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Prevalence and Associated Risk Factors of Gastrointestinal Nematodes in Small Ruminants in Diguna Fango District, Wolaita Zone, Ethiopia

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Abstract

A cross-sectional study was conducted from January 2022 to August 2022 to estimate the prevalence and associated risk factors of gastrointestinal nematodes infecting small ruminants in Diguna Fango Woreda, Wolaita zone, Southern Ethiopia. A total of 384 fecal samples (150 from sheep and 234 from goats) of all ages and sexes was collected and examined by using floatation technique. The overall prevalence of the nematode infection was 66.7% (256/384). Strongly eggs were the most prominent eggs identified during the study (75%) where by (7%) were positive for strongyloide egg, (5.5%) were positive for trichuris egg and (12.5%) were positive for mixed infections with strongly and strongyloide type of eggs. Among the risk factors considered in this study deworming history and sex showed significant association (P<0.05) with gastrointestinal nematode parasites prevalence. However, there was no statistically significant association (P>0.05) between the occurrence of the parasite infection and species, age, body condition and fecal consistency of the animals, In conclusion, the present study highlights the higher prevalence of gastrointestinal tract nematodes in small ruminants in the study area that could affect the health and productivity of the small ruminants. Therefore strategic gastrointestinal tract parasite deworming and control procedures and awareness creation to society should be implemented.

Keywords: Fecal samples • Nematodes • Prevalence • Small ruminants • Livelihood

Introduction

Small ruminant farming has a prominent role in the sustainability of rural communities around the world as well as being socially, economically and politically highly significant at national and international levels, similar to other livestock species. Over two-thirds of the total populations of small ruminant occur in developing countries where they often provide a major contribution to farming enterprises [1]. Ethiopia, with its great variation in climate and topography, possesses one of the largest small ruminant populations in Africa with currently estimated population of 28.89 million sheep and 29.7 million goats [2]. From this annual national mutton and goat meat production is 77 and 62 thousand metric ton, respectively. These animals contribute 13.9% and 11.2 of the total meat production. The share of small ruminants of the total milk output is estimated to 16.4% and Ethiopia exports 155,000 heads of livestock particularly sheep and goats annually [3].

Sheep and goats has great importance as major sources of livelihood and contribute to the sustenance of landless, smallholder and marginal farmers especially to the poor in the rural areas throughout the developing countries. Sheep and goats are also very important for resource-poor smallholder systems of rural Ethiopia due to their ease of management, short generation cycles and high reproductive rates which lead to high production efficiency and significant role in provision of food and generation of cash income [4]. Their use of relatively low inputs needed such as startup capital, feedstuffs, and maintenance expenditures as compared to large ruminants make this sector a more secure source of income generation for poor and landless farmers. They serve as a living bank for many farmers, closely linked to the social and cultural life of resource poor farmers and provide security in bad crop years [5].

Sheep and goats production and productivity is constrained by many factors. Among these GIT parasites, constitutes to pose a serious health threat and a limitation to the productivity of small ruminants. It remains the main constraint to small animal production systems across all agro-ecological zones throughout the world [6]. Gastrointestinal parasite infections also have great impact in Ethiopia due to the availability of a wide range of agro-ecological factors suitable for diversified and parasite species [7].

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Gastrointestinal parasitism is one of the researchable items on sheep and goat health in the Southern Nations Nationalities regional state, since gastrointestinal parasites incur significant economic losses in the region, due to insufficient information on the epidemiology [8].

GIT nematodes of sheep and goats are among the major endoparasitic infections that are responsible for heavy economic losses through reduced productivity and increased mortality [9]. They reduce voluntary feed intake and efficiency of feed utilization and are major contributors to reduced meat, milk and wool production. The loss through reduced productivity is also related to reduced work capacity, cost of treatment and control of GIT nematodes [10]. The most common gastrointestinal nematodes that affect sheep and goats in most sub Saharan countries include; *Haemonchus contortus*, *Teladorsagia (Ostertagia) circumcincta*, *Trichostrongylus* species, *Cooperia curticei*, *Nematodirus* spp., *Bonustomum trigonocephalum*, *Chabertia* spp., *Oesphagostomum* spp., *Strongyloides* spp., and *Trichuris ovis*; and lung worms such as *Dictyocaulus filaria*, *Muellerius capillaris* and *Protostrongylus rufescens* [8]. The life cycles of nematodes are diverse. Many species develop directly (without an intermediate host, while others undergo indirect development (including an intermediate host [11]. The host–parasite relationship and the prevailing agro-climatic conditions of the country play a vital role in the epidemiology of these nematodes [12]. The effect of infection by gastrointestinal parasites varies according to the parasite concerned, the degree of infestation and other risk factors such as species, age, season and intensity of worm burden [13]. Body condition of host animal, age, sex, weather condition and animal husbandry or management practices are major risk factors that do influence the prevalence and severity of gastrointestinal nematode infection [14]. More importantly, environmental conditions such as temperature, rainfall and humidity are major factors to the development of nematode eggs and free living stages [15]. Knowledge of the seasonal population trends, nematode life cycle and the prevalence of larvae in sheep and goats is necessary for the developing of control programs [16].

In many parts of Ethiopia considerable amount of researches have been carried out by different researchers to investigate prevalence and intensity of nematode infection in small ruminants [17]. Accordingly, the results varied greatly among different parts of the country.

Even though, there is large population of small ruminants in the study area, the prevalence and risk factors of gastro-intestinal nematode parasite infection has not been reported. Hence it is very important to generate accurate information about these parasites in the study area in order to design effective control and prevention strategies.

Therefore, the main objectives of the study were:

- Estimating the prevalence of gastrointestinal nematode parasites of small ruminants.
- Assessing associated risk factors in the study area.

Materials and Methods

Study area

Diguna Fango Woreda is located 42 km east from the zonal city named Wolaita Sodo, and 73 km south west from Hawassa which is the capital of Southern Ethiopia; and 300 km South of Addis Ababa. It is part of the Wolaita Zone located on the western edge of Great Rift Valley. The woreda is bordered on the Southwest by Damot Woyde, on the west by Damot Gale, on the North by the Hadiya Zone, on the northeast by the Oromia Region, and on the east by the Sidama region. The woreda is known for its undulating topography and diversified features with mountains, valley, and plateau landforms. In terms of altitude, the woreda lies between 1,303 and 2,318 m.a.s.l. Agro-ecologically, the woreda is dominated by lowland with hot climate of 73% of the total area found within midland (moderate climate) and the rest 27% is highland (moderately cold climate) as point out by The mean annual temperatures of the woreda range from 19.8°C to 28.5°C and the average annual rainfall varies between 800 and 1200 mm. The woreda has different land uses such as forest land, grazing land, cultivation, and settlement areas. Maize, wheat, barley, and teff are commonly grown rain-fed crops throughout the Woreda. With a total population of 123,033 and the Woreda covers a total of 46,660 hectare of land and farm sizes are generally small and on average farmers cultivate about 0.5 ha per head. The total livestock population of the Woreda recorded is 52,252 cattle population, 22,123 sheep, and 75,225 goats, 752456 poultry and 12000 equine species [18].

Study design and study population

A cross-sectional study was undertaken to determine the prevalence of small ruminant's gastrointestinal nematodes by qualitative fecal examination. A total of 384 small ruminants (150 sheep and 234 goats) of all ages and sexes were used in the study area. They study animals were all local breeds, kept under traditional extensive management system. Conventionally, those animals with the age of less than one year were considered as young while those greater than or equal to one year were included as adults as described by Gatenby, et al. [19]. Body condition scoring of sampled animal was categorized into three scores as poor, medium and good according to Kripali et al.

Sample size determination

The sample size for this study was determined by the formula described by Thrusfield. Accordingly, at 95% confidence level and precision of 5% the total sample size was determined to be 384 since there was no research carried out on the title previously in the study area. So, for this particular study the sample size was as following:

$n=(1.96)^2 Pexp(1-Pexp)/d^2$

$n=(1.96)^2 0.5(1-0.5)/(0.05)^2=384$

Where,

n=Sample size required.

1.96=The value of Z at 95% confidence interval.

Pexp=Expected prevalence.

d=Desired absolute precision.

Hence, the required sample size was 384 small ruminants.

Study methodology

Sample collection and examination: Fecal sample was collected directly from the rectum of the study animals using disposable plastic gloves and placed in universal bottles. Collected samples were recorded along with all necessary information *i.e.* the animal number corresponding to owner's name, date, age, sex, body condition, anthelmintic treatment (deworming) history. The faecal samples were placed in a universal bottle, labeled and 10% formalin was added to preserve parasite eggs and transported and then transported to Bitena veterinary clinic laboratory. Samples were kept in refrigerator at 4°C when immediate processing is not possible. Faecal examination was carried out by direct smear in order to detect some parasite eggs or larvae and simple floatation technique and was examined microscopically (10X and 40X) [20]. The faecal samples were examined for the detection of nematode eggs using standard procedures of floatation technique. The eggs of parasite species were identified using keys given by Soulsby L and Taylor et al.

Data analysis

All the data collected were entered in a Microsoft excel spread sheet and summarized. Then analysis was done by using SPSS version 26 software of the computer programmed for the statistical analysis. Descriptive statistics was used to quantify the problems and Chi-square test and Odds ratio were used to compare association between independent variables (species, sex, age, deworming history and body condition scores) and parasitism. Confidence interval was set at 95% and statistically significant association between variable was considered to exist if the computed p-value is less than 0.05.

Results

From a total of 384 small ruminants (150 sheep and 234 goats) examined during the study period, 256 (66.7%) of small ruminants positive for the nematode parasite infection, with 101 (67.3%) sheep and 155 (66.2%) goats [21].

Among the samples which were examined positive for nematode infection, 192 (75%) were positive for strongyle egg, 18 (7%) were positive for strongyloide egg, 14 (5.5%) were positive for trichuris egg and 32 (12.5%) were positive for mixed infections with strongly and strongyloide type of eggs as shown in Table 1.

Type of eggs	Number of animals examined	No. positive	Prevalence (%)
Strongyles	384	192	75
Strongloides	384	18	7
Trichuris	384	14	5.5
Mixed infections	384	32	12.5
Total	384	256	66.7

Table 1. Prevalence of nematode infection based on the type of egg.

Association between nematodes infection and various risk factors

During this study different factors; such as species, sex, age, Body Condition Score (BCS), treatment history (deworming history) and Fecal consistency were considered as putative factors and tested for a relationship with the occurrence of disease [22].

Among the risk factors considered for this study, sex and deworming history were shown significant association (P<0.05) with the prevalence of parasite infection, so that female animals harbored high rate of infection (75.5%) than males (63.3%); and also the small ruminants in the study area which were not treated get highly infected by nematodes (89.2%) than those regularly dewormed (24%) as shown in Table 2.

Higher prevalence rate was observed in adult small ruminants (67.4%) than young's (63.9%). In relation to body condition scores, the animals with medium body condition score were relatively highly infected (70.4%); followed by good body condition score which is (65.1%) whereas (64%) infection was recorded in in small ruminants with poor body condition score. In relation to consistency of faeces, higher prevalence of infection 135 (77.6%) was encountered in animals having soft to diarrheic faeces, whereas 121 (57%) with dry feces were identified positive with non-significant prevalence (P>0.05). However, there is no statistically significant association (P>0.05) was observed in nematode infection in small ruminants with different body condition score, age, species and consistency of feces [23].

Variables		No. animals examined	No. animals positive	95% CI (OR)	X^2	P-Value
Species	Sheep	150	101 (67.3%)	1.597-1.749	0.049	0.457
	Goat	234	155 (66.2%)	1.602-1.723		

Sex	Male	245	151 (63.3%)	1.639-1.757	2.982	0.018*
	Female	139	105 (75.5%)	1.533-1.690		
Age	Young	86	55 (63.9%)	1.539-1.740	0.367	0.315
	Adult	298	201 (67.4%)	1.621-1.728		
BCS	Good	209	136 (65.1%)	1.586-1.715	1.183	0.555
	Medium	125	88 (70.4%)	1.621-1.787		
	Poor	50	32 (64%)	1.509-1.771		
Deworming history	Not treated	251	224 (89.2%)	1.180-1.301	166.216	0.00*
	Treated	133	32 (24%)	1.848-1.937		
Fecal consistency	Dry	210	121 (57%)	1.653-1.783	6.224	0.099
	Soft to diarrheic feces	174	135 (77.6%)	1.522-1.668		

Table 2. Association between nematodes infection and various risk factors.

Discussion

The coprological examination performed for this study revealed the existence of gastrointestinal nematodiasis in small ruminants with an overall prevalence of 66.7%. The result showed that 67.3% and 66.2% in sheep and goats respectively were infested with nematode parasites. The current finding of overall prevalence agree and comparable with findings from some parts of Ethiopia; Lemma, et al. and Mekonnen G; who reported 69.01% in and around Arsi Negelle, 64.32% in and around Jimma town, and 64.1% in Boloso sore district, Wolaita zone respectively. However, this report is relatively lower than Samuel, et al. Demewez, et al. and Kabada, et al. Who reported 88.6% in and around Diredawa, 72.5% in Andabet district North West Ethiopia and 70.5% in Tiyo district, Arsi zone, respectively? Lower prevalence was also reported in different parts of Ethiopia; 54.1%, in Kaffa and Benchi maji zones; Tigist Kenea, et al. 40.8% in Bale zone; Dabasa, et al. 49.22% In and around Ambo Town; Terfassa et al; 50.8% in Tullo district, Western Hararghe; Getachew, et al. and 21.35% in Kurmuk district, Assosa Zone; Yasin, et al. The reason for the difference might be due to variation in agro-ecology, which could affect survival and development of infective larval stage of nematode parasites. Variation in the use of anthelmintic and grazing practices might also contribute to the difference in the prevalence [24].

In the present study a relatively higher prevalence of GIT nematode parasites were observed in sheep than in goats, 67.3% in sheep and 66.2% respectively. This observation was comparable with earlier findings from some parts of Ethiopia: Abdulaziz and Abdurhaman, Tigist Kenea, et al., Jiregna, et al., and Terfasa, et al. who reported: 60.9%: 43.8%, 55.1%: 52.6%, 75.8%: 61.2%, and 49.8%: 47.8% in sheep and goats respectively. The higher prevalence of nematode parasites found in sheep than in goats might be due to the fact that sheep have frequent exposure to communal grazing land that has been contaminated by feaces of infected animals. Goats are browsers in behavior but sheep are grazers from the ground where the GIT-parasites egg hatches and reaches the infective stage, Getachew, et al. [25]. So, as the animals graze closer to the ground or closer to feces, consumption of infective larvae also increase.

In this study, a significant association (P<0.05) was observed in nematodes infection in small ruminants with deworming history, where a higher prevalence of nematodes was recorded in non-dewormed animals (89.2%) when compared to regularly dewormed groups (24%). This finding agrees with the findings in selected sites of North Gondar, zone, Dagnachew, et al. and in North East Ethiopia Yimer, et al. This indicated that routine deworming of small ruminants with effective anthelmintic will reduce egg burden, thereby safe-guarding the animals from nematode infections [26].

In current study, sex of the animal also showed significant association (P<0.05) with the prevalence of nematode infection so that female animals were seen highly infected than males. Similar findings were revealed from Boloso sore district, Wolaita zone, Mekonnen G; in selected areas of North Gondar Zone Dagnachew, et al. and in North East Ethiopia Yimer, et al. This might be due to the assumption that females are more prone to parasitism especially during pregnancy and peri-parturient period due to both stress and decreased immune status [27].

The present study revealed no statistically significant differences (P>0.05) between ages categories of small ruminants, despite slightly higher infection noticed in adults (67.4%) than young's (63.9%). This difference in prevalence is comparatively similar to the findings of; Tigist Kenea, et al., Kabada, et al., and Ibsa, et al. The lower prevalence of nematode infection in younger animals could be most likely due to the tradition of keeping young animals homestead than letting them to travel distance in search of grass [28].

In the present study, there was no statistically significant association seen between body condition scores and prevalence of gastrointestinal nematodes in small ruminants. This finding agrees with the study reports of Kabada, et al.

Based on the egg types, this study showed that strongyles were the most prominent among those gastrointestinal nematodes of sheep and goats (75%) and strongyloides and trichuris species were represented in low percent in the study area [29]. Mixed infection was also found in this study both strongyles and strongyloides. The dominance of strongyle parasite in small ruminants in this

study agrees with the finding of Ibsa, et al. This might be due to due to the suitability of the climatic condition that could support survival and development of infective larval stage of strongyles in the study area [30-32].

Conclusion

The gastrointestinal nematodes of small ruminants are one of the important parasitic diseases that obviously result in reduced productivity. The coprological examination performed for this study revealed the existence of gastrointestinal nematode infection in small ruminants with an overall prevalence of 66.7%. The predominant GIT nematode parasites identified were strongyles followed by strongyloides, trichuris species and mixed infection of strongest and strongyloides. In the present study a relatively higher prevalence of GIT nematode parasites were observed in sheep than in goats. Among the risk factors considered for this study, sex and deworming history were shown significant association with the prevalence of parasite infection.

Based on the above conclusion the following recommendations are forwarded:

- Strategic GIT parasite deworming and control should be followed.
- Creating awareness to different individuals, and owners, towards management practices, so that extension program should be forwarded by governmental organization and non-governmental organizations.
- Further investigation involving wider areas, larger sample size and seasonal dynamics of gastrointestinal nematodes should be required.

References

1. Gatenby, M. Sheep, the Tropical Agriculturalist, Macmillan (London) and CTA (Wageningen), (1991): 6-11.
2. Pant, Kripali, MKS Rajput, Jitendra Kumar, and Shivani Sahu, et al. "Prevalence of helminthes in small ruminants in Tarai region of Uttarakhand." *Vet World* 2 (2009): 265.
3. Thrusfield, M. "Veterinary epidemiology (3 edn., pp. 233–250)." Black Well Science Ltd, (2005).
4. Babiso Badesso, Barana, Aklilu Bajigo Madalcho, and Merkineh Mesene Mena. "Trends in forest cover change and degradation in Duguna Fango, Southern Ethiopia." *Cogent Environ Sci* 6 (2020): 1834916.
5. FAO. Diguna Fango Woreda Agriculture, Livestock and Fishery Resourse Department, (2021).
6. National Meteorological Service Agency (NMSA). Climate of Ethiopia. Series Vol. II No. 2 Rainfall, Open File Materials from National Meteorological Service Agency, 135, (2008).
7. Dugassa, Jiregna, Abdela Hussein, Abriham Kebede, and Chala Mohammed, et al. "Prevalence and associated risk factors of gastrointestinal nematodes of sheep and goats in Ziway Dugda District, Eastern Arsi Zone of Oromia regional state, Ethiopia." *Multidiscipl Adv Vet Sci* (2018): 2301-310.
8. Woldeyes, Betelehem Bezu. Review on major gastrointestinal nematodes of small ruminants in Ethiopia. *Int J Adv Res Biol Sci* 8 (2021): 58-71.
9. Kabada, T, D Tolera, and A Abera. "Prevalence and the associated risk factors of gastrointestinal parasites of shoats in Tiyo District, Arsi zone, Oromia, South West Ethiopia." *Int J Agric Sc Food Technol* 6 (2020): 75-78.
10. Yimer, Andualem, Dessalegn Sissay, and Shahid Nazir. "Prevalence and associated risk factors of gastrointestinal nematodiasis in small ruminants in North East Ethiopia." *J Anim Res* 6 (2016): 345-350.
11. Chali, AR, and FT Hunde. "Study on prevalence of major gastrointestinal nematodes of sheep in Wayu Tuka and Diga District, Oromia Regional State." *Vet Med Open J* 6 (2021): 13-21.
12. Lemma, Dilgasa, Asrade Biruhtesfa, and Kasaye Surafel. "Prevalence of gastrointestinal nematodes of small ruminants in and around Arsi Negele town, Ethiopia." *Am Eurasian J Sci Res* 10 (2015): 121-125.
13. Terfassa G, Yimer L, Mohammed C, and Seid U, et al. Prevalence of gastrointestinal nematodes of small ruminants in and around Ambo Town of West Shoa, Oromia Regional State, Ethiopia. *N Y Sci J* 11 (2018):12-19.
14. Ibrahim, Nuraddis, Mulugeta Tefera, Mihreteab Bekele, and Sisay Alemu. "Prevalence of gastrointestinal parasites of small ruminants in and around Jimma Town Western Ethiopia." *Acta Parasitologica Globalis* 5 (2014): 12-18.
15. Mekonnen Gizaw. Prevalence of gastrointestinal nematodes in small ruminants in Boloso Sore District, Wolaita Zone, Southern Ethiopia. *J Vet Med Animal Sci* 3 (2020): 1034.
16. Kelemework, Samuel, Alebachew Tilahun, Eskziaw Benalfew, and Abebaw Getachew, et al. "A study on prevalence of gastrointestinal helminthiasis of sheep and goats in and around Dire Dawa, Eastern Ethiopia." *J Parasitol Vector Biol* 8 (2016): 107-113.
17. Demewez G, M Birhan and T Awoke. Prevalence risk factors of gastrointestinal nematode parasites of shoat in Andabet district North West Ethiopia. *Online J Animal Feed Rese* 7 (2014): 134-137.
18. Dabasa, Golo, Tadelle Shanko, Wubishet Zewdei, and Kula Jilo, et al. "Prevalence of small ruminant gastrointestinal parasites infections and associated risk factors in selected districts of Bale zone, south eastern Ethiopia." *J Parasitol Vector Biol* 9 (2017): 81-88
19. Kenea, Tigist, Jemere Bekele, and Desie Sheferaw. "Gastro-intestinal nematodes of sheep and goats in three districts of Kaffa and Bench Maji Zones, Southwest Ethiopia." *Ethiop Vet J* 19 (2015): 67-76.
20. Terfassa, G, L Yimer, Ch Mohammed, and U Seid, et al. Prevalence of gastrointestinal nematodes of small ruminants in and around Ambo Town of West Shoa, Oromia Regional State, Ethiopia. *New York Sci J* 11 (2016).
21. Getachew, M, R Tesfaye, and E Sisay. "Prevalence and risk factors of gastrointestinal nematodes infections in small ruminants in Tullo District, Western Harerghe, Ethiopia." *J Vet Sci Technol* 8 (2017): 428.
22. Yasin, Umer, Bihonegn Wodajnew, and Dejen Tsehaineh. "Study on the prevalence of GIT nematode infection of small ruminants in Kurmuk Woreda, Assosa Zone of Benishangul Gumuz Region, and And Western Ethiopia." *Rep Opin* 9 (2017): 48-59.
23. Abdulaziz Ousman, Abdurhaman Meribo. Study on prevalence of gastrointestinal nematodes of small ruminant in Adami Tulu Jiddo Kombolcha District, East Shoa Zone of Oromia, Ethiopia. *Int J Adv Res Biol Sci* 9 (2022): 72-81.
24. Dawit, Ibsa, Mebrahtu Weldegebriel, Derara Dejene, and Iyasu Israel. "Prevalence of gastrointestinal tract nematodes parasites in sheep in Hawasa Town, Southern Ethiopia." *Biomed J Sci Technol Res* 41 (2022): 33046-33052.
25. Lughano kusilka and Dominic kambarage. Diseases of small ruminants. A hand book. (1995).
26. Tesfaye, Tegegn. "Prevalence, species composition, and associated risk factors of small ruminant gastrointestinal nematodes in South Omo zone, South-western Ethiopia." *J Adv Vet Anim Res* 8 (2021): 597.
27. Dagnachew, Shimels, Asmare Amamute, and Wudu Temesgen. "Epidemiology of gastrointestinal helminthiasis of small ruminants in selected sites of North Gondar zone, Northwest Ethiopia." *Ethiop Vet J* 15 (2011).
28. Deplazes, Peter, Johannes Eckert, Alexander Mathis, and G von Samson-Himmelstjerna, et al. Parasitology in veterinary medicine. Wageningen Academic Publishers, (2016).

29. Soulsby, L. Helminthes, arthropods and Protozoa of domesticated animals. 7th ed., London: BailliereTindall. (1982): 119-127.
30. Taylor, Mike A, Robert L Coop, and Richard L Wall. Veterinary parasitology. John Wiley and Sons, (2015).
31. Sebro E, M Kebamo, and A Abebe. "Prevalence of gastrointestinal parasites of sheep and goats in An-Lemo, Hadiya Zone Southern Ethiopia." *Indian J Sci Technol* 15 (2022): 1084-1090.
32. Amanuel, Abayineh, and Tilahun Bekele. "Prevalence and associated risk factors of Major gastrointestinal nematodes of Cattle in Hawassa City." *Int J Vet Sci Technol* 7 (2022): 1-6.

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