Dry season bovine fasciolosis in Northwestern part of Ethiopia

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SUMMARY
Features of dry season bovine fasciolosis were studied in North Gondar area, Northwest Ethiopia. Out of the total 2226 cattle examined, 774 (33.42 %) were found positive on qualitative coproscopy. The overall herd egg output (EP2G) was 81.16 ± 0.11. The herd infection prevalence, as estimated from the egg-shedding index, was 41.22 ± 4.38. In all the above measurements, the monthly values significantly decreased (p < 0.05) along with the progression of the dry season (November through April) and with an increase of age. The abattoir-based study on older stocks revealed an overall fasciolosis prevalence rate of 90.65 %, without any statistically discernible variation (p > 0.05) between study months. Infections due to Fasciola hepatica, F. gigantica and by both fluke species occur in the order of 67.14 %, 14.1 % and 18.77 %, respectively. Moderately affected livers present the highest mean fluke count (112.73 ± 2.3) followed by severely (61 ± 2.2) and lightly (32.09 ± 2.72) affected ones signifying the presence of acquired resistance and local tissue reaction as chronicity of infection supervenes.

The present study suggests that high fasciolosis pathogenicity is present in the study area, justifying at least one obligatory strategic treatment during the dry season. In addition, as compared with classical coproscopic methods, egg-shedding index was found to be a relatively robust parameter in estimating herd infection prevalence, hence recommended for use in future field investigations and monitoring programmes in the tropics where resource limitations often curtail uses of improved diagnostic techniques. Further detailed study could provide valuable information that foster local planning and implementation of a more sustainable fasciolosis control strategy for Northwest Ethiopia.

KEY-WORDS : fasciolosis - cattle - prevalence - Northwest - Ethiopia.

Introduction
Ethiopia’s rich potential from the livestock sector is not efficiently exploited due to several constraints including sub-optimal nutrition, traditional management and diseases [3, 7]. The presence of fasciolosis due to Fasciola hepatica and F. gigantica in Ethiopia has long been known and its prevalence and economic significance has been reported by several workers [4, 12, 13, 14]. A review of available literature strongly suggests that fasciolosis exists in almost all parts of the Ethiopia. It is regarded as one of the major setbacks to livestock productivity incurring huge direct and indirect losses in the country [19, 20].

Fragmented reports suggest that fasciolosis is a highly prevalent disease in North Gondar area where livestock represent the pillar of the local economy and plays a vital role in
livelihod of the farming communities [18]. It appeared that the loss from fasciolosis is aggravated during the long-dry season (November through April) when the nutritional conditions, in the traditional livestock farming system, are generally compromised. On the other hand, flukicidal treatments are often administered during the rainy season when transmission is anticipated to occur. A thorough epidemiological study and assessment of the magnitude of the problem when the grazing situation becomes sub-optimal is beneficial, the clue to envisaging a rational disease control strategy in this environment. The present study was thus designed with the following specific objectives: 1) to determine the monthly prevalence rate of fasciolosis in three different age categories of local breed cattle during the dry season; 2) to assess the monthly herd Fasciola egg output; 3) to compute the herd egg-shedding index, as an estimate of herd infection-prevalence, and compare it with the values obtained from classical coproscopic examination; and 4) to carry out an abattoir based survey to estimate the extent of Fasciola infection-prevalence in adult stocks and compare the intensity of infection with the severity of liver lesions.

Materials and methods

THE STUDY AREA

The study was conducted during the long dry season (November 1998 to April 1999) in North Gondar administrative zone, Northwestern part of Ethiopia. The area is located at latitude 12.4°N and longitude of 27.25°E and constitutes the North Central mass of the country. It has four main agro-climatic zones, namely lowland, middle altitude, highland and temperate highland [22].

HERD INFECTION PREVALENCE

A total of 2226 randomly selected indigenous Fogera breed cattle managed under extensive traditional system were considered in this part of the study. Based on their dental eruption patterns, three conventional age groups were formed. Group I consisted of very young animals (up to 1.5 years of age) in their first grazing season. Group II comprised apparently young cattle (1.5-5 years of age) that experienced repeated challenges to infections. Animals allotted to Group III were older subjects (above 5 years of age), which also experienced repeated challenges to infections and approaching at the term of their productive lives. Fresh faeces were randomly collected, on a regular basis, directly from the rectum of all animals and transported to the laboratory in an air-tight condition. The specimens were then subjected to qualitative coproscopic examination for the presence of characteristic Fasciola eggs by direct sedimentation technique employing a standard procedure [16]. The mean infection prevalence rate was then compiled on monthly basis and age categories.

HERD EGGS-OUTPUT AND EGG-SHEDDING INDEX

Pooled faecal specimens from a herd of 8-10 animals and from a total of 225 herds were examined by Stoll's egg counting technique (pooling was based on the daily sampling rates) [16]. The procedure involves examination of 3g of faeces, from the pooled sample, after homogenising in 42 ml of water. The suspension was poured in a wire mesh and the filtrate collected. After vigorous stirring, two aliquots of 0.15 ml each were put on a glass slide, each covered with cover slip (22 x 22 mm) and examined under low power microscopy (x 40). All fluke eggs were counted and the result multiplied by 100 to obtain the number of eggs per 2 grams of faeces (EP2G). In addition, qualitative coproscopy was conducted on individual faecal samples of each animal in all herds to assess herd-infection prevalence of fasciolosis. The latter database and that from EP2G, will ultimately be used, as basic variables, in the computation of the herd-egg-shedding index, a parameter used to estimate the herd-infection prevalence, using the following formula set by MALONE et al., [17]:

\[
\text{HERD EGG-SHEDDING INDEX} = \text{PREVALENCE} \times \text{EP2G}
\]

ABATTOIR BASED SURVEY

A total of 2504 adult indigenous cattle slaughtered at the Gondar Municipal and Industrial abattoirs were examined and the monthly Fasciola infection-prevalence determined. Besides, comparison between the severity of liver lesions and intensity of fluke infection (worm load) was conducted on 296 randomly selected infected livres. In both cases, on the basis of the intensity of lesions, affected livers were grouped into three categories as per the criteria previously described by OGINRINADE and ADEGOKE, [21]:

- Lightly affected: a quarter of the organ is affected, and only one bile duct is prominently enlarged on the visceral surface of the liver.
- Moderately affected: half of the organ is affected and two or more bile ducts are hyperplastic.
- Severely affected: almost the entire organ is involved, the liver is cirrhotic and triangular in outline as the right lobe is often atrophied.

STATISTICAL ANALYSIS

The possible existence of differences in monthly prevalence rates, herd egg output, egg-shedding index between cattle of varying age groups was assessed with \( \chi^2 \) (Chi-square) statistics and Pearson’s correlation test as appropriate [25]. \( P < 0.05 \) was considered significant in all these analyses.

Results

INFECTION PREVALENCE BASED ON INDIVIDUAL COPROSCOPIC EXAMINATION

Out of the total 2226 faecal samples of cattle examined, 774 (33.42%) were found positive for Fasciola infection. The prevalence of fasciolosis was smallest in Group III (30.27%) and highest in Group I (36.64%). In all age groups, the highest and the lowest infection prevalence rates were obtained during the months of November and April.
FIG. 1. — Age-based monthly and total infection prevalence of dry season bovine fasciolosis in North Gondar area. Assessment was based on individual qualitative coproscopy (n = 2226).

FIG. 2. — Variation of total and monthly mean herd Fasciola egg output with age of examined cattle. Assessment was based on pooled faecal samples of 8-10 animals forming a herd and from a total of 225 herds.
respectively. Statistical analysis of prevalence rates among cattle of different age groups revealed that there exists significant variation ($\chi^2$ Cal = 6.74, df = 2, $P < 0.05$). An inverse correlation ($r = -0.99$) was evident showing a decrease in prevalence with an increase in age. Depiction of the monthly prevalence of fasciolosis in all age groups showed a statistically significant variation ($\chi^2$ cal = 54, 14.21 and 13.88, respectively, for Group I, II and III; df = 5; $P < 0.05$) (Fig. 1).

**HERD EGG-OUTPUT AND EGG-SHEDDING INDEX**

The dry season mean EP2G for Groups I, II and III was depicted as 92.9 ± 0.14, 81.72 ± 0.11 and 68.86 ± 0.09, respectively, while the overall value being 81.16 ± 0.11. A statistically significant variation ($p < 0.05$) in mean EP2G and an inverse correlation was obtained in the three age categories. Similarly, a pattern of significant decrease in mean egg output was obtained with the progression of the dry season, from November through April (Fig. 2).

Computation of egg-shedding index revealed an estimated herd-infection prevalence value of 41.22 ± 4.38 for the whole of the dry season. The mean monthly egg-shedding indices for Groups I, II and III were 53.02 ± 5.33, 39.15 ± 4.07 and 31.48 ± 3.73, respectively. It was noted that there exists a negative correlation ($r = -0.34$) that tend to decrease in prevalence with an increase in age. Similarly, a decreasing trend in monthly herd-egg shedding indices were recognised along with the progression of the dry season, the highest and lowest values being observed in November (64.68 ± 4.12) and April (6.94 ± 1.49), respectively. Statistical analysis revealed the occurrence of significant monthly variation ($p < 0.05$) in different age categories ($\chi^2$ cal = 31.24, 17.39 and 15.29, respectively, for Groups I, II, and III; df = 5, $P < 0.05$) (Fig. 3).

**ABATTOIR BASED SURVEY**

From the total of 2504 adult cattle slaughtered, 2270 (90.65 %) were found positive for fasciolosis. Of these, 46 (18.41 %), 927 (37.02 %) and 882 (35.22 %) were lightly, moderately and severely affected, respectively. The highest (93.21 %) and lowest (77.19 %) infection prevalence rates were obtained during April and January, respectively. However, there was no detectable statistically significant variation ($p > 0.05$) between study months (Fig. 4).

A total of 19603 flukes were recovered from the 296 infected livers examined, the overall mean count being 66.23 ± 2.61 (range 10-364). Moderately affected livers showed the highest mean count (112 ± 2.3) while lightly affected ones revealed the lowest value (32.09 ± 2.72) (Fig. 5). The variation in intensity of infection between the three lesion categories was statistically significant ($p < 0.05$). The results of the present study also disclosed that the predominant fluke species involved was *F. hepatica*. Pure infections with *F. hepatica* and *F. gigantica* occurred in 67.14 % and 14.1 %, respectively, while mixed infections due to both fluke species was in the order of and 18.77 % (Fig. 6).

**Discussion**

One of the most important factors that influence the occurrence of fasciolosis in an area is availability of suitable snail habitat [24, 27]. In addition, optimal base temperature levels of 10°C and 16°C are necessary for snail vectors of *F. hepatica* and *F. gigantica*, respectively [31]. These thermal requirements are also needed for the development of *Fasciola* within snails. The ideal moisture conditions for snail bree-
FIG. 4. — Overall and monthly fasciolosis infection prevalence and intensity of lesions in cattle slaughtered at Gongar Municipality and Industrial abattoirs. No data is available for the month of February because there were no slaughter during this period.

FIG. 5. — *Fasciola* species recovered from infected livers from Gondar Municipality and Industrial abattoirs during the dry season (November - March).
ding and the development of larval stages within the snails are provided when rainfall exceeds transpiration and field saturation is attained. Such conditions are also essential for the development of fluke eggs, miracidiae searching for snails and dispersal of cercariae.

In Ethiopia, bovine fasciolosis exists in almost all regions [12, 14]. However, the prevalence rates, epidemiology and Fasciola species involved vary significantly with locality. This is attributed mainly to the variation in the climatic and ecological conditions such as altitude, rainfall, temperature and livestock management system. GRABER and DAYNES [15] reported that, in Ethiopia, Fasciola hepatica and F. gigantica infections occur in areas above 1800m a.s.l. and below 1200m a.s.l., respectively. Recently, YILMA and MALONE [31] have developed a geographic information systems (GIS) forecast and risk assessment model for fasciolosis in Ethiopia. The work, which is based on moisture and thermal regimes, revealed that varying degrees of F. hepatica risk occur in most parts of the country and distinct regional transmission patterns could be identified. F. gigantica risk could be present at elevation below 1700m a.s.l. where the transmission cycle could only be completed in a single year. The results of the present study disclosed infection prevalence rates of 33.42 %, 41.22 % and 90.65 % as estimated from qualitative coproscopy, egg-shedding index and abattoir survey data, respectively. This finding is comparable to previous reports of 52-62 % in the same areas [10, 12, 30, 32]. Our observation generally suggest that bovine fasciolosis is an endemic condition in the study area and is an indication of the existence of favourable bionomic and ecological conditions for the survival, multiplication and spread of intermediate snail host and the parasite in that environment.

Relatively higher prevalence rates of fasciolosis have been reported in other parts of the country including 86 % in Keffa [12]; 84.4 % at Bahir Dar abattoir [10]; 80-89 % in Debre Birhan [6]; and 82.5 % in Western Shoa [29].

Statistical analysis indicated the existence of significant difference and inverse correlation in infection prevalence among different age groups. The decrease in infection prevalence as age increases is the result of acquired immunity manifested by humoral response and tissue reaction in bovine liver due to previous challenges [21]. The increase in resistance, as expressed in lower prevalence rate with the increase of age, is most likely related to the high level of tissue reaction seen in bovine liver [8]. Previous observations made in Ethiopia by various scholars concord with the present findings [5, 6, 10, 23].

In this study, the highest prevalence rate was observed during the month of November (42.41 %) when the wet ecological conditions still prevailed. However, the prevalence rate gradually decreased from December through April, during the long dry period of the year in the study area. Such seasonal variation in Fasciola infection may be related to the seasonal activity of the intermediate host snails. It has been described that the bionomic requirements for breeding of the Lymnaea snails and development of the intra-molluscan stages of the flukes often reach the optimum threshold during the wet months of the year. During the dry periods, breeding of the snails and development of the larval flukes slow down or stop completely and snails undergo a state of aestivation [2, 9, 24, 27]. Although a decreasing trend was observed along with the advancement of the dry season, relatively high prevalence rates were recorded throughout the study period. This may be

\[ \text{FIG. 6. — Relationship between mean intensity of infection and the corresponding severity of liver lesions.} \]
attributed to infections acquired during previous peak snail activity season. In addition the existence of permanent suitable ecological conditions in areas like lake-borders, slowly flowing rivers and low lying marshy areas may contribute to persistent but low-grade infection during the dry season. High cattle population often concentrates at these sites to graze, as these areas usually remain green during the dry season. Supplementation with hay harvested from endemic localities may also serve, as a major vehicle infection during periods normally considered unfavourable for fluke propagation.

The result from abattoir survey indicated that the dominant fluke in the study area is Fasciola hepatica. This may be associated with the existence of favourable ecological biotops for Lymnaea truncatula, the recognised intermediate host of F. hepatica in Ethiopia [15]. Relatively small proportions of cattle were found infected with F. gigantica alone or mixed infection with both species. This may be explained by the fact that most cattle for slaughter came from highland and middle altitude zones. Lake borders, flood prone areas, drainage ditches are areas which are favourable habitat to L. natalensis [26] also allow the existence of F. gigantica in the study area. YILMA and MALONE [31] reported that both species co-exist in areas with an altitude range of 1455-1700 m.a.s.l. Mixed infection may occur in the liver of the same animal so long as ecological conditions conducive for replication of both snail species exist and intermingling of cattle from various grazing areas occur. ADEM [1], FEKADU [10] and GRABER [14] have reported observations that support the present findings.

Egg-shedding index, as an estimate of herd-infection prevalence, was found to be a relatively robust parameter when compared with results obtained from individual coproscopic examination. Although abattoir based post-mortem survey appeared superior to the other approaches, it has its own limitations. The most important of these is the selection pressure for animals to be slaughtered, which undoubtedly dictate the prevalence value. As it is generally regarded to be a cost- and labour-effective method, egg-shedding index could be applied in field investigations and monitoring programmes in the Tropics where resource limitations often curtail uses of improved diagnostic techniques. MALONE et al., [17] have successfully used this parameter in fasciolosis herd-infection prevalence studies in Southern United States.

Flukicidal treatments in the study area are often restricted to the rainy season alone and could not rationally suffice the intended purpose in an environment of such high fluke pathogenesity. At least one strategic treatment during the long dry season is, thus, justifiable for North Gondar area. Further more, in order to foster planning and implementation of sustainable control strategy, future detailed study on epidemiology of fasciolosis and ecology of intermediate host snails, as related to the specific husbandry practices, is recommended.

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References

10. — FEKADU R. : A preliminary survey of bovine fascioliasis around Bahir Dar (Gogjam) and evaluation of the flukicidal activity of rafoxanide and closantel preparations. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia, 1998.


29. — YADETA B. : Epidemiology of bovine and ovine fascioliasis and distribution of its snail intermediate host in Western Shoa. DVM Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debret Zeit, Ethiopia, 1994.


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