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Occurrence of Indigestible Foreign Bodies in Forestomachs and Adjacent Structures of Cattle Slaughtered at Hawassa, Southern Ethiopia

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Abstract: This study was conducted to assess the occurrence of foreign bodies (FBs) in forestomach and adjacent organs and identify associated risk factors in apparently healthy cattle slaughtered at Hawassa municipal abattoir. The study involved careful examination of relevant organs of 410 randomly selected slaughter cattle for ingested FBs. Foreign bodies were detected in the rumen, reticulum, abomasum and abdominal and thoracic cavities. Both metallic and non-metallic FBs were identified. From cattle examined (N=410), 17.1% (95% CI:13.7-21.0) had one or another type of FBs. The prevalence for metallic and non-metallic FBs was 5.6% (95% CI: 3.7-8.3) and 11.5% (95% CI: 8.7-14.9), respectively. The prevalence of FBs was significantly higher (P <0.05) in females (59.1%) than in males (14.7%). Crossbred cattle and cattle originated from urban areas had significantly higher (P <0.05) prevalence of FBs than local cattle and cattle from rural areas, respectively. Foreign body prevalence was also highest (P <0.05) in cattle older than ten years and in cattle with poor body condition compared to their counterparts. The findings of the study suggest that ingested FBs and hence contamination of the environment with non-biodegradable waste, are significant health and welfare risk to cattle in the study area.

Key words: Cattle · Ethiopia · Foreign Bodies · Forestomach · Reticulum · Rumen

INTRODUCTION

Cattle play significant role in Ethiopian economy as source of meat, milk, draught power, house-hold income and foreign currency earnings for the country [1, 2]. However, their contribution to the national economy is far below expected given the high cattle population the country owns, which stands first in Africa with estimated 59.5 million heads [3]. The low productivity is assumed to be due partly to the prevalent livestock diseases in the country [2, 4].

Cattle's indiscriminate eating habits make them susceptible to inadvertent ingestion of foreign bodies (FBs) that would be rejected by other species [5, 6]. As a result foreign body disease is important problem in cattle and its importance, in Ethiopia, might have increased in recent years due to widespread contamination of the environment with plastic waste [7].

Ingested FBs encountered in cattle are divided into two main groups, those of metallic origin or penetrating FBs (nails, wires) and of non-metallic origin or non-penetrating FBs (plastic materials, rubber articles, leather pieces and cloth) [8, 9]. Ingestion of FBs may have severe economic implications to the producer as it can cause loss of production and even mortality. Ingestion of metallic FBs may result in perforation of the reticulum causing acute peri-reticular inflammation, adhesions and abscesses. Piercing the diaphragm, the FB may enter the thoracic cavity, the pericardium and even the heart, producing inflammation enroute [6]. The FB may also pierce and infect the liver or spleen. The path of the FB through the tissue is accompanied by contamination with ingesta, detritus and bacteria, which cause acute inflammation [10, 11].

Non-metallic FBs in the reticulorumen may interfere with the flow of ingesta (obstruction), may occupy significant portion of the forestomach leaving little space for feed and may interfere with contraction affecting rumination, digestion, absorption and eructation [12-15] and hence production. Ingestion of FBs by cattle is extremely common especially in developing countries, such as Ethiopia, where cattle, especially in urban areas,

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are commonly seen scavenging in garbage collection/dumping sites [7, 9, 16-18]. However, information regarding the occurrence and magnitude of the problem in the country is very much limited. Therefore, this study was carried out with the objectives to determine the occurrence and identify risk factors associated with occurrence of indigestible foreign bodies in the forestomach and adjacent organs of cattle slaughtered at Hawassa municipal abattoir.

MATERIALS AND METHODS

Study Area: The study was conducted at Hawassa municipal abattoir in Southern Nations, Nationalities and Peoples Regional State (SNNPR) from October 2010 to March 2011. Hawassa, the capital city of SNNPR, lies at 7°5' latitude N and 38°29' longitude E on the shores of Lake Hawassa, 275 km south of Addis Ababa. The total area of the town is 50 square km. The town is bordered by Lake Hawassa to the west, Hawassa zuria district to the south and east and Oromia Region to the north. Hawassa has an altitude of about 1680 m a.s.l. The climate is warm with mean annual temperature of 25 ºC and 997.6 mm rainfall. Sidama zone, where Hawassa is located, possesses large livestock resources comprising 1,573,318 cattle, 183,462 goats and 221,505 sheep [19].

Study Animals: The study was conducted on 410 apparently healthy slaughtered cattle (388 males and 22 females). Animals from Sidama zone and neighboring zones (Wolayta, West Arsi) and from different parts of the country (southern and central Ethiopia) with varying husbandry practices and agro-ecological conditions are slaughtered at Hawassa. Study animals were indigenous zebu and Holstein-Zebu (HZ) crosses managed under extensive and semi-intensive husbandry systems. They were of different age groups and body condition and of both sexes. Age was estimated using dentition pattern as described by DeLauta and Habel [20] and body condition scoring was made as described by Nicholson and Butterworth [21]. Selected cattle were identified by sex, age, breed, body condition score (BCS) and origin prior to slaughter.

In Ethiopia, male cattle are kept mainly for ploughing except in pastoral areas. Cattle in most of the rural areas of Ethiopia are raised on pasture with supplementary feeding of crop residues, especially in the highlands where mixed crop-livestock farming is practiced, when pasture is scarce especially during long dry season. In towns like Hawassa, where HZ crosses dominate, semi-intensive management system is practiced and animals are fed with concentrates and hay.

Study Design, Sampling and Sample Size: The study was cross- sectional observational study. Animals were selected, from those destined to be slaughtered on the date of data collection, by simple random sampling technique using ante-mortem inspection list as a sampling frame. Only manageable number of cattle were selected for examination in a day. The minimum sample size for this study was determined using 50% expected prevalence 5% absolute precision at 95% confidence level using the formula provided by Thrusfield [22]. Accordingly, the sample size was determined to include 384 animals. However, it was increased and 410 animals were examined.

Postmortem Examination: Common sites for occurrence of foreign bodies, including rumen, reticulum, omasum, abomasum and other adjacent organs such as liver, heart, spleen and abdominal and thoracic cavities were examined by visual inspection and palpation. The stomachs were opened for careful exploration for FBs. Any metallic FB felt embedded in the tissue of various organs was removed by incision, washed and identified. When detected, the type of the FB (metallic, non-metallic), its site and whether it has penetrated the tissue or not was recorded.

Data Management and Analysis: The variable of interest considered as an output variable was occurrence (as present or absent) of FBs in the fore-stomach and adjacent organs of the study animals, while sex, breed (local, crosses), age (≤5-young, 5-10-adult, ≥ 10 years-old), body condition (poor, medium, good) and origin of the animals (rural, urban) were considered as risk factors. The data were entered and managed in MS Excel work sheet. The analysis was conducted using Stata version 7 (Stata Corp., College Station, TX). Prevalence of FBs was expressed as percentage of cattle positive for FBs to the total number of cattle examined. Association between FB prevalence and presumptive risk factors was determined using Chi-square or Fisher's exact test. A P-value <0.05 was considered for statistical significance.

RESULTS

Out of the total 410 cattle examined for presence of FBs 70 (17.1%, 95% CI:13.7-21.0) were found positive for one or another type of FB. Foreign bodies of metallic and

Table 1: Occurrence of metallic and non-metallic foreign bodies in different body locations in cattle slaughtered at Hawassa municipal abattoir (n = 410)

	Metallic			Non-metallic			Total		
Location	No. (%) positive	x^2	*P* value	No. (%) positive	x^2	*P* value	No. (%) positive	x^2	*P* value
Rumen	0	58.2	0.000	35 (8.5%)	118.0	0.000	35 (8.5%)	76.7	0.000
Reticulum	17 (4.1%)			3 (0.7%)			20 (4.9%)		
Abomasum	0			5 (1.2%)			5 (1.2%)		
Abdominal cavity	4 (1.0%)			0			4 (1.0%)		
Rumen and reticulum	0			4 (1.0%)			4 (1.0%)		
Thoracic cavity	2 (0.5%)			0			2 (0.5%)		
Total	23 (5.6%)			47 (11.5%)			70 (17.1%)	9.0	0.003*

*Difference in proportion of occurrence of non-metallic and metallic FBs

Table 2: Results of Chi-square analyses of occurrence of foreign bodies by risk factors in cattle slaughtered at Hawassa municipal abattoir, Ethiopia

Variable	Category	No. examined	No. (%) positive	x^2	*P* value
Sex	Male	388	57 (14.7)	29.0	0.000
	Female	22	13 (59.1)		
Age	≤5 years	28	4 (14.3)	0.8	0.661
	5-10 years	46	6 (13.0)		
	≥ 10 years	336	60 (17.9)		
Breed	Cross	17	10 (58.8)	21.8	0.000
	Local	397	60 (15.3)		
Body condition	Poor	76	33 (43.4)	57.8	0.000
	Medium	100	22 (22.0)		
	Good	234	15 (6.4)		
Origin	Rural	243	19 (7.8)	36.1	0.000
	Urban	167	51 (30.5)		
Total		410	70 (17.1)		

Table 3: Frequency (proportion) of detection of metallic and non-metallic foreign bodies in male and female cattle slaughtered at Hawassa municipal abattoir

		Metallic			Non-metallic			Total		
Sex	No. examined	No. (%) positive	x^2	*P* value	No. (%) positive	x^2	*P* value	No. (%) positive	x^2	*P* value
Male	388	17 (4.4)	26.6	0.000	40 (10.3)	9.5	0.002	57 (14.7)	29.0	0.000
Female	22	6 (27.3)			7 (31.8)			13 (59.1)		

non-metallic nature were recovered from 5.6% (3.7-8.3) and 11.5% (8.7-14.9) of the study animals, respectively (P <0.01). Out of the total of 23 cattle observed to have metallic FBs 15 (65.2%) had penetrations of different depth. Although FBs were recovered from rumen, reticulum, abomasum and abdominal and thoracic cavities; rumen and reticulum (in that order) were the most affected. Rate of detection of metallic FBs was highest in the reticulum (4.1%) followed by abdominal cavity (1.0%), whereas the rate of occurrence of non-metallic FBs was highest (P <0.001) in the rumen (8.5%) followed by abomasum (1.2%; Table 1).

Risk Factors: Sex, breed, body condition and origin of the study animals were statistically significantly associated (P <0.001) with occurrence of FBs, while age of the animals did not (P >0.05). Foreign bodies were detected at higher proportion in females than males, cross bred cattle than local ones, cattle with poor body condition than those with better condition and cattle from urban areas compared to their counterparts from rural areas (Table 2).

Both metallic and non-metallic FBs were detected in higher proportion in females compared to male cattle (P <0.001) (Table 3).

Occurrence of penetrating and non penetrating metallic FBs was also compared between male and female cattle. Penetrating metallic FBs were detected at higher (P <0.001) proportion in female (22.7%) cattle than male cattle (2.6%). However, there was no statistically significant difference (P >0.05) in the proportion of detection of non penetrating metallic FBs between male and female cattle (Table 4).

Table 4: Frequency (proportion) of detection of penetrating and non-penetrating metallic foreign bodies in male and female cattle slaughtered at Hawassa Municipality Abattoir

Sex	No. examined	Penetrating (%)	x^2	*P* value	Non-penetrating (%)	x^2	*P* value
Male	388	10 (2.6)	24.0	0.000	7 (1.8)	0.82	0.366
Female	22	5 (22.7)			1 (4.5)		
Total	410	15 (3.7)			8 (2.0)		

DISCUSSION

The study revealed a 17.1% overall prevalence of foreign bodies (FBs) in cattle slaughtered at Hawassa municipal abattoir. Similar prevalence of 17.4% has been recorded in a large abattoir study in Rwanda [23]. Our result is also comparable to the 13.2% and 14% prevalence recorded in cattle slaughtered in Jimma [24] and Asella [25] towns in western and central Ethiopia, respectively. However, a slightly higher prevalence of 23.9% has been reported from Hirna in Eastern Ethiopia [17]. Anwar *et al.* [18] recorded a much higher prevalence (59.1%) in Pakistan. The difference in prevalence is likely to be due to difference in the level of environmental contamination with FBs and/or differences in husbandry practices among respective study areas; which would affect availability of FBs or access of cattle to such items. The recovery of most FBs in the rumen agrees with many previous reports [9, 17, 18, 25]. The higher prevalence of non-metallic FBs observed in our study is consistent with other reports where plastics were the most frequent [9, 24, 25]. This is likely due to the widespread use and improper disposal of plastic materials especially plastic bags in the country. It has been reported that plastic materials are commonly seen littering the environment in towns in the country [7].

Metallic FBs were most frequently recovered (4.1%) from reticulum, while none was found in the rumen. On the other hand, nonmetallic FBs were more prevalent in rumen (8.5%) than reticulum (0.7%). This result is in agreement with the reports of Tesfaye and Chanie [24]. Metal objects that are ingested invariably lodge in the floor of the reticulum due to their relative mass and the position of the reticulum [10]. The finding of penetrating FBs with 3.7% prevalence may signify the potential importance of hardware disease (traumatic reticulitis) in cattle in the study area.

The differences in prevalence observed between female (59.1%) and male (14.7%) cattle have also been reported earlier in Ethiopia [24] and elsewhere [18, 23]. This might be associated with physiological difference between male and female animals. Female animals face higher demand for certain minerals (e.g. calcium and phosphorus) during late pregnancy to support fetal growth and during early lactation for milk production [26, 27]. The resulting increase in appetite and possible development of pica (e.g. phosphorus deficiency) may lead to ingestion of FBs [26]. It may also be associated with longevity of female animals which increases their chance of exposure [28].

Consistent with Tesfaye and Chanie [24], occurrence of FBs was higher in cross-bred cattle (58.8%) compared to local cattle (15.3%). This might be associated with high level of milk yield in crossbred cattle which puts them on high demand for nutrients and hence increase their exposure to FBs. The apparent higher prevalence of FBs in cross-bred cattle may also be associated with the urban environment in which they usually are kept and is commonly littered with indigestible materials such as plastic bags.

In this study, animals with poor body condition were found to be most affected with indigestible FBs. Several studies associated poor body condition with presence of FBs in the fore-stomach of cattle [9, 18, 23-25]. Foreign bodies in the fore-stomach may interfere with flow of ingesta, affect contraction of the organs, reduce absorption of volatile fatty acids (VFA) and reduce the effective volume of the fore-stomach, all of which could reduce weight gain [12-14]. It is also possible that animals in poor body condition were deficient in certain minerals and therefore are more likely to have pica and hence ingestion of strange objects [23, 29].

Detection of FBs was higher in cattle originated from urban areas (30.5%) compared to that of rural areas (7.8%). Cattle from rural areas are more likely to be fed on pasture, where occurrence of disease conditions due to ingested FBs is very rare, than cattle from urban areas [6]. It has been recorded that 95% of urban stray cattle in India had indigestible FBs [30]. In free grazing system, livestock reared in urban and semi urban areas are often left in market places, road sides and near kitchen wastes. In an attempt to eat vegetable waste and food thrown in plastic bags, cattle may ingest the packaging material with the food [15].

In conclusion, occurrence of ingested foreign bodies in cattle in areas supplying slaughter cattle to Hawassa appears to be considerable. Proper nutritional management of cattle and keeping cattle away from areas

littered with indigestible materials, which could be ingested by cattle, may help reduce the problem. Awareness may also be created on the environmental effects of careless disposal of plastic bags in general and its animal health effect in particular, for public action.

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