Сәкен Сейфуллин атындағы Қазақ агротехникалық зерттеу университетінің Ғылым жаршысы: пәнаралық = Вестник науки Казахского агротехнического исследовательского университета имени Сакена Сейфуллина: междисциплинарный. – Астана: С. Сейфуллин атындағы Қазақ агротехникалық зерттеу университеті, 2025. -№ 1 (124). - P. 83-90. - ISSN 2710-3757, ISSN 2079-939X

doi.org/ 10.51452/kazatu.2025.1(124).1821
UDC 63.637.05 **Research article**

The impact of various stress factors on lactation in goats

Meruert Kh. Parmanbekova[1], Sholpan S. Shynybekova[2], Gaukhar U. Baitasheva[1], Elmira M. Imanova[1], Laura U. Koibasova[3]

[1]Kazakh National Women's Pedagogical University, Almaty, Kazakhstan,
[2] Abai Kazakh National Pedagogical University, Almaty, Kazakhstan,
[3]"Institute of Genetics and Physiology" KN MES RK, Almaty, Kazakhstan

Corresponding author: Laura K. Koibasova.: laura.koibasova74@mail.ru
Co-authors: (1: MP) mparmanbekova@gmail.com; (2: ShS) sholpan_63@inbox.ru;
(3: GB) baitasheva2004@gmail.com; (4: EI) imanovaelmira74@gmail.com;
(5: LK) laura.koibasova74@mail.ru
Received: 13-01-2025 **Accepted:** 27-03-2025 **Published:** 31-03-2025

Abstract

Background and Aim. The study of milk formation and secretion physiology is essential for addressing various biomedical issues related to the biological significance of lactation and milk in supporting offspring immunity and metabolism, as well as for the production of high-quality dairy products. The occurrence and duration of hypogalactia are determined by the quantitative balance between lactogenic and stress hormones.

The aim of the study was to assess the levels of stress hormones and their impact on milk secretion in lactating goats under normal conditions and various stress factors.

Materials and Methods. The study was conducted on goats, biochemical analyses of blood and milk were carried out. The levels of adrenaline and noradrenaline were measured using the fluorimetric method, considering different stress conditions and lactation stages.

Results. The levels of key lactogenic hormones were found to be highest during the early stages of lactogenesis. For the first time, it was established that stress hormone levels in goats vary depending on the lactation period and the influence of stress factors. The highest concentrations of adrenaline and noradrenaline were observed in the initial days of lactogenesis, followed by a decline during subsequent stages of lactopoiesis.

Conclusion. The results of the study showed that low milk yield is associated with increased levels of adrenaline and noradrenaline in the bloodstream. Under such conditions, milk production decreases, and a reduction in fat, protein and lactose content is observed, leading to a shorter lactation period.

Keywords: Lactation; adrenaline; noradrenaline; hormone; stress factor.

Introduction

The preservation of health and the education of the population in the Republic of Kazakhstan are nationally significant issues. Human health begins to form from the first days of life. Nutrition plays a crucial role in the formation of the baby's immune system. The most optimal nutrition at this stage is natural breastfeeding.

Currently, the study of milk formation and secretion physiology is highly relevant to addressing various medical and biological challenges. These challenges include understanding the biological significance of lactation and milk in supporting the immune system and metabolism of offspring, as well as optimizing the production of high-quality dairy products.

Numerous studies have demonstrated changes in the concentration of individual hormones during lactation. However, there is limited research on the simultaneous assessment of different classes of

hormones - protein, thyroid and steroid, which hinders a comprehensive understanding of the mechanisms underlying hormonal regulation of metabolism in lactating animals [1, 2]. As a result, many aspects are still being investigated worldwide.

In addition to the nervous system, the endocrine system, including the hormone prolactin, is of great importance in regulating the lactation process [3]. It is known that the thyroid gland and adrenal glands also affect the synthesis of the main components of milk. The influence of various factors on the secretion of this hormone has not been fully studied. Research indicates that the administration of thyroxine and insulin to goats and cows increases milk volume and fat content [4]. In addition, it has been established that environmental stresses (ambient temperature, air pollution, noise) change the levels of hormones including thyroxine, cortisol, growth hormone, prolactin, adrenaline and noradrenaline, reducing milk yield in dairy cattle [5, 6].

It should also be noted that somatotropin plays a role in the regulation of lactation in ruminants, promoting increased milk production and enhancing its organic composition[7]. Previous studies have established that stress-induced hormones such as adrenaline and noradrenaline negatively affect lactation and contribute to hypogalactia [8]. In estrous cows, prolonged exposure to heat stress has been shown to increase plasma progesterone levels from days 2 to 19 of the first cycle and from days 2 to 8 of the second cycle. However, heat stress also resulted in decreased plasma cortisol levels in both cycles, reducing the correlation coefficient between these steroids during specific periods of the estrous cycle [9].

Additionally, studies have reported that stress negatively affects metabolic processes in cows of different breeds during lactation. Significant correlations have been observed between progesterone, cortisol, and mineral levels in the body. These findings highlight the importance of breed-specific management strategies for improving dairy farm efficiency [10, 11, 12].

Stress factors affect the physiological and psychological condition of animals. An effective way to detect stress is to measure the activity of the hypothalamic-pituitary-adrenocortical axis by measuring plasma cortisol levels, which can lead to reduced immunity, increased susceptibility to disease, and impaired reproductive performance. While complete elimination of stress is not feasible, improvements in agricultural practices can help mitigate its effects and enhance productivity [13, 14].

The occurrence and duration of hypogalactia are influenced by the quantitative balance between lactogenic and stress hormones,necessitating further investigation. In connection with the aforementioned factors, there is a need to study the degree of stress hormone secretion and the physicochemical composition of milk under the influence of various stress factors on the milking process in lactating goats.Thus, the objective of our research was to determine the amount of stress hormones and the degree of milk release in lactating goats under normal conditions and under various stress factors.

It was first established that stress hormones in goats depend on the lactation period and are influenced by stress factors. The highest hormone concentrations were observed in the early days of lactogenesis, followed by a decline in the subsequent stages of lactopoiesis.

Furthermore, a decrease in milk secretion was found to be associated with elevated levels of adrenaline and noradrenaline in the bloodstream. During this period milk secretion was reduced, along with a decrease in fat, protein and lactose levels, leading to a shorter lactation period.

Materials and Methods

The research was conducted at the Scientific Research Institute of Genetics and Physiology. The experiment was performed on lactating goats. The goats were housed in a barn at the Institute of Human and Animal physiology and were fed according to general nutritional requirements based on body weight. The diet consisted of concentrated feed and various types of grasses.

The total protein content in milk was determined using the formalin titration method (also known as the A.Ya. Dudenkov method) with 0.1 N NaOH and 40% formalin solutions. This method is based on the interaction of protein amino groups with formalin. The milk sample was titrated first with a phenolphthalein solution, and then with a formalin solution. The volume of alkali used in the final titration was multiplied by a coefficient of 0.959 [15].

The fat content, dry matter and milk density were measured using a LAKTAN 1-4 milk analyzer (Russia). The pH of the milk was determined using a pH meter. Adrenaline and noradrenaline levels were

measured using the fluorimetric method [16]. All procedures using laboratory animals were conducted in accordance with ethical guidelines. The study was approved by the Local Ethics Committee (LEC) of the RSE "Institute of Human and Animal Physiology" (IHAP) SC MES RK No. 3 (3), dated October 8, 2020, reference No. 07-05 /158.

The obtained data were statistically analyzed using Microsoft Excel and the changes obtained were considered statistically significant according to the Fisher-Student test – *p < 0.05 and *p < 0.001.

Results and Discussion

The experiment was conducted on lactating goats in the second half of the lactation period. In the first experimental setup, the stress factor was the noise generated during the separation of goats from their kids, and in the second setup, a controlled noise level of 60-65 dB was used. The experiment was carried out in three phases: before exposure to the stress factor, during exposure, and after exposure.

Before the experiment, the animals were acclimated to the experimental conditions, and were milked in the absence of any stress factors.

In the control group, where no stress factors were present, the baseline level of stress hormones (adrenaline and noradrenaline) before milking was 0.59±0.26 µg/ml.During milking, this level increased to 0.85±0.16 µg/ml, while exposure to engine noise resulted in a hormone level of 0.62±0.07 µg/ml (Fig. 1).

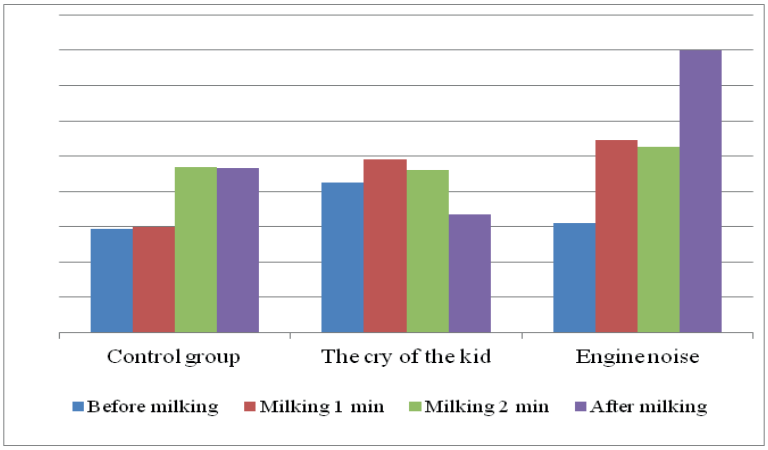

Figure 1 – Adrenaline levels in the blood of lactating goats under the influence of stress factors and the control group

One minute after milking, compared to the control group, the concentration of adrenaline increased by 63%, while the level of noradrenaline showed a slight decrease. Under exposure to engine noise, adrenaline increased by 216%, whereas noradrenaline increased by only 11% (Table 1).

Table 1 – Dynamics of adrenaline and noradrenaline levels in the blood plasma of goats under stress
Adrenaline, µg/ml

Stages	Control group	In the roar	Motor noise
Before milking	0.59±0.26	0.85±0.16	0.62±0.07
1 min during milking	0.60±0.06	0.98±0.027	1.09±0.07
2 min during milking	0.94±0.11	0.92±0.19	1.05±0.21
After milking	0.93±0.11	0.67±0.44	1.60±0.71
Norepinephrine, µg/ml			
Before milking	0.17±0.008	0.16±0.01	0.14±0.02
1 min during	0.18±0.006	0.17±0.012	0.21±0.08
2 min during milking	0.19±0.005	0.17 ± 0.008	0.21±0.12
After milking	0.35±0.012	0.18±0.003	0.17±0.005

After weaning, the concentration of adrenaline in the blood of goats two minutes after milking was the same as in the control group, while noradrenaline decreased to 0.67±0.44 μg/ml (in the control group, noradrenaline decreased to 0.93±0.11 μg/ml), under exposure to engine noise, the concentration of adrenaline increased by 11%, while noradrenaline levels rose by 77%.

After milking, the concentration of adrenaline in the control group was 0.93±0.11 μg/ml, whereas in weaned goats, it was 0.67±0.44 μg/ml. Under exposure to engine noise, adrenaline levels increased by 72%. The concentration of noradrenaline in the blood of goats decreased twofold during both weaning and exposure to engine noise compared to the control group (0.35±0.012 μg/ml) (Fig. 2).

During the goats' weaning and subsequent milking, the concentration of adrenaline increased from 0.59 ± 0.26 to 0.98 ± 0.027 μg/ml compared to the control group. The noradrenaline level changed only slightly. By the third minute after milking cessation, the adrenaline concentration returned to its initial level.

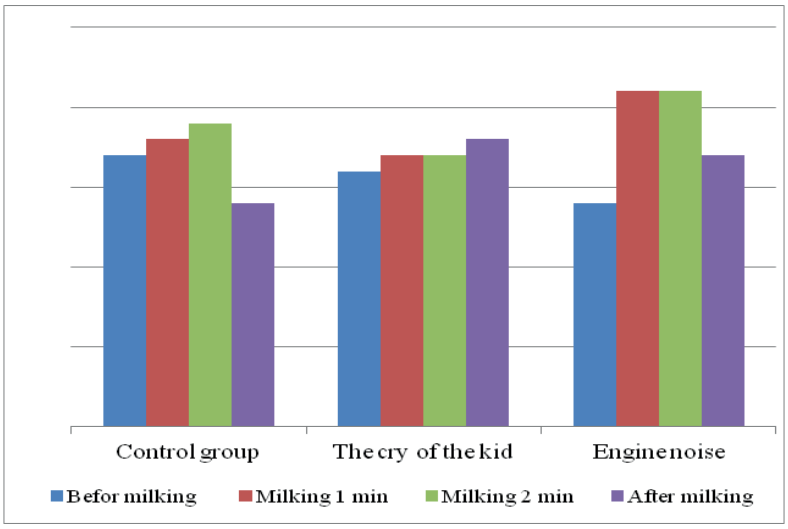

Figure 2 – The level of noradrenaline in the blood of lactating sows under the influence of stress factors in the control group and stressors

In an experiment involving exposure to engine noise, a significant increase in the concentration of stress hormones in the blood of animals was detected. The concentration of norepinephrine, a neurotransmitter, doubled compared to the baseline state. In some goats, adrenaline levels increased 5 to 6 fold under the influence of noise. Even after the cessation of noise exposure (in this case, presumably related to the milking process), the elevated adrenaline concentration persisted, indicating a prolonged stress response. This suggests that noise exposure triggered not just a short-term adrenaline surge but a systemic physiological reaction, requiring more time to restore homeostasis. After milking cessation, adrenaline levels remained elevated. Exposure to noise significantly increased the release of stress hormones into the bloodstream. Under stress, the activity of the sympatho-adrenal and hypothalamic-pituitary-adrenal systems intensifies. A prolonged increase in stress hormone levels in peripheral blood can lead to pathological conditions. The study demonstrated that stressors such as noise not only elevate the concentration of catecholamines (adrenaline and norepinephrine) in arterial and venous blood but also inhibit the oxytocin from the neurohypophysis. Oxytocin, a hormone essential for regulating lactation and social behavior, is suppressed under stress. This suppression may explain the decline in milk production observed in goats exposed to noise pollution. Inhibition of milk production directly results from decreased oxytocin levels, as oxytocin is necessary for stimulating the contraction of myoepithelial cells in the mammary gland, facilitating milk ejection. Any stressor increases catecholamine levels in arterial and venous blood, suppresses oxytocin release from the neurohypophysis, and inhibits milk production [17, 18]. The variability in stress hormone levels among individual animals in response to stimuli may be attributed to differences in their physiological characteristics and varying stress tolerance.

Conclusion

To investigate the relationship between some lactogenic and stress hormones, as well as monoamines in the regulation of lactation under stress conditions, we conducted studies on the dynamics of hormones in the blood of goats. Exposure to engine noise acting as an auditory stressor, led to a sharp increase in the secretion of adrenaline and noradrenaline, accompanied by a decrease in prolactin levels. Consequently, the average daily milk yield declined, along with a reduction in milk fat and total solids. Since the duration of noise exposure in the experiments was relatively short, it can be assumed that the animals experienced a state of fear and anxiety.During this period, the activation of the body's defense mechanisms led to increased energy expenditure, which may explain the observed decline in milk production and its components.

Our findings indicate that stress significantly alters the hormonal profile of lactating goats. Under stress exposure, adrenaline and noradrenaline levels increased by 2 to 6 times compared to the control group.

Considering advancements in modern lactation physiology, the analysis of our research results highlights the complexity of interactions between lactogenic and stress hormones. This study represents an effort to obtain new scientific data to address key questions in lactation regulation. It provides a quantitative assessment of adrenaline and noradrenaline levels in the blood of goats during both stimulation and inhibition of lactation. These findings help bridge gaps in the understanding of the dynamics of lactogenic and stress hormones, as well as neurotransmitters, during lactation.

Thus, the results of our study can be instrumental in developing scientifically validated and effective strategies for enhancing milk production. Furthermore, they offer a basis for predicting future milk productivity in cattle and small ruminants by assessing the levels of lactogenic and stress-related hormones in advance.

Authors' contributions

MP and ShS: conceptualized and designed the study, conducted a comprehensive literature search, analyzed the collected data, and drafted the manuscript. GB, EI, LK: conducted the literature search, statistically processed the data, and proofread the manuscript. All authors read, reviewed, and approved the final version of the manuscript.

References

1 Радченков, ВП, Матвеев, ВА, Бутров, ЕВ, Буркова, ЕИ. (1991). *Эндокринная регуляция роста и продуктивности сельскохозяйственных животных*. М.: Агропромиздат, 160.

2 Laudet, V., Markov, GV. (2018). Evolution of Hormonal Mechanisms. *Reference Module in Biomedical Sciences.* DOI:10.1016/B978-0-12-801238-3.64198-3.

3 Liu, X., Duan, C., Yin, X., Li, X. et.al. (2024). Effekts of prolactin inhibition on lipid metabolism in goats. Animals, 14(22), 336. DOI:10.3390/ani14223336.

4 Дюсембин, ХД. (1977). *Торможение и стимуляция лактации у животных.* Алма-Ата: Наука, 208.

5 Johnson, HD, Vanjonack, WJ. (2018). Effects of Environmental and Other Stressors on Blood Hormone Patterns in Lactating Animals. *Journal of Dairy Science,* 9(59).

6 Kurpińska, A., Skrzypczak, W. (2020). Hormonal changes in dairy cows during periparturient period. *Acta Sci. Pol. Zootech*, 18, 13-22.

7 Тулегенов, БТ, Куанышбекова, ГА, Шыныбекова, ШС. (1988). Динамика пролактина, СТГ, кортикостероидных гормонов в крови у лактирующих коз. Сб.науч.трудов. Алматы: 116.

8 Кобегенова, ЛС, Шыныбекова, ШС. (1989). К вопросу об участии серотонина и гистамина в лактационном процессе. *Физиология висцеральных систем продуктивных животных,* 28.

9 Dovolou, E., Giannoulis, T., Nanas, I., Amiridis, GS. (2023). Heat Stress: A Serious Disruptor of the Reproductive Physiology of Dairy Cows. *Animals (Basel)*, 1:13(11), 1846. DOI: 10.3390/ani13111846.

10 Fazio, E., Bionda, A., Attard, G. (2024). Effect of the Lactation Phases on the Amplitude of Variation in Blood Serum Steroid Hormones and Some Hematochemical Analytes in Three Dairy Cow Breeds. *Animals*, 14(22), 3336. DOI: 10.3390/ani14223336.

11 Spaans, OK, Kuhn-Sherlock, B., Hickey, A., Crookenden, MA, Heiser, A., Burke, CR, Phyn, CV, Roche, JR. (2022). Temporal profiles describing markers of inflammation and metabolism during the transition period of pasture-based, seasonal-calving dairy cows. *J. Dairy Sci*., 105, 2669-2698.

12 Walter, LL, Gärtner, T., Gernand, E., Wehrend, A., Donat, K. (2022). Effects of parity and stage of lactation on trend and variability of metabolic markers in dairy cows. *Animals*, 12, 1008.

13 Kurpińska, A., Skrzypczak, W. (2019). Hormonal changes in dairy cows during periparturient period. *Acta Sci. Pol. Zootech.*, 18, 13-22.

14 Andjelić, B., Djoković, R., Cincović, M., Bogosavljević-Bošković, S., Petrović, M., Mladenović, J., Čukić, A. (2022). Relationships between milk and blood biochemical parameters and metabolic status in dairy cows during lactation. *Metabolites*, 12, 733.

15 Дуденков, АЯ, (1972). *Биохимия молока и молочных продуков: учебное пособие.* Москва.

16 Долгов, ВВ. (2012). *Клиническая лабораторная диагностика*. Москва: ГЭОТАР-Медиа, 928.

17 Базанова, НУ, Бюсембин, ХД (1973). *Стимуляция молокоотдачи у животных*. Алма-Ата: Кайнар. 112.

18 Bao, QN, Yin, ZH, Zhou, YF, Li,YQ, Zhang, XY, Xia, MZ, Chen, ZH, Zhong, WQ, Yao, J, Wu, KX, Zhang, ZY, Xu, SJ, Liang, FR. (2024). Efficacy and safety of acupuncture for postpartum hypogalactia: A systematic review and meta-analysis of randomized controlled trials. *PLoS One,* 19(6), e0303948. DOI: 10.1371/journal.pone.0303948.

References

1 Radchenkov, VP, Matveev, VA, Butrov, EV, Burkova, EI. (1991). *Endokrinnaya regulyaciya rosta i produktivnosti sel'skohozyaistvennyh zhivotnyh.* M.: Agropromizdat 160.

2 Laudet, V., Markov, GV. (2018). Evolution of Hormonal Mechanisms. *Reference Module in Biomedical Sciences*. DOI:10.1016/B978-0-12-801238-3.64198-3.

3 Liu, X., Duan, C., Yin, X., Li, X. et.al. (2024). Effekts of prolactin inhibition on lipid metabolism in goats. *Animals,* 14(22), 336. DOI:10.3390/ani14223336.

4 Dyusembin, HD. (1977). Tormozhenie i stimulyaciya laktacii u zhivotnyh. Alma-Ata: Nauka, 208.5 Johnson, HD, Vanjonack, WJ. (2018). Effects of Environmental and Other Stressors on Blood Hormone Patterns in Lactating Animals. *Journal of Dairy Science,* 9(59).

6 Kurpińska, A., Skrzypczak, W. (2020). Hormonal changes in dairy cows during periparturient period. *Acta Sci. Pol. Zootech*, 18, 13-22.

7 Tulegenov, BT, Kuanyshbekova, GA, Shynybekova, ShS. (1988). Dinamika prolaktina, STG, kortikosteroidnyh gormonov v krovi u laktirujushhih koz. *Sb.nauch.trudov*. Almaty: 116.

8 Kobegenova, LS, Shynybekova, ShS. (1989). K voprosu ob uchastii serotonina i gistamina v laktacionnom processe. *Fiziologiya visceral'nyh sistem produktivnyh zhivotnyh,* 28.

9 Dovolou, E., Giannoulis, T., Nanas, I., Amiridis, GS. (2023). Heat Stress: A Serious Disruptor of the Reproductive Physiology of Dairy Cows. *Animals (Basel)*, 1:13(11), 1846. DOI: 10.3390/ani13111846.

10 Fazio, E., Bionda, A., Attard, G. (2024). Effect of the Lactation Phases on the Amplitude of Variation in Blood Serum Steroid Hormones and Some Hematochemical Analytes in Three Dairy Cow Breeds. *Animals*, 14(22), 3336. DOI: 10.3390/ani14223336.

11 Spaans, OK, Kuhn-Sherlock, B., Hickey, A., Crookenden, MA, Heiser, A., Burke, CR, Phyn, CV, Roche, JR. (2022). Temporal profiles describing markers of inflammation and metabolism during the transition period of pasture-based, seasonal-calving dairy cows. *J. Dairy Sci.*, 105, 2669-2698.

12 Walter, LL, Gärtner, T., Gernand, E., Wehrend, A., Donat, K. (2022). Effects of parity and stage of lactation on trend and variability of metabolic markers in dairy cows. *Animals*, 12, 1008.

13 Kurpińska, A., Skrzypczak, W. (2019). Hormonal changes in dairy cows during periparturient period. *Acta Sci. Pol. Zootech*., 18, 13-22.

14 Andjelić, B., Djoković, R., Cincović, M., Bogosavljević-Bošković, S., Petrović, M., Mladenović, J., Čukić, A. (2022). Relationships between milk and blood biochemical parameters and metabolic status in dairy cows during lactation. *Metabolites*, 12, 733.

15 Dudenkov, AYa, (1972). *Biohimiya moloka i molochnyh produkov: uchebnoe posobie.* Moskva.

16 Dolgov, VV. (2012). *Klinicheskaya laboratornaya diagnostika.* Moskva: GJeOTAR-Media,, 928.

17 Bazanova, NU, Biusembin, HD. (1973). *Stimulyaciya molokootdachi u zhivotnyh*. Alma-Ata: Kainar. 112.

18 Bao, QN, Yin, ZH, Zhou, YF, Li, YQ, Zhang, XY, Xia, MZ, Chen, ZH, Zhong, WQ, Yao, J, Wu, KX, Zhang, ZY, Xu, SJ, Liang, FR. (2024). Efficacy and safety of acupuncture for postpartum hypogalactia: A systematic review and meta-analysis of randomized controlled trials. *PLoS One*, 19(6), e0303948. DOI: 10.1371/journal.pone.0303948.

Әртүрлі күйзеліс факторларының ешкілердің лактациясына әсері

Парманбекова М.Х., Шыныбекова Ш.С., Байташева Г.Ө., Иманова Э.М., Койбасова Л.У.

Түйін

Алғышарттар мен мақсат. Сүттің түзілу және бөліну физиологиясын зерттеу ұрпақтың иммундық жүйесі мен зат алмасуын қамтамасыз етудегі лактация мен сүттің биологиялық маңызына байланысты көптеген биомедициналық мәселелерді шешу үшін, сонымен қатар жоғары сапалы сүт өнімдерін өндіру үшін өзекті болып табылады. Гипогалактия құбылысының пайда болуы мен ұзақтығы лактогендік гормондар мен стресс гормондарының сандық қатынасына байланысты. Зерттеудің мақсаты: қалыпты және әртүрлі күйзеліс факторларында сүттену кезіндегі ешкілердің стресс гормондарының деңгейін және сүт бөліну дәрежесін анықтау.

Материалдар мен әдістер. Зерттеу ешкілерге жүргізілді, қан мен сүт құрамына биохимиялық талдаулар жүргізілді. Адреналин мен норадреналин деңгейі күйзеліс және сүттену кезеңіне байланысты флуориметриялық әдіспен зерттелді.

Нәтижелер. Сүт өндіретін осы негізгі гормондардың деңгейі лактогенез кезеңінде өте жоғары екендігі анықталды. Алғаш рет ешкілердегі күйзеліс гормондарының деңгейі сүттену кезеңіне және оларға стресс факторларының әсеріне байланысты екені анықталды. Гормондардың ең жоғары деңгейі лактогенездің алғашқы күндерінде байқалды және лактопоэздің кейінгі кезеңдерінде төмендеді.

Қорытынды. Зерттеу нәтижелері сүт өнімділігінің төмендігі ешкі қанындағы адреналин мен норадреналин мөлшерінің жоғарылауымен байланысты екенін көрсетті. Бұл жағдайда сүт өнімділігі төмендейді, май, ақуыз және лактоза азаяды және лактация кезеңі қысқарады.

Кілт сөздер: лактация; адреналин; норадреналин; гормондар; күйзеліс факторы.

Влияние различных стрессовых факторов на лактацию у коз

Парманбекова М.Х., Шыныбекова Ш.С., Байташева Г.У., Иманова Э.М., Койбасова Л.У.

Аннотация

Предпосылки и цель. Изучение физиологии образования и секреции молока актуально для решения многих биомедицинских проблем, связанных с биологической важностью лактации и молока в обеспечении иммунной системы и метаболизма потомства, а также в производстве высококачественных молочных продуктов. Возникновение и продолжительность феномена гипогалактии зависят от количественного соотношения лактогенных гормонов и гормонов стресса. Цель исследования: определить уровень гормонов стресса и степень секреции молока у лактирующих коз при нормальных и различных стрессовых факторах.

Материалы и методы. Исследование проводилось на козах, были проведены биохимические анализы крови и молока. Уровень адреналина и норадреналина исследовали флуориметрическим методом в зависимости от стресса и периода лактации.

Результаты. Было обнаружено, что уровни этих основных гормонов, вырабатывающих молоко, очень высоки в период лактогенеза. Впервые было обнаружено, что уровень гормонов

стресса у коз зависит от периода лактации и влияния на них стрессовых факторов. Самый высокий уровень гормонов наблюдался в первые дни лактогенеза и снижался на последующих стадиях лактопоэза.

Заключение. Результаты исследования показали, что низкая молочная продуктивность связана с увеличением количества адреналина и норадреналина в крови коз. В этом случае снижается молочная продуктивность, уменьшается количество жира, белка и лактозы, а период лактации сокращается.

Ключевые слова: лактация; адреналин; норадреналин; гормоны; фактор стресса.