

Original Research Article

PREVALENCE AND INTENSITY OF INFECTION OF GASTROINTESTINAL PARASITES IN CAVIES FROM MENOUA DIVISION-WEST REGION OF CAMEROON

Abstract

Background: Domestic caviés, commonly known as guinea pigs are more widely filling a niche in livestock production in West Africa, most especially in Cameroon. Caviés have been shown to play a vital role in the animal protein supply and income generation in rural areas in Cameroon. Despite this, there is a dearth of information concerning diseases and parasites of caviés in Cameroon. The aim of this study was therefore to have an inventory of gastrointestinal parasites of caviés in Menoua Division, West Region of Cameroon., and to characterize the infection rates.

Method: Three hundred Caviés (171 females and 129 males) aged 1 week to 1 year old were examined from May 2013 to June 2014. A qualitative (double centrifugation flotation technique) and a quantitative (Mc Master Technique) coprologic analyses were used for the egg or oocyst count of gastrointestinal parasites.

Result: Of the total number of caviés examined, 237 showed positive with one or more gastro-intestinal parasites, giving an overall prevalence of 79.0%. Six genera of gastrointestinal nematodes: *Spirocerca* spp. (3.0%), *Trichuris* spp. (3.3%); *Ascaris* spp. (4%); *Trichostrongylus* spp. (10.3%); *Strongyloides* spp. (10.7%); *Paraspidodera* sp. (31.0%) and one species of Protozoa represented by *Eimeria* spp. (48.7%) were identified. There was a significant difference in prevalence ($P < 0.05$) for *Eimeria* spp, *Strongyloides* spp and *Paraspidodera* sp based on locality while with respect to age group, only *Ascaris* spp., *Paraspidodera* spp. and *Eimeria* spp. showed significant difference in prevalence ($P < 0.05$).

Conclusion: The overall high prevalence recorded in this study clearly indicates that the services of Veterinarians should be employed to ensure appropriate treatment with specific antihelminthics in order to reduce worm loads of the parasitized animals. This will help to improve cavy productivity and enhance smallholder livelihood in this area (was high prevalence connected with low productivity?: if not or not in research, there is no basis for the conclusion.-

Key words: Prevalence, Intensity, Helminths, Protozoa, Cavies.

1.0 Background

Domestic cavies, commonly known as guinea pigs are more widely filling a niche in livestock production in West Africa, and is becoming more widespread in Cameroon (Niba *et al.*, 2012). However, these animals are susceptible to gastrointestinal parasitic infection, as these parasites are known to be widespread in Cameroon and limit livestock production in many areas (Ndamukong 1985., Ntonifor *et al.*, 2013). Studies have shown that helminth and protozoan parasites are by far the most serious causes of production losses in farmed animals and are indisputably the cause of serious production losses in sub-Saharan Africa, and indeed worldwide (Odoi, *et al.*, 2007). Rosenio *et al.* (2013) highlighted the fact that parasitism is generally believed to be the most important disease problem of domestic animals raised in the rural areas. In Nigeria, where 70-80% of livestock production employs native practices that involve extensive grazing of animals, parasites cause serious economic losses due to emaciation, reduced/low growth rates, anaemia, and death of the infected animals. [\(Are cavies extensively grazed in Nigeria? If not former statement doesn't make sense\)](#) Cavies (Guinea pigs) have been shown to play a vital role in the animal protein supply and income generation in rural areas in Cameroon (Fonteh *et al.*, 2005) Despite this, the health of these animals have been accorded little scientific efforts. This observation is supported by Niba *et al.*, 2012 who reported that one of the major constraints to cavy culture in Cameroon is the health of these animals. They further highlighted the fact that there is a dearth of information concerning diseases and parasites of cavies in Cameroon. The aim of this study therefore was to have an inventory of gastrointestinal parasites of cavies from Menoua Division, West Region of Cameroon, and to characterize the infection rates.

2.0 Methods

2.1 Area of study

This study was carried out between May 2013 and June 2014 in Menoua Division, West Region of Cameroon. Menoua Division covers a surface area of 1380Km². It is composed of six Sub-Divisions; the division spans from Santchou at an altitude of 600m through Dschang (1200 m) and topping on the Plateau of Djuttitsa at an altitude of 2200m. Specifically, the study was carried out in the following localities: Santchou (600m). Dschang (1200m), Fokoue(1200m), Penka -Michel (1500m) ,Fongo – Tongo (2000m), and Nkong-ni (2000m).

64 Menoua Division was purposively chosen based on its high level of cavy culture, it is a
65 grassland area with above 80% of the inhabitants being farmers (Seino *et al.*, 2013). Menoua
66 division is thus one of the major suppliers of vegetables in the country.

67 2.2 Type of study

68 It was a cross-sectional study carried out in 15 villages within Menoua division, West region
69 of Cameroon. The animals were randomly selected using table of random numbers or lottery
70 system. The sample size was estimated according to the methods provided by Thrusfield,
71 (2005).

72 2.3 Sample collection

73 In order to evaluate the prevalence and intensity of infection of gastrointestinal
74 parasites, a total of 300 cavies were examined from 49 households from 15 villages within
75 the following localities: Santchou (42), Nkong-ni (49), Penka -Michel (51), Fongo-Tongo
76 (52), Dschang (53), Fokoue (53). Mean flock size was about 12 animals; all the age groups
77 were represented in all the localities. The number of animals sampled per farm varied,
78 depending on the litter size. Because we encountered only small animal number per
79 household, we decided to sample 50% of the animals from each household. Ages were
80 determined based on weight of the animal, length of the toenails, together with information
81 from the cavy farmers (Anye *et al.*, 2010b; WikiCavy 2014). The sampled animals were
82 attributed numbers (ear tattoo), weighed and sex determined, after which they were placed in
83 a ten chambered cage, each per chamber. They were allowed to defaecate within a six-hour
84 period in their various chambers at the different farms. Faeces were put in sealable plastic
85 bags, labeled with the number attributed to a specific animal, age, sex, date and time of
86 collection. The faeces were then dispatched to the laboratory where they were analyzed
87 within 24 hours.

88 2.4 Farming methods

89 In Cameroon, cavy farming is carried out mainly in the Western High Lands, especially in the
90 West Region . Cavy production in Cameroon is still a secondary activity carried out by many
91 small holder farmers. They are produced in polygamous groups of 10 adult females to 2
92 adult males (without considering the immature animals). Offtake for home consumption,
93 sales or gifts are usually adult males while females are allowed to reproduce. These cavies
94 are thus produced mainly in the traditional way. This extensive production system shows no
95 defined management practices for most stakeholders. Most feed is provided from kitchen

wastes and farm residues, and sometimes, supplemented with vegetables and forages. Differences were noted only in cavy housing, depending on the purpose of cavy farming and available space. An individual farmer might confine his animals in one corner of the kitchen in order to pile up faeces and decaying forage to be used as manure or organic fertilizer in gardening. Such farmers maintain the same bedding for about six weeks and above. In some cases, cavies shared same bedding with other domestic animals like fowls, ducks goats etc. This section is general information and could be moved to the introduction!!

This was commonly seen in Penka-Michel and Nkong-Ni, which are the major centers for market gardening. Dschang being an urban area and a university town has a high population density. Thus, most cavy farmers confine their animals either in a small kitchen corner or in raised cages (photo 3). Most farmers in this locality responded that they do a weekly bedding change (Mostly during weekends). On the other hand, in Fongo-Tongo, Fokoue and Santchou, most farmers allow their animals to scavenge freely on kitchen floors. Interspecific animal rearing(rearing of animals of different species in the same house) is very common in Fongo-Tongo because most farmers in that locality are hunters. Therefore cavies were found to be housed with other animals like cane rat, hunting dogs, goats and ducks (photo 1 and 2). In Santchou, most kitchen floors are linned with bamboos because this locality is swampy, being a lowland area (600m above sea level, as compared to the other five localities which are found between 1200 and 2200m above sea level.



Photo 1: Inter-specific animal rearing under free range system in Fokoue



Photo 2: Interspecific animal rearing under free range system in Fongo-Tongo



Photo 3: Cavy production under confined system in
Dschang

2.4 Parasitological examination

Corprologic analysis was done to have a quantitative and qualitative appreciation of the prevalence and parasitic load of infection of parasites. For the qualitative analysis, faeces were analysed by the double-centrifugal flotation technique using saturated sodium chloride solution (concentration : 6.84M) as described by Baker (2007). For quantitative analysis, the number of eggs per gram (EPG) in case of helminthic infections or oocyst per gram (OPG) in case of protozoan infection was determined using the Mc Master technique as described by Thienpont *et al.*, 1986; Foreyt, 2001). The infection was considered as mild if ~~eggs/~~~~(oo)cysts/gram~~ EPG/OPG were <100, moderate if ~~eggs/~~~~oocysts/gram~~ EPG/OPG were 100–300, and as heavy or severe if ~~EPG/OPG~~ >300 ~~eggs/oocysts/gram~~ (Gressler *et al.*, 2010).

2.5 Statistical analysis

The collected data was stored in Excel 2007, later transferred to Statistical Packages for Social Science (SPSS version 19.0) for statistical analysis. The prevalence of gastrointestinal parasites was compared using Chi square test. Mann-Whitney test was used to evaluate parasite intensity between sex and Kruskal-Wallis test was used to compare parasite intensity between age and locality. Means were separated using Post Hoc of Turkey. A critical probability of ($P < 0.05$) was adopted throughout as a cut-off point for statistical significance between groups compared. All statistical tables retrieved from analysis with SPSS.

3.0 Results

3.1. Overall prevalence of gastrointestinal parasites in cavies

The following six genera of gastrointestinal nematodes were recorded : *Spirocerca* spp. 9 (3.0%), *Trichuris* spp. 10 (3.3%); *Ascaris* spp. 12(4.0%); *Trichostrongylus* spp. 31(10.3%); *Strongyloides* spp. 32(10.7); *Paraspidodera* sp. 93(31.0%) while one genus of Protozoa

represented by *Eimeria* spp. 146 (48.7%) was also identified, giving an overall prevalence of 79.0 for gastrointestinal parasites. Of the 49 farms surveyed, only one farm containing 11 cavies showed negative for gastrointestinal parasitism (very interesting to notice that it is possible to have no parasites: what was the management on this farm?).

3.1. 1 Influence of host age on the Prevalence of gastrointestinal parasites

Eimeria spp., *Paraspidodera* sp., *Ascaris* spp., and *Trichostrongylus* spp. were found in all age groups and had highest prevalence in middle and old age animals (this conclusion is not true). *Strongyloides* spp., *Trichuris* spp. and *Spirocerca* spp. were completely absent in young animals, with highest prevalence in the middle to old age animals (Table 1). However, there was a significant difference in prevalence ($P < 0.05$) based on age groups only with *Ascaris* spp., *Spirocerca* sp., and *Paraspidodera* sp.

Table 1: Influence of host age on the prevalence of gastrointestinal parasite [N (%)]

	Age group (weeks)				
	1 - 4	5 - 8	9 - 12	13 -16	> 16
N in different agegroup	65	88	60	50	37
<i>Eimeria</i> spp.	21 (32.3) ^a	41(46.6) ^a	30(50.0) ^{ab}	34(68.0) ^{ab}	20 (54.1) ^{ab}
<i>Ascaris</i> spp.	2 (3.1) ^{ab}	2 (2.3) ^b	2 (3.3) ^{ab}	1 (2.0) ^b	5 (13.5) ^a
<i>Trichostrongylus</i> spp.	2 (3.1) ^a	7 (8.0) ^a	6 (10.0) ^{ab}	11(22.0) ^{ab}	4 (10.8) ^{ab}
<i>Trichuris</i> sp.	0	3 (3.4) ^a	3 (5.0) ^a	4 (8.0) ^a	0
<i>Strongyloides</i> spp.	0	9 (10.2) ^b	9 (15.0) ^b	8 (16.0) ^b	6 (16.2) ^b
<i>Spirocerca</i> spp.	0	0	2 (3.3) ^a	4 (8.0) ^b	3 (8.1) ^b
<i>Paraspidodera</i> sp.	10 (15.4) ^b	30(34.1) ^{ab}	18(30.0) ^{ab}	16(32.0) ^{ab}	18 (48.7) ^a

Means followed by different letters within the same row differ significantly ($P < 0.05$)

Ascaris agegroup 1-4, 9-12 and > 16 weeks not different

Spirocerca agegroup 13-16 and > 16 weeks different

Paraspidodera agegroup 1-4 weeks different from >16 weeks

3.1.2. Influence of host sex on the prevalence of gastrointestinal parasite

Both sexes were susceptible to all genera of gastrointestinal parasites recorded. Generally, it was observed that of the seven gastrointestinal parasites recorded, prevalence

was ~~not significantly slightly~~ higher in females than in males (Table 2) ~~except for~~ .
~~Nevertheless, this difference in prevalence was significant between sex ($P > 0.05$) only for~~
Ascaris spp.

Table 2: Prevalence of gastrointestinal parasite by sex of cavies [N (%)]

	Sex	
	FEMALE	MALE
N per sex	171	129
<i>Eimeria</i> spp.	89 (52. ~~105~~)	57(44. ~~249~~)
<i>Ascaris</i> spp.	10 (5. ~~685~~) ^b	2 (1. ~~655~~) ^a
<i>Trichostrongylus</i> spp.	17 (9. ~~94~~)	14 (10. ~~985~~)
<i>Trichuris</i> spp.	8 (4. ~~70~~)	2 (1. ~~655~~)
<i>Strongyloides</i> spp.	16 (9. ~~436~~)	16 (12.40)
<i>Spirocerca</i> spp.	5 (2. ~~92~~)	4 (3.1)
<i>Paraspidodera</i> sp.	56 (32. ~~875~~)	37 (28. ~~768~~)

Means followed by different letters within the same row differ significantly ($P < 0.05$)

3.1.3. Prevalence of gastrointestinal parasite in cavies per locality

Eimeria spp. and *Paraspidodera* sp. were found in all the six localities of the study. The prevalence of *Eimeria* spp. was highest in cavies from Penka-Michel (76,5%) followed by those from Dschang (62.3%) and Nkong-ni (51.0%). The lowest prevalence for *Eimeria* spp. was recorded in Fongo-Tongo (21.2%). The prevalence of *Paraspidodera* sp. was highest in Dschang (43.4%), followed by those from Nkong-ni (38.8%) and Santchou (38.1%). The other five gastrointestinal parasites were found to be completely absent in some localities. On the other hand, during this study, it was noted that *Spirocerca* spp. (17.3%) was found only in Fongo- Tongo. However, difference in prevalence was significant ($P < 0.05$) for *Eimeria* spp, *Strongyloides* spp and *Paraspidodera* sp based on locality (Table 3).

Table 3: Prevalence of gastrointestinal parasite in cavies per locality [N (%)]

localities					
Dschang	Fokoue	Fong-Tongo	Nkong-ni	Penka Michel	Santchou
					TOTAL(%)

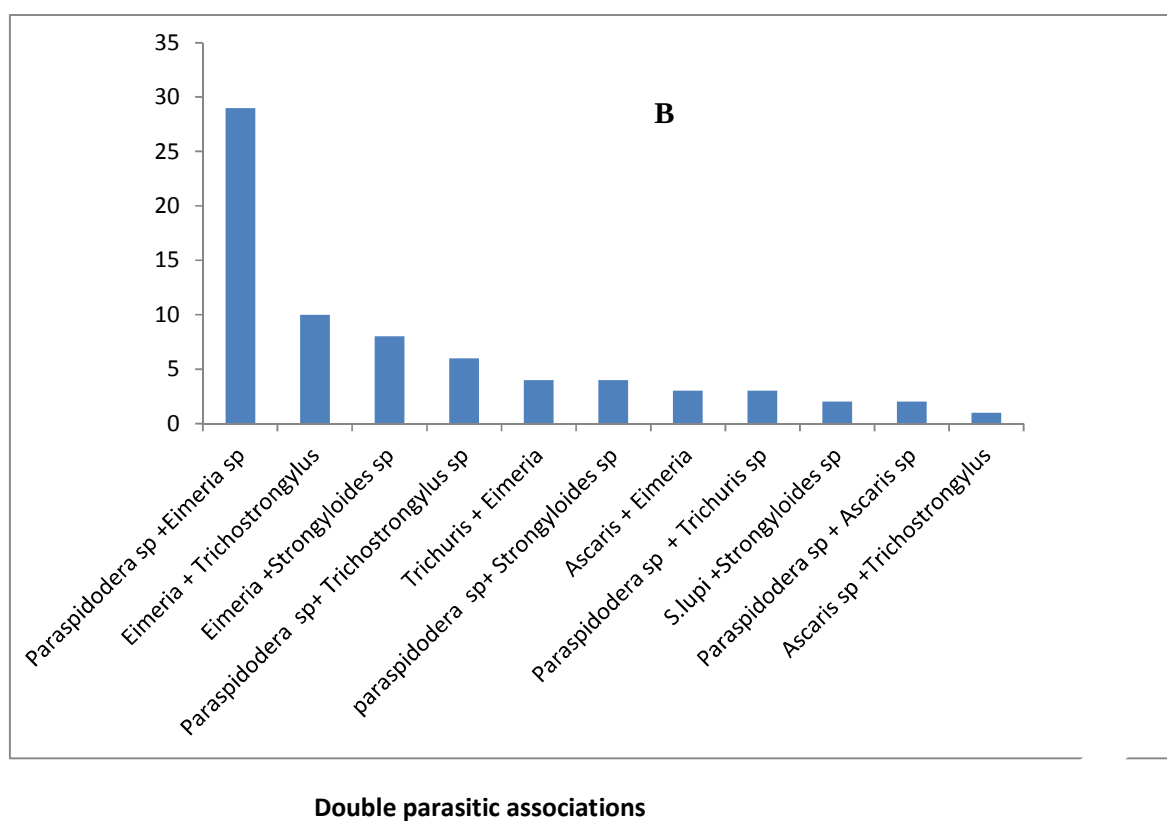
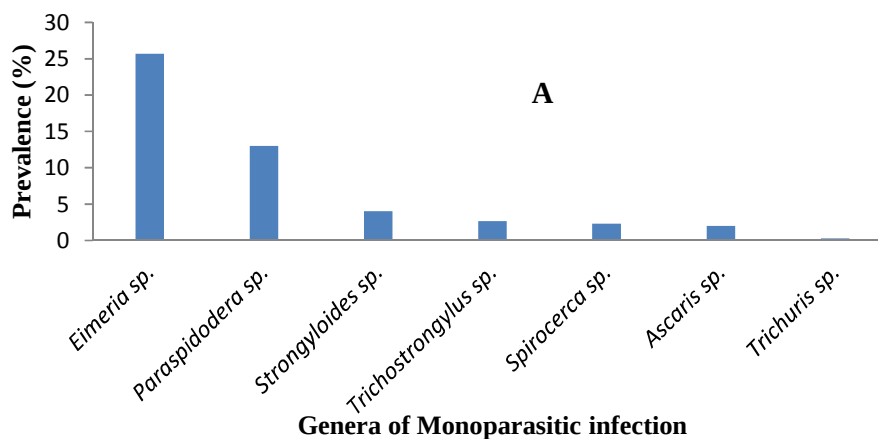
Gastro-intestinal parasites / N

	53	53	52	49	51	42	300
<i>Eimeria</i> spp.	33(62.3) ^{bc}	20(37.7) ^b	11(21.2) ^a	25 (51.0) ^{abc}	39(76.5) ^c	18 (42.9) ^{abd}	146(48.7)
<i>Ascaris</i> spp.	0	8 (15.1) ^a	0	0	0	4 (9.5) ^a	12 (4.0)
<i>Trichostrongylus</i> spp.	11 (20.8) ^a	7 (13.2) ^a	0	0	10 (19.6) ^a	3 (7.1) ^a	31 (10.3)
<i>Trichuris</i> sp.	0	0	0	4 (8.2) ^a	6 (11.8) ^a	0	10 (3.3)
<i>Strongyloides</i> spp.	8 (15.1) ^{ab}	4 (7.6) ^a	12 (23.1) ^b	8 (16.3) ^{ab}	0	0	32(10.7)
<i>Spirocerca</i> spp.	0	0	9 (17.3) ^b	0	0	0	9 (3.0)
<i>Paraspidodera</i> sp.	23 (43.4) ^b	15(28.3) ^{ab}	10(19.2) ^a	19 (38.8) ^{ab}	10 (19.6) ^a	16 (38.1) ^c	93 (31.0)

Means followed by different letters within the same row differ significantly ($P<0.05$)

3.1.4. Prevalence of gastrointestinal parasitic associations

Of the 300 cavies examined for gastrointestinal parasites, xx- had no parasites and 150 (50%) were infected with only one parasite (Figure 1A) ~~with a prevalence of 50%~~, seventy-five (25%) had double parasitic infections ~~(25%)~~ while twelve (4%) had triple parasitic infection ~~(4%)~~. ~~One farm was found to be negative for all gastrointestinal parasites (earlier already mentioned).~~ From Sseventy-five cavies ~~were found~~ with ~~different combinations of~~ double associations of parasites. ~~Of this number,~~ 29 (9.7%) had a combination of *Paraspidodera* sp. + *Eimeria* spp., ~~giving the highest prevalence of 9.7% followed by xx (3.3%) a combination of~~ *Eimeria* spp. + *Trichostrongylus* spp. ~~with a prevalence of 3.3%~~ (Figure 1B). Twelve animals had 3 different combinations of triple association; a combination of *Eimeria* spp. + *Strongyloides* spp.+ *Paraspidodera* sp. were recorded in 2% of the animals, followed by the combination of *Eimeria* spp. + *Trichostrongylus* spp. + *Paraspidodera* sp., recorded in 1.3% of the animals. What is the relevance of this: different treatment?



3.2. MEAN INTENSITY OF INFECTION

3.2.1. Intensity of infection in relation to host age

The intensity of infection of gastrointestinal parasites did not quite vary with age of the animal, except for two parasites (Table 4). The genera *Ascaris* spp, *Spirocerca* spp and

237 *Paraspidodera* increased with age of the animal, with the highest intensity of infection with
238 the older animals (>16weeks). These parasites showed significant difference in intensity
239 ($P<0.05$) based on age group.

240 | Table 4: Mean intensity of gastro-intestinal parasites with respect to age group (round to integers, EPG or OPG?)

PARASITE	Age Group (weeks)					TOTAL
	1 - 4	5 - 8	9 - 12	13 - 16	> 16	
<i>Eimeria</i>	219.05 ± 280.84 ^a	385.0 ± 271.98 ^a	481.67 ± 602.94 ^a	459.76 ± 600.13 ^a	505.7 ± 438.21 ^a	2
<i>Ascaris</i>	75.0 ± 35.355 ^a	75.0 ± 35.355 ^a	250.0 ± 70.711 ^a	100.0 ± 0.0 ^a	270.0 ± 130.38 ^b	255.38 ± 236.880
<i>Trichostrongylus</i>	75.0 ± 35.355 ^a	114.29 ± 85.217 ^a	183.33 ± 211.35 ^a	195.45 ± 165.0 ^a	300.0 ± 353.55 ^a	187.50 ± 126.356
<i>Trichuris</i>	—	66.67 ± 28.868 ^a	100 ± 0.0 ^a	100 ± 70.711 ^a	—	148.44 ± 120.807
<i>Strongyloides</i>	—	144.44 ± 123.60 ^a	127.78 ± 112.11 ^a	175.0 ± 146.39 ^a	150 ± 118.32 ^a	175.81 ± 186.579
<i>-Spirocerca</i>	—	—	50.0 ± 0 ^a	75.0 ± 35.36 ^{ab}	131.50 ± 55.868 ^b	85.33 ± 42.249
<i>Paraspidodera</i>	155.0 ± 89.598 ^a	121.67 ± 75.067 ^a	275.0 ± 271.299 ^a	321.88 ± 284.59 ^a	458.33 ± 242.69 ^b	255.38 (236.88)

241 | Means followed by different letters within the same row differ significantly ($P < 0.05$)

3.2.2. Mean intensity of infection in relation to sex

Only *Paraspidera* sp. and *Ascaris* showed significantly higher intensity in females than in males. Generally, most of the gastrointestinal parasites showed no difference in infection intensity between sexes (Table 5).

Table 5: Mean intensity of infection of gastrointestinal parasites in relation to sex (EPG or OPG?, round data in table to integers)

Parasite	Gender	
	Female	Male
<i>Eimeria</i>	452.78 ± 601.288	395.61±505.883
<i>Ascaris</i>	210.0 ± 126.91 ^b	75.0 ± 35.355 ^a
<i>Trichostrongylus</i>	197.06±209.516	150.0 ±158.114
<i>Trichuris</i> sp.	81.25 ± 25.877	125.0±106.066
<i>Strongyloides</i>	156.25±123.659	140.63±121.407
<i>Spirocerca</i>	50.0 ±0.0	120.66±48.249
<i>Paraspidodera</i>	301.79±265.598 ^b	185.14±164.935 ^a

Means followed by different letters within the same row differ significantly ($P<0.05$)

3.2.3. Mean intensity of infection of gastrointestinal parasites in relation to locality.

Intensity of infection of gastrointestinal parasites varied with locality. The highest intensity was recorded for the genus *Eimeria* (692.31 ± 761.278OPG) in Penka – Michel, followed by Nkong-ni (434.62 ± 334.60 OPG), then Dschang (427.27 ± 356.87 OPG). The genus *Paraspidodera* equally registered high intensities in all the six localities, with its highest intensity in Nkong-ni (363.16 ± 231.45 EPG) and the lowest in Fongo-Tongo (165.0 ± 88.35 EPG). The genus *Trichostrongylus* registered the highest intensity in Santchou (363.16± 231.446 epg) as compared to the other localities. Statistically, it was noticed that the intensity of *Eimeria* spp, *Paraspidodera* sp and *Trichostrongylus* spp was significantly different based on locality ($P<0.05$).

Localities(EPG
or OPG?,
round data in
table to
integers)

..

PARASITE	FONGO				PENKA	
	DSCHANG	FOKOUÉ	TONGO	NKONG-NI	MICHEL	SANTCHOU
<i>Eimeria</i> sp.	427.27± 356.872 ^b	155.0 ±95.834 ^a	168.18±128.982 ^a	434.62±334.595 ^b	692.31±761.278 ^c	330.56 ±285.50 ^{ab}
<i>Ascaris</i> spp.	—	218.75±125.178 ^b	—	—	—	125.0 ±119.024 ^{ab}
<i>Trichostrongylus</i> spp.	77.27 ±46.710 ^a	307.14±297.809 ^b	—	—	150 ± 70.71 ^{ab}	316.67 ±275.38 ^b
<i>Trichuris</i> spp.	—	—	—	75.0 ±28.868 ^a	100.0 ± 54.772 ^a	—
<i>Strongyloides</i> spp.	162.50±130.247 ^{ab}	125.0 ±119.024 ^{ab}	195.83 ±138.92 ^{ab}	75.0 ±26.726 ^a	—	—
<i>Spirocerca</i> spp.	—	—	85.33±42.249 ^a	—	—	—
<i>Paraspidodera</i> sp.	250.0 ±294.649 ^{ab}	220±168.819 ^{ab}	165.0 ±88.349 ^a	363.16±231.446 ^b	220.0±191.775 ^{ab}	246.87 ± 277.17 ^{ab}

Means followed by different letters within the same row differ significantly ($P<0.05$)

4.0 DISCUSSION

Based on faecal examination, six genera of nematodes (*Paraspidodera* sp, *Trichuris* spp, *Trichostrongylus* spp., *Strongyloides* spp., *Ascaris* spp., and *Spirocerca* spp.), were identified, giving a prevalence of 63.3% for helminths, and one genus of Protozoa (*Eimeria*) was equally identified, giving an overall prevalence of 79.0% for gastrointestinal parasites. This high prevalence could be attributed to the fact that in Menoua Division, cavies are reared traditionally, with very little intervention and follow up by the stakeholders. In some cases, cavies are co-reared with other domestic animals, feeding and sleeping in the same area. Again, a sensitive method of coprologic analysis was used (double centrifugation flotation technique) instead of simple flotation technique. Baker (2006) revealed that centrifugal flotation is more sensitive than simple flotation because it magnifies gravitational forces, thereby accelerating the downward movement of more dense debris and the upward movement of less dense parasite forms. Furthermore, the genera *Eimeria*, *Trichuris*, *Ascaris*, *Trichostrongylus* and *Strongyloides*, are equally common parasites of domestic animals, and have been recorded in other parasitological studies involving *Cavia* sp. such as that carried out by Dittmar (2002), Gressler *et al.* (2010), and other ecological associates of cavies such as goats, sheep and cane rat both in Cameroon and Africa at large (Ndamukong, 1985; Mpoame *et al.*, 1994; Odoi, *et al.*, 2007; Omonona 2011; Meaza *et al.*, 2012; Ntonifor *et al.*, 2013). Again, the climatic condition of Menoua is described as humid tropical climate (Seino *et al.*; 2013) is highly suitable for survival and transmission of infective stages of these parasites.

There was a significant difference ($p < 0.05$) in prevalence and intensity for *Ascaris* spp, *Paraspidodera* sp and *Spirocerca* sp in relation to age, being significantly higher in >16 weeks age group: this is not/partly true . (*Ascaris* agegroup 1-4, 9-12 and > 16 weeks not different, *Spirocerca* agegroup 13-16 and > 16 weeks different, *Paraspidodera* agegroup 1-4 weeks different from >16 weeks)

~~The infections were described as severe for these parasites with epg/opg > than 300.~~

These results corroborate the findings of Tadesse *et al.*, 2010 and Ntonifor *et al.* (2013) who also registered higher intensity of infection with nematode parasites in older animals than the young. However, this observation is not in agreement with the fact that immunity against infections increases with age due to acquired immunity (Tadesse *et al.*, 2010). It was observed that adult animals have a higher potential of scavenging within their kitchen confinement than younger animals. They therefore are more likely to ingest faeces contaminated with eggs of nematodes.

Again, of the 87 adult cavies surveyed (that is >13 weeks cavies), 72(82.8%) were females and 15(28.2%) were males. Literature reveals that reproductions in cavies begin as early as two months, and these animals have a post- partum oestrus of three and a half hours (Wagner, 1976). Therefore, females older than 8 weeks are almost always pregnant and lactating. This places a stress on the immune system of these pregnant/lactating cavies making older females more susceptible to infection. (so the immune system does only has effect on *Paraspidera* sp. and *Ascaris*?)

The observation of *Spirocerca* eggs in the faeces of domestic cavies is a rare finding. However, this parasite registered low prevalence 9 (17.31) and intensity (85.33± 42.249) (on how many different farms?) Nevertheless, Anderson (2000) and Cameron (2003) reported that rodents are paratenic hosts of this parasite. Although it is uncommon in domestic cavies, it is possible that the infected cavies became contaminated faeco-orally by hunting dogs which were reared in the same household with the cavies in Fongo Tongo. Therefore, the presence of this ‘rare’ parasite in cavies can be attributed to cross infection from dogs.

As concerns sex of cavies, *Ascaris* spp showed significant difference in prevalence and intensity being higher in females while for *Paraspidodera* sp, difference was significant only for intensity, with females shedding more eggs than males. Soulsby (1982) indicated that the establishment and reproductive potential of these parasites depend on host immunity. Since these animals are housed such that males and females are found in the same house, mating is haphazard. Therefore most of the >8weeks females were always pregnant and lactating as and this increased their susceptibility as described above.

Regarding locality differences, prevalence was significantly higher for *Eimeria* spp, *Strongyloides* spp and *Paraspidodera* sp, while difference in intensity was significant for *Eimeria* spp, *Paraspidodera* sp and *Trichostrongylus* spp. This could be attributed to the fact that the traditional cavy management system slightly differs in the method of cavy housing within the different localities. It was noted that in those localities where cavies were confined (Dschang, Penka-Michel and Nkong-Ni), the prevalence and intensity of *Eimeria* spp and *Paraspidodera* sp were significantly higher., and lowest where these animals did not have a specific bedding and were allowed freely to scavenge on the floor (Fongo-Tongo and Fokoue). Confining these animals increased the likelihood of transmission of parasites faeco-orally since food becomes easily contaminated with faeces from infected animals. This is in alignment with

the reports of Tanideh *et al.* (2010) and Tadesse *et al.* (2011) who both registered 100% prevalence for *Eimeria* sp and *Paraspidodera* sp respectively in confined cavies. Infection of cavies with these two parasites is very common and can reach epidemic proportions (Soulsby, 1982, Foreyt, 2001). Again, these parasites have short life cycle with environmentally resistant eggs or oocysts. Thus confining cavies in a small kitchen corner, especially exacerbated by irregular change of bedding provides the microclimate for easy survival and transmission of extra-host stages. On the other hand, *Strongyloides* spp showed significantly higher prevalence in those localities with free range housing system, where animals are housed in association with other domestic animals like chicken, dogs, ducks and in two cases cane rats. This parasite was completely absent where animals were confined and inter-specific animal housing avoided. Rearing cavies on earth floors, together with other species of domestic animals encourages disease transmission from infected to uninfected animals or from the soil through the skin to achieve transmission to a new host. This is because *Strongyloides* sp is a geohelminth (Anderson 2000) and is easily transmitted through the soil to uninfected animals. Furthermore, Menoua Division has two agro- ecological zones with slightly different temperature and humidity ranges due to a variation in altitude (Seino *et al.*, 2013). Temperature is inversely proportional to altitude, and it was noted that higher prevalence of infection with gastrointestinal parasites was in the low land districts (600m to 1200m above sea level) while high altitude area like Fongo-Tongo (2000m above sea level) registered lowest prevalence for these parasites. Again, cavies are frequently exchanged between farmers within the same locality (sub division) than between localities. These exchanges are done to minimize inbreeding (cross between parents and offspring within the same farm). Thus, parasites from one farm are easily transmitted to cavies in another farm within localities than between localities.

It was equally noticed during this study that no gastrointestinal parasite was isolated from cavies reared in raised cages in a household in Dschang. Although only 11cavies were reared in this manner; none of them was positive for any of the parasites recorded. This is attributed to improved housing since these animals were protected from geohelminths in the soil or from cross infection by other domestic animals. Bedding change for these animals was done every two days, thus minimizing infection and re-infection faeco-orally.

As concerns gastro-intestinal parasitic association, it was observed that the most prevalent gastrointestinal parasitic association was between *Eimeria* spp. and *Paraspidodera* sp.

This is because both parasites have similar lifecycle, being transmitted by infective eggs or sporulated oocyst and both have short duration of 2-5days for eggs or oocysts to become infective. Again, Gorsich *et al.* (2014) reported that coccidia are intracellular microparasites, which replicate within the epithelial cells of the intestinal mucosa, often resulting in physical damage of the mucosal immune system, while *Paraspidodera* sp is extracellular. Intracellular and extracellular parasites invoke opposite and cross-regulating immune responses. As a result, hosts may have difficulty simultaneously mounting a strong response to co-infection by intracellular and extracellular parasites, leading to increased disease severity in co-infected animals.

Conclusion

This present study indicated that cavies in Menoua Division are infested with helminthic parasites and *Eimeria* oocysts. The overall high prevalence recorded in this study clearly indicates the need for strategic parasite control in cavies with particular attention focused on adult to old aged cavies which showed non significantly higher prevalence and parasitic load for most of the gastrointestinal parasites. (How is growth and reproduction affected by parasites: if not significant, why treat and apply veterinary service?) Thus, the services of Veterinarians should be employed to ensure appropriate treatment with specific ~~antihelminthics~~ anthelmintic in order to reduce worm loads of the parasitized animals. This will help to improve cavy productivity and enhance smallholder livelihood in this area. T-he results further underscore the importance of proper sanitation and improved housing of these animals so as to prevent soil and faeco-oral transmission of gastrointestinal parasites (in this study it is not researched: there is no cross tabulation for management on individual farms). Stakeholders are advised to avoid inter-specific animal rearing and cavy housing should be designed to control breeding especially in lactating females (is there evidence in this research for this statement or is it a general statement). These females should be housed separately from the males and mated only after weaning so as to reduce the stress on their immune system (is there evidence for this statement: there is hardly difference in parasites and there are no results from farms with and without separation of males and females).

ACKNOWLEDGEMENT

Great appreciation goes to the cavy farmers in Menoua Division, for kindly providing animals for the present study. Special thanks to the Laboratory for Animal Biology and Applied Ecology of the University of Dschang where technical procedures were carried out, Bamou Roland for assisting in the Statistical analysis

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