Research Article

Factors Influencing the Prevalence of *Cryptosporidium* spp. in Cattle and their Breeders

Asmaa Ghafer Hussin[1*], Jenan Mahmood Khalaf[2], Haider Mohammed Ali[3]

[1]Ministry of Health, Baghdad, Iraq; [2]Zoonotic Unit, Faculty of Veterinary Medicine, University of Baghdad, Iraq; [3]Department of Parasitology, College of Veterinary Medicine, University of Baghdad, Iraq.

Abstract | A study was conducted to identify the prevalence of *Cryptosporidium* spp. as well as to investigate the effect of the region, age and sex on the infection rate in cattle and their breeders. A total of 288 samples (200 samples for cattle and 88 samples for their breeders) were collected during November 2014 to May 2015. Results showed a significant difference in the prevalence of *Cryptosporidium* spp. in cattle (57%) and their breeders (32.95%). The effect of age on infection rate in cattle was significant (P<0.01). The highest infection rate (75.68%) was shown in the early age category (less than 1 year), while the lowest (43.47%) was found in age ≥6 years. In general, the infection rate dropped gradually with advanced age until reached the lowest estimation in the older age (≥6 years). On the other hand, the effects of region and sex were not significant. Concerning the cattle breeders all studied effects were not significant.

Keywords | *Cryptosporidium* spp., Cattle, Prevalence, Breeders

Editor | Asghar Ali Kamboh, Sindh Agriculture University, Tandojam, Pakistan.
Received | November 18, 2015; **Revised** | December 06, 2015; **Accepted** | December 07, 2015; **Published** | February 13, 2016
***Correspondence** | Asmaa Ghafer Hussin, Ministry of Health, Baghdad, Iraq; **Email:** firasrashad@gmail.com
Citation | Hussin AG, Khalaf JM, Ali HM (2016). Factors influencing the prevalence of *Cryptosporidium* spp. in cattle and their breeders. J. Anim. Health Prod. 4(2): 50-54.
DOI | http://dx.doi.org/10.14737/journal.jahp/2016/4.2.50.54
ISSN | 2308–2801

INTRODUCTION

Much attention has been paid to parasite as they caused diseases in human and animals. Although, most of parasitic infections recorded in developing countries, their effect extended to include developed countries (Ortega et al., 2008). World Health Organization (WHO, 2011) reported that diarrheal disease has the greatest effect on the individuals as compared to any other disease not only in developing countries but also even in high income countries. Many species of enteric protozoa that associate with diarrheal illnesses in humans and animals are well documented (Stark et al., 2009; Sokolova, 2011; Stensvold et al., 2011).

In many developed countries, only a few or no parasitic protozoa are included in operational surveillance systems, as the major focus is on bacterial and viral infections (Craun, 2010; Waldron, 2011) However, evidence suggests that while some enteric protozoa, such as *Cryptosporidium* is isolated frequently from diarrheal humans and animals in developing regions such as Asia and sub-Saharan Africa (Nair, 2010; Fletcher et al., 2011). One major species of *Cryptosporidium* spp. is *C. Parvum*, which infects both farm animals and humans (Sahinduran, 2012). Although, animals of all ages can be infected, but only young animals show diarrhea (Gunn et al., 2009).

Different estimations of prevalence of *Cryptosporidium* spp. were reported in cattle ranged from 10.24% to 37.50% (Enemark et al., 2002; Goz et al., 2006; Zhang et al., 2013; Byomi et al., 2010; Akinkuotu et al., 2014) in different countries. The prevalence in Iraq was ranged between 33.37%-76.25% (Al-Zubaidi, 1994; Ali, 1998; AL-Gelany, 2003; Khalil et al., 2011). In regards with the prevalence of *Cryptosporidium* spp. in breeders of cattle the estimation ranged between 8.5% - 37.50% (Byomi et al., 2010; Naguib et al., 2013; Wegayehu et al., 2013). The objective of this study was to identify the relation between the prevalence of *Cryptosporidium* spp. in cattle and their breeders as well as to investigate the effect of the region, age and sex on the infection rate of cattle and their breeders.

MATERIALS AND METHODS

Fecal samples (5-10 grams) were collected from different

ages, sexes and six regions (Hor-rageb, Abu Ghraib, AL-Jaderiya, AL-Makaseb, AL-Dowanem and AL-Hamdaniaa) in the province of Baghdad/Iraq. A total of 288 samples (200 samples for cattle and 88 samples for their breeders) were collected during November/ 2014 to May/2015. Because of some difficulties in the collection of breeders samples, only three regions (AL-Makaseb, AL-Dowanem and AL-Hamdaniaa) of breeders were included in the study. The fecal samples were collected in a clean plastic containers (100ml size) and were tightly closed and given sequential numbers. All information for the animals and their breeders included age, sex and the name of region were recorded on a special form bearing the number of the sample, then the samples were transported in refrigerated bag to the zoonotic unite at the College of Veterinary Medicine in Baghdad University. Diagnosis was established microscopically, with the acid-fast Ziehl–Neelsen stain to identify the infected cases.

Statistical Analysis

Data were subjected to statistical analysis using SAS program. Chi-square test was used to assess the significant differences among infection rates.

RESULTS AND DISCUSSION

Table 1 show that the prevalence of *Cryptosporidium* spp. in the present study (57%) was close to 52.2% reported by Hasan et al. (2010) in Iraq and to others reported by many researchers in different countries: 59% in USA (Okhuysen, et al., 1999), 55% in Czech Republic (Kvac and Vitovec, 2003), 54.5% in Tanzania (Swai and Schoonman, 2010), and 56% in Myanmar (Bawm et al., 2014).

Table 1: The infection rate of *Cryptosporidium* spp., according to regions in cattle

Regions	No. of animals	*Cryptosporidium* spp.	
		+ve No.	%
Hor-Rageb	31	14	45.16
Abu- Ghraib	34	22	64.70
AL-Jaderiya	26	14	53.84
AL-Makaseb	38	20	52.63
AL-Dowanem	37	22	59.45
AL-Hamdaniaa	34	22	64.70
Chi-square value			3.91
P			0.56
Total Prevalence	200	114	57

The high estimation of prevalence of *Cryptosporidium* spp. in this study could be attributed to the ability of protozoa oocysts to survive for a long period in the faeces and environment, moreover, the low dose of the oocysts needed to cause infection (Chako et al., 2010). Results revealed that infection rate across regions ranged from 45.16% to 64.70% with no significant differences (Table 1). This result is in the line of other results obtained by Ranjbar-Bahadori et al., (2011).

Results showed that there was no significant difference between infection rate of males (50.76%) and females (60%) (Table 2). Similar results were obtained by Akinkuotu et al. (2014). The non-significant difference is anticipated because both sexes exposed to the same environmental condition.

Table 2: The infection rate of *Cryptosporidium* spp., according to the sex in cattle

Sex	No. of animals	*Cryptosporidium* spp.	
		+ve No.	%
Males	65	33	50.76
Females	135	81	60
Total	200	114	57
Chi sq			50.76
P			60

Table 3: The infection rate of *Cryptosporidium* spp. according to age in cattle

Age (years)	No. of animals	*Cryptosporidium* spp.	
		+ve No.	%
<1	58	44	75.68
1-<3	49	28	57.14
3-<6	47	22	46.80
≥6	46	20	43.47
Chi-square value			13.84
P			< 0.01

The differences of infection rates among different age groups were significant (P< 0.01) (Table 3). The highest infection rate was shown in the early age category (less than 1 year) while the lowest was found in age ≥6 years (43.47%). In general, the infection rate dropped gradually with advanced age until it reached the lowest estimation in older age (≥6 years). These results is consistent with the results obtained by Bawm et al. (2014) where they found that calves with age of under 6 months had significantly higher infection rate than older animals. The high infection rate in early age could be attributed to poor immunity in newborn calves and ease of oocyst contamination through bucket-feeding (Castro-Hermida et al., 2002). Another explanation was adopted by some researchers (Anderson, 1981; Hein et al., 1984). The high infection rates found in the cattle could be due to the inclusion of diarrhoeal neonatal calves which is more frequent than older cattle in the estimation of prevalence. In the same context, Akinkuotu et al. (2014) interpreted the high infection rate in early age

of animals to the high susceptibility to infection as those animals did not expose to protozoa previously, whereas, older animals have acquired immunity as they infected in early age.

In the present study, the prevalence of *Cryptosporidium* spp. (32.95%) in cattle breeders (Table 4) is close to 37.50% reported by Naguib et al. (2013) in Egypt. However our estimation is higher than 18.9% reported by Al-Alousi and Mahmood (2012) in Iraq. These differences in prevalence could be belonged to the variation in sample size and method of diagnosis.

Results showed that there was no significant difference in infection rate among different regions (Table 4). The infection rate across regions ranged from 21.87% to 40.74%. This result agreed with results obtained by Wegayehu et al. (2013).

Table 4: The infection rate of *Cryptosporidium* spp according to the regions in breeders of cattle

Regions	No. of breeders	*Cryptosporidium* spp.	
		+ve No.	%
AL-Makaseb	27	11	40.74
AL-Hamdaniaa	32	7	21.87
AL-Dowanem	29	11	37.93
Chi-square value			2.84
P			0.24
Total	88	29	32.95

Table 5: The infection rate of *Cryptosporidium* spp. according to sex in breeders of cattle

Sex	No. of breeders	*Cryptosporidium* spp.	
		+ve No.	%
Males	33	8	24.24
Females	55	21	38.18
Chi-square value			1.81
P			0.17

The infection rate of males (24.24%) and females (38.18%) of *Cryptosporidium* spp. in cattle breeders were shown in Table 5. The difference between two infection rates was no significant. In rural regions, both males and females are contact with cattle and exposed to same pathogenic agents that could lead to non-significant difference between them. Similar results are obtained by AL-Gelany (2003). The results further demonstrated that the differences among infection rates for age categories were not significant (Table 6).

Although, the younger age group could be at high risk to get infection of intestinal protozoa as compared with the older age group, the infection rate was the same for all ages.

Table 6: The infection rate of *Cryptosporidium* spp. according to the age in breeders of cattle

Age (years)	No. of breeders	*Cryptosporidium* spp.	
		+ve No.	%
<10	38	12	31.57
10-<30	27	10	37.03
≥30	23	7	30.43
Chi-square value			0.30
P			0.85

This could be attributed to environment and socio-behavioral epidemiology, as all the age groups will get the same infection if they expose to the same contaminated source. Furthermore, personal hygiene in rural regions for all ages usually was very poor.

The Relationship of Prevalence between Cattle and their Breeders

The hypothesis adopted in the present study is to suppose that there is no difference in the infection rates between cattle and their breeders. When the hypothesis is accepted this will confirm the relationship of the infection rates between cattle and their breeders. From the view of statistics, the estimation of correlation coefficient is the better way to confirm the relation between two traits. To perform such estimation we must have values of two continuous variables. As the case in this study was different because we have only two proportions (infection rate of cattle and infection rate of breeders), thus, the only way that can confirm the association between two proportions is to compare the two proportions by Chi-square test. All we need for the detection of the relationship between cattle and their breeders is to get non-significant difference. Although, it is usually preferred in statistics not to explain the non-significant effect of any factor, but our results represents an exception for the statistical base because the non-significant effect is what we are looking for. According to results shown in Table 7, the difference was significant (P< 0.01) between the prevalence of cattle (58.71%) and their breeders (32.95%) which mean that there is no relationship between the prevalence of cattle and their breeders. In other words, cattle are at higher risk to infect than breeders.

The significant difference in prevalence between cattle and their breeders is not reducing the importance of the correlated infection that could be occurred as the prevalence in breeders is generally high. In this regards, a study conducted by Al-Warid (2010) included 737 human (not contact) fecal samples from North of Baghdad/Iraq showed the prevalence of *Cryptosporidium* spp. as 14.78% which is more lower than our estimation.

Moreover, there are many researches confirmed the

Table 7: The relationship of the infection rate of *Cryptosporidium* spp. according to regions in cattle and their breeders

Regions	*Cryptosporidium* spp.							
	Cattle			Breeders				
	Total	+	%	Total	+	%	Chi sq	P
Al-Makaseb	38	20	52.63	27	11	40.74	0.89	0.34
Al-Hamdaniaa	34	22	64.7	32	7	21.87	12.27	<0.01
Al-Dowanem	37	22	59.45	29	11	37.93	3.01	0.08
Total	109	64	58.71	88	29	32.95	12.96	<0.01

significant difference in the infection rate between peoples contact with animals and those who did not (Miron et al., 1991; Shehata, 1997). In this regards, Byomi et al. (2010) found a significant (P< 0.01) difference in the infection rate of *Cryptosporidium parvum* between two groups of children (16.67% in children contact and 4.20% in children with no contact). Besides, the differences in infection rate between cattle and cattle breeders were not significant in two regions (Al-Makaseb and Al-Dowanem) and significant (P< 0.01) in only one region (Al-Hamdaniaa).

In conclusion, our results demonstrate the high prevalence of *Cryptosporidium* spp. in cattle and cattle breeders. These results could be an important evidence about the high resistant of the oocysts to environment and that will increase its opportunity to be widespread and that is what we have found indeed. Further studies are needed using more accurate methods such as PCR to investigate the real relation in the infection by *Cryptosporidium* spp. in cattle and their breeders.

CONFLICT OF INTEREST

No conflict of interests are declared by authors for the contents in the manuscript.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. Firas Rashad Al-Samarai for his assistance in data analysis and perusing the initial draft of this manuscript.

AUTHORS' CONTRIBUTION

The present paper is a part of MSc. study of the corresponding author (Asmaa Ghafer Hussin), whereas, the second and third authors (Jenan Mahmood Khalaf, and Haider Mohammed Ali) worked as supervisors.

REFERENCES

- Akinkuotu OA, Fagbemi BO, Otesile EB, Dipeolu MA, Ayinmode AB (2014). *Cryptosporidium* infection in cattle in Ogun State, Nigeria. Sokoto J. Vet. Sci. 12(2):52-56.
- Al-Alousi T, Mahmood M (2012). Detection of *Cryptosporidium* oocysts in calves and children in Mosul, Iraq. Proceeding of the Eleventh Veterinary Scientific Conference. Pp. 280-285.
- AL-Gelany B (2003). An epidemiological and diagnostic study of *Cryptosporidium* in man and animal in AL-Thahab-AL-Abiyadh Village. Ph.D. Thesis. College of Veterinary Medicine, University of Baghdad. Iraq.
- Ali NH (1998). Prevalence of Cryptosporidiosis with zoonotic aspect. M.Sc. Thesis. College of Veterinary Medicine, University of Basrrah, Iraq.
- Al-Warid HS (2010). Study in epidemiology and PCR detection of *cryptosporidiosis* in North of Baghdad. Ph.D. Thesis. College of Science, University of Baghdad, Iraq.
- Al-Zubaidi M (1994). Study of Cryptosporidiosis in calves, MSc. Thesis. College of Veterinary Medicine, University of Baghdad, Iraq.
- Anderson BC (1981). Patterns of shedding of Cryptosporidial oocysts in Idaho calves. J. Am. Vet. Med. Assoc. 178:982-984.
- Bawm S, Kyi S, Lay KK, Htun LL, Myaing TT (2014). Prevalence and associated risk factors of *Cryptosporidium* and *Giardia* species in cattle with in Mandalay Region, Myanmar. J. Adv. Parasitol. 1 (4): 49 -53. http://dx.doi.org/10.14737/journal.jap/2014/1.4.49.53
- Byomi AM, Samaha HA, Zidan SA (2010). Epidemiological studies on some zoonotic enteric protozoa in different areas of Nile Delta. Proceeding of the 3rd International Conference of the Arab Society for Medical Research, 12-14 Oct. 2010, Libya. (2): 199-207.
- Castro-Hermida JA, Gonzalez-Losada YA, Mezo-Menendez M, Ares-Mazas E (2002). A study of Cryptosporidiosis in a cohort of neonatal Calves. Vet. Parasitol. 106:11–17. http://dx.doi.org/10.1016/S0304-4017(02)00038-9
- Chako CZ, Tyler JW, Schultz LG, Chiguma L, Beerntsen BT (2010). Cryptosporidiosis in people: it's not just about the cows. J. Vet. Int. Med. 24(1): 37–43. http://dx.doi.org/10.1111/j.1939-1676.2009.0431.x
- Craun GF (2010). Causes of outbreaks associated with drinking water in the United States from 1971 to 2006. Clin. Microbiol. Rev. 23:507–528. http://dx.doi.org/10.1128/CMR.00077-09
- Enemark HL, Ahrens P, Lowery CJ, Thamsborg SM, Enemark JMD, Bille-Hansen V, Lind P (2002). *Cryptosporidium andersoni* from a Danish cattle herd: Identification and preliminary characterisation. Vet. Parasitol. 107: 37–49. http://dx.doi.org/10.1016/S0304-4017(02)00083-3
- Fletcher SM, Stark D, Ellis J (2011). Prevalence of gastrointestinal pathogens in Sub-Saharan Africa: Systematic review and meta-analysis. J. Pub. Health Afr. 2:127–137. http://dx.doi.org/10.4081/jphia.2011.e30
- Goz Y, Altug N, Yukseki N, Özkani C (2006). Parasites detected in neonatal and young calves with diarrhea. Bull. Vet. Inst.

Pulawy. 50:345-349.
•Gunn AA, Naylor JA, House JK (2009). Diarrhea. In: Smith, B.P. (Eds): Large Animal Internal Medicine. Mosby, Elsevier, St. Louis. Pp. 340- 363.
•Hasan MH, Butty ET, Al-Taee AF (2010). A study on intestinal protozoa in calves in Ninevah governorate. Iraqi J. Vet. Sci. 24 (2): 163-167.
•Hein J, Pohlenz LF, Moon HW (1984). Enteric lesions and diarrhea in genotobiotic calves mono infected with *Cryptosporidium* spp. J. Infect. Dis. 150:768-775. http://dx.doi.org/10.1093/infdis/150.5.768
•Khalil MM, Al- Zubaidi M, Kadhim FS (2011). Prevalence of Cryptosporidiosis in calves and efficiency of ELISA in detection of the infection compared with some traditional methods. Iraqi J. Vet. Med. 2: 533-543.
•Kvac M, Vitovec J (2003). Prevalence and pathogenicity of *Cryptosporidium andersoni* in one herd of beef cattle. J. Vet. Med. B. Infect. Dis. Vet. Pub. Health. 50: 451-457. http://dx.doi.org/10.1046/j.0931-1793.2003.00701.x
•Miron D, Kenes J, Dagen R (1991). Calves as a source of an outbreak of Cryptosporidiosis among young children in an agricultural closed community. Paeditr. Infect. Dis.10(6):438-441. http://dx.doi.org/10.1097/00006454-199106000-00004
•Naguib D, El-Gohary AH, Mohamed AA, Al-Araby MA (2013). Study on role of cattle in transmission of *Cryptosporidium parvum* and *Entamoeba* species to man with special reference to its molecular characterization. www.academia.edu/10061599
•Nair G (2010). Emerging trends in the etiology of enteric pathogens as evidenced from an active surveillance of hospitalized diarrhoeal patients in Kolkata, India. Gut. Pathog. 2(4):1757-4749. http://dx.doi.org/10.1186/1757-4749-2-4
•Okhuysen PC, Chappell CL, Crabb JH, Sterling CR, Dupont HL (1999). Virulence of three distinct *Cryptosporidium parvum* isolates from healthy adults. J. Inf. Dis. 180:1275-1281. http://dx.doi.org/10.1086/315033
•Ortega YR, Eberhard ML, Kris H (2008). Protozoan diseases: Cryptosporidiosis, giardiasis and other intestinal protozoan diseases, international encyclopedia of public health. Academic Press, Oxford, United Kingdom. pp. 354–366.
•Ranjbar-Bahadori SH, Sangsefidi H, Shemshadi B, Kashefinejad M (2011). Cryptosporidiosis and its potential risk factors in children and calves in Babol, North of Iran. Tropic. Bio. Med. 28(1):125–131.
•Sahinduran S (2012). Protozoan diseases in farm ruminants. In A Bird's Eye View of Veterinary Medicine. Perez-Marin, C. C. (Ed). In. Tech. pp. 473-500. http://dx.doi.org/10.5772/30251
•SAS (2010). SAS/STAT Users Guide for Personal Computer. Release 9.1.SAS Institute, Inc., Cary, N.C., USA.
•Shehata NR (1997). Detection of *Cryptosporidium* oocysts in diarrhoeic stools. MSc. Thesis, Faculty of Medicine, Cairo University, Egypt.
•Sokolova OI (2011). Emerging microsporidian infections in Russian HIV- infected patients. J. Clin. Microbiol. 49:2102–2108. http://dx.doi.org/10.1128/JCM.02624-10
•Stark D, Barratt J, Ellis J, Harkness J, Marriott D (2009). Repeated *Dientamoeba Fragilis* infections: A case report of two families from Sydney, Australia. Infect. Dis. Rep. 1:7–9. http://dx.doi.org/10.4081/idr.2009.e4 http://dx.doi.org/10.4081/idr.2009.1280
•Stensvold CR, Nielsen SD, Badsberg JH, Engberg J, Friis-Moller N, Nielsen SS, Nielsen HV, Friis-Moller A (2011). The prevalence and clinical significance of intestinal parasites in HIV-infected patients in Denmark. Scand. J. Infect. Dis. 43: 129-135. http://dx.doi.org/10.3109/00365548.2010.524659
•Swai ES, Schoonman L (2010). Investigation into the prevalence of *Cryptosporidium* infection in calves among small-holder dairy and traditional herds in Tanzania. Vet. Med. Int. Article ID 676451. 1-5. http://dx.doi.org/10.4061/2010/676451
•Waldron LS (2011). Molecular epidemiology and spatial distribution of a water borne Cryptosporidiosis outbreak, Australia. Appl. Environ. Microbiol. 77:7766–7771. http://dx.doi.org/10.1128/AEM.00615-11 http://dx.doi.org/10.1128/AEM.00616-11
•Wegayehu T, Adamu H, Petros B (2013). Prevalence of *Giardia* duodenalis and *Cryptosporidium* species infections among children and cattle in North Shewa Zone, Ethiop. BMC. Infect. Dis. 13:419. http://dx.doi.org/10.1186/1471-2334-13-419
•WHO (World Health Organization) (2011). An information bulletin for WCO Kenya. Vol 1 January 2011, Kenya hosts 1st African Regional Workshop on Coordinated Approaches to Pneumonia and Diaorrhea Prevention and Control. 1: 1-4. http://dx.doi.org/10.1371/journal.pone.0067564
•Zhang W, Yang F, Liu A, Wang R, Zhang L, Shen Y, Cao J, Ling H (2013). Prevalence and genetic characterizations of *Cryptosporidium* spp. in pre-weaned and post-weaned piglets in Heilongjiang Province, China. PLoSOne. 38(7):122-124.