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DYNAMICS OF THE CORTISOL LEVEL IN THE BLOOD OF YOUNG CATTLE

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***Abstract**: The aim of the study was to evaluate the biological patterns of the dynamics of cortisol levels in the blood serum of calves of the Ukrainian Red-and-White dairy breed. According to the results of the eosinophilic test, 52.4% of individual's resistant to stress were identified in the group of studied calves. Of all the calves assessed as resistant to the stressor, 68.2% were bulls. The average level of cortisol in calves was 26.2±0.8 ng/ml. As the age of the calves' increases, there is an increase in the concentration of cortisol in the blood serum. The intensity of the increase in the level of cortisol in different periods of postnatal ontogenesis is uneven. A high direct statistically significant rank correlation was recorded between the levels of cortisol in the blood serum of calves at different ages (r=+0.89±0.054 - + 0.99±0.117, P<0.001). It has been established that the change in the level of cortisol in the blood serum of calves in the process of postnatal ontogenesis depends on gender. In bulls, serum cortisol concentration was significantly lower (on average by 66%, P<0.01)*

***Keywords:** dairy cattle, Ukrainian Red-and-White Dairy breed, sensitivity to stress, hormonal level*

INTRODUCTION

In farm animals, under modern conditions, the stress load increases due to the discrepancy between the physiological capabilities of the body and environmental factors. There are several main reasons for the development of stress in animals: conditions of detention (temperature conditions, air humidity, ventilation, socialization), hunger, thirst, fatigue, various critical physiological conditions (hunger, thirst, fatigue, illness, injury). Weaning and transportation are strong stressors for animals [10]. Stress is a factor in the process of evolution, the continuum of chronic and progressive reactions of the body, as it disrupts homeostasis and is blamed as a result of neuron-endocrine and metabolic disorders in the development of supernormal and pathological factors, which are manifested by an adaptation syndrome [14] . The negative effects of stress occur when adaptive mechanisms are overstrained, which manifests itself in a significant disruption of hormonal status and metabolism [5, 7]. With the development of a stress reaction, the glucocorticoid system is activated, cortisol and corticosterone are released into the bloodstream, which leads to a change in the blood picture, including a decrease in the number of eosinophilic granulocytes [26].

Cortisol, as well as other glucocorticoid hormones, directly or indirectly affects all physiological and biochemical processes in organisms of animals, including productive signs. It has been established that cortisol can be supplemented with cortisol in cows by various paratypic factors [6]. Cortisol is often called the hormone of stress, and its concentration in the blood significantly rises for stressful minds, a shock state, as well as for injuries, important infections, intoxications, hunger [17,19]. Since stress triggers a cascade of etological, physiological, biochemical reactions, it is known about the harmful effect of this reaction on the quality characteristics of livestock products [9], growth and

development retardation [22], reduction in reproductive ability [18], productivity [2, 20], nonspecific protective body forces [1]. Calves born from cows with reduced stress tolerance have an increased susceptibility to diseases due to insufficient formation of collostral immunity [27].

In recent decades in the scientific literature, considerable attention is paid to the study of heat stress and the mechanisms of tolerance to it [4,8,13], economic losses due to the deterioration of productivity, health, reproduction [12, 21], are determined, appropriate breeding strategies are being developed to include thermal tolerance in breeding indices [1]. Since the stress reaction of the body is nonspecific, there is a prospect of developing breeding programs taking into account the general adaptive ability of animals. It is important to pay attention to the adaptability of animals from the early postnatal period, not only in order to reduce productive losses, but also to enable early identification of stress-resistant animals [24]. There are prerequisites for breeding farm animals, in particular dairy cattle, for resistance to stress [2]. It is important to identify traits that can be included in the stress tolerance index when appropriate breeding programs are implemented [1].

The patterns of cortisol dynamics, its influence on postnatal ontogenesis in cattle have not been studied enough [16,25]. Animal typing according to the level of stress tolerance is relevant when creating herds that would meet the requirements of modern dairy cattle breeding.

The aim of the study was to evaluate the biological patterns of the dynamics of cortisol levels in the blood serum of calves of the Ukrainian Red-and-White dairy breed.

MATERIALS AND METHODS

The study was carried out at the «Khristinivske» farm of the IRGT named after M.V. Zubts of the NAAS. The object of study was of the Ukrainian Red-and-White dairy breed calves (53 heifers, 31 bull-calf). Venous blood sampling was carried out until the age of one, according to the rules of asepsis and humane treatment of animals. The test for cortisol in the blood syrup of young animals was carried out using an enzyme immunoassay analyzer (Stat Fax 4700, USA) and a standard kit for the analysis of cortisol (DRG, Germany). For testing the eosinophilic test for sensitivity to stress, blood was tested with an anticoagulant (6% of EDTA products). A number of eosinophils were examined under a microscope (×150-200) at Goryaev's chamber [29]. Calves were brought to stress-resistant calves, which may contain eosinophils per μL, higher than the average, and to stress-sensitive, lower than the average value for the group of pre-existing animals.

Biometric processing of data was carried out according to the standard method [28].

RESULTS AND DISCUSSION

According to the results of the eosinophilic test, 52.4% of individual's resistant to stress were identified in the studied calves group. Of all the calves assessed as resistant to the stressor, 68.2% were bulls. In the group of bull-calf, only 3% of the animals were sensitive to stress according to the results of the eosinophilic test.

It was found that the level of cortisol in the blood serum of calves ranged from 0 to 68.3 ng/ml. The average cortisol level in calves was 26.2±0.8 ng/ml. The results obtained correspond with the data obtained by other researchers [11, 15]. The dynamics of the data obtained by us in the study of cortisol in calves is shown in fig. 1. As the age of calves increases, there is an increase in the concentration of cortisol in the blood serum. Thus, in a group of animals aged 2-3 months, the minimum mean value of cortisol concentration in the blood was found to be 15.3±2.4 ng/ml. And in the age group of 14-15 months, the average level of cortisol increased to 35.5±2.8 ng/ml. At the age of 12-13

months, there was no increase in cortisol levels. There were no significant differences between the age groups of 10-11 and 12-13 months (P > 0.05). Which may indicate hormonal disorders in the process of ontogenesis.

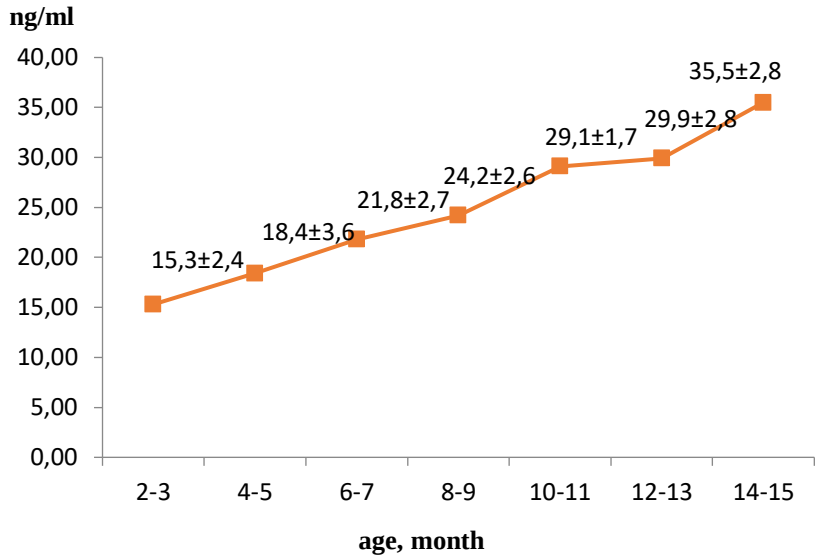

Fig.1 Age-related dynamics of cortisol levels in the blood of young cattle Ukrainian Red-and-White dairy breed

When studying separately bulls and heifers, the level of cortisol in the blood serum of calves was found to depend on the sex of the animals (Fig. 2). Thus, the average level of cortisol in the blood of bulls was 11.7 ± 0.8 ng/ml, and in the blood of heifers - 34.8 ± 0.9, which is significantly higher by 23.1 ng/ml (P < 0.01) . Lower levels of cortisol in the blood of bulls have also been established by other researchers [3].

As the age of the heifers increased, a gradual increase in the concentration of cortisol in the blood serum was noted. Thus, in a group of heifers aged 2-3 months, the minimum average value of cortisol concentration in the blood was 22.2±1.8 ng/ml. And in the age group of 14-15 months, the average level of cortisol increased to 45.6±2.5 ng/ml. At the age of 8-9 months, no increase in cortisol levels was observed. There were no significant differences between the age groups of 6-7 and 8-9 months (P > 0.05). At the same time, in bull-calfs of these age groups, there is a rapid increase in the level of cortisol in the blood serum. Thus, a significant difference between the age groups of 6-7 and 10-11 months was 10.8 ng/ml (P < 0.01). In bull-calfs, a statistically significant increase in the rate of increase in the average level of serum cortisol in the period from 6 to 11 months may be associated with hormonal changes in the body, which may trigger the stress response mechanism. When providing normal conditions for growing and keeping during this period, adaptive mechanisms are activated. In the concentration of cortisol in the blood serum of bulls are stabilized.

In other periods of ontogeny, bull-calfs show a slow growth or even a slight decrease (P > 0.05) in the level of cortisol. The minimum average value of cortisol in the blood serum was found in a group of bull-calfs aged 2-3 months (3.3±1.6 ng/ml). And in the age group of 14-15 months, the average level of cortisol increased to 18.9±2.1 ng/ml.

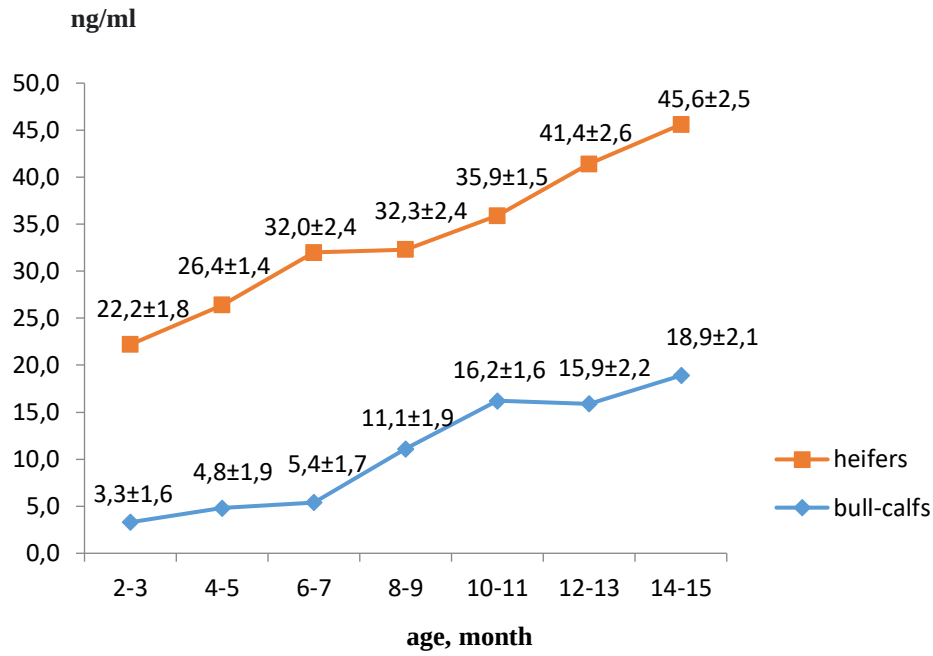

Fig.2 Comparative characteristics of hormonal changes in calves of different sexes

Thus, in the course of obtaining data on the dynamics of cortisol in calves and their analysis, the presence of significant differences in heifers and bull-calfs was revealed. The level of cortisol in bull-calfs was statistically significantly ($P < 0.01$) lower in all age periods. The levels of cortisol in the blood serum of bulls were significantly lower (by 85-55% in different age periods). Differences were established both in the level of cortisol in the blood serum and in the intensity of the increase in the level of the hormone in different periods of postnatal ontogenesis, which may indicate differences in the formation of stress tolerance in animals of different sexes.

It is known from the literature that the level of formation of the immunobiological functions of the body in bull-calfs and heifers in early ontogenesis is different. In the initial stages of postnatal development, a lower level of natural resistance was noted in bulls compared to heifers. However, the rates of formation of the potential of natural resistance in terms of age are higher in steers than in heifers, especially up to 3 months of age, which indicates the expediency of early consideration of the sex of animals in targeted breeding [23].

In our study, when studying the age dynamics of cortisol levels in the general group of calves(n=84), a high direct statistically significant rank correlation was recorded between the levels of cortisol in the blood serum of calves at different ages ($r = +0.89±0.054$ - $+0.99±0.117$, $P<0.001$).

It can be assumed that the status of an animal in response to stress does not change during ontogeny. It is known that the degree of reaction to stress is a hereditary trait, although it has a low heritability [1,27]. This fact indicates the relevance of studying the possibility of early prediction of sensitivity to stress by the level of cortisol in the blood in response to the impact of a stress factor.

CONCLUSIONS

As the age of the calves increases, there is an increase in the concentration of cortisol in the blood serum. However, the intensity of growth in different periods of postnatal ontogenesis is uneven. It has been established that the change in the level of cortisol in the blood serum of calves during postnatal ontogenesis depends on gender. In bulls, the concentration of cortisol in the blood serum was significantly lower (on average by 66%, $P<0.001$). In bull-calfs, a statistically significant increase in the rate of increase in the average level of serum cortisol at the age of 10-11 months may be associated with the activation of the hormonal system and an increase in the number of stressful influences.

The study of the patterns of formation of the hormonal status and its influence on the economically useful and biological characteristics of dairy cattle requires further study.

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