



## DEVELOPMENT OF FUNCTIONAL NUTRITIONALLY BALANCED FOOD PRODUCTS FROM RECYCLED RAW MATERIALS OF ANIMAL ORIGIN

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**Abstract.** In recent years, the research carried out has been aimed at developing technologies that ensure the conditions for a more complete use of food blood and its fractions in the development of products of new assortment groups according to the technical standards of organizations. Therefore, the goal of research is to create products with a high content of easily digestible iron based on little-used raw materials, which are currently the blood and liver of farm animals.

**Keywords:** secondary raw materials, blood, protein, plasma, albumin, hemoglobin, leukocytes, platelets, erythrocytes

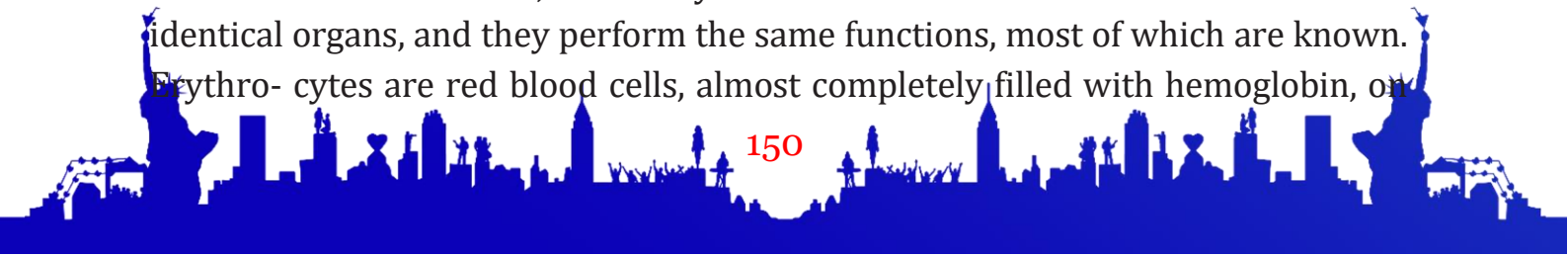
The need for products for therapeutic and prophylactic purposes enriched with iron, the presence of significant blood resources of slaughter animals, the lack of a modern technological solution for the development of products for therapeutic and prophylactic purposes with its use determine the development of new scientific approaches to create a waste-free intensive technology for processing this raw material for these purposes.

Blood is the internal environment and the main communication system of the body. It is a viscous opaque liquid, salty taste, continuously circulating in a closed system of blood vessels and performing vital functions, maintaining the integrity and functionality of living systems.

Morphologically, blood is one of the varieties of the body's connective tissue, it consists of a liquid intercellular substance - plasma and cells-shaped elements: erythrocytes, leukocytes, platelets, which are rudimentary in nature and perform specific functions in the life of organisms.

The ratio of plasma and blood cells fluctuates depending on the species of animals (table 1.)

At the same time, the biosynthesis of formed elements is localized in identical organs, and they perform the same functions, most of which are known. Erythrocytes are red blood cells, almost completely filled with hemoglobin, on





average their content in 1 mm<sup>3</sup> of animal blood is 6.5-9 million, in birds - 2.5-4 million additionally contain highly digestible carbohydrates.

**Table 1.**

Mass fraction of blood fractions (%) depending on the type of animals

<b>Livestock type</b>	<b>Plasma</b>	<b>Shaped elements</b>	
Cattle	67,4	32,6	
Pigs	56,5	43,5	
Small cattle	72,0	28,0	
Horses	60,2	39,8	

The morphological composition of the blood of animals and birds is influenced by a number of vital factors: genetic characteristics, maintenance and feeding, productivity, speed of movement of animals, growth rate (table 2).

A detailed analysis of the fractional composition of the blood cells of cattle and pigs indicates the variability of particle sizes in a wide range, with a predominance of particles with a diameter of 7.9-11.56 μm (20.4%) in cattle, and with a diameter of 5.968.72 in pigs. (15.52%).

Erythrocytes are specialized cells with a diameter of 7-9 microns, non-nuclear in mammals and in the form of a biconcave disc. In poultry, erythrocytes have nuclei, and differ in shape, representing a biconvex disc. Erythrocytes are formed from precursors - reticulocytes, which subsequently lose cellular organelles and synthesize a large amount of hemoglobin. Thus, erythrocytes are rudimentary cells, in the aqueous cytosol of which hemoglobin is dissolved in very high concentrations (34%), due to which their main function is performed - the transfer of oxygen and carbon dioxide, i.e. respiratory function. Every day, hemoglobin of erythrocytes transfers from the lungs to the tissues about 0.6 m<sup>3</sup> of oxygen. Erythrocytes are characterized by softness, flexibility and elasticity, due to which they are able to pass through narrow capillaries, while strongly stretching in length, when entering a wide channel they turn into discs.

Erythrocytes are adapted to perform their main function - the transfer of respiratory gases. Red blood cells are formed inside the vessels in the sinuses of the red bone marrow. Ripe erythrocytes circulate in the blood of animals for 100-120 days, the erythrocyte of chickens lives for 28 days, after which they are phagocytized by the cells of the reticuloendothelial system of the liver, spleen and bone marrow. In adult and old animals, birds, they live longer than in young and newborns. It takes longer for large animals than for small ones. On average, 0.8-





1.0% of erythrocytes are renewed per day, however, the rate of erythropoiesis (the formation of red blood cells) can sharply increase with blood loss, lack of oxygen, pathological shortening of the life span of erythrocytes. Fluctuations in the content of red blood cells in the blood also depend on feeding and productivity. The presence of animal feed in the diet contributes to an increase in the number of red blood cells.

**Table 2.**

The content of formed elements in the blood of farm animals and birds

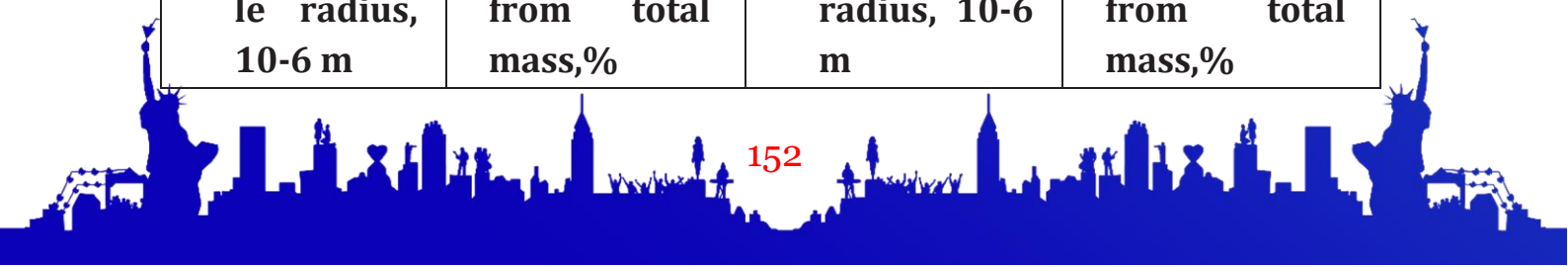
Animals, birds	Quantity in 1 mm <sup>3</sup>								
	erythrocytes, mln.			leukocytes, thousand.			platelets, thous.		
Cattle	,0-0	5,0-7,5	6,0-8,0	6,0-10,0	4,5-12,0	7,0-9,0	260,0-710,0	260,0-700,0	200,0-600,0
Horses	,0-0,0	6,0-9,0	8,0-10,0	7,0-11,5	7,0-12,0	8,0-11,0	250,0-600,0	180,0-300,0	
Small cattle	,0-8,8	7,0-12,0	6,0-11,0	6,3-14,7	6,0-14,0	9,0-16,0	270,0-1000,0	270,0-500,0	
Pigs	,3-7	6,0-7,5	6,0-8,0	10,2-21,2	8,0-16,0	6,0-10,0	180,0-300,0	180,0-300,8	
Rabbits	,9-1	4,5-7,5	6,0-7,0	4,6-10,6	6,5-9,5	-	125,0-480,0	125,0-250,01	
Hen	,0-0	2,5-4,5	-	9,0-51,0	20,0-40,0	-	22,0-41,0	32,0-100,0	-
goose	,8-0	-	-	16,0-60,0	-	-	60,0-70,0	-	-
Duck	,0-7	-	-	20,0-30,0	-	-	70,0-120,0	-	-
Turkey	,7-2	-	-	12,0-83,5	-	-	19,0-100,0	-	-

The generalized average data on the values of the size of the formed elements in the blood of farm animals are presented in Table 3.

**Table 3**

The size of the particles of the formed elements of the blood of farm animals

Cattle		Pigs	
partic le radius, 10 <sup>-6</sup> m	quantity from total mass,%	particle radius, 10 <sup>-6</sup> m	quantity from total mass,%



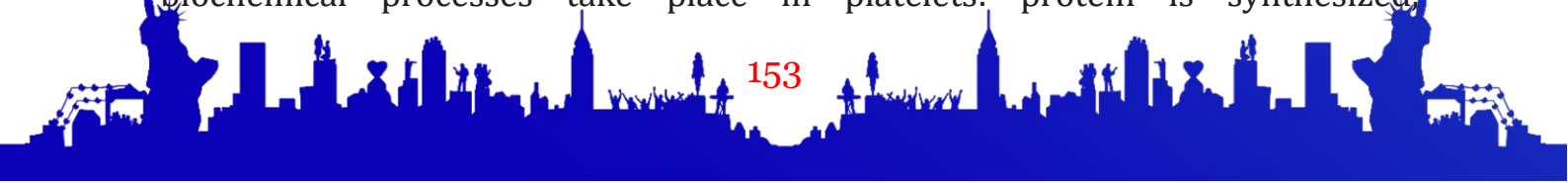


0,88	0,96	0,67	24,82
0,88-2,02	8,16	0,67-1,53	6,20
2,02-2,93	9,18	1,53-2,22	6,98
2,93-3,95	12,24	2,22-2,08	9,31
3,95-5,78	20,40	2,98-4,36	15,52
5,78-7,20	13,26	4,36-5,44	10,02
7,20-8,85	11,32	5,44-6,67	8,53
8,85-10,80	9,18	6,67-8,20	6,98
10,80-13,50	7,14	8,20-10,20	5,43
13,50-17,60	5,10	10,20-13,20	3,88
17,60-24,40	3,06	13,20-20,0	2,33

Thinning of blood after taking a large volume of water by a bird somewhat reduces the number of erythrocytes, and, conversely, when the blood thickens due to a lack of drinking water, their number increases. The reason for the persistent decrease in blood erythrocytes and hemoglobin (in case of anemia) may be a lack of iron and copper in feed.

The membrane of erythrocytes consists of proteins, lipo- and glycoproteins, its thickness is about 10 nm. The membrane is a million times more permeable to anions than to cations. The transfer of substances through the membrane is carried out both by diffusion and by binding by carrier molecules embedded in the membrane. The ATP required for these processes is formed as a result of glycolysis. The content of proteins in erythrocytes is higher, and low-molecular substances (glucose, salts, etc.) are lower than in plasma. In general, the osmotic pressure in erythrocytes is slightly higher than in plasma, which ensures their turgor. In a hypotonic solution, erythrocytes absorb water, swell, acquire a spherical shape and burst; hemoglobin comes out on Wednesday. This is a process of osmotic hemolysis, which has found great application in preparative and technological practice. Hemolysis can also occur when exposed to chemicals that dissolve fats (ether, chloroform, saponins, snake venom) and disrupt the structure or integrity of the membrane. In a hypertonic solution, plasmolysis of erythrocytes is observed, while they lose water and shrink.

Platelets are platelets that are formed from the cytoplasm of the bone marrow megakaryotes. Each platelet is about three microns in size. All basic biochemical processes take place in platelets: protein is synthesized,





carbohydrates and lipids are exchanged, biological oxidation is carried out, coupled with phosphorylation, etc. Platelets are involved in the process of blood coagulation, performing a protective function.

Leukocytes or white blood cells are colorless full-fledged cells with a nucleus and protoplasm of a specific structure with a high content of nucleic acids, their average size is about fifteen microns. All blood glycogen is concentrated in them, which serves as a source of energy when there is a lack of oxygen. In terms of the composition of leukocytes, the blood of birds is subject to significant individual fluctuations, but the average data can, to a certain extent, characterize the order as a whole. The predominant cells in the blood of birds are non-granular leukocytes, that is, the blood of birds has a pronounced lymphocytic profile. Lymphocytes are formed in the lymphatic tissue, and their main function is to participate in protective and repair processes. They are able to produce various antibodies, in particular, immunoglobulins, destroy and remove toxins of protein origin, and phagocytose microorganisms. The number of leukocytes in the blood is in the thousands, they differ from each other both morphologically and in the biological role performed in the body. Leukocytes are represented by three types of cells: lymphocytes (26%), monocytes (7%) and polymorphonuclear leukocytes or granulocytes (67%).

Protein product as food blood of slaughter animals, in which, on average, 0.040% iron in the heme form in the hemoglobin protein. Since hemoglobin is the main protein of the corpuscular elements, we subject the stabilized food blood to separation for separation into plasma and corpuscular elements. The latter in the dry residue contain 0.15% iron, which is concentrated in the prosthetic group of this complex protein - heme.

### **Conclusion**

For the introduction into production, the development of new types of anti-anemic food products based on the blood of slaughtered animals, it is necessary to convincingly and skillfully demonstrate its harmlessness, high digestibility and effectiveness of use in daily diets for the prevention and treatment of anemic diseases.

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