European Journal of Applied Sciences 7 (2): 56-63, 2015
ISSN 2079-2077

DOI: 10.5829/idosi.ejas.2015.7.2.93193

Prevalence of *Coenurus cerebralis* in Small Ruminants Slaughtered at Hashim Export Abattoir, Debre Zeit, Central Oromia

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Abstract: A total of 608 small ruminant (80 sheep and 528 goats) heads from Hashim Export Abattoir in Debre Zeit, Oromia regional State and central Ethiopia were examined for *Coenurus cerebralis* (*C.cerebralis)* from November 2009 to March 2010. An overall prevalence of 23(3.78%) *C. cerebralis* was recorded in examined small ruminants. Where as a prevalence of 3.9% in goats and 2.5% in sheep was detected. Statistically significant ($p<0.05$) variations in the prevalence of *C. cerebralis* among species was never observed. The result of the study also revealed that, 4.8% prevalence of *C. cerebralis* was observed in small ruminants originated from Jinka than those from the other study areas where there is no statistically significant variations ($p<0.05$). In addition, 8.1% prevalence was recorded during November than other study months. Likewise, higher prevalence of *C. cerebralis* was observed in young (6.8%) than adult age small ruminants. Maximum number of cyst burden was seen in caprines (Four cysts per brain. The major economic losses associated to coenuruses of small ruminants for the export Abattoir are brain condemnation, time and loss of energy to dissect the brain of small ruminants for export purpose. Further detail studies involving different agro ecology, management system, breeds of hosts and analysis of economic losses are urgently needed to be conducted in Ethiopiain Ethiopia.

Key words: Hashim Abattoir · *Coenuruses cerebralis* · Prevalence · Small Ruminants

INTRODUCTION

Livestock in developing countries play a crucial role in improving the ever worsening situation between food supply and demand due to human population pressure. Ethiopia possesses the largest livestock in Africa, with an estimated population of 47.5 million cattle, 26.1 million sheep, 21.7 million goats, 7.8 million equines, 1 million camels and 39.6 million chickens [1]. Nowadays small ruminant production enterprises are very attractive in the world market, this is due to small ruminants are sources of food such as milk and meat; provide 30% of local meat consumption, generate cash income from export of meat, live animal and skin; are adaptable to abroad range of environments; have short generation cycles and high production rate.

In spite of the presence of large number of small ruminant population and profitability of small animal production enterprises, Ethiopia fails to optimally utilize this resource as the sector is suffering from lower productivity. Among many factors which limit the economic return from small ruminants parasitism stands in the front line. It is a well established fact that parasitized animals perform less efficiently, food conversion is adversely affected, carcass quality is reduced, wool yield declines and consequent economic losses are significant [2, 3].

Cestodes of the family Taenidae, for which the dog is the final host, infect a wide range of intermediate host species where they cause echinococosis\ hydatidosis, cysticercosis or coenurosis. Infections with the larval stages of some species of Taenia have great veterinary

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importance due to economic loss from condemnation of infected offal or meat [4-6]. Coenurosis is a disease caused by invasion of the larval stage of *Taenia multiceps* in the central nervous system (brain and spinal cord) of sheep, goats and rarely humans. The adult tape worm, *Taenia multiceps*, is found in the small intestine of the dogs and wild canides. Where as the larval stages, *C cerebralis*, are normally found in the brain or spinal cord of sheep and goats. The larval form may rarely infect man, where it causes neurosis on accidental ingestion of tape egg in the faces of dogs [7].

Coenurus cysts sometimes could be found in unusual locations like in subcutaneous or intramuscular tissue and other organs especially in goats and have also been reported to exist in sterno-cleidomastoid muscle, Axilla and eye in man [8]. Coenurosis is more commonly reported in growing sheep aged 6-18 months where it presents as a slowly progressive focal lesion of the brain typically involving the cerebral hemisphere [9].

The adult tape worm is found in dogs and wild canids. It inhabits the small intestine, where it can reach a length of 40-100 cm without causing any symptoms in this host. The mature proglottid segments pass with the faces, after which the eggs are liberated and distributed into the environment. These eggs consist of an embryo or onchosphere covered by a thick, tough envelope which prevents the desiccation and inactivation of the onchosphere in the environment [10]. The life-cycle is indirect with sheep and goats acting as an intermediate hosts. After ingestion of the eggs, the gastric and intestinal juices digest the embryo and the onchosphere is activated. After penetrating the gastric and intestinal mucosa, it passes into the blood and lymphatic circulation. The onchosphere of *Taenia multiceps* has a specific affinity for nervous tissue and eventually lodges in two predilection sites (Brain or spinal cord). Here it develops into the metacestode. This is a fluid filled cyst containing clusters of numerous invaginated scolices attached to its inner wall. The cyst takes approximately eight months to mature, during which it becomes progressively larger, as the volume of the fluid increases. At maturity, it can reach a diameter of five centimeter or more in which will result in the onset of clinical signs due to increased intracranial pressure causes deviation of the head, headache, stumbling and paralysis. The disease is also called “GID” or sturdy. Coenurosis is worldwide in distribution but most common in developing countries of Africa and south eastern region [8].

Coenurosis causes a serious problem in sheep and goat production. The clinical signs are variable and may be confused with other nervous conditions the case fatality rate is 100% [11]. Njau *et al*. [12] reported 5% annual mortality of sheep in the Ethiopian highlands due to Coenurosis. No single satisfactory treatment method has yet been devised under field conditions. Although trephing has been advocated [13-15]. In spite of the cost, the department of agriculture and fisheries in republic of South Africa recommended praziquantel at a dose rate of $100mg^{-1}$body weight as a successful coenuricide [16]. The life cycle can be interrupted most satisfactorily by control of tape worm infection in dogs and preventing dogs having access to sheep carcasses [17].

Coenuruses due to larval stage of *Taenia multiceps* can occur in both an acute and a chronic disease form. Acute coenuruses occurs during the migratory phase of the disease, usually 10 days after ingestion of the large number of tape worm eggs. Young lambs aged 6-8 weeks are most likely to show signs of acute disease. The signs are associated with an inflammatory and allergic reaction. There is transient pyrexia and relatively mild neurological signs such as listlessness and a slight head aversion. Occasionally the signs are more severe and the animal may develop encephalitis, convulse and die within 4-5 days [14, 18].

Chronic coenurosis typically occurs in sheep of 6-18 months of age. The time taken for the larvae to hatch, migrate and grow large enough to present nervous dysfunction varies from 2 to 6 months. The earliest signs are often behavioral, with the affected animal tending to stand apart from the flock and react slowly to external stimuli. As the cysts grows, the clinical signs progress to depression, unilateral blindness, circling, altered head position, in coordination, paralysis and recumbency. Localization in the CNS of sheep causes the “staggers”. Unless treated surgically, the animal will die after recumbency [15].

Coenuruses is a relatively unusual zoonotic disease of humans, caused by the larval stage (Coenuruses) of a dog tape worm *Taenia* (Multiceps) *multiceps*. *Taenia multiceps* have a wide distribution in temperate areas, where it usually circulates, in a domestic cycle, between dogs and herbivores (Sheep). Human infection occurs if eggs are accidentally ingested as result of poor personal hygiene after being shed in the faces of the dog. After ingestion of the eggs, larvae hatch, penetrate the intestinal wall and migrate to various tissues, where they develop in to large, cystic larvae. Symptoms are

secondary to the presence of a cyst in a vital structure. Patients with coenuruses present with headache and papille edema. The cysts have been responsible for Jacksonian epilepsy, hemiplegia, monoplegia and cerebral ataxia. When the spinal cord is affected, there may be spastic paraplesia, lymphadenopathy, fever and malaise can occur, raising the suspicion of lymphoma. Cysts are found in the liver, muscle and brain [8].

Computed tomography (CT) is recently used in the diagnosis of coenuruses and allowed precise evaluation of the size and location of the cyst, which appeared as a hypo attenuating structure is a mass effect [19].

C cerebralis may be found upon necropsy in the brain of sheep and goat but the condition needs to be differentiated from other local space occupying lesions of the cranial cavity and spinal cord including abscess and tumor. Hemorrhage in the early stage of the disease may be confused with encephalitis because of signs of brain irritation [20].

Currently, in Ethiopia there is a paucity of information and comprehensive study is not available on this disease. In addition significance of coenuruses in small ruminants slaughtered for export purpose at newly emerging export abattoirs is not studied in detail. The results of this study helps to implement appropriate control measures which may ensure the sustainability of foreign market to the brain of sheep and goats as the export market is highly sensitive to diseases due to aesthetic and zoonotic point of view.

Therefore the major objectives of this study were:

- To determine the prevalence of *C. cerebralis* in sheep and goats slaughtered at Hashim Export Abattoir.
- To assess the effect of risk factors such as the origin, age and study months on the occurrence of coenuruses.

MATERIALS AND METHODS

Study Area: The study was conducted from November 2009 to March 2010 at Hashim Export Abattoir located in Debre Zeit central Oromia Regional State. The abattoir is a privately owned exporting meat and edible organs like liver, kidney and brain of sheep and goat to Middle East. The abattoir is found in Debre Zeit town located 47km south east of Addis Ababa at altitude of 1850meters above sea level. The area has annual rain fall of 866mm and the mean annual maximum and minimum temperature are 26°C and 14°C respectively and the mean humidity is 61.3%. The abattoir slaughter up to 500 animals per day with few numbers meat inspectors assigned by Ministry of Agriculture and Rural Development (MOARD) [21].

Study Population: The study population constitutes of local breeds of sheep and goats coming from different agro ecological zone of the country including Borana, Jinka, Konso, Shashemene, Arbaminch and Bedesa areas of the country for slaughter in Hashim Export Abattoirs, in Debre Zeit town. Age, origin of the animal, months of the study period, distribution of the cyst on the different part of brain and the number of cyst per brain was considered as variables.

Study Design and Sampling Method: Cross sectional type of study was used to determine prevalence of coenuruses in sheep and goats by post mortem examination of heads of animals slaughtered at Hashim Export Abattoir. Individual heads of slaughtered sheep and goats are separated from the carcass by ventral disarticulation of the Atlanto-occipital joint and after removal of the skin; the area just caudal to the frontal bone was cut cross-sectionals with large size knife gently and meanings incised then brains were sliced into thin slices with a scalpel blade in order to check the presence of cyst [7].

Sample Size Determination: To determine the sample size, a prevalence rate of 50% was taken into consideration since there was no research work on prevalence *C. cerebralis* in small ruminants at the study area. The required sample size for the study only for goats were determined by the formula given in Thrusfield [22] with 95% confidence interval at 5% desired precision

$$N=\frac{1.96^2(P\exp(1-Pex))}{d^2}$$

where,
N = sample size
P exp= expected prevalence
d= desired population

Accordingly, the estimated sample size was 384 animals; however, to increase the precision 528 goats were included in the study.

Data Analysis: Date was entered in to the Microsoft excel spread sheet and coded accordingly. The coded data were analyzed using SPSS version 16 and Chi-square was used to test the association between the different factors such as age, origin and species of animals and the disease.

RESULTS

Out of the total 608 small ruminants examined for the presence of *C cerebralis* an overall prevalence of 3.78% was recorded. Of the total 528 goats examined for this parasite, 21(4.0%) were found positive. Likewise, of the 80 sheep examined, 2(2.5%) were found positive for *Coenurus cerebralis* (Table 1). The percentages for the number of cysts per brain from 1-4 cysts/brain was: 17(5.3%), 3(0.6%), 2(0.4%), 1(0.2%) for one, two, three and four cysts, respectively (Table 1). The characteristic Cyst of *C. cerebralis* observed during the study period were as shown in Table 1.

In the present study 18.3% and 10% of the cysts were located in the left and right cerebral hemisphere and 1% and 3.5% of the cyst were located in the middle cerebellum and cerebrum, respectively. The prevalence of *C. cerebralis* in small ruminants from Borana is 10(4.0%), 9(4.8%) in Jinka, 3(3.6%) in Konso, 0(0.0%) in Shashemene, 1 (3.3%) in Bedesa and 0(0.0%) in Arba Minch. Whereas a prevalence of 17(12.3%), 3(2.1%), 2(0.9%) and 1(0.4%) was recorded for one, two, three and four cysts in the brain of animals from these sites (Table 2).

In the study a prevalence of 16 (6.8%) in young and 7(1.9%) in adult small ruminants was recorded. The overall prevalence of one, two, three and four cysts per brain in small ruminants was 17(6.7%), 3(0.9%), 2(0.7%) and 1(0.4%) cysts respectively (Table 3).

In the study an overall prevalence of 7(8.1%), 3(3.0%), 4(3.7%), 4(4.0%) and 5(4.7%) of *C. cerebralis* was recorded during the months of November, December, January, February and March, respectively (Table 4).

Table 1: Prevalence of *Coenurus cerebralis* and number of cysts per brain in small ruminants

		No of Cyst/s per brain No. (%)						
Species	No. examined	Total	1	2	3	4	$\chi 2$	P-value
Ovine	80	2 (2.5)	2(2.5)	0(0.0)	0(0.0)	0(0.0)	0.95	0.971
Caprine	528	21 (-3.9	15(2.8)	3(0.6)	2(0.4)	1(0.2)		
Total	608	23 (3.78)	17(5.3)	3(0.6)	2(0.4)	1(0.2)		

Table 2: Prevalence of *C. cerebralis* and number of cysts per brain in small ruminants by origin

		No. of cyst/s per brain (%)						
Origin	Total sample	Total	1	2	3	4	$\chi 2$	P –value
Borena	247	10(4.0)	7(2.8)	1(0.4)	1(0.4)	1(0.4)	6.264	0.998
Konso	85	3(3.6)	2(2.4)	1(1.2)	0(0.0)	0(0.0)		
Jinka	184	9(4.8)	7(3.8)	1(0.5)	1(0.5)	0(0.0)		
Shashemene	3	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)		
Bedesa	30	1(3.3)	1(3.3)	0(0.0)	0(0.0)	0(0.0)		
Arba Minch	59	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)		
Total	608	23 (15.7)	17 (12.3)	3(2.1)	2 (0.9)	1 (0.4)		

Table 3: Prevalence of *C. cerebralis* and number of cysts per brain by age

		No. of cyst/s per brain (%)						
Age	Total sample	Total	1	2	3	4	$\chi 2$	P-value
Young	232	16(6.8)	13(5.6)	1(0.4)	1(0.4)	1(0.4)	12.722	0.013
Adult	376	7(1.9)	4(1.1)	2(0.5)	1(0.3)	0(0.0)		
Total	608	23(8.7)	17(6.7)	3(0.9)	2(0.7)	1(0.4)		

Table 4: Prevalence of *C. cerebralis* and number of cysts per brain by month in small ruminants

		No. of Cyst/s per brain (%)						
Month	Total sample	Total	1	2	3	4	$\chi 2$	P-value
November	191	7(8.1)	6(3.1)	0(0.0)	0(0.0)	1(5.0)	13.551	0.632
December	100	3(3.0)	3(3.0)	0(0.0)	0(0.0)	0(0.0)		
January	109	4(3.7)	4(3.7)	0(0.0)	0(0.0)	0(0.0)		
February	100	4(4.0)	2(2.0)	1(1.0)	1(1.0)	0(0.0)		
March	108	5(4.7)	2(1.9)	2(1.9)	1(0.9)	0(0.0)		
Total	608	23 (23.5)	17 (13.7)	3 (2.9)	2 (1.9)	1 (5.0)		

DISCUSSION

Coenuruses is endemic in Ethiopia, especially in the highland sheep where 75% of the population is found [23-26]. The presence of freely roaming dogs on grazing land greatly contributes to the existence of the disease. Dogs are routinely fed on offal, including sheep and goats head are not dewormed. Thus maintaining the *C. cerebralis Taenia multiceps* cycle.

The findings of the present study revealed that up to 3.78% of sheep and goats slaughtered at Hashim Export Abattoir in Debre Zeit were found to be infected with *Coenuruses cerebralis* (3.9% in goats and 2.5% in sheep). The result of the current study in sheep is consistent with the report of Abo-Shehada *et al*. [27] in Jordan (3% in sheep), Varma and Malviya [28] in India (2.88% in sheep). But is slightly lower than Sharma and Chauhan [29] in Ethiopia (5% in sheep) and Oryan *et al.* [30] in Iran (9.8% in sheep). In addition the prevalence of coenuruses in goats in this study is lower than the report by Vink *et al.* [10] in Mozambique (13.8%in goats). The most probable reason for the variation of the results in different countries is supposed due to variations in climatic, geographical management of the study animals and the final dog hosts and social conditions.

Monthly prevalence of *C, cerebralis* was found 8.1% in November and 3.0% in December. This finding is higher than the report [31] in Turkey (16.34% in sheep). But statistically significant difference was never observed among the months of the study period.

In this study the prevalence of coenuruses was higher in small ruminants from Jinka (4.8%) than those animals from Shashemene (0.0%) and Arba Minch (0.0%). However, statistically significant ($p>0.05$) was not observed among small ruminants of different origins.

Statistically higher ($p=0.013$) prevalence of coenuruses was recorded in young (6.8%) animals than adult (1.9%) small ruminants. Similar work was reported by Morris [2], (5%in sheep), Adem [32] and Hayelome [33] (4% in goats and 5.3% in sheep) in different parts of Ethiopia. This higher prevalence in young sheep and goats is most probably attributed to under developed immunity in young animals thus higher infection rate in these animals whereas the adults have acquired immunity. Gemmell *et al*. [34] suggested that most Taeniid eggs are not capable of developing to mature metacestodes. For instance in *Taenia hydatigena,* only 7% of eggs will transform into cysts. However, an important proportion of the remaining 93% still can stimulate immunity. Furthermore, because it require only 10 eggs to stimulate immunity to *Taenia hydatigena* [34, 35] in the presence of high infection pressure such as in Ethiopia, immunity is lifelong [36, 37], this fact may also holds true in *Taenia multiceps.*

The cyst may be localized in any part of the brain, more commonly in the cerebral hemisphere [20, 38] in the present study 18.3% and 10% of the cysts were located in the left and right cerebral hemisphere and 1% and 3.5% of the cyst were located in the middle cerebellum and cerebrum respectively. This observation is lower than the report by Adem [32] in Ethiopia [10] in Mozambique (62% in left, 30%in right,). The higher percentage of localization of the cysts in the cerebral hemisphere is most probably due to its higher biomass than the other part of brain, particularly the median fissure. However, Varcasia *et al*. [39] found most cysts in the occipital area in Welsh mountain, Suffolk and Dorset sheep. Hypothetically this difference might be either of genetic variability of *Taenia multiceps* [33] or of anatomic difference within breeds.

All of the 23 positive brains of small ruminants were found to contain only 1 to 4 cysts in each brain. Thus, 91.89% of the positive brains had only one cyst in the cerebrum (In left, right and middle cerebrum) which is higher than Hayelome [33], (81% one cyst per brain).

Statistically significant variation was never observed between the number of cysts and months of the study period or origins of the study animals. The finding of significantly higher one cyst in each brain than two to four cysts per brain of positive small ruminants findings of the current study agrees with the observation of Achenef *et al*. [26], Adem [32] and Hayelome [33] in different parts of Ethiopia (One to three cysts per brain).

CONCLUSION

Results of the present study showed that coenuruses in small ruminants, is among one of the most important problem of animals in the study area. The report clearly indicated also that coenurosis affects both sheep and goats host in the area. According to this paper higher prevalence of *C. cerebralis* was recorded in animals from Jinka than those from other parts of the country. The prevalence of coenurosis was also higher in young than adult small ruminants. This suggests coenurosis is responsible for huge economic losses in both sheep and goats of the study area. In appropriate disposal of heads being practiced by the abattoirs can enhance the continuation of the life cycle between the intermediate and final host (Dog) and further may increase the zoonotic risk of the diseases to human of the study area.

Therefore, on the basis of the results obtained from the present study the following recommendations are forwarded:

- Infection of dogs should be interrupted by regular dewarming.
- To interrupt the life cycle of the parasite the carcasses or offal and brains of the intermediate hosts should not given to dogs nor left for wild carnivores.
- Dog owners and the whole society should aware about the danger of feeding uncooked viscera and head from slaughtered sheep and goats.
- Public education programs should convey the messages that dogs infected with tapeworms present a danger to both the human population and livestock.

ACKNOWLEDGEMENTS

We would like to acknowledge Hashim Export abattoir for their over overall guidance during data collection and Haromaya University for financing this research activity.

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