

Research Article

Study on Prevalence of Rumen and Reticulum Indigestible Foreign Bodies in Cattle at Asella Municipal Abattoir

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Abstract

This cross-sectional study, conducted at Asella Municipal Abattoir in Oromia Regional State, southeastern Ethiopia, aimed to estimate and identify the prevalence of indigestible rumen and reticulum foreign bodies in cattle and explore associated risk factors. A total of 500 randomly selected cattle were subjected to postmortem examinations of the rumen and reticulum to identify and estimate the prevalence of foreign bodies. Among the examined cattle, 77 (17.42%) males and 20 (34.48%) females were found positive for foreign bodies. The prevalence of foreign body occurrence varied across age groups, with 2 (11.8%) in young, 19 (12.03%) in adult, and 76 (23.4%) in old cattle. Similarly, prevalence rates were observed in poor (33.3%), medium (30.77%), and good (16.6%) body condition cattle. Plastic, clothes, nails, and wires were identified as the main types of foreign bodies, with the rumen harboring 84.5% and the reticulum retaining 12.4% of the positive cases. Statistical analysis revealed significant associations ($p < 0.05$) between the occurrence of foreign bodies and potential risk factors, including age, gender, and body condition. Plastic materials were predominantly found in the rumen, while metallic objects were more commonly retained in the reticulum. A lower prevalence of rumen and reticulum foreign bodies was observed in cross-breed cattle (5.2%) compared to local breeds (94.8%). However, no statistically significant difference was found between local and crossbreed cattle ($p = 0.199$). Regional variations were noted, with the highest prevalence observed in

cattle originating from Sagure (24.29%) and the lowest from Kersa (9.30%), although no statistically significant differences were identified among the origins ($p = 0.156$). The study underscores the need for an effective solid waste disposal system in the study area to mitigate health risks for ruminants and environmental concerns.

Keywords: Asella Municipal Abattoir; Cattle; Indigestible foreign bodies; Postmortem examination; Prevalence; Rumen; Reticulum

List of Abbreviations

CSA: Central Statistical Authority

TPL: Traumatic Pericarditis

TRP: Traumatic Reticulo-Peritonitis

VFA: Volatile Fatty Acids

WARD: Woreda Agricultural and Rural Development Office

Introduction

The livestock population in Ethiopia is significant, with approximately 59.5 million cattle, 30.7 million sheep, 30.2 million goats, and various other animal species such as horses, donkeys, mules, camels, and poultry [1]. These animals serve as vital sources of income for agricultural communities and play a crucial role in the country's economy. They are major contributors to foreign currency earnings through the export of skins and meat and also serve as essential sources of animal protein, providing meat and milk for consumption [2]. Cattle, in particular, make a substantial contribution to the economy by providing meat, milk, income, and foreign exchange. However, their overall potential impact is hindered by prevalent livestock diseases, suboptimal management systems, and poor genetic performance [3]. Environmental pollution also poses a significant concern, leading to ingestible foreign body ingestion, which has become a global health problem for ruminants [4]. This issue has been cited as one of the common causes of sudden death among these animals, particularly due to the ingestion of metallic and non-metallic foreign bodies [5,6]. Several influencing factors, including the presence of old rusting fences, baling wire, and inappropriate waste disposal, contribute to the ingestion of foreign bodies by cattle [7]. This condition tends to be more prevalent during drought periods when animals graze closer to the ground or consume contaminated harvested material. In urban and peri-urban areas, extensive building construction without proper waste disposal measures has led to a serious impact, resulting in the loss of dairy cattle mainly associated with foreign bodies [8]. The presence of foreign bodies in the rumen and reticulum not only poses economic repercussions due to potential loss of animal productivity and increased mortality but also hampers the absorption of important nutrients, thus impacting the overall health and well-being of the animals [9]. The perforation of the reticulum wall leads to the leakage of ingesta and bacteria, resulting in peritonitis, while foreign objects can penetrate the pleural and pericardial cavities, causing pleuritis, pneumonitis, and pericarditis [10]. The implications of this condition

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vary depending on the duration and location of the foreign body, the degree of obstruction, and the material involved [11-13] Rumen impaction, often asymptomatic and challenging to diagnose in live animals, necessitates post-mortem examination for comprehensive evaluation. This study seeks to illuminate the prevalence, locations, and varieties of indigestible foreign bodies in the rumen and reticulum, aiming to offer essential insights into the health and digestive challenges encountered cattle. Furthermore, by identifying the risk factors associated with the ingestion of these foreign bodies, the research endeavors to contribute to the development of preventive strategies and management protocols. The findings of this study hold significant implications for enhancing both the understanding and the mitigation of rumen and reticulum foreign bodies in cattle, thereby contributing to the overall welfare of these animals and the management practices within abattoir settings.

This study aims to address the following objectives:

- To estimate the prevalence of rumen and reticulum foreign bodies and to identify the location and type of these indigestible foreign bodies in cattle slaughtered at Asella Municipal Abattoir.
- To identify the type of rumen and reticulum foreign bodies and to study the risk factors associated with the ingestion of those foreign bodies in cattle.

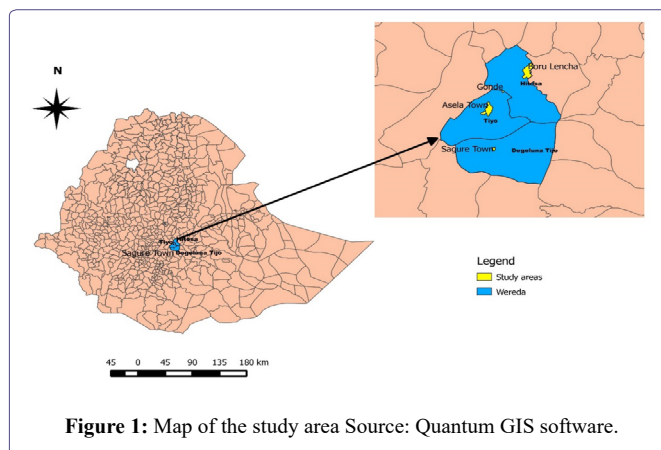
Materials and Methods

Study Area

The study was conducted in and around Asella town, situated 175 km southeast of Addis Ababa, the capital of Ethiopia. Geographically, Asella is located in the Tiyo district at 6°79' and 8°49' N latitude and 38°41' and 40°44' E longitude. Covering an area of 2,118,675 hectares, the region features 39.7% highland, 29.1% lowland, and 27.5% mid-altitude landscapes. The area experiences a mid-subtropical climate, with temperatures ranging from 8.4 to 22.6°C and relative humidity ranging from 43 to 60%. Rainfall is characterized by two phases: March to April (short rainy season) and July to October (long rainy season), with an average annual rainfall of 2000 mm. The agricultural landscape comprises a mixed crop-livestock farming system. The livestock population in the Tiyo district includes 107,608 cattle, 90,894 sheep, 16,117 goats, 10,845 horses, and 20,180 donkeys, according to the Arsi Zone Livestock and Fishery Bureau (2022) (Figure 1).

Study Animals

The study involved 500 healthy slaughtered cattle at Asella Municipal Abattoir between November 2022 and May 2023. These animals were sourced from various agroecological zones, including Asella, Sagure, Hetosa, Boru, Kersa, and Golja, each characterized by different management systems. The sampled animals comprised both local and crossbreed cattle, reared under extensive and semi-intensive farming systems. While the management practices varied across the regions, most rural areas typically involved pasture grazing on grasslands with supplementary feeding of crop residue during periods of limited pasture, particularly in the long dry season. In Asella town, a semi-intensive management system was observed, where animals were provided with concentrated feed and hay. The cattle population predominantly consists of local breeds, with some Holstein Friesian cattle kept for dairy purposes. The transportation of these animals to the abattoir was facilitated both by vehicles and on foot.



Study Design

A cross-sectional study was conducted at Asella Municipal Abattoir from November 2022 to May 2023 to assess the prevalence of rumen and reticulum foreign bodies in slaughtered cattle. The study aimed to identify the types of foreign bodies and the associated risk factors, considering the breed, age, body condition, sex, and origin of the animals. Age groups were categorized based on dentition, distinguishing between young, adult, and old animals. Body condition was assessed as poor, medium, or good through visual examination and palpation of the lumbar vertebrae [14]. The animals' origins were grouped into six districts. After slaughter, the rumen and reticulum of each cattle were carefully examined and any foreign bodies retrieved were documented, washed, dried, and identified.

Sample Size Determination and Sampling Technique

The sample size was determined using the following formula given by Thrusfield (2018). There was no previous study on the rumen and reticulum indigestible foreign bodies in cattle slaughtered at Asella Municipal Abattoir. Thus, a 50% prevalence with a 5% desired level of precision and 95% confidence interval was considered to calculate the sample size.

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

Where,

N = required sample size.

P_{exp} = Expected proportion of the population knowing about IFB is 50%.

d = Desired absolute precision (0.05).

Therefore, the minimum sample size of the present study was 384. However, to maximize the precision 500 cattle were selected using a simple random sampling technique and examined for the presence of rumen and reticulum indigestible foreign bodies.

Study Methodology

Antemortem examination

Upon arrival at the abattoir, cattle slated for slaughter underwent antemortem inspection. This inspection involved a series of procedures considering the animals' behavior, physical condition, and signs of disease [15]. Each animal was individually assessed and

documented in terms of sex, age, breed, place of origin, and body condition. Additionally, a unique identification number was assigned to each selected cattle for both antemortem and post-mortem evaluations, and a specific code was marked on the animal's gluteal muscle for identification purposes.

Postmortem examination and identification of rumen and reticulum indigestible foreign bodies

In the postmortem examination, the stomach of each animal was extracted from the abdominal cavity. A thorough visual and tactile assessment of the rumen and reticulum was conducted to identify any foreign non-dietary material. Special attention was given to visual inspection and tactile exploration to detect the presence of foreign bodies. This involved the careful removal of adherent feed materials to aid in determining the nature and location of any identified foreign entities. Positive findings were meticulously documented, noting the nature and location of the foreign bodies, while negative results were duly recorded. Identified foreign bodies were carefully rinsed with water as part of the examination process.

Data Analysis

The collected data underwent coding in a Microsoft Excel spreadsheet and subsequent analysis was performed using STATA version 14 software. Descriptive statistical methods, including tabulation, were utilized to summarize and present the gathered data. The total prevalence of rumen and reticulum foreign bodies was calculated as a percentage, obtained by dividing the total number of positive cases by the total number of examined cattle. To assess associations between the prevalence of foreign bodies and various potential risk factors, the Pearson chi-square (χ^2) test was applied. A statistically significant result was determined based on a 95% confidence interval (CI) and a p-value of less than 0.05.

Results

Overall Prevalence of Rumen and Reticulum Indigestible Foreign Bodies in Cattle

Out of the 500 examined cattle (442 males and 58 females), 19.40% (97/500) tested positive for foreign bodies in their rumen and reticulum. Of the positive cases, 84.5% (82) were located in the rumen, 12.5% (12) in the reticulum, and 3% (3) in both. The detected foreign bodies included clothes (6.4%), plastics (9.8%), metal (2%), wire (0.6%), plastic and wire (0.4%), and plastic and nail (0.2%). These findings are summarized in Table 1.

Occurrence of Foreign Bodies With Regard To Age

The study assessed the prevalence of indigestible foreign bodies across different age groups of cattle. Rumen and reticulum foreign bodies were found to be more prevalent among older (> 10 years) cattle at 23.4% (76/325), followed by adult animals (5–10 years) at 12.03% (19/158), and the least among young animals (< 5 years) at 11.8% (2/17). The difference in the occurrence of foreign bodies was found to be statistically significant ($p < 0.05$), with older animals showing a higher prevalence compared to the other age groups, as presented in (Table 2).

Factors	Categories	Prevalence (%)	Odds Ratio	P-Value	95CI%
Age	Young	21%	1.950877	0.276	0.59- 6.49
	Adult	12%	ref	ref	ref
	Old	22%	2.17417	0.005	1.26- 3.75
Breed	Local	20.09%	1.86	0.206	0.71-4.86-
	Hf cross	11.9%	ref	ref	ref
Sex	Male	17.42%	0.4	0.003	0.22-0.72
	Female	34.48%	ref	ref	ref
Body Condition	Good	16.6%	ref	ref	ref
	Medium	30.8%	2.23	0.002	1.33-3.73
	Poor	33.3%	2.5	0.294	0.45-13.97
Origin	Boru	15.8%	0.68	0.44	0.27-1.76
	Golja	17.95%	0.8	0.631	0.33-1.96
	Hetosa	11.3%	0.47	0.106	0.19-1.18
	Kersa	9.3%	0.38	0.078	0.13-1.12
	Sagure	24.3%	1.18	0.54	0.7-1.98

Table 1: Association of age, breed, sex, body condition score, and origin of the animals examined with rumen and reticulum foreign bodies in cattle at Asella Municipal Abattoir

Occurrence of Foreign Bodies with Regard to Sex

Out of the total 500 examined cattle, the prevalence of foreign bodies was 17.42% (77/442) in male animals and 34.48% (20/58) in female animals (Table 3).

Occurrence of Foreign Bodies with Regard to Body Condition Score

It was observed that 33.3% (2/6), 30.8% (28/91), and 16.6% (67/403) of the poor, medium, and good body condition cattle respectively carried various types of rumen and reticulum foreign bodies, showing a statistical significant difference as indicated in (Table 4).

Factor	Variable	Number of examined	Number of positive animals	Prevalence (%)	Chi-square (χ^2)	p-value
Age	Young (≤ 5 years)	17	2	11.8%	9.43	0.009
	Adult (5-10 years)	158	19	12.03%		
	Old (≥ 10 years)	325	76	23.4%		
	Total	500	97	19.40%		

Table 2: Age distribution of rumen and reticulum foreign bodies in cattle slaughtered at the Asella municipal abattoir.

Occurrence of Foreign Bodies with Regard to Location

The types of foreign bodies were detected clothes, metal, Plastic, wire, Plastic and wire, plastic and nail. From these plastics, 49 (9.8%), cloth 32 (6.4%), metal 10(2%), wire 3 (0.6%), Plastic and wire 2 (0.4%), and nail 1(0.2%) were more frequently encountered of the positive cases, respectively (Table 5 & Figure 2).

Factor	Variable	Examined animal	Ng of positive animals	Prevalence (%)	Chi-square (X ²)	p-value
Sex	Male	442	77	17.42	9.54	0.002
	Female	58	20	34.48		
	Total	500	97	51.9		

Table 3: Prevalence and frequency of rumen and reticulum foreign bodies about sex in cattle slaughtered at Asella municipal abattoir.

Factor	Variable	Number of examined	Number of positive animals	Prevalence (%)	Chi-square (X ²)	p-value
Body Condition	Good	403	67	16.6%	10.3	0.006
	Medium	91	28	30.8%		
	Poor	6	2	33.3%		
	Total	500	97	19.40%		

Table 4: Association of body condition scores with rumen and reticulum foreign bodies in cattle at Asella Municipal Abattoir.

Type of Foreign body	Location of foreign body			Total	Prevalence (%)	Chi-square (X ²)	p-value
	Rumen	Reticulum	Rumen & Reticulum				
Cloth	32	ref	ref	32	6.4%	18	0.0001
Metal	ref	10	ref	10	2%		
Plastic and nail	ref	ref	1	1	0.2%		
Plastic	49	ref	ref	49	9.8%		
Plastic and wire	ref	ref	2	2	0.4%		
wire	1	2	ref	3	0.6%		
Total	82	12	3	97	19.40%		

Table 5: Frequency of occurrence of rumen and reticulum regarding to location of foreign bodies in cattle slaughtered at Asella Municipal Abattoir.

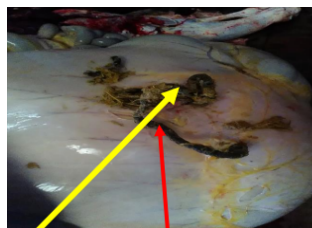
Occurrence of Foreign Bodies with Regard to Breed and Origin of Animals

Out of the 500 cattle examined, 458 were local breeds and 42 were crossbreeds, with both breeds exhibiting the presence of foreign bodies. The prevalence of rumen and reticulum foreign bodies was notably higher in local breed cattle (94.8%) compared to HF crossbreeds (5.2%). Frequencies of these foreign bodies were most prevalent in cattle from Sagure (24.3%) and least prevalent in those from Kersa (9.3%) as shown in Table 4. The study further revealed no statistically significant differences in the prevalence among breeds (p=0.199) and the origin of animals (p=0.156) (Table 6 & Figure 3).



A. Clothes Chewed From Rumen

B. Nails And Chewed Clothes From Reticulum And Rumen



C. Plastic Material And Chewed Rope From The Rumen



D. Plastic Chewed From The Rumen

Figure 2: Camera captions of encountered indigestible foreign bodies during the study period.

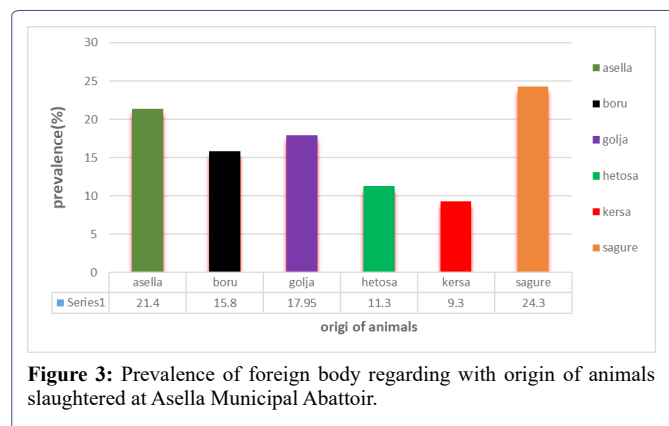
Category	Animal origin	Number of animals examined	Number of positive animals	Prevalence (%)	Chi-square (X ²)	p-value
Origin	Asella	187	40	21.4%	7.9968	0.156
	Boru	38	6	15.8%		
	Golja	39	7	17.95%		
	Hetosa	53	6	11.3%		
	Kersa	43	4	9.3%		
	Sagure	140	34	24.3%		
	Total	500	97	19.40%		
Breed	Cross	42	5	11.9%	1.6474	0.199
	Local	458	92	20.09%		
	Total	500	97	19.40%		

Table 6: The origin of slaughtered animals and breed of cattle examined for rumen and reticulum foreign body at Asella Municipal Abattoir was summarized under this table.

Discussion

In our investigation, we recorded an overall prevalence of 19.40% (n=97) of indigestible foreign bodies in bovine, a statistic carrying potential ramifications including adverse economic effects, diminished output, and a heightened risk of animal mortality. This aligns with Igbokwe et al. (2003), who reported a similar prevalence of 19.3% in sheep in Nigeria. However, our findings surpassed those of Basa and Tesfaye (2017), who documented a prevalence of 17.16% in rumen and reticulum foreign bodies in cattle slaughtered in Wolaita Sodo Municipal Abattoir, Ethiopia, and were notably higher than the extremely low prevalence of 8.9% reported by Hailat et al. (1996) in Jordan.

In contrast, Remi-Adewunmi et al. (2004) reported an exceptionally high overall prevalence of 97% in sheep and goats



slaughtered in Nigeria, indicating considerable regional disparities. These differences in prevalence could be attributed to variations in waste management systems among countries and inadequate animal management practices, especially in rural, urban, and pre-urban settings [16]. These disparities become particularly pronounced during periods of feed scarcity, such as the prolonged dry season in Ethiopia, where most cattle owners do not provide additional feed to their animals. The occurrence of indigestible foreign bodies, as indicated by the majority of research focusing on case reports, is often associated with sick cattle brought into clinics exhibiting clinical signs that raise suspicion of foreign body involvement. This emphasizes the need for vigilant monitoring and preventive measures to minimize the economic impact and potential fatality associated with these incidents. Our investigation revealed notable variations in the prevalence of rumen and reticulum foreign bodies across different age groups and genders in bovine. Older cattle (> 10 years) exhibited the highest prevalence at 23.4%, followed by adult animals (5–10 years) at 12.03%, and the lowest prevalence was observed in young animals (< 5 years) at 11.8%. While the prevalence was higher in older animals, this difference lacked statistical significance ($p < 0.05$). This finding aligns with Rahel (2011), who reported a higher frequency of foreign bodies in the rumen and reticulum of older animals, suggesting a potential link to the gradual accumulation of indigestible materials over an extended period (Tsfaye, 2012). In our study, a higher prevalence of foreign bodies was observed in female cattle (34.48%) compared to males (17.42%) [17-19]. This aligns with several reports, including Berrie et al. (2015), who found that 87% of dairy cattle were impacted by foreign bodies. Similarly, Vikhaya et al. (2017) reported a higher prevalence in females at the Queens Town Abattoir in South Africa, and Mushonga et al. (2017) observed a higher prevalence in female crossbred cattle from Rwanda. Potential factors contributing to this gender disparity include the feeding practices, with females more likely to be fed chopped feeds like silage or hay, as suggested by Kouam et al. (2017). Additionally, the nutritional demands associated with milk yield during pregnancies and lactation periods may contribute to the higher prevalence in females [20-22]. This study provides valuable insights into the correlation between body condition, rumen localization, and the prevalence of indigestible foreign bodies in bovine. When comparing different body conditions, our findings revealed that indigestible foreign bodies were predominantly detected in cattle with low body condition (33.3%), followed by medium (30.8%) and good body condition (16.6%). This aligns with the observations of Mushonga et al. (2015) and Ushula Nana (2017), suggesting that foreign bodies lodged in the ruminal area can impede normal rumen and reticulum function, making it challenging for animals to maintain

a healthy body condition. The interference with nutrient absorption, particularly volatile fatty acids (VFA) and minerals, contributes to body condition loss, as emphasized by Remi-Adewunmi et al. (2004).

Furthermore, our investigation unveiled a higher prevalence of indigestible foreign bodies in the rumen (84.5%) compared to the reticulum (14%), with a minor proportion occurring in both. Plastic bags emerged as the most common indigestible foreign element in the rumen, constituting 9.8% of cases, followed by cloth (6.4%), metal (2%), and wire (0.6%). These findings are consistent with the conclusions drawn by various researchers. Mekuanint et al. (2017) reported 46.1% of plastic bags in the rumen of sheep in Jordan, while Hailat et al. (1996) found 74% in the rumen of sheep in the same region. Remi-Adewunmi et al. (2004) and Berrie et al. (2015) observed plastics in cattle slaughtered in Gondar Elfora Abattoir, documenting 42.3% and 85%, respectively, from rumen impaction cases at Addis Ababa Abattoir Enterprise. Bwatota et al. (2018) reported 50.5% of plastic bags in cattle slaughtered at Morogoro Municipal Slaughterhouse in Tanzania [23-26].

These findings underscore the significance of body condition assessment and the predominant role of the rumen in the accumulation of indigestible materials. Implementing preventive measures and targeted interventions for specific types of foreign bodies may contribute to the overall health and well-being of the bovine population. Our study underscores a concerning prevalence of plastic bags as the predominant ingested foreign body in the rumen and reticulum of bovine species. The consensus among various researchers supports the notion that plastic bags surpass other types of foreign bodies in occurrence. This escalating incidence of non-metabolic foreign entities, particularly plastic bags, across diverse countries can be attributed to the rapid forces of globalization, industrialization, and the challenges associated with waste disposal and urbanization [27-29]. The scarcity of recycling industries in many developing nations exacerbates the issue, contributing to the persistence of plastic-related incidents in the rumen and reticulum. The inherent characteristics of the rumen, characterized by higher volume and its position as the primary site of ingesta accumulation, play a pivotal role in the higher prevalence of foreign bodies, particularly plastic bags. The rumen's expansive nature makes it more susceptible to the retention of ingested materials, contributing to the elevated prevalence of plastic bags over other foreign bodies [30-32]. Our findings revealed no statistically significant differences ($p=0.199$) in the prevalence among different breeds and ($p=0.156$) in the origin of animals. This contrasts with previous studies by Roman and Hiwot (2010) and Hailat et al. (1996), which identified significant associations between species differences and indigestible substances. The observed variation could be attributed to the diverse origins of animals studied, where some areas have excess feed for both species while others lack feed, leading to a heightened likelihood of animals consuming indigestible foreign materials due to scarcity of grazing pasture. Frequent droughts in the research area further exacerbate the shortage of animal feed, prompting animals to indiscriminately ingest foreign material in response to nutritional deficits in key elements such as calcium, phosphorus, and other micronutrients [33]. These insights emphasize the urgent need for global strategies addressing plastic waste management, especially in developing nations, and highlight the importance of tailored interventions considering regional variations in animal management and environmental conditions [34-35].

Conclusion and Recommendations

This study sheds light on the prevalent occurrence of rumen and reticulum indigestible foreign bodies among cattle slaughtered at Asella Municipal Abattoir. The diverse types of foreign bodies identified encompassed clothes, metal, plastic, wire, and combinations such as plastic and wire or plastic and nail. Nonmetallic foreign bodies predominantly lodged in the rumen, while metallic foreign bodies were more commonly found in the reticulum. Breed, age, and body condition score emerged as significant risk factors for the incidence of foreign bodies, with a highly statistically significant degree of association ($p < 0.05$). This underscores the need for targeted interventions and preventative measures to mitigate the risks associated with foreign body ingestion in cattle populations. Thus based on the above conclusion the following recommendations are forwarded.

- Implement measures to keep cattle away from both new construction sites and older, unclear grazing areas to minimize exposure to potential foreign bodies.
- Advise animal owners on practices to reduce the risk of foreign body ingestion by their cattle, emphasizing responsible management and feeding practices.
- Promote awareness and education within the general population to reduce environmental pollution caused by the presence of foreign bodies. This includes emphasizing responsible waste disposal and minimizing environmental contaminants.
- Given the limited scope of previous studies on foreign bodies in the region, recommend further research initiatives to underscore the significance of the issue. Future studies should focus on prevention and control measures to address the identified challenges effectively.

Declaration

Data Availability

All the datasets generated or analyzed during this study are included in this manuscript.

Ethical Approval

The best practice guidelines for veterinary care were followed and those cattle owners were informed as to the purpose of the study, and that the Wolaita Sodo University of Research Ethics and Review Committee approved the protocol of the study with the reference number WSU 41/22/2241 and the verbally informed consent process in the manuscript.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Author's Contribution

TK and ND contributed to the study conception, design, data gathering, data analysis, manuscript write-up, and editing of the manuscript; HFG, IAK, and TB contributed to the data analysis, reviewing, and re-editing of the manuscript. All authors have approved the submission of the manuscript.

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