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Prevalence and Intensity of Infection of Gastrointestinal Parasites in Cavies from Menoua Division-West Region of Cameroon

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Authors' contributions

This work was carried out in collaboration between all authors. Authors VKP, NG, FN, CY, LM, FAF, MM and BBCF designed the study, wrote the protocol and wrote the first draft of the manuscript. Author NG managed the analyses of the study and the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: Domestic cavies, commonly known as guinea pigs are more widely filling a niche in livestock production in West Africa, most especially in Cameroon. Cavies 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 cavies in Cameroon. The

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aim of this study was therefore to have an inventory of gastrointestinal parasites of cavies in Menoua Division, West Region of Cameroon; and to characterize the infection rates.
Methods: Three hundred Cavies (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.
Results: Of the total number of cavies 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 *Paraspidodera* spp. and *Eimeria* spp. showed significant difference in prevalence ($P< 0.05$). As concerns sex of cavies, *Ascaris* spp was significantly more prevalent in females than in males.
Conclusion: The overall high prevalence recorded in this study clearly indicates the need for strategic parasite control in cavies with particular attention focused on middle to old aged cavies which showed significantly higher prevalence and parasitic load for most of the gastrointestinal infections.

Keywords: Prevalence; intensity; helminths; protozoa; cavies.

1. 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 [1]. In this country, cavy farming is carried out mainly in the Western High Lands, especially in the West Region. Cavy production in this area is still a secondary activity carried out by many small holder farmers. They are produced in polygamous groups of 10 adult females to 2 adult males (without considering the immature animals). Off-take for home consumption, sales or gifts are usually adult males while females are allowed to reproduce. These cavies are thus produced mainly in the traditional way. This extensive production system shows no defined management practices for most stakeholders. Most feed is provided from kitchen wastes and farm residues, and sometimes, supplemented with vegetables and forages. However, cavies are susceptible to gastrointestinal parasitic infection, as these parasites are known to be widespread in Cameroon and limit livestock production in many areas [2,3]. 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 [4,5]. [6] highlighted the fact that parasitism is generally believed to be the most important disease problem of domestic animals raised in the rural areas. Parasites cause serious economic losses due to emaciation, reduced/low growth rates, anaemia, and death of the infected animals. Cavies have been shown to play a vital role in the animal protein supply and income generation in rural areas in Cameroon [7]. Despite this, the health of these animals have been accorded little scientific efforts. This observation is supported by [1] 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. 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 1380Km^2. 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 2200 m. Specifically, the study was carried out in the following localities: Santchou (600 m). Dschang (1200 m), Fokoue (1200 m), Penka - Michel (1500 m) ,Fongo – Tongo (2000 m), and

Nkong-ni (2000 m). Menoua Division was purposively chosen based on its high level of cavy culture; it is a grassland area with above 80% of the inhabitants being farmers [8]. Menoua division is thus one of the major suppliers of vegetables in the country.

2.2 Type of Study

It was a cross-sectional study carried out in 15 villages within Menoua division, West region of Cameroon. The animals were randomly selected using table of random numbers or lottery system. The sample size was estimated according to the methods provided by [9].

2.3 Sample Collection

In order to evaluate the prevalence and intensity of infection of gastrointestinal parasites, a total of 300 cavies were examined from 49 households from 15 villages within the following localities: Santchou (42), Nkong-ni (49), Penka -Michel (51), Fongo–Tongo (52), Dschang (53), Fokoue (53). Mean flock size was about 12 animals; all age groups were represented in all the localities. The number of animals sampled per farm varied, depending on the litter size. Because we encountered only small animal number per household, we decided to sample 50% of the animals from each household. Ages were determined based on weight of the animal, length of the toenails, together with information from the cavy farmers [10,11]. The sampled animals were attributed numbers (ear tattoo), weighed and sex determined, after which they were placed in a ten chambered cage, each per chamber. They were allowed to defaecate within a six-hour period in their various chambers at the different farms. Faeces were put in sealable plastic bags, labeled with the number attributed to a specific animal, age, sex, date and time of collection. The faeces were then dispatched to the laboratory where they were analyzed within 24 hours.

2.4 Farming Methods

Although cavy farming in Cameroon shows basically the same management practices and feed type, variations in husbandry practices were noticed, being associated with cavy housing. The nature of cavy house depended 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 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 (usually during weekends). Exceptionally, one farm was surveyed in Dschang with 11 animals reared in raised cages and a more regular bedding change (every day or every 2 days). On the other hand, in Fongo-Tongo, Fokoue and Santchou, most farmers allowed their animals to scavenge freely on kitchen floors. Interspecific animal rearing (rearing of animals of different species in the same house) was very common in Fongo-Tongo because most farmers in that locality were hunters. Therefore cavies were found to be housed with other animals like cane rat, hunting dogs, goats and ducks (Photos 1 and 2). In Santchou, most kitchen floors are linned with bamboos because this locality is swampy, being a lowland area (600 m above sea level, as compared to the other five localities which are found between 1200 and 2200 m above sea level.

2.5 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: 6.84 M) as described by [12]. 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 [13,14]. The infection was considered as mild if EPG/OPG were<100, moderate if EPG/OPG were 100–300, and as heavy or severe if EPG/OPG >300 [15].

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

2.6 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. 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.

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 while *Strongyloides spp., Trichuris* spp. *and Spirocerca* spp. were completely absent in young animals (Table 1). However, there was a significant difference in prevalence ($P<0.05$) based on age groups only for *Spirocerca* sp (between 9-12 weeks and >16 weeks animals) and *Paraspidodera* sp. (between 1-4 weeks and >16 weeks animals).

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 age group	65	88	60	50	37
Eimeria spp.	21 (32.3)^{a}	41(46.6)^{a}	30 (50.0)^{ab}	34 (68.0)^{ab}	20 (54.1)^{ab}
Ascaris spp.	2 (3.1)^{ab}	2 (2.3)^{b}	2 (3.3)^{ab}	1 (2.0)^{b}	5 (13.5)^{a}
Trichostrongylus spp.	2 (3.1)^{a}	7 (8.0)^{a}	6 (10.0)^{ab}	11(22.0)^{ab}	4 (10.8)^{ab}
Trichuris sp.	0	3 (3.4)^{a}	3 (5.0)^{a}	4 (8.0)^{a}	0
Strongyloides spp.	0	9 (10.2)^{b}	9 (15.0)^{b}	8 (16.0)^{b}	6 (16.2)^{b}
Spirocerca spp.	0	0	2 (3.3)^{a}	4 (8.0)^{b}	3 (8.1)^{b}
Paraspidodera 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)

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 higher in females than in males (Table 2) except for *Ascaris* spp.

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

	Sex	
	Female	**Male**
N per sex	171	129
Eimeria spp.	89 (52.1)	57 (44.2)
Ascaris spp.	10 (5.9)^{b}	2 (1.6)^{a}
Trichostrongylus spp.	17 (9.9)	14 (10.9)
Trichuris spp.	8 (4.7)	2 (1.6)
Strongyloides spp.	16 (9.4)	16 (12.4)
Spirocerca spp.	5 (2.9)	4 (3.1)
Paraspidodera sp.	56 (32.8)	37 (28.)

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, the difference in prevalence was significant (P< 0.05) for *Eimeria* spp, *Strongyloides* spp and *Paraspidodera* sp based on locality (Table 3).

3.1.4 Prevalence of gastrointestinal parasitic associations

Of the 300 cavies examined for gastrointestinal parasites, 150 (50%) had no parasites, 150 (50%) were infected with only one parasite (Fig. 1A). Seventy-five (25%) had double parasitic infections while 12 (4%) had triple parasitic infection. From seventy-five cavies with different combinations of double associations of parasites, 29 (9.7%) had a combination of *Paraspidodera* sp. + *Eimeria* spp., 10 (3.3%) a combination of *Eimeria* spp. + *Trichostrongylus* spp. (Fig. 1B). Twelve animals had 3 different combinations of triple association; a combination of *Eimeria* spp. + *Strongyloides* spp. + *Paraspidodera* sp. *(*2%) and *Eimeria* spp. + *Trichostrongylus* spp. + *Paraspidodera* sp., (1.3%) of the animals.

3.2 Mean Intensity of Infection

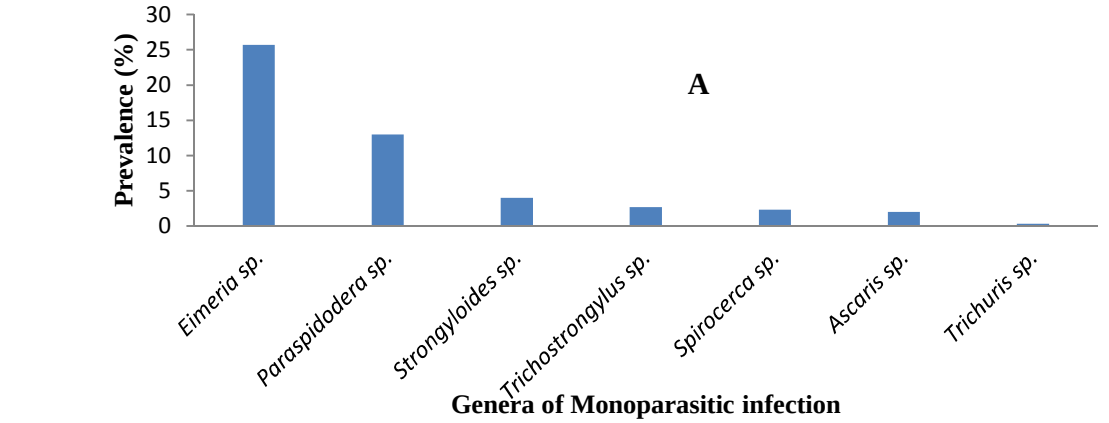
3.2.1 Intensity of infection in relation to host age

The intensity of infection of gastrointestinal parasites did not quite vary with age of the animal, except for three parasites (Table 4). The genera *Ascaris* spp, *Spirocerca* spp and *Paraspidodera* increased with age of the animal, with the highest intensity of infection in the older animals (>16 weeks). These parasites showed significant difference in intensity (P<0.05) based on age group.

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

	Localities						Total (%)
	Dschang	**Fokoue**	**Fong-tongo**	**Nkong-ni**	**Penka michel**	**Santchou**	
Gastro-intestinal parasites / N	53	53	52	49	51	42	300
Eimeria 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)
Ascaris spp.	0	8 (15.1)^{a}	0	0	0	4 (9.5)^{a}	12 (4.0)
Trichostrongylus spp.	11 (20.8)^{a}	7 (13.2)^{a}	0	0	10 (19.6)^{a}	3 (7.1)^{a}	31 (10.3)
Trichuris sp.	0	0	0	4 (8.2)^{a}	6 (11.8)^{a}	0	10 (3.3)
Strongyloides spp.	8 (15.1)^{ab}	4 (7.6)^{a}	12 (23.1)^{b}	8 (16.3)^{ab}	0	0	32 (10.7)
Spirocerca spp.	0	0	9 (17.3)^{b}	0	0	0	9 (3.0)
Paraspidodera sp.	23 (43.4)^{b}	15 (28.3)^{ab}	10 (19.2)^{a}	19 (38.8)^{ab}	10 (19.6)^{a}	16 (38.1)^{ab}	93 (31.0)

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



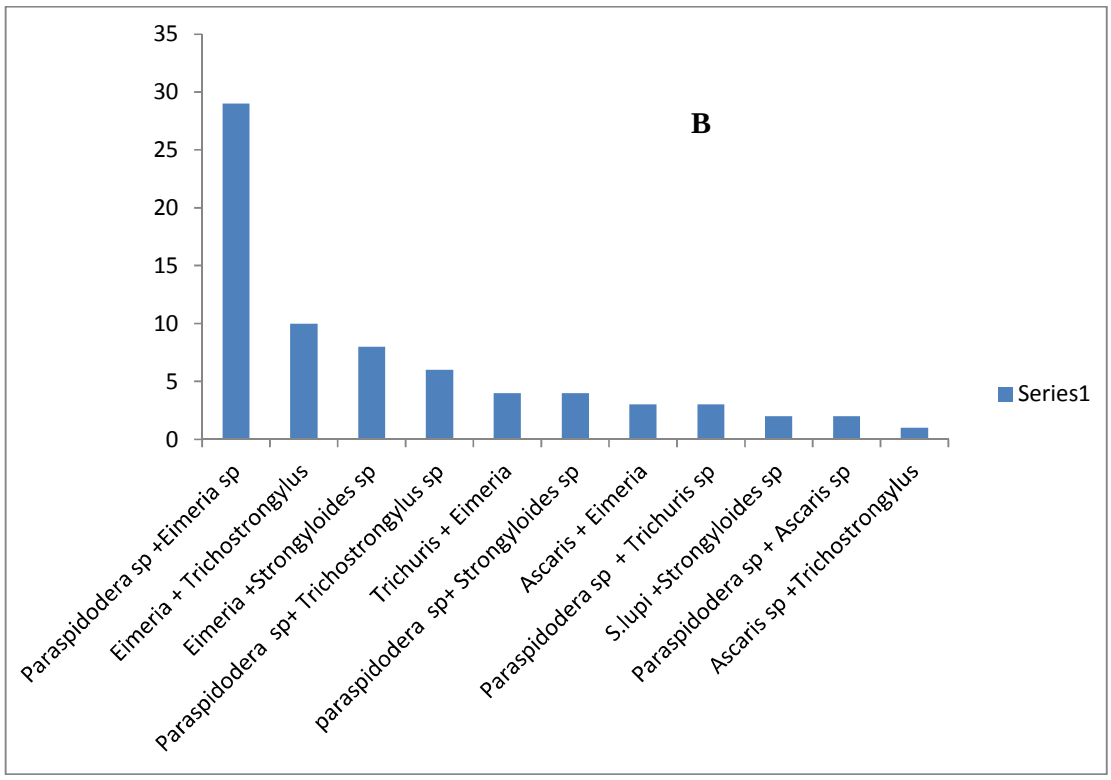


Fig. 1. Parasitic infection and associations

Table 4. Mean intensity of gastro-intestinal parasites (EPG/OPG) with respect to age group

Parasite	Age group (weeks)					Total
	1 - 4	5 - 8	9 - 12	13 - 16	> 16	
Eimeria	219.±280[a]	385±271[a]	481±602[a]	459±600[a]	505±438[a]	430±494
Ascaris	75±35[a]	75±35[a]	250±70[a]	100±0[a]	270±130[b]	255±236
Trichostrongylus	75±35[a]	114±85[a]	183±211[a]	195±165[a]	300±353[a]	187±126
Trichuris	-	66±28[a]	100±0[a]	100±70[a]	-	148±120
Strongyloides	-	144±123[a]	127±112[a]	175±146[a]	150±118[a]	175±186
Spirocerca	-	-	50±0[a]	75±35[ab]	131±55[b]	85±42
Paraspidodera	155±89[a]	121±75[a]	275±271[a]	321±284[a]	458±242[b]	255±236

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 (EPG/OPG) of gastrointestinal parasites in relation to sex

Parasite	Gender	
	Female	Male
Eimeria	452±601	395±505
Ascaris	210±126[b]	75±35[a]
Trichostrongylus	197±209	150±158
Trichuris sp.	81±25	125±106
Strongyloides	156±123	140±121
Spirocerca	50±0	120±48
Paraspidodera	301±265[b]	185±164[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 with locality (P<0.05).

4. 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. A sensitive method of corprologic analysis was used (double centrifugation flotation technique) instead of simple flotation technique. [12] 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 [15,16] and other ecological associates of cavies such as goats, sheep and cane rat both in Cameroon and Africa at large [2,3,5,17,18,19]. The climatic condition of Menoua is described as humid tropical climate [8] 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 *Paraspidodera* sp and *Spirocerca* sp in relation to age, being significantly higher in >16 weeks animals. These results corroborate the findings of [3] and [20] 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 [20]. 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 feed contaminated with eggs of nematodes. Furthermore, 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 reproduction in cavies begin as early as two months, and these animals have a post-partum oestrus of three and a half hours [21]. Therefore, females older than 8 weeks were almost always pregnant and lactating. This placed a stress on the immune system of these pregnant/lactating cavies making older females more susceptible to infection.

The observation of *Spirocerca* eggs in the faeces of domestic cavies is a rare finding. However, this parasite registered low prevalence 9 (17.31) from 3 different farms and intensity (85±42)

Nevertheless, [22,23] 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. [24] indicated that the establishment and reproductive potential of these parasites depend on host immunity. Since these animals were reared such that males and females were found in the same house, they had equal exposure to the parasites. The fact that females passed out significantly more eggs than males could be attributed to the triple stress of pregnancy, lactation and care of the young simultaneously. This led to a reduced ability of these females to build up immunity against the parasites.

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 [20,25] 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 [14,24]. 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* spp is a geohelminth [22] 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 [8]. Temperature is inversely proportional to altitude, and it was noted that higher prevalence of infection with gastrointestinal parasites was in the low land districts (600 m to 1200 m above sea level) while high altitude area like Fongo-Tongo (2000 m 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 11 cavies 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 2-5 days for eggs or oocycts to become

Table 6. Mean intensity of infection (EPG/OPG) of gastrointestinal parasites in relation to locality

Parasite	Localities					
	Dschang	Fokoue	Fongo Tongo	Nkong-Ni	Penka Michel	Santchou
Eimeria sp.	427±356[b]	155±95[a]	168±128[a]	434±334[b]	692±761[c]	330±285[ab]
Ascaris spp.	-	218±125[b]	-	-	-	125±119[ab]
Trichostrongylus spp.	77±46[a]	307±297[b]	-	-	150±70[ab]	316±275[b]
Trichuris spp.	-	-	-	75±28[a]	100±54[a]	-
Strongyloides spp.	162±130[ab]	125±119[ab]	195±138[ab]	75±26[a]	-	-
Spirocerca spp.	-	-	85±42[a]	-	-	-
Paraspidodera sp.	250±294[ab]	220±168[ab]	165±88[a]	363±231[b]	220±191[ab]	246±277[ab]

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

infective. Again, [26] 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.

5. CONCLUSION

This present study indicated that cavies in Menoua Division are infested with helminthic parasites and *Eimeria* oocyts. 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 significantly higher prevalence and parasitic load for most of the gastrointestinal parasites. Thus, the services of Veterinarians should be employed to ensure appropriate treatment with specific anthelminthics in order to reduce worm loads of the parasitized animals. This will help to improve cavy productivity and enhance smallholder livelihood in this area. The 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.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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