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COLOSTRUM ROLE IN THE FORMATION OF IMMUNITY IN NEWBORN CALVES

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The regularities in the formation of the blood plasma proteinogram was established, including the level of antibodies in newborn calves in first 36 hours of life,which defined qualitative and quantitative composition of colostrum and intense formation during this period maternal immunity.

Colostrum, newborn calves, maternal immunity, blood plasma proteinogram immunoglobulins.

With colostrum mother in the first hours of life, newborn animal receives the maximum number of antibodies that are natural protective factors and remind passive oral immunization. In colostrum, compared to milk 3 times more protein, 80 % of whom are immunoglobulins (maternal antibodies) [1, 2]. The last ones are in colostrum in 10 – 12 times higher than in blood. Part of antibodies in colostrum comes from the blood, and the other - produced plasma cells of the breast. During the first 1-3 days of life in the digestive tract of the newborn immune colostrum proteins are not subjected to enzymatic hydrolysis. During this period in the gastric juice is absent hydrochloric acid; enzymes of the digestive juices are inactive due to colostrum inhibitors specific action. This is one of the factors ensuring assimilation of antibodies and other proteins in the digestive tract in native form. Mother antibodies are destroyed in the body of newborn mammals during the first months of life [3, 4]. Their products of disintegration initiate the development of own immune system that occurs during the first four - five months of life [5, 6]. In bovine colostrum is the only one source of maternal immunoglobulins that protect newborn calves in the neonatal period of development. The maximum concentration of antibodies it appears in the first days after calving, and then rapidly decreases [7]. It may be connected with active development of the immune system of calves in early postnatal period and expression of immunoglobulin genes in immunocompetent B-lymphocytes. In the colostrum of cows content Ig G dominates Ig A and M, as they effectively

transported in breast epithelium and alveoli, whose cells have a higher density of Fc-γ-receptor [8].

Receptor and endocytotic mechanism of the formation of immunoresistant condition of the body of newborn calves is proved today [9] and larger role in this process features of the natural variations acid-alkaline blood parameters [10].

The aim of investigation is to determine the features of adaptive changes of the blood plasma protein spectrum in newborn calves during feeding colostrum.

Materials and methods. Newborn calves was added into the investigation immediately after birth and was under the care in the first 36 hours of life (n = 12).

Venous blood was the material of investigation. It was taken from animals three times: one hour after birth to watering colostrum and on 24 and 36 hours of life. The samples of blood plasma were investigated on total protein content with the help of biochemical analyzer performance Microlab-200 ("AVL", Germany). Fractional composition of blood plasma proteins of calves was examined by vertical gel electrophoresis in 10% polyacrylamide gel with 0,1% solution of DS-Na on the system AVGE-1 "Hiu-Kallur" [11]. Densitogram`s mathematical analyses was performed on laser densitometer Ultroscan LX Laser Densitometer (LKB-Pharmacia, Sweden). Protein fraction was identified as value Rf and marker proteins HMW (LKB-Pharnacia, Sweden) – 212, 170, 116, 76, 53 kDa. Conventional methods of variation statistics were uesd for the results of experimental investigations [12]. Data considered as valid at $p < 0,05$.

Results. With the help of vertical electrophoresis method in polyacrylamide gel and addition of the Na-DS in blood plasma of newborn calves was received 16 protein fractions that are identified as (table): 1 start zone that consists of high total protein fraction with M. m>1000 kDa (β-lipoproteins zone and IgM); 2 – 725 kDa (α_2-macroglobulin zone); 3 – 340 kDa (fibrinogen zone); 4 – 200–220 kDa (proteins zone of the complement system and properdin); 5 –γ-globulin zone with M.w. 161-163 kDa (IgG_1) and 150-154 kDa (IgG_2); 6 - 132 kDa (zone ceruloplasmin); 7 - 100 kDa (haptoglobin zone); 8 - proteins zone from M. w. 96 kDa and is probably haptoglobin sub fraction [8, 152], as in cattle shows considerable polymorphism of

the protein; 9 - 92 kDa (plasminogen zone); 10, 11, 12 – 79 kDa, 78 kDa and 77 (transferrins zone); 13 – 72 kDa (postalbumins zone), which may include prothrombin (72 kDa) and α-fetoprotein (70 kDa); 14 – 68 kDa (albumin zone), composed in newborn calves are fetal plasma proteins (67,3 kDa); to 15 and 16 fractions belong proteins of prealbumins zone, such as: 15 fraction – 60 kDa (zone α_1-antichimotrypsin and thyroxin binding globulin), 16 fraction – 58 kDa (zone hemopexin and transcortin). Quantitative changes in obtained protein fractions of the blood plasma during the first 36 hours of life calves are characterized by a number of appropriatenesses (table), which is explained by some peculiarities in the course of digestion processes, absorption and biosynthesis of proteins in newborn animals.

Table – Blood plasma proteinogram of newborn calves, M±m, n = 12

Blood proteins	Molecular weight, kDa	Unit of measurement	Periods of investigation		
			to the watering colostrum	24 hours of life	36 hours of life
Total protein		g/l	48,70±0,76	69,80±0,25*	72,70±0,20*
1	950–1000	%	9,38±3,01	7,86±1,11	6,34±0,72
		g/l	4,41±1,34	5,59±0,91	4,64±0,33
2	725	%	8,05±0,57	8,93±0,10	4,31±0,21
		g/l	3,77±0,30	6,55±0,78	3,34±0,22
3	340	%	3,13±0,71	2,99±0,61	1,71±0,31
		g/l	1,53±0,36	2,05±0,41	1,28±0,26
4	200–220	%	1,21±0,09	1,66±0,45	2,14±0,29*
		g/l	0,58±0,04	1,20±0,32	1,61±0,21
5	161–163 + 150–154	%	4,70±1,02	14,08±0,25*	14,81±0,96*
		g/l	2,23±0,53	9,63±0,14*	11,17±0,73*
6	132	%	2,07±0,52	4,10±0,13*	2,23±0,13
		g/l	1,25±0,31	2,84±0,18*	1,67±0,10
7	100	%	1,37±0,18	3,09±0,33*	2,85±0,24*
		g/l	0,77±0,15	2,14±0,21*	2,26±0,18*
8	96	%	5,13±0,76	3,82±0,52	3,26±0,14*
		g/l	2,60±0,35	2,62±0,30	2,44±0,13
9	92	%	1,82±0,31	1,40±0,25*	1,23±0,12
		g/l	0,90±0,15	0,97±0,16	0,94±0,11
10	79	%	1,48±0,22	1,14±0,15	1,12±0,11
		g/l	0,72±0,12	0,81±0,11	0,86±0,09

Blood proteins	Molecular weight, kDa	Unit of measur ement	Periods of investigation		
			to the watering colostrum	24 hours of life	36 hours of life
11	78	%	2,50±0,32	2,63±0,40	1,65±0,20*
		g /l	1,20±0,15	1,85±0,26*	1,24±0,17
12	77	%	4,06±0,80	2,86±0,19	3,53±0,12
		g /l	1,93±0,34	1,98±0,11	2,60±0,06
13	72	%	7,31±0,78	5,42±0,41*	5,46±0,30*
		g /l	3,49±0,30	3,77±0,27	4,08±0,28
14	68	%	43,03±2,62	39,09±0,21	42,84±0,69
		g /l	20,59±0,78	27,09±0,89	32,09±1,19*
15	60	%	0,56±0,05	0,79±0,06	0,39±0,09
		g /l	0,30±0,02	0,58±0,06	0,29±0,07*
16	58	%	2,82±0,72	3,35±0,32	4,72±0,44
		g /l	1,34±0,32	2,34±0,24*	3,55±0,36*
Albumin/globulin			0,77	0,61	0,77

Note. * – Significant difference ($p < 0.05$) dynamics of blood proteins as compared with the initial data

Low level of total protein and trace protein content of γ-globulin fraction in blood plasma are observed at the moment of the calves' birth till the first watering colostrum levels. Immunoglobulins in the newly born calves are represented by G_1 and M classes [9, 10]. These proteins are essential in formation of the general and local immunity. So their negligible content at birth of the calves characterizes areactivite status of the organism.

Intensive increasing of total protein level on 43 % compared with the initial data is during the first days of life. As known, this is due to a high content of proteins in the first portions of colostrum, the presence of protease inhibitors and specific receptor mechanism absorbtion of native proteins in the gut [1, 2, 9, 10]. This process is the most active at pH 6,0-6,5 of digestive juices [10]. The maximum value of total protein level acquires on 36 hour of calves life.

Along with changes in the level of total protein in the blood plasma of calves at 24 and 36 hours of life observed significant increase in the concentration of immunoglobulins in 4,3 and 5 times according to the time of observation.

It is important that in the period of intensive increasing level of total protein and immunoglobulins in blood plasma are observed corresponding changes in the concentration of protease inhibitors, among them were investigate the dynamics of the content of α_2-macroglobulin and total fraction α_1-antichymotrypsin. Was established that on 24 hour of life in blood plasma of the intact calves significantly increased level of the protein fractions – α_2-macroglobulin on 74 % and α_1-antichimotripsin on 93 %, which is in the future (on 36 life hour) gradually decreases respectively on 47 and 50 % (table). In addition, is known that α_2-macroglobulin belong to the major immunosuppression proteins of the postnatal period of life. According to the publications data [1, 2], the increasing in plasma of newborn calves concentration of the immunoglobulins is accompanied by the gradual disappearance of her immunosuppression proteins.

Obtained data confirmed that the most intensive process of the formation of maternal immunity in the body of newborn calves is within the first 24 hours of life.

The area of albumin is the most massive of protein fractions in the blood plasma of calves. Suggested that to the composition of this fraction belong fetuins, which are synthesized in embryonic tissues [10]. Features of the illegible picture of electrophoretic mobility of albumin is also explained by the presence in blood plasma fetuses of fetal type of this protein (AlbF).

Further changes in the concentration of albumin fraction in blood plasma of the intact calves characterized a comparative reducing of its content on 24 life hour and increased to initial level at 36 hour (table). In this case, the absolute level of this fraction increased significantly (on 31 and 56 % according to the observation time) (table). Perhaps the dynamic of these changes is associated with special functional significance of albumin in the body of newborn calves. It is known for its buffer, transport and plastic functions [3, 4]. Buffer characteristics of this protein are explained its amphoteric character and ability to form and carbomate compounds.

Increasing in blood plasma level of total protein is also due to other proteins fractions, including transport: haptoglobin zone, hemopeksin, transferrins, ceruloplasmin, thyroxyn linking protein and transcortin, retinol linking protein and β-lipoproteid. The dynamics of these proteins in the blood plasma of newborn calves is closely related with the exchange of relevant materials – Cuprum, Ferum, hemoglobin, hormones and other. In the blood plasma of newborn calves transport proteins level increased significantly during the first 24 hours of life. Further, it remains unchanged or slightly increased.

The peak of the functional activity of ceruloplasmin take a place on 24 hour of the investigation period. It is further its level gradually decreases (on 42 %). It is suspected that this protein has cuprum contained protein had an oxidase activity, is involved in the regulation of metabolism of the mentioned metal and transports cuprum to the sites of synthesis of the corresponding enzymes of the respiratory chain [5].

Concentration of total thyroxin linking protein and transcortin and retinol linking protein fractions characterized by changing in the blood plasma of intact calves during the observation period. Each molecule of thyroxin linking protein binds one molecule of thyroxin. This process is very sensitive to the changes in pH value. Increasing transcortin content in blood plasma is obviously connected with the need to maintain in the blood of newborn calves corresponding concentration of active forms of the corticosteroids. Thus, level specified protein fraction on 24 hour of its life increased up 75%, and on 36 hour up 52%.

Total fraction β-lipoproteid dynamics of the level in the blood plasma of calves is characterized by a tendency to increase after 24 hours of life (up 27 %) and a further reduction up 17 % at 36 hour. The function of this protein is to transport in the bloodstream insoluble in water lipids [10].

At the same time, veritable increasing of the proteins content of the complement system (in 2,0-2,8 times as compared to initial data) as at 24 and 36 hours of life appears in the blood plasma of calves. Complement is considered one of the most universal natural resistance factors, which integrates humoral and cellular

reactions of specific and nonspecific immunity [10]. Therefore, these changes in the concentration of proteins of the complement system in the blood of healthy calves may indicate about increasing of the responsiveness their organism, beginning from the first day of life.

A similar tendency was observed regarding the dynamics of blood coagulation proteins content: fibrinogen, prothrombin, plasminogen. Recently demonstrated that fibrinogen revealed buffer features, which supports sustainability acid-base status of blood [10].

Conclusions

1. Significant changes in plasma proteinogram revealed in the newborn calves first hours of life who first defined the specific nature of their nutrition in early postnatal period of life, and, therefore, qualitative and quantitative composition of colostrum.

2. Identified patterns in the blood plasma proteinogram development of newborn calves of first 36 hours of life are stipulated also intensive formation of maternal immunity in this period.

3. Timely quality colostrum feeding of newborn calves is an important factor in the formation of the immune resistance condition of the body and successful adaptation to extrauterine existence of animals.

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