



Prevalence of Foot Lesions Among the Slaughtered Cattle in the Northwest of Iran*

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Abstract: The objective of this study was to determine the prevalence of foot lesions in cattle slaughtered in the northwest of Iran. This study was performed on lower limbs of slaughtered cattle in four seasons of 2018-19. The feet of 400 cattle were divided into various zones to differentiate the lesions. The associations between gender and season with the lesions were assessed using the chi-square method and the results were presented as a percentage. $P < 0.05$ was considered significant. The association between gender and season with the lesions was statistically significant ($P < 0.01$). Lesions were observed in 61.5% of cattle and 78.5% of them were male. The lesions were more prevalent in autumn and winter (35.4%). 27% of total lesions were related to the forelimbs and 73% of them were related to the hindlimbs. Double sole and subclinical laminitis were the most frequent lesions of the limbs followed by sole, toe, and heel ulcers, white line disease, hoof cracks, interdigital hyperplasia, and interdigital necrobacillosis. Since a high percentage of slaughtered cattle in northwest Iran had at least one lesion in their feet, especially in the autumn and winter, it seems that proper management of herds is necessary to eliminate predisposing factors and improve livestock health.

Keywords: Cattle, Foot Lesions, Hoof, Iran, Prevalence.

İran'ın Kuzeybatısında Kesilen Büyükbaş Hayvanlarda Ayak Lezyonlarının Görülme Sıklığı

Öz: Bu çalışmanın amacı İran'ın kuzeybatısında kesilen sığırlarda ayak lezyonlarının yaygınlığını belirlemektir. Bu çalışma 2018-19 dört mevsiminde kesilmiş sığırların alt ekstremitelerinde gerçekleştirildi. 400 büyükbaş hayvanın ayakları lezyonları ayırt etmek için çeşitli bölgelere ayrıldı. Lezyonlarla cinsiyet ve mevsim arasındaki ilişki ki-kare yöntemi ile değerlendirildi ve sonuçlar yüzde olarak sunuldu. $P < 0.05$ anlamlı kabul edildi. Lezyonlarla cinsiyet ve mevsim arasındaki ilişki istatistiksel olarak anlamlı idi ($P < 0.01$). Sığırların %61.5'inde lezyonlar gözlemlendi ve %78.5'i erkekti. Lezyonlar sonbahar ve kış aylarında daha sıkı (%35.4). Toplam lezyonların %27'si ön ayaklar, %73'ü arka ayaklar ile ilişkiliydi. Ekstremitelerde en sık görülen lezyonlar çift taban ve subklinik laminit olup bunu taban, ayak ve ökçe ülserleri, beyaz çizgi hastalığı, toynak çatlakları, interdigital hiperplazi ve interdigital nekrobasiloz izledi. Kuzeybatı İran'da kesilen sığırların yüksek bir yüzdesi özellikle sonbahar ve kış aylarında ayaklarında en az bir lezyon bulundurdıklarından, predispozan faktörleri ortadan kaldırmak ve hayvan sağlığını iyileştirmek için sürülerin uygun şekilde yönetilmesi gerektiği görülmektedir.

Anahtar Kelimeler: Ayak Lezyonları, İran, Prevalans, Sığır, Tırnak.

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INTRODUCTION

Lameness is an important cause of economic losses and a primary cause of reduced animal welfare in both beef and dairy herds is of crucial concern to bovine herd health (1). It causes the third-largest economic losses in the dairy cattle industry following mastitis and reproductive disorders. However, due to the impact of lameness on production and reproduction, some researchers consider it as the most important factor in damaging dairy herds today. The economic losses due to lameness in the UK were estimated to be £ 90 million a year (2). Approximately 90% of lameness incidents in cattle are related to digital lesions (3).

Information on the prevalence of lameness and limb injuries in North American and European dairy herds has been collected in recent decades and efforts have been made to find solutions to reduce these diseases. Its prevalence at the herd level was reported to be 43.5% in a Brazilian state, 9% in Canada, and 18% in France, Germany, Spain, and Sweden (4-6). Several studies have also been conducted to estimate the prevalence of lameness in various regions of Iran. The results of Azizi-Mahmoudjig and coworkers' study (7) demonstrated that 14.7% of heifers and cows in semi-industrial and 3.4% of them in industrial herds of Urmia suffer from lameness. Mohammadnia et al. (8) found that 55.14% of studied dairy cows in Shahrekord are lame based on locomotion scoring. Another study in dairy herds of Shahrekord showed that 48.6% and 40.17% of affected digits are in autumn and spring, respectively (9).

Determining the frequency of foot lesions in each geographical area may play an effective role in planning the prevention and treatment of these problems because there are obvious differences in the estimated prevalence of digit lesions in different countries. There are several known factors affecting the occurrence of the lesions such as type of housing, weather, production rate, nutrition, individual

factors, as well as the presence of pathogenic organisms in the area, leading to a big variation in the prevalence of diseases reported in the literature (10). For instance, in the case of housing conditions, daily access of the majority of the cattle (89%) to pasture in the Netherlands was associated with a reduced prevalence of hoof lesions (11). Cattle, which had access to thick bedding of straw, have also shown the least amount of digit lesions (12). However, to our knowledge, there is no data available concerning the prevalence of hoof lesions in culled cattle or herds of the northwest of Iran. Mostly traditional loose-housing system with the cold and humid climate in this area led us to assume that number of affected cattle may be increased. Thus, the purpose of this study was to determine the prevalence of foot lesions in culled cattle in the northwest of Iran during a whole year.

MATERIALS and METHODS

Animals

This study was done in the cattle slaughtered at the Tabriz and Urmia Industrial Slaughterhouses, located in Azarbaijan provinces of Iran, in spring, summer, and autumn of 2018 and winter of 2019. Approval of the ethics committee was not required because of the use of slaughtered animals. Attending times were randomly selected so that the abattoirs were visited four times in each season to examine the limbs of the cattle. Sex and approximate weight were recorded before slaughter.

The sample size was determined using the Cochran's sample size formula with a 95% confidence interval. The population size was estimated 30,000 based on the national statistical reports (13). Regarding the number of cattle slaughtered in the province, the sample size of 380 was calculated. So, the total number of 400 cattle was examined in this study to estimate the prevalence of digit lesions in the region.

Detection of the lesions

On each sample collecting day, the feet of each cattle were collected and washed to check for lesions. Since the feet of each cattle after slaughtering were delivered together, we had to detect that each foot belongs to hindlimbs or forelimbs. The forelimbs and hindlimbs were distinguished based on the oval shape of the metacarpus and circular shape of the metatarsus bones, as well as the relative size of the proximal and middle phalanges which are reported to be shorter in the hindlimbs than forelimbs (3). After the foot was fixed on the special clamp and the primary hoof trimming was done, the lesions were recorded and photographed. Then, the hoof horn was removed from the underlying tissues after placing the limb in boiling water, to determine the extent of lesion penetration to the underlying tissues.

To easier differentiate the lesions, the sole and hoof wall were hypothetically subdivided into different zones (Figure 1), and the following lesions were traced (14): double sole (zones 3, 4, 5, and 6), subclinical laminitis (zones 1-6), white line disease (zones 1, 2 and 3), toe ulcer (zones 1 and 5), sole ulcer (zone 4), heel ulcer and erosion (zone 6), horizontal and vertical cracks and hoof fractures (zones 7, 8, 11 and 12), interdigital necrobacillosis, dermatitis and hyperplasia (zone 0) with extensive lesions of digital dermatitis (zone 10).

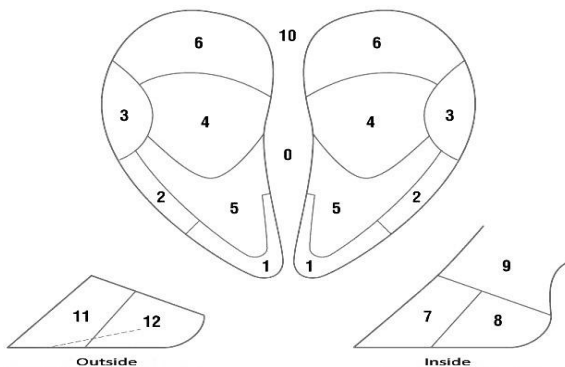


Figure 1. Subdividing the solar surface, interdigital space, and axial and abaxial hoof wall of the cattle into various zones to help trace different lesions.

Şekil 1. Farklı lezyonları izlemeye yardımcı olmak için sığırların axial ve abaxial tırnak duvarı, interdigital boşluk ve taban yüzeyinin çeşitli bölgelere ayrılması.

Statistical Analysis

IBM SPSS Statistics for Windows (Version 22, IBM Corp., Armonk, NY, USA) was used for statistical analysis. Hoof lesions data and their types were reported as descriptive statistics and percentages. The effects of gender and season on the lesions were evaluated using the chi-square method and the results were presented as percentages. $P < 0.05$ was considered significant.

RESULTS

Totally, 400 cattle (67 females and 333 males) with the average weight of 325 ± 42 kg were examined during the four seasons. Lesions were observed in 61.5% of the animals and 38.5% of them were healthy. There was a significant difference between healthy and affected animals percentage ($P = 0.001$). Among the affecteds, 78.5% were male and 21.5% female. In addition, 79.1% of all females and 58% of all males had lesions. In terms of the prevalence of lesions in different seasons, 17.1% were in spring, 12.1% in summer, 35.4% in autumn and 35.4% in winter (Table 1). The differences between healthy and affected animals in each season was also significant ($P = 0.001$). Of the total lesions, 27% were in the forelimbs and 73% were in the hindlimbs.

Double sole (28.5%) and subclinical laminitis (23.5%) were the most prevalent diseases followed by sole ulcer (13%), toe ulcer (9.3%), heel ulcer (7.7%), white line disease (7.75%), hoof fracture (5.75%), and interdigital hyperplasia (2.1%). Interdigital necrobacillosis (0.8%), horizontal crack (0.8%), and vertical crack (0.8%) were the lowest lesions identified (Figure 2). Some of these lesions are shown in Figure 3.

Table 1. The number and percentage of healthy and affected cattle based on gender and season in culled cattle in northwest Iran.

Tablo 1. İran'ın kuzeybatısında kesilen sığırlarda, cinsiyete ve mevsime göre sağlıklı ve etkilenen sığırların sayısı ve yüzdesi.

Categorical variables		Hoof status				Total	P-value
		Affected		Healthy			
		No. (% in affected)	% in category	No. (% in healthy)	% in category		
Gender	Female	53 (21.5)	79.1	14 (9.1)	20.9	67	0.001
	Male	193 (78.5)	58	140 (90.9)	42	333	
	Spring	42 (17.1)	60.9	27 (17.5)	39.1	69	
Season	Summer	30 (12.2)	36.6	52 (33.8)	63.4	82	0.001
	Autumn	87 (35.4)	72.5	33 (21.4)	27.5	120	
	Winter	87 (35.4)	67.4	42 (27.3)	32.6	129	
Total		246	38.5	154	61.5	400	

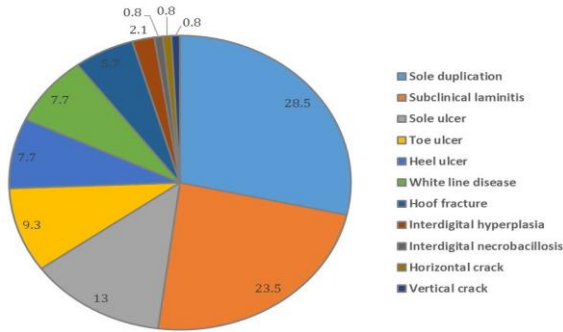


Figure 2. The contribution of each lesion to the total number of detected foot lesions (%) in culled cattle in northwest Iran.

Şekil 2. İran'ın kuzeybatısındaki kesilen sığırlarda her bir lezyonun tespit edilen toplam ayak lezyonu sayısına (%) katkısı.

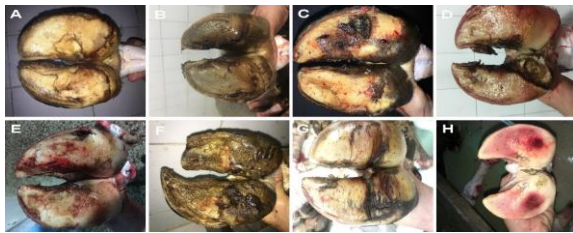


Figure 3. Detected lesions in cattle hooves. A. duplicate sole, B. subclinical laminitis, C. sole ulcer, D. heel ulcer, E. white line disease, F. hoof fracture, G. interdigital hyperplasia, H. interdigital necrobacillosis along with sole ulcer.

Şekil 3. Sığır tırnaklarında tespit edilen lezyonlar. A. çift taban, B. subklinik laminit, C. taban ülseri, D. ökçe ülseri, E. beyaz çizgi hastalığı, F. tırnak kırığı, G. interdigital hiperplazi, H. taban ülseri ve interdigital nekrobasiloz.

DISCUSSION and CONCLUSION

This study was performed on hoof and digit lesions of slaughtered cattle. Our findings showed that 61.5% of the cattle examined had at least one lesion in their feet, which is much higher than that of the results of a similar study in the neighbour province, Ardabil, reporting 24.2% of slaughtered cases had hoof lesions (15). Given that in the surveyed geographical area, cattle are usually culled if keeping them is not justified because of low milk yield or lameness, it is likely that the prevalence of lameness in the livestock population of the area is less than our finding. It has been previously reported that lameness should be considered as an important factor for the culling of Iranian dairy cows (16). The reason for the higher incidence of lesions in cows than bulls in our study may be the fact that the cows slaughtered at the end of their economic period of life; while bulls and steers are slaughtered at a relatively younger age. For instance, the mean age of slaughtered cows in Switzerland is 5.6 years, while the number of slaughtered bulls in this age range is much lower (17). Although among the affected cattle, 78.5% were male and 21.5% female, this does not indicate a high incidence of lesions in males compared to females; instead this is because the total number of slaughter males was greater than female cows.

In this study, lesions were higher in autumn and winter seasons so that 35.4% of total lesions were observed in both seasons and the lowest amount of lesions was observed in summer. This finding is in contrary to the results of Madadzadeh and coworkers (15) who observed a higher incidence of lesions in Ardabil in summer. Lack of access to the pasture increases risk of hoof problems (18). Because cattle housing is a combination of traditional and industrial systems in the region (19), it is difficult to attribute the lesions to lack of access to the pasture in the winter. Cattle are brought to the pasture in the traditional systems in the warm seasons, but they are housed indoors in industrial systems throughout the year. So, although the lower rate of lesions in the warm seasons may be partly attributable to the access of some cattle to the pasture, it seems most likely that the high prevalence of lesions in wet seasons is due to poor hygiene and high humidity. According to the report of Azizi Mahmoudjigh et al. (7), 69% of lesions in Urmia were related to hindlimbs which were almost twice the lesions of the forelimbs. In this study, the rate of lesions in the hindlimbs was almost three times that of the forelimbs, accounting for 73% of total lesions. The high prevalence of lesions in the hindlimbs seems to be due to the greater weight-bearing of the cattle on their hindlimbs compared to the forelimbs. Most bodyweight is tolerated by the hindlimbs, especially in the pregnancy period (7).

Mohammadnia and coworkers (9) found that double sole counts for 14.49% of hoof lesions in dairy herds of Shahrekord during autumn. In our study, double sole was 28.5% of the identified lesions and was the most common problem of the limbs indicating lack of proper and regular hoof trimming in the herds. Subclinical laminitis accounted for 23.5% of the detected lesions in this study. In this form of laminitis, haemorrhages in the sole horn, yellow discolouration, softening of the sole horn, or sole ulcers may develop (20). Since high concentrate intake and limited roughage intake increase the risk of subclinical laminitis (21), this high prevalence reveals the necessity of proper nutritional

management of cattle in the area. The sole ulcer is one of the most severe pathologies causing lameness and is associated with impaired milk yield (22). A herd-level study at the vicinity of Tehran concluded that 55% of feet with thin soles had lesions such as sole haemorrhage. Concrete surface, commingling of animals with different ages and prolonged water contact of the hoof horn are aggravating factors (23). In another study, Nouri and coworkers found that toe ulcer, sole ulcer, and heel ulcer account for 6.9%, 20.9%, and 13.9% of hoof lesions in an abattoir near Tehran, respectively (24). Our findings also showed 13% sole ulcers, 9.3% toe ulcers, and 7.7% heel ulcers.

Researchers have emphasised the relationship between the grooved concrete floor and the increase in white line disease. Cattle that are in the pasture during the day and are housed in the stall at night are also at greater risk of developing the lesion than those are in the pasture all the time (25); therefore, it seems that this factor, as well as the inappropriate floor of the stalls, caused 7.75% of white line disease in this study. Although, the prevalence of this lesion in a similar study in Ardabil was higher (25.1%) than our findings, which may also be related to the differences in moisture (15).

In our study, hoof fractures accounted for 5.75% of the lesions, which is relatively high, but still much lower than the results of a study in Ethiopia with 40% of the hoof fracture rate (26), pointing out the necessity of preventing excessive hoof growth as well as preventing trauma to the hoof. Interdigital hyperplasia or wart has the highest estimate of heredity in a research on hereditary limb lesions in dairy herds of California (27) and the prevalence of this lesion in beef cattle referred to the Auburn University Large Animal Hospital in the United States was determined to be 15.8% (1). Despite the lesion was affected a smaller percentage of cattle in our study, it is necessary to take measures to eliminate it. Interdigital necrobacillosis is caused by trauma as well as the presence of a muddy, moisture bedding, and may eventually lead to reduced milk yield and culling of cattle. *Fusobacterium necrophorum* is the

main known pathogen to cause this disease. The disease is sporadic, with a prevalence rate of 0.2 to 5% in North America (28), which is similar to that observed in this study (0.8%). Horizontal and vertical cracks were accounted for 0.8% of lesions. Horizontal cracks are associated with changing winter nutrition to spring lush grass or in response to climatic conditions. These cracks represent a stressful event in the past (29). The prevalence of vertical cracks in a dairy farm of Nazarabad, Iran was 3.2% (30). Trauma, diet, dehydration and low environmental humidity affects the mechanical properties of horn tissue and increases the fragility of the dorsal wall horn (7); therefore, changes in diet and environmental moisture may contribute to these lesions in the studied cattle.

In conclusion, the results of this study showed that a high percentage of culled cattle in northwest Iran have at least one type of digit lesions and these lesions are more prevalent in autumn and winter seasons. Since limb problems and lameness are important factors in reducing production, which causes economic losses to the herd, more attention should be paid to the management conditions of herds in the region to eliminate predisposing factors and the possibility to increase the bovine digital health.

Conflict of interest

The authors declare that they have no conflict of interest.

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REFERENCES

1. Newcomer BW., Chamorro MF., 2016. Distribution of lameness lesions in beef cattle: A retrospective analysis of 745 cases. *Can Vet J*, 57, 401-406.
2. Ozsvari L., 2017. Economic cost of lameness in dairy cattle herds. *J Dairy Vet Anim Res*, 6, 00176.
3. Gündemir O., Özkan E., Mutuş R., 2020. Morphometric study on the digital bones in the domestic cattle. *Kafkas Univ Vet Fak Derg*, 26, 75-82.
4. Costa JH., Burnett TA., von Keyserlingk MA., Hötzel MJ., 2018. Prevalence of lameness and leg lesions of lactating dairy cows housed in southern Brazil: effects of housing systems. *J Dairy Sci*, 101, 2395-2405.
5. Cutler JH., Rushen J., de Passille AM., Gibbons J., Orsel K., Pajor E., Barkema HW., Solano L., Pellerin D., Haley D., Vasseur E., 2017. Producer estimates of prevalence and perceived importance of lameness in dairy herds with tiestalls, freestalls, and automated milking systems. *J Dairy Sci*, 100, 9871-9880.
6. Sjöström K., Fall N., Blanco-Penedo I., Duval JE., Krieger M., Emanuelson U., 2018. Lameness prevalence and risk factors in organic dairy herds in four European countries. *Livest Sci*, 208, 44-50.
7. Azizi Mahmoudjig S., Dalir Naghadeh B., Ahmadian K., 2005. Clinical study of lameness associated with digital diseases in dairy cows in Urmia. *J Fac Vet Med Univ Tehran*, 60, 241-246.
8. Mohamadnia AR., Mohamaddoust M., Shams N., Kheir, S., Sharifi S., 2008. Study on the prevalence of dairy cattle lameness and its effects of production indices in Iran. A locomotion scoring base study. *Pak J Biol Sci*, 11, 1047-1050.
9. Mohammadnia AR., Kheiri S., Mohammaddoust M., Kabiri J., 2007. Study on distribution of dairy cattle hoof lesions and its relation to locomotion scoring. *Iran J Vet Surg*, 2, 22-30.
10. Clarkson MJ., Downham DY., Faull WB., Hughes JW., Manson FJ., Merrit JD., Murray RD., Russell WB., Sutherst JE., Ward WR., 1993. An epidemiological study to determine the risk factors of lameness in dairy cows. The Liverpool Report of the UK Ministry of Agriculture,

- Fisheries and Food.
11. Sogstad AM., Fjeldaas T., Osteras O., Forshell KP., 2005. Prevalence of claw lesions in Norwegian dairy cattle housed in tie stalls and free stalls. *Prev Vet Med*, 70, 191-209.
 12. Somers JGCJ., Frankena K., Noordhuizen-Stassen EN., Metz JHM., 2003. Prevalence of claw disorders in Dutch dairy cows exposed to several floor systems. *J Dairy Sci*, 86, 2082-2093.
 13. Statistical Center of Iran, 2016. Statistics of animal slaughter in slaughterhouses of the country, Tehran, Statistical Center of Iran.
 14. Solano L., Barkema HW., Mason S., Pajor EA., Leblanc SJ., Orsel K., 2016. Prevalence and distribution of foot lesions in dairy cattle in Alberta, Canada. *J Dairy Sci*, 99, 6828-6841.
 15. Madadzadeh T., Nouri M., Noweouzian I., 2013. Breed and season effects on the claw lesions of dairy cows in Ardebil, Iran. *Anim Vet Sci*, 1, 46-50.
 16. Bahonar A., Sharifi H., Bokaie S., Vodjgani M., Rahimi Foroushani A., Haghdoost AA., 2009. Modeling the effect of lameness on culling of dairy cows in Tehran Province. *Iran J Vet Surg*, 4, 37-44.
 17. Vial F., Scharrer S., Reist M., 2015. Risk factors for whole carcass condemnations in the Swiss slaughter cattle population. *PLoS One*, 10, e0122717.
 18. Mandel R., Whay HR., Klement E., Nicol CJ., 2016. Invited review: Environmental enrichment of dairy cows and calves in indoor housing. *J Dairy Sci*, 99, 1695-1715.
 19. Vagef R., Mahmoudi R., 2013. Occurrence of Aflatoxin M1 in raw and pasteurized milk produced in west region of Iran (during summer and winter). *Int Food Res J*, 20, 1421-1425.
 20. Wilhelm K., Wilhelm J., Füll M., 2015. Use of thermography to monitor sole haemorrhages and temperature distribution over the claws of dairy cattle. *Vet Rec*, 176, 146.
 21. Pilachai R., Schonewille JT., Thamrongyoswittayakul C., Aiumlamai S., Wachirapakorn C., Everts H., Hendriks WH., 2013. Diet factors and subclinical laminitis score in lactating cows of smallholder dairy farms in Thailand. *Livest Sci*, 155, 197-204.
 22. O'Driscoll K., McCabe M., Earley B., 2015. Differences in leukocyte profile, gene expression, and metabolite status of dairy cows with or without sole ulcers. *J Dairy Sci*, 98, 1685-1695.
 23. Nowrouzian I., Nouri M., 2009. Thin sole as a cause of sole hemorrhages: Study on a herd level. *Vet Res Pajouhesh va Sazandegi*, 82, 31-37.
 24. Nouri M., Nowrouzian I., Vajhi A., Marjanmehr SH., Faskhoudi D., 2011. Morphometric radiographic findings of the digital region in culling lame cows. *Asian J Anim Sci*, 5, 256-267.
 25. Barker ZE., Amory JR., Wright JL., Mason SA., Blowey RW., Green LE., 2009. Risk factors for increased rates of sole ulcers, white line disease, and digital dermatitis in dairy cattle from twenty-seven farms in England and Wales. *J Dairy Sci*, 92, 1971-1978.
 26. Sulayeman M., Fromsa A., 2012. Lameness in dairy cattle: Prevalence, risk factors and impact on milk production. *Glob Vet*, 8, 1-7.
 27. Oberbauer AM., Berry SL., Belanger JM., McGoldrick RM., Pinos-Rodriguez JM., Famula TR., 2013. Determining the heritable component of dairy cattle foot lesions. *J Dairy Sci*, 96, 605-613.
 28. Kontturi M., Kujala M., Junni R., Malinen E., Seuna E., Pelkonen S., Soveri T., Simojoki H., 2017. Survey of interdigital phlegmon outbreaks and their risk factors in free stall dairy herds in Finland. *Acta Vet Scand*, 59, 46.
 29. Greenough PR., 2001. Sand cracks, horizontal fissures, and other conditions affecting the wall of the bovine claw. *Vet Clin N Am-Food A*, 17, 93-110.
 30. Nouri M., Ashrafi Helan J., 2012. Clinical and gross pathologic findings of complicated vertical fissures with digital dermatitis in a dairy herd. *Vet Res Forum*, 3, 291-295.