

DESIGNING OF COMPOSITION AND PROPERTIES OF ANTIANEMIC PRODUCTS WITH HIGH PROTEIN CONTENT FOR CHILDREN

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As is known, the blood of slaughtered animals is one of important sources of bioaccessible iron, playing an active part in oxidation processes of growing baby body. Medicinal and dietetic properties of the blood are associated with high assimilability of blood protein; moreover, the blood contains a number of essential mineral substances. Blood proteins contain essential aminoacids by content similar to meat aminoacids, but methionine and isoleucine. Lack of balance with regard to methionine and isoleucine can be compensated by simultaneous use of milk proteins rich in isoleucine and salts of calcium. The blood contains 30 mg% of iron versus 2.9 mg% of iron in the beef. It was found that food composition had a great effect on iron assimilability. Thus, high preventive and curative effect was achieved when in the production of meat products for children, in addition to beef and pork, whole stabilized blood together with a complex of milk whey proteins was used. Thus, aminoacid composition and high content of easily assimilable iron can be optimized.

The aim of the study was to ground the composition and properties of curative and preventive products with high content of protein with the use of the blood of slaughtered animals. Bio-medicinal evaluation was carried out.

Biologically active components for the composition products were chosen in accordance with biomedicinal demands to raw materials and finished products.

Biological evaluation of finished products was carried out in Moscow Academy of Medical Sciences (headed by A. A. Korolyov) according to accepted methods.

In the study, white male-rats (initial weight - $65,5 \pm 4,5$ gr) were used. Hematological and biochemical criteria as well as criteria of growth were taken into account. All animals were under control from the point of view of:

- the appearance,
- the behaviour,
- feed intake,
- dynamics of body growth.

After the experiment, animals were slaughtered, hematological and biochemical analyses of the blood were carried out in "Technicon" analyzer. Finished products were approbated in the laboratory of healthy children dietary (Institute of Nutrition, Russian Academy of Medical Sciences).

To develop new products in accordance with present demands, it was important to reach balanced chemical composition and satisfactory organoleptic values of finished products provided they contained slaughtered animals blood within the range of 25-40%. In this connection the total complex of demands came to a number of limitations characterized by the percentage both of separate ingredients and elements of the chemical composition. For instance, it was important to solve the problem of selecting the optimal protein complex for new antianemic product of high biological value, based on the blood of slaughtered animals. Daily iron requirement of children is not less than 1.0 mg. 31% of iron is assimilated from the blood. If 100 gr of product contains 30 gr of blood which provides 12.0 mg of iron (the low limit of protein level according to bio-medical demands), then it means that 25 g will correspond to 3.0 mg of iron. Then we add the share of iron from the blood and obtain 1 mg, i.e. the daily requirement of the ration. Similarly, if 100 g of product contains 50 g of blood (the higher limit), then 25 g of product will contain 1.6 mg of iron. To calculate optimal formulations of finished products, methods based on integration principle of the linear programming and coefficient of protein usage (i.e. the index of aminoacid balance) were applied.

Based on the results of treatment of initial data, forming simplex-tables and computer calculations, the formulations, cost and values of indices of chemical composition of the mix and a new blood-based product "HEMALAD" were obtained.

A sweet bar "HEMATOGEN for children" produced commercially, with 5% dry blood served as a control.

Using chemical composition values and optimal formulations of "HEMALAD", particular quality indices and complex (D) quality index were determined. In accordance with bio-medical recommendations, a scale of desirable quality indices was made up.

A complex quality model is showed in Fig. 1.

Comparative evaluation of biochemical analyses of blood serum, obtained from experimental groups of rats during medical and biological evaluation of samples of hematogen (control) and hemalade (calculated formulation) has demonstrated a pronounced positive influence of new versions of product on protein and carbohydrate metabolism, that can be associated with the increase of protein in the formulation and decrease of share of simple carbohydrates.

15 children (from 2.5 to 9 years of age) suffered from iron deficiency anemia and other disturbances of the blood took part in clinical approbation tests. Children received the curative product 3-4 times a day after a meal (daily ironshare was 6-8 mg) during 4-6

weeks. 10 children of the same age and with similar pathology were included in the group of comparison and received various medicinal iron preparations.

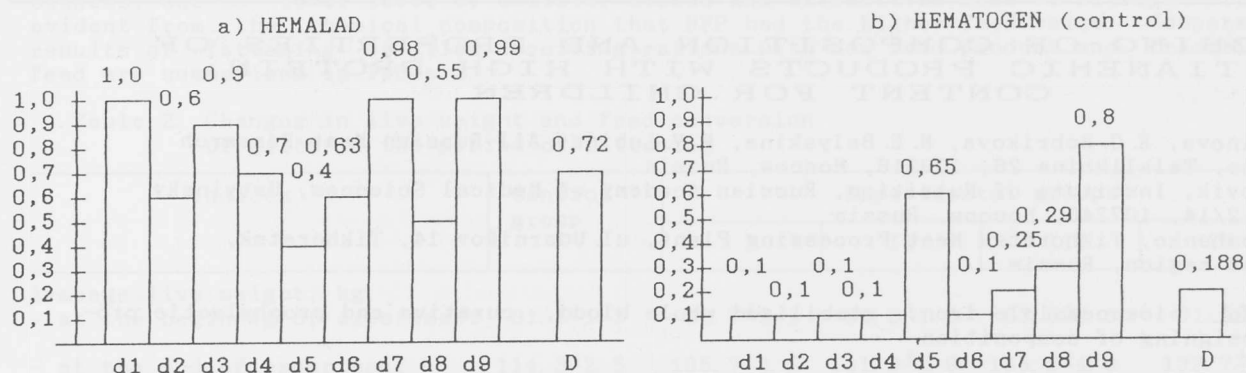


Fig. 1. Complex model of quality

D - generalized quality index,

d... - particular indices of: protein - d1; fat - d2; iron - d3; calcium - d4; magnesium - d5; phosphorus - d6; lysine - d7, methionine + cystine - d8; tryptophan - d9.

As demonstrated, D index of "HEMALAD" blood product was 2-4 times higher in comparison with "HEMATOGEN" control sample.

Prevalent number of children responded positively to "HEMALAD". Hematological analysis demonstrated the statistically reliable increase of the serum iron, hemoglobine, erythrocytes, and colour index (Table 1).

Table 1
Dynamics of various blood indices in children receiving "HEMALAD"

Indices	Number of patients, n	Before treatment, $m \pm m$	At the end of treatment, $m \pm m$	P
Serum iron, g/l	10	11,4 \pm 0,5	13,6 \pm 0,3	/0,01
Hemoglobine, g/l	10	101 \pm 2,08	116 \pm 5,51	/0,05
Erythrocytes, g/l	10	3,1 \pm 0,08	3,8 \pm 0,12	/0,001
Colour index	10	0,72 \pm 0,025	0,86 \pm 0,025	/0,001

It should be noted that dynamics of indices tested was actually similar to the group of comparison. Clinical tests demonstrated adequate taste quality of the new product, good tolerance and expressed clinical efficiency. They make it possible to recommend "HEMALAD" for complex therapeutic treatment of iron deficiency anemia and other blood disturbances followed by the decrease of hemoglobine level. On the basis of similar estimates and specific bio-medical rules, small hematogen sausages were developed. Hematogen sausages contained above 40% of stabilized food blood, besides beef and pork, had balanced protein: fat ratio, and contained bioaccessible iron necessary for the prophylaxis and treatment of anemia. Being combined with ascorbic acid the bioaccessible iron was present in the form of Fe ion and assimilated in full measure by children. The food value of hematogen sausages expressed as % per 100 g of products: protein - 16,31; fat - 16,41; vitamins (mg/100 gr): A - 0,0051, B₁ - 2,799; B₂ - 3,398; PP - 1,479; C - 2,9; R (carotene) - 0,01; mineral substances (mg/100 gr): sodium - 1516,0; potassium - 195,4; calcium - 71,42; magnesium - 17,72; iron - 19,5. Small hematogen sausages contained 64,2% of essential aminoacids, that was above the half of total available aminoacids. Aminoacids scores of essential aminoacids were close to 1. Antianemic properties of small hematogen sausages were analyzed in special experiment. Iron deficiency followed by post-hemorrhagic anemia was provoked in white rats. Animals received hematogen sausages during 28 days. As revealed, the level of hemoglobin in experimented and control group increased by 131% (from 6,4 to 14,8 g/l) and by 51% (from 7,0 to 10,8 g/l), the level of erythrocytes - by 125% (from 3,1 to 7,0 million/($M \times 10^{-3}$)³) versus 66% (from 3.3 to 5.5 mln ($m \times 10^{-3}$)³), respectively. Various age groups of patients suffering from anemia were involved in tests of the clinical approbation: juveniles - gymnasts (12-14 years old) from a sport school and pregnant women from the departments of pathology. Results of the clinical approbation proved the high medical efficiency of small hematogen sausages.

Conclusions

The present study offered a possibility of designing the composition and properties of curative products with high level of proteins. These products had the meat base supplemented by the blood of slaughtered animals. Results of biomedical evaluation as well as clinical approbation allow to recommend new products for complex therapy of blood disturbances followed by the hemoglobine level decrease.