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LIVER FLUKE INFESTATION, CONDEMNED LIVER AND FINANCIAL LOSS FROM CATTLE SLAUGHTERED IN THE BAMENDA ABATTOIR

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Abstract:-
Cattle production in the North West Region provides direct employment to more than 166166 people. Unfortunately, this important meat source is being infested by Fasciola fluke, leading to increased meat loss through liver condemnation during meat inspection. This study therefore set out to determine the state of fluke infestation, quantity of liver condemned and assess economic loss due to condemned liver of cattle slaughtered at Bamenda abattoir. A total of 733 cattle (593 males and 140 females) brought from all seven divisions of the North West Region were sampled from January to June. Palpation and incision technique was used to identify and count adult flukes that had infested each liver of slaughtered cattle. Data was also collected on the quantity of liver condemned due to massive fluke infestation and the financial loss due to condemnation was established. The overall state of fluke infestation was 7.4% (54/733). A higher proportion of fluke's infestation (4264/6386) was recorded during the rainy season compared with the dry season (2122/6386). The majority of the infestation was among cattle from Ngoketungia 12.5% (1/8) and lowest in Momo 5.2% (3/58). A financial loss due to liver condemnation was estimated to be at 477,000Fcfa (954 US dollars) within the period of study. It was thus concluded that Fasciola infestation was found in cattle brought for slaughter at Bamenda abattoir and that butchers suffer financial losses due to condemned liver.

KeyWords: *Fasciola, liver fluke, cattle, infestation, condemned liver, financial loss*

INTRODUCTION

Fasciola species, also known as common liver fluke is a parasitic flatworm of the class Trematoda and phylum Platyhelminthes that infect the livers of various mammals including humans (Blood *and Radostits 1994*). The disease caused by the fluke is called fascioliasis (also known as fasciolosis). *Fasciola hepatica* and *Fasciola gigantica* are the most common species distributed worldwide and have been known to cause disease and great economic losses in cattle and sheep for many years (Overend and Bowen, 1995). There are many emerging parasitic zoonoses that are associated with food and water. Among such diseases fascioliasis has been recognized as an important public health problem in several parts of the world. World losses is estimated to exceed US dollars 3.2 billion annually (Spithill *et al.,* 1999), affecting more than 600 million animals. This would probably not accurately take into account losses due to the implication and consequences of zoonotic diseases, and it has been reported that 2.4 million humans are infected and a further 180 million are at risk of infection (CDC, 2011). Total annual costs to the UK cattle industry have been estimated at between US Dollars 19O and 400 million (FAOSTAT, 2005). In Cameroon, the cattle population is estimated at 5.805 million and its production accounts for 28% of GDP and provides direct employment to 947109 people, 166166 of whom are in the North West Region (MINEPIA Annual report, 2015). The North West Region with a cattle population of 735463 heads ranks third in Cameroon after Adamawa and Extreme North, and contributes 22.4% to the national production. Therefore research in this area is important in order to assess the economic impact of condemned cattle liver in the country. The transmission of fascioliasis can be summarised thus: Once an animal is infected with *Fasciola*, it passes out eggs with the faeces of the animal. On entering the water, the eggs hatch into miracidia. The miracidia locate water snails by chemotaxis. Sporocysts produce rediae and rediae may produce second generation rediae before developing into Cercariae. Cercariae emerge from the snails. Encystment of the cercariae on vegetation occurs at the edge of water. Cattle and sheep become infected by ingesting metacercariae while grazing. The predisposing factors in *Fasciola* infection transmission are determined by the presence of the intermediate snail host, domestic herbivorous animals, climatic conditions and the dietary habits of man. Sheep, goat and cattle are considered the predominant animal reservoirs. Other animals can be infected, but they are usually not very important for human disease transmission. Humans can be infected by ingestion of aquatic plants that contain infectious metacercariae. Several species of aquatic vegetables such as *Nasturtium officinale*, common water cress and lamb's lettuce are known as vehicles of human infection. Because *Fasciola hepatica* also encysts on water surface, humans can become infected by drinking of fresh untreated water containing metacercari**ae** (Mas-Coma *et al., 2005*). In addition, consumption of raw or uncooked fresh liver infected with juvenile flukes could lead to human infection (Taira *et al*., 1997).

Statement of Problem

Cases of bovine liver infestation have been observed frequently in Bamenda municipal abattoir at slaughter but no empirical evidence exists on the level liver condemnation and financial losses. Routine meat inspection at the Bamenda Municipal Abattoir is carried out by the staff of the Ministry of Livestock Fisheries and Animal Industries (MINEPIA) under the supervision of a sworn-in veterinary doctor. During the process of meat inspection, cases of liver fluke infestations are condemned and buried. This liver condemnation leads to both meat and financial losses. Thus there is need to establish the state of infestation, quantify the condemned liver and assess the financial loss due condemnation.

Research Questions

- What is the *Fasciola* fluke infestation state of cattle slaughtered at the Bamenda abattoir?
- What is the quantity of liver condemned at the Bamenda abattoir due to liver flukes?
- What is the financial loss due to condemned liver at Bamenda abattoir?

Objectives

1. To establish the level of liver fluke infestation among cattle slaughtered in the Bamenda municipal abattoir
2. To determine the quantity of liver condemned due to *Fasciola* fluke infestation among cattle slaughtered in the Bamenda municipal abattoir
3. To assess the financial loss due to condemned liver among cattle slaughtered in the Bamenda municipal abattoir

Materials and Method

The study was carried out in the Bamenda Municipal Abattoir. It is located in Nkwen, Bamenda III Sub Division, Mezam Division, North West Region with coordinates 5°56'N, 10°10'E and is 1614 m above sea level. The study animals were all brought from all the seven divisions of the North West Region, namely, Boyo, Bui, Donga Mantung, Menchum, Mezam, Momo and Ngoketunjia and the cattle were slaughtered in the Bamenda Municipal Abattoir.

Bamenda municipality harbours the biggest cattle market in the Region where cattle sold come from all the seven divisions of the region. A range of 800—1000 cattle are sold in this cattle market weekly. It is from this cattle market that majority of cattle slaughtered at Bamenda abattoir are obtained. Constructed some twenty years ago with a slaughter capacity of 75 cattle per day, the abattoir has the following features:

- Main building where slaughter takes place,(kill floor and post mortem inspection section).
- Lairage (fence for ante-mortem inspection measuring 50mx50m).
- Commercial area with meat sale slabs
- Sewage tank and meat condemnation pit.

The population under study comprised all cattle brought for slaughter at the Bamenda Municipal abattoir during the period of study. The study period was divided into two phases of three months each. The first phase considered to be the dry season covered the months of January to March. The second phase considered to be the rainy season covered the months of April to June. A cross-sectional study design and a multi-stage sampling technique were used to select all the cattle from which all necessary data was collected at the abattoir. In the first stage, four days of the week were randomly selected such that the same days were used for sample collection throughout the study period. In the second stage, all the cattle to be slaughtered each day were numbered and the even numbers were used for sample collection. Since there was no previous study in Bamenda to establish the prevalence of bovine *Fasciola* infection, the sample size required for this study was determined based on the expected prevalence (30%) of bovine fascioliasis and the 5% desired absolute precision and 95% confidence interval, using the formula according to Thurfield (2005).

i.e $$N = \frac{(1.96)^2 \, x \, P_{ex} \, (1-P_{ex})}{d^2}$$

- Where N = required sample size
- P_{ex}= expected prevalence=50%
- d= desired absolute precision =5%
- 1.96= constant for 95% confidence interval

Accordingly, 384 cattle were supposed to be sampled but in order to increase the precision a total of 733 study cattle were used. Active abattoir survey was conducted based on cross sectional study during routine meat inspection in Bamenda abattoir. During ante-mortem inspection examination the animals were identified as male or female based on the appearance of the external genitalia (testes and udder) and the source of the cattle was recorded based on the declarations of the owners. Routine meat inspection at the Bamenda Municipal Abattoir is carried out by the staff of the Ministry of Livestock Fisheries and Animal Industries (MINEPIA) under the supervision of a sworn-in veterinary doctor. This study was carried out with the collaboration of the MINEPIA staff regularly on duty at the abattoir. The liver inspection was carried out by visual examination, palpation, and incision and squeezing of the organs according to the Guideline on Meat Inspection for developing countries (FAO, 2009). Identification of *Fasciola* adult flukes was carried out using morphology and size parameter as described by Soulsby (1982). An adult *Fasciola* fluke has a characteristic leaf shape with the anterior end being broader than the posterior end and reddish brown in colour. The anterior end has a coneshaped projection. Adult fluke lives in the bile ducts. A total of 733 livers were weighed using a clock-face Hana weighing scale made in China and recorded. All livers having *Fasciola* species were registered and the number of flukes recovered from each liver counted. Recordings were also made of the number and weights of the livers condemned by the Veterinary Meat Inspector due to fluke infestation. Intensity of adult flukes was first expressed as average number of flukes per liver and later correlation between fluke count, liver weight and animal weight when calculated. The average price of a kilogramme of liver meat was gotten from butchers as it was sold in the commercial section of the abattoir and was standardized at 2000 Francs CFA. During the period of the research, 52 livers with total weight of 238.5kg were condemned due to massive liver fluke infestation at the Bamenda Municipal Abattoir. An estimation of financial loss was calculated in Franc CFA based on the quantity of condemned meat between January and June of the study period. The direct financial loss due to infested liver condemnation was calculated using the formula given by Rahmeto *et al.* (2014): DFL = N x PxW. Where DFL is direct financial loss, N is number of condemned liver, P is average liver price (francs/kg), W is average liver weight (kg).

Results

A total of 733 cattle were sampled in the Bamenda Municipal Abattoir during slaughter for a period of six months in two phases of three months each. The overall prevalence of liver fluke infestation from the studied area was 54 (7.4%) . The intensity of adult worms per liver in the cattle from the studied areas was 118.3 fluke per liver (fpl). .

The first phase covered January to March and 362 cattle were sampled, while the second phase covered April to June and 371 cattle were sampled. From all the cattle sampled, 140 (19.0%) were females and 593 (81%) were males. The highest number of cattle slaughtered came from Mezam Division (27.7%, 203), while the least was from Ngoketunjia Division (1.1%, 8) as shown in Table 1.

Table 1. Demographic data of cattle slaughtered at Bamenda municipal abattoir

Characteristic	Category	Number examined	Number infected (Prevalence) (%)
Gender	Female	140	31 (22.1)
	Male	593	23 (3.9)
Age (years)	< 5years	366	18 (4.9)
	≥ 5years	367	36 (9.8)
Seasons	Dry	362	21 (5.8)
	Wet	371	33 (8.9)
Origin	Boyo	123	7 (5.7)
	Bui	199	18 (9)
	Donga-Mantung	60	6 (10)
	Menchum	82	9 (11)
	Mezam	203	10 (4.9)
	Momo	58	3 (5.2)
	Ngoketunjia	8	1 (12.5)
Overall *fasciola* prevalence		733	54 (7.4)

The overall prevalence of *Fasciola* fluke infestation in cattle slaughtered at Bamenda Municipal Abattoir was 7.4% (54/733) (Table 8). The highest prevalence of adult flukes was recorded in Ngoketunjia 12.5% (1/8) while the lowest was recorded in Momo 5.2% (3/58).

Table 2: Prevalence of liver flukes among cattle slaughtered at the Bamenda Municipal abattoir

Division of Origin	Number Sampled	Number positive	Prevalence (%)
Boyo	123	7	5.7
Bui	199	18	9.0
Donga Mantung	60	6	10.0
Mechum	82	9	11.0
Mezam	203	10	4.9
Momo	58	3	5.2
Ngoketunjia	8	1	12.5
Level of significance/P-value			0.0031
Total	**733**	**54**	**7.4**

Infestation intensity of *Fasciola* among cattle slaughtered at Bamenda Municipal Abattoir

The intensity of infection shown in **Table 3** is considered in terms of the average number of adult flukes recovered per liver of cattle. A total of 6386 flukes were detected with the majority (4264) detected in the rainy season than in the dry season (2122). More liver were infested in the rainy season (32) compared to the dry season (22).

Table 3: Fluke intensity according to season among cattle slaughtered at the Bamenda Municipal Abattoir

Variable	Dry season	Rainy season	Total
Flukes recovered from liver	2122	4264	6386
Number of livers infested	22	32	54
Intensity(average flukes per liver)	**97**	**133**	**118**

The intensity of adult flukes was observed to be higher in the rainy season than in the dry season as could be seen on table 3 above. The weight of the *Fasciola*-infected liver condemned was grouped and compared with weight of the cattle and the results could be seen as presented in Table 4. The highest kg of liver condemned was in the weight range of 251 to 400 kg animals 199 (60.1%). Among animals in the 100 to 250kg body weight 5.6 to7.5 kg of liver were destroyed, while the least quantity (kg) of liver destroyed was amongst animals weighing more than 550kg. This relationship between liver destroyed and animal weight was statistically significant at $P<0.05$ ($P=0.000$).

Table 4: Weight of animal slaughtered compared with weight of liver condemned

Weight of animal (Kg)	Weight of liver condemned (Kg)				Total	P value
	1-2.5	2.6-5.5	5.6-7.5	>7.5		
100-250	21 (20.6)	20 (6.0)	23 (13.0)	7 (5.7)	71 (9.7)	0.0261
251-400	64 (62.7)	199 (60.1)	74 (41.6)	94 (76.4)	431 (58.8)	0.0683
401-550	16 (15.7)	110 (33.2)	75 (42.4)	21 (17.1)	222 (30.3)	0.0405
>550	1 (1.0)	2 (0.6)	5 (2.8)	1 (0.8)	9 (1.2)	0.0332
Total	102 (100)	331(100)	177(100)	123(100)	733(100)	

Adult fluke count was performed on each liver of the slaughtered cattle and association was established between the adult flukes recovered, weight of liver and the weight of cattle as shown in table 5 The weight of the liver had statistically significant association with the number of the adult worm (p=0.047).

Table 5: Association between adult fluke and liver, and animal weight of slaughtered cattle

Variables	Categories	Adult Fluke				P value
		Absent	50-100	101-150	151-200	
Liver weight	1-2.5	92 (13.5)	8 (42.1)	2 (14.3)	0 (0)	0.047
	2.6-5.5	309 (45.3)	6 (31.6)	7 (50)	9 (500	
	5.6-7.5	168 (24.6)	2 (10.5)	2 (14.30)	5 (27.8)	
	>7	113 (16.5)	3 (15.8)	3 (21.4)	49 (22.20)	
Weight of animal	100-250	66 (9.7)	0 (0)	2 (14.3)	3(16.70	0.153
	251-400	406 (59.5)	13 (68.40	3 (21.40	9 (50.5)	
	401-550	201 (29.50	6 (31.6)	9 (64.3)	6 (33.3)	
	>550	9 (1.30)	0 (0)	0 (0)	0 (0)	

A record of the number and the weight of livers condemned due to massive fluke infestation was done and an evaluation of financial loss due to liver condemnation presented in Table 5

Table 6: Financial loss due to condemnation of massive infested liver

Division of Origin of cattle	Number of livers condemned	Quantity of liver condemned (kg)	Average price per kg of liver	Estimated financial loss (FCFA)
Boyo	06	26	2000	52000
Bui	17	86	2000	172000
Donga mantung	05	26	2000	52000
Menchum	09	45	2000	90000
Mezam	10	42	2000	84000
Momo	03	13	2000	26000
Ngoketunjia	O2	10.5	2000	21000
Total	**52**	**238.5**	**2000**	**477000F**

The average weight of 52 livers condemned= 238.5 divided by 52 = 4.59kg
Direct Financial Loss (DFL) =52 x 2000 x 4.59 = 477000 Fcfa
Annual cost of condemned liver at Bamenda Abattoir=14310 x 7.4% x2000 =2117880Fcfa=3850 USD.
The highest loss was observed in Bui Division where 17 livers were condemned with total weight of 86kg and this translates to 172000 Fcfa.

Discussion

Fascioliasis is a well-known worldwide helminthic disease of silvatic ruminants, with the widest geographic spread of any emerging vector borne disease occurring in 51 countries. Global estimations indicate between 2.4 to 17 million human cases, and 300 million cattle infected with estimated economic loss of 3 billion US dollars annually in the livestock sector. The direct economic impact of fascioliasis is increased liver meat condemnation at abattoir during meat inspection. There is great need for laboratory help to confirm diagnosis and urgent need for greater awareness of the increasing role of fascioliasis as an emerging human disease. The direct economic impact of fascioliasis is increased liver meat condemnation at abattoir during meat inspection. An overall prevalence of 7.4% was observed in cattle slaughtered in Bamenda Municipal Abattoir using the palpation and incision technique (table2). The result showed that *Fasciola* infestation is prevalent in the study area. Although the levelof infestation here is relatively higher than what Ntonifor and Ndaleh (2013) recorded in Jakiri, it is however lower than the finding of Ntonifor and Ndaleh (2012) in Douala abattoir most probably due to differences in ecological zones and the fact that their study was carried out from March to September in contrast to this one that was done from January to June. The findings are consistent with the reports of Ardo *et al.* (2013) in Adamawa, Akpabio (2014) in Port Harcourt, Oladele-Bukola *and* Adetokun (2014) in Ibadan, Simbwa *et al.*

(2014) in Lyantonde Uganda and Rahmeto *et al.* (2014) in Hawasa Ethiopia. The level of infestation was observed to vary with the division of origin of the cattle, with Ngoketunjia recording the highest followed by Donga Mantung and Bui, while Mezam was the least (table 2). This concords with the geographic and climatic conditions where *Fasciola* is likely to strive. Ngoketunjia, Bui and Donga Mantung divisions have plains (Ndop and Mbaw plains) with stagnant waters which provide conducive environment for the multiplication of *Fasciola.* The practice of transhumance, i.e. the seasonal movement of cattle during the dry season from up the hills to the plains in search of pasture and water, allows cattle to easily pick up *Fasciola* infection. It is noteworthy that most cattle slaughtered in Bamenda originate from the other six divisions particularly Bui, Donga Mantung, Menchum and Boyo which are the cattle producing basins of the region (DREPIA North West, Annual Report 2015). It was also observed on a general note that more male cattle were brought to the abattoir for slaughter than female animals (table 1). This is explained on the basis that cattle owners' rear cows for longer periods because they are used for reproduction and also produce milk unlike the bulls. This longer stay makes them more exposed to parasitic diseases like fascioliasis (Oladele - Bukola and Odetokun, 2014). The number of males usually presented at slaughter was higher because male generate higher revenue for cattle sellers than the female animals. These findings were in agreement with other works like those of Phiri *et al,*(2005) and Keyyu *et al.*(2005). The intensity was higher in the rainy season than in dry season (table?). This is explained by the fact that cattle go on transhumance between January and end of March during which they pick up metacercariae which are the infective stage of *Fasciola.* By the time the cattle return to their rainy season grazing area the metacercariae have completed migration and attained maturity in the liver bile duct. This finding agrees with seasonal variation of *Fasciola* infection as described by Radostits and Blood (1995). Heavily infested cattle had lower body weight (table 5). With respect to adult fluke, a mean of 118.3 of fluke per liver was observed and statistical significant association between liver weight and fluke was significant, meaning that high concentration of adult flukes goes along with low liver weight (table?). This can be explained in terms of the pathology caused by flukes. Flukes suck large quantity of blood leading to anaemia and damage to liver parenchyma, with attendant weight loss and emaciation. The liver condemnation rate during the study period of six month was observed to 7.4% (52 out of 733) livers inspected. This is a pioneer study in Bamenda and the result showed that a direct financial loss due to liver condemnation at the Bamenda Municipal Abattoir was 477 000 francs (954 US dollars –table 6). According to a method used by Ephrem *et al.* (2012), annual cost of condemned liver was estimated at 2117880 francs (3850 US dollars). These results indicate that *Fasciola* infestation is an important condition that leads to high liver condemnation rate in cattle slaughtered, resulting in high financial loss in Bamenda Municipal Abattoir. Similar studies conducted in some abattoirs elsewhere showed the following annual financial losses: 9121 US dollar in Numan and Mubi (Ardo *et al*., 2013), 2703 US dollars in Lyantode Uganda (Simbwa *et al.,* 2014), 3569 US dollars in Adwa, Ethiopia (Mihreteab *et al.,* 2010).

Conclusion

The study demonstrates that bovine Fasciola fluke infestation is prevalent in cattle brought for slaughter in Bamenda from all the Divisions of the North West Region, with overall infestation level of 7.4% using the palpation and incision diagnostic technique. A total of 52 livers weighing 238.5kg were condemned due massive fluke infestation. Fasciola infestation caused financial loss as a result of condemnation of infested liver, evaluated to be 477,000 FRS at the Bamenda Municipal Abattoir during the six months study period. In addition, the survey illustrates the usefulness of meat inspection in disease monitoring. Fascioliasis is an emerging parasitic disease of cattle which imposes huge economic losses to farmers, butchers and consumers.

Recommendations

From the study the following recommendations can be made:

- A national programme for the control of fascioliasis should be elaborated and executed.
- Farmers should be informed and made aware of the losses impose by Fasciola infestation and the control programme
- Public awareness campaign should be organized in order to enlighten the populace on the consequences of fascioliasis as zoonotic disease.
- Compensation of butchers whose liver samples are condemned should be upheld

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