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Prevalence, associated factor and economic importance of major Metacystode in slaughtered cattle at Jimma Municipal Abattoir, Southwestern Oromia, Ethiopia

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ABSTRACT

A cross-sectional study was conducted to assess the prevalence and associated factor of major metacestode in slaughtered cattle and its economic importance at Jimma municipal abattoir from October 2019 to June 2020. Out of 384 bovine examined at Jimma municipal abattoir 197 (51.3%) at 95% CI of: 46.29-56.29) cattle were found positive for Metacestode, of which 191 (49.74%, 95% CI: 44.74-54.75) and 9 (2.34%, 95%CI: 1.22-4.45) were positive for Hydatid cyst and Cysticercous bovis, respectively. The highest prevalence of metacestode were found in Asendabo (66.67%) followed by Bilida (58.44%) and Agaro (57.89%) and lowest in Sarbo (43.94%) and Kefa (40%). The highest prevalence of hydatid cysts was observed in lung (58.64%), and liver (23.04%). While the highest prevalence of cysticercus bovis was detected in heart (33.33%). Furthermore, out of 190 hydatid cyst identified, the proportion of small, medium, large and mixed cyst were 13.16%, 7.89%, 4.21% and 74.74%, respectively. The prevalence of metacestode infection showed a significant difference ($p < 0.05$) between sex, age, and body conditions of the animals. A total of 528,155.32 ETB annual financial losses were calculated during the study period. In conclusion, the present study has revealed the presence of metacestode which have significant impact on the health and production of the cattle in the study area. Therefore, Control of the parasite directed both in the intermediate and definitive host should be carried out.

Keywords: Cattle, Factor, Jimma municipal abattoir, Metacestode, Prevalence

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INTRODUCTION

Background of the Study

Cestodes of the family Taeniidae infect dogs and humans as the definitive host and are transmitted to a wide range of intermediate host species where they cause Hydatidosis, and Cysticercosis, respectively. Among the parasitic diseases metacestode of *Taenia saginata* and *Echinococcus granulosus* are the most important ones because they have economic as well as public health significance (4,5). Metacestode of *taeniasis* and *echinococcosis* prevalence are considered to be higher in developing countries because of poor sanitation, traditional cattle husbandry systems and inadequate meat inspection facilities (6)

Bovine cysticercosis, is an infection of cattle with metacestode of the human tapeworm *Taenia saginata* (8,9). Even though, clinical infection of Bovine with is not significant but it is more important on its public health impact and regarding to high economic losses due to the condemnation of heavily infected carcasses and (10). In Africa, there are an estimated 12 million carriers with a 30% incidence in some African stockmen (11). In Ethiopia, the prevalence of *bovine cysticercosis* reported ranges from the lower prevalence of 1.7% in Central Ethiopia (12) to higher prevalence of 26.25% in Hawassa (5). It is believed that the cultural habit of eating raw meat in the form of “Kourt”-meat cubes and “Kitfo”-minced meat in Ethiopia, has favored the spread of this disease (13–15).

Cystic *echinococcosis* (*CE*) is another frequently encountered metacestode in developing countries. Infested carnivores eliminate eggs with their feces. Intermediate hosts (cattle, shoat and camels) become infested with the eggs on account of having fed on contaminated pastures (16). The disease is characterized by the formation of large fluid field cyst in the internal organs of the intermediate host(17). Adult worms have been reported to be found in small intestines of dogs and wild carnivores like the wolf and fox (18). It is extensive distribution with a broad range of host worldwide, and highly endemic in the continent of southern America, Africa, Asia and Australia (19). In Ethiopia, Hydatidosis is known and documented since the 1970s and it is one of the major causes of organ condemnation in most abattoirs and slaughter houses and leads to huge economic losses (20), and prevalence of 51% in cattle with area specific occurrences of 44% in Arsi, 30% in Borana, 85% in Jimma and 67% in Mi'eso were reported by (21).

Multiple factors seem responsible for the observed fluctuations. It may be associated to the poor hygienic conditions that prevail in different regions, illegal slaughtering of animals, lack of proper disposal of infected carcass, and the alarming high number of stray dogs. Remains of animal that die due to any disease become food of such free roaming dogs. Such remains may contain fertile hydatid cysts, thus infecting stray dogs. These dogs become a major cause of dissemination of infected eggs on pasture. Most herder were ignorant of the fact that these dogs shed infective stages (eggs) of Echinococcus in the field (22). Having almost no knowledge about mode of transmission of disease, majority of villagers offer raw visceral organs to dogs. These organs may carry infective stage of parasite (23).

Economic losses associated with Hydatidosis were estimated at various levels in different locations of Ethiopia. Annual losses of 19,847,704.00 ETB in Addis Ababa Abattoirs Enterprise (24), 1,791,625.89 ETB at the Hawassa (25), 473,173.75 ETB at Debre Markos (26), 52,828 ETB at Adama (27) and 930,918.52 ETB at Mekelle (28) were reported due to CE and bovine cysticercosis. Moreover, annual economic losses of 1,841,311.00 ETB (73,652.44 USD) consisting of 1,831,890.00 ETB due to C. bovis from organ condemnation were estimated (29) in Ethiopia.

The rest 9,421 ETB annual economic loss were due to cirrhosis, fasciolosis and other factors. Globally, *cystic echinococcosis* was estimated to cause livestock associated annual economic losses of at least US$141,605,195 (30). Despite it has a significant economic impact due to organ contamination by the case of metacestode; there is no study conducted yet on the determination of prevalence, associated factor and economic loss by major metacestode in cattle slaughtered at Jimma municipal abattoir. Therefore, the aim of this research is to assess the prevalence and associated factors of major metacestode in cattle and its economic importance at Jimma municipal abattoir from October 2019 to June 2020.

MATERIALS AND METHODS

Description of study area

The study was conducted at Jimma town which is located about 352km south west of Addis Ababa. It has a latitude and longitude of $7^0$40'N $36^0$50'E/ 7.667^0N 36.833^0E. The area received a bimodal rain fall with an average annual rain fall of 1530mm. The long rainy season occur during the

months of June to September while the short rainy season occurs during the months of March to May. The climatic condition of the town is "Weinadega" and the town is located at an altitude of 1915 MASL. The annual maximum and minimum temperature ranges from 24-30◦c and 7-14◦c respectively. According to the statistical data obtained (34) Jimma districts has a livestock population of 2,016,823 cattle.

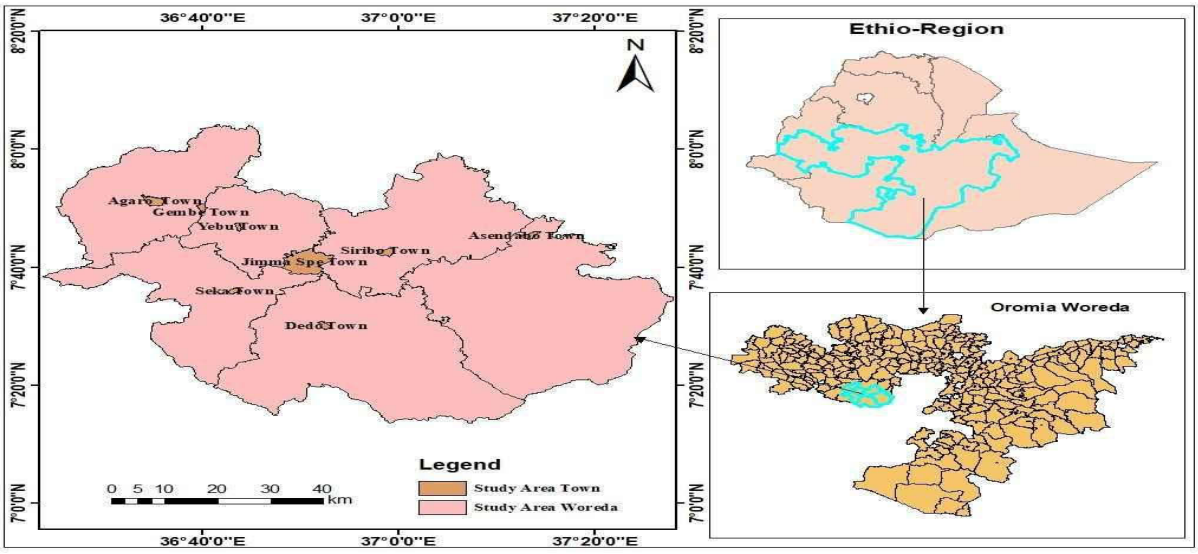


Figure 1: Map of study area for bovine metacestode

Study Population.

The study animal were all cattle comes from different districts of Jimma zone to Jimma municipal abattoir for slaughtering purpose. Those are 384 cattle of two breed (47 cross and 337 local breed). Both sexes (58 females and 326 male), body condition score was made (35) and recorded as poor, medium and good. The age of the animal was estimated by looking to the dentition pattern of the animals (36). Based on this, study animals were classified as < 5 year and >5 year. Animal origins were categorized into Jimma, Agaro, Blida, Dedo, Asendabo, Serbo, Seka, Kefa and from Unknown districts.

Study Designs.

A cross sectional study was carried out to assess the prevalence, determinants, and economic significance of major metacestode of cattle slaughtered cattle at Jimma municipal abattoir from October 2019 to June 2020.

Sampling method and Sample Size Determination.

Simple random sampling technique was employed to select the study animal. The total number of cattle required for the study was calculated based on the formula given by (37). By rule of thumb where there is no information for an area, it is possible to take 50% prevalence. In this study 50% prevalence with 5% desired level of precision and 95% of confidence interval are used to calculate the sample size using the following formula.

$$N=\frac{1.96^2 \times Pexp\ (1-Pexp)}{d^2}$$

Where N= Sample size

Pexp= expected prevalence

d= desired absolute precision

Then by taking Pexp=50% and d=5%

$$N = 1.96^2 \times 0.5(1-0.5)/0.05^2$$

N=384

Abattoir Based survey

During meat inspection, carcasses and their respective organs were carefully examined in accordance to the procedures of the Ethiopian Ministry of Agriculture Meat Inspection Regulation (1972) for the detection of T. *saginata cysticercosis* and *hydatidosis*.

During ante-mortem inspection, each of the study animals was given an identification number (with a paint mark on their body). Origin, breed, age, sex and body condition scoring of the study animals were also recorded accordingly.

During meat inspection of each organ of an animal was strictly and separately examined to avoid mixing up of organs. All cattle slaughtered on visiting days of the abattoir were examined at Jimma University school of veterinary medicine. Postmortem examination was conducted thorough visual inspection, palpation and systemic incision of each visceral predilection sites such as heart, tongue, masseter muscle, diaphragm, neck muscle, thigh muscle, spleen, liver and lung were being inspected carefully for the presence of metacyst of *Taeniasis* and *Hydatidosis* (47).

The infected organs from positive animal were collected; the total number cyst was counted per infected organ and recorded. The size of the diameter of hydatid cyst, was measured and classified as large (>10cm), medium (5 - 10cm) and small (Diameter<5cm) (26).

Assessment of Direct Financial Loss due to organ condemnation

Losses due to infected organs and tissue condemnation were calculated by considering information on the recent market price of the condemned organs and tissues (22) at butcher shops and customer interview in Jimma town. Direct losses were calculated on the basis of the condemned organs and tissues (38). Average market prices of the lungs, liver, spleen, kidneys, heart, tongue and a kilogram of beef were found to be 20, 60, 10, 15, 30, 20 and 240 Ethiopian Birr (ETB), respectively. The economic loss due to condemnation both totally and partially was estimated by the weight of each organ per (kg) and its current price in Jimma town. Financial losses were then computed mathematically by adapting the formula of Ogunrinade and Ogunrinade (1980) as follows:

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

Where:

EL = estimated annual economic loss due to organs condemnation from domestic market

n Srx = annual cattle slaughter rate of the abattoir

Coy = average cost of each cattle liver/ lung/ heart /kidney

Roz = condemnation rate of cattle liver /lung/ kidney/ heart

Data Management and Analysis

The data has been entered and managed in Microsoft Excel. All the data analysis has done by Stata software version 14. The prevalence of metacyst was analyzed using percentages. Accordingly, after chi square testing for Bernoulli assumptions both bi-variable and multi variable analysis were performed to determine the occurrence of metacestode by explanatory variables. Variable with P value less than 0.3 in the Bi variable was fitted for multi-variable analysis. The result of Bi-variable analysis was presented as Crude odds ratio (COR) with 95% CI and to identify the predictors of metacestode among slaughtered cattle on the Jimma municipal abattoir, adjusted odds ratio (AOR) with 95% CI was computed and a P-value <0.05 was used as a measure of statistical significance.

RESULTS

Frequency distribution of variable

A total of 384 bovines were sampled in the Jimma municipal abattoir. Among these 77 (20.05%), are originated from Bilida, and 66 (17.19%) from Sarbo. In this study nearly two-third 235 (61.20%) of the cattle sampled for investigation were found in the age of >=5 (adult). Regarding the breed of cattle, the majority 337 (87.76%) of cattle sampled were local breed. in terms of sex the majority 326 (84.90%) of cattle were male in sex. Regarding body condition of the animal around 190 (49.48%) of the sampled cattle had good body condition (Table 1).

Table 1: frequency table of Variable on Metacestode

Variable	Category	Frequency	Percentage (%)
Origin	Seka	28	7.29
	Agaro	38	9.90
	Asendabo	30	7.81
	Bilida	77	20.05
	Dedo	45	11.72
	Jimma	42	10.94
	Kefa	10	2.60
	Sarbo	66	17.19
	Unknown	48	12.50
Breed	Local	337	87.76
	Cross	47	12.24
Sex	Male	326	84.90
	Female	58	15.10
Body Condition	Good	190	49.48
	Medium	117	30.47
	Poor	77	20.05
Age	<5	149	38.80
	>=5	235	61.20
Pus formation	Negative	325	84.64
	Positive	59	15.36
Level of condemnations	Pass	185	48.18
	Partially	74	19.27
	Totally	125	32.55
Total		**384**	**100%**

Prevalence

Out of 384 bovine examined 197 (51.3%, 95%CI: 46.29-56.29) were found positive for Metacestode of which 191 (49.74%, 95CI: 44.74-54.75) and 9 (2.34%, 95%CI: 1.22-4.45) were positive for Hydatid cyst and Cysticercous bovis, respectively. (Table 2).

Table 2: The prevalence of Metacestode among cattle slaughtered at Jimma abattoir

	Category	Frequency	Percent (%)	CI
Metacestode	Negative	187	48.70	43.71 53.72
	Positive	197	51.30	46.29 56.29
Hydatid Cyst	Negative	193	50.26	45.25 55.26
	Positive	191	49.74	44.74 54.75
C. Bovis	Negative	375	97.66	95.55 98.78
	Positive	9	2.34	1.22 4.45
Total		**384**	**100%**	

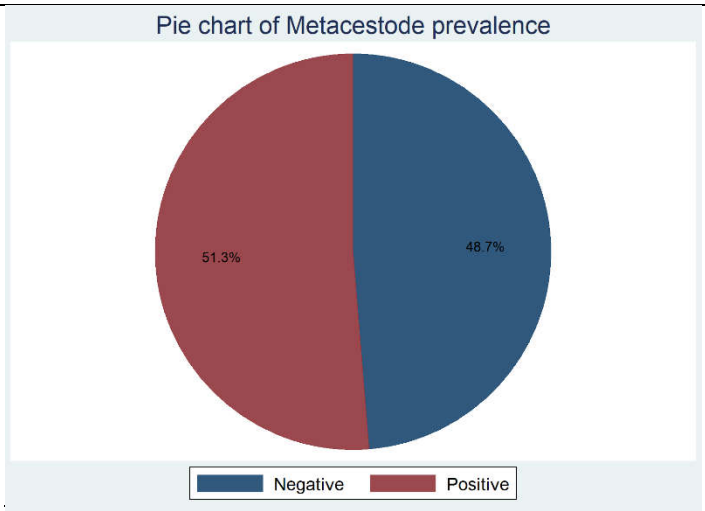


Figure 2: Prevalence of metacestode in the study area

In this study there were variation on the prevalence of metacestode among cattle found in Jimma zone of Ethiopia. Regarding area prevalence, the highest prevalence of metacestode were found in Asendabo (66.67%) followed by Bilida (58.44%) and Agaro (57.89%) and lowest in Sarbo (43.94%) and Kefa (40%) (Figure 2).

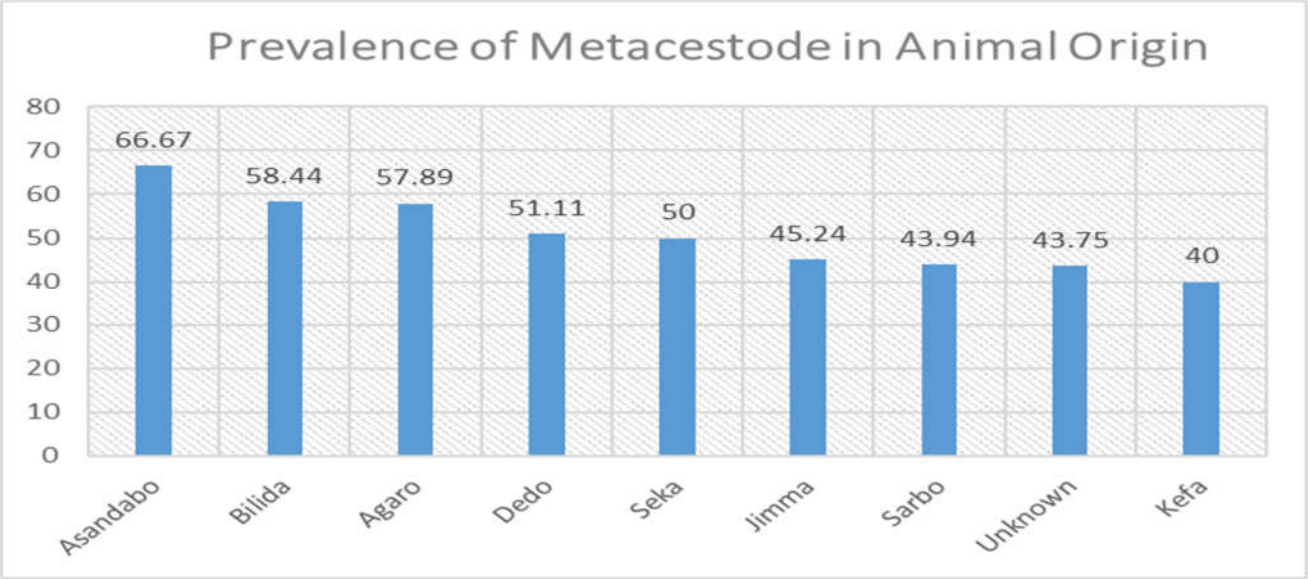


Figure 3: Prevalence of metacestode among the origin of animal

Associated risk factors

The present study used multivariable logistic regression model for the analysis of risk factors that affect the occurrence of metacestode on the study area. All of the variables that were found significant at p-value <0.3 were included into multivariable logistic regression model for further analysis to control confounding.

On the multivariable logistic regression analysis association of potential risk factors for the occurrence of metacestode were depicted on table 4. Accordingly, there was a significant association (P< 0.05) in the prevalence of metacestode between sex, age, body condition, (table 4).

Logistic regression analysis of the potential risk factors revealed presence of significant difference in the prevalence of Metacestode between sex, body condition and age of animals (*P* <0.05). In line with this female (OR=2.41, 95%CI=1.27-4.60), poor body condition (OR=3.61,95% CI=1.96-6.63), medium body condition (OR=2.46, 95% CI=1.49-4.05), and age ≥ 5 (OR=2.87, 95%CI=1.82-4.52) had higher odds to acquire Metacestode infestation than males, good body condition and age <5 years of animals respectively. Conversely, statistically insignificant association (P>0.05) was observed for ages, breed and origin of the animals

Table 3: Bi-variable logistic regression analysis of risk factors for bovine Metacestode among cattle slaughtered in Jimma municipal abattoir

Risk factor	Category	Presence of Metacestode		COR	95%CI		P-value
		-Ve	+Ve				
Origin	Seka	14	14	1	1		
	Agaro	16	22	1.38	0.52	3.67	0.525
	Asendabo	10	20	2.00	0.69	5.78	0.200
	Bilida	32	45	1.41	0.59	3.35	0.442
	Dedo	22	23	1.05	0.41	2.69	0.926
	Jimma	23	19	0.83	0.32	2.15	0.696
	Kefa	6	4	0.67	0.15	2.89	0.588
	Sarbo	37	29	0.78	0.32	1.90	0.590
	Unknown	27	21	0.78	0.31	1.98	0.598
Breed	Local	162	175	1	1		
	Cross	25	22	0.82	0.44	1.50	0.511
Sex	Male	168	158	1	1		
	Female	19	39	2.18	1.21	3.94	0.009
BCs	Good	115	75	1	1		
	Medium	48	69	2.20	1.38	3.53	0.000
	Poor	24	53	3.39	1.93	5.95	0.000
Age	<5	94	55	1	1		
	⩾ 5	93	142	2.61	1.71	3.98	0.000
Total		**187**	**197**				

COR: Crude Odds Ratio, CI: Confidence Interval, 1: Reference

Table 4: Multivariable logistic regression analysis of risk factors for bovine Metacestode

Risk factor	Category	Presence of Metacestode		AOR	95%CI		P-value
		-Ve	+Ve				
Origin	Seka	14	14	1	1		

	Agaro	16	22	1.19	0.40	3.47	0.757
	Asendabo	10	20	1.90	0.61	5.96	0.271
	Bilida	32	45	1.30	0.50	3.38	0.586
	Dedo	22	23	0.92	0.33	2.57	0.870
	Jimma	23	19	0.63	0.22	1.80	0.388
	Kefa	6	4	0.58	0.12	2.90	0.511
	Sarbo	37	29	0.66	0.25	1.75	0.407
	Unknown	27	21	0.65	0.23	1.82	0.315
Sex	Male	168	158	1	1		
	Female	19	39	2.41	1.27	4.60	0.008**
BCs	Good	115	75	1	1		
	Medium	48	69	2.46	1.49	4.05	0.000**
	Poor	24	53	3.61	1.96	6.63	0.000**
Age	<5	94	55	1	1		
	⩾ 5	93	142	2.87	1.82	4.52	0.000**
Total		**187**	**197**				

AOR: Adjusted odds ratio, CI: Confidence interval, 1: Reference *Significance at P<0.05, **Significance at P<0.01

Distribution of Metacestode among the organ of animal

The present study showed that the highest prevalence of hydatid cysts was observed in the lung (58.64%), and liver (23.04%). While in case of cysticercus bovis the highest prevalence was detected in heart (33.33%) (Table 5)

Table 5: Distribution of hydatid cysts & C. bovis in different organs of positive cattle

Organ	Number of H. cyst	Percent (%)	Number of C. bovis	Percent (%)
Lung	112	58.64	0	0.00
Liver	44	23.04	0	0.00
Heart	6	3.14	3	33.33
Kidney	0	0.00	0	0.00

Neck-Muscle	0	0.00	2	22.22
Tongue	0	0.00	1	11.11
Masseter Muscle	0	0.00	2	22.22
Spleen	8	4.19	0	0.00
Diaphragm	0	0.00	1	11.11
Liver and lung	21	10.99	0	0.00
Total	**191**	**100**	**9**	**100**

Size of Hydatid Cyst

On this study out of 190 hydatid cyst identified during study period, the proportion of small, medium, large and mixed cyst were 13.16%, 7.89%, 4.21% and 74.74%, respectively. From the hydatid cyst found on lung majority 79 (70.54%) had mixed size and 14 (12.50%) had small and medium size respectively. Regarding the cyst found on liver 36 (83.72%) had mixed size (Table 6).

Table 6:- The size of hydatid cyst in the respective organ inspected at Jimma municipal abattoir

Organ	Small cyst	Medium Cyst	Large Cyst	Mixed Cyst	Total
Lung	14	14	5	79	**112**
Liver	4	1	2	36	**43**
Heart	5	0	0	1	**6**
Spleen	2	0	0	6	**8**
Liver and lung	0	0	1	20	**21**
Total	**25**	**15**	**8**	**142**	**190**

Financial loss assessment

The direct financial loss was analysed based on the information obtained during post-mortem examination and interview. Accordingly, the annual loss due to organ condemnation was calculated to be **528,155.32 ETB** (Table 7)

Table 7: Financial loss assessment among organ condemned at Jimma municipal abattoir during study period

Organ inspected	No of organ condemned	Percent involvement of organ	Average unit price
Lung	112	29.16%	20
liver	44	11.46%	60
heart	6	1.56%	30
tongue	1	0.26%	20
spleen	8	2.1%	10
Total	**171**	**44.54%**	**140**

EL = n Srx * Coy * Roz

EL= 8470X44.54X140

= 528,155.32 ET

DISCUSSION

Both metacestode of the Taeniosis and echinococcosis are downgrading and responsible for lowering the quantity and quality of animal commodities. Out of 384 bovine examined 197 (51.3%, 95CI: 46.29-56.29) were found positive for Metacestode. Among this the overall prevalence of cysticercosis in cattle slaughtered at Jimma Municipal abattoir was 2.34%, which is comparable to the prevalence of 2.0 % from Bedelle municipality abattoir (39), 2.6% around Batu (40), and 1.7% from Shashemene (12). Conversely, the current finding lower than previous findings conducted in Southern Ethiopia 26.25% (41) and also in Hawassa municipal abattoir (22.9%) (42) and in Northwestern Ethiopia (18.49%) (43). But this study is relatively higher than study conducted in Croatia (0.11%) (44) and South Africa (0.2%) (45). This could be due to better application of public health extension education (developing the habit of using a toilet) and meat inspection techniques.

Variations in the values of prevalence for the bovine hydatid cyst from different parts of globe have been reported. In this study from the overall prevalence of metacestode in Jimma municipal abattoir, the Hydatid accounts 48.96%. This result similar with the study conducted in Debre Markos (48.9%) (26) and Shashemane (50.1%) (12). Conversely, this result was relatively lower than study conducted in Jimma (85%) (21) and slightly higher than study conducted in Bishoftu (42.86%) (46) and in Jimma(31.44%) (28). However, the current prevalence of hydatid cyst in contrary with the study conducted in northern India (5.39%) (47) and (2.76%) in Hail province of

Saudi Arabia (48). This variation on the prevalence of metacestode could be due to differences in management system, topography, de-worming practices and climatic condition that favors the survival of infective stage of the parasite.

Regarding determinants of metacestode in Jimma municipal abattoir, regression analysis identified several factors that affect the occurrence of metacestode. Sex, age and body condition of animal were among factors significantly associated with the occurrence of metacestode in cattle in and around Jimma town.

In this study, statistical analysis has revealed that; there is a significant relation ($P<0.05$) between sex of animals and occurrence of metacestode. Accordingly, being female 2.41 (95% CI=1.27-4.60) times more likely acquire the disease as compared to male. This finding is consistent with previous study done in Ethiopia by (49). This might be due to differences in exposure to infection as a result of the variation in stocking density (sex ratio). One more reason to elevated prevalence value observed in cows might be due to their longer captivity for breeding that increase the chances for higher prevalence and intensity to the parasitic infections (50). Certain factors can break down the immunity to parasitic diseases in female animals like various stages in the reproductive cycle, lactation and gestation. However, this result is contradicted by (43,51).

This study identified that body condition of animal was strongly associated with the occurrence of metacestode in Jimma municipal abattoir. According to this study animal that had poor body condition 3.61 (95%CI=1.96-6.63), and medium body condition 2.46 (95%CI=1.49-4.05) more likely attain metacestode as compared to animal that had good body condition. This finding is in line with the study conducted in Ethiopia (52). This might be due to in moderate to severe infections, the parasite may cause retarded performance and growth, reduced quality and yield of meat and milk as well as live weight loss (38).

There were statistically significant association ($P<0.05$) between occurrence of metacestode and age of the animal. Found on the age of >5 years of age increase the odds of attaining metacestode infestation as compared to the animal that are found on the age of <5 years of age. This finding agrees with studies conducted on different part of Ethiopia (25,53). The possible explanation could be the age increase; the risk of developing disease is also increases

In the present study, direct financial loss was estimated to be **528,155.32 ETB** were lost due to the effect of the diseases during the study period on the peculiar organs examined. Affected organs were condemned accordingly as per the degree of infestation. Variations in the amount of economic lost in different abattoirs probably due to the differences in the prevalence of diseases, rejection rate of organs, slaughtering capacity of the abattoirs, local market price of organs and management of animals.

CONCLUSION

The present study has shown that metacestode is a major cause of organ condemnation at Jimma municipal abattoir with having the overall prevalence 51.3%, from this hydatid cyst and Cysticercus bovis accounts 49% and 2.3% respectively. Most risk factors such as sex, age, body condition of animal have significant relationship ($p< 0.05$) with the presence of parasitic infestation. Accordingly, being female, having poor and medium body condition and also found on the age of >5 years are factors that affect the occurrence of metacestode in the study area. **528,155.32 ETB** were lost due condemnation of organ infested by this parasite this year. This high prevalence of metacestode in the study area indicates the disease has a great economic importance and requires a great control and preventive issue. So to minimize the wide spread prevalence of this parasitic problem in the study area Prohibition of back yard and road side slaughter activities, and construction of fenced abattoirs in towns and villages controlled by properly trained meat inspector should be conducted.

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