Isolation of food protein from blood of slaughter animals

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At the present time at Russian meat plants about 10-12% of total amount of slaughter blood is used for food and medicinal industry, the rest of the available blood goes for technical needs or practically is not used. This is not economically justified because blood is a very valuable product containing 16-18% of proteins with all the essential aminoacids, i.e. the same amount as in meat, therefore one can call the blood "meat in liquid form". Since only one third of world population is provided with wholesome protein food, blood can be considered as a reserve source of food protein. The blood itself and its ingredients are an excellent nutritive medium for bacteria and thus one of possible sources of contamination of environment, that requires an increase of the volume of its processing.

In connection with this it seems practical to use methods of utilization allowing to obtain useful products from the wastes with different degree of degradation.

Blood of slaughter animals is ideal raw materials where proteins are in the dissolved or semi-dissolved aggreaged state that makes carrying out of different steps of processing considerably easier. Peculiarities of the ingredient composition of blood predetermine the choice of possible ways of separation and modification of the ingredients of blood substances taking into account the present achievements of biotechnology.

Due to this fact the problem of rational use of blood itself, proteins and their biologically active substances and also biologically assimilable iron, bound into hemin, has been a challenge up to the present time. Specific taste, smell and color of blood limit its use as a food and require special methods of processing.

Objective of work

The objective of the work was to find the method of isolation of a food protein from the whole blood of slaughter animals, study of its functional and consumer properties and possibility of use in food products.

Materials and methods

For carrying out the work we have used:

- whole blood of the cattle (OST 49-161-80) with solids content 18-19%, with that of hemoglibin – 10,3%;
- the preparation of soluble carboxymethylcellulose (CMC) OST 6-05-386-80, mark 70/450 "O" of Russian make with the degree of polymerization 500±50 with the degree of substitution 65-75%, the content of ferric oxide 0,05% and humidity 15%.

Purified pancreatin, containing 80% of protein (as determined according to Lawrie) with the activity of 500 u/mg, determined by modified method of Anson, was used as an enzymic preparation.

Analysis of decolourized blood was fulfilled on aminoacid analyzer LG 3000 of "Eppendorf-Biotronic" (Germany). A four-buffer system with a gradient supply was used for efficient separation of aminoacids.

Clarification of the blood by means of its sorption on carboxymethylcellulose was carried out as follows: one litre of whole blood of slaughter animals was added with 1-1,5 l of distilled or boiled water, then pH of the solution was brought to 1,5, then at a room temperature it was added with an equal volume of 1% solution of carboxymethylcellulose; the solution was maintained with this pH value during 10 min, then pH of the solution was brought to 3.0, the mixture was stirred during 35-40 min at the same temperature, and then the residue of carboxymethylcellulose with the bound hemin was separated from the supernatant by centrifugation, then pH of the solution was brought to 6.8-7.0, and the precipitated proteins were separated by centrifugation. The supernatant was discarded, and the protein suspension was dried in a spray of freeze drier.

Digestibility of produced specimens was evaluated according to A.A. Pokrovsky and I.D. Ertanov. The experiments were carried out vitro in the instrument allowing to accomplish hydrolysis under the conditions of continuous stirring of the medium and removal of low-molecular products of protein hydrolysis through semi-permeable membrane.

Results and discussion

During the last 20 years a great deal of information has been published in literature about the collected blood of slaughter animals, where the results and technological experience beginning from slaughter technology to the use of blood in present food industry are widely dealt with. There are many ways of blood clarification at the present time. All of them have some advantages and disadvantages. We made an attempt to modify the method of globin production using carboxymethylcellulose [1], that had not been previously used, for the clarification of the whole blood of slaughter animals which contains, as distinct from globin, a large number of essential aminoacids, for example isoleucin.

Analysis of literature data shows that for a more complete removal of heme it is necessary that dissociation in the system heme-globin was shifted into the heme formation side. In this case the degree of dissociation becomes the higher, the more profound transformations undergoes a native protein [2]. However, reverse and side reactions have influence on the residual content of heme in the protein. Thus, dissociation in the system heme-globin should be carried out under conditions of denaturation close to reversible ones and allowing to control this process. Taking into account the above-mentioned the initial technique was modified and extended. Optimum parameters of blood protein concentration and carboxymethylcellulose have been found. As a result of the investigations it was found that 35-40 min. is required to achieve a full saturation of carboxymethylcellulose with respect to hemin and globin, and in the case of addition of 1% solution of carboxymethylcellulose to 7% solution of blood (with respect to protein), the yield of protein dried by lyofilization increases from 58 to 67% with practically the same iron content in the final product (0,2%) [3]. We have manufactured experimental lots of clarified blood proteins under semi-pilot conditions. The comparative evaluation of protein

fractions of native and clarified blood carried out by means of electrophoresis in 15% polyacrilamide gel has shown that the proteins of clarified blood contained both the proteins of plasma and globin being the main protein of erythrocytes, that demonstrates rather a high quality of the obtained protein product.

As is known, one of most important characteristics of protein substances is their biological value. In evaluation of biological value of proteins the amino acid composition or the ratio of essential aminoacids is considered as the main characteristic; the second main characteristic is digestibility of proteins. The observed high velocity and degree of digestibility of the obtained protein product of the blood at the level of reference proteins demonstrates good prospects of use of this product as nutrient additives. The aminoacid composition of the obtained proteins of clarified blood is presented in the Table.

As can be seen from the Table, the method allows to obtain a product that is by its amino acid composition is close to the whole blood, but with no hemin in it which prevents from a wide use of blood in food products.

From the obtained clarified blood an experimental lot of sardelles having good sensory characteristics was obtained.

Table

Aminoacid composition of clarified blood proteins

Aminoacid	Blood, whole, dried, % to protein	Blood, clarified, % to protein
Lysin	8,76	9,18
Histidine	5,87	6,81
Arginine	4,19	3,76
Aspartic acid	8,2	7,05
Threonine	3,84	4,14
Serin	4,24	5,32
Glutamic acid	8,36	6,53
Proline	4,15	4,71
Glycine	5,11	4,82
Alanine	8,87	9,11
Valine	7,04	7,65
Methionine	1,46	1,19
Isoleucine	1,62	0,87
Leucine	13,61	13,28
Tyrosine	4,34	5,90
Phenylalanine	7,40	6,98

Conclusions

Thus the method of blood clarification with the help of dissolved carboxymethylcellulose can be considered as an efficient method for obtaining a wholesome protein product from the wastes of meat industry.

References

1. US Patent No. 437627, NKI 260-112.
2. Antonini E., Brunori M. "Hemoglobin and myoglobin in their reactions with ligands", Amst., London, 1971 (Eds A.N. Neuberser E.L. Tatum).
3. Nekludov A.D., Evstafyeva E.A., Baburina M.I., Ilukhina V.P., Lisitsyn A.B., Belova S.M. Method of production of protein from slaughter animals blood. Patent of RF, No. 2060681, B.I. No. 5, 1996.