

REVIEW ARTICLE • PEER-REVIEWED • OPEN ACCESS • HAC/OAK 16.00.00 — VETERINARY SCIENCES •
UDC: 619:616.596:636.2

Aetiology, pathogenesis and clinical signs of laminitis in cattle

Qoramollarda laminitlarning etiologiyasi, patogenez va klinik belgilari**Этиология, патогенез и клинические признаки ламинита у крупного рогатого скота****S. B. SULAYMANOV¹, Kh. B. NIYOZOV¹, A. I. RUZIYEV¹**¹ Samarkand State University of Veterinary Medicine, Animal Husbandry and Biotechnologies, Uzbekistan**ARTICLE INFO****ARTICLE TYPE**

Review Article

LANGUAGE OF FULL TEXT

O'zbekcha (UZ)

SCIENTIFIC FIELD / OAK☒ 16.00.00 – Veterinary Sciences

Veterinariya fanlari

HAC Presidium decision No. 371/5, 13.06.2025

UDC / UDK

619:616.596:636.2

ARTICLE HISTORY**Received:** 2026-07-13**Revised:** 2026-07-24**Accepted:** 2026-07-30**Published:** 2026-07-31 **DOI**<https://doi.org/10.66073/ReFocus.V5I7.0711>**CONTACT**

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AUTHOR, TITLE AND ABSTRACT METADATA (EN / UZ / RU)**ENGLISH****S. B. SULAYMANOV¹, Kh. B. NIYOZOV¹, A. I. RUZIYEV¹**¹ Samarkand State University of Veterinary Medicine, Animal Husbandry and Biotechnologies, Uzbekistan

Abstract. Laminitis is one of the most common orthopaedic diseases affecting high-producing dairy cows and represents a significant economic challenge in modern cattle production. This article presents a review and analysis of national and international scientific literature on the aetiology, pathogenesis and clinical manifestations of laminitis in cattle. The analysis revealed that the major risk factors contributing to the development of the disease include subacute ruminal acidosis, endotoxaemia, disturbances of microcirculation, nutritional imbalances and inadequate housing conditions. Laminitis induces morphofunctional alterations in the hoof lamellar apparatus, resulting in lameness, reduced milk production and impaired reproductive performance. Early diagnosis of the disease and the improvement of preventive strategies are essential for increasing the economic efficiency and sustainability of cattle farming.

Keywords: cattle; laminitis; aetiology; pathogenesis; metabolism; pH; ruminal acidosis; keratinization; microcirculation; lameness; productivity

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Annotatsiya. Laminit yuqori mahsuldor sog'in sigirlarda uchraydigan va katta iqtisodiy ahamiyatga ega bo'lgan ortopedik kasalliklardan biri hisoblanadi. Ushbu maqolada qoramollarda laminitning etiologiyasi, patogenez va klinik belgilari bo'yicha mahalliy va xorijiy adabiyotlar tahlil qilindi. Tadqiqotlar natijasida kasallikning rivojlanishida subakut rumen atsidozi, endotoksemiya, mikrotsirkulyatsiya buzilishlari, oziqlantirishdagi xatolar hamda saqlash sharoitlarining nomutanosibligi asosiy xavf omillari ekanligi aniqlandi. Laminit tuyuq lamellyar apparatida morfofunktsional o'zgarishlarni keltirib chiqarib, oqsoqlik, sut mahsuldorligining pasayishi va reproduktiv ko'rsatkichlarning yomonlashishiga sabab bo'ladi. Kasallikni erta aniqlash va profilaktika chora-tadbirlarini takomillashtirish qoramolchilikda iqtisodiy samaradorlikni oshirishda muhim ahamiyatga ega.

Kalit so'zlar: qoramol; laminit; etiologiya; patogenez; metabolism; pH; rumen atsidozi; keratinizatsiya; mikrotsirkulyatsiya; oqsoqlik; mahsuldorlik

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Аннотация. Ламинит является одним из наиболее распространённых ортопедических заболеваний высокопродуктивных молочных коров и представляет значительную экономическую

How to cite / Iqtibos keltirish / Как цитировать: SULAYMANOV, S. B., NIYOZOV, Kh. B., RUZIYEV, A. I. (2026). Aetiology, pathogenesis and clinical signs of laminitis in cattle. Research Focus International Scientific Journal, 5(7), 62–66. <https://doi.org/10.66073/ReFocus.V5I7.0711>

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HAC / OAK: On the HAC list of national scientific publications (Academy of Sciences of the Republic of Uzbekistan) for 06.00.00 Agricultural Sciences and 16.00.00 Veterinary Sciences. O'zbekiston Respublikasi FA huzuridagi OAK ro'yxatida: 06.00.00 – Qishloq xo'jaligi fanlari; 16.00.00 – Veterinariya fanlari.

проблему в современном животноводстве. В настоящей статье проведён анализ отечественной и зарубежной научной литературы, посвящённой вопросам этиологии, патогенеза и клинических проявлений ламинита у крупного рогатого скота. По результатам анализа установлено, что основными факторами риска развития заболевания являются субакутный ацидоз рубца, эндотоксемия, нарушения микроциркуляции, погрешности в кормлении, а также несоответствующие условия содержания животных. Развитие ламинита сопровождается морфофункциональными изменениями ламеллярного аппарата копыт, что приводит к возникновению хромоты, снижению молочной продуктивности и ухудшению репродуктивных показателей.

Ключевые слова: крупный рогатый скот; ламинит; этиология; патогенез; метаболизм; pH; ацидоз рубца; кератинизация; микроциркуляция; хромота; продуктивность

1. MAVZUNING DOLZARBLIGI

Relevance of the topic

Davlatimiz tomonidan chiqarilayotgan bir qator farmon va qarorlar chorvachilik mahsulotlarini ko'paytirishga qaratilgan bo'lib, respublikamiz aholisini sifatli go'sht va sut bilan ta'minlash bugungi kunning dolzarb masalalaridan biri hisoblanadi. Ayniqsa, mahsuldor sigirlar orasida aseptik laminit kasalliklarining ko'plab uchrashi oqibatida fermer xo'jaliklari va aholiga qarashli sigirlarda mahsuldorlikning keskin pasayishi, sut va sut mahsulotlarining kamayishi hamda yuqori mahsuldor hayvonlardan foydalanish muddatlarining qisqarishi hisobiga katta iqtisodiy zarar ko'rilmog'da. Shuning uchun ushbu holatni bartaraf etish maqsadida kasallikning uchrash darajasini o'rganish, davolash va oldini olishni takomillashtirish dolzarb vazifalardan biri hisoblanadi.

Adabiyotlar tahlili shuni ko'rsatadiki, sigirlarda laminitlar chorvachilikning intensivlashuvi bilan bog'liq holda eng ko'p uchraydigan ortopedik kasalliklardan biri hisoblanadi. Ko'plab mualliflarning ta'kidlashicha, laminitlar yuqori mahsuldor sigirlarda ko'proq qayd etilib, bu holat asosan ratsion tarkibining nomutanosibligi va metabolik buzilishlar bilan bog'liq.

2. ADABIYOTLAR TAHLILI

Literature review

Laminit tuyuq terisining diffuz aseptik yallig'lanishi bo'lib, yakka tuyuqli hayvonlarda (otlarda) uchraydi. Kasallik o'rganilgan va adabiyotda yaxshi tasvirlangan. Juft barmoqli kavsh qaytaruvchi hayvonlarda bu kasallik uzoq vaqt davomida amaliy ahamiyatga ega emas edi [1]. Mahsuldor sigirlarda laminit kasalligi to'g'risidagi adabiyot manbalarining ko'pchiligi chet el olimlari tomonidan keltirilgan; otlarda laminit haqida esa alohida maqolalar ko'p bo'lib, ularda qisqacha ma'lumotlar keltirilgan [2].

Tadqiqotchilar ma'lumotiga ko'ra, Sibirda sog'in sigirlarda laminit keng tarqalgan bo'lib, uning uchrash darajasi 50–60 % ni tashkil etadi [3]. Laminit — tuyuqlar dermasining diffuz aseptik yallig'lanishi bo'lib, aksariyat hollarda undan oldin shox kapsulasida funksional va morfologik o'zgarishlarga olib keladigan tizimli kasallik — katta qorin atsidozi yoki endometrit paydo bo'ladi [4, 5].

Ayrim tadqiqotchilar laminit rivojlanishining bir necha bosqichi mavjudligini ta'kidlaydilar. Laminitning dastlabki faollashuvi tizimli metabolik o'zgarishlar bilan bog'liq. Ushbu bosqich katta qorin buzilishi va keyinchalik tizimli pH buzilishining natijasidir. Qon muddatidan oldin arteriyalardan venalarga qaytariladi; kislorod va qon orqali o'tadigan boshqa oziq moddalar shox hosil qiluvchi to'qimalarga (koriumga) yetib bormaydi va shu bilan tomirlarda qon bosimini oshiradi [6, 7]. Mualliflarning ta'kidlashicha, tuyuqdagi qon aylanishining buzilishi laminit rivojlanishi bilan bog'liq asosiy etiologik omil hisoblanadi. Ushbu patologiyada kuchli vazodilatator va arterial konstriktor bo'lgan gistamin faol rol o'ynaydi. Katta qorindagi pH darajasi, ichakdagi gistamin konsentratsiyasi va hayvonning sog'lig'i o'rtasida to'g'ridan-to'g'ri bog'liqlik mavjudligi qayd etilgan; gistamin sintezi

katta qorinda mikroblar populyatsiyasining o'zgarishi bilan bog'liq [8, 9].

Tuyuq shoxining sifati keratinizatsiyaga bog'liq bo'lib, shox hujayraning strukturaviy qattiqligi va mustahkamligini beradi. Laminit bilan bog'liq qon tomir disfunktsiyasi hujayra darajasida korium to'qimalariga ta'sir qiladi. Bu juda muhim masala, chunki shox koriumdan yaxshi qon ta'minlanishiga bog'liq bo'lgan keratinotsitlar deb nomlanuvchi maxsus epidermal hujayralar tomonidan hosil qilinadi. Keratinotsitlar koriumdan oziq moddalarni bazal membrana orqali diffuziya yo'li bilan oladi. Keratinizatsiya — bu keratinotsitlarning keratin oqsillarini ishlab chiqarish jarayoni bo'lib, ular hujayra uchun tizimli yordamni ta'minlaydi va shuning uchun tuyuq shoxining qattiqligi hamda mustahkamligini ta'minlaydi. Keratinotsitlar teri (yoki shox) yuzasiga nisbatan ko'chib o'tganda, ular asta-sekin koriumdan diffuziya orqali yetarli miqdorda oziqa ololmaydigan darajaga yetadi. Bu hujayra o'limiga va kornifikatsiyaga olib keladi — bu jarayonda hujayra qattiqlashadi va keratinlashadi. Natijada yallig'lanish yuzaga kelib, keratinotsitlar ortiqcha zararlanishi mumkin. Oxir-oqibat sifatsiz shox hosil bo'ladi; shunday qilib, yomon shox hosil bo'lishiga sabab bo'luvchi omillardan biri laminit, ayniqsa subklinik laminit rivojlanishi hisoblanadi [10].

Mualliflarning ta'kidlashicha, yirik shoxli hayvonlarda tuyuq laminitdan chorvachilikda sut ishlab chiqarishning kamayishi, bepustlik hamda hayvonlarni mahsuldorligi pasayishi natijasida hisobdan chiqarish katta iqtisodiy zarar keltiradi. Xorijiy olimlar o'z ilmiy tadqiqotlarida tuyuq va barmoq kasalliklaridan kelib chiqadigan bir yillik iqtisodiy zarar har 100 bosh sigir uchun 1750 dan 3724 AQSH dollarigacha bo'lishini aniqladilar [11].

3. TADQIQOT MAQSADI

Aim of the study

Qoramollarda laminitning etiologiyasi, patogenezi va klinik belgilari bo'yicha mavjud ilmiy ma'lumotlarni tahlil qilish hamda kasallikning rivojlanish mexanizmlari va profilaktika choralarini umumlashtirish.

4. MATERIALLAR VA TADQIQOT USULLARI

Materials and methods

Tadqiqot obyekti sifatida mahalliy va xorijiy olimlarning laminit bo'yicha e'lon qilingan ilmiy ishlari, monografiyalari, xalqaro konferensiyalar materiallari va taqriz qilinuvchi jurnallarda chop etilgan maqolalar xizmat qildi.

Tadqiqot jarayonida bibliografik tahlil, qiyosiy baholash, ma'lumotlarni tizimlashtirish va ilmiy umumlashtirish usullaridan foydalanildi. Laminitning rivojlanish mexanizmlari, klinik namoyon bo'lishi va profilaktika choralarini bo'yicha turli mualliflar fikrlari tahlil qilindi.

5. NATIJALAR TAHLILI

Results and discussion

Ko'plab tadqiqotchilarning fikricha, laminit mustaqil kasallik sifatida emas, balki organizmda kechayotgan tizimli metabolik buzilishlarning mahalliy ifodasi sifatida qaralishi lozim. Xususan,

yuqori mahsuldor sigirlarda laktatsiyaning dastlabki bosqichlarida kuzatiladigan energiya tanqisligi, katta miqdorda konsentrat ozuqalarning berilishi va ratsion tarkibida samarali tolaning yetishmasligi katta qorin muhitida chuqur biokimyoviy o'zgarishlarni keltirib chiqaradi.

Zamonaviy tadqiqotlar ma'lumotlariga ko'ra, laminit polietologik xususiyatga ega bo'lib, uning rivojlanishida bir qator endogen va ekzogen omillar ishtirok etadi. Asosiy etiologik omillar sifatida ratsion tarkibida tez parchalanuvchi uglevodlarning me'yordan ortiq bo'lishi, yetarli miqdorda tolali ozuqalarning yetishmasligi, subkut rumen atsidozi, endotoksemiya, tug'ruqdan keyingi endometritlar, mineral va vitaminlar tanqisligi hamda zoogiyenik sharoitlarning qoniqarsizligi qayd etiladi.

Subkut rumen atsidozi sharoitida katta qorin muhitining pH ko'rsatkichi pasayadi, mikrobiotsenoz tarkibi o'zgaradi va biologik faol moddalar, jumladan gistamin miqdori ortadi. Bu esa o'z navbatida tuyuq to'qimalarida qon aylanishining buzilishiga olib keladi. Ratsionda kraxmal va yengil hazm bo'ladigan uglevodlarning ortiqcha bo'lishi natijasida katta qorinda sut kislotasi miqdori oshib ketadi; bu holat rumen muhitining pH ko'rsatkichini fiziologik me'yordan pasayishiga olib keladi. Natijada sellyuloza parchalovchi mikroflora faoliyati susayadi va grammusbat kislotasevar mikroorganizmlar ustunlik qila boshlaydi. Rumen muhitidagi mazkur o'zgarishlar oqibatida endotoksinlar, biogen aminlar va gistamin miqdori ortadi. Gistamin qon tomirlari devoriga ta'sir ko'rsatib, ularning fiziologik faoliyatini izdan chiqaradi; ayniqsa tuyuq dermasidagi mikrotsirkulyatsiya tizimi bunday ta'sirlarga yuqori darajada sezuvchan hisoblanadi.

Laminit patogenezining asosiy bosqichlaridan biri tuyuq to'qimalarida mikrotsirkulyatsiyaning buzilishidir. Qon tomirlar tonusining o'zgarishi, arteriovenoz shuntlarning faollashishi va kapillyarlar o'tkazuvchanligining ortishi natijasida tuyuq dermasida shish, gipoksiya va trofik o'zgarishlar rivojlanadi. Gipoksiya sharoitida hujayralarda energetik almashinuv buzilib, adenozintrifosfat sintezi kamayadi; bu esa shox hosil qiluvchi to'qimalarning fiziologik faoliyatiga salbiy ta'sir ko'rsatadi. Mikrotsirkulyatsiya buzilganda keratinotsitlarning trofikasi yomonlashadi va keratin sintezi jarayoni izdan chiqadi. Natijada tuyuq shoxining mexanik mustahkamligi pasayadi, elastikligi kamayadi hamda tashqi ta'sirlarga nisbatan chidamliligi yo'qoladi.

Keratinizatsiya jarayonining buzilishi tuyuq devorida va tovon qismida bir qator morfologik o'zgarishlarni keltirib chiqaradi. Jumladan, tuyuq devorida gorizontaal halqalar hosil bo'lishi, oq chiziqning kengayishi, shox qatlamining yumshashi, tovon eroziyalari va ikkilamchi infeksiyon jarayonlarga moyillikning ortishi kuzatiladi. Ushbu o'zgarishlar keyinchalik oq chiziq kasalligi, tovon yaralari va barmoq dermatitlari kabi ikkilamchi ortopedik patologiyalarning rivojlanishi uchun zamin yaratadi.

Laminitning klinik kechishi o'tkir, surunkali va subklinik shakllarda namoyon bo'ladi. O'tkir shaklda hayvonlarda harakatlanish og'irqli bo'lib, ular ko'proq yotishga intiladi. Tuyuq harorati oshadi, raqamli arteriyalarda pulsatsiya kuchayadi va palpatsiya paytida og'riq reaksiyasi qayd etiladi. Hayvonlar yurish vaqtida ehtiyotkorlik bilan harakatlanib, tanasining og'irligini orqa oyoqlarga ko'proq o'tkazishga harakat qiladi.

Surunkali laminitda patologik jarayonlar uzoq muddat davom etishi natijasida tuyuq shaklining deformatsiyanishi kuzatiladi: tuyuq devori uzayadi, tovon qismi pasayadi, barmoq o'qi o'zgaradi va hayvonlarda turg'un oqsoqlik rivojlanadi. Bunday hayvonlarda ozuqa iste'moli pasayadi, jismoniy faollik cheklanadi va mahsuldorlik ko'rsatkichlari keskin yomonlashadi.

Subklinik laminit amaliyot nuqtai nazaridan eng xavfli shakl hisoblanadi, chunki tashqi klinik belgilari yaqqol namoyon bo'lmashligi sababli kasallik ko'pincha o'z vaqtida aniqlanmaydi. Biroq tuyuq shoxida kechayotgan morfofunksional o'zgarishlar keyinchalik og'ir ortopedik kasalliklarning rivojlanishiga sabab bo'ladi. Ayrim mualliflarning ma'lumotlariga ko'ra, yuqori

mahsuldor podalarda subklinik laminit tarqalishi klinik shakllarga nisbatan bir necha barobar yuqori bo'lishi mumkin.

6. XULOSALAR

Conclusions

1. Laminit yuqori mahsuldor qoramollarda keng tarqalgan va katta iqtisodiy ahamiyatga ega bo'lgan polietologik kasallik hisoblanadi. Kasallikning asosiy etiologik omillari sifatida subkut rumen atsidozi, endotoksemiya, oziqlantirishdagi xatolar va zoogiyenik omillar namoyon bo'ladi.

2. Patogenez asosida tuyuq dermasida mikrotsirkulyatsiyaning buzilishi, gipoksiya va keratinizatsiya jarayonining izdan chiqishi yotadi. Laminit oqsoqlik, sut mahsuldorligining pasayishi, reproduktiv ko'rsatkichlarning yomonlashishi va hayvonlarning erta yaroqsizlanishiga olib keladi.

3. Kasallikning oldini olish uchun ratsionlarni ilmiy asosda balanslashtirish, tuyuqlarni muntazam profilaktik parvarish qilish, saqlash sharoitlarini yaxshilash va subkut rumen atsidozini erta aniqlash muhim ahamiyatga ega.

DECLARATIONS

Declarations

Author contributions ^{CRedit}

Conceptualization; Methodology; Investigation; Data curation; Writing – original draft; Writing – review & editing. All authors have read and agreed to the published version of the manuscript.

Funding

This research received no external funding.

Ethics approval

The article is a review of published scientific literature. The work involved no experiments on animals and no human participants, and therefore required no separate ethics committee approval.

Informed consent

All authors have read and approved the final version of the manuscript and have given their consent to its submission and publication. The study involved no human participants and no personal data.

Data availability statement

All data discussed in this review are taken from the publications listed in the reference list and are available from those sources.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

The authors thank Samarkand State University of Veterinary Medicine, Animal Husbandry and Biotechnologies for the support provided during the preparation of this review.

Generative AI disclosure

Generative AI was used only partially. The authors used Claude (Anthropic, Opus 5) for language editing, transliteration of the Uzbek text from Cyrillic into the Latin script, formatting of the reference list and preparation of the English and Russian metadata. No text, data, figures or conclusions were generated by AI. The authors reviewed and verified all output and take full responsibility for the content of the publication.

EXTENDED SUMMARY IN ENGLISH

Кенгайрилган inglizcha xulosa / Расширенный реферат на английском языке

Purpose and research problem

A number of decrees and resolutions adopted by the state are directed at increasing the output of livestock products, and providing the population of the republic with high-quality meat and milk is one of the pressing tasks of the present day. The frequent occurrence of aseptic laminitis among productive cows causes farms and private owners considerable economic damage through a sharp fall in productivity, a reduction in milk and dairy products and a shortening of the productive

life of high-yielding animals. Analysis of the literature shows that laminitis in cows is one of the most common orthopaedic diseases associated with the intensification of animal husbandry; many authors note that it is recorded more often in high-producing cows and is connected mainly with an unbalanced ration and metabolic disturbances. Laminitis is a diffuse aseptic inflammation of the corium of the hoof, long known in solipeds and well described in horses, whereas in cloven-hoofed ruminants it was for a long time of little practical importance. Most of the literature on laminitis in productive cows comes from foreign authors, and researchers report a prevalence of 50–60 per cent among dairy cows in Siberia. The aim of this article is to analyse the available scientific data on the aetiology, pathogenesis and clinical signs of laminitis in cattle and to generalize the mechanisms of its development and the measures for its prevention.

Materials and methods

The object of the study was the published scientific work of national and foreign scholars on laminitis, including monographs, materials of international conferences and papers published in peer-reviewed journals. Eleven sources were analysed. The methods used were bibliographic analysis, comparative evaluation, systematization of data and scientific generalization; the opinions of different authors on the mechanisms of development of laminitis, on its clinical manifestation and on preventive measures were compared. The review was structured around three groups of questions: the endogenous and exogenous factors reported as aetiological; the sequence of pathogenetic events from ruminal disturbance through microcirculatory failure to disordered keratinization; and the clinical forms of the disease together with the secondary orthopaedic pathologies that follow from it.

Results and discussion

According to many researchers, laminitis should be regarded not as an independent disease but as the local expression of systemic metabolic disturbances in the organism. In high-producing cows the energy deficit observed in the early stages of lactation, the feeding of large quantities of concentrates and the shortage of effective fibre in the ration produce deep biochemical changes in the ruminal environment. Modern data show that laminitis is polyaetiological: the principal factors are an excess of rapidly fermentable carbohydrates in the ration, a shortage of fibrous feeds, subacute ruminal acidosis, endotoxaemia, post-partum endometritis, deficiency of minerals and vitamins, and unsatisfactory zoohygienic conditions. Under subacute ruminal acidosis the pH of the rumen falls, the composition of the microbiocenosis changes and the quantity of biologically active substances, including histamine, increases. An excess of starch and easily digestible carbohydrates raises the concentration of lactic acid in the rumen and lowers pH below the physiological norm; the activity of cellulolytic microflora declines and acid-tolerant gram-positive microorganisms begin to predominate, so that endotoxins, biogenic amines and histamine accumulate. Histamine, a powerful vasodilator and arterial constrictor, acts on the walls of the blood vessels and disturbs their physiological function, and the microcirculatory system of the hoof corium is highly sensitive to such effects. Disturbance of microcirculation in the tissues of the hoof is one of the key stages of pathogenesis: changes in vascular tone, the opening of arteriovenous shunts and increased capillary permeability lead to oedema, hypoxia and trophic changes in the corium. Under hypoxia the energy metabolism of the cells is disturbed and the synthesis of adenosine triphosphate falls, which impairs the physiological activity of the horn-forming tissues. The horn is produced by specialized epidermal cells, the keratinocytes, which obtain nutrients from the corium by diffusion through the basal membrane; when microcirculation is disturbed their trophic supply deteriorates and keratin synthesis fails. As a result the mechanical strength and elasticity of the hoof horn decrease and its resistance to external influences is lost. Disordered keratinization produces a series of morphological changes in the hoof wall and sole: horizontal rings on the wall, widening of the white line, softening of the horn layer, sole erosions and an increased tendency to secondary infection, which in turn create the basis for white line disease, sole ulcers and digital dermatitis. Clinically the disease occurs in acute, chronic and subclinical forms. In the acute form movement is painful, the animals tend to lie down, the temperature of the hoof rises, pulsation of the digital arteries increases and a pain reaction is recorded on palpation; the animals move cautiously and shift the weight of the body onto the hind limbs. In the chronic form the prolonged pathological process deforms the hoof: the wall lengthens, the sole is lowered, the axis of the

digit changes and persistent lameness develops, feed intake falls, physical activity is limited and productivity deteriorates sharply. The subclinical form is the most dangerous in practice, because the absence of obvious external signs means that the disease often goes undetected in time, while the morphofunctional changes proceeding in the hoof horn later give rise to severe orthopaedic disease; according to some authors the prevalence of subclinical laminitis in high-producing herds may be several times higher than that of the clinical forms. Foreign researchers have established that the annual economic loss from diseases of the hoof and digits amounts to between 1 750 and 3 724 US dollars per 100 cows.

Conclusion and contribution

Laminitis is a widespread polyaetiological disease of high-producing cattle with considerable economic significance; its principal aetiological factors are subacute ruminal acidosis, endotoxaemia, errors in feeding and zoohygienic factors. Its pathogenesis rests on disturbance of microcirculation in the corium of the hoof, hypoxia and failure of the process of keratinization, and it leads to lameness, reduced milk production, impaired reproductive performance and the early culling of animals. For the prevention of the disease, the scientifically based balancing of rations, regular preventive hoof care, improvement of housing conditions and early detection of subacute ruminal acidosis are of major importance. The contribution of this review lies in assembling, for veterinary practice in Uzbekistan, a coherent account of the chain that runs from ration composition through ruminal pH and histamine release to microcirculatory failure and defective horn formation, and in drawing attention to the subclinical form as the point at which prevention is both possible and economically decisive.

ADABIYOTLAR RO'YXATI

References (original language)

- [1] Greenough P.R. Reflections on the prevention of claw disease in cattle. Proceedings of the 14th International Symposium on Lameness in Ruminants. Uruguay, 2006.
- [2] Бурденюк А.Ф., Кузнецов Г.С. Ветеринарная ортопедия. Ленинград, Колос, 1976, 200 с.
- [3] Лопатин С.В., Самоловов А.А. Ламинит — ведущий фактор болезней копыт крупного рогатого скота. Практик, 2008, № 5, с. 62–67.
- [4] Nuss K., Steiner A. Erkrankungen der Klauen und Zehen des Rindes. Stuttgart, Schattauer, 2004, S. 63–76.
- [5] Beige A., Bakir B., Nenci R.G., Ormanci S. Subclinical laminitis in dairy cattle. Turkish Journal of Veterinary and Animal Sciences, 2005, vol. 29, pp. 9–15.
- [6] Nuss K., Paulus N. Measurements of claw dimensions in cows before and after functional trimming. Veterinary Journal, 2006, vol. 172, pp. 284–292.
- [7] Nocek J.E. The link between nutrition, acidosis, laminitis and environment. 1996.
- [8] Shearer J. Laminitis, claw disorders and infectious foot diseases. University of Florida, 2005.
- [9] Enting H., Kooij D., Dijkhuizen A.A. Economic losses due to clinical lameness in dairy cattle. Livestock Production Science, 1997, vol. 49, pp. 259–267.
- [10] Vermut J.J. One step closer to unravelling the pathophysiology of claw horn disruption. Veterinary Journal, 2007, vol. 174, pp. 219–220.
- [11] Oehme B., Grund S., Huber K. Subacute ruminal acidosis and claw health in dairy cows. Journal of Dairy Science, 2019, vol. 102, pp. 1–12.

REFERENCES (ROMAN SCRIPT)

Transliterated list — required by Scopus and Web of Science

- [1] Greenough P.R. Reflections on the prevention of claw disease in cattle. Proceedings of the 14th International Symposium on Lameness in Ruminants. Uruguay, 2006.
- [2] Burdenyuk A.F., Kuznetsov G.S. Veterinarnaya ortopediya [Veterinary orthopaedics]. Leningrad, Kolos, 1976, 200 p. (in Russian)
- [3] Lopatin S.V., Samolovov A.A. Laminitt — vedushchiy faktor bolezney kopytets krupnogo rogatogo skota [Laminitis as the leading factor in claw diseases of cattle]. Praktik, 2008, no. 5, pp. 62–67. (in Russian)
- [4] Nuss K., Steiner A. Erkrankungen der Klauen und Zehen des Rindes. Stuttgart, Schattauer, 2004, pp. 63–76. (in German)

- [5] Beige A., Bakir B., Nenci R.G., Ormanci S. Subclinical laminitis in dairy cattle. *Turkish Journal of Veterinary and Animal Sciences*, 2005, vol. 29, pp. 9–15.
- [6] Nuss K., Paulus N. Measurements of claw dimensions in cows before and after functional trimming. *Veterinary Journal*, 2006, vol. 172, pp. 284–292.
- [7] Nocek J.E. The link between nutrition, acidosis, laminitis and environment. 1996.
- [8] Shearer J. Laminitis, claw disorders and infectious foot diseases. University of Florida, 2005.
- [9] Enting H., Kooij D., Dijkhuizen A.A. Economic losses due to clinical lameness in dairy cattle. *Livestock Production Science*, 1997, vol. 49, pp. 259–267.
- [10] Vermunt J.J. One step closer to unravelling the pathophysiology of claw horn disruption. *Veterinary Journal*, 2007, vol. 174, pp. 219–220.
- [11] Oehme B., Grund S., Huber K. Subacute ruminal acidosis and claw health in dairy cows. *Journal of Dairy Science*, 2019, vol. 102, pp. 1–12.