

PREVALENCE OF CLAW DISORDERS IN DAIRY FARMS WITH TIE STALLS

BOJKOVSKI J.¹, HADŽIĆ I.⁷, PRODANOVIĆ R.¹, VUJANAC I.¹, NEDIĆ S.¹,
ARSIĆ S.¹, PAVLOVIĆ I.³, ZDRAVKOVIĆ N.³, BOJKOVSKI D.⁴, BECSKEI ZS.¹,
DOBORSVLJEVIĆ I.⁵, MILANOV D.⁶, RELIĆ R.²

¹University of Belgrade, Faculty of Veterinary medicine, Bulevar Oslobođenja 18,
Belgrade, Serbia

²University of Belgrade, Faculty of Agriculture, Serbia

³Scientific Veterinary Institute of Serbia, Serbia

⁴University of Ljubljana, Biotechnical faculty, Slovenia

⁵Specialistic veterinary institute, Serbia

⁶Scientific Veterinary Institute "Novi Sad", Serbia

⁷Al dahra, Serbia, Serbia

E-mail: bojkovski@vet.bg.ac.rs

Summary

In intensive rearing conditions, dairy cows are exposed to many factors that can cause health disorders and significant economic losses. Today, claw diseases are the main problem in high-milk cow's herd, along with metabolic diseases, mastitis and reproduction disorders. Claw diseases can have direct effects on reproductive parameters. The aim of our research was to determine the frequency of certain diseases of the locomotor apparatus of dairy cows on farms with tie stall system. In the period of two years, a total of 37,893 cows were examined, wherein the following has been found: Laminitis in 34,217 cows (90.30%), Dermatitis interdigitalis in 25,876 cows (68.29%), Dermatitis digitalis in 11,817 cows (31.18%), Rusterholz ulcer in 8,272 cows (21.83%), Fibroma in 3063 cows (8.08%), and Panaritium in 618 cows (1.63%). The results show that laminitis dominates in the herds. Considering the etiology of diseases determined at the farms it is primarily to focus on preventing the formation of metabolic disorders and adequate nutrition of the animals, and then on the improvement of housing conditions and the regular implementation of measures to prevent the spread of infectious claw diseases.

Keywords: dairy cows, claw diseases, tie-stall system

In intensive production cows are exposed to the numerous factors that can cause health problems. Nutrition based on high-energy feed with the addition of large amounts of proteins, poor housing conditions in tie stall system, increased body weight and even the size of the cow milk of high-productive race, they all present a great threat to the health of cows. Based on the large number of studies, about 60% of cows in herds annually have problems related to locomotor tract, followed by a smaller or larger degree of lameness.

Today, the claw diseases are the biggest problem in high productive dairy herds and they affect economic parameters, together with metabolic diseases, mastitis and reproduction disorders. Reproductive problems are still considered as the most important factor for economic losses and, at the same time, it is a quite clear that many reproductive problems arise precisely due to acropodic diseases.

Any stage of the lameness in the first 30 days after delivery causes reduced production and reproductive capacity of the animal. There is a high likelihood that, in such animals, the heat will be concealed and not manifested by clear clinical symptoms.

Claw diseases cause significant direct and indirect damages. Direct damages are due to the cost of the therapy and the inability to use milk due to the withdrawal period after the therapy, as well as due to the forced slaughter of animals that cannot be cured (1, 2, 9). Indirect damage is caused by reduced production of milk in lactation, reduced fitness, reproductive disorders and predisposition for mastitis appearance (5).

Lameness is the earliest and the most important clinical symptom of acropodium diseases of cattle. In 90% of cases the cause of lameness is in claws, and only in 10% of cases in other anatomical parts of the limb. Likewise, in 90% of the cases of lameness, the pathological process is at the hind extremities, in the area of the outer claw, while on the front extremities the process is located on the inner claw.

In tie-system, which is still largely represented in Serbia, the hind extremities are in significantly less hygienic conditions than the front ones, and they are often exposed to mechanical influences (8). In most cases, the primary pathological process is aseptic pododermatitis (laminitis). In some farms, it causes more than 80% cases of lameness. When the process take a chronic course, deformities of the claw's corium and the sole occur, followed by secondary infections (8, 6, 5).

The aim of this study was to determine the frequency of certain claw diseases of dairy cows in farms with tie stalls system, with particular review to laminitis.

Materials and methods

At seven dairy farms with tie stalls housing system the condition of claws of lactating cows was monitored. During two years totally 37,893 cows were examined. The checkup and diagnostics were performed during routine processing of claws, twice a year (in total four processing cycles). The obtained data were statistically processed.

Results and discussions

According to the results, at dairy farms in the two-year period Laminitis dominated, which was diagnosed in total 34,217 cows (90.30%), followed by Dermatitidis interdigitalis in 25,876 (68.28%), Dermatitidis digitalis at 11,817 (31.18%), Rusterholz disease 8,272 (21.83%), Fibroma in 3,063 (8.08%) and Panaritium in 618 cows (1.63%).

Table 1

The prevalence of claw diseases in two consecutive years and two cycles of trimming per year

Farm	Year	Cycle	Diagnosis (%)*						
			L	Rh	Did	Dd	P	F	PS
1	1	1	88.87	13.62	68.82	13.50	2.14	4.81	-
		2	92.74	21.77	61.65	25.87	1.34	7.96	-
	2	1	94.06	14.44	71.10	29.71	1.32	4.79	-
		2	89.62	26.84	74.97	28.01	1.17	8.20	1.81
2	1	1	88.17	11.53	72.34	16.63	1.04	5.62	-
		2	89.79	23.24	69.58	28.16	0.9	9.48	-
	2	1	87.94	24.11	76.27	31.24	1.33	8.14	2.89
		2	97.44	30.06	60.26	45.88	0.82	9.12	3.38
3	1	1	69.18	21.28	49.40	47.73	-	-	-
		2	92.79	14.24	72.42	23.32	0.59	7.46	-
	2	1	90.97	29.15	66.66	32.41	6.43	1.16	-
		2	93.57	27.5	76.24	27.92	1.44	8.66	1.68
4	1	1	88.68	18.93	54.59	15.00	0.54	3.45	-
		2	91.07	10.48	76.60	28.25	0.40	5.32	-
	2	1	90.57	17.45	72.42	35.17	5.27	0.86	-
		2	91.46	18.55	70.36	30.78	0.61	4.83	1.58
5	1	1	79.29	13.38	66.70	33.24	1.95	13.84	-
		2	89.03	30.55	58.62	40.99	1.25	9.45	-
	2	1	96.82	19.98	71.08	33.38	1.43	9.09	-
		2	96.50	33.25	70.70	34.03	1.63	15.77	3.96
6	1	1	78.28	12.36	62.56	36.37	0.95	8.11	-
		2	91.05	31.84	63.68	43.82	1.36	7.88	-
	2	1	89.80	17.67	65.54	37.9	1.94	10.11	-
		2	95.65	33.52	73.23	38.93	2.63	12.95	5.76
7	1	1	90.33	11.90	81.79	28.99	0.71	11.39	-
		2	90.70	25.61	63.71	28.71	4.92	13.30	-
	2	1	100	13.74	75.08	35.9	0.75	10.76	-
		2	92.84	24.9	67.76	25.49	1.06	20.31	2.22

*L - Laminitis, Rh - Rusterholz ulcus, Did - Dermatitis interdigitalis, Dd - Dermatitis digitalis, P- Panaritium, F - Fibroma, PS- Pododermatitis septica

Laminitis is a huge problem because mostly cows with high production get sick. It is not an infectious disease, such as interdigital dermatitis, digital dermatitis and interdigital phlegmon (foot rot). Laminitis is a metabolic disease with degenerative changes in the corium and claw's wall (the process infiltrates papillae of the corium), and it appears in period around calving. Laminitis does not last for a long time (for several weeks mainly), but walking problems can be prolonged due to deformity of the claws (8).

Causes of laminitis are stress in calving, unbalanced nutrition and overloading of claws. A sudden change in the meal can lead to laminitis, especially

the high content of easily digestible low-fiber carbohydrates, as well as an inadequate rumen development. Rumen acidosis (followed by lactic acid bacteria development and reduction of gram-negative bacteria) accelerates the release of endotoxins. As a consequence, the cow organism produces histamine that first causes vasoconstriction and then vasodilation of the claw's corium capillaries. There are a swelling, hyperemia and destruction of the blood vessels of the corium presented. Claws become painful as the consequence of capillaries' damage which decrease the synthesis of keratin of the wall. Also, ketosis, poor body condition, hormonal changes in the period of calving, udder edema, retention of placenta and dystocia may be the cause of laminitis. Metritis and mastitis may also lead to laminitis development: toxins from the microorganisms in udder via blood can reach the claws and cause the problems in wall development and hemorrhages. Diseases such as interdigital dermatitis, digital dermatitis, IBR (Infectious Bovine Rhinotracheitis) and BVD (Bovine Viral Diarrhea) have been associated with the onset of laminitis (9).

Endotoxins are considered to be a key etiological factor linking nutrition errors, acidosis of the rumen and particular systemic diseases. The source of endotoxins are gram-negative bacteria. When in the lumen of the fore-stomachs a larger amount of easily digestible carbohydrates enters, they start to decompose due to amylolytic bacteria and release the large quantity of organic acids, of which the most important is lactic acid. The acid decreases pH of the rumen's content and this causes an increased disintegration of gram negative bacteria' body and the release of endotoxins. At the same time, permeability of the cutaneous mucous membrane of the rumen is disturbed, which further facilitates the resorption of endotoxins present in the content.

In acidotic conditions, in rumen content the process of decarboxylation of amino-acids is intensified and so histidine generates large amounts of histamine. By reducing the pH of the content, the activity of histaminase in the wall of the rumen is reduced. Therefore, much higher amounts of histamine reach the liver and from there go into systemic circulation. Disorders in histamine-induced circulation confirm the hypothesis of histamine intoxication in rumen acidosis (4, 8).

In etiology and pathogenesis of laminitis, as one of the important predisposing factors, especially at the onset of the disease, the anatomical characteristics of blood vessels in corium which is constricted between the falangeal bone and the wall are mentioned. In such filled space there is no possibility of spreading the vessels in the case of fluid leakage into the interstitium, which is one of the earliest disorders that arises as a result histamine effect on the vascular elements of the claws' corium. Increased transduction and later exudation cause an increase of tissue' pressure that further complicates the blood circulation in laminas and causes their ischemia. This is quite understandable if consider the inelasticity of the corium which cannot be spread under the pressure of created swelling of the claw's corium. At this stage, laminitis is followed by increased temperature and pain of the claw and a high degree of lameness from the onset of the disease. The leaves of the corium, about 1300 in each of the claws, are narrow

and very delicate. They are well-supplied with blood and have a lot of arteriovenous anastomosis. In the tissue of the corium, a rich network of nerve plexuses is spreading, because as it known, the claws are not just mechanical support for the body, but they represent a specific tactile organ (they are involved in maintaining balance and motion). Other actors, such as body weight, body condition, hereditary and acquired anomalies, they can all play a certain role in the pathogenesis of laminitis. Circulation, ischemia and hypoxia disorders cause degenerative changes in the corium and damage of laminas. When the process takes chronic form, a change in the position of the falangeal bone may occur, deformation of the claw and breaking the top of the bone through the sole. These are mechanical damages due to pressure of the cornea lamina, circulation disturbances and the resulting necrotic processes. Related to this, there are a number of changes that occur later, such as thickening of the sole (double sole), bleeding in the sole, and sometimes the appearance of a hematoma. In some cases, this process is characterized by the changes in the color of the sole. Pale fields are often mottled by hyperemic areas or many hemorrhages (1, 2, 3, 4, 8).

On the corium is noticeable the redness, serofibrous to hemorrhagic exudate, bleeding on the surface of the sole surface, especially haemorrhage, cell infiltration and necrosis of the corium, and thrombosis of small blood vessels. In subcutaneous cases, there are histiocytes and fibrosis. In chronic cases, there are deformities of the wall and corium and changes in the position of the bone. A histological finding reveals the process of sclerosing and arising of the perineural connective tissue (4).

In the acute phase of the disease, depending on the degree of inflammation, localization, and intensity of the pain, there is an inability or avoidance of reliance on the claws, which are tempered, diffusely sensitive to pressure, and sometimes with redness and swelling of the corneal margin. In the case of diseased fore claws, the animal kneel on the carpal joints for long period while getting up, so they take food in such a position. When standing and walking in order to relieve the tip of the claw the forelegs are a forward stroke, the walk is reluctant, prolonged and stiff, with short steps. In affected hind claws, the animals are raised to the forelegs and occupy the dog's sitting position or their back is hunched, the hind legs are noticeable under the body and the claws are spared by abduction or leg induction. The heavily diseased animals do not get up, they lie on the side or on the chests with as much possible relief of the hind and the forelegs. This condition is often accompanied by more rapid pulse (up to 120 per minute), fast breathing (up to 80 per minute), increased body temperature (up to 40.5°C) muscle trembling, mucous membrane hemorrhage, decreased or stopped appetite, sweating and, depending on the causes the presence of digestive tract disorders (increased or decreased by number of rumen contraction or diarrhea), puerperal disorders, mastitis, polyarthritis and/or polysynovitis. In sub-acute cases, the symptoms described are less pronounced (1, 2, 3, 4, 8).

Chronic or recurrent cases arise from untreated or untreated acute and sub-acute cases. On the claw's wall dents are formed (ring changes more or less

parallel with the coronary edge). In addition, the softening of the wall may appeared, with creation of yellow or partially reddish changes on the sole of the claw. The walk is rigid and the load is predominantly on the heel portion of the claw. Animals lose weight. The easier acute cases, after removing the cause, they are cured for one to two weeks. Serious cases, if not treated, often became chronically, with the possibility of complications in the form of taking off the claw, breakthroughs of the sole, infection with the onset of rotten or necrotic pododermatitis. Decubitus wounds and phlegmons, claws' and bone deformities, chronic lameness, progressive weight loss and total exhaustion of the animal appear later (1, 2, 3, 4, 8).

Anamnestic data and clinical picture are sufficient to set the diagnosis. Examination should include the discontinuation of individual claw, "stall claws", coronary margin disease, interdigital phlegmone, claw bone fracture, joint distortion and osteomalatia. In fattening cattle, rickets should be excluded considering the same clinical picture as pododermatitis. The difference is that in rickets the changes are located in long bones (thickening of the epiphysic-diaphragic border), and in pododermatitris they are in claw's corium (8).

Laminitis usually occurs on the hind lateral claw. Acute laminitis appears suddenly and is accompanied by swelling and severe pain. Heart rate and ventilation of the lungs are increased, the claw is heated and swelling over the coronary side of the claw is presented. Hemorrhages are sometimes visible on a white line, or at the passage of the wall into the sole. Sometimes hemorrhage is not visible, causing segregation on the white line, the entry of dirt and the formation of abscess. Subclinical laminitis can last 1 to 3 months. Symptoms of the disease can be seen only after a few weeks or months, based on changes in the wall and in the form of the claw. The most recognizable changes caused by laminitis are: thrived fingers (resulting in increased creation of the horn, with the incorrect growth rings falling backwards; because of this, the outer claw becomes too high and overburdened so that the pain arises, and consequently the unnatural position of the hind legs, as well as limping), the occurrence of hemorrhage in the sole (due to pathological changes in the wall the blood clotting and spraying of the capillaries occur, so the blood is visible during the claw trimming), defect of the white line (the white line can change color from yellow to red, and may be ulcerated), the appearance of a double sole (in severe cases, the sole can be completely separated, often developing a new sole). Chronic laminitis develops without symptoms for 1 to 3 months, then lesions appear on the sole and the wall of the claw, and then a soft claws with unpigmented areas with yellow and haemorrhagic streaks (4, 8).

In acute form, good results are achieved by administering an antihistamine. The most important preventative measure in relation to laminitis is minimizing cows' stress on calving by keeping them in special groups and feeding with balanced meals. It is necessary to use the seeds of proven bulls for easy calving. A good hygienic conditions for cows need to be provided (4, 5).

Conclusions

In a two-year study, laminitis was found to be the most serious health problem on dairy farms with tie-stall system. Infectious diseases of claws are also largely represented (interdigital and digital dermatitis). Considering the etiology of detected claw diseases, it is primarily to focus on preventing the development of metabolic disorders and proper nutrition of the cows, and then on the improvement of housing conditions and the regular implementation of measures to prevent the spread of claw diseases pathogens.

Conflict of interest statement

The authors have no conflict of interest.

Acknowledgements

This research was financed by Ministry of Education, Science and Technological Development of Serbia, Grants TR 31071.

References

1. **Bojkovski, J., Šamanc, H., Ivanov, I., Janković, D., Bugarski, D., Urošević, D.**, Aseptično zapaljenje korijuma papaka goveda (Aseptic inflammation of the corium of cattle claws), *Savremena poljoprivreda*, 2001, 50, 3-4, 355-356 (In Serbian).
2. **Bojkovski, J., Hadžić, I., Rogožarski, D., Pavlović, I., Savić, B., Đedović, S.**, Contribution to knowledge laminitis by dairy cows in Serbia, *Lucrări Stiintifice: Medicina Veterinara Timisoara*, 2013, 46, 4, 24-32.
3. **Bojkovski, J., Savić, B., Relić, R., Petrujkić, T.**, Prilog poznavanju aseptičkiog pododermatitisa mlečnih krava (Contribution to the knowledge of aseptic pododermatitis of dairy cows), *Veterinarski Žurnal Republike Srpske*, 2011, vol. XI, 1, 53-58 (In Serbian).
4. **Djoković, R., Giadinis, N., Stamatis, A., Bojkovski, J.**, Zdravstvena zaštita preživara (Health care of ruminants), *Univerzitet u Kragujevcu, Agronomski fakultet, Čačak*, 2014 (In Serbian).
5. **Hadžić, I., Pavlović, I., Hudina, V., Anđelić Buzadžić, G., Bojkovski, J.**, Dermatitis interdigitalis and dertmatitis digitalis the great problem on cattle production, *Bulletin USAVM, Veterinarary Medicine*, 2013, 70, 2, 242-248.
6. **Milosavljević, P., Savić-Stevanović, V.**, Frequency of acropodium disease in dairy cow in Serbia, *Acta Veterinaria*, 2013, 63, 2, 247-254.
7. **Radostits, O.M., Clive, C.G., Kenneth, W., Hinchcliff, P.D.**, *Veterinary Medicine, A textbook of the diseases of cattle, horses, sheep, pigs and goats*, Saunders Elsevier, 2006.
8. **Radojičić, B., Bojkovski, J., Jonić, B., Čutuk, R.**, *Bolesti preživara (Diseases of ruminants)*, Naučna, Beograd, 2017 (In Serbian).
9. **Shearer, J.K., van Amstel, S.R.**, Functional and Corrective Claw Trimming, *Veterinary Clinics of North America, Food Animal Practice*, 2001, 17, 1, 53-72.