_{B6}	0,31
P_c	0,83	P_c^{basic}	0,94	m_c	0,01	K_c	0,88

Weight coefficient value of nutrient materials m_{ij} has been calculated due to the recommended norms of physiological needs (Table 1) by the formula (4). Weight coefficients are the following: proteins – m_p = 0,50; fats – m_f = 0,40; carbohydrates – m_c = 0,10; sodium– m_{Na} = 0,03; potassium – m_K = 0,05; calcium– m_{Ca} = 0,25; magnesium– m_{Mg} = 0,50; phosphorus– m_P = 0,17; thiamine – m_{B1} = 0,36; ribofflavinum – m_{B2} = 0,32; perydoxine – m_{B6} = 0,31; cevitamic acid – m_c = 0,01.

Simple indexes'quality rating of proteins, fats, carbohydrates has been calculated by the formula (3) using data from Table 3. Simple indexes'estimation is the following: from proteins – K_p = 1,42; fats – K_f = 1,13; carbohydrates– K_c = 0,94; sodium– K_{Na} = 1,08; potassium– K_K = 0,57; calcium– K_{Ca} = 1,31; magnesium– K_{Mg} = 0,97; phosphorus– K_P = 1,83; thiamine – K_{B1} = 1,50; ribofflavinum – K_{B2} = 3,88; perydoxine – K_{B6} = 0,31; cevitamic acid – K_c = 0,88.

Complex qualitative index of meal due to nutrient materials equation for two-level structure has been determined from formula (5), in which weight coefficient values (M) are for macronutrients– 0,35; vitamins – 0,55; mineral matters– 0,1.

Due to the calculation results breakfast has complex quality rate K_o = 1,60.

2. Complex quality rating of dinner

Due to norms of macronutrients, mineral matters and vitamins content, included in dinner dishes, the calculation of nutrient materials found in canteen menu is provided (Table 4).

Table 4

Calculation of macronutrients, mineral matters and vitamins content included in dinner dishes

Nutrient materials	Name of the dish							Total
	Pickled cucumbers	Borshch with cabbage and potato	Dumplings	Wheat porridge	Rye bread	Pastry gingerbread	Compote	
Weight, г	50	250	115	150	150	50	200	965
Macronutrients, g:								
proteins	0,40	2,45	19,40	7,50	11,40	4,80	0,40	46,39
fats	0,05	5,15	17,70	0,66	1,65	2,80	0,00	28,02
carbohyd-rates	0,80	13,10	0,00	32,10	61,10	77,70	29,60	214,35
Mineral matters, mg:								
Na	0,00	782,00	656,60	585,00	874,50	11,00	24,00	2933,15
K	70,50	424,50	244,90	177,00	309,00	60,00	86,00	1371,95
Ca	11,50	41,50	16,10	33,00	57,00	9,00	17,00	185,10
Mg	7,00	29,50	21,85	36,00	73,50	0,00	9,00	176,85
P	12,00	47,20	166,70	153,00	234,00	41,00	12,00	665,95
Vitamins, mg:								
B_1	0,01	0,06	0,30	0,12	0,27	0,08	0,06	0,84
B_2	0,01	0,05	0,15	0,06	0,17	0,04	0,04	0,47
B_6	0,05	0,21	2,65	0,21	0,09	0,06	0,53	3,26
C	2,50	6,85	0,00	0,00	0,00	0,00	25,0	9,35

Absolute values of qualitative indexes of macronutrients, mineral matters and vitamins calculated by the formula (1) are the following: for proteins – P_p = 0,16; fats – P_f = 0,10; carbohydrates – P_c =0,74; sodium– P_{Na} = 0,55; potassium – P_K = 0,27; calcium– P_{Ca} = 0,03; magnesium– P_{Mg} = 0,03; phosphorus– P_P = 0,12; thiamine – P_{B1} = 0,06; ribofflavinum – P_{B2} = 0,04; perydoxine – P_{B6} = 0,23; cevitamic acid – P_c = 0,67 (Table 5).

Table 5

Calculation of absolute values of qualitative indexes and estimation of simple indexes of nutrient materials

Absolute values		Basic values		Weight coefficients		Simple qualitative indexes	
Macronutrients							
P_p	0,16	P_p^{basic}	0,15	m_p	0,50	K_p	1,13
P_f	0,10	P_f^{basic}	0,17	m_f	0,40	K_f	1,79
P_c	0,74	P_c^{basic}	0,68	m_c	0,10	K_c	1,09
Mineral matters							
P_{Na}	0,55	P_{Na}^{basic}	0,45	m_{Na}	0,03	K_{Na}	1,23
P_K	0,27	P_K^{basic}	0,34	m_K	0,05	K_K	0,76
P_{Ca}	0,03	P_{Ca}^{basic}	0,07	m_{Ca}	0,25	K_{Ca}	0,48
P_{Mg}	0,03	P_{Mg}^{basic}	0,03	m_{Mg}	0,50	K_{Mg}	0,92
P_P	0,12	P_P^{basic}	0,11	m_P	0,17	K_P	1,16
Vitamins							
P_{B1}	0,06	P_{B1}^{basic}	0,02	m_{B1}	0,36	K_{B1}	3,40
P_{B2}	0,04	P_{B2}^{basic}	0,02	m_{B2}	0,32	K_{B2}	1,71
P_{B6}	0,23	P_{B6}^{basic}	0,02	m_{B6}	0,31	K_{B6}	0,09
P_c	0,67	P_c^{basic}	0,94	m_c	0,01	K_c	0,88

Quality rating of simple indexes for a group of nutrient materials has been determined from the formula (3), as a result the values are the following: for proteins – K_p = 1,13; fats– K_f = 1,79; carbohydrates– K_c = 1,09; sodium– K_{Na} = 1,23; potassium – K_K = 0,76; calcium – K_{Ca} = 0,48; magnesium– K_{Mg} = 0,92; phosphorus – K_P = 1,16; thiamine – K_{B1} = 3,40; ribofflavinum – K_{B2} = 1,71; perydoxine – K_{B6} = 0,09; cevitamic acid – K_c = 0,88.

Complex qualitative index of meal due to nutrient materials equation for two-level structure has been determined from formula (5). Due to the calculation results breakfast has complex quality rate – K_o=1,57.

3. Complex quality rating of supper №1

Due to norms of macronutrients, mineral matters and vitamins content, included in supper №1, the calculation of nutrient materials found in canteen menu is provided (Table 6).

Absolute values of qualitative indexes of nutrient materials calculated by the formula (1) are the following: for proteins – P_p = 0,13; fats – P_f = 0,12; carbohydrates– P_c =0,75; sodium – P_{Na} = 0,42; potassium – P_K = 0,28; calcium – P_{Ca} = 0,08; magnesium– P_{Mg} = 0,04; phosphorus– P_P = 0,18; thiamine – P_{B1} = 0,04; ribofflavinum – P_{B2} = 0,03; perydoxine – P_{B6} = 0,10; cevitamic acid – P_c = 0,83 (Table 7).

Table 6

Calculation of macronutrients, mineral matters and vitamins content included in supper №1

Nutrient materials	Name of the dish						
	Green peas	Milk rice soup	Natural minced schnitzel	Cooked noodles	Wheat bread from first grade flour	Waffles	Total
Weight, g	50	250	75	150	100	50	675
Macronutrients, g:							
proteins	2,50	6,15	7,92	15,60	7,60	1,70	41,47
fats	0,10	7,85	11,28	1,35	0,90	15,10	36,58
carbohydrates	6,40	23,20	4,56	112,8	49,70	32,35	229,01
Mineral matters, mg:							
Na	1,00	455,50	199,80	15,00	488,00	3,50	1162,80
K	142,50	191,50	88,80	186,00	127,00	21,50	757,30
Ca	13,00	150,50	8,40	27,00	26,00	4,00	228,90
Mg	19,00	20,50	12,00	24,00	35,00	1,00	111,50
P	61,00	122,50	67,80	130,50	83,00	16,50	481,30
Vitamins, mg:							
B1	0,17	0,05	0,04	0,26	0,16	0,02	0,69
B2	0,10	0,16	0,07	0,12	0,08	0,01	0,53
B6	1,00	0,08	0,17	0,09	0,06	0.18	1,58
C	12,50	0,65	0,00	0,00	0,00	0,00	13,15

Quality rating of simple indexes of nutrient materials has been determined from the formula (3), as a result the values are the following: for proteins – K_p = 1,0; fats – K_f = 1,46; carbohydrates – K_c = 1,09; sodium – K_{Na} = 0,95; potassium – K_K = 0,82; calcium – K_{Ca} = 1,16; magnesium– K_{Mg} = 1,00; phosphorus – K_P = 1,63; thiamine – K_{B1} = 2,44; ribofflavinum – K_{B2} = 1,71; perydoxine – K_{B6} = 0,20; cevitamic acid – K_c = 0,88.

Complex qualitative index of meal due to nutrient materials equation for two-level structure has been determined from formula (5). Due to the calculation results supper №1 has complex quality rate – K_o=1,35.

4. Complex quality rating of supper №2

Due to norms of macronutrients, mineral matters and vitamins content, included in supper №1, the calculation of nutrient materials found in canteen menu is provided (Table 8).

Absolute values of qualitative indexes of nutrient materials calculated by the formula (1) are the following: for proteins – P_p = 0,11; fats – P_f = 0,32; carbohydrates – P_c = 0,57; sodium – P_{Na} = 0,06; potassium– P_K = 0,47; calcium– P_{Ca} = 0,17; magnesium – P_{Mg} = 0,05; phosphorus– P_P = 0,25; thiamine– P_{B1} = 0,01; ribofflavinum – P_{B2} = 0,06; perydoxine – P_{B6} = 0,10; cevitamic acid – P_c = 0,83 (Table 9).

Table 7

Calculation of absolute values of qualitative indexes and estimation of simple indexes of nutrient materials

Absolute values		Basic values		Weight coefficients		Simple qualitative indexes	
Macronutrients							
P_p	0,13	P_p^{basic}	0,15	m_p	0,50	K_p	1,0
P_f	0,12	P_f^{basic}	0,17	m_f	0,40	K_f	1,46
P_c	0,75	P_c^{basic}	0,68	m_c	0,10	K_c	1,09
Mineral matters							
P_{Na}	0,42	P_{Na}^{basic}	0,45	m_{Na}	0,03	K_{Na}	0,95
P_K	0,28	P_K^{basic}	0,34	m_K	0,05	K_K	0,82
P_{Ca}	0,08	P_{Ca}^{basic}	0,07	m_{Ca}	0,25	K_{Ca}	1,16
P_{Mg}	0,04	P_{Mg}^{basic}	0,03	m_{Mg}	0,50	K_{Mg}	1,00
P_P	0,18	P_P^{basic}	0,11	m_P	0,17	K_P	1,63
Vitamins							
P_{B1}	0,04	P_{B1}^{basic}	0,02	m_{B1}	0,36	K_{B1}	2,44
P_{B2}	0,03	P_{B2}^{basic}	0,02	m_{B2}	0,32	K_{B2}	1,71
P_{B6}	0,10	P_{B6}^{basic}	0,02	m_{B6}	0,31	K_{B6}	0,20
P_c	0,83	P_c^{basic}	0,94	m_c	0,01	K_c	0,88

Table 8

Calculation of macronutrients, mineral matters and vitamins content included in supper №2

Nutrient materials	Name of the dish		Total
	Chocolate covered curd cheese bar	Apple juice	
Weight, g	100	200	300
Macronutrients, g:			
proteins	8,50	1,00	9,50
fats	27,80	0,00	27,80
carbohydrates	32,00	18,20	50,20
Mineral matters, mg:			
Na	43	12,0	55,0
K	181	240,0	421,00
Ca	137	14,0	151,0
Mg	35	8,0	43,00
P	213	14,0	227,00
Vitamins, mg			
B_1	0,03	0,02	0,05
B_2	0,31	0,02	0,33
B_6	0,35	0,20	0,55
C	0,50	4,00	4,50

Table 9

Calculation of absolute values of qualitative indexes and estimation of simple indexes of nutrient materials

Absolute values		Basic values		Weight coefficients		Simple qualitative indexes	
Macronutrients							
P_p	0,11	P_p^{basic}	0,15	m_p	0,50	K_p	0,76
P_f	0,32	P_f^{basic}	0,17	m_f	0,40	K_f	0,55
P_c	0,57	P_c^{basic}	0,68	m_c	0,10	K_c	0,84
Mineral matters							
P_{Na}	0,06	P_{Na}^{basic}	0,45	m_{Na}	0,03	K_{Na}	0,14
P_K	0,47	P_K^{basic}	0,34	m_K	0,05	K_K	1,40
P_{Ca}	0,17	P_{Ca}^{basic}	0,07	m_{Ca}	0,25	K_{Ca}	2,35
P_{Mg}	0,05	P_{Mg}^{basic}	0,03	m_{Mg}	0,50	K_{Mg}	1,34
P_P	0,25	P_P^{basic}	0,11	m_P	0,17	K_P	2,35
Vitamins							
P_{B1}	0,01	P_{B1}^{basic}	0,02	m_{B1}	0,36	K_{B1}	0,52
P_{B2}	0,06	P_{B2}^{basic}	0,02	m_{B2}	0,32	K_{B2}	3,00
P_{B6}	0,10	P_{B6}^{basic}	0,02	m_{B6}	0,31	K_{B6}	0,20
P_c	0,83	P_c^{basic}	0,94	m_c	0,01	K_c	0,88

Quality rating of simple indexes of nutrient materials has been determined by the formula (3), as a result the values are the following: for proteins – K_{p0} = 0,76; fats – K_f = 0,55; carbohydrates – K_c = 0,84; sodium– K_{Na} = 0,14; potassium– K_K = 1,40; calcium – K_{Ca} = 2,35; magnesium – K_{Mg} = 1,34; phosphorus– K_P = 2,35; thiamine – K_{B1} = 0,52; riboflavinum – K_{B2} = 3,00; perydoxine – K_{B6} = 0,20; cevitamic acid – K_c = 0,88.

Complex qualitative index of meal due to nutrient materials equation for two-level structure has been determined from formula (5). Due to the calculation results supper №2 has complex quality rate – K_o=1,09.

5. Complex quality rating of dialy ration

According to the canteen menu original data is calculated for determination of daily ration (Table 10).

Absolute values of qualitative indexes of nutrient materials are the following: for proteins – P_p = 0,16; fats – P_f = 0,14; carbohydrates – P_c =0,70; sodium – P_{Na} = 0,47; potassium – P_K = 0,25; calcium– P_{Ca} = 0,07; magnesium– P_{Mg} = 0,04; phosphorus– P_P = 0,17; thiamine – P_{B1} = 0,04; riboflavinum – P_{B2} = 0,06; perydoxine – P_{B6} = 0,11; cevitamic acid – P_c = 0,79. The results are brought in the Table 11.

Quality rating of simple indexes of nutrient materials has been determined by the formula (3), as a result the values are the following: for proteins – K_p = 1,06; fats – K_f = 1,21; carbohydrates – K_c = 1,03; sodium – K_{Na} = 1,04; potassium– K_K = 0,74;calcium – K_{Ca} = 1,00; magnesium – K_{Mg} = 1,00; phosphorus– K_P = 1,53; thiamine – K_{B1} = 2,00; riboflavinum – K_{B2} = 3,00; perydoxine – K_{B6} = 0,18; cevitamic acid – K_c = 0,85.

Complex qualitative index of meal due to nutrient materials equation for two-level structure has been determined from formula (5). Due to the calculation results daily ration has complex quality rate K_o=1,39.

Table 10

Calculation of macronutrients, mineral matters and vitamins content for daily ration

Nutrient materials	Name of the dish				
	Breakfast	**Dinner**	**Supper №1**	**Supper №2**	**Total**
Weight, g	675	965	675	300	2615
Macronutrients, g:					
proteins	49,27	46,39	41,47	9,50	146,62
fats	37,34	28,02	36,58	27,80	129,74
carbohydrates	156,38	214,35	229,01	50,20	649,94
Mineral matters, мг:					
Na	2317,30	2933,15	1162,80	55,0	6468,25
K	922,60	1371,95	757,30	421,0	3472,85
Ca	451,90	185,10	228,90	151,0	1016,90
Mg	167,60	176,85	111,50	43,0	498,95
P	946,50	665,95	481,30	227,0	2320,75
Vitamins, mg:					
B_1	0,83	0,84	0,69	0,05	2,41
B_2	2,41	0,47	0,53	0,33	3,75
B_6	2,12	3,26	1,58	0,55	7,51
C	25,84	9,35	13,15	4,50	52,84

Table 11

Calculation of absolute values of qualitative indexes and estimation of simple indexes of nutrient materials

Absolute values		**Basic values**		**Weight coefficients**		**Simple qualitative indexes**	
Macronutrients							
P_p	0,16	P_p^{basic}	0,15	m_p	0,50	K_p	1,06
P_f	0,14	P_f^{basic}	0,17	m_f	0,40	K_f	1,21
P_c	0,70	P_c^{basic}	0,68	m_c	0,10	K_c	1,03
Mineral matters							
P_{Na}	0,47	P_{Na}^{basic}	0,45	m_{Na}	0,03	K_{Na}	1,04
P_K	0,25	P_K^{basic}	0,34	m_K	0,05	K_K	0,74
P_{Ca}	0,07	P_{Ca}^{basic}	0,07	m_{Ca}	0,25	K_{Ca}	1,00
P_{Mg}	0,04	P_{Mg}^{basic}	0,03	m_{Mg}	0,50	K_{Mg}	1,00
P_P	0,17	P_P^{basic}	0,11	m_P	0,17	K_P	1,53
Vitamins							
P_{B1}	0,04	P_{B1}^{basic}	0,02	m_{B1}	0,36	K_{B1}	2,00
P_{B2}	0,06	P_{B2}^{basic}	0,02	m_{B2}	0,32	K_{B2}	3,00
P_{B6}	0,11	P_{B6}^{basic}	0,02	m_{B6}	0,31	K_{B6}	0,18
P_c	0,79	P_c^{basic}	0,94	m_c	0,01	K_c	0,85

Obtained values of complex qualitative index of breakfast, dinner, supper №1, supper №2 and daily ration are brought in the Table 12.

Table 12

Complex quality rating of daily rations

Name	Breakfast	Dinner	Supper № 1	Supper № 2	Daily ration
K_0	1,60	1,57	1,35	1,09	1,39

Due to the data (Table 12), we can draw a conclusion that the biggest value of the complex index K_{0max}=1,60 is obtained in breakfast, the lowest value is typical for supper №2 K_{0min}=1,09. Whereas, supper №2 is considered to be the most balanced meal with value K_0=1,09, which is close to the optimal value of complex quantitative rating K_0=1,00. Quality rating of daily rations in hotels and restaurants provides an opportunity to determine diet balance due to the norms of physiological need for daily ration.

Conclusions

Method of quality rating of daily rations in hotels and restaurants is considered. The structure of qualitative indexes and results of experimental research of complex diet quantitative rating are represented. Taking into account the norms of physiological need of a common person, complex qualitative rate of one meal and daily ration in a canteen is calculated. For this daily ration, complex qualitative indexes for group of macronutrients, mineral matters and vitamins are identified. The most balanced values of the complex qualitative index are determined which are common to super №2 with rate K_0=1,09.

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