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Full Length Research

Prevalence of gastrointestinal parasites in pigs (*Sus domesticus* Linnaeus, 1758) of Chandragiri Municipality Kathmandu, Nepal

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ABSTRACT: A cross-sectional study was conducted to determine prevalence and associated risk factors of gastrointestinal (GI) parasites of pigs reared in three different locations (Bishnu Devi, Kanchan Basti and Balambu) of Chandragiri Municipality from February, 2017 to June, 2017 using opportunistic random method. A total of 105 pigs were sampled to assess and identify different species of GI parasites of pig. For this study, faecal samples were collected from a total of 105 pigs' reared in three different locations (Bishnu Devi, Kanchan Basti and Balambu) of Chandragiri Municipality. The collected faecal samples were examined by differentiation floatation technique and sedimentation techniques for isolation of parasitic eggs and/or oocysts. Out of 105 samples tested, an overall prevalence of 88.57% GI parasite was observed. Eight types of parasites were identified in which *Eimeria* spp. showed the highest prevalence rate (42.8%) and *Schistosoma suis* to be lowest (4.76%). The study had also revealed that about 15.23 and 73.33% pigs had harbored mixed and single infection, respectively. A Chi-square computed statistical analysis indicated that location ($\chi 2=9.233$; $p<0.05$), and sex ($\chi 2=0.031$; $p>0.05$) were significantly and insignificantly associated with the infection of GI parasites in the study area respectively. There was statistical significance difference of the GI parasites with infection types in relation to locations ($\chi 2= 9.5733$; $p<0.05$). However, there was no statistical significance difference of the GI parasites with infection types in relation to sex (Male and female) ($\chi 2=0.3142$; $p>0.05$). This study revealed that pig GI parasites were the major biological constraints contributing to the low productivity of pig and hampered the economic benefit obtained from the sector. Therefore, further detailed investigations are needed to formulate appropriate and cost-effective strategies for the control of gastrointestinal parasites in pig farms in Chandragiri Municipality.

Keywords: Chandragiri Municipality, faecal, gastrointestinal parasites, oocysts, pig.

INTRODUCTION

Swine production is an integral part of the rural economy in many parts of the world. Pig rearing is becoming an important livestock business in Nepal. In Nepal, pig accounts for the second contribution in meat production (MOAC, 2008/09). The native pig breeds of Nepal are Chwanche, Hurrah, Bampudke, Pakhribas black and Dharane Kalo banggur etc. Exotic breeds of pig are imported in Nepal since 1957 A.D like Landrace, Hampshire, Duroc and Yorkshire etc.

Pig production has a number of advantages over other livestock sectors. These includes higher and quick returns on investment, early maturity, short generation interval and smaller space requirement of production. However, lack of knowledge, low literate rate and poor economic conditions, still modernize and scientific technique of raring the pigs has not been practiced in Nepal. Due to these reasons, the parasitic infections have been found to be emerging threat in pigs in context of Nepal.

Definable entities that have the potential to bring about a change in a health condition or other defined outcome and predominant risk factors to have parasites associated with pig is due to farming system (Nansen and Roepstorff,

1999). Free range pig keeping is still common in the rural set-up of many developing countries in spite of its shortcomings such as poor feed conversion, high mortality rates and poor products (Lekule and Kyvsgaard, 2003) and the risk of spreading zoonotic diseases such as cysticercosis (Githigia et al., 2005; Kagira et al., 2010). Under this type of production system, pigs are mainly kept for income generation and provision of protein. Internal parasitism of pigs can result in loss of appetite, poor growth rate, poor feed conversion efficiency and potentiation of other pathogens or even death (Stewart and Hoyt, 2006).

Poor environmental hygiene couple with extensive management is reported as risk factors of infection of pigs with gastrointestinal parasites. Gastrointestinal helminthes including *Oesophagastomum dentaatum, Trichuris suis, Ascaris Suum, Oesophagastomum quadrispinulatum, Trichostrongylus axei, Strongyloides ransomi, Hyostrongylus rubidus and Physcocephalus sexalutus* have been identified in pigs raised under extensive production in Kenya, Ghana and Burkina Faso. Semi-extensively managed pigs are reported to harbour *Taenia solium* in Nigeria. Similarly, the presence of *Taenia solium* in Nepal was first reported more than 30 years ago (Joshi, 2004), yet further research has remained limited. Pigs were also found to be infected with *Ascaris suum* and *Oesophagostomum* spp. in Holeta, Ethiopia. In addition to helminthes, extensively managed pigs are also reported to harbour intestinal protozoans including *Cryptosporidium* spp., *Isospora suis, Giardia lamblia, Balantidium coli*, *Eimeria* spp. etc in developing countries. In addition, pig can harbour a range of parasites and diseases that can be transmitted to humans. These includes trichinosis, *Taenia solium*, cysticercosis and fasciolopisis. Thirty-nine percent (39%) of children have been found to be infected with *Fasciolopsis buski* in India and Bangladesh (Dey et al., 2014).

In Nepal, raring of pigs have been found in different places including rural and urban areas. However, the management is mainly extensive whereby pigs are allowed to scavenge on household wastes at backyards and municipal garbage dumping sites. Such extensive pig husbandry with poor environmental hygiene and pigs edacious feeding behavior may render infection of the animals with helminth and GI in Nepal. Information on the prevalence of porcine gastrointestinal helminthiasis in Nepal is scanty. This study therefore seeks to investigate GI parasite infections among pigs in three different locations (Bishnu Devi, Kanchan Basti and Balambu) of Chandragiri Municipality.

Materials and Methods

Study area

The main study was conducted in the three different locations (Bishnu Devi, Kanchan Basti and Balambu) of Chandragiri Municipality. It is extended over 27^0 $41^{'}$ $25^{"}$ N latitude and 85^0 $13^{'}$ $13^{"}$ E longitude. It covers an area of 43.9 km^2 with population of 85,195. It is in the central development region of Nepal lying in Kathmandu district of the Bagmati zone. The capital city Kathmandu is approximately 5 to 8.9 km away from study area. The altitude of study areas is about 1466 m above sea level and have tropical climate. The average annual temperature in Chandragiri is 28.9^0C and average rainfall is about 870 mm. The main attraction of Chandragiri is Chandragiri Hills and different bio-diversity. Majority of people living in these locations are Newar, Bahun, Chettri, Tamang and Magar (Figure 1).

In the study area, a very poor technique of raring the pigs was noticed and pigs were found feeding on household garbage. Till now, there is no any veterinary related health programs performed by both government sector as well as by private sector in the study area. This may result in various kinds of pig's diseases caused by the parasites.

Sample and data collection methods:

The three different locations (Bishnu Devi, Kanchan Basti and Balambu) which lies in the Chandragiri Muncipality is far from the urban areas of Kathmandu, Nepal. So, it is considered as the best place for agriculture and raring different domestic animals including pigs for the betterment of their economic conditions. During the collection of faecal samples in three locations, three (3) days was allocated to each location. Faecal samples were collected by the help of research assistants selected in the study area. Fresh faecal samples were taken from individual's pigs at early mornings during time period between 7 to 9 am. About 10 gram faecal sample from each pig was taken with help of disposable gloves and transferred inside the clean 25 ml vial. The same collection process was repeated for all collected faecal samples. Necessary information was noted clearly, such as faecal samples collection data and sex of pigs. Data were collected by using direct field observation. Collected samples were brought to Laboratory of Central Department of Zoology, Kirtipur, Kathmandu.

Differentiation flotation and sedimentation technique

Differentiation Floatation Technique and Sedimentation was used as described by Soulsby (1982) and Zajac and Conboy (2012). This technique was carried out as follows: Approximately 3 grams of faecal sample was placed in a beaker and added with 42 ml of water, then the samples were grinded lightly with the help of rod and filtered by tea strainer. The filtrate solution was poured into a centrifuge tube and centrifuged at 1,000 rpm for 5 minutes. The tube's water was replaced with more saturated Nacl solution and again centrifuged. After centrifugation, super

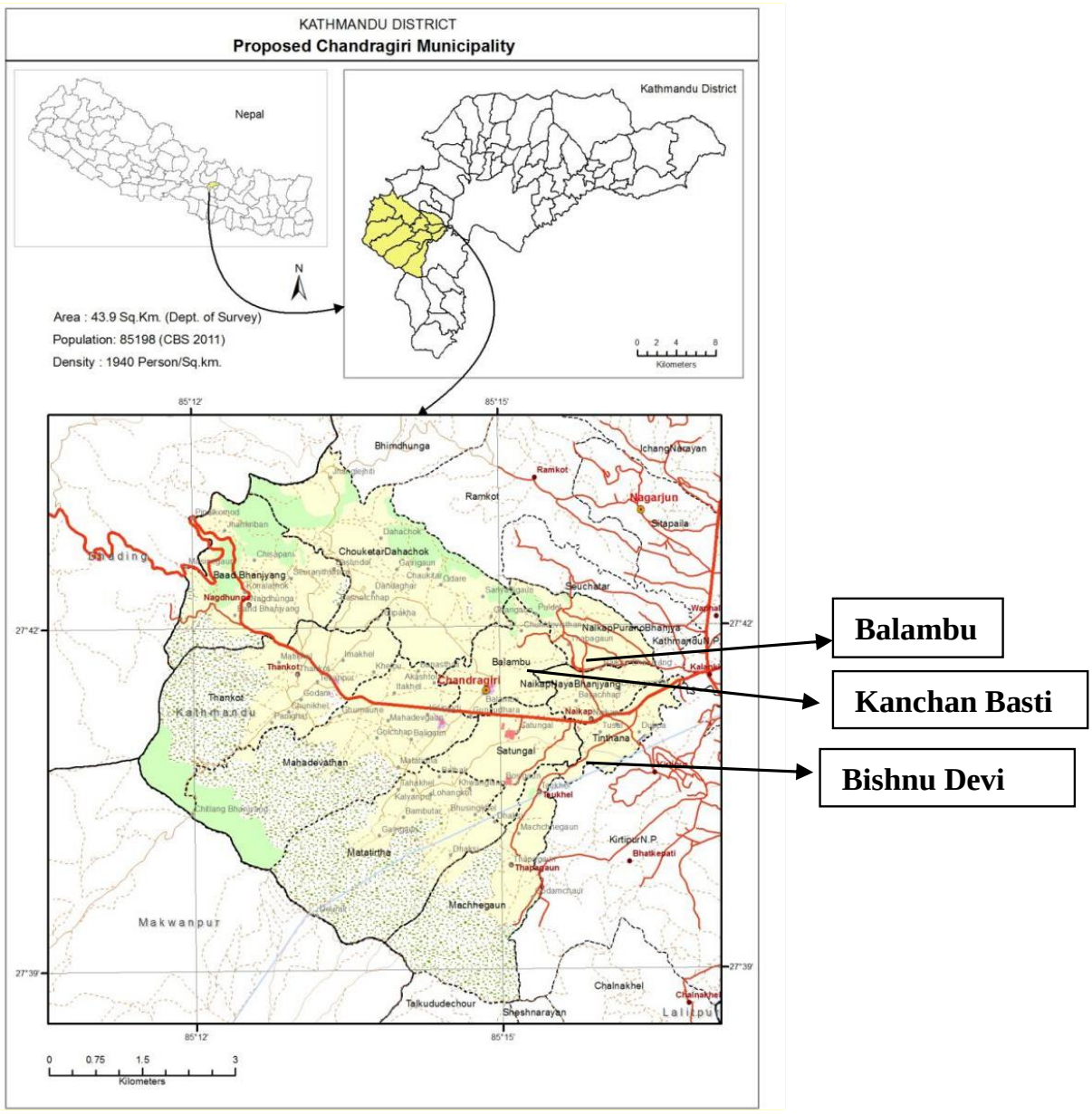

Figure 1. Map of Chandragiri Municipality showing study areas.

saturated Nacl solution was added to develop convex meniscus at the top of the tube and one drop of Methylene Blue (to stained) was added. A cover slip was placed over the top of the tube so that NaCl touches the cover slip for few minutes and then the cover slip was placed on a slide and examined at 10X and 40X. In the sedimentation technique, supernatant was discarded gently leaving the heavier particles at the bottom. A drop of deposited materials was taken out from the test tube with the pipette and placed on the slide. The specimen was stained with iodine wet mount's solution and examined at 10X and 40X. The sedimentation technique was used in this study because some oocyst/egg of trematode are heavier which do not float on the top of the tube but settle at the bottom of the centrifuge tube.

Data analysis

For this study, prevalence was measured as the percentage of host individuals infected with a particular parasite (Margolis et al., 1982; Bush et al., 1997). The collected data were coded and entered into Microsoft Excel spread sheet. Data were statistically analyzed using Pearson's Chi-square test with Yates' continuity correction, performed by "R", version 3.3.1 software packages. Percentage was used to calculate prevalence. Data were statistically analyzed using Chi-square. In all

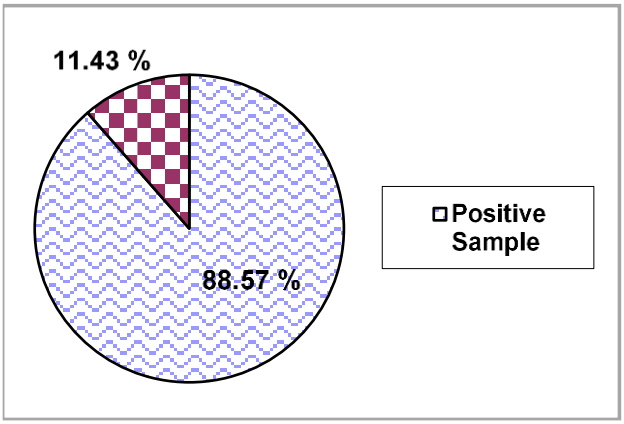

Figure 2. Overall prevalence.

Table 1. Overall protozoan parasites in pigs.

S.N	Class	Parasite Name	Frequency	Absolute frequency (%)	*P* -Value
1.	Coccidia	*Eimeria* spp.	45	42.8	2.2×10^{-16}
		Isospora suis	8	7.61	
2.	Litostomatea	*Balantidium coli*	25	23.80	

Table 2. Overall helminth parasites in pigs.

S.N	Class	Parasite Name	Frequency	Absolute frequency (%)	*P* -Value
1.	Nematode	*Ascaris suum*	40	38.09	2.2×10^{-16}
		Strongyloides sp.	15	14.28	
		Trichuris suis	8	7.61	
2.	Trematode	*Fasciolopsis buski*	10	9.52	
		Schistosoma suis	5	4.76	

cases 95% confidence interval (CI) and $p<0.05$ was considered for statistically significant difference.

RESULTS

Overall prevalence of gastrointestinal parasites in pigs

Out of 105 samples, 93 (88.57%) samples showed positive results for parasitic egg, cysts and larvae. Among them, three protozoan parasites and five helminths parasites were recorded. Protozoan parasites include *Eimeria* spp. (42.8%), *Isospora suis* (7.61%) and *Balantidium coli* (23.80%) whereas, helminths parasites include *Ascaris suum* (38.09%), *Strongyloides* sp. (14.28%), *Trichuris suis* (7.61%), *Fascilopsis buski* (9.52%) and *Schistosoma suis* (4.76%) (Figure 2, Tables 1 and 2).

Location-wise and infection types prevalence of GI parasites in pigs

The highest prevalence (95.55%) was revealed in Kanchan Basti location followed by Bishnu Devi (91.42%) and Balambu (72%) respectively. The study showed effects of different locations of Chandragiri Municipality on the prevalence of gastrointestinal parasites (Tables 3, 4 and 5) and there was statistical significant difference of the prevalence of intestinal parasite among selected location ($\chi2 = 9.233$; $p<0.05$).

Overall sex-wise prevalence of GI parasites in pigs

Sex-wise males (87.65%) and females (91.66%) were found to be positive for one or more parasites. The study showed effect of sex on the prevalence of gastro-intestinal parasite infection. While absolute figure indicates a higher prevalence in females pigs (91.66%) (Figure 3 and Table 3). There were no statistical significant differences of the prevalence of intestinal parasite infection between males and females ($\chi2 = 0.031$; $p > 0.05$ (Figure 3) [$p = 0.8592$].

DISCUSSION

In the present study, the prevalence of gastrointestinal

Table 3. Infection types in relation to location and sex. For location, df = 4; sex, df = 2 (df= degree of freedom).

Variables	No. of pig examined	Infection type		χ2	p-value
		Mixed (polyparasitic) (%)	Single (monoparasitic) (%)		
Location					
Bishnu-Devi	35	5 (14.28%)	27 (77.14%)	9.5733	0.048
Kanchan-Basti	45	7 (15.55%)	36 (80 %)		
Balambu	25	4 (16%)	14 (56 %)		
Total	105	16 (15.23%)	77 (73.33%)		
Sex					
Male	81	12 (14.81%)	59 (72.83%)	0.3142	0.8546
Female	24	4 (16.66%)	18 (75%)		
Total	105	16 (15.23%)	77 (73.33%)		

Table 4. Location-wise comparative prevalence of parasite classes.

Class	Parasite Name	Bishnu-Devi (n= 35)	Kanchan-Basti (n= 45)	Balambu (n= 25)
Coccidia	*Eimeria* sp.	15 (42.85 %)	20 (44.44%)	10 (40%)
	Isospora suis	6 (17.14 %)	2 (4.44%)	-
Litostomatea	*Balantidium coli*	4 (11.42 %)	10 (22.22%)	11 (44 %)
Nematode	*Ascaris suum*	5 (14.28 %)	28 (62.22%)	7 (28 %)
	Strongyloides sp.	1 (2.85 %)	6 (13.33 %)	8 (32%)
	Trichuris suis	6 (17.14 %)	2 (4.44 %)	-
Trematode	*Fasciolopsis buski*	3 (8.57 %)	6 (13.33 %)	1 (4 %)
	Schistosoma suis	3 (8.57%)	2 (4.44 %)	-

Table 5. Sex-wise prevalence of GI parasites in pigs in three different location of Chandragiri Municipality.

Location Name	Sex	No. of examined	No. of Positive	Prevalence (%)
Bishnu-Devi	Male	28	25	89.28%
	Female	7	7	100%
	Total	35	32	91.42%
Kanchan-Basti	Male	35	33	94.28%
	Female	10	10	100%
	Total	45	43	95.55%
Balambu	Male	18	13	72.22%
	Female	7	5	71.42%
	Total	25	18	72%

parasites of pigs have been carried out from three different locations (Bishnu Devi, Kanchan Basti and Balambu) of Chandragiri Municipality. Overall prevalence rate was found to be 88.57%. This result is nearly similar to the findings of Waiswa et al. (2007) in South Eastern Uganda (94.8%), Nissen et al. (2011) in Uganda and Tamboura et al. (2006) in Burkina Faso (91%). The present report is higher than Ismail et al. (2010) in Korea, Nganga et al. (2008) in Kenya, Dogo et al. (2017) in Nigeria, Geresu et al. (2015) in Ethopia, Marufu et al. (2008) in Zimbabwe, Solaymani-Mohommadi et al. (2003) in Western Iran, Borthakur et al. (2007) in Aizawl and Jufare et al. (2015) in Ethiopia who reported 73.5, 67.8, 63.8, 61.8, 58.7, 58.3, 37.5 and 25% respectively. The difference in the prevalence may be due to the difference in climatic conditions, husbandry practices, breeds and inherent characteristics such as host immunity in the study regions.

The total number of species observed during faecal examination were eight in numbers. Among identified parasites *Eimeria* spp. (42.8%) showed the highest prevalence and *Schistosoma suis* (4.76%) showed the lowest prevalence. Two parasites (*Isospora suis* and

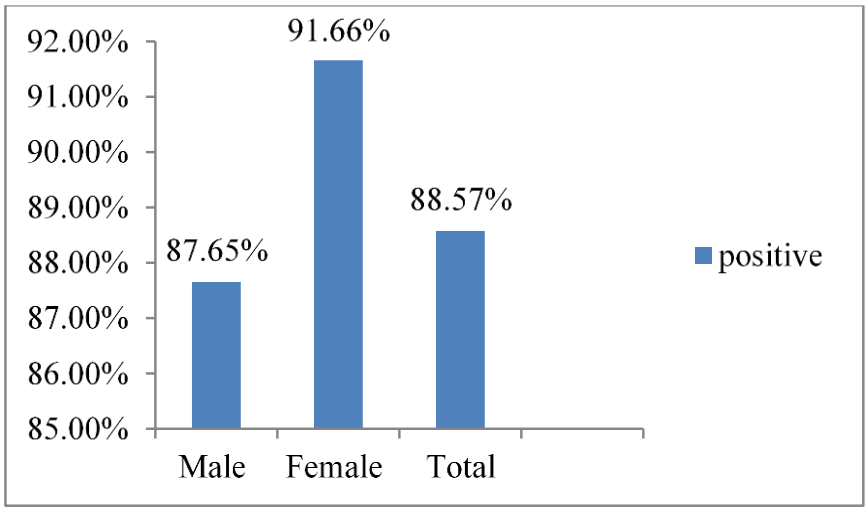

Figure 3. Overall sex-wise prevalence of GI parasites in pigs.

Trichuris suis) showed the same prevalence of 7.61 %. The remaining parasites *Ascaris suum*, *Balantidium coli*, *Strongyloides* sp. and *Fascilopsisi buski* showed the prevalence of 38.09, 23.80, 14.28 and 9.52% respectively.

The results found in the case of *Fascilopsis buski* was 9.52% was little bit similar with earlier findings of Shaikh and Huq (1984) in Bangladesh (16.7%) and highly differs from Chandra (1984) in india and Inpankaew et al. (2015) in Cambodia which was recorded to be 29.4 and 30% respectively. The differences in prevalence could include different factors such as presence of reservoir hosts, presence of snail intermediate host and ability of *F. buski* to colonize and adapt new hosts contribute for its spread in livestock in an area.

The rate of *Schistosoma suis* infection is little bit higher than the previous finding of Permin et al. (1999) in Ghana which was found to be 0.4% only. The differences in the prevalence of *Schistosoma suis* could be due to husbandry practice, environmental factors and different vectors as an intermediate host found in an area.

The prevalence of 38.09% recorded for *Ascaris suum* in this study is nearly similar with earlier findings of Boes et al. (2000) in china (36.7%), Sachin et al. (2016) in Mumbai (32.59%) and Naganga et al. (2008) in Kenya (28.7%). The present report is higher than Nsoso et al. (2000) in Botswana and Rajkhowa et al. (2003) in Nagaland which was 54.6 and 67.4% respectively. The moderately high prevalence of *Ascaris suum* in the present study might be associated with farm management systems and access of household wastes and municipal garbage dumping sites which may facilitates ingestion of thick-shelled eggs of *Ascaris suum*. These thick-shelled eggs are resistant to adverse environmental factors as well as chemicals and can maintain infectivity for long periods of time.

The study revealed that *Strongyloides* sp. was the most prevalent parasite followed by *Ascaris suum*. The present finding related to *Strongyloides* sp. is similar to Geresu et al. (2015) in Ethiopia and Marufu et al. (2008) in Zimbabwe which was 16.2 and 14% respectively. Whereas, there was a great difference of present finding from Obonoyo et al. (2012) in Kenya which was 26.9%. The differences in prevalence of *Strongyloides* sp. (14.28%) could be due to differences in climatic conditions, management systems and local circulatory parasites in the locality. The survival of *strongyloides* larvae depends on the environmental temperature and moisture. The larvae of these species are susceptible with the dry areas providing unfavorable environment for survival of *Strongyloides* larvae.

The result shows 7.61% of *Trichuris suis* infection in faecal sample which was found to be similar with previous findings of Sachin et al. (2016) in Mumbai (11.11%), Basak et al. (1988) in Bangladesh (8.2%), Geresu et al. (2015) in Ethiopia (6.9%) and highly differs from Tiwari et al. (2009) in West Indies (38%). The above mentioned differences in the prevalence of *Trichuris suis* could be due to ability of the eggs to survive for long in the environment.

Detection of highest prevalence of *Eimeria* spp. was 42.8% in the present study. The result of *Eimeria* spp. infection is similar to Matsubayashi et al. (2009) in Japan (40.3%), Pilarczyk et al. (2004) in Poland (58.5%) and highly differs from permin et al. (1999) in Ghana (77.2%) and Tiwari et al. (2009) in Greneda, West indies (88%).The differences in prevalence could be due to poor hygienic status of farm and requirement of 5 to 12 days (depending on the species) to sporulate the occysts of *Eimeria* spp.

Asaolu et al. (2012) in Ibadan South west Nigeria reported 6.3% of *Isospora suis* which was similar to present findings whereas Karamon et al. (2007) in Poland found to be 27.8% which was slightly higher than present findings. The differences in the prevalence of *Isospora suis* could be due to the time period needed for *Isospora suis* oocyts to become infective (the sporulation time) is very short (about 24 to 48 hours). More importantly, *Isospora suis* infection is more in suckling piglets.

The present result of *Balantidium coli* infection is similar to Permin et al. (1999) in Ghana (19.3%) and highly differs from Ismail et al. (2010) in Korea (64.7%), Kagira et al. (2010) in Kenya (64%) and Basak et al. (1988) in Bangladesh (60.3%). The differences in the prevalence may be due to the differences in husbandry practices, period and place of study, environmental factors, breed of animal, contamination of pig and human faecal matter in the water supply etc.

The lack of cestodes in current study show that there is scarcity of infection by this class of parasites which was in line with the report of Borthakur et al. (2007).

There was significant association (X^2=9.233; p< 0.05) of locations of Chandragiri and parasitic prevalence which was 32 (91.42%), 43 (95.55%) and 18 (72%). The present results obtained is just opposite of the results obtained by Geresu et al. (2015) with locations.

The infection rate in females (91.66%) higher than in male pig (87.65%) as reported in present study. This finding is in agreement with the earlier study of Tamboura et al. (2006) in Burkina Faso and Obonyo et al. (2012) in Kenya. The present study differs from Asaolu et al. (2012) in Nigeria who recorded higher prevalence in male (45%) than female (30.4%). Nsoso et al. (2000) in Botswana and Zewdneh et al. (2013) reported that there was not significant association between sex and prevalence of parasites p>0.05 which agree the present study. The reason for higher prevalence of infection in females cannot be explained exactly but it might be assumed that the alternation of the physiological conditions of the female during pregnancy, lactation and parturition as well as stress.

The study showed effects of study area on infections status of parasites and there was statistical significant difference among infection status in study area ($\chi 2$ = 9.5733; p<0.05). The present study also revealed as there was higher monoparasitic infection (73.33%) compared to polyparasitic (mixed) (15.23%) infection. Similar results were found by Geresu et al. (2015) in Ethiopia (11.28%) and Ismail et al. (2010) in mixed infection but found higher by Tiwari et al. (2009). In single infection, the prevalence is (73.33%) which is higher as compared to Geresu et al. (2015) in Ethiopia (37.69%). Higher prevalence of both mixed (polyparasitic) and monoparasitic infection was observed in females compared to male pigs. This could be explained by the fact that males are slaughtered at early age while females are kept for breeding purpose and will have greater chance to acquire infection before they are eventually slaughtered especially for chronic infection like fasciolosis.

Conclusion and recommendations

This study has revealed overall prevalence of 88.57% from three different locations (Bishnu Devi, Kanchan Basti and Balambu) of Chandragiri Muncipality which includes eight gastro-intestinal parasites. Female pigs (91.66%) were more infected as compared to male (87.65%). The present study shows that pigs were more infected with single infection than mixed infection. Management practices and different locations can be considered as the important factors which influence the prevalence of GI parasites. Veterinary health program, appropriate prevention and control strategy actions supported by both government as well as private sector will be necessary to minimize the gastro-intestinal parasites of pigs in order to utilize them efficiently.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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