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# Epidemiology of Gastrointestinal Strongylid Infection in Sheep from Nziih, West Region of Cameroon

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***Authors' contributions***

*This work was carried out in collaboration among all authors. Authors MTS, YJ and MM designed the study, wrote the protocol and wrote the first draft of the manuscript. Author ATRJ performed the statistical analysis. Authors NTA and NVR managed the analyses and literature searches of the study. All authors read and approved the final manuscript.*

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## ABSTRACT

**Aims:** This study was aimed to describe the epidemiology of sheep gastrointestinal strongylid infection in Nziih, West Region of Cameroon as a necessary step to prevent the disease (strongylosis).
**Study Design:** A longitudinal prospective study.
**Place and Duration of Study:** The study was carried out in Nziih locality between January and November 2019.
**Methodology:** 739 ovine dung were collected and questionnaires were administered in 6 reasoned selected farms to describe strongylid infection. For the qualitative examination, the floatation

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technique was used to detect the presence of strongylid eggs and the Mac Master technique was used for quantitative examination. Coprocultures were set to obtain the strongylid genera which were identified morphologically. Prevalence, intensity and number of infective larvae were compared using the Chi-square and the Kruskal Wallis tests respectively while the odds ratios were calculated to determine the risk factors.

**Results:** Out of the 739 faecal samples examined, 450 were found positive for gastrointestinal strongylids with an overall prevalence of 60.2% and a mean intensity of 884.67±1569.04 egg per gram of faeces. Deworming status, breeding sites and season are identified as the risk factors associated to infection in the locality. However, young animals were significantly ($P<0.05$) more infected (63.9%) than adults (57.4%) and Prevalence was significantly highest ($P=0.000$) in rainy season (85.8%) followed by the transition of wet season to the dry season (65.2%) and then to the dry season (49.0%). *Trichostrongylus, Haemonchus, Oesophagostomum/Chabertia and Cooperia* where the four genera found all the year round with a peak in the wet season. The genus of *Trichostrongylus* was the more prevalent followed by *Haemonchus*.

**Conclusion:** The present study shows that there is need to control ovine gastrointestinal strongylid in Nziih by a best management of farms, putting emphasis to a strategical program of deworming according to age, sites and season.

*Keywords: Gastrointestinal strongylids; sheep; prevalence; intensity; risk factors; Nziih; Cameroon.*

## 1. INTRODUCTION

Animal husbandry, occupies a very important place in the economical pastoralism of tropical countries especially in Cameroon, being amongst the most profitable traditional activities of rural communities [1,2]. According to the National Institute of Statistics (NIS) [3], small ruminants are amongst the predominantly farmed in Cameroon and they play a significant role in the gathering of the wealth of Cameroonians. People rely on them for meat, milk, manure and skin [4] and more, Bafou farmers do small ruminants husbandry for commercial and social reasons. They are offered as sacrifice during animist ceremonies, a gift to visitors and dowry. Furthermore, they are widely eaten and much appreciated during the funeral, wedding and sacrificial ceremonies [5]. Small ruminants support a variety of socioeconomic function worldwide and hold an important niche for sustainable agriculture in tropical countries [6]. Nonetheless, small ruminant husbandry in Cameroon is currently facing low production with high mortality rates leading to a significant decline in the sheep flock size within the last decade [7]. Sheep meat passed from 8881 tons in 2010 to 4715 tons in 2013, as such the sheep production cannot satisfy the needs of the domestic market. This decline is attributed to several causes amongst which are pathologies [7]. Gastrointestinal strongylosis is the most troublesome disease that threatens sheep production especially in pasture-based flocks which are more susceptible than sheepfold animals [8,9]. Moreover, strongylid nematodes are responsible for severe damage in infected livestock, inducing low growth rate, loss of weight, diarrhoea and in severe cases, death of the animal leading to poor of animal health, low productivity and profitability [9]. The genera *Haemonchus, Trichostrongylus, Teladorsagia, Oesophagostomum, Chabertia, Nematodirus, Cooperia* and *Bunostomum* are the strongylid that affect the intestinal tract of small ruminants [10]. The incidence and the severity of strongylid infection risk vary depending on local climatic conditions and farm management [11]. In Cameroon there are several studies on ovine gastrointestinal strongylosis [12,13,14,15] but, there are no data about strongyle nematodes of sheep in the Bafou area. Therefore, this study was aimed to describe the epidemiology of sheep gastrointestinal strongylid infection in Nziih, West Region of Cameroon as a necessary step to prevent the disease (strongylosis).

## 2. METHODOLOGY

### 2.1 Study Area

This study was conducted at Nziih in “Bafou nord”, Nkong-ni subdivision, Menoua Division in West Region of Cameroon. Bafou is divided into three zones: “Bafou nord”, “Bafou centre” and “Bafou sud”. This group of villages are situated between 8’10° latitude North and 5’8° longitude East. Altitude is between 800 m and 2740 m on red ferralitic and volcanic soils. Vegetation is made up of shrub savanna with galleries modified by the anthropic action. Climate is of the soudano-guinean type and consist of two

seasons: the rainy season (March to November) and the dry season (December to February). Precipitation varies between 1910 to 2000 mm from March to November and temperature varying from 14.3° C to 23.4° C annually. Humidity varies from 40% in the dry season to 100% during the rainy season. Pasture is abundant in the rainy season characterised by several forage species [16,5,17].

### 2.2 Sample and Data Collection

The study was carried out from January 2019 up to November 2019. Seven hundred and thirty-nine (739) samples of faeces were collected from 6 sheep breed out of the 10 herds with more than 30 animals in the locality. They were chosen based on the herd size and were divided into two types. Type 1 included herd sizes between 30 to 100 sheep and type 2 included herd sizes with more than 100 animals. These herd size ranges were established to avoid losing information on rearing because of the constant sale of sheep in the locality. After herd selection, questionnaires were given to farmers to collect data on the structure (production, herd size, number of young, adults, male and female) and management (type of alimentation, practise of rotation and deworming) of their farms. Animals were selected based on their fattening status: 50% of ill-looking with a body condition score (BCS) of 1 or 2 and 50% of healthy-looking (BCS ranging from 3 to 5) for comparison [18]. Animals were classified as adults (≥1-year-old) and young (<1-year-old). At least 30 samples were collected from each site during the full dry season (January-February), the transition of the dry season to the rainy season (April-May), the full rainy season (August) and the transition of the rainy season to dry season (November). Samples of faeces were directly collected from the rectum of each animal using latex gloves, put in a well labelled and clean plastic bottle and directly transported in an icebox to the Research Unit of Biology and Applied Ecology (RUBAE) of the University of Dschang. Then, they were stored into a refrigerator at + 4° C for processing after a maximum of 48 h.

### 2.3 Egg Examination, Coproculture and Identification of Infective Larvae

For the qualitative examination, the floatation technique was used to detect the presence of strongylid eggs and the Mac Master technique was used for quantitative examination [19]. The samples from each site were pooled in triplicate for coproculture and larvae were harvested using the method of Füllerborn [20]. Therefore, 1 ml of aliquot was left in a graduated test tube, a drop of this aliquot was transferred to a microslide with a drop of iodine and cover by a coverslip for examination under a microscope at 100x magnification. These steps were repeated until the number of larvae was counted in 0.5 ml of the 1 ml of the aliquot. To determine the number of larvae/ml the formula 1 was used:

$$N = \frac{n}{0.5} \quad (1)$$

Where N=Expected number of larvae, n=Number of larvae counted in 0.5 ml.

Identification of the third larvae stage of gastro-intestinal strongylids was done using the morphological characteristics such as the presence of sheath, the total length of the larvae, the length of the sheath tail and the presence of two refringent bodies in the head of the larvae [10].

### 2.4 Statistics Analysis

The data obtained from the study were recorded in Microsoft excel 2016 software and transferred for analysis to Statistical Package of Social Sciences (SPSS) software version 22.0. Prevalence of strongylids nematodes, number of eggs per gram of faeces and number of infective larvae were compared using the Chi-square and the Kruskal Wallis tests respectively, according to intrinsic (sex, age) and extrinsic epidemiological factors (season, sites, herd size). Additionally, the odds ratios were calculated to determine the degree of dependence between random qualitative variables. The confidence level was held at 95%.

## 3. RESULTS

### 3.1 Prevalence and Intensity of Gastrointestinal Strongylids of Sheep in Nziih

The total number of infected sheep was 450, giving an overall prevalence of gastro-intestinal strongylids of 60.9% and the average number of Egg per Gram of Faeces (EPG) found to be 884.67±1569.04 with ranges going from 50 to 13200.

### 3.2 Prevalence and Intensity by Herd Size of Breeding in Nziih

The type 1 herds (<100) had 254 animals infected with a mean EPG of 766.14±1444.85. Type 2 herd size (≥100) had 196 animals infected with a mean EPG of 1038.5±1707.15. There were no statistical differences (P>0.05) between those values.

### 3.3 Prevalence and Intensity Related to Sheep Age Group in Nziih

All age groups of sheep were infected by strongylid but, young (<1 year) were significantly (P<0.05) infected than adults (≥1 year) with a prevalence of 63.9% and EPG intensity of 1030.43±1759.91 (Table 1).

### 3.4 Sex-Wise Comparison in Gastrointestinal Strongylid Infection in Nziih

Male and female sheep were both infected by gastrointestinal strongylids, in the same manner (P>0.05). Prevalence and EPG are presented in Table 2.

### 3.5 Spatial Variation in Gastrointestinal Strongylid Infection in Nziih

Animals of Mezet 1 were more infected than animals of the other sites (P>0.05). Also, Pastorale 3 and Mezet 1 recorded the highest EPG (Table 3).

### 3.6 Seasonal Variation of Gastrointestinal Strongylid Infection in Nziih

Gastro-intestinal ovine strongylid infection varied seasonally in this study. Most infected animals and highest EPG were found during the rainy season (P≤0.001) (Table 4).

### 3.7 Risk factors linked to the occurrence of gastrointestinalstrongylid infection in Nziih

The occurrence of gastro-intestinal strongylid infection at Nziih locality depends on the season, sites and deworming status. Animal breed at Mezet 1 has 2.3 chances of getting strongylid infection more than the animals in Mezet 2. Moreover, during rainy season sheep are exposed 9.7 times more than the transition of the dry season to the rainy season, 7.5 times more than a dry season and 3.86 times more than the

**Table 1**. **Age-wise comparison of strongylid infection in Nziih**

| Age | Number of animals examined | Frequency (%) | EPG ± SD | Range |
|---|---|---|---|---|
| Adults (≥1 year) | 343 | 197(57.40$^{b}$) | 697.46±1262.88$^{b}$ | 50-11300 |
| Young (<1 year) | 396 | 253(63.90$^{a}$) | 1030.43±1759.91$^{a}$ | 50-13200 |
| Total | 739 | 450(60.90) | 884.67±1569.04 | 50-13200 |

**Letters a and b on the same column indicate a significant difference (P<0.05)*

**Table 2. Sex-wise comparison in gastrointestinal strongylid infection in Nziih**

| Sex | Number of sampled animals | Frequency (%) | EPG ± SD | Range |
|---|---|---|---|---|
| Female | 521 | 316(60.70$^{a}$) | 861.55±1553.48$^{a}$ | 50-13200 |
| Male | 218 | 134(61.50 $^{a}$) | 939.18±1609.73$^{a}$ | 50-11100 |
| Total | 739 | 450(60.90) | 884.67±1569.04 | 50-13200 |

**Letters on the same column indicate non-significant difference (P>0.05)*

**Table 3. Spatial variation in gastrointestinal strongylid infection in Nziih**

| Sites | Number of animals examined | Frequency (%) | EPG ± SD | Range |
|---|---|---|---|---|
| Mezet 1 | 120 | 83(69.2$^{a}$) | 1137.35±2228.021$^{a}$ | 50-13200 |
| Mezet 2 | 126 | 69(54.8 $^{b}$) | 410.87±394.81$^{b}$ | 50-1800 |
| Feumock | 123 | 78(63.4 $^{b}$) | 574.36±610.77$^{b}$ | 50-3500 |
| Pastorale 1 | 126 | 75(59.5 $^{b}$) | 956.00±1132.65$^{ab}$ | 50-4800 |
| Pastorale 2 | 121 | 74(61.2 $^{b}$) | 852.03±1643.64$^{ab}$ | 50-11100 |
| Pastorale 3 | 123 | 71(57.7 $^{b}$) | 1349.3±21$^{a}$ | 50-10300 |
| Total | 739 | 450(60.9) | 884.67±1569.04 | 50-13200 |

**Letters on the same column indicate non-significant difference (P>0.05)*

transition of the rainy season to the dry season. Also, dewormed animals had the lowest risk of 35% being infected by gastro-intestinal strongyles than those which are not dewormed (Table 5).

### 3.8 Strongylid Genera Found by Coproculture

Four genera of infective larvae were found in the 72 pooled faecal samples submitted for coproculture namely: *Haemonchus Trichostrongylus, Oesophagostomum/Chabertia,* and *Cooperia.* The total average of infective larvae was 16.85±21.68 and the most abundant were *Trichostrongylus* (35.78±26.89 $L_3$/ml) and *Haemonchus* (22.44±19.14 $L_3$/ml) respectively. A peak number of infective larvae was recorded in the wet season (34.5±29.97 $L_3$/ml) (Fig. 1).

According to sites, Mezet 1 and Pastorale 3 had recorded the highest amount of third stage larvae and the genus *Cooperia* was absent in Pastorale 1 and Pastorale 2. The observed number of $L_3$ in different sites are represented Fig. 2.

## 4. DISCUSSION

The overall prevalence of 60.9% found of gastrointestinal strongylid infection in sheep from Nziih locality is similar to the prevalence of 66.3% of sheep strongylid reported by Ntonifor et al. [14] in Jakiri, North West Region of Cameroon. Nevertheless, this result is far-off the prevalences of 31.06% and 41.7% revealed by Pousga et al. [21] in Yatenga (Burkina-Faso) and Ardo and Bitrus [4] in Nigeria. This high prevalence can be attributed to the poor management system of the farms in the locality. Hence, because the breeding type is pastoralism in the locality, animals are always in contact with gastrointestinal nematodes. According to Duvauchelle et al. [22] grazed animals are the

**Table 4. Seasonal variation of strongylid infection in Nziih**

| Seasons | Number of animals examined | Frequency (%) | EPG ± SD | Range |
|---|---|---|---|---|
| Dry | 192 | 94(49.0$^c$) | 386.17±352.75$^c$ | 50-1800 |
| Transition dry –rainy | 185 | 79(42.7$^c$) | 252.53±239.11$^c$ | 50-1200 |
| Rainy | 181 | 159(87.8$^a$) | 1441.82±159.29$^a$ | 50-13200 |
| Transition rainy -dry | 181 | 118(65.2$^b$) | 954.24±1722.41$^b$ | 50-11300 |
| Total | 739 | 450(60.9) | 884.67±1569.04 | 50-13200 |

**letters a, b and c on the same column mean significant difference (P<0.05)*

**Table 5. Risk factors of gastrointestinal strongylid infection in Nziih**

| Variable | Odds ratio (IC) | P-value |
|---|---|---|
| **Sites** | | |
| Mezet 1 | 1 | |
| Mezet 2 | 2.3 (1.10-3.12) | 0.02 |
| Feumock | 1.2 (0.76-2.21) | 0.34 |
| Pastorale 1 | 1.5 (0.90-2.58) | 0.11 |
| Pastorale2 | 1.4 (0.84-1.30) | 0.19 |
| Pastorale3 | 1.6 (0.97-2.78) | 0.06 |
| **Season** | | |
| Rainy | 1 | |
| Dry | 7.5 (4.44-12.77) | P<0.0001 |
| Transition rainy-dry | 9.70 (5.70-16.52) | P<0.0001 |
| Transition dry-rainy | 3.86 (2.25-6.62) | P<0.0001 |
| **Deworming** | | |
| Yes | 0.65 (0.43-0.99) | 0.04 |
| No | | |
| **Mixed pastures** | | |
| No mixture | 1 | |
| With cattle | 0.93 (0.61-1.40) | 0.74 |
| With goats | 1.28 (0.77-1.13) | 0.33 |

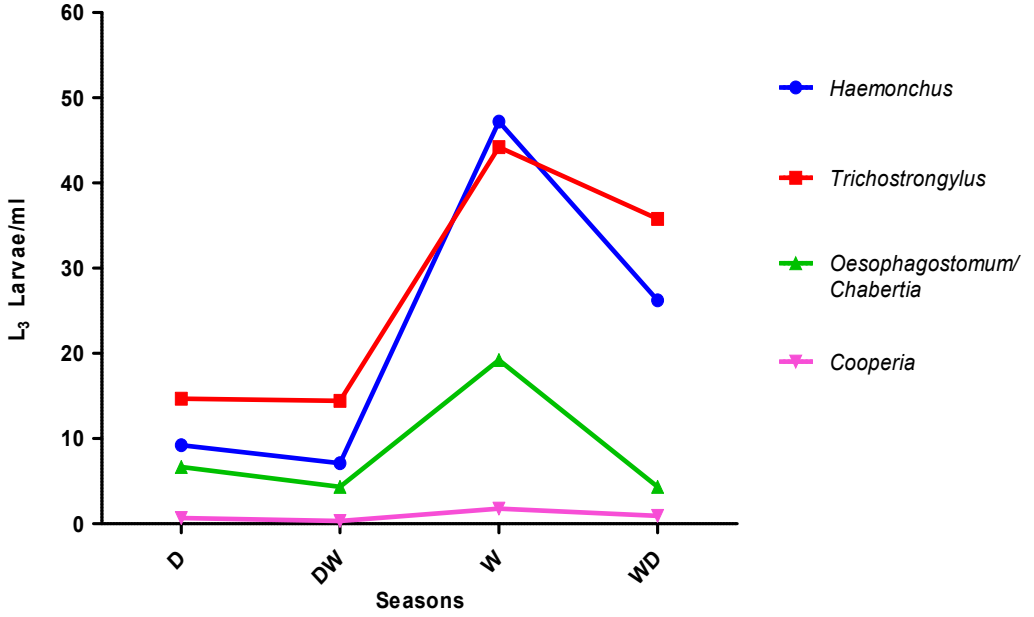


**Fig. 1. Seasonal variation of the strongylofauna in Nziih**

*Legend: D=Dry season;W=Wet season; DW=Transition of dry season to wet season;WD=Transition of wet season to dry season*

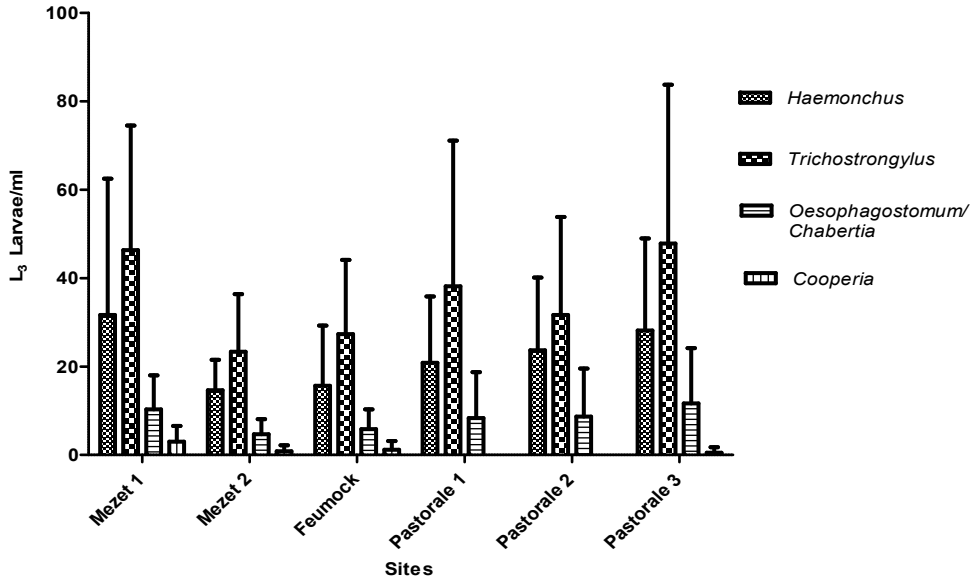


**Fig. 2. Variation of strongyles genera in different sites of Nziih**

most susceptible to gastrointestinal infection. Also, some farmers do not supplement the nutrition of sheep if they do so, it is with domestic waste. Also, a supplementation rich in proteins is necessary to strengthen the immune system of sheep [23]. In the addition to the above, many of them do not deworm their flock frequently so, animals which are regularly dewormed have a 35 % reduced risk to be infected by gastro-intestinal strongylids than non-dewormed sheep.

It is recommended to mix cattle and sheep and to avoid putting goats and sheep in the same pasture [24], but in this study sheep that grazed with cattle and those that grazed with goats are similar to sheep that grazed alone in strongylids infection. Firstly, this can be explained by the fact that the ratio one cattle for four to five sheep were not respected. Eichsdadt [24] reported that cattle can reduce the parasitic load in the sheep population by ingesting strongylids larvae specific to small ruminants when the ratio is respected. Secondly, goats present in studied farms were tethered and their herd size varied from one to five, so they could not infect the pasture meaningfully.

Although the density of sheep population is positively correlated to the level of strongylid infection [25], type 1 herd size (≥100) and type 2 herd size (<100) were similar in prevalence and intensity of gastrointestinal strongyles at Nziih. It could be that the 30 to 35 faecal samples taken in each farm were not enough for big herd size.

The higher prevalence and egg excretion in the young compared to adults are in agreement with reports of Ngambia et al. [13]; Ntonifor et al. [14] in Cameroon and Ardo and Bitrus [4] in Nigeria. This reflects the immaturity of the immune system of the young chiefly, their first grazing season [9]. Furthermore, immunity of the young is still weak to withstand the infection like adults even with high pressure from the contaminated environment [26,27]. Paraud et al. [28] also reported that the acquired immunity against gastrointestinal nematode is characterised by the reduction of the number of eggs per gram of faeces (EPG) when the animal grows old because it does not develop before the second year of pasture.

In this study, prevalence and faecal egg count were similar in both male and female. This result is in agreement with the work of Poddar et al. [29] and Rahman et al. [30] and. It can be explained by the fact that both sexes are equally exposed to the gastrointestinal nematodes.

Prevalence in strongylid infection at Mezet 1 (69.2%) and faecal egg concentration of Pastorale 3 and Mezet 1 were higher than the prevalence and the EPG of the other sites. The highest proportion (62.5%) of young was recorded at Mezet 1 and the very low frequency of deworming may be the explanation. Also, the shepherd of Pastorale 3 did not place the bought sheep in isolation and they did not deworm them before their introduction in the flock. Consequently, if they are infected, they would contaminate the flock by increasing the load of the parasite in the pasture.

Gastrointestinal strongylid (GIS) infections were more present in the wet season compared to the dry season. These results corroborate with various reports [13,15,31,32]. O'connor et al. [33] revealed that helminths are more abundant during the wet season because of the high amount of rainfall and moisture in the pasture which facilitate the hatching of eggs and the migration of infective larvae on herbage. However, eggs and larvae are more susceptible to the desiccation induced by high temperature, less moisture and evaporation during the dry season.

Coproculture revealed the presence of *Trichostrongylus, Haemonchus, Oesophagostomum/Chabertia* and *Cooperia* genera with a predominance of the first two. These findings are in agreement with the study of Ngambia et al. [13], Sassa et al. [15], Djawe et al. [32] in Cameroon, Kenea et al. [34] in Ethiopia and Apala et al. [35] in Ivory coast who have found the same genera. As revealed by Mahieu et al. [23], *Trichostrongylus, Haemonchus* and *Oesopha- gostomum/Chabertia* are more frequent in the tropical areas. Contrarily to the assertion that *Haemonchus* is the most prevalent genus in tropical zone, [8] this study demonstrated *Trichostrongylus* to be the most prevalent instead. This may be due to the species diversity in *Trichostrongylus* genus. The genus *Trichostrongylus* counts three species that could infect sheep in Nziih locality. Also, there can be an interspecific competition between *Trichostrongylus* of the abomasum (*T. axei*) and *Haemonchus*. The low occurrence of *Oesophagostomum/Chabertia* despite the high fecundity of their females (12000 egg/day) compared to *Haemonchus* (5000 to 10000 egg/day) and *Trichostrongylus* (200 egg/day) may be due to the low number of adults in the intestine of sheep. According to Mahieu [8], adults of *Oesophagostomum* genus are generally low in the intestine of their hosts. The genus *Cooperia* was the less abundant and it did not vary significantly all the year, Djawe et al. [32] assert that this genus has low fecundity in soudano-guinean climate. The absence of *Cooperia* in Pastorale 1 and Pastorale 2 may be due to the absence of cattle in these 2 breeds. Indeed, sheep can be infected by *Cooperia* of cattle [36].

## 5. CONCLUSION

The study of the epidemiology of gastrointestinal strongylids infection in sheep in the locality of Nziih revealed that animals were infected by gastrointestinal strongylids with non-deworming, sites and season as risk factors. There is a permanent polyparasitism dominated by *Trichostrongylus* and *Haemonchus* genera which are known to cause severe damage to sheep flock resulting in production losses. The faecal egg concentration of all genera of strongylids presented a peak in the wet season (August) and tended to decrease in transition of the wet season to dry season (November). This suggest that animals must be treated before and after the middle of the rainy season, precisely in June and in November. A program of strategical treatment should be put in place, emphasising to the importance of deworming sheep and particularly the young ones.

## CONSENT AND ETHICAL APPROVAL

This work was carried out in accordance with the Animal Ethical Committee of the Animal Biology Department of the University of Dschang, Cameroon. The authorization to carry out the study was given by the Departmental delegate of the Ministry of Livestock, Fisheries and Animals Industries of the Menoua Division. After explained the objectives of the study, consent was obtained from all owners prior to fecal sample collection which was made without any harm.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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