IJABR

International Journal of Advanced Biotechnology and Research (IJABR)
ISSN 0976-2612, Online ISSN 2278–599X,
Vol-10, Issue-2, 2019, pp588-595
http://www.bipublication.com

Research Article

Physiological features of the antiaggregation control of vessels over the main formed elements of blood in calves at the beginning of ontogenesis

Glagoleva T.I.[1] and Medvedev I.N.[2*]

[1] All-Russian Research Institute of Animal Physiology, Biochemistry and Nutrition, Branch, Federal Science Center for Animal Husbandry named after Academy Member L.K. Ernst, Borovsk, Institute village, 249013, Russian Federation

[2]Russian State Social University, st. V. Pika, 4, Moscow, 129226, Russian Federation

[Received: 21/05/2019; Accepted: 03/06/2019; Published: 05/06/2019]

ANNOTATION

Objective: to establish the severity of antiaggregatory effects of blood vessels on the main formed elements of blood in calves during the neonatal phase.

Materials and methods: The study was performed on 32 calves of black-and-white breed, obtained from healthy cows after 2-3 pregnancies. Calves were taken in the study for 1-2 days of life. The survey was conducted during the neonatal phase five times - 1-2, 3-4, 5-6, 7-8 and 9-10 days of life. Used biochemical, hematological and statistical research methods.

Results: During the whole newborn period, calves showed a tendency to enhance the aggregation activity of erythrocytes with a high degree of disaggregating control of the vascular wall over them. This was combined in the observed animals with low platelet aggregation, which has a tendency to increase their sensitivity to disaggregating influences from the vascular wall. Low aggregation of neutrophils in calves of colostrum nutrition was effectively hampered by pronounced antiaggregatory activity of their vessels. As a result of the study, it became clear that physiologically justified balance of aggregation of blood corpuscles and disaggregating control of them from the vascular wall is characteristic of newborn calves.

Conclusion: In newborn calves that are under physiological conditions, there is a slight tendency to increase the aggregation of the main blood cells. This is completely balanced by their tendency to increase the disaggregation capacity of the vascular wall in relation to erythrocytes, platelets and neutrophils.

Keywords: Newborn phase, Calves, Ontogenesis, Vascular wall, Aggregation, Erythrocytes, Platelets, Neutrophilic leukocytes.

***Corresponding author:** Medvedev Ilya Nikolaevich, Tel +79102732263, E-mail: ilmedv1@yandex.ru

INTRODUCTION

The need to intensify the production of milk and beef around the world[1]urgently dictates the need for further research in the field of the physiology of cattle throughout the ontogeny[2,3]. Special attention in this regard is drawn to the blood consisting of formed elements and plasma[4], continuously moving through the vessels of the animal, providing gas exchange, delivering nutrients and biologically active substances to the tissues, as well as removing toxic substances and slags from them[5]. The success of hemocirculation, which significantly determines the completeness of the implementation of hereditary information[6] and the general physiological and biological status of an animal[7,8], is largely related to the level of

aggregation of blood cells[9] and the severity of control of it from the vascular wall during the entire ontogenesis[10,11].

In view of the high social significance of the development of thrombosis, the aggregation properties of the blood corpuscles[12] and vascular disaggregation control over them[13] have been actively studied in humans. As a result of these studies, it was possible to find out the mechanisms of aggregation-disaggregation processes that are very valuable for physiology, their age dynamics and trace the level of their changes in the conditions of pathology. It was observed that excessive aggregation of erythrocytes, platelets and leukocytes can disrupt metabolic processes and weaken the functional state of the body[14]. The possibility of regulating, if necessary, aggregation-disaggregation phenomena directly into the blood was also established. In the conditions of cardiovascular pathology, the possibility of achieving a balance between them through various effects was shown[15, 16].

It is now becoming clear that the vascular control over the aggregation properties of the blood corpuscles largely determines the fluid properties of the blood and, thus, the optimal microcirculation in the tissues of farm animals during the entire ontogenesis[17]. Their condition is of great biological importance for the processes of growth, development, and ensuring maximum disclosure of the productive potential of animals[18,19].

However, despite the undoubted physiological significance of vascular control over the aggregation of blood cells on the life support processes in all species of productive animals on cattle, these studies have not previously been conducted. Their peculiarities are not assessed at the very beginning of ontogenesis - in the neonatal phase, when all the subsequent development of the animal depends on the fluid properties of the blood. To close this gap in the system of physiological knowledge, it was necessary to assess the disaggregation capabilities of the vessels in calves during the neonatal phase. Obtaining knowledge data can not only enrich fundamental science, but will also be useful for practice, because elucidation of the severity of antiaggregatory vascular disorders in newborn calves in certain diseases, assessment of the extent of their dynamics in the application of various approaches to the correction of animal condition, is possible only with knowledge of the standard values of these indicators. In this regard, in the work carried out, the goal is to establish the severity of antiaggregatory effects of blood vessels on the main formed elements of blood in calves during the neonatal phase.

MATERIALS AND METHODS

The study was conducted in strict accordance with the ethical principles established by the European Convention for the Protection of Vertebrate Animals used for experimental and other scientific purposes (adopted in Strasbourg on March 18, 1986 and confirmed in Strasbourg on June 15, 2006).

The study was performed on 32 calves of black-and-white breed, obtained from healthy cows after 2-3 pregnancies. Calves were taken in the study for 1-2 days of life. The survey was conducted during the neonatal phase five times - 1-2, 3-4, 5-6, 7-8 and 9-10 days of life.

The expression of lipid peroxidation (POL) in plasma was estimated by the content of thiobarbituric acid-active products by the Agat-Med kit and acyl hydroperoxides[20]. The antioxidant potential of the liquid part of blood was determined by its antioxidant activity[21].

The plasma of the examined animals was determined by the content of endothelin-1 by the radioimmunoassay method using DRG reagents (USA), as well as the levels of thromboxane B2 and 6-keto-prostaglandin F1α by enzyme immunoassay using the Enzo Life science kits (USA). In the blood of the observed calves, the total content of nitric oxide metabolites was detected[22].

The vascular control over the aggregation of blood cells was determined by its weakening in the plasma obtained after temporary venous occlusion, carried out by applying a sphygmomanometer cuff to the limb for 3 minutes and exerting a pressure of 10 mm Hg in it. higher systolic.

The severity of erythrocyte aggregation before and after temporary ischemia of the vessel wall was determined using a light microscope in the Goryaev chamber, recording the number of erythrocyte aggregates, the number of aggregated and non-aggregated erythrocytes. All calves by dividing the sum of all red blood cells in aggregates by the amount of this amount against the background of temporary venous occlusion was calculated vascular control index over the amount of red blood cells in the aggregate, by dividing the number of aggregates without temporary venous occlusion by their number against the background of temporary venous occlusion was determined vascular control index over the number of erythrocyte aggregates and during the division of the number of free erythrocytes against the background of temporary venous occlusion by the number of free erythrocytes b The value of the index of vascular control over the number of free erythrocytes was calculated without it.

Platelet aggregation (AP) was determined using a visual micromethod for assessing AP before and after venous occlusion using ADP ($0.5x10^{-4}$ M), collagen (1: 2 dilution of the main suspension), thrombin (0.125 units/ml), ristomycin (0.8 mg/ml), adrenaline ($5.0x10^{-6}$ M), hydrogen peroxide ($7.3x10^{-3}$ M) and combinations of inductors - ADP and adrenaline, ADP and collagen, adrenaline and collagen in the same concentrations in platelet-rich plasma with standardized platelet count 200x109 platelets. The index of antiaggregatory activity of the vascular wall was detected by dividing the time of AP development after venous occlusion by the time without it.

The limiting influence of the vessels on the neutrophil aggregation process in the plasma obtained after the cuff was applied and without it was evaluated by the ability of these cells to aggregate on a photoelectric colorimeter. Wheat germ lectin at a dose of 32 μg / ml, concanavalin A - 32 μg/ml and phytohemagglutinin - 32 μg/ml were used as inducers. In all calves, the index of inhibition of vascular wall neutrophil aggregation was calculated by dividing the magnitude of neutrophil aggregation in plasma obtained without a cuff by its value in plasma taken with a cuff overlay.

Statistical processing of the results was carried out by t-student criterion.

RESULTS AND DISCUSSION

In the examined calves, low plasma LPO activity was observed, which tended to decrease during the observation period — the content of acyl hydroperoxides in it decreased from 1.53±0.26 D_{233}/1 ml to 1.42±0.31 D_{233}/1 ml, thiobarbituricacid -active products from 3.62±0.12 μmol/l to 3.48±0.24 μmol/l. This was accompanied by a tendency to an increase in the acto-oxidative plasma activity from 32.0±0.42% for 1-2 days to 33.4±0.28% for 9-10 days.

Initially, the optimal concentration of arachidonic acid metabolites in plasma in newborn calves did not experience significant dynamics, remaining stable until the end of observation (thromboxane B_2 at 9-10 days of life was 104.0±0.09 pg/ml, 6-keto-prostaglandin $F_{1\alpha}$ 74.5±0.13 pg/ml. This was accompanied in the observed calves by the constancy of the level of endothelin-1, which by the end of the observation was 3.1±0.05 pg/ml, and the invariance of the total amount of nitrogen oxide metabolites - at the end of the observation 24.7±0.09 μmol/l (table).

Table. Hematological parameters in newborn calves

Registered indicators	Neonatal phase, n=32, M±m				
	1-2 dayoflife	3-4 dayoflife	5-6 dayoflife	7-8 dayoflife	9-10 dayoflife
Thromboxane B2, pg /ml	102.1±0.05	102.9±0.12	103.1±0.10	103.6±0.07	104.0±0.09
6-keto-prostaglandin F1α, pg/ml	72.3±0.10	73.0±0.12	73.4±0.08	73.9±0.07	74.5±0.13
Nitric oxide metabolites, μmol/l	24.1±0.03	24.3±0.07	24.4±0.05	24.6±0.08	24.7±0.09
Endothelin -1, pg / ml	3.2±0.07	3.3±0.05	3.4±0.02	3.2±0.03	3.1±0.05
The sum of all red blood cells in the unit	38.5±0.24	39.2±0.31	39.6±0.39	39.9±0.27	40.3±0.38
The number of erythrocyte aggregates	8.0±0.14	8.0±0.18	8.1±0.09	8.1±0.15	8.2±0.19
The number of free red blood cells	253.1±1.34	251.0±1.63	250.1±1.42	248.9±2.08	247.2±1.85

Platelet aggregation with ADP, s	40.8±0.14	40.6±0.16	40.3±0.10	40.0±0.18	39.8±0.19
Platelet aggregation with collagen, s	31.6±0.19	31.4±0.12	31.3±0.11	31.0±0.09	30.8±0.17
Platelet aggregation with thrombin, s	53.9±0.14	53.6±0.12	53.2±0.19	52.8±0.14	52.6±0.20
Platelet aggregation with ristomycin, s	48.6±0.14	48.5±0.19	48.2±0.21	47.8±0.19	47.5±0.23
Platelet aggregation with adrenaline, s	99.8±0.34	99.3±0.29	98.9±0.37	98.4±0.28	97.9±0.31
Aggregation of neutrophils with lectin,%	14.2±0.12	14.2±0.18	14.3±0.16	14.4±0.23	14.6±0.20
Neutrophil Aggregation with ConcanavalinA, %	13.5±0.13	13.7±0.14	13.9±0.18	14.2±0.09	14.5±0.15
Aggregation of neutrophils with phytohemagglutinin, %	26.2±0.16	26.5±0.18	26.7±0.16	26.9±0.15	27.2±0.22
The index of vascular control over the amount of red blood cells in the unit	1.17±0.007	1.19±0.006	1.21±0.004	1.24±0.009	1.27±0.007
The index of vascular control over the number of erythrocyte aggregates	1.11±0.004	1.12±0.006	1.14±0.008	1.16±0.005	1.17±0.003
The index of vascular control over the number of free red blood cells	1.18±0.012	1.19±0.009	1.20±0.010	1.21±0.006	1.23±0.009
The index of antiaggregatory activity of the vascular wall with ADP	1.59±0.006	1.60±0.005	1.62±0.007	1.64±0.005	1.65±0.004
The index of antiaggregatory activity of the vascular wall with collagen	1.56±0.004	1.58±0.005	1.59±0.007	1.60±0.005	1.62±0.008
The index of antiaggregatory activity of the vascular wall with thrombin	1.50±0.006	1.50±0.004	1.51±0.008	1.52±0.004	1.53±0.006
The index of antiaggregatory activity of the vascular wall with ristomycin	1.49±0.005	1.50±0.006	1.50±0.009	1.51±0.007	1.52±0.004
The index of antiaggregatory activity of the vascular wall with adrenaline	1.62±0.003	1.62±0.006	1.63±0.005	1.64±0.004	1.64±0.008
The index of antiaggregatory activity of the vascular wall with ADP and adrenaline	1.37±0.008	1.38±0.005	1.38±0.007	1.40±0.002	1.40±0.004
The index of antiaggregatory activity of the vascular wall with ADP and collagen	1.29±0.007	1.30±0.004	1.30±0.003	1.31±0.004	1.32±0.006
The index of antiaggregatory activity of the vascular wall with adrenaline and collagen	1.47±0.006	1.48±0.005	1.48±0.007	1.49±0.004	1.50±0.003
Index of inhibition of vascular wall aggregation of neutrophils with lectin	1.20±0.006	1.22±0.005	1.23±0.006	1.24±0.008	1.26±0.008
Index of inhibition of vascular wall aggregation of neutrophils with ConcanavalinA	1.22±0.005	1.24±0.007	1.24±0.008	1.25±0.007	1.26±0.004
Index of inhibition of vascular wall aggregation of neutrophils with phytohemagglutinin	1.16±0.005	1.17±0.006	1.18±0.007	1.19±0.004	1.20±0.005

Note: thereliability of the dynamics of the indicators taken is not received.

During the neonatal phase, calves showed a tendency to an increase in spontaneous aggregation of erythrocytes, as judged by the tendency to an increase in the total number of erythrocytes in the aggregate (by 4.7%), an increase in the number of erythrocyte aggregates (by 2.5%) and a slight tendency to a decrease in the number of free lying red blood cells (by 2.4%) (table).

Against the background of temporary venous occlusion in calves during the neonatal period, the total number of erythrocytes in the aggregates for the first 10 days of life decreased by 3.1%, the number of these aggregates decreased by 2.8%, which was accompanied by an increase in the number of free erythrocytes by 1.7%, ensuring tendency to increase an index of vascular control over the amount of erythrocytes in an aggregate, an index of vascular control over the number of erythrocyte aggregates and an index of vascular control over the number of free erythrocytes (table).

In all calves during the neonatal period, there was a tendency towards increased platelet

aggregation (see table). In the sample with temporary venous occlusion, their aggregation tended to slow AP. This indicated a tendency toward a gradual enhancement in the observed calves of the control of the vessel wall over platelet aggregation. This was confirmed by their tendency to increase the values of vascular wall antiaggregation index that reached calves by 9-10 days of life: for adrenaline 1.64±0.008, for ADP 1.65±0.004, for collagen 1.62±0.008, for thrombin 1.53±0.006, for ristomycin 1.52±0.004. With the combined use of inductors, the index values of the antiaggregatory activity of the vascular wall also tended to increase (table).

During the neonatal period, calves showed a tendency towards increased neutrophil aggregation (table). In the sample with temporary venous occlusion, their aggregation tended to weaken with respect to all inductors tested, which led to a tendency for index of inhibition of vascular wall neutrophil aggregation values to increase by 5.0% for lectin, by 3.3% for concanavalin A, and by 3.4% for phytohemagglutinin (table).

Cattle are an important source of milk and meat on the planet[1]. In this regard, a comprehensive study of its physiology is justified in order to help maximize the use of its biological potential in relation to the level of milk production[23], obtaining full-fledged offspring[24] and meat productivity [25]. In modern biological science, an understanding of the great importance of the rheological properties of blood[26,27], largely dependent on the disaggregation effects of blood vessels on blood cells[28], is gradually being formed.

The study was conducted to assess the disaggregation properties of the vascular wall in calves at the very beginning of their postnatal ontogenesis - during the neonatal phase. Stable high plasma antioxidant activity was detected in the examined animals, which ensured effective containment of lipid peroxidation activity in it. The low intensity of free radical processes in plasma found in newborn calves undoubtedly contributed to maintaining their pronounced functional activity of endotheliocytes, including their antiaggregatory potential[29].

During the neonatal period, calves showed a stable synthesis of thromboxane A_2 and endothelin-1 with a high level of production of antiplatelet agents -prostacyclin and NO [30]. This was the basis for maintaining the limiting influence of the vascular wall on the aggregation of blood cells[31,32].

During the whole newborn period, calves showed a tendency to enhance the aggregation activity of erythrocytes, which was effectively restrained by anti-aggregation effects from the vessel walls[33]. Obviously, normal aggregation of erythrocytes in calves in vivo is largely ensured by the high disaggregating ability of the vascular wall while at the same time the optimal electronegativity of the erythrocyte surface due to the large amount of negatively charged proteins on it[34]. Effective control over the generation of reactive oxygen species minimizes the oxidative damage of these membrane proteins and those contained in the optimal amount of plasma proteins[35], which are able to bind erythrocytes among themselves in already formed aggregates[36]. A high degree of control of the vascular wall over the aggregation of erythrocytes is based on increased production of prostacyclin and NO in newborn calves[37]. Connecting on the surface of red blood cells with their own receptors, they maintain the optimum activity of adenylatecyclase and phosphodiesterase, providing a physiological ratio in their cytoplasm of the amount of cyclic adenosine monophosphate and Ca^{2+}.

The revealed tendency to an increase in the index of antiaggregatory activity of the vascular wall in calves during the first 10 days of life was probably the result of a simultaneous tendency towards increased production of disaggregants in the vascular walls and a tendency to increase the sensitivity of the platelets themselves. Low AP in newborn calves in response to ristomycin was undoubtedly due to the physiologically minimal production of von Willebrand factor in the vascular endothelium[38]. The rather high duration of antibodies with combinations of inductors before and after venous occlusion indicated the optimality of vascular platelet interactions in vivo in the observed animals[39], which created conditions for them to minimize

the number of platelet aggregates in their blood[40].

The revealed low aggregation of neutrophils in the observed calves was undoubtedly due to the large antiaggregation capabilities of the vessels and the optimum composition of the glycoprotein receptors of neutrophilic leukocytes and their sensitivity to lectins, used in the study as inducers. The weak tendency to growth of lectin and concanavalin A-induced neutrophil aggregation in newborn calves was generally based on a tendency to enhance the expression of adhesion receptors with a tendency to increase in their composition the sections containing N-acetyl-D-glucosamine, N-acetyl-neuraminic acid and mannose [4]. The tendency to growth induced by phytohemagglutinin aggregation of neutrophils was provided with a tendency to increase in their receptors of glycoprotein regions containing bD-galactose. The observed slight tendency to enhance neutrophil aggregation was fully functionally balanced in the observed calves by a tendency to an increase in the values of the inhibition index of the vascular wall of neutrophil aggregation with all inducers. This should be associated with effective inhibition of neutrophil aggregation in vivo due to the high production of prostacyclin and NO in the vessels of newborn calves.

CONCLUSION

In newborn calves in physiological conditions, there is a slight tendency to increase the aggregation of the main blood cells. This is completely balanced by their tendency to increase the disaggregation capacity of the vascular wall in relation to erythrocytes, platelets and neutrophils.

REFERENCES

1. Smolin SG. Physiology and ethology of animals. St. Petersburg: Publishing House "Lan", 2016 : 628.
2. Kulig H, Żukowski K, Kowalewska-Łuczak I, Łakomy P. Scd1Polymorphism and Breeding Value for Milk Production Traits in Cows. Bulgarian Journal of Agricultural Science. 2016;22 : 131-134.
3. ZavalishinaSYu. Functional Activity Of Primary Hemostasis In Calves During The First Year Of Life. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) : 1575-1581.
4. Sushkevich GN. 2010. Abnormal hemostasis system and the principles of their correction. Krasnodar: Sovetskaya Kuban,2010 : 240.
5. Zavalishina SY, Vatnikov YA, Kulikov EV, Kubatbekov TS, Vilkovysky IF, Petrov AK, Tishchenko AL, Drukovsky SG, Zharov AN, Grishin VN, Glagoleva TI. Effect of a combination of arterial hypertension and insulin resistance on hemostasis activity. Bali Medical Journal. 2019; 8(1): 211-215. DOI:10.15562/bmj.v8i1.1151
6. ZavalishinaSYu.Dynamics Of The Functional State Of Platelet Functions In Newborn Calves Receiving Correction For Dyspepsia. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) : 1566-1572.
7. GunayAytekin, UlgenGunay, AbdülkadirOrman. Effects of retained placenta on the fertility in treated dairy cows. Bulgarian Journal of Agricultural Science. 2011; 17: 126-131.
8. ZavalishinaSYu. Physiological Features Of Primary Hemostasis In Newborns Calves With
   Functional Digestive Disorders. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6): 1514-1520.
9. Krasnova EG. Physiological characteristics of platelet hemostasis piglets power plant. Veterinary. 2013;2 : 46-49.
10. Burnier L, Fontana P, Kwak BR, A. Angelillo-Scherrer. Cell-derived microparticles in haemostasis and vascular medicine. Thromb. Haemost. 2009;101 :439-451.
11. ZavalishinaSYu. Functional Features Of Primary Hemostasis In Newborns Calves With
    Functional Disorders Of The Digestive System. Research Journal of

Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6): 1630-1636.
12. Bikbulatova AA.Creating Psychological Comfort In Women Who Wear Corrective Clothing For A Long Time. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) : 1112-1121.
13. Bikbulatova AA.Functional Features Of Microcirculatory Processes In Obese Women Against A Background Of Long Daily Wearing Of Corrective Clothing. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) : 785-793.
14. White GC, Rompietti R. Platelet secretion: indiscriminately spewed forth or highly orchestrated? J.Thromb. Haemost. 2007; 5 : 2009-2016.
15. Vorobyeva NV, Mal GS, ZavalishinaSYu, Glagoleva TI, Fayzullina II.Influence Of Physical Exercise On The Activity Of Brain Processes. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) : 240-244.
16. ZavalishinaSYu. Functional Features Of Hemostasis In Calves Of Dairy And Vegetable
Nutrition. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6): 1544-1550.
17. ZavalishinaSYu. Functional Activity Of Vascular Hemostasis In Newborn Calves With Iron Deficiency. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) : 1490-1496.
18. Yousefi M, Hoseini S.M., VatnikovYu.A.,Nikishov A.A., Kulikov E.V.Thymol as a new anesthetic in common carp (Cyprinuscarpio): Efficacy and physiological effects in comparison with eugenol. Aquaculture. 2018; 495 :376-383.
19. ZavalishinaSYu. Elimination of platelet dysfunctions in newborn calves with functional
digestive disorders. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6): 1650-1656.
20. Gavrilov VB, Mishkorudnaya MI. Spectrophotometric determination of lipid hydroperoxides in plasma. Laboratory work. 1983; 3 : 33-36.
21. Volchegorskiy IA, Dolgushin II, Kolesnikov OL. Experimental modeling and laboratory evaluation of adaptive reactions of the organism. Chelyabinsk, 2000 : 167.
22. Metel'skaja VA, Gumanova NG. Nitric pxide: role in the regulation of biological functions, methods of determining human blood. Laboratornajamedicina. 2005;7:19-24.
23. CsillaTóthová, Oskar Nagy, Gabriel Kováč, VeronikaNagyová. Changes in the concentrations of serum proteins in calves during the first month of life. Journal of Applied Animal Research. 2016;44(1) : 338-346.
24. Usha BV, Zavalishina SY, Vatnikov YA, Kulikov EV, Kuznetsov VI, Sturov NV, Kochneva MV, Poddubsky AA, Petryaeva AV, Glagoleva TI. Diagnostics of early dysfunctions of anticoagulant and fbrinolytic features of rats' vessels in the course of metabolic syndrome formation with the help of fructose model. Bali Medical Journal. 2019; 8(1) : 201-205. DOI:10.15562/bmj.v8i1.923
25. ZavalishinaSYu. Prevention Of Violations Of The Functional Status Of Platelet Hemostasis In Newborn Calves With Functional Disorders Of The Digestive System. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) : 1672-1678.
26. Shitikova AS. Thrombocytopathy congenital and acquired. St. Petersburg, 2008 : 320.
27. ZavalishinaSYu. The Functional State Of Vascular Hemostasis In Calves During The Neonatal Phase. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) :1507-1512.
28. ZavalishinaSYu. Physiology OfAntiaggregatory Manifestations Of The Vascular Wall In Newborn Calves With Iron Deficiency,

Receiving Metabolic Significant Effects. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) : 1530-1536.
29. Lenchenko E, Lozovoy D, Strizhakov A, Vatnikov Y, Byakhova V, Kulikov E, Sturov N, Kuznetsov V, Avdotin V, Grishin V. Features of formation of Yersinia enterocolitica biofilms, Veterinary World. 2019; 12(1): 136-140.
30. Suleymanov SM, Usha BV, Vatnikov YA, Sotnikova ED, Kulikov EV, Parshina VI, Bolshakova MV, Lyshko MU, Romanova EV. Structural uterine changes in postpartum endometritis in cows. Veterinary World. 2018; 11(10): 1473-1478.
31. YousefiM, VatnikovYA, KulikovEV, GhelichpourM. Change in blood stressand antioxidant markers and hydromineral balance of common carp (Cyprinuscarpio)anaesthetized with citronellal and linalool: comparison with eugenol. Aquac. Res. 2019. https://doi.org/10.1111/are.14007.
32. ZavalishinaSYu. Functional Features Of Vascular Hemostasis In Calves Of Dairy Nutrition. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) : 1754-1759.
33. Yousefi M, Hoseini SM, VatnikovYuA, Kulikov EV, Drukovsky SG. Rosemary leaf powder improved growth performance, immune andantioxidant parameters, and crowding stress responses in common carp(Cyprinuscarpio) fingerlings, Aquaculture. 2019;505 : 473-480 https://doi.org/10.1016/j.aquaculture.2019.02.070
34. ZavalishinaSYu. The Dynamics Of The Physiological Properties Of Hemostasis In Newborn Calves With Functional Disorders Of The Digestion Against The Background Of Their Consumption Of Needles Extract. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) : 1726-1731.
35. ZavalishinaSYu. Physiological Properties Of Platelets In Newborn Calves With Functional
Disorders Of The Digestive System, Treated With The Sorbent "Ecos". Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6): 1697-1702.
36. Yavuz E, Todorov N, Ganchev G, Nedelkov K. The effect of feeding different milk programs on dairy calf growth, health and development. Bulgarian Journal of Agricultural Science. 2015; 21: 384-393.
37. ZavalishinaSYu.Physiological Control Of The Vascular Wall Over Platelet-Induced Aggregation In Newborn Calves With Iron Deficiency. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) : 1601-1606.
38. ZavalishinaSYu.The Functional State Of Primary Hemostasis In Newborns Calves With
Dyspepsia. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2018; 9(6) : 1543-1549.
39. Korepanova LV, Starostina OS, Batanov SD. Blood as an indicator of the interior characteristics of crossbred animals. Zootechny. 2015; 10 : 26-28.
40. Sizov AA, Shahbazov RF. Penal protection of medical staff on the territory of the Russian Federation. Bali Medical Journal. 2017; 6(1): 211-215.