ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Physiological Dynamics Of The Blood Coagulation System Activity In Calves During The Phase Of Dairy Nutrition.

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ABSTRACT

The ontogenetic dynamics of the activity of the coagulating system of blood plasma in the phase of milk nutrition in calves is one of the most important physiological elements of providing homeostasis in the postnatal period. The formation of the functional activity of the coagulation system largely ensures the adaptation to the external environment of all body systems, controlling the fluid properties of blood, the expression of its fluidity through the vessels, thereby facilitating the optimal deployment of an individual calf development program, despite all possible negative environmental influences. In the study, it was found that in healthy calves of dairy nutrition there is a regular dynamic of the functional state of plasma hemostasis activity, which provides the optimal rheology of blood necessary for growth and development of the organism. Increasing the activity of blood clotting mechanisms helps the animal to adapt to the phase of dairy nutrition, ensuring its preparation for nutrition with plant foods.

Keywords: calves, ontogeny, phase of milk nutrition, development, hemocoagulation.

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ISSN: 0975-8585

INTRODUCTION

It becomes clear that further intensification of the economy and raising the standard of living of the population is possible only with the obligatory further development of the food base [1,2,3]. Its important basis is livestock breeding [4]. To develop this branch of agriculture is possible only taking into account new physiological data, which must be received and refined continuously [5].

Practitioners of biology and medicine have long come to the conclusion that optimal functioning and development of the body is possible with good rheological properties of blood [6,7]. They largely depend on the blood coagulation system, closely related to the vascular wall, liver and blood cells [8,9]. In this connection, a serious task arises to assess the activity of the coagulation system of blood in ontogenesis in cattle [10].

The ontogenetic dynamics of the activity of the coagulating system of blood plasma in the phase of milk nutrition in calves is one of the most important physiological elements of providing homeostasis in the postnatal period [11]. The formation of the functional activity of the coagulation system largely ensures the adaptation to the external environment of all body systems, controlling the fluid properties of blood, the expression of its fluidity through the vessels, thereby facilitating the optimal deployment of an individual calf development program, despite all possible negative environmental influences. At the same time, many aspects of the age-related changes in the activity of the coagulation system in healthy calves in the phase of dairy nutrition have not been adequately studied.

In this regard, the goal of the study was formulated: to determine the dynamics of the physiological state of the coagulating system of blood plasma in healthy calves in the phase of milk nutrition.

MATERIALS AND METHODS

Research was conducted in strict accordance with ethical principles established by the European Convent on protection of the vertebrata used for experimental and other scientific purposes (adopted in Strasbourg March 18, 1986, and confirmed in Strasbourg June 15, 2006) and approved by the local ethic committee of Russian State Social University (Record №12 dated December 3, 2015).

The study included 32 healthy calf dairy nutrition at the age of 11 days. The complex of examinations consisted of determining the activity of peroxide oxidation of plasma lipids by the content of acyl hydroperoxides, thiobarbituric acid-active products by the Agat-Med company (Russia) and the antioxidant activity of the liquid part of the blood. Each level of the monitored calf was evaluated for the level of coagulation factors (I, II, V, VII, VIII, IX, X, XI, XII), duration of activated partial thromboplastin time, prothrombin and thrombin time.

Healthy calves were examined during the milk feeding phase 5 times: on 11, 15, 20, 25 and 30 days of life.

Statistical processing of the results was carried out using Student's t-test.

RESULTS OF THE STUDY

During the whole phase of milk feeding in healthy calves, the level of antioxidant plasma activity was stable (on average 32.6±0.21%) and lipid peroxidation activity. Thus, the level of primary products of lipid peroxidation - acyl hydroperoxides averaged 1.48±0.02 D_{233}/1ml with a low content of free radical free lipid oxidation products - thiobarbituric acid-active compounds (an average of 3.29±0.02 μmol/l), reliably not differing from the study to the study during the whole phase of the dairy diet.

All healthy calves included in the study evaluated the activity of coagulation factors throughout the whole phase of the dairy diet. In the dynamics of activity of coagulation factors, they found a statistically significant regularity (Table 1).

On the 11th day of life in calves, the low activity of all coagulation factors was noted. By 15 days of life in animals, the increase in the content of factors II and VII was observed with a tendency to an increase in

ISSN: 0975-8585

the content of fibrinogen in the blood and factors X and XII. At the same time, the activity of V, VIII, X and XI factors did not experience statistically significant dynamics. The twenty-second day of life of healthy calves was marked by a further increase in the level of fibrinogen, Factors II, VII, IX, XI, XII with the level of V, VII and X factor unchanged. On the 25th and 30th days, additional significant increase in the level of fibrinogen and factors II, VII, IX, XI, XII in the absence of statistically significant fluctuations in plasma, V, VIII, and X factor plasma activity was observed in calves.

Table 1. Activity of coagulation factors in healthy calves of dairy nutrition

Registered parameters	Milk phase, n=32, M±m				
	11 day of life	15 day of life	20 day of life	25 day of life	30 day of life
Coagulation factor I, g/l	2.2±0.14	2.3±0.14	2.6±0.18 p<0.05	2.8±0.09 p<0.01	3.0±0.07 p<0.01
Coagulation factor II, %	84.5±0.11	85.0±0.02 p<0.05	85.8±0.10 p<0.05	86.7±0.03 p<0.05	87.4±0.09 p<0.05
Coagulation factor V, %	82.7±0.12	82.6±0.10	82.9±0.08	83.1±0.16	82.8±0.17
Coagulation factor VII, %	68.0±0.04	69.5±0.07 p<0.01	69.9±0.04 p<0.01	71.6±0.07 p<0.01	72.7±0.05 p<0.01
Coagulation factor VIII, %	85.3±0.16	84.9±0.20	85.7±0.26	85.3±0.29	86.0±0.21
Coagulation factor IX, %	83.0±0.14	82.8±0.15	84.6±0.03 p<0.05	85.6±0.08 p<0.05	86.5±0.11 p<0.05
Coagulation factor X, %	61.3±0.19	61.4±0.26	62.6±0.25	62.9±0.23	63.3±0.16
Coagulation factor XI, %	90.1±0.10	90.6±0.22	92.3±0.15 p<0.05	93.4±0.20	94.6±0.12
Coagulation factor XII, %	86.3±0.17	86.9±0.14	88.3±0.16 p<0.05	90.1±0.14 p<0.01	92.2±0.17 p<0.01
Activated partial thromboplastin time, s	48.0±0.22	46.1±0.12 p<0.05	44.0±0.14 p<0.01	41.7±0.10 p<0.01	39.3±0.11 p<0.01
Prothrombin time, s	19.0±0.17	18.7±0.13 p<0.05	17.0±0.08 p<0.01	16.5±0.07 p<0.01	16.0±0.05 p<0.05
Thrombin time, s	16.2±0.12	15.9±0.19	15.6±0.10 p<0.05	15.2±0.04 p<0.05	14.9±0.02 p<0.05

Legend: p - reliability of ontogenetic dynamics of the indicators being evaluated.

Coagulation tests in healthy calves during the milk feeding phase revealed a regular dynamics of activity of the coagulation system, reflecting changes in the plasma content of individual clotting factors in this phase of early ontogeny (Table 1). Thus, when assessing the age-related dynamics of activated partial thromboplastin time, it was established that its acceleration from 48.0±0.22 c at the beginning of the phase of dairy nutrition to 39.6±0.11 s at its end was established beginning at 15 days. The prothrombin time, slowed down at the beginning of the phase, reached 18.7±0.13 c at the end of the 15 days, with a subsequent steady reduction to the end of the phase. Thrombin time, reflecting the intensity of the transition of fibrinogen to fibrin from 11 to 30 days of life in calves, was overall accelerated by 8.7%.

Thus, in healthy calves of dairy nutrition there is a characteristic age-specific dynamics of the basic coagulation tests, which ensures effective adaptation of the animal to environmental conditions.

DISCUSSION

In healthy calves of dairy nutrition, there was a lack of reliable fluctuations in the level of lipid peroxidation and antioxidant protection of the plasm at a certain dynamics of plasma hemostasis activity [12,13], which undoubtedly allows calf to adapt to the conditions of extrauterine existence [14,15], providing normal rheological the state of blood, and thus, an adequate influx of nutrients and oxygen to the developing tissues of the animal's body [16,17]. This is an important element of protecting calves against possible adverse environmental factors [18,19], affecting their body in the phase of milk nutrition [20,21]. Dynamics of the clotting system that controls the aggregate state of blood is largely ensured by the stability of lipid peroxidation at the optimal level with the growing influence of environmental factors [22,23]. The acceleration of prothrombin clotting time, reflecting the enhancement of mechanisms of activation of plasma hemostasis along the external pathway, is largely due to the increase in this phase in calves of the intensity of formation and activity that triggers the clotting of thromboplastin [24,25]. Summation of these phenomena provides the level of liquid blood properties necessary for this stage of ontogeny and the optimal degree of perfusion of internal organs, which largely maintains the necessary level of metabolism in calf tissues, contributing to its growth and development [26,27].

During the phase of milk nutrition, the content of V, VII and X factors in the blood is unchanged with the activity of the other coagulation factors increasing [28]. As a result, activated partial thromboplastin time, reflecting the activity of the internal coagulation pathway and prothrombin time, revealing the activity of the external coagulation pathway and its final stage, estimated by thrombin time, are accelerated [29,30]. It is obvious that the revealed dynamics of blood clotting activity is an indispensable element of the organism's preparation for a new diet - the beginning of consumption of plant foods [31,32,33].

Thus, calves have a small but significant increase in plasma hemostasis activity, which is probably an element of the general adaptation process of the organism in early ontogeny.

CONCLUSION

In healthy calves of dairy nutrition there is a regular dynamic of the functional state of the plasma hemostasis activity, which ensures the optimal rheology of blood necessary for growth and development of the organism. Increasing the activity of blood clotting mechanisms helps the animal to adapt to the phase of dairy nutrition, ensuring its preparation for nutrition with plant foods.

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