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THE ROLE OF METABOLIC DISORDERS IN THE DEVELOPMENT OF LAMINITIS IN HIGH-PRODUCING DAIRY COWS

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Annotation: This article explores the etiological and pathogenetic role of metabolic disorders in the development of laminitis in high-producing dairy cows imported to Uzbekistan. Factors such as subacute ruminal acidosis (SARA), hyperinsulinemia, endotoxemia, and disturbances in lipid metabolism are analyzed in the context of how they trigger adverse physiological responses in exotic breeds under local agroclimatic conditions. The article also presents improved diagnostic and preventive strategies. These findings contribute to maintaining hoof health in highly productive cows, ensuring stable milk yield, and reducing economic losses in dairy farms.

Keywords: Imported dairy cattle, laminitis, metabolic disorder, SARA, endotoxemia, insulin, hoof health, nutrition, adaptation, acclimatization.

Annotatsiya: Ushbu maqolada chetdan olib keltirilgan yuqori mahsuldor sut sigirlarida laminit kasalligining rivojlanishida metabolik buzilishlarning etiologik va patogenetik roli o‘rganiladi. Subakut ruminal asidoz (SARA), giperinsulinemiya, endotoksemiya, lipid almashinuvining buzilishi kabi omillar O‘zbekiston agroiqlim sharoitida chet el zotlarining organizmida qanday salbiy fiziologik reaksiyalarni keltirib chiqarishi yoritiladi. Maqola, shuningdek, diagnostika va profilaktika strategiyalarini takomillashtirish bo‘yicha takliflarni o‘z ichiga oladi. Ushbu tahlillar yuqori mahsuldor sigirlarda sog‘lom tuyoq holatini saqlash, sut mahsuldorligini barqaror ushlab turish hamda fermer xo‘jaliklarida iqtisodiy yo‘qotishlarni kamaytirishga xizmat qiladi.

Kalit so‘zlar: Chetdan keltirilgan sigir, laminit, metabolik buzilish, SARA, endotoksemiya, insulin, tuyoq salomatligi, parhez, moslashuv, adaptatsiya.

Annotation: This article explores the etiological and pathogenetic role of metabolic disorders in the development of laminitis in high-producing dairy cows imported to Uzbekistan. Factors such as subacute ruminal acidosis (SARA), hyperinsulinemia, endotoxemia, and disturbances in lipid metabolism are analyzed in the context of how they trigger adverse physiological responses in exotic breeds under local agroclimatic conditions. The article also presents improved diagnostic and preventive strategies. These findings contribute to maintaining hoof health in highly productive cows, ensuring stable milk yield, and reducing economic losses in dairy farms.

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Аннотация: В данной статье рассматривается этиологическая и патогенетическая роль метаболических нарушений в развитии ламинита у высокопродуктивных молочных коров, завезённых из-за рубежа в Узбекистан. Анализируются такие факторы, как субклинический рубцовый ацидоз (SARA), гиперинсулинемия, эндотоксемия и нарушения липидного обмена, и их влияние на физиологические реакции организма импортированных пород в условиях агроклиматической среды Узбекистана. В статье также предлагаются усовершенствованные стратегии диагностики и профилактики. Представленные данные способствуют сохранению здоровья копыт, стабильной молочной продуктивности и снижению экономических потерь в фермерских хозяйствах.

Ключевые слова: Импортированные коровы, ламинит, метаболические нарушения, SARA, эндотоксемия, инсулин, здоровье копыт, рацион, адаптация, акклиматизация.

Introduction. In recent years, in Uzbekistan's livestock sector, imported high-yield dairy cattle breeds — particularly Holstein and Ayrshire breeds brought from the Netherlands, Germany, the USA, and Russia — have been widely reared. However, these animals, which have not fully adapted to local agro-climatic conditions and feeding systems, are commonly affected by hoof diseases, especially laminitis. Laminitis is a disease that damages the connective structures between the hoof wall and the lamellar tissues, leading to impaired locomotion, a sharp decline in milk production, and reduced reproductive performance. This disease frequently occurs in high-producing dairy cows against the background of metabolic stress. Local scientific observations (Karimov B.T., 2023) and international studies (Lean et al., 2013; Goff, 2006) indicate that metabolic disorders — particularly subclinical acidosis, insulin imbalance, and endotoxemia — are the primary causes of laminitis pathogenesis.

Main Body. The Role of Metabolic Factors in the Development of Laminitis. Laminitis is a polyetiological disease occurring in cattle that primarily damages the connective structures between the hoof wall and the lamellar tissues. In imported high-yield dairy cows, this disease typically develops due to high productivity demands, inability to adapt to changes in the diet, and drastic differences in the rearing environment. Several key metabolic factors play a significant role in the pathogenesis of laminitis: *Subacute Ruminal Acidosis (SARA).*
Imported breeds such as Holstein, Montbéliarde, and other high-producing cattle require a high-energy, balanced, and gradually adjustable diet. However, under Uzbekistan's conditions, these animals are often fed with local energy feeds such as barley, wheat bran, silage, and molasses. Since the rumen microflora is not adapted to such rapidly fermentable feeds, the ruminal pH drops below 5.5, resulting in subacute ruminal acidosis (SARA). Under SARA conditions, lipopolysaccharides (LPS) released from the lysis of gram-negative bacteria translocate from the gut wall into the bloodstream. These endotoxins trigger inflammatory responses in the body and particularly adversely affect the capillary blood vessels of the hoof. This leads to capillary spasms, microthrombosis, and hypoxia, culminating in ischemia, necrosis, and edema of the lamellar tissues. Prolonged SARA episodes manifest clinically as inflammation centers in the hooves, internal fissures, and separation between the hoof wall and lamellar tissues. SARA is regarded as the "silent cause" of laminitis and remains the basis for many subclinical and chronic hoof pathologies.
Insulin and Glucose Imbalance. High-producing breeds require significant energy expenditure for milk synthesis, prompting the organism to activate endogenous mechanisms

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to maintain glucose homeostasis. This often results in hyperinsulinemia — an elevated insulin level in the blood. Insulin hypersecretion disrupts the function of endothelial cells in the blood vessels of the hoof, increasing capillary permeability. Endothelial dysfunction leads to micro-edema, pain, and dystrophic changes in the lamellar structures. Furthermore, hyperinsulinemia enhances the release of inflammatory cytokines (such as interleukin-1 and TNF-alpha), promoting the emergence of subclinical inflammatory foci in the hoof. In other words, the imbalance between insulin and glucose disturbs trophic metabolism in the hoof and creates a background conducive to laminitis development. *Endotoxemia.* Changes in rumen flora and disruption of intestinal epithelial barriers allow pathogenic microbes and their toxins (e.g., LPS, histamine, ammonia) to enter the bloodstream, causing endotoxemia. The LPS endotoxin reaches the lamellar capillaries of the hoof via circulation, disrupting microcirculation, inducing vascular spasms, and causing necrotic changes. Additionally, endocrine responses (such as cortisol secretion) are involved in this process, leading to an increase in inflammatory mediators and structural tissue changes in the laminae. Such endotoxemic reactions are commonly observed in imported cows during the adaptation phase, particularly within the first three months. *Protein and Lipid Metabolism Disorders.* During early lactation, the organism mobilizes fat reserves to meet increased energy demands, resulting in elevated levels of non-esterified fatty acids (NEFA) and ketone bodies. Excessive accumulation of these substances exerts toxic effects, especially on vascular endothelium and lamellar tissues. Ketone bodies exacerbate oxidative stress in the hoof, and in the absence of sufficient antioxidant protection (e.g., vitamin E, selenium), laminitis severity increases. Protein deficiency slows regenerative processes. Since imported cows are often sensitive to local diets, disturbances in energy balance, ketosis, and lipidosis frequently occur among them, creating favorable conditions for laminitis development.

Clinical Signs and Diagnosis. Clinically, laminitis manifests as inflammation of the lamellar structures of the hoof, tissue changes in response to metabolic stress, and ultimately impaired locomotion in the affected animal. In imported high-yield dairy cows, the disease may present more acutely and severely due to incomplete adaptation to Uzbekistan's local feeding and husbandry conditions. The primary clinical signs of laminitis include: *Pain during locomotion:* Using the Locomotion Scoring System (Sprecher et al., 1997), lameness in cows is typically scored between 3 and 4 points. Affected cows place their hind limbs cautiously, elevate the hindquarters, and display unsteady gait. *Heat and hyperemia in the hoof area:* On external examination, redness and noticeable warmth are observed between the hoof wall and the sole, sometimes accompanied by swelling. *Increased lying behavior:* Due to pain, affected cows spend more time lying down, leading to reduced overall activity and feed intake. *Decreased milk production:* Energy imbalance and pain result in a decline in lactation by approximately 10–25%. *Signs of impaired blood circulation:* Cows frequently shift their weight on cold or smooth surfaces and exhibit signs of discomfort. This may be indicative of hypoperfusion and capillary spasms.

Diagnostic Methods. The diagnosis of laminitis requires not only clinical observation but also several laboratory and instrumental methods, including: Rumen pH measurement: One of the key criteria for detecting Subacute Ruminal Acidosis (SARA). A rumen pH below 5.5 confirms an acidic environment. Blood biochemical analysis: NEFA (Non-esterified fatty acids) levels: Values above 0.3 mmol/L indicate an energy deficiency. Ketone bodies (beta-hydroxybutyrate): Levels ≥1.2 mmol/L indicate ketosis and abnormal lipid metabolism. LPS (lipopolysaccharides) levels: Indicate the presence of endotoxemia. Insulin and glucose

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levels: Important for diagnosing metabolic syndrome or insulin resistance. Thermography: Infrared scanning detects temperature changes in the hoof, allowing early diagnosis of subclinical inflammation. Periodic hoof examination: Orthopedic evaluations and functional hoof trimming are performed every three months to maintain hoof health.

Prevention and Management Strategies in the Context of Uzbekistan. Effective control of laminitis and reduction of its economic impact require a systematic and comprehensive approach to adapt imported high-yield dairy cows to the agro-climatic conditions of Uzbekistan. Since laminitis is primarily associated with metabolic imbalance, preventive strategies in livestock farms must include tailored feeding regimes, husbandry, environmental management, and hygiene measures.

Scientific Organization of the Adaptation Period. Imported high-yield dairy cows are highly sensitive to differences in feed types, ruminal microflora, and climatic conditions. Therefore, creating specialized feeding and zoohygienic conditions during the adaptation period is crucial. Diets should be predominantly composed of fibrous components, with low levels of rapidly fermentable carbohydrates, such as roughage and green fodder as the base. Use of rapidly fermentable feeds—such as ground barley or wheat bran—should be limited. This helps maintain ruminal microbial balance and prevents the development of acidic conditions.

Balanced Ration Composition.To ensure metabolic stability, the diet must meet the following criteria: Fibrous feedstuffs should constitute at least 40–45% of the total dry matter intake. Rapidly fermentable starchy components (barley, wheat, corn) should not exceed 20–25%, as exceeding this increases the risk of ruminal acidosis and subsequent laminitis. The calcium-to-phosphorus ratio should be maintained around 2:1. Vitamins A, D, and E, as well as microelements such as selenium, biotin, and zinc, must be supplied at optimal levels. These contribute to maintaining metabolic balance and strengthening hoof tissues.

Use of Buffers and Probiotics. Buffers and beneficial microorganisms are key agents in preventing subacute ruminal acidosis leading to laminitis. Adding buffering agents such as sodium bicarbonate ($NaHCO_3$) and magnesium oxide (MgO) to the diet helps maintain ruminal pH within the physiological range of 6.2–6.5. Additionally, probiotics such as *Bacillus subtilis*, *Bifidobacterium bifidum*, and *Lactobacillus acidophilus* stabilize rumen microflora, reduce inflammatory responses, and promote the dominance of beneficial microbes.

Hoof Care and Orthopedic Monitoring. Regular monitoring of hoof shape and condition is of paramount importance in the prevention of laminitis. Functional trimming — i.e., shaping and cleaning of the hooves — should be performed every three months. This practice eliminates improper load distribution and deformities on the hoof surface, reduces internal capillary pressure, and improves blood circulation. Instead of the traditional "footbath" method for hoof disinfection, modern high-density disinfectant walkways (e.g., filled with copper sulfate, formalin, or organic acid solutions) are employed. Animals regularly walk through these walkways, effectively eliminating harmful microflora accumulated on the hooves.

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Optimization of Physical Environmental Conditions. Hoof health is directly influenced by environmental factors. The comfort of walking paths and resting areas is critical: Walking surfaces should be smooth, non-slip, and elastic (e.g., rubber mats). This minimizes micro-injuries and preserves hoof wall flexibility. Resting areas must be equipped with moisture-absorbing, dust-free, and hygienic materials (such as sand, shavings, or biodegradable bedding). Encouraging daily locomotion improves blood circulation, reduces stress, and enhances oxygenation of the hoof laminae.

Conclusion. Imported high-yield dairy cows face significant metabolic stresses during adaptation to Uzbekistan's agro-climatic, zoohygienic, and nutritional conditions. Particularly in breeds requiring intensive milk production, metabolic disorders such as subacute ruminal acidosis (SARA), hyperinsulinemia, endotoxemia, and disruptions in lipid and protein metabolism are observed, which are the primary etiopathogenic factors contributing to laminitis. Laminitis is not merely a podometabolic inflammation but a complex systemic disorder caused by metabolic dysfunction. Its progression involves immune reactivity, impaired capillary microcirculation, necrosis in lamellar tissues, and changes in hemodynamics. In Uzbekistan, especially on smallholder farms, direct transfer of imported animals to local feed bases, short adaptation periods, poor dietary balance, and intensive exploitation have led to an increase in laminitis cases. Therefore, laminitis prevention can be achieved through adapted feeding regimes, fermentation-controlling probiotics and buffer agents, as well as hoof health monitoring and ergonomic housing systems. Implementation of scientifically based preventive measures under veterinary supervision, early disease diagnosis, and the development of metabolic monitoring systems will ensure animal health, maintain productivity, and enhance the economic sustainability of farming enterprises.

References

1. Lean, I.J., Westwood, C.T., Golder, H.M. (2013). Management strategies for acidosis and laminitis in dairy herds. *Veterinary Clinics: Food Animal Practice*, 29(2), 393–408.
2. Goff, J.P. (2006). Major advances in our understanding of metabolic diseases in dairy cows. *Journal of Dairy Science*, 89(4), 1299–1313.
3. Nocek, J.E. (1997). Bovine acidosis: Implications on laminitis. *Journal of Dairy Science*, 80(5), 1005–1028.
4. Zinpro Corporation (2020). Laminitis in imported dairy cattle: Global case studies. Zinpro Technical Bulletin, Minneapolis, USA.
5. Karimov, B.T., Toirov, R.N. (2023). Metabolic stress and laminitis conditions in imported cows. *Journal of Veterinary Science in Livestock*, 1(15), 45–51.
6. Shodmonov, A.K., Iskandarov, Z.A. (2022). Metabolic diseases and prevention methods in modern intensive dairy farming. Tashkent State Agrarian University Publishing.
7. Rakhmatov, O., & Rakhmatov, F. (2023). Experimental study of the process of drying melon slices in a chamber-convection dryer. In E3S Web of Conferences (Vol. 443, p. 02004). EDP Sciences.
8. Radostits, O.M., Gay, C.C., Hinchcliff, K.W., Constable, P.D. (2007). *Veterinary Medicine: A textbook of the diseases of cattle, horses, sheep, pigs and goats*. 10th Edition. Saunders Elsevier.

ISSN: 2692-5206
AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

9. Raxmatov, F. O., Raxmatov, O., Nuriev, K. K., & Nuriev, M. K. (2021, October). Combined dryer with high efficiency for drying high-moist agricultural products. In IOP Conference Series: Earth and Environmental Science (Vol. 868, No. 1, p. 012076). IOP Publishing.
10. Нуриев, К. К., Рахматов, О., Кадирова, Р. С., & Рахматов, О. О. (2015). Биоконверсия органических отходов растительного происхождения в условиях Узбекистана. In Проблемы рекультивации отходов быта, промышленного и сельскохозяйственного производства (pp. 468-470).
11. Рахматов, Ф. О., & Нуриев, К. К. (2022). Исследование плодов дыни как объекта технической переработки. Илмий мақолалар тўплами, 330.
12. Obidov, A., Nuriev, K., Allanazarov, M., Kurbonov, E., & Khudoyberdiev, R. (2021). Parameters of tillage working bodies. In E3S Web of Conferences (Vol. 284, p. 02012). EDP Sciences.
13. Рахматов, О. О., Рахматов, О., Нуриев, К. К., & Тўхтамишев, С. С. (2019). Мини технологическая линия по безотходной переработке плодов дыни. In вклад университетской аграрной науки в инновационное развитие агропромышленного комплекса (pp. 332-337).