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Investigation of Etiological Prevalence of Neonatal Calves with Acute Diarrhea in Şanlıurfa Province with Immunochromatographic Test

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Abstract: Neonatal calf diarrhea is a significant global concern, frequently causing morbidity and mortality and resulting in substantial economic losses. This study aimed to assess the prevalence of *E. coli* F5, *Clostridium perfringens*, *Cryptosporidium* spp., *Rotavirus*, *Coronavirus*, and *Giardia* spp. as contributors to diarrhea in neonatal calves in Şanlıurfa province. We also evaluated the clinical severity associated with these etiological agents. The study involved 123 neonatal calves (62 males, 61 females) aged 1-28 days from Şanlıurfa province with acute diarrhea. Calf Health Scores (CHS) were assigned based on clinical examination data. Rapid diagnostic tests were conducted on stool samples to identify *E. coli* F5, *Clostridium perfringens*, *Cryptosporidium* spp., *Rotavirus*, *Coronavirus*, and *Giardia* spp. regardless of mono or co-infection status, the rapid test results showed a prevalence of 9.76% for *E. coli* F5, 41.46% for *C. perfringens*, 30.89% for *Cryptosporidium* spp., 16.26% for *Rotavirus*, 13% for *Coronavirus*, and 27.64% for *Giardia* spp. CHS varied, with the highest score observed in *E. coli* F5 + *Giardia* spp. co-infection (CHS: 7) and the lowest in *Coronavirus* + *Rotavirus* co-infection (CHS: 4). In Şanlıurfa province, *C. perfringens* and *Cryptosporidium* spp. were identified as the most common agents. It has been determined that as the etiological factor diversity increases CHS may increase but there may be different variables that change CHS. These results are significant for developing effective diagnosis and control strategies for the prominent etiologies of diarrhea in calves.
Keywords: *Calf, Clinical score, Diarrhea, Etiology, Neonatal, Prevalence.*

Şanlıurfa İlindeki Akut İshalli Neonatal Buzağıların İmmunokromatografik Test ile Etiyolojik Prevalanslarının Araştırılması

Özet: Neonatal buzağı ishalleri, yapılan tedavi masrafları, buzağıların büyüme ve performans kayıpları (et ve süt verimi) ile buzağı ölümleri nedeniyle ciddi ekonomik kayıplara neden olduğundan dolayı, dünya çapında sık bildirilen, en önemli morbidite ve mortalite sebeplerindendir. Bu çalışmanın amacı; Şanlıurfa ilindeki akut ishalli neonatal buzağılarda görülebilen ishalin etiyolojisinde rol oynayan *E. coli* F5*, Clostridium perfringens, Cryptosporidium* spp.*, Rotavirus, Coronavirus* ve *Giardia* spp. etkenlerinin prevalansını tespit etmek ve etiyolojik etkenlerin klinik şiddetini değerlendirmektir. Araştırmaya, Şanlıurfa ilinden 1-28 günlük yaşta, 62 adet erkek ve 61 adet dişi olmak üzere 123 adet akut ishalli neonatal buzağı dahil edildi. Dahil edilen buzağılar, yapılan klinik muayene neticesinde elde edilen veriler ile buzağı sağlık skorları (BSS) belirlendi. Takibinde, buzağılardan alınan dışkı örneklerinden *E. coli* F5*, C. perfringens, Cryptosporidium* spp.*, Rotavirus, Coronavirus* ve *Giardia* spp. etkenlerinin belirlenmesi için hızlı tanı test kiti analizleri yapıldı. Dışkıdan yapılan hızlı test kiti sonuçları neticesinde mono ve ko-enfeksiyon durumlarına bakılmaksızın yaygınlıkları; %9,76 *E. coli* F5, %41,46 *C. perfringens*, %30,89 *Cryptosporidium* spp., %16,26 *Rotavirus*, %13 *Coronavirus* ve %27,64 *Giardia* spp. tespit edildi. Yapılan BSS'ye göre en yüksek skorun *E. coli* F5 + *Giardia* spp. koenfeksiyonuna (BSS: 7) ait olduğu, en düşük skorun ise *Coronavirus* + *Rotavirus* koenfeksiyonuna (BSS: 4) ait olduğu saptanmıştır. Şanlıurfa ilinde gerçekleştirilen bu çalışma ile bölgede en çok *C. perfringens* ve *Cryptosporidium* spp. etkenlerinin bulunduğu, etiyolojik etken çeşitliliğinin arttıkça BSS'yi arttırabileceği fakat BSS'yi değiştiren farklı değişkenlerin de olabileceği tespit edilmiştir. Bu sonuçlar, buzağılarda ishalin öne çıkan etiyolojilerine yönelik etkin tanı ve kontrol stratejileri geliştirme açısından önemlidir.
Anahtar Kelimeler: *Buzağı, Etiyoloji, İshal, Klinik skor, Neonatal, Prevalans.*

Introduction

The neonatal period in calves is a critical phase during which physiological functions develop and adapt to life after birth (Constable et al., 2017; Smith, 2015). Although calves have higher body fluids than adults, neonatal diarrhea is a significant health issue. This is attributed to the limited compensation and regulation ability, leading to rapid fluid-electrolyte losses, particularly in agammaglobulinemic births (Aydoğdu and Güzelbekteş, 2018).

Neonatal calf diarrhea is caused by infectious agents and non-infectious factors (managerial, host factor, nutritional, and environmental factors, etc.) (Bendali et al., 1999; Blanchard, 2012). The most important etiological factors include bacterial (*C. perfringens*, *E. coli*), viral (*Coronavirus*, *Rotavirus*), and parasitic (*Cryptosporidium parvum*, *Eimeria* spp., *Giardia* spp.) factors (Aydoğdu et al., 2018a; Güzelbekteş et al., 2007; Kaske and Kunz, 2003).

Diarrhea is recognized as the health problem with the highest mortality and morbidity in neonatal calves (Aygün and Yıldız, 2018; Yıldız et al., 2018). Consequently, treatment costs, the negative impact of diarrhea on calf growth and productivity, and deaths contribute to economic losses (Aydoğdu et al., 2018a; Aydoğdu et al., 2018b). Rapid identification of the causes of diarrhea in calves and appropriate treatment are reported to reduce losses in the neonatal period (Kalınbacak, 2003).

The aim of this study was to determine the etiology of diarrhea in neonatal calves with acute diarrhea in Şanlıurfa province. This provides etiological prevalence data for future studies on neonatal calves with diarrhea and contributes to the scientific literature. Additionally, the study aimed to assist in developing treatment and prophylaxis strategies by providing etiological prevalence information to veterinarians working in the region. Furthermore, the severity of clinical findings in calves with neonatal diarrhea, which may vary according to etiological diversity, was determined using the Calf Health Scores (CHS), a scoring system that indicates the degree of severity of clinical findings in calves.

Material and Methods

Ethics committee approval: This study was carried out with the approval of Harran University Animal Experiments Local Ethics Committee, Session No. 2022/002, Decision No. 01-13.

Animal material: The animal material of the study comprised 123 Holstein and Simmental breed calves in the neonatal period (1-28 days of age) brought to Harran University Faculty of Veterinary Medicine, Animal Hospital, Department of Internal Medicine with diarrhea from August 2022 to November 2023.

Inclusion/Exclusion criteria: The study did not indlude calves that had previously received any medical intervention for diarrhea (such as fluid therapy, antibiotics, vitamin-mineral supplements, and positive inotrope applications), which may lead to errors in making etiological determinations.

Clinical and laboratory examinations: Clinical examinations were performed on each calf meeting the study criteria, including the evaluation of palpable lymph nodes, auscultation of the heart and lungs to measure pulse and respiration rates, and assessing the parameters included in the Calf Health Score (CHS) (McGuirk, 2013). The CHS of each calf was calculated and recorded as a result of clinical examinations.

After clinical examinations and CHS calculation, fecal samples taken from the rectum by massage and/or during spontaneous defecation were examined for six etiological agents (*C. perfringens*, *Cryptosporidium* spp., *Coronavirus*, *Rotavirus*, *E. coli* F5, and *Giardia* spp.) using immunochromatographic rapid diagnostic test kits (BIO K 306 - Rainbow Calf Scours 5, Belgium, and VET Diagnostix Giardia AG Test, China) according to the manufacturer's instructions.

Statistical analysis: The prevalence of both pathogens and co-infection diarrheal etiology among the calves with 95% confidence intervals was calculated by dividing the number of positive cases by the total number of the enrolled calves with diarrhea. All data were summarized using a statistical software (SPSS 25.00 for Windows, IBM).

Results

Etiological prevalence, CHS, age, and sex data of the 123 neonatal calves with diarrhea evaluated in the study are summarized in Table 1. In 87.8% of the 123 neonatal calves with acute diarrhea included in the study, at least one agent was found positive in the test kits. The percentages of positive cases by at least 2, 3, and 4 etiologic agents were 38.21%, 11.38%, and 4.07%, respectively. Positivity by 5 or more etiologic agents was not observed in the cases evaluated within the scope of the study. The mean CHS score and mean daily age of the positive cases were 5.02 and 12.55, respectively. Out of the 123 calves, 62 were male, and 61 were female. The percentage distributions of the etiological agents of the present study were presented in Figure 1.

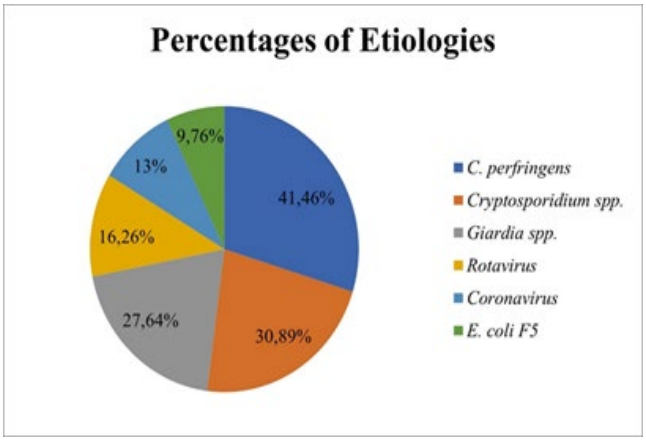

Figure 1. Percentage distribution of etiologies.

Discussion and Conclusion

Diarrhea is recognized as a significant health issue in neonatal calves (Uhde et al., 2008). Rapid identification of diarrhea etiology during the neonatal period and the implementation of effective treatments are reported to reduce economic, yield, and life losses in this critical period (Kalınbacak, 2003). Our study conducted in Şanlıurfa province, we determined the prevalence of etiological agents causing neonatal acute diarrhea in calves, regardless of mono or coinfection. The identified agents and their respective prevalence rates were as follows: *C. perfringens*

Table 1. Etiological prevalence, CHS, age and sex data in neonatal calves with acute diarrhea.

Etiology	Number of calves (n=123)	Prevalence (%)	CHS Mean (Min-Max)	Age (Day) Mean (Min-Max)	Sex (M/F)
Negative	15	12,2	4,67 (2-8)	11 (1-25)	10/5
C. perfringens	51	41,46	4,92 (2-9)	10,82 (2-28)	26/25
***E. coli* F5**	12	9,76	5,75 (3-8)	3,67 (1-7)	6/6
Rotavirus	20	16,26	4,4 (2-9)	10,45 (2-28)	10/10
Coronavirus	16	13	5 (2-8)	13,69 (3-28)	8/8
***Cryptosporidium* spp.**	38	30,89	5,16 (3-9)	14,71 (7-28)	22/16
***Giardia* spp.**	34	27,64	3,88 (1-6)	16,82 (2-28)	18/16
***C. perfringens* + *Cryptosporidium* spp.**	12	9,76	5,67 (3-9)	14,17 (7-28)	9/3
***C. perfringens* + *E. coli* F5**	6	4,88	5,67 (3-8)	3,67 (3-7)	3/3
C. perfringens* + *Coronavirus	10	8,13	5,17 (2-8)	15,5 (6-28)	7/3
C. perfringens* + *Rotavirus	7	5,69	4,29 (2-9)	7,86 (2-14)	5/2
***C. perfringens* + *Giardia* spp.**	12	9,76	4,75 (2-8)	18,17 (13-28)	7/5
E. coli* F5 + *Rotavirus	2	1,63	6 (5-7)	4,5 (2-7)	1/1
***E. coli* F5 + *Giardia* spp.**	1	0,81	7 (7-7)	5 (5-5)	1/0
Cryptosporidium* spp. + *Rotavirus	3	2,44	5,67 (3-9)	9,33 (8-10)	1/2
Cryptosporidium* spp. + *Coronavirus	6	4,88	5,83 (3-8)	14,17 (7-28)	3/3
***Cryptosporidium* spp. + *Giardia* spp.**	10	8,13	4,6 (3-6)	15,3 (10-28)	8/2
Coronavirus* + *Rotavirus	4	3,25	3 (2-5)	9,25 (3-14)	2/2
***Coronavirus* + *Giardia* spp.**	6	4,88	5,33 (2-8)	17 (10-28)	4/2
***Rotavirus* + *Giardia* spp.**	4	3,25	3,5 (2-5)	13,5 (2-28)	1/3
***C. perfringens* + *Coronavirus* + *Giardia* spp.**	6	4,88	5,17 (2-8)	17,83 (10-28)	4/2
***C. perfringens* + *Cryptosporidium* spp. + *Giardia* spp.**	4	3,25	5,5 (4-6)	18,25 (10-28)	4/0
C. perfringens* + *Cryptosporidium* spp. + *Coronavirus	4	3,25	5,5 (3-7)	13,75 (7-28)	3/1
C. perfringens* + *E. coli F5* + *Rotavirus	1	0,81	7 (7-7)	2 (2-2)	1/0
***Cryptosporidium* spp. + *Rotavirus* + *Coronavirus* + *Giardia* spp.**	1	0,81	5 (5-5)	10 (10-10)	0/1
***C. perfringens* + *Rotavirus* + *Coronavirus* + *Giardia* spp.**	1	0,81	2 (2-2)	14 (14-14)	0/1
C. perfringens* + *Cryptosporidium* spp. + *Rotavirus* + *Coronavirus	1	0,81	3 (3-3)	10 (10-10)	1/0
***C. perfringens* + *Cryptosporidium* spp. + *Coronavirus* + *Giardia* spp.**	2	1,63	6 (6-6)	19 (10-28)	2/0

*M: Male, F: Female

(41.46%), *Cryptosporidium* spp. (30.89%), *Giardia* spp. (27.64%), *Rotavirus* (16.26%), *Coronavirus* (13%), and *E. coli* F5 (9.76%). Among co-infections, the most common combinations were *C. perfringens* + *Cryptosporidium* spp. and *C. perfringens* + *Giardia* spp. (both 9.76%).

We observed significant differences when comparing our findings with studies conducted in Aydın province, In a study involving 198 calves in Aydın, the prevalence of *Giardia duodenalis* was reported as 17.67% (Gültekin et al., 2017). Another study in the same region reported a prevalence of 7.19% (Balıkçı et al., 2023). The disparity between these

studies can be attributed to variations in the age distribution of cases (0-3 months and 1-28 days age, respectively). It was observed that *Giardia* spp. was detected at a lower intensity in calves in the neonatal period compared to calves in the post-neonatal period. In our study, where calves up to 28 days were included, all positive cases for *Giardia* spp. accounted for 27.64%, indicating a higher prevalence compared to Aydın province.

A study conducted on 71 calves in Van province reported a high prevalence of *Giardia duodenalis*, detected using both rapid test kits (38 cases positive) and PCR (46 cases positive) (Ayan et al., 2019). However, the prevalence found in our study (27.64%) suggests that the high prevalence in Van province might be influenced by the inclusion of calves up to 90 days of age. Contrarily, a study in Aydın province (Gültekin et al., 2017) focusing on calves up to 3 months reported a lower prevalence compared to Van province. These regional differences indicate that Van province may have a higher prevalence of *Giardia* spp. than Şanlıurfa province. Notably, our study's *Giardia* spp. prevalence (27.64%) was considerably higher than reported levels in Siirt (4%) (Kozat and Tuncay, 2018), Sivas (4.13%) (Değerli et al., 2005), and Tokat (16.82%) (Coşkun and Kaya, 2018).

In a study investigating the impact of various etiological factors on haemogram parameters in neonatal calf diarrhea in 44 calves aged 1-20 days in Burdur province, the prevalence of *C. perfringens*, *E. coli*, *Cryptosporidium* spp., *Rotavirus*, and *Coronavirus* were determined to be 43.2%, 9.1%, 38.6%, 22.7%, and 11.4%, respectively, with 22.7% of cases showing no positivity of these agents (Atcalı and Yıldız, 2020). In another study conducted in 50 calves aged 1-30 days in Burdur province, it was reported that *Cryptrosporidium* spp., *Rotavirus*, *E. coli*, *Giardia* spp., *Coronavirus* were detected at rates of 24%, 12%, 6%, 6% and 2%, respectively (Mamak et al., 2023). The results of two studies conducted in Burdur province show that even a change in the 10-day age distribution of calves in the same region can change the prevalence of etiology. The observed disparities in etiological agent-based prevalences between this study and others may be attributed to varying distributions in different regions and/or differences in calf age distribution (Atcalı and Yıldız, 2020, Mamak et al., 2023) compared to this study (1-28 days age).

Another study in Uşak province, involving 100 neonatal calves with diarrhea aged 1-28 days, reported the prevalence of *C. perfringens*, *E. coli*, *Cryptosporidium* spp., *Rotavirus*, and *Coronavirus* as 21%, 15%, 18%, 31%, and 10%, respectively, with 10% of cases were negative (Sezer and Akgül, 2022). Given the consistent age distribution in both this study and the Uşak study, differences in the prevalence of the etiological factor (*C. perfringens*) may be attributed to regional variations. Comparing this study with the Uşak study, a proportional similarity was observed in the prevalence of *E. coli*, *Rotavirus*, *Cryptosporidium* spp., and *Coronavirus* (9.76%, 16.26%, 30.89%, and 13%, respectively), suggesting a consistent intensity of neonatal calf diarrhea caused by these agents in the two regions.

In a study conducted on 192 calves with diarrhea aged 2-40 days in the South-Eastern region of Turkey, the prevalence of *E. coli* K99, *Cryptosporidium* spp., *Rotavirus*, and *Coronavirus* etiologies were investigated and found to be 26%, 47.7%, 55.2%, and 5.1%, respectively, with 7.3% reported as negative (İçen et al., 2013). Despite both studies being conducted in similar geographical regions, a divergence in etiological prevalence was observed, indicating changes in regional prevalences over the 10-years gap between the two studies. In an another study, *Coronavirus* prevalence (5.32%) was found in <3 months old calves with diarrhea in Şanlıurfa province, located in the same region (Abikoğlu and Özgünlük, 2022). It was reported that the prevalence found in this study was low, but also the coronavirus tends to spread rapidly. Although the study was published in 2022, it is noteworthy that the faecal samples are primarly from 2016. Therefore, similar to the comparison in the other study (İçen et al., 2013), time elapsed (7 years) between our study and the aforementioned study (Abikoğlu and Özgünlük, 2022) cannot negligible. In summary, it can be said that the prevalence of *Coronavirus* in the region has increased over the years.

In Sivas province, a study on 138 calves with diarrhea aged 1-30 days reported the prevalence of *E. coli*, *C. perfringens*, *Cryptosporidium* spp., *Rotavirus*, and *Coronavirus* agents as 26%, 38%, 7%, 22%, and 9%, respectively, with a 20% negative rate (Kuliğ and Coşkun, 2019). Although both studies shared a similar age distribution range for calves with diarrhea and observed a high prevalence of the causative agent (*C. perfringens*), the prevalence of other etiological agents differed between the two studies.

In Elazığ province, a study on 30 calves with diarrhea aged 1-28 days reported the prevalence of *E. coli*, *Cryptosporidium* spp., *Rotavirus*, and *Coronavirus* agents as 17%, 0%, 30%, and 13%, respectively (Al and Balıkçı, 2012). *Cryptosporidium* spp., absent in the study, may account for the lower case count compared to other studies. Another study reported a *Cryptosporidium* spp. prevalence of 7.2% in Elazığ province (Özer et al., 1990). *Rotavirus* prevalence in the Al and Balıkçı (2012) study aligns with those in Burdur (Atcalı and Yıldız, 2020), Uşak (Sezer and Akgül, 2022), Elazığ (Al and Balıkçı, 2012) and our study, indicating *Rotavirus* as a common agent.

A study in Siirt province, examining 100 calves with diarrhea aged 0-90 days, reported the prevalence of *E. coli* K99, *Cryptosporidium* spp., *Rotavirus*, *Coronavirus*, and *Giardia lambia* agents as 18%, 22%, 25%, 7%, and 4%, respectively, with 52% of cases were negative results (Kozat

and Tuncay, 2018). In our study, the prevalence of *Giardia* spp. (27.64%) was notably high, and the prevalence of *E. coli* was almost double (9.76%) compared to the Siirt study, consistent with the other etiological factors.

In Tokat province, a study on 107 calves with diarrhea aged 3-28 days reported the prevalence of *E. coli* K99, *Cryptosporidium* spp., *Rotavirus*, *Coronavirus*, and *Giardia lambia* agents as 7.48%, 11.21%, 44.86%, 9.35%, and 16.82%, respectively (Coşkun and Kaya, 2018). *Rotavirus* had the highest prevalence, aligning with studies in Burdur (Atcalı and Yıldız, 2020), Uşak (Sezer and Akgül, 2022), and Elazığ (Al and Balıkçı, 2012). In our study, *Rotavirus* was found to have the fourth highest prevalence after *C. perfringens, Cryptosporidium* spp. and *Giardia* spp.

An investigation encompassing 175 diarrheic calves aged 1-34 days in Kayseri and its adjacent provinces (Sivas, Nevşehir, Yozgat, Niğde, Kırşehir) revealed prevalence rates of 37.7% for *Coronavirus*, 34.9% for *Cryptosporidium* spp., 30.3% for *Rotavirus*, 15.4% for *E. coli*, and 0.6% for *Giardia* spp. (Ekinci et al., 2021). When the aforementioned study is compared with this study, it is noteworthy that the prevalence of *Rotavirus* is similar. Compared to the aforementioned study, *Giardia* spp. had high prevalence in this study. These findings support that the prevalence of etiology of calves with diarrhea may vary depending on geographical region differences.

In a study conducted in 30 calves aged 1-10 years in Kars province, it was reported that *E. coli*, *Rotavirus*, *Coronavirus* and *Cryptosporidium* spp. were detected at the rates of 63.33%, 43.33%, 26.66%, 3.33% respectively (Akyüz et al. 2022). It is noteworthy that *E. coli*, which exhibited the highest prevalence in the aforementioned study, demonstrated the lowest prevalence in this study (9.76%). *E. coli* is commonly implicated as the etiological agent of diarrhea in calves within the initial four days of life (Foster and Smith, 2009). Thus, the disparity in prevalence is likely attributable to variations in the age range of the calves utilized across the two studies, rather than differences in geographical regions.

In this study, 12.2% of the calves were identified as negative. Diarrhea in neonatal calves may due to from non-infectious causes such as managerial, host factor, nutritional, and environmental factors, in addition to infectious causes including bacterial (*C. perfringens*, *E. coli*), viral (*Coronavirus*, *Rotavirus*), and parasitic (*Cryptosporidium parvum*, *Eimeria* spp., *Giardia* spp.) (Aydoğdu et al., 2018a; Güzelbekteş et al., 2007; Kaske and Kunz, 2003). Other infectious agents like *Salmonella* spp., *Adenovirus*, Bovine Viral Diarrhea Virus, *Torovirus*, *Calicivirus*, *Nebovirus*, *Norovirus*, and *Candida* spp. may also contribute to neonatal calf diarrhea (Cho and Yoon, 2014). The negative cases in this study may arise from both non-infectious and other etiological agents.

Limited data exist on the severity of clinical findings based on etiology in neonatal calves with diarrhea. In a study in Siirt province, cases were classified into mild, moderate, and severe classes based on dehydration severity, revealing that 28.6% of cases with mild dehydration were monoinfections and 71.4% were negative, 60% of cases with moderate dehydration were co-infections, and 40% were negative, and 64.3% of cases with severe dehydration were coinfections, with 35.7% being negative (Kozat and Tuncay, 2018). In another prevalence study with 167 calves with neonatal acute diarrhea aged between 1-28 days, a scoring system (CHS) was used (Balıkçı et al., 2023). The highest score was observed in calves positive for *E. coli* K99 (6.29), and a similarly high score was noted in calves positive for *Cryptosporidium* spp. + *Rotavirus* (6.28). In our study, the most severe findings (high score) belonged to *E. coli* F5 + *Giardia* spp. (7), while the lowest score belonged to *Coronavirus* + *Rotavirus* (4). *E. coli* appeared to induce severe clinical outcomes in both studies. These findings suggest that co-infections may lead to more severe clinical manifestations than monoinfections, but the severity may vary based on the etiological agent causing monoinfection, emphasizing the need for further studies with larger sample sizes to determine variations in clinical outcomes based on etiological agents.

In conclusion, this study sheds light on the etiology of neonatal calf diarrhea in Şanlıurfa province, providing valuable data for future studies and aiding veterinarians in developing effective treatment and prophylaxis strategies. The prevalence of *C. perfringens*, *E. coli* F5, *Cryptosporidium* spp., *Rotavirus*, *Coronavirus*, and *Giardia* spp. was determined as 41.46%, 9.76%, 30.89%, 16.26%, 13%, and 27.64%, respectively, in calves with acute diarrhea. Notably, 12.2% of the cases tested negative for these investigated agents, suggesting the involvement of other infectious agents and non-infectious causes. *C. perfringens* and *Cryptosporidium* spp. emerged as the most common agents in the region. The findings contribute to the scientific understanding of calf diarrhea etiology, emphasizing the need for tailored treatment and preventive measures. Additionally, the study provides essential information for future research and supports veterinarians in the region. Furthermore, CHS that has a significant place in the health controls of calves, was determined according to the etiologies of neonatal calves with acute diarrhea and a contribution was made to the current literature.

Conflict of Interest

The authors stated that they did not have anyreal, potential or perceived conflict of interest.

Ethical Approval

This study was approved by the Harran University Animal Experiments Local Ethics Committee (28.03.2022, 2022/002 – 01-13 Number Ethics Committee Decision). In addition, the authors declared that Research and Publication Ethical rules were followed.

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