



## Incidence of Foot Diseases in Beef Cattle in Kirikkale Region

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**Abstract:** One of the significant economic losses in cattle farming is associated with hoof diseases. It has been scientifically proven that the incidence of hoof diseases increases in intensive farming operations. This study aims to investigate the incidence of hoof diseases in beef cattle in Kirikkale and its surrounding region. A total of 3047 head of beef cattle, representing different breeds and ages, were examined for hoof and claw deformities. The animals were examined for hoof diseases during specific months of the year by visiting the farms. The study revealed 53 animals with splayed hooves, 1 with an overgrown hoof, 1 with a separated hoof, 1 with a scissor-like hoof, and 1 with a double sole formation. As for hoof diseases, 2 animals had interdigital dermatitis, 8 had digital dermatitis, 10 had heel erosion, 21 had sole ulcers, 5 had interdigital phlegmon, 4 had white line disease, and various forms of laminitis were observed in 22 animals. Considering the barn flooring, management conditions, and intensive farm feeding, it was determined that barn hygiene and hoof care were inadequate. As a result, the impact of management factors specific to the farms, such as barn flooring and ration composition, varied depending on the breed's susceptibility or resistance. Based on the statistical data obtained in conjunction with these factors, the incidence of foot diseases in beef cattle in the Kirikkale region was determined to be 4.23%.

**Keywords:** Beef cattle, Foot diseases, Kirikkale province, Incidence.

### Kirikkale ve Yöresinde Bulunan Besi Sığırlarında Ayak Hastalıklarının İnsidansı

**Özet:** Sığır yetiştiriciliğinde önemli ekonomik kayıplardan biride ayak hastalıklarına bağlı olarak oluşan kayıplardır. Özellikle entansif yetiştiricilik yapılan işletmelerde ayak hastalıklarının arttığı bilimsel olarak kanıtlanmış gerçeklerdendir. Bu çalışmada, Kirikkale ve yöresinde bulunan besi sığırlarında ayak hastalıklarının insidansının araştırılması amaçlanmıştır. Bu lokasyonda farklı ırk ve yaşlarda toplam 3047 adet büyükbaş besi sığırı ayak ve tırnak deformasyonları yönünden incelendi. Yılın belirli aylarında işletmeler ziyaret edilip ayak hastalıkları yönünden hayvanlar incelendi. Yapılan çalışmada hayvanların 53 adet hayvanın ayağında yayvan geniş tırnak, 1 adet hayvanda çift taban oluşumu, 1 adet hayvanda sivri tırnak, 1 adet hayvanda ayırık tırnak, 1 adet hayvanda makasvari tırnak, 1 adet hayvanda da çift taban oluşumu saptanmıştır. Ayak hastalığı olarak; 2 adet hayvanda interdigital dermatitis, 8 adet hayvanda digital dermatitis, 10 adet hayvanda ökçe çürüğü, 21 adet hayvanda taban ülseri, 5 adet hayvanda interdigital flegmon, 4 adet hayvanda beyaz çizgi hastalığı 22 adet hayvanın tırnağında ise laminitisin çeşitli formları tespit edildi. İşletmelerde ahır zemini, bakım koşulları ve yoğun besleme göz önüne alındığında, ahır hijyeni ve tırnak bakımının yetersiz olduğu belirlendi. Sonuç olarak ayak hastalıklarının oluşumunda ahır zemini ve rasyon içeriği gibi işletmelere ait yönetimsel faktörlerin etkisi, ırkın duyarlılık veya direncine göre farklılıkların olduğu belirlendi. Bütün bu faktörlerin eşliğinde istatistiksel olarak elde edilen verilere göre Kirikkale yöresindeki besi sığırlarının ayak hastalıklarının insidansı %4.23 olarak tespit edilmiştir.

**Anahtar Kelimeler:** Ayak hastalıkları, Besi sığırı, Kirikkale ili, İnsidans.

## Introduction

Closed and semi-closed farming system management practices are increasingly adopted in modern dairy and beef cattle farming to increase productivity. In closed barns, where high-yielding and heavy-bodied breeds are kept without access to pasture, hoof diseases are more commonly observed due to irregular wear resulting from insufficient hoof care (Şındak et al., 2003). Foot diseases constitute one of the most important health issues in cattle farming, causing significant financial losses in modern farms. Apart from the financial burden of treatment expenses for reforming and diseased animals, they lead to milk and productivity loss, extended calving intervals, reduced fertility in female animals, and additional costs associated with extra insemination. The etiology of foot diseases involves various factors, including external factors such as season, lactation in female animals, age, live weight, genetic predisposition, herd size, care conditions, nutrition, and farm-specific flooring structure (Dogra et al., 2020; Han et al., 2017; Jelinski et al., 2018; Keskin and Durmuş, 2016; Langova et al., 2020; Tutuş and Genççelep, 2017; Yakan, 2018; Yayla et al., 2012; Yurdakul and Şen, 2018). Hoof disorders are frequently reported in dairy and beef cattle worldwide, accounting for approximately 90% of lameness cases. Hoof diseases can be classified as clinical or subclinical, and they are a source of pain and suffering for cattle due to the chronic and painful nature of the conditions (Abid et al., 1989; Kavuş, 2022; Tutuş and Genççelep, 2017; Weaver, 1981). It has been reported that the incidence of hoof diseases is higher in intensive farming operations. Particularly in confined feedlot operations, factors such as limited exercise, accumulation of manure, and urine under animals triggered by the flooring structure play a significant role in the etiology of hoof diseases (Ishler et al., 2023). Depending on the environmental conditions, dermatitis, heel erosion, and secondary contamination agents such as *Streptococcus*, *Staphylococcus*, *Spirochaete*, and *Bacillus* species have been identified. Nutritional errors, such as excessively high carbohydrate content in the diet, can also lead to hoof deformities and laminitis (Berg and Loan, 1975; Cygan et al., 1977; Kamiloğlu, 2014; Masalski, 1986). As farms transition into more extensive operations with cattle trade, an increase in the incidence of infectious hoof diseases such as interdigital dermatitis, heel erosion, digital dermatitis, and interdigital phlegmon has been observed (Canpolat and Bulut, 2003; Özgen, 2014; Whitaker et al., 1983). The incidence of possible hoof diseases and lameness in herds has been reported to range from 0% to 60%. Especially subclinical hoof diseases often go unnoticed, leading to underestimated economic losses. Research shows that the problem of hoof diseases remains significant and is increasing (7-58%).

These rates have been reported as 0.3-3% in South Korea, 3.7% in Australia, 6.6% in the United States, 7.6% in Pakistan, 9.5% in Ireland, 10.9% in France, 16.4% in Switzerland, and 17.4% in the United Kingdom (Ablan, 1995; Murray et al., 1996; Özgen, 2014; Russell et al., 1982). Economic losses arise from hoof problems rather than

treatment expenses. Depending on the severity of hoof diseases, they exhibit symptoms such as weight loss, decreased milk production and dry matter intake, reduced herd longevity, and fertility problems. Early diagnosis, prompt and regular treatment minimize losses, accelerate recovery, and prevent animal suffering (Antepioğlu et al., 1992; Çeçen and Görgül, 2007; Greenough et al., 1981; Olcay and Sağlam, 1997; Sağlıyan and Ünsaldı, 2002; Şındak et al., 2003; Yavru et al., 1992). Digital dermatitis is a bacterial infectious disease affecting dairy cattle's feet. It is known to cause lameness, as well as a decrease in milk and reproductive performance. The current treatment protocol includes routine hoof trimming and topical antibiotics. Although several commercial topical products are used to control digital dermatitis lesions, there is limited or almost no evidence regarding their efficacy. Furthermore, it has been emphasized that washing the animals' feet with pressurized water at each milking session is more important than using non-antibiotic preparations compared to control groups where isotonic solutions were used. This approach can help prevent uncontrolled antibiotic use (McLennan, 1988; Özgen, 2014; Yücel, 1982).

Compared to dairy cattle farming, intensive beef cattle farming is more common in Kirikkale and its surrounding region. Due to the reported continuous financial losses experienced by farmers attempting to practice intensive beef cattle farming using traditional methods, this study aims to investigate and identify the possible causes of these losses. The study was conducted by examining a total of 3047 beef cattle from 6 different-scale farms in the Kirikkale region, representing different ages and breeds, to determine the incidence of existing hoof diseases and their causes.

## Material and Methods

The study material consisted of a total of 3047 beef cattle from six different farms located in various regions of Kirikkale and its surrounding areas, where the population of beef cattle is high. The animals represented different ages, breeds, genders, and weights. It was determined that five of the examined barns had slatted concrete flooring (n=2445), while one barn had earthen flooring (n=602). Since the study did not involve an invasive intervention on animals, a letter was received from HADYEK (Animal Experiments Local Ethics Committee) that there was no need for ethics committee approval.

Anamnesis was obtained from the responsible farm veterinarian, farm workers, and farm owners during the farm visits. After examinations and observations, animals with hoof problems were identified. Animals with lameness complaints underwent detailed hoof examination to diagnose the diseases.

After completing the farm visits, the obtained data were evaluated to identify the relationships between disease types, disease-animal breed, disease-barn flooring, and disease-feeding management.

The adequacy of the housing conditions and the flooring structures of the six visited barns were examined. Anamnesis was obtained from the livestock owners regarding the frequency of hoof diseases and hoof deformities in cattle. The animals were examined for hoof diseases while standing and walking. The hoof and claw structures were examined for conformity with the animal's size, hoof deformities, abnormalities in the heel and sole regions, separations, shape changes, presence of fistulas, interdigital area diseases, and abnormalities in the corona region. All obtained data were recorded for further analysis. The records were evaluated using statistical methods, specifically the SPSS for Windows 20.0 Descriptive Statistics Analysis Crosstabs method, and the Chi-Square test was employed to investigate the effects of barn flooring types (concrete and earthen) on the occurrence of hoof diseases and hoof deformities in cattle. Based on the obtained results, significance levels of  $P < 0.05$  and  $P < 0.01$  were considered statistically significant for the study data.

## Results

In this study, a total of 3047 beef cattle were examined for hoof diseases in the Kirikkale region. The examination results, together with the anamnesis obtained from the responsible farm supervisor, farm workers, and farm owners, were recorded in a patient follow-up form. As a result of this study, hoof lesions and foot diseases were detected in 100 animals out of the scanned 3047. It was found that some animals had lesions in one or more hooves, which prevented them from standing up.

Based on the research, it was observed that farms with a low number of animals and farms that did not employ any consulting services or veterinarians were not aware of hoof and claw care and diseases, and they were unaware of the magnitude of economic losses caused by these hoof and claw diseases. It was also observed that traditional methods were still being used to raise animals and that the hygiene and ventilation in the barns were inadequate.

In conscious farms, the presence of slatted concrete flooring in the barns was due to the aim of rapid weight gain through intensive feeding, which resulted in hoof diseases caused by imbalanced diets and sudden increases in the amount of barley in the diet. It was also observed that some farms had a pool for foot washing, which the animals passed through during monthly weight measurements, and it was observed that the farmers poured lime into this pool and used the vaccination route. In addition to nutrition, various premixes containing feed additives to prevent hoof diseases associated with intensive feeding, as well as zinc, copper, bicarbonate, and magnesium oxide, were observed.

The farm animals were mainly fed with clover at the beginning of the feeding period, as well as hay, corn silage, molasses, bran, crushed/cracked barley, corn meal, and commercial feed.

The visited farms raised animals of various breeds, including native breeds, European Angus breeds imported through private import companies, and animals imported

from South American countries through the Meat and Milk Institution.

According to the obtained data, out of the scanned 3047 animals, hoof diseases were detected in 100 animals. In animals subjected to foot disease screening, some images of deformed hoof structures and foot diseases are presented in Figure 1 and Figure 2. Among these, the highest rate of hoof disease occurrence was found to be 18.36% in Holstein beef cattle, which are born in Turkey, while the breed with the lowest incidence of hoof diseases was determined to be Charolais, imported from European countries, with a rate of 1.33% (Table 1).

**Table 1.** Distribution of foot diseases among the researched animals in the Kirikkale region, categorized by breeds.

Animal Breeds	Examined Animals	Number of Beef Cattle with Foot Disease	Ratio (%)
Native breed	293	16	5.46
S. American Angus	660	21	3.18
European Angus	488	9	1.84
Limousine	565	13	2.30
Charolais	672	9	1.33
Simmental	150	14	9.33
Holstein	49	9	18.36
Brangus	170	9	5.29
<b>Total</b>	<b>3047</b>	<b>100</b>	<b>3.28</b>

**Table 2.** The Rate of Occurrence of Foot Diseases in the Anteroposterior, Lateral-Medial Nails of the Beef Cattle Researched in the Kirikkale Region.

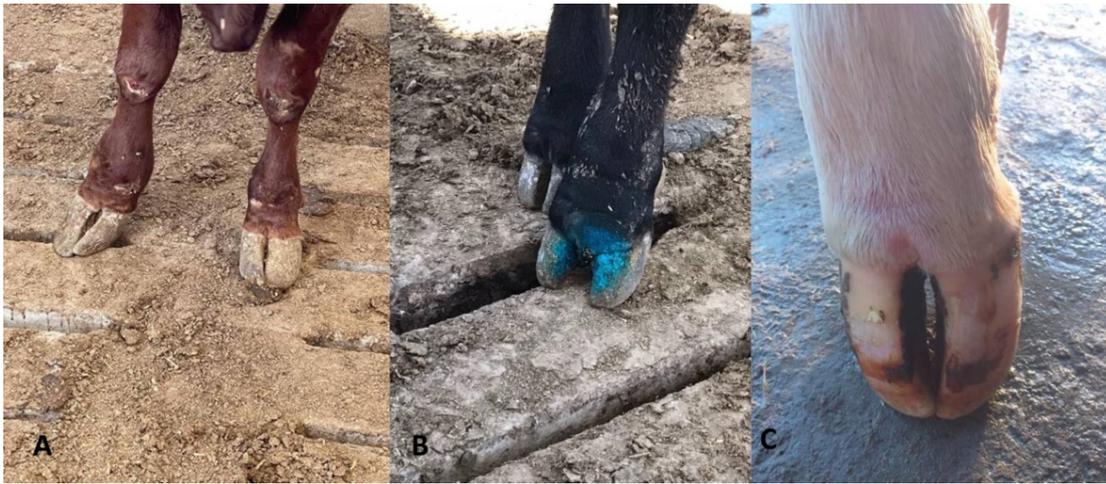
Localization of foot diseases	Lateral	Medial	Lateral+Medial	N
Front-Right	8	5	3	16
Front-Left	13	4	5	22
Behind-Right	11	15	2	28
Behind-Left	20	12	2	34
<b>Total</b>	<b>52</b>	<b>36</b>	<b>12</b>	<b>100</b>

**Table 3.** Distribution of Hoof Deformities Detected in Animals Investigated in the Kirikkale Region.

Hoof Deformation	N	Ratio(%)
Sprawled and Wide Hooves	53	91.37
Overgrown Hoof	1	1.72
Separated Hoof	1	1.72
Scissor-like Hoof	1	1.72
Double Sole Formation	1	1.72
<b>Total</b>	<b>57</b>	<b>99,98</b>

**Table 4.** Distribution of Foot Diseases Detected in Animals Investigated in the Kirikkale Region.

Foot Diseases	N	Ratio(%)
Interdigital Dermatitis	2	2,77
Digital Dermatitis	8	11,1
Hoof rot	10	13,88
Ulcus solea	21	29,16
Interdigital Phlegmon	5	6,94
White line disease	4	5,55
Laminitis	22	30,55
<b>Total</b>	<b>72</b>	<b>99,95</b>



A: Sprawled and wide hoof, B: Separated hoof and limax, C: Scissor-like hoof.

**Figure 1.** Some images of hoof deformities in animals investigated for foot diseases in Kirikkale region.



A: Solea abscess, B: Interdigital dermatitis and heel bruise, C: Ulcus solea.

**Figure 2.** Some images of foot diseases in animals investigated for foot diseases in Kirikkale region.

According to the examinations, when analyzing the distribution of diseases in the hooves, hoof diseases were detected in 30 hooves of the front limbs and 57 hooves of the hind limbs. The distribution of cases with hoof diseases in terms of front, rear, lateral, medial, and combined involvement is shown in (Table 2).

According to the data obtained from the study, a total of 57 animals (1.87%) were identified with hoof deformities (Table 3). It was determined that 2,445 % of the animals completed their feeding period in an open-semi-closed barn system with a concrete grid floor. The remaining 602 animals completed their feeding period freely in an open system with an earth floor.

According to the obtained data, out of the scanned 3047 animals, 72 animals (2.36%) were diagnosed with hoof diseases. The most common disease was laminitis, which was observed in 22 animals (30.5%), due to the intensive feeding system aiming for rapid weight gain in intensive beef cattle farming (Table 4).

## Discussion and Conclusion

Increasing population growth has led to a rise in intensive cattle farming, where foot diseases are prevalent, especially in closed-confinement feedlots. Factors such as limited exercise opportunities due to confinement, the structure of the barn floor leading to the accumulation of manure and urine under the animals, and poor foot and barn hygiene, as well as feeding style and ration, play significant roles in the etiology of foot diseases (Han et al., 2017; Keskin and Durmuş, 2016; Yayla et al., 2012). In facilities with inadequate barn floors, cattle can experience lesions, laminitis, hemorrhages due to heel bruising, sole ulcers, white line separations, heel crush, and hoof cracks, which are considered triggering factors for foot diseases (Han et al., 2017; Vermunt and Greenough, 1995). The hardness and abrasive effect of concrete floors, in particular, lead to faster wear of the horn's hoof, resulting in lesions and lameness (Han et al., 2017; Vermunt and Greenough, 1995). Based on

the data obtained from the study, it was determined that the main issues in farms with high disease rates are the condition of the barn floor, inadequate hygiene, and insufficient preventive medicine. A secondary problem identified in the visited feedlots was the occurrence of subclinical and clinical laminitis cases due to ration errors.

Rapid live weight gain in feed animals, combined with flooring problems, results in a high incidence of sole lesions. In this study, farms with unsuitable barn floors, particularly those using grid-like concrete and hard surfaces, showed a high incidence of comprehensive claw deformities. Proper barn floor maintenance, hygiene, and adequate preventive measures are essential in such feedlots to prevent foot diseases and subsequent economic losses for the farmers.

The incidence of foot diseases was reported as 12.38% in a study conducted in the Tunceli region (Sağlıyan and Ünsaldı, 2002), and 17.1% in a study conducted in the Elazığ region (Canpolat and Bulut, 2003). A study conducted with dairy farms in the UK reported foot disease incidence ranging from 4.7% to 30% (Andersson and Lundstrom, 1981). In this current study, an incidence of 4.23% was found in feed cattle in the Kirikkale region. These findings indicate a significant presence of foot diseases in both beef and dairy cattle farming, leading to substantial economic losses that necessitate informing producers about the economic impact of foot diseases.

In cattle, the medial digits of the forelimbs and the lateral digits of the hind limbs carry more load. Consequently, foot diseases in cattle predominantly occur in the medial digits of the forelimbs and the lateral digits of the hind limbs (Anteplioglu et al., 1992; Yavru et al., 1989). Our research in the Kirikkale region also revealed that foot diseases mainly occurred in the lateral digits of 21 animals and the medial digits of 9 animals in the forelimbs. In contrast, in the hind limbs, they occurred in the lateral digits of 31 animals and the medial digits of 26 animals.

Deformed hooves have been highlighted as important factors contributing to foot diseases (Ablan, 1995; Anteplioglu et al., 1992; Görgül, 1983). According to some studies, more than 24% of hoof deformities have been reported in Turkey (Han et al., 2017; Kamiloğlu, 2014; Keskin and Durmuş, 2016; Yayla et al., 2012). Moreover, 90% of detected lameness cases were localized in the hooves in a study with 11,000 affected animals (Murray et al., 1996). Our study found 35 cases of foot diseases, 57 cases of hoof deformities, and 37 cases of both foot diseases and hoof deformities among 129 cattle in the Kirikkale region. These results indicate a high frequency of hoof deformities associated with foot diseases, emphasizing the importance of early diagnosis and treatment of hoof deformities.

Regarding the incidence of hoof deformities based on cattle breeds, our study identified 57 cases of deformed hooves among different cattle breeds in the Kirikkale region. Holstein cattle showed the highest incidence of foot diseases (18.36%), followed by South American Angus (Aberdeen Angus) (3.18%), and the native breed (5.46%). This suggests that specific cattle breeds, such as Holstein and South American Angus, are more susceptible to foot diseases, and

it could be related to the system of the semi-open, closed concrete-gridded floors in feedlots.

In this study field, laminitis and sole ulcers were the most prevalent foot diseases, making up 30.55% and 29.16% of the identified cases, respectively. Based on the results, the majority of detected diseases were due to farm management reasons. Cattle with deformed hooves showed poor hoof maintenance, while cases of foot ulcers and subclinical laminitis required appropriate hoof care and medical treatment.

In conclusion, properly adjusting the ration according to the animals' needs, prioritizing barn hygiene, and regular hoof trimming in long-term feedlot operations are essential measures to reduce the incidence of foot diseases in feed cattle. The study highlighted the importance of educating farm managers and animal caregivers on these measures, which resulted in a reduction in foot diseases in farms with previously identified issues during the second visit.

### Conflict of interest

The authors declare that there is no conflict of interest.

### Ethical Approval

This study is not subject to HADYEK's permission in accordance with Article 8 (k) of the "Regulation on Working Procedures and Principles of Animal Experiments Ethics Committees".

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### References

- Ablan L, 1995: Lameness in Danish dairy cows: frequency and possible risk factor. *Prev Vet Med*, 22, 213-225.
- Abid TA, Eshoue SM, Badrany MS, Singh AP, 1989: Slaughter house survey of bovine foot disorders. *Indian Vet J*, 66:154-157.
- Andersson L, Lundstrom K, 1981: The influence of breed, age, body weight and season on digital diseases and hoof size in dairy cow. *Zentralbl Veterinarmed A*, 28, 141-151.

- Antepliöglü H, Samsar E, Akın F, Güzel N, 1992: Sığır ayak hastalıkları (2.baskı) Ankara Üniversitesi Veteriner Fakültesi Yayınları, Ankara.
- Berg JN, Loan RW, 1975: Fusobacterium necrophorum and bacteroides melaninogenicus as etiologic agents of foot rot in cattle. *Am J Vet Res*, 36 (08), 115-1122.
- Canpolat İ, Bulut S, 2003: Elazığ ve çevresinde sığırlarda görülen ayak hastalıklarının insidansı üzerine gözlemler. *Firat Univ Sag Bil Derg*, 17, 155-160.
- Cygan Z, Wiercinsky J, Szewczuk P, 1977: Experimental study on the aetiology of interdigital necrobacillosis in cattle. *Med Weter*, 33, 720-724.
- Dogra S, Singh R, Ravinder S, Tikoo A, 2019: Effect of claw disorders on haemato-biochemical parameters and acute phase protein levels in crossbred cattle. *Indian J Anim Res*, 54 (2), 173-176.
- Görgül O, 1983: Sığırların önemli ayak hastalıklarında operatif sagaltım yöntemleri. *Uludağ Üniv Vet Fak Derg*, 2, 21-29.
- Greenough PR, MacCallum FJ, Weaver AD, 1981: Lameness in Cattle. 2nd ed., Wright Sciencetechnica, Bristol, UK.
- Han MC, Sağlıyan A, Polat E, 2017: Sığırlarda ahır zemin tiplerinin ayak hastalıkları ve tırnak deformasyonları üzerine etkilerinin araştırılması. *Harran Üniv Vet Fak Derg*, 6 (1), 19-24.
- Ishler V, Wolfgang D, Griswold D, 2023: Prevention and control of foot problems in dairy cows. <https://dairy-cattle.extension.org/prevention-and-control-of-foot-problems-in-dairy-cows/>, Date of Access; 15.05.2023.
- Jelinski M, Waldner C, Penner G, 2018: Case-control study of mineral concentrations of hoof horn tissue derived from feedlot cattle with toe tip necrosis syndrome (toe necrosis). *Can Vet J*, 59, 254.
- Kamiloğlu A, 2014: Çiftlik hayvanlarında ayak hastalıkları. Medipress, Malatya.
- Kavuş MT, 2022: Elazığ ve Erzincan Yöresi Sığır Ayak Hastalıklarının Değerlendirilmesi. Yüksek Lisans Tezi, Fırat Üniversitesi Sağlık Bilimleri Enstitüsü, Elazığ.
- Keskin E, Durmuş AS, 2016: Gaziantep ve yöresinde gözlenen sığır ayak hastalıklarının insidansı ve tedavileri üzerine gözlemler. *SÜ Sağ Bil Vet Derg*, 30 (3), 181-86.
- Langova L, Novotna I, Nencova P, Machacek M, Havlicek Z, Zemanova M, Chrast V, 2020: Impact of Nutrients on the Hoof Health in Cattle. *Animals*. 10(10):1824. <https://doi.org/10.3390/ani10101824>.
- Masalski N, 1986: Properties of Bacteroides nodosus isolated from cattle. *Veterinarnomeditsinski Nauki*, 23, 32-36.
- McLennan MW, 1988: Incidence of lameness requiring veterinary treatment in dairycattle in Queensland. *Aust Vet J*, 65, 144-147.
- Murray RD, Downham DY, Clarkson MJ, Faul WB, Hughes JW, Manson FJ, Merritt JB, Russell WB, Sutherst JE, Ward WR, 1996: Epidemiology of lameness in dairy cattle: description and analysis of foot lesion. *Vet Rec*, 138 (24), 586-591.
- Olçay B, Sağlam M, 1997: Büyük Hayvanların Ayak Hastalıkları ve Ortopedisi. Ankara Üniversitesi Veteriner Fakültesi Ders Notları, Ankara.
- Özgen E, 2014: Erzurum Yöresi Koyunlarında Görülen Ayak Hastalıklarının Prevalansı. Yüksek Lisans Tezi, Kırıkkale Üniversitesi Sağlık Bilimleri Enstitüsü, Kırıkkale.
- Russell AM, Rowlands GJ, Shaw SR, Weaver AD, 1982: Survey of Lameness in british dairy cattle. *Vet Rec*, 111, 155-160.
- Sağlıyan A, Ünsaldı E, 2002: Tunceli ve yöresindeki sığırlarda görülen ayak hastalıklarının prevalansı üzerine gözlemler. *Firat Univ Sag Bil Derg*, 16, 47-56.
- Şındak N, Keskin O, Selçukbiricik, H, Sertkaya H, 2003: Şanlıurfa ve Yöresinde Sığır Ayak Hastalıklarının Prevalansı. *YYÜ. Vet Fak Derg*, 14 (1), 14-18.
- Tutuş D, Gençcelep M, 2021: Van Muradiye İlçesinde Ruminantlarda Görülen Ekstremit ve Ayak Hastalıklarının İnsidansı. *Van Vet J*, 32 (2), 82-90.
- Vermunt JJ, Greenough PR, 1995: Structural characteristics of the bovine claw: Horn growth and wear, horn hardness and claw conformation. *Br Vet J*, 151, 157-180.
- Yakan S, (2018). Ağrı İlinde Sığırlarda Ayak Hastalıkları Prevalansının Belirlenmesi. *Harran Üniv Vet Fak Derg*, 7(2), 207-212.
- Yavru N, Özkan K, Elma E, 1994: Ayak hastalıkları ve ortopedisi, Selçuk Üniversitesi Veteriner Fakültesi basım ofset matbaası, Konya.
- Yayla S, Aksoy Ö, Kılıç E, Cihan M, Özaydın İ, Ermutlu ÇŞ, 2012: Kars ve yöresinde sığırların bakım ve barındırma koşulları ile ayak hastalıkları arasındaki ilişkinin değerlendirilmesi. *Harran Üniv Vet Fak Derg*, 1(1), 22-27.
- Yurdakul İ, Şen İ, 2018: Sivas ve yöresinde sığır ayak hastalıkları prevalansının belirlenmesi. *Harran Üniv Vet Fak Derg*, 7(1), 51-55.
- Yücel M, 1982: İstanbul ve Tekirdağ bölgesindeki sığırlarda görülen ayak hastalıklarının toplu bir değerlendirilmesi. *İstanbul ÜnivVet Fak Derg*, 8, 47-61.
- Weaver AD, 1981: Lameness in Cattle, Wright Sciencetechnica, 1nd Ed. Bristol.