

**Research Article****Prevalence of protozoan parasites in gastrointestinal tract of Goats**Sira Tabassum<sup>1</sup>, Mateen Arshad<sup>1</sup>, Saima Naz<sup>2\*</sup>, Durali Danabas<sup>3</sup> and Rayees Ahmad Bhat<sup>4</sup><sup>1</sup>Department of Zoology, Lahore College for Women University, Lahore, Pakistan<sup>2</sup>Department of Zoology, Government Sadiq College Women University, PK63100, Bahawalpur, Punjab, Pakistan<sup>3</sup>Munzur University, Fisheries Faculty, TR62000, Tunceli, Turkiya<sup>4</sup>Department of Zoology, Kurukshetra University, Kurukshetra, India\*Correspondence: [saima.naz@gscwu.edu.pk](mailto:saima.naz@gscwu.edu.pk)**ARTICLE INFO**

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**ABSTRACT**

Protozoan parasites cause severe diseases in livestock including buffaloes, sheep, goats and human either by ingestion of contaminated meat or faeces containing oocysts, and also from drinking milk of infected cattle. In present study prevalence of gastrointestinal protozoan parasites were examined in goats. A total of 100 faecal samples were obtained from Lahore Meat Processing Unit (LMPC) to detect the presence of protozoan parasites like *Entamoeba histolytica*, *Neospora* species, *Eimeria*, *Balantidium coli*, *Giardia* and *Cryptosporidium*. Qualitative techniques (direct smear, floatation and centrifugation techniques) were used to identify parasites. Data analysis revealed that overall prevalence of protozoan in faecal samples was 56%. The percentage prevalence of *Eimeria*, *Entamoeba*, *Balantidium* and *Neospora* species, was 31, 13, 7 and 5%, respectively. *Giardia* and *Cryptosporidium* were not observed. Detailed analysis revealed that *Eimeria* species were observed. In which *Eimeria ahasta* had highest prevalence (20%) followed by *Eimeria intricate* (8%) and *Eimeria arloingi* (3%). Gender-wise comparison revealed that 24% male and 32% female goats were infected with protozoan. Challenges are there by the wide prevalence of protozoan so there is the need to bring awareness in public for control strategies to reduce parasitic load.

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**Introduction**

Rearing of goat has importance in global animal husbandry as goat provides milk and meat to humanities (Kagan et al. 2011). Animal husbandry is playing vital role in socio-economic growth in rural along with urban localities (Rafi et al. 2021). Ruminants are suffering with large variety of parasitic infection (Nouri et al. 2022). Parasites are causing heavy lose i.e., reduce the profitability of livestock industry up to 15% (approximately 19.7 million per year) as lowering the productivity of affected animals, improper growth and even lead to death (Guel 2007). Severe effects produce mortality and reproductive failure rate increases through parasites in domestic animals (Northrop-Clewes and Shaw 2000; Ghimire and Bhattarai 2019). Different protozoan parasites of wild animals at zoological gardens of the world, like oocysts of *Entamoeba*, *Sarcocysts*, *Giardia*, *Cryptosporidium* and sporozoite of *Babesia* have been recognized (Radhy et al. 2013). Various researches have shown that parasites cause public health infection like *Balantidium coli* and *Entamoeba* spp. as these are the source of zoonotic transmission (Elmadawy and Diab 2017). Several researchers observed that death rate produced by *Entamoeba* spp. was higher than the number of deaths caused from

schistosomiasis as well as malaria (Sebba et al. 2021). The domestic goat was considered as the earliest known animals, which is also well-known as poor man's cow (Guel 2007).

A study was conducted with the aim to determine the route of transmission of parasite (protozoan, helminths and disease causing parasite) in different cattle (Sultan et al. 2016; Elmadawy and Diab 2017; Mohamaden et al. 2018). The *Coccidia* (commonly spread by *Eimeria*) and *Cryptosporidium* (parasitic diseases) have been shown to cause worldwide economic lose in domestic animals (Wang et al. 2010; Khezri and Khezri 2013; Gadelhaq et al. 2015; Majeed et al. 2015). Australian scientist determined that dog is the definitive host of *Neospora* (Guel 2007). Dog act as definitive host for the dispersal of oocysts of *Neospora* through the ingestion of faeces by the intermediate host, such as cattle. It may be congenital type transmission i.e. mother to offspring.

Thirteen *Eimeria* spp. have been reported from the goats that destroy the villous epithelium and mucosa of host's intestinal cells leading to anemia and poor absorption of nutrients. *Eimeria christenseni*, *Eimeria ovinoidalis* and *Eimeria arloingi* have shown to be highly pathogenic in kids (Wang et al. 2010; Kagan et

al. 2011). This study is therefore performed with the aim to determine the percentage prevalence of gastrointestinal protozoan parasites along with various species of *Eimeria* in faecal samples of goat by using direct smear, flotation and centrifugation methods. The purpose of this study is to find the prevalence of protozoan in intestinal tract of goat as well as to reduce the threats by good hygiene conditions of housing and ventilation, depopulation of protozoa rearing points, limit the transmission through grazing to avoid fecal contamination and risk factors associated with protozoan infection.

## Materials and Methods

### Study design

Lahore Meat Processing Unit (LMPC) is a Government project under the Punjab Agriculture and Meat Company (PAMCO). It is now located at 18 km Multan Road New Baker Mandi Shahpur Kanjran Lahore. LMPC was inaugurated outside the city in 2011. Faecal samples were collected from September 2013 to March 2014 from the gastrointestinal tract of goat slaughtered in the slaughter house (LMPC). The fresh faecal samples from the rectum of male (n=50) and female (n=50) goats were collected in polythene zipper bags labeled for the parasitological examinations and preserved in refrigerator. The samples were transported to Lahore College for Women University laboratory for further observation. These polythene bags were airtight to prevent the rate of development and hatching of eggs.

### Gross Examination

Before microscopic examination, gross examination was performed to describe the physical features of faeces, in parasite (protozoan) samples. Observation of any disorder in the faecal samples suggested that there may be incidence of any parasite. Age of faeces, consistency, color, odor, presence of blood and adult trophozoites parasite were observed in gross examination.

Faecal samples were observed by microscopic examination in smear for the purpose to observe the protozoan cysts. Various techniques like direct method, flotation method and sedimentation method were applied to detect the protozoan in faecal samples (as same techniques were applied in a research work conducted by Ruhoallah et al. 2021).

With the help of direct smear method cysts can be identified according to their shape, size and nuclei arrangements. In fresh faecal samples mobility of parasite can be seen through microscope because they can be observed by direct smear method as it is quick and simple technique.

It is commonly known as Fecalizer or egg flotation as well as faecal floats. It is performed under the sodium nitrate flotation technique. It has worth after direct smear technique. Magnesium sulfate, sugar, zinc sulfate and sodium nitrate are the commonly known flotation fluids (Azrul et al. 2017).

The most appropriate technique (centrifugation) other than the direct saline and flotation method was performed under the principal of density gradient centrifugation. It requires short time interval than the other techniques. On heavier objects, a greater force

is needed when flotation is applied in a centrifuge machine (Das et al. 2017; Hassan et al. 2019).

### Data analysis

The Chi-square test (Hassan et al. 2019; Rafi et al. 2021) was applied to find out the relationship among several categories like percentage value of parasites in fresh faecal samples of goats. P-values <0.5 was considered as significant. The data was analyzed by using Minitab 16. By using Microsoft Excel 2007, results were expressed in graphical form.

## Results and Discussion

The fresh faecal samples were collected a day before examination and then samples were kept in refrigerator to cease the growth of oocyst and next day the samples were taken for analysis in research laboratory at LCWU as early as possible in the morning. The infective stages of protozoan parasites were observed in freshly collected faecal samples. Therefore, fresh faecal samples of goats were used. Solid or watery consistency of fresh faecal sample indicated constipation and diarrhea respectively. Usual smell of faeces was noticed. Moreover, foul smell of faecal samples was also observed in some faecal samples. Color variations like green, brownish green and brown were observed in samples. In faecal samples gray color was not observed that could be due to the abundance of fat in liver. The results showed that no blood and adult parasite were found in fresh faecal samples of goats collected from Lahore Meat Processing Unit (LMPC). It was studied that gastrointestinal parasite were present in ruminants in Malaysia as well as at global level (Hao et al. 2018; Yusof and Isa 2016). In another research work it was observed that gastrointestinal infection parasites (GIPs) had high prevalence in South Africa and GIPs had possible effects of age, breed, sex and season (Mpofu et al. 2022). Literature review has revealed that *Eimeria* protozoan can survive for a long-time in infected goats and causes anemia, electrolyte loss and poor absorption (Wang et al. 2010; Cavalcante et al. 2012; Verma et al. 2018). Higher the incidence of parasitic infections in animals by grazing system lowers productivity, leading to economic losses. *Entamoeba histolytica* makes disturbance in gastrointestinal tract of cattle (Saritha et al. 2015). In tropical areas the potential of sheep and goats have been adversely affected by gastrointestinal parasites, which lead to countless effect even deaths (Soliman and Zalut 2003).

In different studies protozoa infection (*Giardia*, *Eimeria* and *Cryptosporidium*) was observed in small grazing animals especially in lambs, kids and cattle that produce important clinical disease which cause death in severe infection (Lianou et al. 2022; Wuthijaree et al. 2022). By microscopic examination, it was observed that *Eimeria* has highest percentage prevalence (31%) followed by *Entamoeba histolytica*, *Balantidium coli* and *Neospora* spp. with percentage prevalence of 13, 7 and 5% respectively. Statistical analysis revealed that faecal parasites had highly significant relationship with each other. *Giardia* is considered to be one of the leading causative agents of diarrhea. Goats grazed in natural pastures got infection with cysts of *Giardia*. The transmission of this infection is due to the ingestion of faeces or

contaminated water or food (Adam 2001; Windsor et al. 2018). *Entamoeba histolytica* was proved to be pathogenic microorganism for both humans and animals. Cryptosporidiosis mainly caused by *Cryptosporidium parvum* that is primarily the disease of lambs and kids. Fluid loss was observed as one of the most commonly known pathological effects of *Eimeria* and *Cryptosporidium* species in ruminants. Scientific research was performed for prevalence of *Eimeria*, *Giardia* and *Cryptosporidium* in small ruminants (Lianou et al. 2022).

Direct smear method analysis of data revealed that infection with oocysts of *Eimeria* and *Entamoeba histolytica* was 28 and 11% in goats. *Neospora* spp. and *Balantidium coli* oocysts identified by direct smear method was 1% (Fig. 3). Analysis for the oocysts of *Cryptosporidium* and *Giardia* were made but they were not found in any sample. Oocysts of *Eimeria ahasta* had highest percentage (19%). The prevalence of Oocysts of *Eimeria intricate* and *Eimeria arloingi* were observed with 8% and 1%. *Eimeria parva* and *Eimeria ovinidalis* were not observed (Badran et al. 2012). Centrifugation method is used for more precise results in a very short time period by applying centrifugation i.e a force on floating liquid. Direct smear method was used to examine the faecal parasites of goats. *Eimeria* was found with 28% prevalence in all faecal samples. Examination of sample revealed that *Entamoeba histolytica* had 11% prevalence. The *Balantidium coli* and *Neospora* spp., when analyzed by direct smear method had percentage prevalence of 6% and 1% respectively. *Giardia* and *Cryptosporidium* were not observed by direct smear method. The results of present study were in agreement with findings in Cairo goats (El-Manyawe et al. 2010) that *Eimeria* had highest prevalence among other protozoans with 73% prevalence rate when examined by direct smear while *Cryptosporidium* and *Giardia* had low prevalence percentage. In another study it was determined that 7.1% goats suffered with balantidiasis infection (Elmadawy and Diab 2017). However, another research (Verma et al. 2018) showed high level of coccidian infection and *Eimeria* was not present in pure situation while it may present in combined form with other GIP (gastrointestinal parasite).

Analysis of data examined by flotation technique showed that there was 31% prevalence of *Eimeria* (Fig. 1) in faecal samples. It was revealed that *Entamoeba histolytica*, *Balantidium coli* and *Neospora* spp. (Fig. 2) had parasitological prevalence of 13, 6 and 5% respectively in faeces of goats (Fig. 3). The eggs of *Cryptosporidium* and *Giardia* were not observed in any sample. *Eimeria* was also identified with different species by this method. Oocysts of *Eimeria ahasta* were identified with high percentage prevalence of 19% while *Eimeria intricate* (8%) and *Eimeria arloingi* were (4%) was also found in faecal samples of goats. It was also observed that oocysts of *Eimeria aparva* and *Eimeria ovinidalis* had no prevalence. During analysis of protozoan in faecal samples of goats by direct smear technique, it was observed that *Eimeria* had prevalence with its different species like *Eimeria ahasta*, *Eimeria intricate*, *Eimeria arloingi*, *Eimeria parva* and *Eimeria ovinidalis*. *Eimeria ahasta* had high prevalence (19%) while *Eimeria intricate* had 8% and *Eimeria arloingi* was observed in 1% in faecal

samples of goats while *Eimeria parva* and *Eimeria ovinidalis* had no prevalence in goats. Similarly, the study on protozoan parasites through direct smear method have revealed that, *Eimeria ahasta* had 53% prevalence followed by *Eimeria arloingi* (35.71%) (Ibrahim 2012), whereas *Eimeria parva* and *Eimeria ovinidalis* was not found in this study.

For the observation of protozoan in faecal samples of goat through flotation method suggested that *Entamoeba histolytica* and *Eimeria* were clearly observed with high prevalence with 13 and 31% respectively, whereas, *Giardia* and *Cryptosporidium* were not observed. *Balantidium coli* and *Neospora* spp. had low prevalence rate with 6 and 5% respectively. Similar research work was directed previously (Sangvaranonond et al. 2010; Sutaaker et al. 2017) using flotation method for detection of protozoan. It was observed that *Eimeria*, *Entamoeba* cysts and *Giardia* cysts were present with percentage prevalence of 93, 71 and 3% respectively by using the flotation technique. Species of *Eimeria* were also analyzed by flotation technique and it was resulted that *Eimeria arloingi* (4%), *Eimeria intricate* (8%) and *Eimeria ahasta* had 19% whereas *Eimeria parva* and *ovinidalis* were also observed in samples. Another similar research was conducted in Saudi Arabia on species of *Eimeria* by using flotation technique (Ibrahim 2012). This study revealed that *Eimeria ovinidalis* was observed in only 5% of faecal samples collected from goats. *Eimeria ahasta* had highest prevalence (56%) among other species.

Results of analysis indicated that *Eimeria* (31%) and *Entamoeba histolytica* (13%) were identified with high prevalence than other protozoans of gastrointestinal tract. Eggs of *Balantidium coli* and *Neospora* spp. were detected in faecal samples with percentage prevalence of 7 and 4% respectively (Fig. 3). Oocysts of *Cryptosporidium* and *Giardia* were not observed. Species of *Eimeria* were identified by using centrifugation technique. *Eimeria ahasta* oocysts were identified with its high prevalence of 20% in faecal samples of goat. By centrifugation method oocysts of *Eimeria intricate* was also observed in 8% samples but on the other hand *Eimeria arloingi* was detected in 3% faecal samples. Eggs of *Eimeria parva* and *Eimeria ovinidalis* were not observed by centrifugation method in faecal samples from goats. Summary of data obtained by different technique is tabulated in Table 1. In present research *Eimeria* was observed with prevalence percentage of 31% and *Entamoeba histolytica* (13%) followed by *Balantidium coli* (7%) and *Neospora* spp., (4%). However, *Giardia* and *Cryptosporidium* were not found in any samples. Research work was done with similar results by previous scientists (Zvinorova et al. 2016; Khodakaram-Tafti and Hashemna 2017; Sebba et al. 2021) who determined that *Eimeria* had high prevalence of (6.4 %) followed by *Entamoeba histolytica* (6%) and *Balantidium coli* 4.3% by using centrifugation method. Results of present study made it clear that female (32%) were more infected with faecal protozoan parasites compare to male (24%) animals as research work described the same analysis (Zvinorova et al. 2016; Khodakaram-Tafti and Hashemna 2017; Sebba et al. 2021) (Fig. 4).

It was concluded that goats of Lahore, Pakistan have gastrointestinal (GI) protozoan as they were observed

in fresh fecal samples obtained from gastrointestinal tract (rectum). The percentage showed the rate of infection in goats. There is an adverse effect of parasitic load on cattle industry as well as public health. By this study we concluded the percentage of

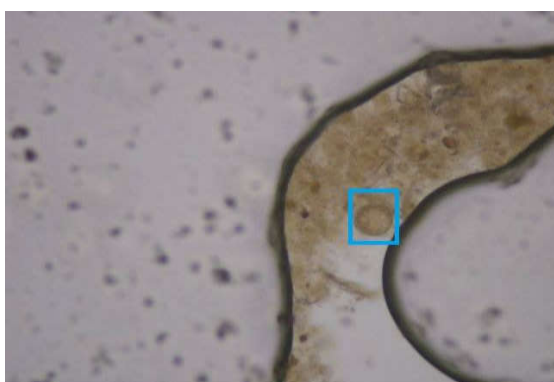
these protozoan in goat in Punjab, which will enhance the awareness in cattle owners for the control of parasitic infection.

**Table 1:** Prevalence of various protozoan parasites among male and female goats by different methods

Protozoan Parasites	Direct Smear Method				Flotation Technique				Centrifugation Method			
	Male=50		Female=50		Male=50		Female=50		Male=50		Female=50	
	-Ve	+Ve	-Ve	+Ve	-Ve	+Ve	-Ve	+Ve	-Ve	+Ve	-Ve	+Ve
<i>Eimeria spp</i> (31%)	44	6	41	9	43	7	41	9	43	7	41	9
<i>Entamoeba histolytica</i> (13%)	47	3	47	3	47	3	46	4	47	3	46	4
<i>Balantidium coli</i> (7%)	47	3	48	2	48	2	48	2	48	2	47	3
<i>Neospora spp</i> (5%)	50	-	49	1	50	-	46	4	49	1	47	3
<i>Giardia</i>	50	-	50	-	48	2	48	2	50	-	50	-
<i>Cryptosporidium</i>	50	-	50	-	47	3	47	3	50	-	50	-
<b>Total No. of Samples</b>												100



**Fig. 1:** Eggs of *Eimeria* is seen under 4X objectives of microscope by using flotation technique



**Fig. 2:** Eggs of *Neospora* species as seen under 4X objectives of microscope by using flotation technique

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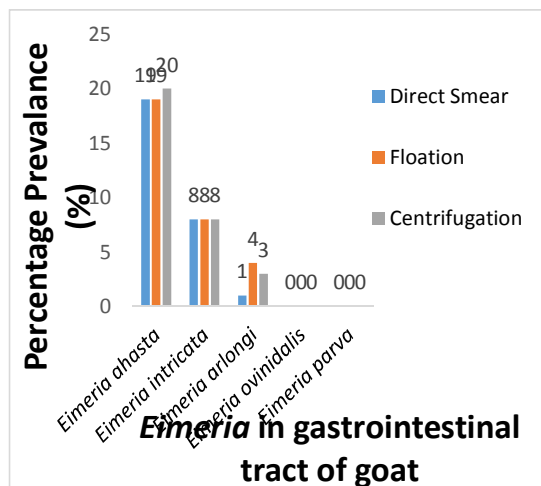
**Author Contribution:** All authors contributed to the study conception, design and analysis.

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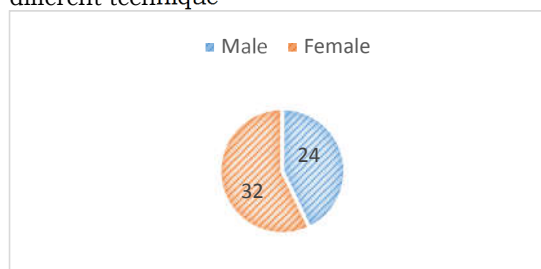
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**References**

Adam RD, 2001. Biology of *Giardia lamblia*. Clinical Microbiology Review 14(3): 447-475.  
 Azrul LM, Pongpong K, Jittapalpong S and Prasanpanich S, 2017. Descriptive prevalence of gastrointestinal parasites in goats from small farms in Bangkok and vicinity and the associated risk factors. Annual Research Review of Biology 16: 1-7.  
 Badran I, Abuamsha R, Aref R, Alqisi, W and Alumor J, 2012. Prevalence and diversity of gastrointestinal parasites in small Ruminants under two different rearing



**Fig. 3:** Prevalence of *Eimeria* spp., in faecal samples collected from gastrointestinal tract of goat by different technique



**Fig. 4:** Gender wise comparison for percentage prevalence of infected male and female

Systems in Jenin District of Palestine. An - Najah Univ. Journal of Research (Natural Science) 26:1-18.

Cavalcante ACR, Teixeira M, Monteiro JP and Lopes CWG, 2012. *Eimeria* species in dairy goats in Brazil. Veterinary Parasitology 183(3-4): 356-358.  
 Das M, Laha R, Goswami A and Sen A, 2017. Gastrointestinal parasitism of goats in hilly region of Meghalaya, India. Veterinary World 10(1): 81-85.  
 Elmadauy RS and Diab MS, 2017. Prevalence of *Balantidium coli* and molecular analysis of *Isospora* oocysts found in goats in Qalyobia Governorate, Egypt. Annual Veterinary Animal Science 4(1): 8-17.  
 El-Manyawe SM, Abdel Rahman MAM, Abd El-Aal AMAI, Kamal AM and Snousi SA, 2010. Prevalence of some protozoa and its effects on biochemical changes in goats in Cairo, MarsaMatrouh, and El-Wa di El-Gadid provinces, Egypt. Journal of Compact Pathology and Clinical Pathology 23(1):102-115.  
 Gadelhaq SM, Arafa WM, and Aboelhadid SM, 2015. Molecular characterization of *Eimeria* species naturally infecting Egyptian Baldi Chickens. Iran Journal of Parasitology 10(1): 87-95.

- Ghimire TR and Bhattarai N, 2019. A survey of gastrointestinal parasites of goats in a goat market in Kathmandu, Nepal. *Journal of Parasite Diseases* 43(4): 686-695.
- Guel A, 2007. The prevalence of *Eimeria* species in Goats in Iğdir. *Turkish Journal of Veterinary and Animal Sciences* 31 (6): 411-414.
- Hassan NM, Farag TK, Abu-El-Ezz NMT and Abou-Zeina HA, 2019. Prevalence assessment of gastrointestinal parasitic infections among goats in Giza Governorate, Egypt. *Bull. Natural Research Center* 43: 127-134.
- Hao G, He X and XU R, 2018. Prevalence of Gastrointestinal Parasites in Black Goats in Liangshan Prefecture, Southwest China. *Asian Journal of Animal and Veterinary Advances* 13(4):346-351.
- Ibrahim MM, 2012. Prevalence of *Eimeria* species of the domestic goats *Capra hircus Linnaeus*, 1758 in Al-Baha area, Saudi Arabia and Egypt. *Academic Journal of Biological Science* 4(1): 165-172.
- Khodakaram-Tafti A and Hashemna M, 2017. An overview of intestinal coccidiosis in sheep and goats. *Revue of Medicinal Veterinary* 167(1-3): 9-20.
- Kagan J, Dann M, Guterman L, Butters J, Swain P and Fallin TW, 2011. Devices and methods for attaching an endoluminal gastrointestinal implant: Google Patents.
- Khezri M and Khezri O, 2013. The prevalence of *Cryptosporidium* spp. in lambs and goat kids in Kurdistan, Iran. *Veterinary World* 6(12): 974-977.
- Lianou, DT, Arsenopoulos KV, Michael CK, Papadopoulou E and Fthenakis GC, 2022. Protozoan Parasites in Adult Dairy Small Ruminants and Potential Predictors for Their Presence in Faecal Samples. *Microorganisms* 10(10): 1931.
- Majeed QAH, Alazemi MS, Henedi AAM and Tahrani LMA, 2015. Study on parasites from farm animals in Kuwait. *Journal Egypt of Social Parasitology* 45(1): 71-74.
- Mohamaden WI, Sallam NH and Abouelhassan EM, 2018. Prevalence of *Eimeria* species among sheep and goats in Suez Governorate, Egypt. *International Journal of Veterinary Science and Medicine* 6: 65-72.
- Mpofu TJ, Nephawe, KA and Mtileni B, 2022. Prevalence and resistance to gastrointestinal parasites in goats: A review. *Veterinary World* 15(10): 2442-2452.
- Northrop-Clews CA and Shaw C, 2000. Parasites. *Br. Med. Bull* 56(1): 193-208.
- Nouri NV, Rahmatian R and Salehi A, 2022. Gastrointestinal Tract of cattle in Mazandaran Province (Northern Iran). *Journal of Parasitology Research*. vol. 2022, Article ID 7424647, 7 pages, 2022. <https://doi.org/10.1155/2022/7424647>
- Radhy AM, Khalaf JM and Faraj AA, 2013. Some gastro-intestinal protozoa of zoonotic importance observed in captive animals of al-Zawraa zoo in Baghdad. *International Journal of Science and Nature* 4(3): 567-570.
- Rafi Z, Yasmeen R, Qurashi AW, Bokhari R and Bokhari SS, 2021. Prevalence of Parasitic Species in Ruminants Found in the Vicinity of Lahore, Pakistan. *Scientific Inquiry and Review* 5(4): 38-53.
- Ruhoolaha, Khan W, Al-Jabr OA, Khana T, Khan A, El-Ghareeb WR, Aguilar-Marcelino L, Hussein EOS, Alhimaidi AR and Swelumh AA, 2021. Prevalence of gastrointestinal parasite in small ruminants of District Dir Upper Khyber Pakhtunkhwa Province of Pakistan. *Brazilian Journal of Biology* 23.
- Sangvaranond A, Lampa N, Wongdachkajorn D and Sritong D, 2010. Prevalence of helminthes parasites and intestinal parasitic protozoa among meat goats raised in private farms in Saraburi Province Thailand. *Journal Kasetsart Veterinary* 20(2): 85-95.
- Saritha K, Rajesh A, Manjulatha K, Setty OH and Yenugu S, 2015. Mechanism of antibacterial action of the alcoholic extracts of *Hemidesmus indicus* (L.) R. Br. ex Schult, *Leucas aspera* (Wild.), *Plumbago zeylanica* L., and *Tridax procumbens* (L.) R. Br. ex Schult. *Frontal Microbiology* 6: 577.
- Sebba S, Behnke JM, Broudi D, Hakem A and Abu-Madi MA, 2021. Prevalence protozoan infection among symptomatic and asymptomatic population in rural and urban areas of southern Algeria. *BMC Infectious Diseases* 21:888.
- Sultan P, Jan A and Pervaiz Q, 2016. Phytochemical studies for quantitative estimation of iridoid glycosides in *Picrorhizakurroa* Royle. *Botany Study* 57(1):7
- Soliman MF and Zalat SM, 2003. Prevalence and intensity of *Nematodirus* spp. and *Eimeria* spp. infections in the domestic goats of St. Katherine's Protectorate (Sinai, Egypt): relations with some ecological and biological factors. *Egypt Journal of Biology* 5(1):78-85.
- Sutaaker K, Myhr N, Bajwa RS, Joshi H, and Robertson LJ, 2017. Goats in the city: prevalence of *Giardia duodenalis* and *Cryptosporidium* spp. in extensively reared goats in northern India. *Acta Veterinaria Scandinavica* 59: 86.
- Verma R, Sharma DK, Paul S, Gururaj K, Dige M and Saxena VK, 2018. Epidemiology of common gastrointestinal parasitic infections in goats reared in semi-arid region of India. *Journal of Animal Research* 8(1): 39-45.
- Wang C, Xiao J, Chen AH LMA, Chen J, Wang Y and Gao JF, 2010. Prevalence of coccidial infection in sheep and goats in northeastern China. *Veterinary Parasitology* 174(3-4): 213-217.
- Windsor PA, Nampanya S, Putthana V, Keonam K, Johnson K, Bush RD and Khounsy S, 2018. The endoparasitism challenge in developing countries as goat raising develops from smallholder to commercial production systems: A study from Laos. *Veterinary Parasitology* 251: 95-100.
- Wuthijaree K, Tatsapong P, Lambert C, 2022. The prevalence of intestinal parasite infections in

- goats from smallholder farms in Northern Thailand. *Sciend* 59: 64 – 73
- Yusof AM and Isa MLM, 2016. Prevalence of gastrointestinal nematodiasis and coccidiosis in goats from three selected farms in Terengganu, Malaysia. *Asian Pacific Journal of Tropical Biomedicine* 6(9): 735-739.
- Zvinorova PI, Halimani TE, Muchadeyi FC, Matika O, Riggio V and Dzama K, 2016. Prevalence and risk factors of gastrointestinal parasitic infections in goats in low-input low-output farming systems in Zimbabwe. *Small Ruminants Research* 143:75-83.