

Prevalence of *Coenurus cerebralis* and its Economic Loss in Small Ruminants Slaughtered at Bishoftu Elfora Export Abattoir, Ethiopia

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Abstract: A cross-sectional study was carried out at Elfora Export Abattoir in Bishoftu town, Ethiopia from November 2014 to April 2015 to assess the prevalence and economic impact of *Coenurus cerebralis* in small ruminants. Of a total 384 sheep 384 goats heads examined, 19(4.9%) and 45(11.7%) sheep and goats were found to be affected by coenurosis, respectively. The difference in prevalence between the two species was statistically significant ($p < 0.05$). The localization of cyst in the brain of small ruminants showed that the *Taenia multiceps* larval stages, *C. cerebralis*, most commonly found in the cerebral hemispheres (94.7%) and the rest in the cerebellum (5.3%). In the cerebral hemispheres, the left side cerebral hemisphere contained (64.44%) in goats, (47.37%) in sheep, in the right side cerebral hemisphere (20.0%) in goats, (42.11%) in sheep, in the median fissure of the cerebrum (13.33%) in goats, (5.26%) in sheep and the rest in the cerebellum (5.3%) both in sheep and goats Postmortem examination had showed that *C. cerebralis* occurred with a range of 1 to 5 cysts per brain. The total annual financial loss due to brain condemnation was estimated at 18,127.2 USD (335,353.2 ETB). Based on this study, it was concluded that coenurosis was one of the most important parasitic diseases in small ruminants in Ethiopia which resulted in great economic loss at national level and therefore, appropriate control measure should be taken.

Key words: *Coenurus cerebralis* • Prevalence • Small Ruminants

INTRODUCTION

Naturally endowed with different agro-ecological zones and suitable environmental conditions, Ethiopia is a home for many livestock species and for production of livestock. As estimate indicates that the country is the home for about 25.5 million of sheep and 24.06 million of goats [1-3]. About 99.8% of the sheep and nearly all goat populations of the country are local breeds [1].

Coenurus cerebralis (*C. cerebralis*) is the metacestode or larval form of the dog tapeworm *Taenia multiceps* (*T. multiceps* or *multiceps*), which causes coenurosis also known as gid or sturdy [4]. *Coenurus cerebralis* is a commonly occurring parasitic disease that affects ruminants, horses, pigs, canines and human beings [5, 6]. The larval stage of *T. multiceps* is mainly found in the brain and in some instances in the spinal cord of sheep and goats. The cysts of *T. multiceps* may be present elsewhere in the brain and spinal cord, protruding into the cerebral ventricles, but they often found near the surface of parietal cerebral cortex. The

predilection sites of *C. cerebralis* are in the cerebral hemispheres of the brain, especially in the subarachnoid space, which facilitates the nourishment of the cysts by cerebro-spinal fluid (CSF) of the brain [7].

Coenurus cerebralis is distributed worldwide especially, most common in the developing countries of Africa and Asia where sheep and goat rearing is a common source of income [8-11].

The adult parasite of *C. cerebralis* is found in small intestines of the definitive host (domestic dogs and wild canids such as coyotes, foxes and jackals). The adult parasite tapeworm of dogs reaches maturity after 40-42 days. The life cycle *C. cerebralis* starts when the definitive host, mainly dogs, starts to disseminate the gravid proglottids which contain almost 37,000 eggs that are released from proglottids with the feces. Eggs then contaminate the environment and water which resists for 15 days under dry environmental conditions or 30 days with high level of humidity [12]. The intermediate hosts, sheep and goats, are infected by ingesting the eggs deposited in the grass or water. In the small intestines of

sheep and goats the eggs hatch to the oncospheres (embryos) which then penetrate the wall of small intestine and circulate in blood to lodge in the brain of sheep and goats [13].

Morphologically, *C. cerebralis* reaches full development in the brain of sheep and goats 6-8 months and can grow to a size of 5 cm or more with cysts containing a considerable amount of fluid and germinal epithelium with 500-700 scolices distributed in the non-linear groups [14].

The pathogenic effects of *C. cerebralis* are that of the space occupying lesion and the pressure applied to the brain by the cyst during its development. The clinical signs depend on the size and sites of cyst in the brain. Affected sheep and goats may become blind in one or both eyes and indifferent to feed and water which results in emaciation and death of the animals [15, 16].

The significant economic loss incurred by *C. cerebralis* in small ruminants slaughtered at abattoirs in Ethiopia is due to the condemnation of edible organ (brain) of small ruminants affected with *C. cerebralis* [17].

Therefore the main objectives of the study were:

- To determine the prevalence of *C. cerebralis* in small ruminants slaughtered at ELFORA export abattoirs.
- To estimate the economic loss due to brain condemnation by *C. cerebralis* in small ruminants slaughtered at ELFORA abattoir

MATERIALS AND METHODS

Study Area: The study was conducted at ELFORA Export Abattoir in Bishoftu town, Ethiopia. ELFORA Export Abattoir is found in Bishoftu town, Oromia Regional State. Bishoftu town is located at 47 km South East of Addis Ababa. The area has an altitude of 1,880 meters above sea level with an average annual rainfall of 866mm. It has a bimodal rainy seasons; a main rain season extends from the month of June to September and a short rain season from March to May. The annual average minimum and maximum temperature is 14°C and 26°C, respectively. Day length is constant throughout the year (12-13hours) with about six hours sunshine during the rainy season and eight to ten hours for the rest of the year. Humidity is about 63.8% [18].

Study Animals: The population of target animals were sheep and goats slaughtered at ELFORA Export Abattoir at Bishoftu, for the prevalence and economic loss caused

by *C. cerebralis* in the brain. The animals were originated from different parts of the country (Borena, Omo, Konso, Afar, Jijiga, some parts of Arsi and Babile) representing different agro-ecological zones.

Study Design: A cross-sectional study was conducted from November 2014 to April 2015 on the heads of sheep and goats slaughtered at ELFORA Export Abattoir at Bishoftu for the determination of prevalence and economic loss due to coenurosis.

Sample Size Determination: By using simple random sampling methods and 95% confidence interval with required 5% precision, the sample size was determined by the formula [19].

$$n = \frac{1.96^2 P_{exp} (1 - P_{exp})}{d^2}$$

Where;

n= required sample size

P_{exp}=expected prevalence

d= Absolute precision

The expected prevalence of *C.cerebralis* was 50% with the required precision (d) of 5% (0.05). By substituting the value in the above formula:

$$n = \frac{1.96^2 \times 0.5(1-0.5)}{(0.05)^2}$$

n=384 for each sheep and goats

Sample Collection and Methodology: An active abattoir survey was conducted to detect the presence of coenurosis in sheep and goats presented for slaughter to the ELFORA export abattoir at Bishoftu. The sheep and goats purchased for slaughter were randomly selected, marked with color paints on their heads while they were in the lairage and ante-mortem examinations were conducted to observe any specific clinical signs (neurological signs).

Three visits per week were paid to the abattoir during the study and twelve to fifteen heads were examined per visit. The ages and breeds of the animals were recorded. The age was estimated based on dentition [20, 21] and the sex of the animals were all males that were slaughtered for export of meat, edible red offal and brain and the breeds were almost all local. Information on the prior anti-parasitic treatments was not known.

The heads of the slaughtered sheep and goats were separated from the rest of the body of animal by cervical dislocation at the atlanto-occipital joint, then after removal of the tongue by skinning knife at the area just caudal to the frontal bone of the head were cut cross-sectionally by using bone-cutter. After opening the skull, the meninges were incised with the tip of scalpel blade. The brain was carefully examined for the presence of larval stages of dog tapeworm, *C. cerebralis* and in which hemispheres the cyst was located and the number of cysts per brain were counted and the results were recorded.

Direct Economic Loss Assessment: The financial loss from domestic and international markets due to brain condemnation of small ruminants with *C. cerebralis* cysts at ELFORA export abattoir was estimated by adopting the formula [22].

$$EL = \sum Srx * Coy * Roz$$

Where,

EL- Estimated annual economic loss of the brain from domestic or international market due to coenurosis

Srx- Annual sheep and goats slaughter rate of the abattoir

Coy- Average cost of the brains in the abattoir

Roz - Condemnation rates of sheep and goats brains

Data Analysis and Management: Data was entered into data base management software Microsoft Excel computer program and data was analysed by using SPSS statistical computer software program. Chi-square (χ^2) was used to determine the statistical association between age, origin, localization of the cysts in the brain, number of *C. cerebralis* cysts per brain and breeds. The statistically significant associations between variables were considered if the calculated P-value was less than 0.05 with 95% confidence level.

RESULTS

Out of 384 sheep and 384 goats heads examined after slaughter 45(11.7%) and 19(4.9%) in goats and sheep, respectively, harbored *C. cerebralis* in their brains. The prevalence of the *C. cerebralis* was significantly higher in goats than in sheep. The prevalence between the three age groups was not significant (Table 1).

The location of *C. cerebralis* in the brain of sheep and goats were mostly in the cerebrum (94.7%) and two cases were observed in the cerebellum (5.3%) which was significant (Table 2) and the number of cysts per brain were from 1 to five with 1 cyst per brain most frequently observed during the study (Table 4).

Table 1: Prevalence of *Coenurus cerebralis* with age in small ruminants slaughtered in ELFORA export abattoir

Animal examined	Age	No. examined	No. of positive	Chi-square	P-value
Sheep	<2years	299	13(4.3%)	1.243	0.537
	2-3years	75	5(6.5%)		
	>3years	10	1(10.0%)		
Total		384	19(4.9%)		
Goats	<2years	317	39(12.3%)	2.403	0.301
	2-3years	64	5(7.8%)		
	>3years	3	1(33.3%)		
Total		384	45(11.7%)		

Table 2: Localization of *Coenurus cerebralis* cysts in the brain of sheep and goats infected with *Coenurus cerebralis*

Animals examined	No. examined	No. of positive	Localization of the cyst in the brain				χ^2	P-value
			RCH	LCH	MF	CRL		
Sheep	384	19	8	9	1	1	3.840	<0.001
Goats	384	45	9	29	6	1		
Total	768	64	17	28	7	2		

RCH= Right side cerebral hemisphere

LCH= Left side cerebral hemisphere

MF= Median fissure of the cerebrum

CRL= Cerebellum

Table 3: Prevalence of *Coenurus cerebralis* with respect to the origin of small ruminants slaughtered in the abattoir

Animals examined	Origin	No. examined	No. of positive	Chi-square	P-value
Sheep	Lowland	334	16(4.8%)	0.135	0.713
	Midland	50	3(6.0%)		
	Total	384	19(4.9%)		
Goats	Lowland	318	35(11.0%)	2.403	0.301
	Midland	66	10(15.2%)		
	Total	384	45(11.7%)		

Table 4: Number of *Coenurus cerebralis* cysts per brain of positive sheep and goats

No. of cysts/brain	No. of positive animals		
	Sheep	Goats	Total
1	9	33	42
2	3	4	7
3	5	4	9
4	1	3	4
5	1	1	2
Total	19	45	64

Economic Loss Assessment: The financial loss from domestic and international markets due to brain condemnation of small ruminants with *C. cerebralis* cysts at ELFORA export abattoir was estimated at 18,127.2 USD or 335,353.2 ETB. Where the annual slaughter rate of sheep and goats were 149,760, the rejection rate of brain was 8.3% and average cost of brain was 1.75 USD/kg.

DISCUSSIONS

Coenurosis is an important parasitic disease in sheep and goats worldwide caused by the larval stages *C. cerebralis* and cause severe economic loss [23].

According to the findings of the study the prevalence of coenurosis in sheep and goats were 4.9% and 11.7%, respectively. The difference in the two species was highly significant ($P < 0.05$). The observed difference might be due to the fact that the origin of the sampled animals could be from different localities within the same agro-ecological zones. The study indicated that there was no significant difference in age and origin of the small ruminants ($P > 0.05$).

The study was in agreement with the study done at Ethiopian Health and Nutrition Research Institute (EHNRI), Addis Ababa by Asefa *et al.* [24] which reported *C. cerebralis* cysts 4.7% in sheep. Previous studies by Adem [25] indicated that the higher prevalence due to *C. cerebralis* was reported in goats (12.44%) and lower in sheep (2.3%). The agreement in prevalence of the cysts in goats with the present study might be due to similarity in origin and the method of sampling.

The study was in-line with the prevalence *C. cerebralis* in Gaza and Tete Provinces of Mozambique that had been reported to range from 7.3% to 13.8% based on abattoir findings in goats by Vink *et al.* [26]. The reason for the correlation between the prevalence in goats might be due to related ecological variables such as rain fall, relative humidity and air temperatures.

The annual estimated financial loss in the present study need to be cautiously interpreted as it would be affected by factors which are dynamic and change over time due to market price of sheep and goats as condemnation of the brain means condemnation of the animal, prevalence of disease and number of animals slaughtered every year which can change the amount of financial loss from year to year. Financial loss analysis due to coenurosis in sheep and goats were done based on number of brains condemned per year and its retail price in international market and the condemnation rate of sheep and goats brain. Based on this, the estimated

financial loss due to coenurosis in sheep and goats during the study period was 2,184 USD (149,760 ETB). The financial loss analysis was reported by Ejeta *et al.* [27] mentioned that coenurosis in small ruminants was a major cause for condemnation of brain (85.7%) in Ethiopia from apparently healthy slaughtered sheep and goats.

CONCLUSION

The study indicated that coenurosis was an important parasitic disease in sheep and goats caused by the larval stages *C. cerebralis* and induced severe economic loss due to brain condemnation in Ethiopia. Inappropriate disposal of heads of small ruminants being practiced by some of the abattoirs could enhance the continuation of the life cycle of *C. cerebralis* between the intermediate (sheep and goats) and final hosts (dogs).

Based on above conclusion the following recommendations were forwarded:

- ▶ To prevent infection in dogs and to interrupt the life cycle of the parasite, infected sheep and goats' heads should not be fed to dogs nor left available for wild carnivores.
- ▶ Dogs should be regularly dewormed and prohibition of backyard slaughter.
- ▶ Proper disposal of heads of small ruminants infected with *C. cerebralis* cysts.
- ▶ For human protection, dogs should be kept out of vegetable plots to prevent contamination of the vegetables by eggs from the dog's faeces. Hygienic measures should also be observed or vegetables should be thoroughly washed and cooked before consumption.
- ▶ Immediate attention should be paid to the safe and controlled elimination of all condemned abattoir heads of sheep and goats.
- ▶ Awareness creation programs should be launched for the butchers, abattoir workers, meat-sellers and dog owners as to the danger of the *C. cerebralis* to human as well as animal health.

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