

## USE OF BY-PRODUCTS IN PRODUCTION OF CANNED FOODS FOR CHILD NUTRITION

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**Key words:** by-products, canned foods for curative-preventive nutrition of children, bioavailable iron, immunomodulating effect**Introduction**

Nutrition plays an important role in prophylaxis of such diseases as anemia, food allergy of infants. However, the range of special curative-preventive foods, particularly canned meats, for infants available at Russian market is quite limited. Use of untraditional kinds of meat raw materials having high biological value, for example pork, is of special interest in solving the problem of child nutrition. Rational use of pork having increased content of fat in production of canned foods dictates the necessity of enrichment of the product with protein through incorporation of isolated soya protein. This can lead to decrease in the level of biologically active iron, that is absolutely undesirable for infant's organism. The problem of enrichment of canned foods being newly developed for infants with bioavailable iron without decrease of their food value, as well as of the rational use of the meat raw materials can be solved through the incorporation into formulations of natural by-products and blood being not significantly worse than meat with respect to aminoacid balance, and better than meat with respect to iron content.

**Objective of investigations**

Substantiation of the composition and study of the quality of canned foods from pork with by-products for imparting preventive-curative properties to them and with consideration of rational use of raw materials.

**Methods of investigations**

Computer design of the formulation of canned foods was carried out according to methodology of N.N.Lipatov. Biological evaluation of ready canned foods and the study of their effectiveness against iron deficiency was carried out at the Moscow Medical Academy named after I.M.Sechenov under the guidance of A.A.Korolev according to generally accepted methods with the use growth-weight, biochemical and hematological criteria on white male rats with the initial weight  $60 \pm 2.5$  g.

The immunomodulating effect - evaluation of the effect of the product on characteristics of immune system - was determined according to the methods of determination of safety and effectiveness at the Institute of epidemiology of the Ministry of Health protection of Russia at a laboratory of immunology and biotechnology under the guidance of V.I.Pokrovsky and V.V.Lebedev. The experimental approach to study of humoral immunity involved the initiation of the process of antigen-dependent proliferation and differentiation of B-lymphocytes, being the precursors and antibody-forming cells. The model for the studying of the cell immune response is the reaction of blasttransformation of lymphocytes (RBTL) under the action of mitogens, particularly phytohemagglutinine (FGA) or concanavallin A (Con A). Lymphocytes after their stimulation with mitogen in vitro increase in size and turn into blast-like cells, actively synthesizing DNA, what is called blast-cell transformation of lymphocytes.

**Results and discussion**

The components of the formulation of canned foods were chosen on the basis of medical and biological requirements to the contents of protein, fat, iron in the raw materials and finished products. Computer designing of products formulation with the pre-determined composition was based upon the following: data base about composition of food ingredients, data base of amino acid, lipid and carbohydrate reference values, procedure for the calculation and evaluation of balanced composition. The procedure of designing of the formulations of canned foods balanced over nutrients allows (according to ingredients chosen from the data base and information about their nutrient composition) to create a formulation mixture corresponding to these requirements and after indication of mass fractions of each ingredient - to determine the composition with respect to quantity and quality of the composition. Thus the formulations of canned foods recommended by the Institute of Nutrition for curative nutrition of children suffering from food allergy to milk and beef proteins, and anemia, and also with the aim of prophylaxis of these diseases have been developed. Results of the evaluation of the nutrients composition of finished products have shown that canned foods meet the pre-determined requirements, which include the provision of balanced chemical composition at high level of iron ( $2.47-2.68$  mg/kg).

Analysis of results of medical and biological evaluation of canned foods as carried out on rats in the Moscow Medical academy named after I.M.Sechenov leads to the conclusion that incorporation of by-products as sources of iron into the formulations did not reduce biological value of final products, and in some cases enhanced it as compared to the control sample -traditional canned meats for child nutrition (Table 1).

Table 1

Characteristics	Samples of canned foods			
	Control	Pork with liver	Pork with spleen	Pork with blood
Consumption of proteins, g	25.3±1.2	23.3±1.4	23.9 ± 1.5	24.4±1.4
Weight gain, g	70.8±3.6	72.3±3.9	69.4±3.1	68.2±3.5
Coefficient of protein effectiveness	2.8±0.2	3.1±0.3	2.9±0.3	2.8±0.2

When studying the influence of new canned foods on hemopoietic function of laboratory animals the results were obtained being in agreement with the data of nutrient composition with respect to iron content. Hematological parameters of laboratory animals are presented in Table 2.

Table 2

Hematological indices of whole blood: (**)	Samples of canned foods			
	Control	Pork with liver	Pork with spleen	Pork with blood
Erythrocytes, x 10 <sup>12</sup> /l	5.7±0.6	5.9±0.7	5.8±0.5	5.8±0.6
	5.5±0.4	6.3±0.6	6.2±0.6	5.9±0.5
Hemoglobin, g/l	151.7±3.7	152.9±3.4	152.4±2.9	153.3±3.2
	152.1±3.9	162.2±3.7	161.4±2.9	157.9±3.1

\*\* In the numerator – the data during 1 week of the experiment; in the denominator – data after completion of the observation

The next step of the investigation was the assessment of actual antianemic efficiency of the canned foods. To this end a model experiment on rats was conducted allowing to objectively observe the dynamics of recovery of hemopoiesis of the organism at potentiated iron deficiency. Hematological parameters of blood of the experimental animals demonstrate practically complete recovery of hemopoietic functions of the organism of the animals and are presented in Table 3.

Table 3

Hematological parameters	Period of experiments, days	Control	Pork with liver	Pork with spleen	Pork with blood
Erythrocytes, X 10 <sup>12</sup> /l	1	6.1±0.8	6.1±1.1	5.9±0.9	6.0±0.8
	14	5.1±0.9	5.2±1.2	5.4±1.2	5.3±1.3
	28	5.5±0.8	6.1±1.3	6.2±0.9	5.8±0.9
Hemoglobin, g/l	1	153.5±3.7	151.1±4.7	152.7±3.9	151.9±4.5
	14	65.8±5.3	89.9±4.3	82.9±4.5	86.9±4.5
	28	127.4±3.3	149.9±3.4	143.9±2.7	142.7±3.5

A complex effectiveness of the experimental products against iron deficiency was noted that had been provided by the equivalent substitutive (in relation to the main ingredient) incorporation of by-products and edible blood, that are the sources of bioavailable and bioeffective iron. To study the immunomodulating effect, the influence of canned pork foods manufactured with by-products, as well as of the initial raw materials - pork and by-products on the parameters of immune system was determined. In the experiments with mice in vivo and in vitro a schedule of feeding was developed and the effect of the products on the function of their immune system was studied. This study was considered necessary because the immune system is closely related with other systems of the organism and any effect on it can lead to undesirable changes. When assessing specific activity of the products with respect to the parameters of immune system its effect on humoral and cell reaction was investigated. In the analysis of the effect of foods on a humoral link of the immunity it is a number of antibody-forming cells (AOK) in spleen of the mouse that is the most informative and standardized parameter of functional activity of B-system. It was determined on the 4<sup>th</sup> day after immunization by the method of local hemolysis in the agar gel. Results of the influence of canned foods and meat products on antibodygenesis of mice are presented in Table 4.

Table 4

Control (compound feed)	AOK number of mice obtaining					
	Canned foods			Meat products		
	Pork	Pork with liver	Pork with spleen	Ground pork	Ground liver	Pork spleen
3590	517	828	1004	531	678	642

As can be seen from Table 4 the addition of by-products into infants' foods doesn't have a marked influence on development of primary immune reaction of mice. Results of investigations of the cell immune response also show that the addition of by-products into these foods doesn't influence the proliferative reaction of the cells of mice' spleen. Thus it can be concluded that the studied canned foods don't have the pronounced effect on the parameters of immune system as compared to the control. These data show that the above products in their influence on the number of antibody forming cells in mice' spleen and on the development of proliferative response of the animals on mitogen are not different from the effect of natural components of the products.

### Conclusions

A composition of canned pork with by-products and edible blood as a source of bioavailable iron is substantiated. Results of medical and biological assessment show a high biological value and actual effectiveness against iron deficiency of the studied canned foods. Investigations of the influence of canned foods on the parameters of the immune system substantiate possibility of use of iron-containing meat by-products (liver, spleen, blood) in curative-preventive nutrition of infants.