

Prevalence and intensity of gastrointestinal nematode infection in domestic horses (*Equus Caballus*) in the Sudano-Guinean Altitude Zone of the North West Region of Cameroon

Mbafor Fidelia Lem¹, Bomba Tatsinkou², Payne Vincent Khan², Seino Richard², Tchoumboue³

- 1) Department of Veterinary Medicine, Faculty of Agriculture and Veterinary Medicine, University of Buea, PO Box 63 Buea. Cameroon
- 2) Department of Animal Biology, Faculty of Science, University of Dschang, PO Box 96, Dschang Cameroon
- 3) Department of Animal Production, Faculty of Agronomy and Agricultural Sciences, University of Dschang, PO Box 222 Dschang, Cameroon

ABSTRACT

A study was conducted from March to September 2020 in five Sub-Divisions in Donga Mantung to determine the prevalence and intensity of gastrointestinal (GI) nematode infection of domestic horses with the objective to develop and implement strategic parasitic control measures. A total of 794 randomly selected horses (317 males and 477 females), aged ≤ 1 to ≥ 7 years old were examined using standard parasitological procedure. Fresh fecal samples were collected from the rectum and examined coprologically in the laboratory for the presence of GI nematode eggs. A qualitative flotation technic using saturated sodium chloride solution and a quantitative technic using the Mc Master Slide method of coprological analysis were realized. Result indicated nine species of nematodes (*Strongylus equinus*, *Parascaris equorum*, *Oxyuris equi*, *Habronema muscae*, *Strongyloides westeri*, *Trichostrongylus axei*, *Trichonema* sp, *Triodontophorus serratus* and *Dictyocaulus aenfieldi*) were identified. Horses harbored one or more nematode infection with a total prevalence rate of 100% for the gastrointestinal nematodes. The two genera of nematodes commonly encounter during the study period were *Strongylus equinus* type of egg (97,0%) and *Parascaris equorum* (52,0%) in horses. There was a significant difference ($P < 0.05$) in prevalence of Strongyle type of eggs and *P. equorum* between species. The mean intensity of infection was 1459 ± 956 in horses with age 3 years. Poly-parasitic infections with prevalence of 98,0% were more common than mono-parasitic infections of 2,0%. These results suggest the possible need of studying the epidemiology, economic impact of these nematodes affecting the equine industry, stimulating important aspects to livestock programs and prevention activities.

Key words: Prevalence, Intensity, Gastro-intestinal Nematodes, Horses, Donga Mantung

1. INTRODUCTION

Cameroon's biological resources can be grouped into agricultural, fisheries, livestock, and the forestry sectors [1]. It is estimated that the population of its horses is about 15000[1]. Horses plays an important role in rural communities providing transport at low cost, building materials, agricultural products and people

[2]. Horse meat consumption doesn't pose any danger to the population if the animal is healthy [3]. Despite its huge population size, horses remain marginal due to high prevalence of malnutrition, management constraints and disease like parasitism. This horse neglect and abuse cases originate from a lack of economic resources needed to adequately maintain the horse's health and most cases of helminthiasis are from gastrointestinal nematodes [4]. Parasitism represents a major obstacle to the development of the horse farming system in the country [5] and characterized by high morbidity and mortality rates. As a result, gastrointestinal nematode infections are serious health hazards, contributing to poor body condition, reduced power output, poor productive performance and short life span. The reason is that gastrointestinal tract provides an environment suitable for the survival and proliferation of many nematodes [6]. These worm infections may be affected by poor sanitation and environmental conditions [7]. Factors like age, sex, breed, physiological status of the host affect the intensity and prevalence of infection of GI nematodes in horses [8] which can be more serious in young, undernourished horses and mares. These gastrointestinal nematodes have the potential to cause serious health crises including diarrhea, emaciation, colic, anaemia, haemorrhage and even death [9], leading to serious economic losses to the breeders. Knowing that more than 80% of the Muslem population of this area depend on horses for work purposes, cultural and festive activities, the objectives of this study are to identify the gastrointestinal nematodes infecting these animals and assess the main risk factors associated with the infection, so as to help this agrarian population adopt a strategic health program to combat these infections and reduce the adverse impacts of gastrointestinal nematode infections in their animals.

2. MATERIAL AND METHODS

2.1 Study area

This study was carried out from March to September 2020 in five sub-divisions (Ako, Misaje, Ndu, Nkambe and Nwa) in Donga Mantung Division in the North West Region of Cameroon. It is located at latitude 6° 40'0''N and longitude of 10° 50'60''E. Numerous mountains, plateaus, hills and streams mark the topography of the zone. The soils are predominantly lateritic. There are also ferruginous soils in some areas and soils formed from alluvial materials, as well as organic soils or andosols. The climate is of the tropical Sudano-Guinean type at high altitude, with two seasons: a short dry season of 4 months from mid-November to mid-March and a long rainy season of about 8 months from mid-March to mid-November. Rainfall varies between 1500 mm and 3000 mm per year with a peak in September. The average number of rainy days is around 175 days a year. Mean annual temperatures range from 14°C to 28°C [10].

3. METHODS

3.1 Collection of fecal samples

Fresh fecal samples were collected with gloved hands, directly from the rectum of each animal at 8:00am five day in the week. They were placed in plastic bags and labeled with the age, sex of the animal, date, and month of collection. The specimens obtained from horses were immediately dispatched in ice packed bags to the Laboratory of the Regional Veterinary Clinic, Regional Delegation of Livestock, Fisheries and Animal Industries, North West Region Cameroon, where they were immediately analyzed or stored in the refrigerator at + 4°C to be analyzed within the following 48 hours.

For the qualitative analysis of feces, the flotation technique using saturated sodium chloride solution (NaCl) as described by [11] and [12] were used to identify the eggs of nematodes.

For the quantitative analysis or determination of the number of eggs per gram of feces (EPG), the Mc Master technique described by [11] and [12] were used to evaluate the parasitic load. For each sample, 2 analyses were carried out to determine the EPG and the average of these two trials taken into consideration.

Identification of eggs of nematodes was done based on morphological characteristics which include:- the size of the egg, the number of blastomeres in the egg, the nature of the egg shell, and the nature of the larvae if the egg was larvated [11] and [12]. Eggs were measured using an ocular micrometer.

3.2 Statistical analysis

Data collected from the field and laboratory investigations were properly coded into appropriate variables and entered in to MicroSoft Excel work sheet for statistical analysis. All these were performed using statistical software packages for social science (SPSS). The prevalence was calculated by dividing the number of positive animals by the total number of animals examined and times 100. The mean intensity of infections of different gastrointestinal nematodes with respect to each sub division, age and sex of animal was expressed in the number of egg per gram (EPG) of faeces as: **EPG = N x 200**

$$N = \frac{N1 + N2}{2}$$

Where

N = Average of the number of eggs counted in the 2 chamber.

N1= Number of eggs counted in the first chamber

N2 = Number of eggs counted in the second chamber

The Chi-square test was used to measure the association of different gastrointestinal nematodes with respect to each sub division, age and sex of animal. In all the analyses, confidence level was held at 95% at the $P < 0.05$ significance level.

4. RESULTS

4.1 Prevalence of gastro-intestinal nematodes of horses per Sub-Division

Nine species of nematodes (*Strongylus equinus*, *Parascaris equorum*, *Strongyloides westeri*, *Trichostrongylus axei*, *Habronema muscae*, *Trichonema sp*, *Oxyuris equi*, *Triodontophorus serratus* and *Dictyocaulus arnfieldi*) were identified in all five Subdivisions (Figure 1). Independent of the sub division *Strongylus equinus* (34,0%) recorded the highest prevalence, followed by *P. equorum* (16,0%), *O. equi* (14,0%), *Trichonema sp* (12,0%), *T. axei* (10,0%). *Strongyloides westeri* and *D. arnfieldi* registered a prevalence of 5,0% each. *Habronema muscae* and *Triodontophorus serratus* (2,0%) had the lowest prevalence in all the sub-divisions with no significant difference ($P < 0.05$) in the prevalence of these nematodes. *Strongylus equinus* recorded its highest prevalence in horses from Nkambe (47,0%) and the lowest from Nwa (22,0%). Pin worms *Oxyuris equi* were more prevalent in horses from Ako (19,0%) while *Trichonema sp* (14,0%) were mostly seen in horses from Ndu Sub

Division. *Parascaris equorum* registered the highest prevalent in horses from Misaje (20,0%) and Ndu (19,0%) compared to horses from Ako (17,0%) and Nkambe (8,0%). *Triodontophorus serratus* was least represented in all the subdivisions, with Nwa recorded the highest prevalence of 4,0% followed by Ndu and Nkambe with 2,0% each. This nematode was not found in horses from Misaje (0,0%) and had a prevalence of 1,0% in horses from Ako.

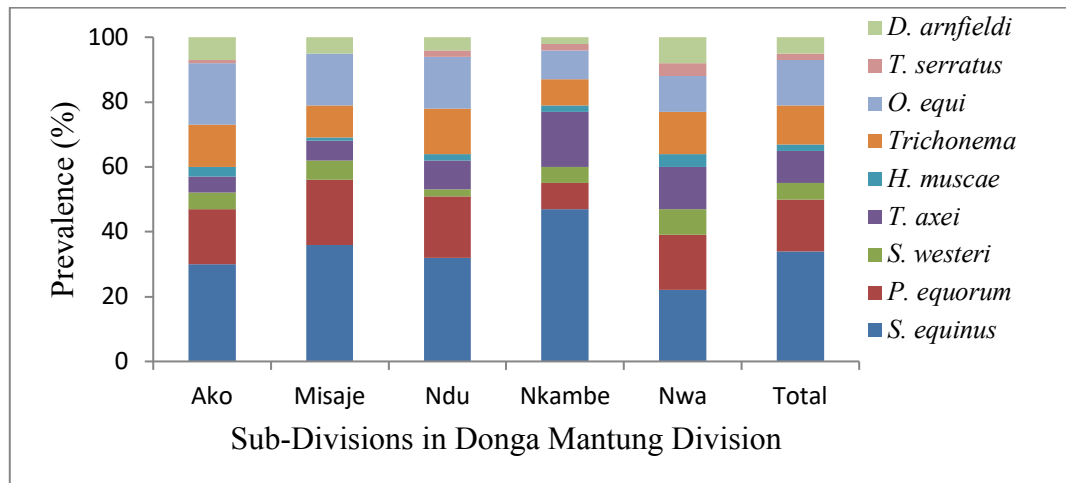


Figure 1: Prevalence of gastrointestinal nematodes in horses per Sub-Division

4.2 Prevalence of gastrointestinal nematodes in horses per age

The prevalence of gastro-intestinal nematode infections of horses per age in 5 Sub-Divisions in Donga Mantung is presented in Figure 2. Whatever the age, the genus most highly represented was *S. equinus* (33,0%) followed by *P. equorum* (18,0%) in all age groups. *Triodontophorus serratus* (1,0%) registered the lowest prevalence in horses of all age groups. Some nematodes prefer horses of a particular age. For example, *P. equorum* were most prevalent in horses ≤ 1 year (26,0%), followed by horses of 2 years old (25,0%). Nematodes like *H. muscae*, *Triodontophorus serratus* and *Dictyocaulus arnfieldi* were not found in horses ≤ 1 year old. *Trichostrongylus axei* (24,0%) were mostly found in old horses ≥ 7 year.

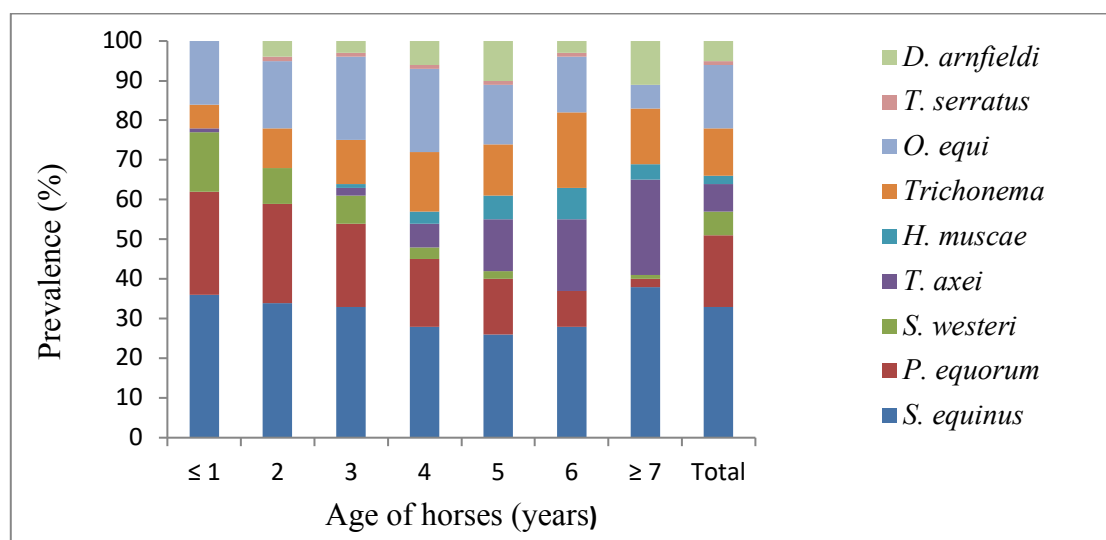


Figure 2: Prevalence of gastrointestinal nematodes of horses per age

4.3 Prevalence of gastrointestinal nematodes in male and female horses

Horses of both sexes were infected with all the nematodes (Figure 3). For some nematodes, female horses were more infected than male horses. *Strongylus equinus* recorded the highest prevalence (30,0%) in both sexes of horses followed by *P. equorum* and *O. equi* with 18,0% respectively. The lowest prevalence was seen in *Tridontophorus serratus* with both male and female horses having only 1,0% each. The overall prevalence of *T. axei* was 5,0% even though it was more prevalent in male (7,0%) than in female horses (3,0%) with a significant difference ($P < 0.05$). On the contrary, *Perascaris equorum* (19,0%) and *S. westeri* (7,0%) brought out a higher preference in female horses compared to the males.

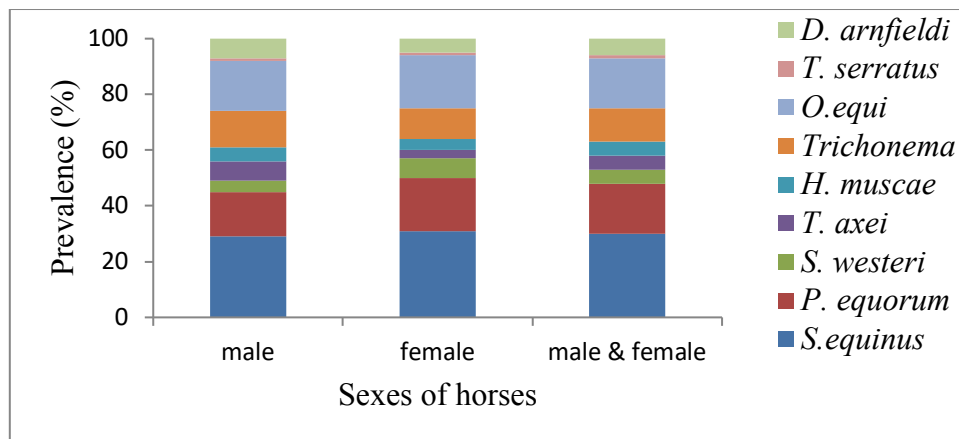


Figure 3: Prevalence of gastrointestinal nematodes of horses per sex

4.4 Prevalence of nematodes associations in horses

Figure 4 illustrates four types of nematode associations in horses. Triple infections (63,0%) was the most frequent, followed by double infections (20,0%), quadruple infection (15,0%) and single infections (2,0%). For horses with triple infections, the most frequent combinations were *Strongylus equinus* + *P. equorum* + *O. equi* (25,6), while for quadruple associations, *S. equinus* + *P. equorum* + *O. equi* + *T. axei* (32,7) were more common. Double nematode infections were characterized by *S. equinus* + *P. equorum* (43,3), while *S. equinus* (25,0) was most common for single infections (See Annexes). However, single infections with *Strongyloides westeri* were common with young female horses (foals) less than 1 year old.

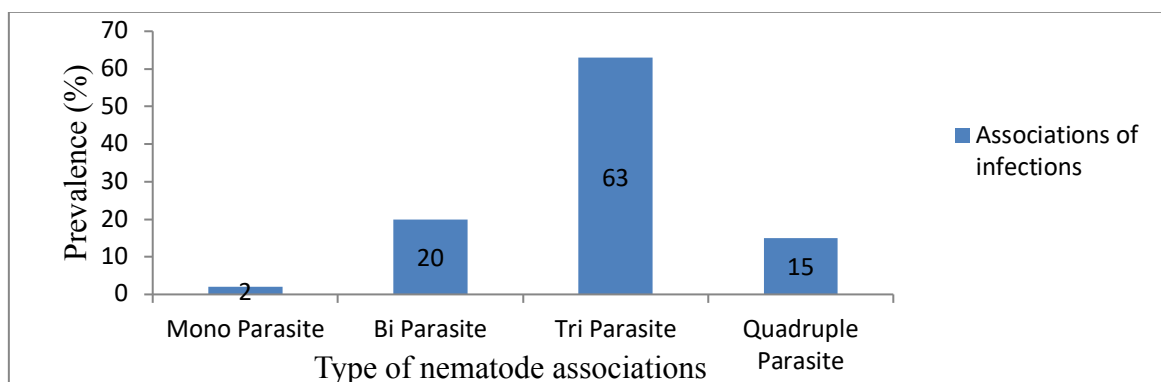


Figure 4: Frequency of Association of mono and poly-parasitic infections

4.5 Intensity of gastrointestinal nematode infection per Age

The intensity of gastrointestinal nematodes infection varies with the different ages of the animals (Table 1) and the highest intensity was observed with *Strongylus equinus* (1459 ± 956) in horses with age less than or equal to 3 years.

Table 1: Intensity of gastrointestinal nematode infection of horses per age

Age	<i>Strongylus equinus</i>	<i>Parascaris equorum</i>	<i>Strongyloides westeri</i>	<i>Trichostrongylus axei</i>	<i>Habronema muscae</i>	<i>Trichonema sp</i>	<i>Oxyuris equi</i>	<i>Triodontophorus serratus</i>	<i>Dictyocaulus arnfieldi</i>
≤ 1	1073±288	862±575	1373±1852	750±100	800±0	954±654	1265±738	600±0	600±0
2	1458±747	700±466	645±326	800±566	450±300	624±267	917±460	1533±643	540±313
3	1459±965	602±397	985±269	558±392	429±220	672±380	909±506	567±223	592±231
4	810±492	467±410	500±242	409±286	440±280	550±305	750±448	400±245	498±269
5	676±368	389±232	222±67	459±286	317±155	404±202	490±295	480±303	394±246
6	547±305	310±177	222±67	379±207	225±68	351±160	427±256	200±0	419±224
≥ 7	1846±1257	300±141	300±141	336±168	300±141	262±126	333±163	200±0	345±93

Type of Associations

Table 2: Monoparasitic Infection of gastrointestinal nematodes in horses

Mono-Parasitic infection	Number of Horses		
	Examined	Infected	Percentage (%)
<i>Strongylus equinus</i>	16	4	25,0
<i>Parascaris equorum</i>		2	12,5
<i>Oxyuris equi</i>		2	12,5
<i>Trichostrongylus axei</i>		2	12,5
<i>Strongyloides westeri</i>		6	37,5
Total		16	100

Table 3: Double- parasitic Infection of gastrointestinal nematodes in horses

Double -Parasitic infection	Number of Horses		
	Examined	Infected	Percentage (%)
<i>Strongylus equinus</i> + <i>P. equorum</i>	159	69	43,3
<i>Oxyuris equi</i> + <i>Strongylus equinus</i>		30	18,9
<i>Parascaris equorum</i> + <i>Oxyuris equi</i>		22	13,8
<i>Strongyloides westeri</i> + <i>Strongylus equinu</i>		13	8,2
<i>T. axei</i> + <i>Strongyles equinus</i>		10	6,3
<i>Habronema muscae</i> + <i>Strongylus equinus</i>		5	3,1
<i>Oxyuris equi</i> + <i>T. axei</i>		4	2,5
<i>Trichonema</i> + <i>Triodontophorus serratus</i>		2	1,3
<i>Dictyocaulus arnfieldi</i> + <i>Strongylus equinus</i>		2	1,3
<i>Triodontophorus serratus</i> + <i>Strongylus equinus</i>		2	1,3
Total		159	100

Table 4: Tripple-parasitic Infection of gastrointestinal nematodes in horses

Tripple -Parasitic infection	Number of Horses		
	Examined	Infected	Percentage (%)
<i>Strongylus equinus</i> + <i>Parascaris equorum</i> + <i>Oxyuris equi</i>	500	128	25,6
<i>Parascaris equorum</i> + <i>Oxyuris equi</i> + <i>T. axei</i>		52	10,4
<i>Parascaris equorum</i> + <i>S. westeri</i> + <i>S. equinus</i>		44	8,8
<i>Parascaris equorum</i> + <i>S. equinus</i> + <i>T. axei</i>		25	5,0
<i>Parascaris equorum</i> + <i>Oxyuris equi</i> + <i>S. westeri</i>		25	5,0
<i>T. axei</i> + <i>Trichonema</i> + <i>S. equinus</i>		15	3,0
<i>Oxyuris equi</i> + <i>S. equinus</i> + <i>Trichonema</i>		15	3,0
<i>Parascaris equorum</i> + <i>Oxyuris equi</i> + <i>T. axei</i>		15	3,0
<i>Oxyuris equi</i> + <i>T. axei</i> + <i>Strongylus equinus</i>		15	3,0
<i>S. westeri</i> + <i>D. arnfieldi</i> + <i>Strongylus equinus</i>		15	3,0
<i>Parascaris equorum</i> + <i>D. arnfieldi</i> + <i>Strongylus equinus</i>		14	2,8
<i>Parascaris equorum</i> + <i>Oxyuris equi</i> + <i>Habronema</i>		14	2,8
<i>Oxyuris equi</i> + <i>D. arnfieldi</i> + <i>Strongylus equinus</i>		13	2,6
<i>Oxyuris equi</i> + <i>T. axei</i> + <i>Trichonema</i>		13	2,6
<i>Parascaris equorum</i> + <i>S. westeri</i> + <i>T. serratus</i>		12	2,4
<i>Parascaris equorum</i> + <i>Oxyuris equi</i> + <i>D. arnfieldi</i>		12	2,4
<i>D. arnfieldi</i> + <i>Trichonema</i> + <i>Strongylus equinus</i>		12	2,4
<i>Parascaris equorum</i> + <i>D. arnfieldi</i> + <i>T. axei</i>		12	2,4
<i>D. arnfieldi</i> + <i>T. axei</i> + <i>Triodontophorus serratus</i>		12	2,4
<i>Parascaris equorum</i> + <i>Habronema</i> + <i>Strongylus equinus</i>		12	2,4
<i>S. westeri</i> + <i>T. axei</i> + <i>Strongylus equinus</i>		11	2,2
<i>Oxyuris equi</i> + <i>Habronema</i> + <i>Strongylus equinus</i>		9	1,8
<i>P. equorum</i> + <i>Triodontophorus serratus</i> + <i>S. equinus</i>		5	1,0
Total		500	

Table 5: Quadruple-parasitic Infection of gastrointestinal nematodes in horses

Quadruple -Parasitic infection	Number of Horses		
	Examined	Infected	Percentage (%)
<i>Parascaris equorum + Oxyuris equi + T. axei + Strongylus equinus</i>	119	39	32,7
<i>Parascaris equorum + Oxyuris equi + S.westeri + Strongylus equinus</i>		20	16,8
<i>Parascaris equorum+ Oxyuris equi+ T. axei + D. arnfieldi</i>		15	12,6
<i>Oxyuris equi + D.arnfieldi + T. axei + Trichonema</i>		15	12,6
<i>Oxyuris equi + T. axei + Trichonema+ Strongylus equinus</i>		12	10,1
<i>Parascaris equorum + Oxyuris equi + Habronema + Strongylus equinus</i>		9	7,6
<i>Parascaris equorum + Oxyuris equi + D.arnfieldi + Trichonema</i>		9	7,6
Total		119	

5. DISCUSSION

Gastrointestinal nematode infection is the main disease condition affecting horses in tropical and sub-tropical areas of the world [13]. . In the present study, nine species of gastrointestinal and lung nematodes were identified following the methodology used. The results are similar with the report of [14], who indicated that no horse was found free out of 1340 examined from Adami Tulu, Ethiopia. *Strongylus equinus* was the most prevalent nematode in all sub-divisions, sexes, and age groups. This finding corroborates with the work of [15]. Other studies also reported very high prevalence of *Strongyles* in horses between 90,0 and 100% [16a and b], since *Strongyles* are the threat of horses. The differences in species and number of nematodes obtained in this study could be due to the fact that, horses are graze permanently on free-range, exposing them to frequent infections. *Parascaris equorum* infection which is an equine specific roundworm has a cosmopolitan distribution because horses were frequently used in cart and do not have enough time to graze on field; only often in the evening for one to two hours. More so, the ecological zone, the cold climate as well as poor deworming practices in these animals favor the development and growth of these nematodes in the horses.

Nematodes like *Trichostrongylus axei* are equally found in ruminants, even though the majority of gastrointestinal nematodes of horses are host-specific [17]. In this study, some nematodes prefers female horses to males, due to the production of some female hormones. The high prevalence and intensity of *Strongylus equinus* shows that there is a risk of infection with this nematode if young and old horses graze together in the same pasture. That is why in mono and poly-parasitic infections, *Strongylus equinus* recorded the highest prevalence. Mono-parasitic infection is relatively rare in horses, may be because they are large mammals with a large digestive tube. Poly-parasitic infection is favored by mutual and auto infections since they graze together. These associations of nematodes indicate that they are non-destructive to each other and are not competing amongst themselves. The effects of the presence of worms are not usually spectacular. However, they do cause decreased work efficiency, poor utilization of food, colic, and occasionally death due to blood clots. Some adult worms may produce toxins that destroy red blood cells, leading to unthrifty anemic condition. Immature worms migrate through body tissues, creating room for secondary bacteria and fungi to enter, causing other serious diseases.

6. CONCLUSION

In conclusion, gastrointestinal nematode infections are the major animal health constraints in horses in Donga Mantung Division, contributing huge losses in their productivity. The prevalence and intensity of infection of nematodes in horses is influenced by the age and sex of animals. Besides the managerial problems, there is also a lack of knowledge on periodic deworming and treatment of horses by the owners. In line with the above conclusion, the following are recommended:

1. Periodic deworming program should be implemented for these animals by the government to show their attachment to the activities of horse breeders in this division.
2. Grazing horses, donkeys and ruminants on same pasture should be avoided.
3. Horse breeders should regularly contact Veterinarians for prophylactic and curative treatment of their animals.

7. ACKNOWLEDGMENTS

The authors wish to express their sincere thanks to all the Horse Breeders, and Veterinarians who contributed to the realization of this work. We also thank the Technicians of the Regional Veterinary Laboratory for their support.

8. CONFLICT OF INTERESTS

The authors have not declared any conflict of interests

References

1. **Ministry of Agriculture and Rural Development (MINADER), 2015.** The State of Biodiversity for Food and Agriculture in the Republic of Cameroon.
2. **Anteneh, W. and S. Getachew, 2017.** Gastrointestinal nematodes of donkeys and horses in Gondar town northwest, Ethiopia. *Journal of Veterinary Medicine and Animal Health* Vol. 9(5), pp. 88-91. May 2017. DOI: 10.5897/JVMAH2012.030. Article Number 899D!C963864 ISSN 2141-2529.
3. **Silvius, S., 2015.** Horse Meat Consumption - Between Scandal and Reality. 2nd GLOBAL CONFERENCE on BUSINESS, ECONOMICS, MANAGEMENT and TOURISM, 30-31 October 2014, Prague, Czech Republic. *Procedia Economics and Finance* 23 (2015) 697 – 703. Available online at www.sciencedirect.com
4. **Kachhawa, J.P., 2015.** Epidemiological Studies on Helminthiasis in Horses in Bikaner Region of Rajasthan. *Indian Vet.* 92 (4) : 100 – 101.
5. **Jobre, Y., F. Gebreab, E. D. Svendsen and M. Abdella, 1991.** Health Problems of Working Donkeys in Debre Zeit and Menagesha of Ethiopia in Field. D and Pearson, R.A., (eds), *Donkey, Mules and Horses in tropical agricultural development*. Proceedings of colloquium held 3-6 September 1990. 151-161.
6. **Umar, Y.A., D.B. Maikaje, U. M. Garba and M.A.F. Alhassan, 2013.** Prevalence of Gastrointestinal Parasites In Horses Used For Cadets Training in Nigeria. *J. Vet. Adv.*, 3(2): 43-48.
7. **Andrade, C.T., Alava and I.A. De Palacio, 2001.** Prevalence and Intensity of Soil transmitted Helminthiasis in the City of Portoviejo (Ecuador). *J. Pub Med.* 96(8): 1075-1079.
8. **Lyons, E.T., S. C. Tolliver and T. A. Kuzmina, 2012.** Investigation of Strongyle EPG values in horse mares relative to known age, number positive, and level of egg shedding in field studies on 26 farms in Central Kentucky (2010-2011). *Parasitology Research* **110**: 2237-2245.
9. **Anazi, A.D and M. S. Alyousif , 2011.** Prevalence of non-strongyle gastrointestinal parasites of horses in Riyadh region of Saudi Arabia. *Saudi Journal of Biological Science* **18**: 299-303.
10. **Innocent, N.M., D. Bitondo and B. R. Azibo, 2016.** Climate Variability and Change in the Bamenda Highlands of North West Cameroon: Perceptions, Impacts and Coping Mechanisms. *British Journal of Applied Science and Technology*, 12(5), 1-8. 89.
11. **Euzeby, J., 1982.** Experimental diagnosis of animal helminthosis. Tome 1, Main- Street of Grenelle, 75015 Paris, France: Technical information of the Veterinarians services, Ministry of Agriculture; 1982. p. 349.
12. **Thienpont, D., F. Rochette and O. F. Vanparijs, 1986.** Diagnosing helminthiasis by coprological examination. Beerse Belgium: Janssen Research Foundation; 1986. p. 205
13. **Svendsen, E.D., 1991.** Donkeys; The international veterinary student 1(2):14-18.
14. **Tegegne, T., A. Alemayehu and G. M. Ayele, 1999.** Cross border livestock Trade and Food Security in the Southern and South-eastern Ethiopia Border lands. OSSREA. Developmental Report series. No.1 Commercial printing Enterprise. Addis Ababa, Ethiopia. pp. 1-6.
15. **Ayele, G., G. Fesha, E.Bojjia, M. Getachew, F. Alemayehu, M. Tesfaye, B. Amare, N. Dereje, C. Chala, A. Asefa, G. Anzunio and A. Trawfod, 2005.** Prevalence of Gastrointestinal Parasites of Donkeys in Dugda Bora districts, Ethiopia. pp. 14-21.
16. **a) Abeba, WD., B. Endebu and A. Gizachew, 2011.** Status of parasitism in donkeys of project and control areas in central region of Ethiopia: a comparative study. *Ethiop Vet J* 2011;15(2):45-55.

b) Asefa, Z., B. Kumsa, B. Endebu, A. Gizachew, T. Merga and E. Debela, 2011. Endoparasites of donkeys in Sululta and Gefersa districts of Central Oromia, *Ethiopia. J Anim Vet Adv.* 2011;10(14):1850-1854.doi; 10.3923/java.20111850-1854.

17. Stoltenow, C.L. and C. H. Purdy, 2003. Internal Parasite of Horses, Extension Service North Dakota State University. Fargo, ND 58105. Available from: <http://www.ag.ndsu.nodak.edu>. [Last accessed on 2003].