JIVS JOURNAL OF ISTANBUL VETERINARY SCIENCES

Coccidiosis cases in cattle in Turkey

Burak Şahin[1], Pelin Şahin[2], Uğur Uslu[3]

1. Kastamonu University Devrekani TOBB Vocational School Department of Veterinary Medicine, Kastamonu, Türkiye.. **2.** Selçuk University Veterinary Faculty Department of Veterinary Medicine, Konya, Türkiye. **3.** Selçuk University Faculty of Medicine, Department of Microbiology, Konya, Türkiye.

Şahin, B. ORCID: 0000-0003-1836-5510; Şahin, P. ORCID: 0000-0002-3269-4532; Uslu U. ORCID: 0000-0003-3456-312X

Review Article

Volume: 7, Issue: 3
December 2023
Pages: 106-111

ABSTRACT

Coccidiosis is a protozoan disease of the Eimeriidae family, mostly caused by *Eimeria* species, sometimes *Isospora* species, seen in all domestic and wild animals, especially in young animals, which can result in hemorrhagic diarrhea, depression, weakening, weight loss, and sometimes death. *Eimeria bovis*, *E. zuernii*, *E. auburnensis*, *E. ellipsoidalis*, and *E. alabamensis* cause clinical coccidiosis by showing pathogenic properties. The disease is more important for young people. In its diagnosis, the age of the animal, the hygienic condition of the environment and clinical signs are evaluated. Clinical findings and stool consistency in calves and calves are also important in diagnosis. In the treatment of coccidiosis is based on the principles of killing the causative agent or preventing its development, eliminating fluid loss, and treating secondary infections. The treatment of coccidiosis in calves naturally infected with *E. zuernii* and *E. bovis*, oral administration of 15mg/kg dose of toltrazuril is reported to be very effective and reduces economic losses by positively affecting the growth performance of animals. In studies conducted in our country, 11 *Eimeria* and 1 *Isospora* species have been found in cattle. In studies on bovine coccidiosis in Turkey, the prevalence of *Eimeria* species in calves and calves was found to be 16-93.3%. In line with the results obtained, it has been observed that coccidiosis continues to be a problem even in cattle farms with relatively good care and feeding conditions in Turkey. It was concluded that routine checks should be made in the enterprises, necessary precautions should be taken and hygiene rules should be followed.

Keywords: coccidiosis, *Eimeria*, cattle, Turkey.

Article History

Received: 17.10.2023
Accepted: 21.12.2023
Available online: 31.12.2023

DOI: https://doi.org/10.30704/http-www-jivs-net.1377073

To cite this article: Şahin, B., Şahin P., & Uslu, U. (2023). Coccidiosis cases in cattle in Turkey. ***Journal of Istanbul Veterinary Sciences, 7*(3),** 106-111. **Abbreviated Title*: J. İstanbul vet. sci.***

Introduction

Coccidiosis is a protozoan disease of the Eimeriidae family, mostly caused by *Eimeria* species, sometimes *Isospora* species, seen in all domestic and wild animals, especially in young animals, which can result in hemorrhagic diarrhea, depression, weakening, weight loss, and sometimes death (Jolley and Bardsley, 2006).

It is very common all over the world and in our country and causes economic losses by causing deaths. *Eimeria* species progress with morbidity manifested by increased feed conversion rates, reduced yield, loss of reproductive performance, continuous oocyst scattering, and increased susceptibility to secondary bacterial infections (Uslu and Ceylan, 2020).

Although coccidiosis in cattle is seen in animals of all ages, it is clinically more important in 0-6 and 6-12 months calves (Levine, 1985).

With this study, it was aimed to comprehensively examine the studies evaluating coccidiosis cases in cattle and coccidiosis disease in Turkey.

*Corresponding Author: Burak Şahin
E-mail: buraksahin@kastamonu.edu.tr

Spread of disease and epidemiology

Coccidiosis in cattle is seen in animals of all ages. It is clinically important in calves less than 6 months old and calves 6-12 months old. In our country, 11 *Eimeria* and 1 *Isospora* species were found to be causative agents, and in studies conducted in the world, 17 *Eimeria* and 2 *Isospora* species were found to be bovine coccidiosis agents (Güven et al., 2010). While these species do not cause clinical coccidiosis in elderly animals, they cause developmental delay and mortality by causing acute bloody diarrhea in calves near the carriers. *E. bovis, E. zuernii, E. auburnensis, E. ellipsoidalis* and *E. alabamensis* cause clinical coccidiosis by showing pathogenic properties. The prevalence of infection varies according to climatic factors, diet, rearing, and cleanliness of barns (Köse, 2011; Karaer et al., 2012).

Studies to determine the spread of bovine coccidiosis in Turkey were examined.

Eimeria species were detected in 140 (93.3%) of 150 cattle feces collected from several provinces of Turkey and 11 different *Eimeria* species were reported (Sayın, 1970).

In the research conducted in the Ankara region, the distribution was determined as 16%, and 8 different *Eimeria* species were identified, and it was reported that the most common species was *E. zuernii* (Mimioğlu et al., 1956).

In a study conducted in the Bursa region, the distribution was determined as 49.3%, 10 different *Eimeria* species were determined. *E. bovis* (28.5%) was the predominant species, followed by *E. auburnensis* (17.2%), *E. ellipsoidalis* (14.7%), *E. zuernii* (12.4%), *E. canadensis* (6.2%), *E. cylindrica* (3.7%), *E. subspherica* (1.9%), *E. alabamensis* (1.6%), *E. brasiliensis* (1.2%), and *E. bukidnonensis* (0.5%) (Güleğen and Okursoy, 2000).

Erzurum *Eimeria* species were found at a rate of 25.9% in the region of the calves in dairy farms and 9 different *Eimeria* species were identified. Nine coccidia species, namely E. ellipsoidalis (51.0%), *E. auburnensis* (38.8%), *E. bovis* (32.7%), *E. zuernii* (22.5%), E. *subspherica* (16.3%), E. canadensis (6.1%), E. alabamensis (4.1%), *E. brasiliensis* (4.1%), and *E. bukidnonensis* (4.1%) were identified in infected calves (Aktaş et al., 2008).

In a study conducted in the Van region, they found 10 different *Eimeria* species and determined the distribution rate as 52.9% They were *E. bovis* (27.27%), *E. zuernii* (17.55%), *E. auburnensis* (9.09%), *E. cylindrica* (9.09%), *E. brasiliensis* (8.26%), *E. subspherica* (7.43%), *E. alabamensis* (7.43%), *E. bukidnonensis* (6.61%), *E. canadensis* (4.13%), *E. ellipsoidalis* (3.30%) (Gül et al., 2000).

In another study conducted in the Van region, *Eimeria* sp. The distribution of oocysts was determined as 22.5% (Gül et al., 2008). In a study conducted on calves, 86.4% prevalence and 10 different *Eimeria* species were determined in the Van region, Identified *Eimeria* species as follows were; *E. bovis* (38.4%), *E. zuernii* (35.2%), *E. auburne*nsis (30.4%), *E. cylindrica* (26.4%), *E. subspherica* (24%), *E. canadensis* (20%), *E. alabamensis* (19.2%), *E. ellipsoidalis* (16.8%), *E. bukidnonensis* (12%), and *E. brasiliensis* (11.2%) (Değer et al., 2001).

In a study in which the spread of coccidiosis in calves was determined, the prevalence in the Kars region was determined as 90.8% and the most common species was *E. bovis* (Arslan, 1997).

Eimeria oocysts were reported in 523 (68.1%) of 768 cattle feces in a study conducted in the Thrace region (Arslan and Tüzer, 1998).

In a study conducted in the Hakkari region, *Eimeria* species were found in 82 (89%) of 92 stool samples from calves (Göz and Aydın, 2005).

In other studies with coccidiosis in cattle, it was reported that the distribution was 50.6% in Kırşehir, 20.04% in Afyon, and 51.4% in Elazığ region (Güven et al., 2010; Çiçek et al., 2007; Dumanlı et al., 1993).

Biology of disease

Eimeria species that cause coccidiosis are single-hosted and spend part of their life cycle in the host and the other part in nature. The life cycle of *Eimeria* species occurs in three stages: merogony, gametogony, and sporogony. The merogony and gametogonia phases occur in the host's digestive system, while the sporogony phase occurs in nature (Denizhan and Kozat, 2022). *Eimeria* oocysts excreted with feces become infective by sporulating in an average of 1-2 weeks in accordance with environmental conditions. Sporulated oocysts containing sporozoites have infective properties for 1-2 years when conditions are appropriate. When sporulated oocysts in contaminated barns and pastures are taken with food, oocysts are broken down by bile, acid, enzyme, carbon dioxide effect and peristaltic movements in the digestive system of the animal and sporozoites come out. After that, the merogony phase begins. In the biology of *E. bovis* and *E. zuernii*, merogony occurs in 2 periods (Hatırnaz, 2015). The resulting sporozoites proliferate asexually in the epithelial cells of the large intestine and in the last part of the small intestine to form merozoites and complete the first merogony period with the

disintegration of the epithelial cells. The released merozoites enter the new epithelial cells and multiply again in the form of merogony. This second stage of merogony is the stage in which the epithelial layer is destroyed, hemorrhages develop most severely and symptoms appear. After the merogony stage, merozoites reproduce sexually, differentiate and form microgametes and, macrogametes and leave the epithelial cells. Macrogametes and microgametes unite extracellularly to form oocysts covered with a durable membrane. The biological cycle of oocysts excreted with feces is completed in 11 to 22 days (Tufan and Çam, 2008).

Pathogenesis and clinical symptoms

Coccidiosis usually has a clinical course in very few animals in a barn. However, in some cases, the incidence of disease (morbidity) can reach 100%. Generally, the disease is not seen in enterprises where care and feeding are appropriate (enzootic stability). In these enterprises, the amount of oocysts is sufficient to create immunity, and thus, limited oocyst removal does not cause an epidemic of disease-causing nature (premunition). Since *Eimeria* species have different growth sites specific to the species, different lesions and appearances may occur during the course of the disease. Although *Eimeria* species are located in the epithelial tissue of the small intestine, large intestine lesions are noted in *E. bovis* and *E. zuernii*, which are located in deeper tissues. Resorption disorders occur in large intestine changes. Water loss with diarrheal stools, resorption disorder due to the inhibition of Na and Cl ions in plasma concentration develops, and dehydration is observed. Thus, the cause of death at the beginning of the disease is due to loss of plasma proteins and minerals, but later to anemia due to erythrocyte loss. In addition, epithelial disorders, mucosal thickening, and catarrhal inflammation of the small intestine are formed. Immunity occurs in survivors and in subclinical infections according to each *Eimeria* species. There is no cross-immunity between species. Antibodies detected in contaminated animal serum are not protective, T lymphocytes are responsible for immunity (Karaer et al, 2012; Denizhan and Kozat, 2022).

The disease is seen as acute, per acute and, subclinical. While clinical signs such as diarrhea, weight loss, and dehydration are observed in calves with acute coccidiosis, the disease progresses more sub clinically in older cattle (Göz and Aydın, 2015; Aslan et al., 2015). Acute coccidiosis first manifests itself with foul-smelling, serous dark green diarrhea. The anus of the animal is contaminated with feces. In the second period of acute coccidiosis, the patient's feed consumption decreases, there is a rapid weakening and he cannot get up in his bed. Other symptoms that can be seen are a body temperature of 40-41°C, an increased need for water, decreased appetite, dry skin, and erect hair. Since excessive bleeding is seen in the intestines at the last stage of acute coccidiosis, the stool is bloody and rectal examinations show that the rectal mucosa is thickened, heavy, hyperemic, and edematous (Denizhan and Kozat, 2022).

Immunity

Immunity in coccidiosis is species-specific. The elderly show immunity due to the infections they have had. Immunity is not seen in young people. The disease is more important for young people. In the first infections, the number of oocysts excreted with feces is high. In subsequent infections, the number of oocysts decreases as a result of the immune system. Because of the immune response, sporozoites and merozoites are prevented from entering the cell. Immunity continues as long as the coccidia agent is present in the body. For this reason, continuous reinfections are required for the continuation of immunity (Chappell, 2001).

The role of T cells in the immune response against coccidiosis is very important. Because cellular immunity plays an important role in the immune response mechanism. First-generation meronts show strong antigenic stimuli. Serum antibodies (IgM, IgG1, IgG2) against 1st generation merozoite antigens are formed in animals infected with *E. bovis*. In particular, secretory IgA contributes to protective immunity. Humoral antibodies play a smaller role in protective immunity (Arslan and Sarı, 2010).

CD4+ (helper T lymphocytes) in initial infections with *Eimeria* species, and later infections; CD8+ (cytotoxic T lymphocytes) T lymphocytes are more important in protective immunity, and especially Th1 type cells play a role in cellular immunity. The effects of T lymphocytes are mediated by cytokines. These cytokines are interleukin-2 (IL-2) and interferon-gamma (IFN γ) secreted by lymphocytes activated by parasite antigens. Th1 cells activate cytotoxic CD8+ T and NK (natural killer) cells by secreting IL-2, and macrophages to produce nitric oxide through IFN γ. Macrophages activated with cytokines cause the destruction of sporozoites in the cell or show their effect by preventing the formation of meronts (Karaer et al., 2012).

Diagnosis

In its diagnosis, the age of the animal, the hygienic condition of the environment, and clinical signs are

evaluated. Clinical findings and stool consistency in calves and calves are also important in diagnosis. The stool is scored according to its consistency. Accordingly, stool; It is classified as normal (zero-0), soft (one-1), diarrhea (two-2), diarrhea and tissue residue (three-3), diarrhea, bloody and tissue residue (four-4). The stool is examined using the flotation method using various concentrated solutions ($ZnSO_4$, $ZnCl_2$, sugar water, $NaNO_3$, NaCl). With the McMaster technique, the number of oocysts in gram stool is determined. In addition, oocysts are sporulated in 2.5% potassium dichromate solution ($K_2Cr_2O_7$) for species identification (Aydenizöz et al., 1999).

Species identification can be made easily in bovine coccidiosis by taking into account the morphological features of non-sporulated and sporulated oocysts by stool examination. The shape and size of the oocyst is very important. Oocyst sizes range from 8 to 54 mm. The smallest oocysts are *E. subspherica* (8-14x8-13 mm); the largest ones belong to *E. bukidnonensis* (33-54x24-41 mm). The presence of oocyst in the stool does not mean coccidiosis. The presence of oocysts belonging to pathogenic species and clinical bloody diarrhea increases the possibility of coccidiosis. The absence of oocysts in the stool does not mean that there is no coccidiosis. Because especially in *E. zuernii* and *E. bovis* infections, pathological disorders occur before oocysts are excreted. By performing a necropsy, macroscopic lesions in the intestines are examined to support the diagnosis. In terms of meronts and gamonts, which are the developmental stages of Eimeria, histopathological preparations are prepared and examined microscopically. However, a necropsy for a definitive diagnosis of bovine coccidiosis is not economical and is not recommended. Only dead animals, if any, are necropsied. Clinically bloody diarrhea, oocyst counts in gram stool over 5.000-10.000, and detection of oocysts belonging to pathogenic species indicate clinical coccidiosis cases. In addition, species-specific molecular diagnostic methods (Polymerase Chain Reaction) have been developed. Coccidia oocysts begin to appear in calves' feces from 14 days of age. Oocyst density usually increases when they are one month old. Animals with clinically soft stools or bloody diarrhea have higher oocyst counts than those with normal stools. When making the differential diagnosis of coccidiosis in cattle, infections such as Clostridial enteritis, Salmonella spp., Escherichia coli, Bovine Viral Diarrhea, Rotavirus, *Campylobacter* spp., Coronavirus, giardiasis, cryptosporidiosis and intestinal helminthosis should also be considered, especially with diarrhea. Since clinical symptoms are formed before oocyst expulsion, repeated stool examinations should be performed by flotation method (Karaer et al., 2012).

Treatment of the disease

The treatment of coccidiosis is based on the principles of killing the causative agent or preventing its development, eliminating fluid loss, and treating secondary infections (Arslan and Sarı, 2010; Arslan 2001). In establishments with high density and large numbers of animals, medication should always be administered with food or by adding it to water (Chartier and Paraud, 2012). In such applications, the aim is a method of protection against coccidiosis before animals are infected and damaged. Not all types of coccidiosis in an animal show the same sensitivity to any drug. For this reason, it is important to determine the species for the treatment of the disease to be successful. When the risk factors are known and eliminated in the control of the disease, the disease can be prevented without using coccidiostatic drugs (Denizhan and Kozat, 2022).

Treatment of coccidiosis in calves requires drug treatment for all animals living in groups. The reason for this is that when the symptoms of the disease begin to appear, the deterioration of the intestinal epithelium in cattle is considered too late for treatment. It is very important in supportive treatments together with the treatment for the causative factors. Drugs used against coccidiosis are generally used with water, milk, and feed (Arslan and Sarı, 2010).

Since the clinical symptoms begin to appear in the last stage of the infection, it is necessary to pay attention to this situation in the treatment. 17-18 days of infection in *E. zuernii* and *E. bovis* coccidiosis. The first clinical symptoms are seen on the first day of life, therefore, the sooner treatment is started, the more successful the results. If several animals in the herd are sick, all animals should be treated together. Anticoccidial drugs and sulfonamide group antibiotics are used in the treatment of coccidiosis (Denizhan and Kozat, 2022).

While sulfonamides are used in combination with trimethoprim in clinical coccidiosis cases, sulfadimidine is used in advanced cases and emergencies. Toltrazuril is an effective and primarily used drug in the treatment of clinical coccidiosis in cattle. In the treatment of coccidiosis in calves naturally infected with *E. zuernii* and *E. bovis*, oral administration of 15mg/kg dose of toltrazuril is reported to be very effective and reduces economic losses by positively affecting the growth performance of animals. Since anticoccidial drugs generally affect meronts, this situation should be considered in treatment (Veronesi et al., 2011).

Table 1. Anticoccidial drugs (Denizhan and Kozat, 2022)

Active ingredient	Purpose of usage, dosage, etc.
Sulfaquinoxalin	15 mg/kg, 4 days, peros
Sulfamethazin	50-100 mg/kg, 4 days, peros
Sulfaguadin	100 mg/kg, 3 days, peros
Sulfathiazol	150 mg/kg, 3-6 days, peros
Sulfadimidin	50-100 mg/kg, peros
Sulfadimethoxine	55 mg/kg(first day), 27.5 mg/kg 4 days, peros
Toltrazurile	10 mg/kg, 2 times a day, 2 days, peros
Furazolidone	15-30 mg/kg, 3-7 days, peros
Amproliume	10 mg/kg, 5 days, peros

Disease prevention and control

Protection and control from coccidiosis is possible with some measures to be taken in barns and pastures. Ensuring the necessary hygienic conditions in the barn; In pasture, it is provided by using the pasture alternately with other animal species (horse, sheep, or cattle). Among the most important factors to be considered in the prevention of coccidiosis are herd management, care-feeding, and hygiene conditions. Young and old animals should be reared in separate compartments, especially calves should be separated from their mothers within 24 hours after birth and kept in separate compartments. The number of animals should not exceed the barn's capacity. This situation should also be considered in terms of the number of animals in the paddocks in semi-open and closed enterprises. Especially in dairy farms, in farms where the number of calves is high, animals should not be kept crowded in paddocks in the front of the barns (Göz et al., 2006).

Contamination of feed and drinkers with feces should be prevented in the barns, the walls should be made of solid concrete, there should be no cracks and crevices, the litter should be cleaned every morning and evening before feeding, animals should not be allowed to eat fodder such as hay and grass from the ground. The temperature of the barn should not exceed 18oC and it should be ventilated to prevent the environment from being humid. Care should be taken when the calves are left on the pasture during the post -weaning period and calves should not be left on the pasture in bulk. Calves should also be checked for gastrointestinal nematode, bacterial, and viral infections. Chemoprophylaxis and immunoprophylaxis are also important in the control and protection of coccidiosis in cattle. Anticoccidial drugs are used in chemoprophylaxis for prophylactic purposes. Anticoccidial drugs for prophylactic purposes should be used for calves up to 6 months of age especially during their laying in pasture, at the time of transfer from single to bulk compartments, and during weaning. Immunoprophylactic methods such as vaccination are practically not applied in bovine coccidiosis. Despite the prevention and control methods, the eradication of coccidiosis and the protection of animals are quite difficult. However, clinical cases are prevented and economic losses are reduced. Unsporulated oocysts lose their vitality in 4 days with less than 25% relative humidity and sunlight. Most of the oocysts lose their infective properties in an average of 60 days at -8 ^{o}C and all within 24 hours at -30 ^{o}C. High temperature (48 ^{o}C) causes shrinkage of oocysts and these types of oocysts cannot become infective because they cannot pass through the sporogonic growth stage. 5% phenol, 1% ammonia, 1.25% sodium hypochlorite, 25% formaldehyde, and 0.5% creosol are used in farm disinfection, which is lethal on oocysts (Karaer et al., 2012).

Conclusion

In studies conducted in our country, 11 *Eimeria* and 1 *Isospora* species have been found in cattle. In studies on bovine coccidiosis in Turkey, the prevalence of *Eimeria* species in calves and calves was found to be 16-93.3%.

In line with the results obtained, it has been observed that coccidiosis continues to be a problem even in cattle farms with relatively good care and feeding conditions in Turkey. It was concluded that routine checks should be made in the enterprises, necessary precautions should be taken and hygiene rules should be followed.

References

Aktaş, M. S., Sarı, B, & Arslan, M. Ö. (2008). Prevalence of *Eimeria* species in dairy calves of Erzurum and vicinity. *Journal of Kafkas University Faculty of Veterinary Medicine, 14*, 25-29.

Arslan, M. Ö. (1997). Prevalence of Eimeria species in calves in Kars region. *Journal of Kafkas University Faculty of Veterinary Medicine, 3*(2), 69-72.

Arslan, M. Ö. (2001). *Coccidiosis in cattle and buffaloes.* Dinçer, Ş. (Ed). Coccidiosis, 17th ed. (pp. 201-218). Izmir, Turkey: Turkish Journal of Parasitology Publications.

Arslan, M. Ö., & Sarı, B. (2010). Eimeridae *(Coccidiosis in Mammals)* Dumanlı, N., Karaer, K.Z. (Ed.). Veterinary Protozoology, 1st ed. (pp. 75-98). Ankara, Turkey: Medisan Publishing.

Arslan, M. Ö., & Tüzer, E. (1998). Prevalence of bovine Eimeridosis in Thracia, Turkey. *Turk Journal Veterinary Animal Science, 22*, 161-164.

Aslan, M., Kırmızıgül, A. H., Parmaksızoğlu, N., & Erkılıç, E. E. (2015). A Case of winter coccidiosis in calves naturally infected by Eimeria zuernii. *Ataturk University Journal of Veterinary Sciences, 10*(3), 193-197.

Aydenizöz, M., Aldemir, O. S., & Güçlü, F. (1999). Parasites detected in cattle by stool examination and their distribution. *Turkish Journal of Parasitology, 23*(1), 83-88.

Chappell, L. H. (2001). *Disease, treatment, therapy*. Mehlhorn, H. (Ed.) Encyclopedic reference of parasitology, 2nd ed. (pp. 673-678). Berlin, Germany: Cambridge University Press.

Chartier, C., & Paraud, C. (2012). Coccidiosis due to *Eimeria* in sheep and goats, A review. *Small Ruminant Research, 103*(1), 84-92.

Çiçek, H., Sevimli, F., Kozan, E., Köse, M., Eser, M., & Doğan, N. (2007). Prevalence of coccidia in beef cattle in Western Turkey. *Parasitology Research, 101*, 1239-1243.

Değer, S., Biçek, K., Gül, A., & Eraslan, E. (2001). The prevalence of Eimeria species in calves in Van area. *Centenary University Journal of Health Sciences, 7*(1-2), 69-72.

Denizhan, V., & Kozat, S. (2022). *Coccidiosis in cattle*. Şahna, E., Akgül, H. (Ed.). Current researches in health sciences-II, 49-66. Ankara, Turkey: Night Library Publishing.

Dumanlı, N., Güler, S., Erdoğmuş, Z., Köroğlu, E., Yılmaz, H., & Küçükerden, N. (1993). The causative agents of coccidia in cattle and their distribution in Elazığ region. *Doğa Turkish Journal of Veterinary Livestock, 17*, 223-227.

Göz, Y., Altuğ, N., Yüksek, N., & Özkan, C. (2006). Parasites detected in neonatal and young calves with Ddiarrhoea. *Bulletin-Veterinary Institute in Pulawy, 50*(3), 345.

Göz, Y., & Aydın, A. (2005). Prevalence of coccidiosis agents in calves in the Yüksekova (Hakkari) region. *Turkish Journal of Parasitology, 29*(1), 13-16.

Gül, A., Biçek, K., & Değer, S. (2000). *Eimeria* species and their epidemiology in cattle slaughtered in the city of Van slaughter house. *Centenary University Journal of the Faculty of Veterinary Medicine, 2*(2), 12-14.

Gül, A., Çiçek, M., & Kılınç, Ö. (2008). Prevalence of *Eimeria* spp., *Cryptosporidium* spp. and *Giardia* spp. in calves in the Van province. *Turkish Journal of Parasitology, 32*, 202-204.

Güleğen, A. E., & Okursoy, S. (2000). Coccidiasis species of cattle and their prevalence in Bursa province. *Turkish Journal of Parasitology, 24*(3), 297-303.

Güven, E., Nalbantoğlu, S., Orkun, Ö., Akçay, A., & Koçak, A. (2010). Prevalance of *Eimeria* species in cattle in Mucur District of Kırsehir. *Journal of Kafkas University Faculty of Veterinary Medicine, 16*(3), 483-486.

Hatırnaz, M. (2015). Molecular Prevalence and phylogenetic characterization of pathogenic Eimeria species, which cause bovine coccidiosis in Mahzemin area of Kayseri. *Master of Science Thesis*, Erciyes University Institute of Health Science, Kayseri.

Jolley, W. R., & Bardsley, K. D. (2006). Ruminant coccidiosis. *Veterinary Clinics Food Animal, 22*(3), 613-621.

Karaer, Z., Orkun, Ö., & Sürsal, N. S. (2012). Koyun ve Keçilerde Coccidiosis. *Turkish Clinics Veterinary Science, 3*(2), 1-8.

Köse, O. (2011). The prevalence of Eimeria species in calves in Burdur Region *Master of Science Thesis*, Mehmet Akif Ersoy University Institute of Health Science, Burdur.

Levine, N. D. (1985). *Veterinary Protozoology. 1st e*d. Iowa, USA: Iowa State University. Press. Ames,

Mimioğlu, M., Göksu, K., & Sayın, F. (1956). Studies on coccidiosis events in cattle in Ankara and its vicinity. *Journal of Ankara University Faculty of Veterinary Medicine, 3*, 136-158.

Sayın, F. (1970). The species of *Eimeria* occurring in cattle in Turkey. *Journal of Ankara University Faculty of Veterinary Medicine, 17*, 311-326.

Tufan, A., & Çam, Y. (2008). Lipid peroxidation level and antioxidant enzyme activities in calves coccidiosis. *Journal of Health Sciences, 17*(3), 131-136.

Uslu, U., & Ceylan, O. (2020). The evaluation of toltrazuril (Coc-Cide®) in treatment of caecal coccidiosis in Hubbard Isa Red-JA Broiler Chickens raised at free range production system. *Journal of Dicle University Faculty of Veterinary Medicine, 13*(2), 135-138.

Veronesi, F., Diaferia, M., Viola, O., & Fioretti, D. P. (2011). Long-term effect of toltrazuril on growth performances of dairy heifers and beef calves exposed to natural *Eimeria zuernii* and *Eimeria bovis* infections. *The Veterinary Journal, 190*(2), 296-299.