

SELECTION OF THE COMPONENT COMPOSITION OF A NEW TYPE OF MEAT-BASED PRODUCT

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Abstract

There has been performed a scientifically grounded selection of component composition of a new meat-based product taking into account a bio comparability of ingredients. The product developed possesses therapeutic and preventive effect in anemia, calcium deficiency and gastrointestinal diseases.

Key words: *meat product, bio comparability, therapeutic and preventive effect.*

One of the most urgent problems today is preservation of human health, which is in many respects determined by its nutritional status. Abnormalities in food pattern on the background of complicated biochemical and environmental conditions lead to emergence and progression of a number of nutrition-related diseases [1–3] critical for vital activities of hematopoietic and digestive systems.

The problem of pollution density in biosphere charges with a vital task to search for funds to improve the health of nation. It is necessary to consider a fundamentally new approach to health food design of the 21st century.

For regions with unfavorable ecological situation a comprehensive prevention approach is particularly relevant.

Global trends in nutrition are associated with the creation of a range of products of preventive character contributing to the improvement of health in case of daily use as part of the diet. The high popularity of these products, according to the patent search they are widely used in such developed countries as the USA, Japan and countries of the European Union, is demonstrated by the statistics of qualitative changes in the food market [3, 4].

The study of state and actual nutrition of different age groups in Kazakhstan leads us to the conclusion about particular importance of preventive products for regions with impaired environment. Thus, the lack of macro- and microelements (iodine, iron, selenium, fluoride, etc.) has been diagnosed in 40% of the population of Kazakhstan that is associated with a reduced content of them in their food. Iron deficiency anemia which is one of the types of diseases in ecologically unfavorable regions of Kazakhstan, accounts for more than 80% of all forms of anemia. More than 30% of adult population of the country are suffering a dysbacteriosis of varying severity while the number of diseases of endocrine system, including those related to iodine deficiency, has also increased.

In view of the above the development of the principles of healthy dieting, taking into account socio-economic situation, ethnic and ecological features, the creation of new food products ensuring their high quality and efficiently using primary and secondary raw materials, combining traditional and non-traditional raw materials, bringing into use food and functional additives possessing preventive action comprise a problem that has a scientific value, environmental importance and social implication, and can be solved applying biotechnological processes, implementing the system of scientific and engineering support of life quality in Kazakhstan.

An equally important factor determining the urgency of the stated problem is the need to ensure and control actual physiological value of new types of meat and milk based products used in production of traditional, enriched and functional foodstuffs with preventive effect.

We have carefully carried out the selection of the component composition of a new type of meat product called soufflé.

Meat soufflé is a sausage product, baked in pans, then vacuum-packed in polystyrene trays or plastic bags.

This is a homogenized comminuted product on the basis of meat, vegetable and milk raw materials with the addition of NBC (Natural Biological Corrector). Meat soufflé is intended for use in diseases of gastrointestinal tract, iron deficiency anemia and calcium deficiency.

Irrational nutrition, eating disorders, and the use of therapeutic drugs suppress natural intestinal flora and are the main causes of gastrointestinal diseases which consequently lead to protein and fat deficiency together with insufficiency in vitamins, calcium and potassium. In our view the replacement of protein and fat deficiency can be achieved with the use of a soufflé prepared from chicken, beef or chicken liver, as well as animal and vegetable oils.

Meat soufflé prepared without nitrite has a favorable effect on the state of gastrointestinal tract. Such component herbs of the soufflé as marjoram and oregano apart from improvement of the taste and odor of the product possess analgesic and antispasmodic properties for colic and pain in stomach and intestines, as well as contribute to a better digestion.

A common disease among children and women is anemia which is characterized by a decrease in hemoglobin in blood. The main cause of this serious disease is the lack of iron in body which is a necessary functional component of hemoglobin and myoglobin. When iron deficiency occurs, the ability of these proteins to bind oxygen is reduced and, consequently, there is a reduction in transportation of oxygen to the tissues from respiratory system and to it. Iron deficiency in children leads not only to the reduction in overall resistance of the organism, but also causes a slowdown in the development of central nervous system.

The amount of easily digestible iron in the meat soufflé developed by us is achieved by the composition of liver, chicken and composite NBC. Ascorbic acid introduced into the product is an indispensable complexing agent with iron contained in the product. Thus, the complexes of iron + ascorbic acid and iron + sulfur containing amino acid are easily absorbed by the body, whereby the body is considerably replenished with iron and as the result health is improving.

Calcium in the body performs a number of important functions.

It is a part of the main mineral component of bone tissue – hydroxyapatite with its microcrystals forming a rigid structure of the bone tissue which performs a safety-support function. Insufficient intake of calcium in the body leads to osteoporosis, tooth decay, allergies, inadequate absorption of nutrients. Calcium is an activator of a number of enzymes and hormones, the most important component of the blood coagulation system. The need of children in calcium is particularly high, since the growth of children is accompanied by a renewal of skeleton bone tissue every 1–2 years. To enrich our product with calcium we introduce calcide, curd and whey which help to normalize the processes of absorption of calcium, thereby preventing the formation of insoluble complexes –phosphoric-calcium salts. The destruction of these complexes is due to the low pH maintained through fermentative action of lactose.

Such combinations of calcium products with high-protein meat products promote formation of digestible amino acid complexes (resulting from the digestion of protein) and calcium. In the product under development there has been achieved a near-optimal ratio of calcium and phosphorus (1: 1) at which the absorption of calcium and other minerals necessary for a growing child's body takes place. In comparing the ratio of calcium and phosphorus in the product taken as an analogue (“Stolichnyi” paste), a significant violation of this ratio which is 1:35 has been found.

The findings are presented in Figure 1 which shows the ratio of calcium and phosphorus in our designed product (meat soufflé) and the analogue (“Stolichnyi” paste).

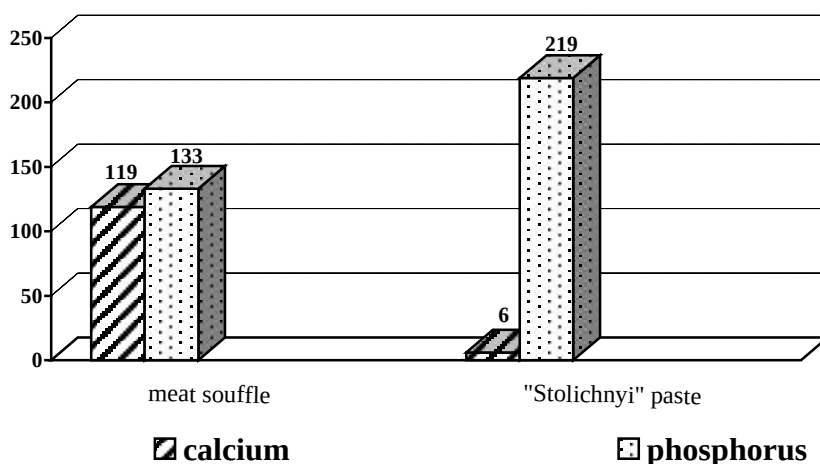


Figure 1 – The ratio of calcium and phosphorus

Excess of fat hinders the absorption of calcium, as an excessive amount of fat in the product can yield that fatty acids formed in the process of fat digestion may bind calcium with insoluble salts. In this regard, the fat content in meat souffle is minimal.

The developed recipes of meat souffle with the use of NBC are characterized by anti-anemic action, improve health in gastro-intestinal diseases and make it possible to replenish calcium deficiency.

According to some data, addition of lysozyme-containing product to raw minced meat increases the shelf life of finished meat products. However, when the concentration of salt is more than 1.2% lysozyme loses its activity.

Its activity in meat product is 5–7 times more than in native egg albumin since lysozyme in a protein product subjected to thermocoagulation with citric acid and sodium chloride is in a free state. However, like many other enzymes lysozyme exposed to heat loses its activity and is destroyed.

In order to maintain a high activity of lysozyme considering bio compatibility when used in sausages and pastes there has been used raw tallow that contains polyunsaturated fatty acids which enter into a chemical bond with lysozyme. Compounding occurs at the place of double bonds of fatty acids with functional groups of polypeptide chain of lysozyme to form esters.

This compound is more stable when heated and is able to be maintained after heat treatment of the product. Constituent ingredients of the product, particularly proteins, entering the human body, under the action of various enzymes in gastrointestinal tract decompose to amino acids and further to final degradation products. This also refers to the compound lysozyme + fatty acids, which is also under the influence of various factors is degraded at the place of their initial bonding to form free fatty acids and free lysozyme with high degree of activity.

As a result of mathematical modeling of recipes there has been found the most optimal ratio between the ingredients in the recipe. The proposed optimized recipes of meat souffle, identified as options 1–3 are shown in Table 1.

Table 1 – The options of meat souffle recipes

Raw materials and other ingredients	Mass content, in kg, per 100 kg of raw material		
	Option 1	Option 2	Option 3
Trimmed beef	20.0	-	-
Pork, semi-fat	35.0	25.0	-
Chicken	-	25.0	50.0
Chicken or beef liver	12.0	16.0	16.0
Butter	5.0	-	6.0
Sunflower oil	5.0	10.0	8.0
Pumpkin	5.0	5.3	5.0
Curd	-	5.0	5.0
Onion	2.0	2.0	2.0
NBC	7.0	10.0	8.0
Beet juice	2.0	2.0	-
Oat-flakes	5.0	-	-
Spices			
Salt	1.2	1.2	1.2
Sugar	0.1	0.1	0.1
Ground black pepper	0.02	0.02	0.02
Oregano	-	0.05	0.05
Marjoram	-	-	0.05
Ascorbic acid	0.005	0.005	0.005

The recipe options presented above are optimized by amino acid score, chemical composition, and the results of it are clearly reflected in Tables 2 and 3.

Table 2 – The amino acid composition of meat souffle

Indispensable amino acids	Amino acids, mg on 100 g of edible weight basis		
	Formula 1	Formula 2	Formula 3
Valine	968.0	919.0	775.9
Isoleucine	901.1	770.5	645.1
Leucine	1428.4	1336.3	1281.2
Lysine	1354.3	1639.4	1252.3
Methionine	438.1	414.8	481.1
Threonine	705.9	526.0	673.1
Tryptophane	242.1	253.0	239.8

Phenylalanine	614.5	712.9	598.4
Dispensable amino acids, limiting			
Cystine	276.7	298.8	259.3
Limiting amino acids score, %			
Methionine + Cystine	120.8	104.0	112.8

Table 3 – The chemical composition of meat soufflé

Chemical composition	Amount by the FAO/WHO, g	Unit of Measure	Amount in 100 g of the product		
			Formula 1	Formula 2	Formula 3
Protein	14–16	%	14.42	16.82	15.92
Fats	18–21	%	23.4	22.9	22.4
Carbohydrates	15–27	%	4.0	4.3	4.3
Calcium	115–220	mg	101.1	123.0	118.6
Phosphorus	125–220	mg	154.6	165.9	132.8
Potassium	250–500	mg	428.0	335.6	312.3
Sodium	200–220	mg	119.4	162.6	160.9
Magnesium	25–30	mg	35.7	34.7	31.0
Iron	4.0–4.5	mg	3.1	3.3	4.2
Vitamin B2 (riboflavin)	0.5–0.7	mg	0.48	0.50	0.55
Vitamin B6 (pyridoxine)	0.3–0.7	mg	0.28	0.29	0.52
Vitamin C	10–60	mg	44.2	45.4	45.2
Energy value	215–235	kcal	290.0	286	282

The results of amino acid and chemical composition of meat soufflé have shown the following:

- proteins of meat soufflé contain all essential amino acids which score is not less than 100%;
- adding NBC to meat soufflé enriches the product with calcium by 50% that allows by using 100 grams of the product providing a child's body with calcium by one tenth of daily requirement, and iron – by a fifth of daily requirement;
- vitamin composition of meat soufflé allows providing a child's body with 50% of daily requirement;
- the use of NBC in the product increases water-binding and emulsifying capacity of minced meat and improves the structure of finished product as well as enriches it with micro- and macronutrients.

The choice of characteristic parameters to the research in the study of the finished product quality is based on the determination of the combination of physico-chemical, organoleptic, microbiological characteristics, safety indicators, medical and biological requirements.

In order to evaluate the composition and properties of a new type of product – meat souffle with a preventive effect complying with medical and biological requirements, its chemical composition: protein, moisture, and fat content as well as moisture-holding capacity have been identified.

The obtained results of physico-chemical characteristics of the produced meat souffle are shown in Table 4.

Table 4 – Physico-chemical characteristics of meat souffle

Options of product formulae	Moisture, %	Fat, %	Protein, %	Moisture-holding capacity
1	60.0	23.33	14.56	50.1
	59.6	21.64	14.37	49.9
	62.2	22.65	14.50	50.2
Average value	60.6	22.54	14.48	50.1
2	61.8	21.59	16.81	50.6
	60.2	21.98	16.57	50.3
	59.7	22.65	16.43	50.4
Average value	60.5	22.07	16.60	50.4
3	60.3	21.62	15.75	49.8
	59.8	21.90	15.88	50.2
	59.6	21.65	15.93	50.4
Average value	59.9	21.72	15.85	50.1

The parameters of protein, fat, moisture and moisture-holding capacity of meat souffle meet performance standards.

Microbiological studies of meat souffle have been carried out and the result are shown in Table 5.

Table 5 – Microbiological characteristics of meat souffle

Characteristic parameters	Study results	Amount of product under study	Allowable value in accordance with the regulatory documents
QMA&OAMO	250 CFU/g	1 g	1×10^3
CGB (coli-forms)	not detected	1 g	not allowed
Pathogenic microorganisms, including <i>Salmonella aureus</i>	not detected	25 g	not allowed
Coagulase-positive staphylococci	not detected	1 g	not allowed
Sulphite-reducing clostridia	not detected	0.01 g	not allowed

The results of microbiological analysis of meat souffle samples when estimating the amount of mesophyll aerobic and optional-anaerobic microorganisms in 1 gram of the product have revealed 250 CFU that is quite allowable value according to the current regulatory documents.

An indicator of product contamination is the presence of coliform bacteria which have not been found in 1 gram of meat souffle. The presence of coagulase-positive staphylococcus and sulphite-reducing clostridia has not been detected in the examined meat souffle.

Thus, samples of meat souffle by microbiological characteristic parameters comply with SanPiN (Sanitary Regulations and Norms) applicable to this type of product.

There has been identified the shelf life of the product which is equal to 3 days. The shelf life of meat souffle was determined by the level of its microbiological contamination.

The new product – meat souffle – has been also examined with the use of safety indicators for the presence of toxic elements, pesticides and heavy metal salts. The results are shown in Table 6.

Table 6 – Safety indicators of meat souffle

Indicators	Study results	Allowable value in accordance with the regulatory documents
1	2	3
1 Toxic elements, mg/kg, no more than		
1.1 lead (Pb)	not detected	0.5
1.2 arsenic (As)	not detected	0.1
1.3 cadmium (Cd)	not detected	0.05
1.4 mercury (Hg)	not detected	0.03
2 Pesticides, mg/kg, no more than		
2.1 hexachlorocyclohexane	not detected	0.1
2.2 Dichlorodiphenyltrichloroethane and its metabolites	not detected	0.1
3 Heavy metal salts		
3.1 cesium (Cs) – 137 Bq/kg	less than 10	no more than 160
3.2 strontium (Sr) – 90 Bq/kg	less than 9.4	no more than 50

According to the results of safety indicators of designed meat souffle for the presence in the product of such toxic elements as lead, arsenic, cadmium, mercury and pesticides taking into account the allowable values none of them have been actually found that is a good indicator in particular, considering the fact that the product is designed as baby food.

The presence of cesium (137) accounts for 6% and strontium (90) accounts for 18% that is consistent with acceptable standards for this type of product, in accordance with the requirements of ST RK (National Standard of the Republic of Kazakhstan) SanPiN no. 4.01.071.03; SanPiN no. 4.01.073.04; SanPiN no. 4.01.060.02.

Thus, in the course of the experiments carried out in the laboratory there have been practiced different biotechnological modes and by the results of organoleptic and physico-chemical studies there has been

selected the best option of meat souffle recipe (option 3) that meets all the requirements for this type of product.

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