

The Reaction of Hematological Parameters of Calves to Transferred Dyspepsia

Tatiana Valentinovna Novikova*, Marina Veniaminovna Mekhanikova, Valentin Alekseevich Bilkov

Received: 18 Feb 2023 / Received in revised form: 10 May 2023, Accepted: 16 May 2023, Published online: 15 June 2023

Abstract

The development of dairy farming requires not only the availability of modern methods of treating young animals but also tracking its long-term results. Until now, calves can often have dyspepsia, which can significantly weaken the animal, sometimes leading to its death. Applicable approaches for its treatment quite effectively eliminate the main symptoms of dyspepsia, however, the state of hematological and hemostasiological parameters that are very significant in terms of prognosis in recovered calves remain unassessed. The purpose of the work: is to determine the state of activity of the main characteristics of hemostasis in calves with dyspepsia. 35-month-old Black-and-White calves cured of dyspepsia after standard treatment were examined. The control group included 28 one-month-old Black-and-White calves that had no health problems. In calves who recovered from dyspepsia, high hemostatic capabilities of platelets were noted, occurring spontaneously and in response to an inductor. These calves also had activation of blood coagulation with a weakening of the biological capabilities of fibrinolysis. It can be assumed that calves cured of dyspepsia have disorders in the hemostasis system that can impair hemocirculation and inhibit their development. This study shows that treatment options for dyspepsia need to be evaluated for their effect on platelet activity and plasma hemostasis for subsequent widespread use of treatment options that positively affect them.

Keywords: Calves, Dyspepsia, Blood, Hemocoagulation, Platelets

Introduction

Animal husbandry of modern mankind is a fairly significant branch of agriculture, supplying food for most of the world's

population. There is a need to continue increasing the volume of livestock products, which can only be done by putting into practice all scientific information (Oshurkova & Glagoleva, 2017). It is very relevant to consider the state of vital systems in calves that have recovered from the most common diseases in them (Glagoleva & Medvedev, 2020). The collection of information on the characteristics of calves after their cure can help improve the current veterinary and zootechnical measures for cattle to more fully preserve their dictated qualities and eliminate the risk of a new pathology in young animals (Zavalishina, 2018a; Shkromada *et al.*, 2022). In the case of a detailed collection of versatile information about calves, it will be possible to supplement the scientific base on the features of their hematological parameters after the main variants of diseases, which will also allow monitoring in relation to the completeness of the elimination of pathology (Zavalishina, 2020d).

A very important problem of modern animal husbandry is disorders in the digestive system, which prevent the maximum safety of calves and their complete recovery after any type of pathology (Lashkova *et al.*, 2022). Researchers see a huge role in solving this problem in the monitoring of hematological parameters, which are very important for ensuring the viability and productivity of animals. Despite some of their ability, they are a reliable marker of the functional status of an organism, reflecting the degree of its response to any external influences (Zavalishina, 2018f). It has long been noted that hematological parameters very early and sensitively react to changes in metabolism in tissues (Kutafina, 2017). At the same time, hematological indicators themselves can be regulators of many vital manifestations of the body (Tkacheva & Medvedev, 2020a) and contribute to their strengthening or weakening (Zavalishina, 2018c).

No objection to maintaining homeostasis in cattle requires optimal perfusion of internal organs, which is significantly affected by the state of the hemostasis system (Krasnova & Kutafina, 2015). It is recognized that the level of cell viability in different tissues is closely related to the processes occurring in the blood, including those associated with the implementation of hemostasis (Vorobyeva & Medvedev, 2020a). The importance of the hemostatic properties of blood is associated with their regulatory effect on the degree of blood supply to tissues, their manifestations of viability, and, ultimately, the realization of the productive potential in the animal (Solovyova *et al.*, 2020). Given the great importance of the hemostasis system for the whole

Tatiana Valentinovna Novikova*

Department of Epizootiology and Microbiology, Vologda state dairy farming academy named after N.V. Vereshchagin, 160555, Vologda, Russia.

Marina Veniaminovna Mekhanikova, Valentin Alekseevich Bilkov

Department of Zootechnics and Biology, Vologda state dairy farming academy named after N.V. Vereshchagin, 160555, Vologda, Russia.

*E-mail: parazitology@yandex.ru



organism, it is studied from different positions in different states of the body (Zavalishina, 2018e; Vorobyeva & Medvedev, 2018).

It is known that in various pathological processes, signs of activation of hemostasis mechanisms are often recorded, which worsens the entire hemocirculation in the body (Kutafina, 2015). In calves that have undergone various diseases, possible changes in the work of hemostasis have not yet been clarified. It is too early to consider the main mechanisms for the development of various hemostatic dysfunctions in case of trouble in their body to be clear.

It has been noted that the body of calves can react early and strongly to the dynamics of the state of metabolic processes while changing several manifestations of their vital activity (Zavalishina, 2020c). First of all, this is possible with various diseases that significantly weaken the body even after treatment with the elimination of the main pathological manifestations (Gryshchenko *et al.*, 2016). Thus, the consequences of dyspepsia for hemostasis in calves preparing to start eating plant foods remain unidentified, which was the reason for this study (Efremov, 2023).

The purpose of the study: is to determine the state of the main characteristics of the activity of hemostasis in calves with dyspepsia.

Materials and Methods

There were observed 35 black-and-white calves at the age of one month, black-and-white breeds kept in livestock farms in the Vologda region of Russia. All calves had dyspepsia and

recovered from it 7-10 days before inclusion in the study. They formed a group of survivors. These calves received standard treatment for their dyspepsia, consisting of antibiotics, sulfonamides, sorbents, and vitamins. The control group included 28 completely healthy calves that had not previously been sick and did not experience any negative environmental effects. The diet of all calves observed in the work was standard.

In all calves, the amount of fibrinogen in the blood was determined using the Claus method. The level of fibrin-monomer complexes was assessed using a visual method, using reagents from the Technology-Standard enterprise (Russia). The amount of plasminogen in the blood of animals was recorded using the apparatus FP-901 (LabSystems, Finland) using chromogens (Dade Behring, Germany). The duration of activated partial thromboplastin time was determined using a HumaClot coagulometer (HUMAN GmbH, Germany) using standard HemoStataPTT-EL reagents. We figured out the value of the international normalized ratio. Platelet aggregation activity was assessed on a two-channel laser analyzer of the aggregation process (Biola, Russia). Platelet aggregation was induced with adenosine diphosphate (ADP) at a dose of 0.5 μ M. Mathematical processing of digital results was performed by calculating Student's t-test.

Results and Discussion

The calves that recovered from dyspepsia demonstrated changes in the hemostatic properties of platelets, the mechanism of coagulation, and the course of fibrinolysis (**Table 1**). The levels of some of these parameters in calves that had dyspepsia significantly differed from the level of calves that did not have it.

Table 1. Hemostatic parameter in observed calves

Indicators of the hemostasis system	Recovered group, n=35	Control group, n=28
Plasminogen, %	88.8±0.56	95.2±0.71
Activated partial thromboplastin time, s	29.5±0.75**	38.2±0.84
Fibrinogen, g/l	3.1±0.22**	2.4±0.29
International normalized ratio, units	1.16±0.16*	1.24±0.12
Soluble fibrin-monomer complex, mg/dl	3.2±0.31*	2.7±0.67
Platelet aggregation 0.5 μ M ADP, units	2.34±0.26*	2.05±0.15
Spontaneous platelet aggregation, units	1.16±0.11*	1.02±0.14

Legend: statistical significance of differences in indicators in recovered calves from the control level * - $p < 0.05$, ** - $p < 0.01$.

In the group of recovered calves, a significant reduction in thromboplastin-activated partial time (by 29.5%), a tendency to decrease in blood plasminogen (7.2%), and an international normalized ratio (6.9%), an increase in the amount of fibrinogen (29.5%) and an increase in the level of soluble fibrin monomers (18.1%). At the same time, in those who had been ill, there was an increase in the severity of spontaneous (by 13.7%) and stimulated by the inducer adenosine diphosphate (by 15.1%) platelet aggregation (Efremov, 2023; Huyen *et al.*, 2023; Keliddar *et al.*, 2023; NGUYEN *et al.*, 2023; Truong *et al.*, 2023; Zoubi *et al.*, 2023).

Modern animal husbandry continues to need intensification, which can be achieved by acquiring additional knowledge on the main points of cattle biology. It is especially necessary to clarify the age aspects of the leading parameters in calves in full health, in the case of the development of pathology, as well as in the course of recovery from it (Terela & Strilets, 2023). The study of the main aspects of the vital activity of the systems of these animals is necessary for the improvement of veterinary measures for the improvement of the population of replacement young animals with potentially high productivity, which can be realized under optimal conditions for their existence (Oshurkova & Glagoleva, 2017).

Until now, systematic studies in veterinary medicine have not made it possible to collect a complete picture of the characteristics of the blood of cattle under various conditions. For this reason, there is a great need to study the processes realized in the blood under many conditions of the animal organism, especially at an early age (Vorobyeva & Medvedev, 2020b).

Obviously, during the development of a calf, there is a risk of many deviations in the parameters of his body, changing the intensity of hemocirculation in all tissues. Of great interest in this are the processes occurring at the level of capillaries. Their importance is extremely high due to their provision of metabolic processes and gases necessary for metabolism. This is especially significant for the main number of biological processes in the body that provide the liquid properties of blood. Modern researchers consider this to be very important for maintaining optimum homeostasis in productive animals (Zavalishina, 2018d).

It is recognized that the entire ontogenesis in different animals is associated with the adaptation of their life support mechanisms to different environmental conditions due to the activation of a mass of life support processes with the mandatory participation of hemostasis in this. This activates the course of the main phenomena of vital activity necessary to maintain the health of the animal (Velikanov *et al.*, 2020).

Being hereditarily determined, the values of hematological parameters can fluctuate in close connection with the current state of the body and influences on it from the external environment. For this reason, there is a great urgency to further study the influence of pathological processes and their consequences on a living organism. Performing additional observations on the biology of calves can provide a reliable basis for further development of technologies for their treatment and maintenance. As a result of the use of information found in the process of observation, it is possible to increase the efficiency of animal husbandry (Smolovskaya *et al.*, 2022).

In the course of performing various studies, it was possible to establish on various biological objects that hemostasis indicators react quite early to changes in the state of the body and, first of all, to the appearance of any diseases or even to the beginning of the formation of dysfunction. A very common mechanism of their development is the intensification of lipid peroxidation, which significantly weakens all vital manifestations. It is noted that under these conditions, as a rule, activation of hemostasis parameters occurs, contributing to a significant deterioration in the rheological characteristics of blood (Mal *et al.*, 2018). In many respects, with the development of these disorders, it is customary to associate the weakening of microcirculation and the depression of metabolism in the presence of pathology against the background of a weakening of the antioxidant defense of the body (Tkacheva & Zavalishina, 2018).

Despite the extreme biological significance, the work of hemostasis, its condition in calves cured of various diseases, remains little studied. It is clear that in the presence of pathology in the body, productive animals develop deviations in blood

parameters (Vorobyeva & Medvedev, 2020c), but their stability after the cure of the underlying disease is unknown (Linh, 2023).

In the course of the study, in calves who had recovered from dyspepsia, an increase in the mechanisms of hemostasis was noted. This was manifested in them by a clear increase in hemocoagulation along both pathways of its activation. This is associated with an increase in the activity of coagulation factors in calves. Apparently, in their blood, in this case, excessive formation of thromboplastin occurs with increased contact activation of factor XII. This is ensured by an increase in their level of fibrinogen and the content of soluble fibrin-monomeric complexes in the blood. These changes indicate the acceleration of fibrin self-assembly, which is little inhibited by the mechanisms of fibrinolysis (Zavalishina, 2020b).

Taking into account the known facts about animal hemostasis, we can say that the weakening of metabolic processes and antioxidant protection throughout the body (Solovyova *et al.*, 2020) occurs primarily due to the activation of platelets (Zavalishina, 2018b). This phenomenon is based, among other things, on a decrease in the amount of cyclic adenosine monophosphate in platelets with an increase in the synthesis of thromboxane A₂ (Mal *et al.*, 2018). Under these conditions, the formation of platelet aggregates is activated in the blood (Fomina *et al.*, 2019; Zavalishina, 2020a).

There is reason to suspect the existence of a connection between the physical condition and the level of development of productivity parameters, on the one hand, with hematological features, on the other hand (Kutafina, 2015). In the work performed, a fragment of early ontogenesis and a separate disease were considered, and in this regard, it is not yet possible to judge in general the consequences of the development of diseases in the first half of early ontogenesis in relation to the entire further development of calves in close connection with the dynamics of their hemostatic parameters (Tkacheva & Medvedev, 2020b). At the same time, the data obtained in the work on the state of hemostasis after recovery from the considered disease can be a stimulus for subsequent detailed observations, taking into account the subsequent productivity of calves. The significance of such observations is beyond doubt due to the presence of a clear relationship between the level of hemostasis activity and the productive qualities of cattle (Oshurkova & Glagoleva, 2017).

Conclusion

Modern animal husbandry continues to need the accumulation of various knowledge for its further intensification. It is necessary to continue to find out the levels of the leading parameters of the body of calves during early ontogenesis in conditions of pathology and after the elimination of its main manifestations. It becomes clear that blood and especially its hemostatic parameters are extremely important for ensuring the viability and realization of the productivity of the body of cattle (Efremov *et al.*, 2023; Febriandika *et al.*, 2023; Hoang & Efremov, 2023; Rouholamin *et al.*, 2023). The beginning of ontogenesis in calves may be accompanied by the appearance of various diseases that affect the state of their life support systems. The great significance of the

study is recognized concerning the vital processes that are realized in the blood, which is the liquid medium of the whole organism. Therefore, it is required to elucidate the activity of the mechanisms that determine the liquid characteristics of the blood under any conditions, especially in productive animals. It was found that after the elimination of signs of dyspepsia in calves, excessive activity of hemostasis persists, worsening their microcirculation and tissue trophism. In calves with dyspepsia, hemostatic disorders consisted of activation of plasma hemostasis, weakening of fibrinolysis, and excessive severity of platelet aggregation. Because the changes found can worsen all types of metabolism and can weaken the formation of productively significant qualities in calves. In this regard, in the treatment of dyspepsia in calves, it is necessary to control the parameters of hemostasis and, in the presence of excessive activity, to carry out therapeutic measures after the elimination of the clinical manifestations of the disease to stop the existing laboratory disorders. In addition, in future studies, it is necessary to search for therapeutic approaches that could affect the state of hemostasis.

Acknowledgments: The team of authors thanks the administration of the Vologda state dairy farming academy named after N.V. Vereshchagin for the opportunity to research its basis.

Conflict of interest: None

Financial support: None

Ethics statement: The study was approved by the local ethics committee of the Vologda state dairy farming academy named after N.V. Vereshchagin on September 15, 2010 (protocol №11).

References

- Efremov, A. (2023). Eliminating psychosomatic pain and negative emotions with dehypnosis. *Journal of Organizational Behavior Research*, 8(1), 1-11. doi:10.51847/RNRhuQMtqY
- Febriandika, N. R., Hakimi, F., Ashfahany, A. E., & Yayuli, Y. (2023). What drives muslims' zakat compliance behavior in the profession? Evidence on Indonesia. *Journal of Organizational Behavior Research*, 8(1), 137-157. doi:10.51847/bEOitzaPj
- Fomina, V. D., Arslanian, G. G., Mal, G. S., & Makurina, O. N. (2019). The impact of the motor activity level of newborn calves with dyspepsia on correction efficiency of hypercoagulation state in them with the help of Gamavit. *Bulgarian Journal of Agricultural Science*, 25(1), 176-181.
- Glagoleva, T. I., & Medvedev, I. N. (2020). Physiological features of aggregation of the main formed elements of blood in calves at the beginning of early ontogenesis. *BIO Web Conf. International Scientific-Practical Conference "Agriculture and Food Security: Technology, Innovation, Markets, Human Resources"* (FIES 2019), 17, 00161. Published online: 28 February 2020. doi:10.1051/bioconf/20201700161
- Gryshchenko, V. A., Chernyshenko, T. M., Gornitska, O. V., & Platonova, T. M. (2016). Evaluation of the functional state of the liver and the efficiency of therapy for enteropathy of calves. *Fiziologichnyi zhurnal*, 62(6), 102-109.
- Hoang, H. T. T., Vu, T. T. M., & Nguyen, D. T. (2023). Debt and firm value, the new approach of hierarchical method. *Journal of Organizational Behavior Research*, 8(1), 158-172. doi:10.51847/ZMCT8rFVcP
- Huyen, N. T., Nghi, P. H., Phuong, D. T. L., Trang, T. T. T., & Huyen, L. T. (2023). Public debt and prosperity nexus in Asian countries: nonlinearity and threshold analysis. *Journal of Organizational Behavior Research*, 8(1), 74-91. doi:10.51847/tw5g65dco8
- Keliddar, I., Dastoorpoor, M., Alaei, R., & Vahidnezhad, F. (2023). The relationship between leadership style and organizational health in educational hospitals. *Journal of Organizational Behavior Research*, 8(1), 92-104. doi:10.51847/HpAKksLryg
- Krasnova, E. G., & Kutafina, N. V. (2015). Basics platelet function. *Veterinary, Animals and Biotechnology*, 8, 6-18.
- Kutafina, N. V. (2015). Platelet mechanisms on the background of the growth process in cattle. *Veterinary, Animals and Biotechnology*, 8, 37-42.
- Kutafina, N. V. (2017). Platelet Parameters of Holstein Newborn Calves. *Annual Research & Review in Biology*, 15(2), 1-8. doi:0.9734/ARRB/2017/35214
- Lashkova, T. B., Petrova, G. V., & Zhukova, M. Yu. (2022). Effectiveness of various treatment regimens for calves with dyspepsia in Novgorod region. *IOP Conference Series: Earth and Environmental Science*, 613(1), 012069.
- Linh, D. T. (2023). The effect of political connection on the performance of small and medium enterprises. *Journal of Organizational Behavior Research*, 8(1), 121-136. doi:10.51847/bBjfnfCHlp
- Mal, G. S., Kharitonov, E. L., Vorobyeva, N. V., Makhova, A. V., & Medvedev, I. N. (2018). Functional aspects of body resistance. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 60-65.
- Nguyen, V. T., Tran, D. T. L., Dang, T. T. N., Nguyen, T. K. P., & Ngo, T. X. B. (2023). The impact of logistics services on customer satisfaction: an empirical study in the COVID 19 pandemic. *Journal of Organizational Behavior Research*, 8(1), 12-24. doi:10.51847/MIoTW6LdxZ
- Oshurkova, Yu. L., & Glagoleva, T. I. (2017). Biological aspects of livestock intensification. *Russian Agricultural Sciences*, 5, 51-53.
- Rouholamin, A., Faromidi, S., Choopani, F., & Akbari, Y. (2023). Investigating the relationship between customer relationship management information systems and the performance of private banks. *Journal of Organizational Behavior Research*, 8(1), 186-196. doi:10.51847/tpd3Xztdxn
- Shkromada, O., Fotina, T., Berezovskyi, A., Dudchenko, Y., & Fotin, O. (2022). Determination of the Therapeutic Effect of the Use of Bacillus Coagulans in Calf Dyspepsia. *Scientific Horizons*, 25(6), 9-20.
- Smolovskaya, O. V., Zubova, T. V., & Korobeinikova, L. N. (2022). Experience of Fir Tree Extract Application for

- Prevention of Gastrointestinal Tract Diseases in Newborn Calves (Prevention of Calf Dispepsy). *Annals of Agri Bioresearch*, 27(1), 126-130.
- Solovyova, L. P., Kalysh, T. V., Voevodina, Yu. A., & Zamuravkin, V. I. (2020). Restoring the functional state of the hemostasis system in piglets experiencing an episode of transportation. *BIO Web Conf.*, 17, 00164. doi:10.1051/bioconf/20201700164
- Terela, H., & Strilets, V. (2023). Supervision and control over compliance with labor law in Ukraine during the martial law. *Journal of Organizational Behavior Research*, 8(1), 39-51. doi:10.51847/mEsB03yCM9
- Tkacheva, E. S., & Medvedev I. N. (2020a). The severity of the disaggregation function of blood vessels in piglets of plant nutrition. *Bioscience Biotechnology Research Communications*, 13(3), 1174-1178.
- Tkacheva, E. S., & Medvedev, I. N. (2020b). Functional features of vascular hemostasis in piglets of milk and vegetable nutrition. *IOP Conference Series: Earth and Environmental Science*, 421(2), 022041. doi:10.1088/1755-1315/421/2/022041
- Tkacheva, E. S., & Zavalishina, S. Yu. (2018). Physiology of platelet hemostasis in piglets during the phase of newborns. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(5), 1912-1918.
- Truong, T. H. L., Le, T. N. Q., Le, T. T., & Phan, H. M. (2023). Fintech driven financial inclusion: the case of vietnamese households. *Journal of Organizational Behavior Research*, 8(1), 52-73. doi:10.51847/G6YEGAGRQK
- Velikanov, V. I., Klyapnev, A. V., Terentev, S. S., Gorina, A. V., Kharitonov, L. V., Elizarova, E. A., Denisova, D. V., & Sletov, A. O. (2020). Economic efficiency of Sinoestrol-2% used for down-calving cows to stimulate non-specific resistance in newborn calves. *IOP Conference Series: Earth and Environmental Science*, 433(1), 012002.
- Vorobyeva, N. V., & Medvedev, I. N. (2018). Physiological features of platelet functioning in calves of holstein breed during the newborn. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 129-135.
- Vorobyeva, N. V., & Medvedev, I. N. (2020a). Functional platelet activity in Dutch newborn calves. *IOP Conference Series: Earth and Environmental Science*, 421(2), 022042. doi:10.1088/1755-1315/421/2/022042
- Vorobyeva, N. V., & Medvedev, I. N. (2020c). Functional Platelet Activity in Dutch Newborn Calves. *Bioscience Biotechnology Research Communications*, 13(1), 201-205. doi:10.21786/bbrc/13.1/35
- Vorobyeva, N. V., & Medvedev, I. N. (2020b). Platelet function activity in black-motley calves during the dairy phase. *BIO Web Conf.* International Scientific-Practical Conference "Agriculture and Food Security: Technology, Innovation, Markets, Human Resources" (FIES 2019), 17, 00167. Published online: 28 February 2020. doi:10.1051/bioconf/20201700167
- Zavalishina, S. Yu. (2018a). Functional activity of vascular hemostasis in newborn calves with iron deficiency. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, 9(6), 1490-1496.
- Zavalishina, S. Yu. (2018b). Physiological features of primary hemostasis in newborns calves with functional digestive disorders. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 1514-1520.
- Zavalishina, S. Yu. (2018c). Physiology of antiaggregatory manifestations of the vascular wall in newborn calves with iron deficiency, receiving metabolic significant effects. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 1530-1536.
- Zavalishina, S. Yu. (2018d). The functional state of primary hemostasis in newborns calves with dyspepsia. *Research Journal of Pharmaceutical, Biological, and Chemical Sciences*, 9(6), 1543-1549.
- Zavalishina, S. Yu. (2018e). Elimination of platelet dysfunctions in newborn calves with functional digestive disorders. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, 9(6), 1650-1656.
- Zavalishina, S. Yu. (2018f). 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*, 9(6), 1672-1678.
- Zavalishina, S. Yu. (2020b). Functional Features of Hemostasis in Weakened Newborn Calves Treated with Aminosol. *Bioscience Biotechnology Research Communications*, 13(3), 1251-1256. doi:10.21786/bbrc/13.3/41
- Zavalishina, S. Yu. (2020c). Functional properties of platelets in piglets when changing methods of nutrition. *BIO Web Conf.* International Scientific-Practical Conference "Agriculture and Food Security: Technology, Innovation, Markets, Human Resources" (FIES 2019), 17, 00171. Published online: 28 February 2020. doi:10.1051/bioconf/20201700171
- Zavalishina, S. Yu. (2020d). Functional condition of the hemostasis in newborn calves with signs of iron deficiency, background to ferroglucin. *BIO Web Conf.* International Scientific-Practical Conference "Agriculture and Food Security: Technology, Innovation, Markets, Human Resources" (FIES 2019), 17, 00172. Published online: 28 February 2020. doi:10.1051/bioconf/20201700172
- Zavalishina, S.Y. (2020a). Physiological characteristics of cattle of different ages. *IOP Conference Series: Earth and Environmental Science. Biological Technologies in Agriculture: from Molecules to Ecosystems*, 548(4), 042066. <https://iopscience.iop.org/article/10.1088/1755-1315/548/4/042066>
- Zoubi, M. K., Jaradat, H. A., Alqamaz, S., Lababneh, H., Kassawneh, F. Y., & Issa, M. M. (2023). The impact of the covid-19 pandemic on interior design students' performance in Jordanian universities. *Journal of Organizational Behavior Research*, 8(1), 25-38. doi:10.51847/ZDkJP32geh