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# Physiological features of platelet aggregation in calves of Ayrshire breed during the phase of plant nutrition.

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**ABSTRACT**

A great practical importance for biology is the evaluation of blood indices and, especially, of hemostasis elements in highly productive animals. It becomes very relevant to work out the age-specific rates of haemostatic indicators for early detection of the onset of onset of hemostasiopathy for various dysfunctions. Particular attention is paid in this respect to platelet hemostasis in highly productive breeds of cattle, including the Ayrshire breed. Objective: to find out the features of platelet activity in calves of Ayrshire breed of plant nutrition. The work was carried out on 42 fully healthy calves of the Ayrshire plant food in the "MałskyPlemzavod" farm in the Vologda region of Russia. Animals were examined 4 times: at 3 months of age, at 6 months of age, at 9 months of age, and at 12 months of age. Biochemical, hematological and statistical methods of investigation has been applied. It was found that during the phase of plant nutrition in the calves of the Ayrshire breed, the adhesive-aggregation activity of their platelets gradually increases, balanced by a change in their ability to disaggregate. It becomes clear that the revealed changes are physiologically significant for the whole hemostasis for the growth of animals of this breed. Low activity of platelets provides the animals with this breed during growth and development the optimal conditions for blood supply to their growing and ripening organs.

**Keywords:** platelets, aggregation, calves, vegetable nutrition, Ayrshire breed.

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## INTRODUCTION

Platelet hemostasis is a very physiologically significant system [1, 2]. From its activity depends the level of functional capabilities of all hemostasis, the processes of microcirculation and metabolism [3, 4, and 5]? It is noted that the environmental factors and the functional state of the organism affect the activity of thrombocytes [6, 7]. This was noted in studies in humans [8] and in laboratory animals in the experiment [9, 10]. The activity of platelets was earlier estimated in productive animals, but without taking into account their genetic features [11]. In particular, studies performed on cattle have shown the possibility of age-related changes in platelet aggregation ability [12]. However, these studies were conducted more often on mixed groups consisting of animals of different breeds [13], which greatly complicate the interpretation of the results.

A great practical importance for biology is the evaluation of blood indices and especially of hemostasis elements in highly productive animals [14, 15]. Earlier, they showed a close relationship with the severity of the somatic and productive characteristics of animals [16] and the intensity of functioning of their organs [17]. It becomes very important to develop age-specific rates of haemostatic indicators [18, 19] for early detection of the onset of onset of hemostasiopathy in various dysfunctions [20]. Particularly great attention in this regard deserves highly productive breeds of cattle, including the Ayrshire breed. Given the high productivity of this breed and the importance for the physiological status of cows and the level of their productivity of platelet activity, it was decided to evaluate the ability of platelets to aggregate in calves of Ayrshire breed of plant nutrition, which are future herd repair flocks. Objective: to find out the features of platelet activity in calves of Ayrshire breed of plant nutrition.

## 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 18 March, 1986, and confirmed in Strasbourg on 15 June, 2006).

The work was carried out on 42 fully healthy calves of the Ayrshire plant food in the "MałskyPlemzavod" farm in the Vologda region of Russia. Animals were examined 4 times: at 3 months of age, at 6 months of age, at 9 months of age, and at 12 months of age.

Blood samples were collected from jugular vein of all the heifers in the morning for studying platelet parameters. Sampling was made into a plastic tube containing 3.8% citrate of sodium dilution in the ratio of blood volumes and citrate of sodium –9:1.

The number of platelets in animals' blood was determined by electron- automatic method on hematological analyzer BC-3000 PLUS (the firm "Shenzhen Mindray Bio-Medical Electronics Co., Ltd.", China).

Platelets' aggregative activity was determined by quantitative method with application of photo-electro-colorimeter KFK-2 (Russia) with such aggregation inductors as ADP, collagen and ristomicin in standard concentrations. Platelets' aggregation was estimated according to the values of summarizing index for platelets' aggregation (SIPA), speed of aggregation (SA) and index of platelets' disaggregation (IPD).

The received deata were processed by Student's t-criterion in the program Stat Soft STATISTICA for Windows 6.0.

## RESULTS OF THE RESEARCH

The total platelet counts in the examined animals (platelet count, mean platelet count and thrombocrit) were within the normal range, did not change during the observation (Table).

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**Table 1: Thrombolytic characteristics of Ayrshire breed calves during the phase of plant nutrition**

| Indicators | Age of calves, n=42, M±m | | | |
|---|---|---|---|---|
| | 3months | 6 months | 9 months | 12 months |
| total platelet counts | | | | |
| Quantity of platelets, thousand/mcl | 311.0±10.19 | 320.3±6.88 | 324.2±4.20 | 340.7±3.17 |
| Average platelet count, fl | 7.2±0.36 | 7.2±0.19 | 7.3±0.24 | 7.3±0.33 |
| Thrombote, % | 0.27±0.09 | 0.27±0.11 | 0.27±0.16 | 0.27±0.11 |
| aggregation of platelets with ADP | | | | |
| SIPA, % | 17.2±0.26 | 20.0±0.38* | 21.5±0.24* | 22.4±0.16** |
| SA, min | 0.026±0.0009 | 0.028±0.0008* | 0.030±0.0005* | 0.031±0.0007** |
| IPD, % | 10.2±0.21 | 10.3±0.15 | 11.0±0.19 | 12.2±0.12* |
| aggregation of platelets with collagen | | | | |
| SIPA, % | 7.0±0.32 | 7.4±0.27* | 8.0±0.14** | 8.1±0.21** |
| SA, min | 0.061±0.0003 | 0.065±0.0004 | 0.070±0.0005* | 0.070±0.0007* |
| IPD, % | 2.5±0.19 | 2.5±0.20 | 2.6±0.25 | 2.7±0.24* |
| aggregation of platelets with ristomicin | | | | |
| SIPA, % | 7.7±0.23 | 8.0±0.40 | 8.1±0.36* | 8.3±0.27* |
| SA, min | 0.067±0.0004 | 0.069±0.0005 | 0.072±0.0006* | 0.075±0.0006* |
| IPD, % | 2.0±0.09 | 2.2±0.10 | 2.3±0.14* | 2.3±0.09* |

Note: the reliability of the dynamics of the recorded parameters as compared to the 3-month age (* - $p < 0.05$, ** - $p < 0.01$).

During the study, platelet aggregation activity in observed calves showed significant changes (Table). The largest response of platelets was noted in ADP. At the same time, SIPA with ADP over the course of plant nutrition tended to grow, reaching 22.4 ± 0.16% at its end. In response to collagen, SIPA in animals during plant nutrition also gradually increased to 8.1 ± 0.21%. This indicated a tendency to increase platelet sensitivity to aggregation inducers during observation in the observed Ayrshire breed calves during intensification of the secretory process from platelets during platelet activation. The activity of platelet aggregation under the influence of ristomycin in the calves of the Ayrshire breed during the phase of plant nutrition tended to increase - SIPA at its beginning was 7.7 ± 0.23%, reaching 8.3 ± 0.27% at its end.

The rate of aggregate formation in the Ayrshire breed calves in response to ADP increased during the phase of plant nutrition from 0.026 ± 0.0009 min to 0.031 ± 0.0007 min. to its end. Similar dynamics was tested by SA under the action of collagen and ristomycin, which in the calves at the end of the observation was 0.070±0.0007 min and 0.075±0.0006 min, respectively.

Evaluation of the platelet disaggregation index, which characterizes the stability of the emerging aggregates, made it possible to determine that the aggregates formed in response to ristomycin are the most stable. The magnitude of the IPD with respect to this inductor increased slightly during the observation, reaching 2.3 ± 0.09%. Aggregates formed under the influence of ADP and collagen during plant nutrition was less stable: the IPD for both inducers gradually increased, reaching 2.7 ± 0.24% with collagen and 12.2 ± 0.12% with ADP.

## DISCUSSION

Previous studies on various aspects of hematology make it possible to consider this system as particularly significant in providing the physiological optimum of the whole organism [21, 22]. It is noted that under different conditions, blood can strongly determine the overall functional status of the organism [23, 24,

and 25]. Its rheological properties [26], hemostasis as a whole [27, 28], including platelet activity [29] play a large role in this.

Previous studies have significantly expanded the understanding of various aspects of hemostasis in different living organisms. This process was studied in many states in humans and animals [3, 12]. At the same time, a large number of aspects of its platelet component in cattle of different breeds and different ages remain very poorly investigated [30]. The pedigree features of platelet activity in the calves of the Ayrshire breed have not been clarified, incl. During a potentially productive-significant period in the phase of plant nutrition.

It is known that during the phase of plant nutrition in the calves, anabolic processes are actively going on, realizing the preparation of their organism for the realization of their productivity [31]. To ensure this process, their tissues at this age are in great need of a maximum influx of blood to them and its good fluid properties [11].

The carried out research on the calves of the Ayrshire breed allowed establishing that the number of platelets and their average volume in plant nutrition do not exceed the limits of the generally accepted normative values. The aggregation activity of their platelets gradually increased during the course of observation. The most active platelets they reacted to the action of ADP. This was manifested by the growth of SIPA with increasing age in relation to this inductor. In response to collagen and ristomycin, SIPA in these calves reached a lower value. This indirectly indicated a low level of expression on platelets of receptors for collagen and will brand factor with a low content of von Will brand factor in their blood during the phase of plant nutrition [32]. In addition, the increase in the rate of platelet aggregation in the observed animals during the phase of plant nutrition also confirmed an increase in the density of these receptors on the platelet membranes [33].

An increase in the severity of the disaggregation capacity of the calf platelets during the phase of plant nutrition indicated an increase in the number of receptors to the disaggregates. This can also be explained by the dynamics of platelet activation mechanisms (the thromboxane synthesis system, the phosphatidic acid system and the synthesis of the platelet activating factor) [34].

Estimating the data obtained in the calves of the Ayrshire breed, it can be concluded that during the phase of plant nutrition, they gradually increase the adhesive-aggregation activity of their platelets, balanced by a change in their ability to disaggregate. It becomes clear that the revealed changes are physiologically significant for all hemostasis for animals of this breed at this age.

## CONCLUSION

In the course of the study, the features of platelet hemostasis in the Ayrshire breed calves in the phase of plant nutrition were revealed. Low activity of platelets provides the animals with this breed during growth and development the optimal conditions for blood supply to their growing and ripening organs.

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