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Functional Activity Of The Blood Clotting System In Calves During The Phase Of Milk And Vegetable Nutrition.

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ABSTRACT

A special role in providing metabolic processes between the blood and tissues is played by the hemocoagulation system and the mechanisms that ensure the content of its activity. It is recognized that thanks to the latter, the blood retains its liquid state when the body enters any environmental conditions. The activity of the coagulation system in the phase of milk and vegetable nutrition in calves is one of the most important physiological elements of providing homeostasis in all early ontogenesis. Dynamics of the functional readiness of the folding system to a large extent provides adaptation to the external environment of all body systems, maintaining the liquid properties of blood at any given moment, contributing to the optimal deployment of an individual calf development program. In healthy calves of dairy-vegetative nutrition there is a regular dynamics of the functional state of plasma hemostasis activity, which provides the optimal blood rheology necessary for growth and development of the organism. It becomes clear that an increase in the activity of blood clotting mechanisms helps the animal to adapt to the phase of dairy-plant nutrition, ensuring its preparation for food only plant foods.

Keywords: calves, ontogeny, development, phase of milk and vegetable nutrition, blood coagulation.

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INTRODUCTION

Provide food to the inhabitants of the planet and maintain the well-being of the population is possible with a firm reliance on the scientific base [1,2,3]. In this regard, further study of the various physiological indicators of cattle, which is a reliable source of dairy and meat products for many countries of the world, remains relevant [4]. It becomes clear that further study of the physiology of blood, which provides an integrating effect on the body, has great significance in this respect [5,6].

A special role in providing metabolic processes between blood and tissues is played by the hemocoagulation system and mechanisms that ensure the content of its activity [7,8]. It is recognized that thanks to the latter, the blood retains its liquid state when the body enters any environmental conditions [9,10].

The activity of the coagulating system of blood plasma in the phase of milk and vegetable nutrition in calves is one of the most important physiological elements of providing homeostasis in all early ontogenesis [11]. Dynamics of the functional readiness of the coagulation system largely ensures adaptation to the external environment of all body systems, maintaining the liquid properties of blood, the degree of its fluidity along the vessels at the level necessary at each particular moment, thus contributing to the optimal development of an individual calf development program [12]. Moreover, many aspects of the ontogenetic dynamics of the activity of the coagulation system in healthy calves in the phase of dairy-plant nutrition have not been studied sufficiently [13].

In this context, formulated the aim of the study was to establish the dynamics of the physiological state of the coagulation system of blood plasma in healthy calves in the phase of milk-vegetable diet.

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 36 healthy calves of milk and vegetable nutrition at the age of 31 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.

RESULTS OF THE STUDY

At the beginning of the phase of milk and vegetable nutrition (45 days) in healthy calves there was a significant decrease in the level of antioxidant activity of the plasma (27.4±0.15%), which led to increased activity of lipid peroxidation. Thus, the level of primary products of lipid peroxidation, acyl hydroperoxides, was 1.80±0.14 D_{233}/1ml for 45 days, with a sharp increase in the content of secondary products of free radical lipid oxidation-thiobarbituric acid-active compounds (3.77±0.16 µmol/l) with their subsequent return (60 days) to a level close to those at the beginning of the phase and a small but significant gradual increase in the antioxidant activity of the plasma (up to 33.9±0.24%) at 90 days and a decrease in lipid peroxidation, which was 90 day acyl hydroperoxides 1,41±0,11 D_{233}/1 ml thiobarbituric acid products 3,45±0,19 µmol/l.

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

On the 31st day of life in calves, the low activity of all clotting factors was noted. By 45 days of life, the animals showed a marked increase in the content of factors I, II, VII, IX, X, XI and XII with the same content of V and VIII factors. By 60 days in calves, a decrease in the activity of activated factors to a level close to that at

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the beginning of the phase was noted, followed by a small but significant increase in their functional readiness until the end of the observation. At the same time, in the calves the levels of factors V and VIII remained unchanged up to 90 days.

Table 1. Dynamics of clotting factor activity in healthy calves of dairy-vegetative nutrition

Registered parameters	Milk and vegetable nutrition phase, n=36, M±m				
	31 day of life	45 day of life	60 day of life	75 day of life	90 day of life
Coagulation factor I, g/l	3.0±0.12	4.7±0.25 p<0.01	3.2±0.07 p<0.01	3.3±0.04	3.5±0.16 p<0.05
Coagulation factor II, %	87.5±0.10	98.0±0.19 p<0.01	86.8±0.04 p<0.01	87.5±0.02 p<0.05	88.9±0.03 p<0.05
Coagulation factor V, %	82.9±0.14	83.5±0.08	83.4±0.07	82.9±0.10	84.0±0.06
Coagulation factor VII, %	72.8±0.06	85.1±0.08 p<0.01	73.4±0.06 p<0.01	74.2±0.05 p<0.05	76.2±0.05
Coagulation factor VIII, %	86.1±0.12	86.8±0.15	87.0±0.19	86.6±0.20	86.9±0.14
Coagulation factor IX, %	86.7±0.13	94.7±0.12 p<0.01	88.2±0.02 p<0.01	88.6±0.04	88.0±0.12
Coagulation factor X, %	63.3±0.20	69.9±0.19 p<0.01	62.4±0.25 p<0.01	62.8±0.14	63.4±0.12
Coagulation factor XI, %	94.8±0.18	99.7±0.16 p<0.01	93.8±0.18 p<0.01	94.5±0.15	94.8±0.17
Coagulation factor XII, %	92.3±0.10	106.2±0.22 p<0.01	94.0±0.07 p<0.01	95.6±0.09 p<0.05	96.6±0.13 p<0.05
Activated partial thromboplastin time, s	39.7±0.18	34.2±0.18 p<0.01	39.9±0.12 p<0.01	39.0±0.04 p<0.05	38.6±0.16
Prothrombin time, s	16.2±0.18	12.8±0.12 p<0.01	16.5±0.05 p<0.01	16.2±0.06 p<0.01	16.0±0.03
Thrombin time, s	15.0±0.07	13.0±0.16 p<0.01	15.2±0.16 p<0.01	14.8±0.06 p<0.05	14.7±0.03

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

Coagulation tests in healthy calves during the phase of milk and vegetable nutrition reflected the patterns of the dynamics of the functioning of the coagulation system associated with 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, its acceleration by 45 days of life was ascertained to 34.2 ± 0.18 c, extending to 60 days again to 39.9 ± 0.12 s and slowly accelerating to its end to 38.6 ± 0.16s. Prothrombin time, slowed down at the beginning of the phase, reached 12.8 ± 0.12 s with 45 days of inhibition to 60 days before the initial values and its subsequent steady contraction to the end of the phase. Thrombin time, reflecting the intensity of the transition of fibrinogen to fibrin, from the 31st to the 90th day of life in calves was accelerated by 2.0%, testing the peak acceleration to 13.0 ± 0.16s by 45 days.

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

DISCUSSION

A healthy increase in lipid peroxidation and a decrease in antioxidant protection of the plasm for 45 days of life are recorded in healthy calves of milk and vegetable nutrition, with a certain dynamics of plasma hemostasis activity [14,15], which is undoubtedly a consequence of the calf's adaptation process to the onset of admission to its the organism of plant foods, providing a normal rheological state of blood [16,17], and thus, an adequate supply of nutrients and oxygen to the developing tissues of the animal's body [18,19]. This is an important element of protection of calves against possible unfavorable environmental factors affecting their organism during the phase of milk and vegetable nutrition [20,21]. Dynamics of the coagulation system controlling the aggregate state of blood is largely ensured by fluctuations in LPO activity at the optimal level with the growing influence of environmental factors [22,23]. The gradual acceleration of prothrombin clotting time with its peak leaps to 45 days and the subsequent decrease to 60 days reflects an increase in the mechanisms of activation of plasma hemostasis along the external pathway and is largely due to the increase in this phase in calves of the intensity of formation and activity triggering the clotting process 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 and vegetable nutrition, the content of V, VIII factors in the blood is unchanged, with the increase in the activity of the other coagulation factors, including a peak for 45 days. As a result, activated partial thromboplastin time, reflecting the activity of the internal coagulation pathway [28,29], prothrombin time revealing the activity of its external pathway [30] and its terminal stage, estimated by thrombin time, are accelerated [31,32]. It is obvious that the established dynamics of blood clotting activity is a necessary element of the organism's transition to a new diet - the beginning of consumption of plant food is in many respects a stress for the organism [33].

Thus, in calves of dairy-vegetative nutrition there is a significant increase in the activity of plasma hemostasis with its brief increase to 45 days, which is probably an element of the general adaptation process of the organism in early ontogeny associated with the beginning of consumption of plant feed.

CONCLUSION

In healthy calves of dairy-vegetative nutrition there is a regular dynamics of the functional state of plasma hemostasis activity, which provides the optimal blood rheology 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-plant nutrition, providing its preparation for food only plant foods.

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