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Background:

The problem of the iron deficit in the human organism is one of the most important medico-biological and technological problems. It is most characteristic for urban inhabitants and can be explained by the use of highly refined products. Statistical data shows that half of population especially women suffer from iron dependent anemia.

This may be caused by lack of iron in the body digestibility decrease due to the large quantity of products of the plant origin in the diet, which reduce its absorption by the digestive track. Prevention of the anemic states is effective enriching the diet by the iron preparation. It is well known, that digestibility of iron from blood of animals is two times higher than that from meat and meat products even more than four times higher than from plants [1].

The blood of agricultural animals is rich in easily digestible proteins and according to the composition is similar to the traditional types of the protein food. According to the content of the protein, 10 kg of beef and 5,6 kg of pork [2], the coefficient of the digestibility of the blood protein being 0,94-0,96 [3].

Irrational use of the animal blood, considerable amounts and accessibility of this valuable protein containing raw material stipulates the interest to search the ways of its use in the diet and opens wide perspectives for the production the disease-preventive products of various technological forms. In this connection, the development of new products for prevention of disease and treatment of the human iron deficit is the actual technological problem [4].

The aim of this work is the to search the possible ways of use of hemcontaining proteins of blood and its fractions for the production of disease-preventive and special products.

Materials and methods:

The object of the study was the blood obtained at the cattle slaughter, recognized healthy by veterinary inspection, at the "Meat plant "Voronezhsky", stabilized by sodium pyrophosphate, plasma and form elements, obtained by separation of blood on the separator БЛA3 in correspondence with the technological instructions, food semiproduct obtained on the base of the above mentioned raw material.

Total chemical reological indices were determined according to the standard methods in correspondence with recommendations [3]: ash mass share – by burning in the oven; fat mass share – refractometrically on the refratometer ИРФ-4546; protein mass share – photometrically with the sample ashing according to the Kjeldal method; moisture mass share – by arbitration method.

Mass share of metals – on the atom – absorptionspectrophotometer C-115M.

pH - potentiometrically on the unit pH-121 [5].

Protein digestibility – by digestive ferments in vitro [5], accumulation of the products of the protein hydrolysis were determined according to hawri and expressed in conventional units (mkg of tyrosine in 1 cm³ of the sample), and also by weighing the residual of the digestion.

Amino acid content of samples has been determined with the use of chromatographic separation of ninhydrine positive compound on the automatic analyzer AAA-T339 (Chechia) according to instruction to the device.

Results and discussion:

High digestibility of iron in the products from meat and blood is due to the fact that it is in the hem form (hemoglobin and mioglobin). In this aspect, of special interest are erythrocytes where mass share of hem is 30-41 %.

At the development of the applied aspects, special importance from biological and functional-technological points of view has the extraction of iron from the cellular structures where they are localized. Here special importance belongs to the choice of hemolysis conditions ensuring technological parameters at the development of the effective preparations of the organic iron. In the present day practice, erythrocyte membranes are destroyed by aqueous hemolysis (by water dilution 1:2). In the result of the studies carried out it has been established that hemolysis of the form elements should be made by hydrochloric acid during 10 minutes. In this case, even young cells of erythrocytes are destroyed and the value of pH is saved at the level of 6-7 and this is necessary for the most food products (Fig 1, 2).

Proceeding from the known formulations and technologies of preparation of children hemotogenum we have developed semi-products to which formulation on blood is added-fresh or chilled, or form elements, sugar, preservatives, mixture of plant and animal fats, aromatizes.

Heat treatment applied in the technology allows to convert iron into unbinded form which makes easier its absorption by the digestive organs. Semi-product technology includes collecting and separating of blood into fractions, hemolysis with the aim of destruction of cell membranes evaporation to 35-40 % of dry substances, making of formulation, cooking, aromatization, pasteurization, cooling and packaging.

Evaporation is recommended to lead under vacuum at temperature 40 °C in order to prevent the coagulation of blood proteins. Pasteurization guarantees microflora destruction. Study of dynamics of microorganisms growth allows to recommend to store the semi-product during 1 month at temperature 0-4 °C.

Recommended fat components allow to enrich semi-products by polyunsaturated fatty acids, phosphatides, fat-soluble vitamins and to prevent from burning to the walls of cooking apparatuses. Aromatizes ensures the necessary fruit or coffee flavour.

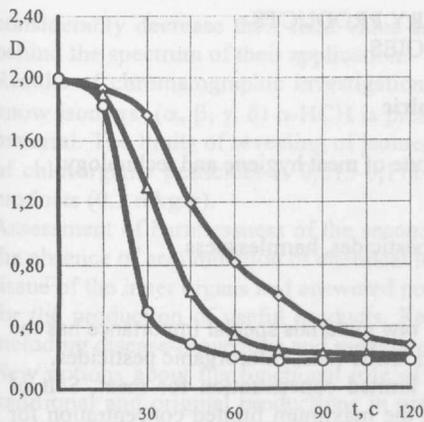


Fig. 1. Track record hemolysis blood forming elements under different concentrations of hydrochloric acid, mol/dm³
 —◇— 0,1; —△— 0,25; —○— 0,5;
 D - absorbances;
 t - time

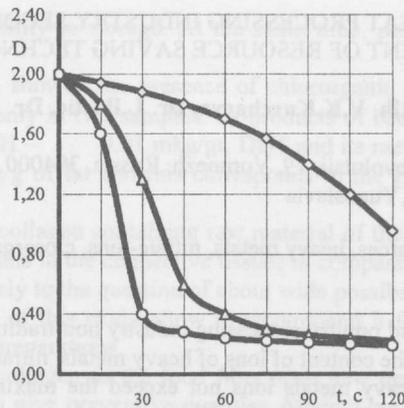


Fig. 2. Track record hemolysis blood forming elements in correlation with hydrochloric acid:
 —◇— 1:0,5; —△— 1:1; —○— 1:1,5;
 D - absorbances;
 t - time

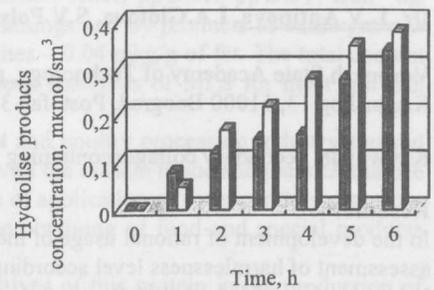


Fig. 3. Protein products digestible:
 ■ - egg protein; □ - gel with carrot juice.

The semi-product development contains considerable share of the protein including all essential amino acids. According to the amino acid content they are similar to the egg protein. This expands aspects and open new perspectives for the application of the protein resources in the formulations of the original products. According to there appearance the semi-products are of the chocolate color with pasty homogenous consistency. The output of the finished product on the base of the blood is 62 %, with the use of the form elements 85 %. Digestibility of the semi-product proteins is 95 %. Energy value – 1360-1420 kJ. Semi-products contain: moisture – 32-35, protein – 20-22, fat – 16-18, ash – 0,2-0,3, carbohydrates – 25-30 and the considerable quantity of the easily digestible forms of the important mineral substances: iron – 75-180 mg%, copper – 1,66-1,84 mkg%, zinc – 0,38-0,38 mkg%.

Reological studies of the semi-products showed that according to their qualities they are similar to masses applied in confectionery industry for the production of sweets. This allow to recommend the semi-product to the application in confectionery industry for the production sweets and products imitating chocolate masses.

It is well known that blood plasma possesses a unique property to form gels at increasing the mass share of the protein up to 4 %. We have determined that structuring of the plasma proteins is rather intensive at displacing pH of blood plasma from the isoelectric point. Herewith the most large values of viscosity, corresponding to the maximum strength of gel being obtained are reached in the fields of acid values at pH 3,2÷3,8 and in the field of alkaline values at pH 12,4÷13,2.

However, as the results have shown the organoleptic properties of taste and decrease considerably their food value. In this connection, we have used the sugar syrup with mass share of dry substances 65 %; natural juices with pulp (carrot and pumpkin) ingredients of the experimental formulation.

It has been established, that food ingredients of the juices have positive influence upon the process of blood plasma structuring.

It is possible to suggest, that the effect of a gel formation is revealed on with the formation of additional bonds between biopolymers in the system of protein-polysaccharides according to the functional-biological indices, including digestibility of food enzymes by the system in conditions, imitating the digestive organs of a human being (Fig. 3), the products can be classified as disease-preventive and be recommended for enriching the diet of patients in the post-operative period, for patients with poor nitrogen and metabolism balance, and also for baby food, for health maintenance of older people.

Conclusion:

Whole stabilized blood forming elements and plasma may be use as the raw material for the production of deacease-preventive products. The semi-product on blood forming elements base imitate chocolate icing and pastes for the production of confectioneries with the high consumer qualities and deacease-preventive action, opens new possibilities for the rational use the blood fractions of the slaughter animals for food aims. The product made by as on the basis of blood plasm with the addition of natural carrot juice with flesh pulp as a vegetarian ingredient, has pleasant taste and flavor, enriched by vitamins, food fibers, micro- and macroelements. The gel has high nutrition and biological value, high organoleptic qualities, good digestibility.

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