A POST-MORTEM, PATHOGENIC, BIO-ECONOMICS-IMPACT AND PUBLIC-HEALTH RISK PREVALENCE DETERMINATION OF *FASCIOLA SPP.* AND *PARAMPHISTOMUM SPP.* IN ABATTOIRS IN ENUGU STATE, NIGERIA

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Abstract

The prevalence of Fasciola spp. and Paramphistomum spp. – trematodes – in cattle slaughtered in Enugu state was studied. Freshly slaughtered cattle were inspected for the parasite samples. Analysis of Variance showed no significant difference among the five abattoirs. The multinomial logistic regression revealed that the probability of acquiring Fasciola spp. for cattle in poorer abattoir conditions was about 1.1 times higher compared to those with in abattoirs with better conditions (Abattoir Condition Score, ACS). Public-health incidence and prevalence likelihood of Fasciola spp. decreased with age making; trematodes (Paramphistomum spp. and Fasciola spp.) in general, a major obstacle for cattle development, bio-economic development and valuable-animal based nutritive diet security. Overall, strategic use of anti-trematodes/trematodicides; practice of trematode fencing of pasture water channels to reduce pasture contamination with fluke eggs; mass treatment in endemic areas by supplying drugs and monitoring of cattle farms by government whilst consistently embarking on proper examination of cattle and meats by veterinary inspectors before these meats are sold were recommended.

Keywords: Public-health incidence; Prevalence; Trematode; Bio-economic development

INTRODUCTION

Fasciola spp. and Paramphistomum spp. are the main trematode parasites infecting cattle. *Fasciola spp.* known as liver flukes are a class of trematode of the family Digenea in phylum platyhelminthes. These digenetic trematodes affect animals such as cattle, goat, sheep and to a less extent horses and pigs (CDC, 2024). *Fasciola spp.* causes the disease known as fascioliasis generally called 'liver rot'. The two *Fasciola* species involved include *Fasciola hepatica* and *Fasciolas gigantica* (Ichikawa-Seki *et al.*, 2017a; Ichikawa-Seki *et al.*, 2017b; Ichikawa-Seki *et al.*, 2016; Ichikawa et al., 2011; Ichikawa *et al.*, 2010). This parasitic disease of ruminant animals – cattle, goat, sheep and to a less extent horses and pigs causes heavy losses in livestock (CDC, 2024).

Fasciola hepatica is leaf-shaped and may reach a size of 30mm by 30mm. It was first identified and described by Brie (1939) and Belding (1964) as a parasite that mainly habitats in the bile duct, liver of a large number of cattle, goats, sheep and other ruminants; its cosmopolitan in its distribution and thus considered a major veterinary problem in most cattle, goat or sheep raising/rearing areas of the world (Tolan, 2011; Olusi & Amuta, 2001; Olusi, 1997).

Fasciola gigantica resembles *F. hepatica* but is easily distinguished by its characteristic shape and large size. After the

liver fluke was first discovered, identified, and described by De-Kock, Wolmarans, Bomman (2004); Brie (1939); Belding (1964); Wright, (1971); Sinclair (1971); and Sewell (1966) man was occasionally reported to be infected from infected cattle, goats and sheep – the main definitive host of fascioliasis species and/or contaminated watercress. As Musir (1992) further observed the worm burrow directly to the liver of the parenchyma causing; liver rot in host animals and therefore a veterinary problem in most cattle's, goats or sheep's-raising areas of the world. In addition, due to these trematode incidence and prevalence, evidence of necrosis and inflammation are reported frequently among ruminant stocks especially (Alatoom *et al.,* 2008; Musir, 1992; Panteleuris, 1965; Olusi and Amuta., 2001). It is common in parts of Africa (e.g., Nigeria and Kenya), the Indian subcontinent, central and southeast Asia, and other subtropical and tropical areas of the world (Alatoom *et al.,* 2008).

Fasciola spp. infection regrettably is not limited to animals. Man can also be infected by drinking water or ingesting vegetables contaminated with the encysted metacercariae after which the live worm burrow through the skin epidermis into the parenchyma of the liver leaving an evidence of necrosis and inflammation (De-Kock, Wolmarans, Bomman, 2004; Muirs, 1992). The cercariae which is the mature form of the miracidum then, develop and multiply with a thick cover around itself.

Most of these flukes are very discriminating in their choice of snail intermediate host and; the geographic distribution of trematode species is dependent on the distribution of suitable species of snails; *Galba truncatula* (formerly *Lymnea truncatula*) and *Radix natalensis* (formerly *Lymnaea natalensis*). They can be found in countries like East, central and West Africa, Algeria, Holland, Argentina, France, Romania, etc (Mas-Coma, Valero, Bargues, 2019; Hamoo, Al-Rubaye, Mustafa, 2019; Mas-Coma, Bargues, Velero, 2005; Mas-Coma, Bargues, Esteban, 1999; Facey and Marschen, 1990; Sinclair, 1971). In extensive out-breaks, hundreds of cases of infection are reported from the above countries and Cuba (Belding, 1964). Heavy infections with fascioliasis species in both animal and human hosts often lead to reduction in survival rate and reproductive ability. The prevention of fascioliasis is chiefly based on the eradication of snail host, control of the parasites in cattle and avoiding consumption of raw watercress and other infected vegetation (Hansen and Perry, 1994; Asanji and Williams, 1988; Wright, 1971).

Paramphistomum spp. is a gastro-intestinal trematode specie also belonging to the family of Digenea in phylum Platyhelminths. They affect animals such as cattle. *Paramphistomum spp.* is known to cause an acute enteritis resulting from the migration of the immature flukes in the duodenal mucosa and is characterized by profuse and foetid diarrhoea, dehydration, loss of body condition, weakness, pallor of the mucosae and submaxillary oedema. *Paramphistomum spp.* are usually thick, short (4-12mm), fleshy maggot-like worms. They may affect all ruminants but young calves and lambs are the most susceptible. They are found to attach in the duodenal. The immature paramphistomes migrate up the alimentary tract and finally attach to the epithelium of the rumen and reticulum (Khedri *et al.,* 2015; Hansen & Perry, 1994). The prepatent period is 3-5 months. The infections are very common in Africa, i.e. (Nigeria, Kenya), Asia, Oceania, etc. Not all the species are pathogenic, but clinical outbreaks of paramphistomiasis have been caused by *Paramphistoum microbothrium* (Africa), and *Cotylophoron cotylophoron* (Asia).

Geographic distribution of Fasciola spp.

Fasciola spp. occurs most in sheep, cattle, and goats, although a wide range of hosts has been reported. It is cosmopolitan in distribution throughout the cattle raising/rearing areas of the world (Food and

Agriculture Organisation (FAO), 2024a, b; Albadawi, 2010; Olusi and Amuta, 2001; Urquahart *et al.*, 1989; Urquhart and Sewell, 1992; Blacklock & Southwell, 1977; Crol, 1966; Allonby, 1980; Allonby and Urquhart, 1975; Allonby and Urquhart, 1973; Allonby and Dargie, 1973; Facey and Marschen, 1990). It is most prevalent in low wet pastures where suitable species of snails (*Lymnea truncatula*) are indigenous (Heydarian *et al.*, 2022; Aryaeipour *et al.*, 2017; Wright, 1971) though, infection of *Fasciola spp.* has been reported along coastal streams in the United States of America (USA), some parts of Nigeria, Europe, Australia, Turkey, France, etc (Aryaeipour *et al.*, 2017; Belding, 1964) amidst reports of its prevalence in South America, the Caribbean, the middle East and tropical countries (Heydarian *et al.*, 2022; Aryaeipour *et al.*, 2017; Olusi and Amuta, 2001; Facey and Marschen, 1960; Smyth and Clergy, 1981; Smyth, 1996)

Pathogenicity/pathology of Fascioliasis

Heavy fascioliasis infection in ruminants ranges in severity from a devastating highly fatal disease in sheep to an asymptomatic infection in cattle. The severity of pathological manifestation usually depends on the number of metacercariae ingested over a period of time and the elative susceptibility of the animal. In animal hosts, acute fascioliasis occurs seasonally and is manifest by anaemia and sudden death. Such sudden deaths can occur within 6 weeks of infection due to severe hepatic lesions, blood and bile in the abdominal cavity and Cirrhosis of the liver obvious when there is excessive migration of the fluke. Chronic cholangitis, hyperplasis of connective tissues and, excessive destruction of the liver of domestic animal hosts occurred with *Fasciola spp.* infection are also obvious when there is excessive migration of the fluke. Cases of chronic fascioliasis occur in all seasons and the clinical signs may include amaemia, reduced weight gain, decreased milk production, thriftiness in productive and reproduction ability, submandibular oedema and possibly death of the animal (Lalor *et al.*, 2021; Gruner, 1991; Dunn, 1978).

In man, *Fasciola spp.* infection of the immature worms produce small necrotic foci or nicroabscesses of irregular contour with characteristic eosinophilic and leukocytic infiltration during the period of invasion. Deposit of ova/ova sclerosis or hepatic enlargement and portal cirrhosis destroys the hepatic cells and portal vessel (Blacklock and Southwell, 1977).

Paramphistomes burden size is the most important factor that determine the degree of small intestinal damage and the possible clinical effects. The immature flukes may be responsible for severe damages while embedding and necrosis in the gut wall. If present in sufficient numbers, the damage may be responsible for clinical signs. Affected animals are listless, with reduced appetite and increased thirst. A profuse foetid diarrhoea develops which may be accompanied with anaemia, oedema and emaciation. Severe cases lead to death in but a few days, especially in young calves and lambs (Stuen & Ersdal, 2022; Olajide *et al.*, 2017; Ardo, Aliyara and Lawal, 2013; Anene *et al.*, 1994; Dixon, 1966).

Bio-economic, clinical and public health impact

The symptom of fasciolasis depends upon the intensity of the infection, the stage of the disease, and the complications. Variable acute symptoms occur during the three-month invasion period of the immature flukes. These symptoms may include weight loss, hepatic pain, asthemia, fever, allergic pulmonary pneumonia, masting, hepatomegaly. *Fasciola spp.* infection may also cause irregular septic temperature, leucocytosis, eosinophilia, enlarged liver and spleen. Bio-economic importance cum impact of fasciolaisis infected cattle consist in economic loss-impacts caused by contamination of the animal liver obvious sometimes at slaughter. Also, productivity losses especially due to reduced weight

gain; digestive disorders, fever, hepatomegaly and jaundice (that sometimes occurs). Across animals, *Fasciola spp.* infection cause ill-health, low productivity, and can even lead to death. Regrettably too, *Fasciola spp.* infection in humans as well can cause death particularly when the human host is infected with largely significant fascioliasis spp. quantity (Lalor *et al.*, 2021).

Diagnosis

Patent Fascioliasis species and *Paramphistomum spp.* infections can be diagnosed by faecal egg and post-mortem worm counting. Examination of eggs in faeces is most commonly used in routine diagnosis of chronic fascioliasis but a more precise assessment of the fluke burden of an animal can be made by post-mortem examination and identification of immature and mature flukes. This is because post-mortem worm examination is generally considered to be the most accurate method of diagnosis of helminthiasis though expensive (Hosseini et al., 2015; Urquahart *et al.*, 1989; Urquhart, 1992; Hall, 1999; Hall, 1977).

Treatment

In animals, treatments with the use of anti-helminths such as; triclabendazole (10mg/kg), rafoxanide (5.0-10.0mg/kg), brotianide (10-15mg/kg), mitroxynil (8-15mg/kg), diamphenetide (80-120mg/kg), and miclofolan (4-8mg/kg), are effective against both the immature and mature stages of *Fasciola spp.* Oxyclozanide (15mg/kg) has been found to be effective against the adult stages. Ciclosamide (90mg/kg), brotianide (15mg/kg) and closantel have been shown to be effective in treating Paramphistomosis (García-Dios *et al.*, 2020).

Prevention and control

Prevention and control of trematode incidence and prevalence is designed to eliminate or reduce the prevalence of trematodes and improve the productivity of the livestock industry. Thus, eradication of trematodes in animals is sometimes difficult due to the aim of control in limiting infection by minimizing the infection burden cum challenge to an economically justifiable level. Hence, public health generally recommended control should be preventive, cost-benefit effective rather than curative (García-Dios *et al.*, 2020). Thus, effective control may incorporate:

a. Reduced number of intermediate hosts
b. Anti-trematodes treatment use strategy to reduce the number of fluke burden in the host animal and the number of fluke eggs in the pasture
c. Fluke-prone area management to reduce exposure to infection especially exposure to water snails during uninfected livestock grazing
d. Veterinary and Public health officer's inspection and early diagnosis to detect the presence of ova in infected animals, abattoir activity and; proper eradication
e. Sustainable control management strategies of; rotational livestock grazing, separation of animals according to age groups, alternative grazing by different animal stock between reared animals to reduce the degree of cross-transmission; reducing animal stock rates to reduce posture contamination with trematode eggs or larvae; management and control improvement manoeuvres employed via parasite free forage, slatted floor housing systems, raised feed or water troughs; breeding/rearing genetic resistant-trematode stocks; vaccination of adult sheep and small ruminants to confer and stimulate persistent immunity

The aim of this study was to evaluate cum determine by post-mortem investigation the prevalence of trematode infection in cattle, the prevalence of infection in relation to sex and estimate values of select potential risk-factors

consequent on bio-economics and productivity.

Materials and method

Description of study area

The study was carried out in New Gariki, Mammy market, Artisan market, Ogbete and Gariki market abattoirs in Enugu state. New Gariki market, Gariki market is located in Enugu south local Government Area of Enugu state. New Gariki and Gariki market is located at the centre of Enugu south Local government town and Agbani road. Agbani road lies at the latitude 281° meters due west of the state. Residents of Gariki urban include mostly students, civil servants, traders and farmers. The Gariki market abattoir is situated along a major river called Inyaba river.

Mammy market abattoir lies at latitude $118^{\underline{0}}$ meters due east and longitude $170^{\underline{0}}$ meters due south of the state. Artisan abattoir and Mammy market abattoir especially are situated at the heart of Enugu urban. Artisan market abattoir and Ogbete market is located in Enugu north local Government area of Enugu state.

Method of sample collection

The trematodes were collected by handpicking with hand glove from the rumen and livers. All samples were collected in transparent specimen jars/bottles containing 70% ethanol/formalin and was labelled. The sex, and number of infected cattle were recorded. This research lasted for a period five (5) weeks. The target per day was between 4 to 6 giving a total of 20 examined cattle, on the average, per week.

Method of laboratory diagnosis

Parasites sample were collected using gloves (hand picking) immediately cattle were killed. The collected samples were placed in a clean universal or transparent bottle that preserves it given the screw top-air tight condition of the transparent bottle. The universal bottles were labelled with a unique identification number which match with detailed data recording using the standard format style. The collected parasite sample was then transported to Enugu State University of Science and Technology Laboratory for gross and microscopic examination.

Results and discussion

Risk Factors Analysis

This result obtained from the cross-sectional study carried out on the prevalence of Fascioliasis and Paramphistomum in cattle in five Enugu abattoirs is as presented in Tables 1-5. The prevalence and abundance values varied greatly. Table (1-5) show that out of the total of 131 cattle slaughtered within the period of the study, 32 (24.4%) were infected in Gariki abattoir; 21 (16.0%) were infected in Mammy market abattoir; 18 (13.7%) were infected in Artisan abattoir; 25 (19.08%) were infected in New Gariki abattoir; 22 (16.80%) were infected in Ogbete abattoir (Table 1-5).

Table 1: Number of Cattle infected per week in Gariki Abattoir

Week	No. of cattle examined	No. of cattle infected	Prevalence (%)
1	27	6	4.58%
2	22	2	1.53%
3	27	4	3.05%
4	31	6	19.35%
5	24	14	10.69%
Total	131	32	24.43%

Table 2: Number of Cattle infected per week in Mammy market Abattoir

Week	No. of cattle examined	No. of cattle infected	Prevalence (%)
1	28	6	4.58%
2	24	5	3.82%

3	27	4	3.05%
4	22	4	3.05%
5	30	2	1.53%
Total	131	21	16.03%

Table 3: Number of Cattle infected per week in Artisan market Abattoir

Week	No. of cattle examined	No. of cattle infected	Prevalence (%)
1	28	5	3.82%
2	27	3	2.29%
3	29	1	0.76%
4	29	7	5.34%
5	18	2	1.53%
Total	131	18	13.74%

Table 4: Number of Cattle infected per week in New Gariki Abattoir

Week	No. of cattle examined	No. of cattle infected	Prevalence (%)
1	34	3	2.29%
2	25	5	3.82%
3	26	9	6.87%
4	24	5	3.82%
5	22	3	2.29%
Total	131	25	19.08%

Table 5: Number of Cattle infected per week in Ogbete market Abattoir

Week	No. of cattle examined	No. of cattle infected	Prevalence (%)
1	27	5	3.82%
2	29	5	3.82%
3	27	4	3.05%
4	23	6	4.58%
5	25	2	1.53%
Total	131	22	16.80%

Prevalence in the abattoir

More than one hundred and thirty-one samples were examined from the period of the study. Results obtained showed slight variance in prevalence among cattle slaughtered during the study. Total summary of prevalence of *Fasciola spp.* and *Paramphistomum spp.* by sex is shown in Table 6 and summary prevalence in Table 7. Result from Table 6 reveal that out of 131 cattle examined, about 9 (6.87%) bulls were positive for Paramphistomum in Gariki abattoir, 3 (2.29%) bulls were positive for fascioliasis in Gariki abattoir while; 6 (4.58%) cows were positive for Paramphistomum and, 29 (22.1%) cows were infected with the fascioliasis trematode all in Gariki abattoir (Table 6).

Table 6: Prevalence by sex of Paramhistomum and Fascioliasis infected Cattle per week in Gariki Abattoir

Week	No. of cattle examined	No. of cattle infected		No. of cattle infected	
		Bull		Cow	
		Paramhistomum	Fascioliasis	Paramhistomum	Fascioliasis
1	27	1	0	1	6
2	22	2	1	0	1
3	27	1	2	5	2

4	31	3	0	0	6
5	24	2	0	0	14
Total	131	9	3	6	29

Table 7: Total prevalence of Fascioliasis infection in cattle in all the Abattoirs

Week	No. of cattle infected		No. of cattle infected		No. of cattle infected		No. of cattle infected		No. of cattle infected	
	Gariki Abattoir		Mammy market Abattoir		Artisan market Abattoir		New Gariki Abattoir		Ogbete Abattoir	
	X	$(X)^2$	X	$(X)^2$	X	$(X)^2$	X	$(X)^2$	X	$(X)^2$
1	6	36	6	36	5	25	3	9	5	25
2	2	4	5	25	3	9	5	25	5	25
3	4	16	4	16	1	1	9	81	4	16
4	6	36	4	16	7	49	5	25	6	36
5	14	196	2	4	2	4	3	9	2	4
Total	32	288	21	97	18	88	25	149	22	106

Computing the sum of infected cattle per abattoir for all abattoirs

X_T= 32+21+18+25+22=118

Computing the sum of squares of infected cattle per abattoir for all abattoirs

$\sum(X_T)^2$= 1024+441+324+625+484=2898

Calculating the total sum of squares

$$\sum(X_T)^2 = \sum X_T^2 - \frac{\sum(X_T)^2}{\sum N}$$

$$= 2898 - \frac{(118)^2}{25}$$

= 2898 – 556.96

= 2341.04

Determining the variance for each abattoir

Variance for Gariki Abattoir

$$S^2_T = \frac{\sum X_T^2 - \frac{\sum(X_T)^2}{\sum N}}{N}$$

$$= \frac{288 - 204.8}{5}$$

= 16.64

Variance for Mammy market Abattoir

$$= \frac{97 - 88.2}{5}$$

= 1.76

Variance for Artisan market Abattoir

$$= \frac{88 - 64.8}{5}$$

= 4.64

Variance for New Gariki Abattoir

$$= \frac{149 - 125}{5}$$

= 4.8

Variance for Ogbete market Abattoir

$$= \frac{106 - 96.8}{5}$$

= 1.84

Table 8. Result of the multinomial logistic regression for *Fasciola spp.*

Parasitic Taxon	Factor	Variable	Odds Ratio	95% CI per Odds Ratio		p-Value
				Lower	Upper	
Fasciola spp.	Abattoir condition score (ACS)	5	Reference			
		4	1.0890 (0.0670)	-.0966744	.230671	0.422
		3	1.0751 (0.0939)	-.1089585	.2591214	0.424
		2	1.100 (0.0747)	-.0461971	.2465623	0.180

		1	1.0628 (0.0732)	-.0807241	.206394	0.391
	Age class	Adults	Reference			
		Calves	-2.479*** (0.662)	-3.776036	-1.182385	0.000
		Young	-1.965*** (0.629)	-3.197553	-.7316708	0.002

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The result of the study and as presented informs policy considering the prevalence of *Fasciola spp.* and *Paramphistomum spp.* in slaughtered cattle in Enugu abattoirs. The multinomial logistic regression revealed that the probability of acquiring *Fasciola spp.* for cattle in poorer abattoir conditions was about 1.1 times higher compared to those with better ACS. This is an important factor influencing the occurrence of *Fasciola spp.* and in tandem with previous studies (Belina *et al.*, 2017; Amanuel & Bekele, 2022) that posit abattoir condition and environmental condition as a higher risk factor influencing animal stock-parasite incidence and prevalence. The results also revealed that *Fasciola spp.* incidence and prevalence decreased with age.

The prevalence of these parasites in the study cattle animals may have been positively influenced by vanishing swampy areas because of global warming to the advantage of cattle rearers. Trematodes (*Paramphistomum spp.* and *Fasciola spp.* especially) are life-cycle-home-grown via intermediate hosts such as *Lymnea truncatula* and, *Bulinus spp*, P*lanorbis spp.* especially in the absence of snails. Thus, infection and prevalence rates in the study may have been higher given possible interrupted life cycles of these parasites due to environmental change global warming that may be desiccating wet-lands and snail proliferation. In consequence, farmers need 33% increased water for their animal rearing from pre-industrial revolution demand in, animal farms, orchards or gardens due to global warming. More complicating is the resort to jigged wells as water sources with multiplier effect of further desiccation of streams or swampy areas – where most of these intermediate host snails live due to the well-drilling. Hence, the odds of *Fasciola spp.* and *Paramphistomum spp.* are lower in the dry season, while wet midland agroecology areas are a higher risk potential (Ibrahim *et al.*, 2014; Hailelul, 2002; Yoseph, 1993a; b)

Conclusion and recommendation

In general, it can be concluded that trematodes (*Paramphistomum spp.* and *Fasciola spp.*) are major obstacles for cattle development, bio-economic development and valuable-animal based nutritive diet security. This is further complicated in the presence of poorer biotype conditions and snail intermediate hosts. Further, prevalence rates of trematode (*Paramphistomum spp.* and *Fasciola spp.*) parasites are economic limiting factors owing to animal mortality, animal-health insecurity, increased likelihood to anti-parasitic medicines purchase and use despite unvalued global warming advantage especially with desiccated wet-lands that influence decrease in presence of intermediate hosts.

Overall, strategic use of anti-trematodes/trematodicides; practice of trematodicides fencing of pasture water channels to reduce pasture contamination with fluke eggs. Also, government should embark on mass treatment in endemic areas by supplying drugs and monitoring treatment of cattle farms by farmers. Again, infected cattle should be well treated and their meats properly examined by

veterinary inspectors before these meats are sold.

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