

Cross-Sectional Study

Prevalence and Associated Risk Factors of Foreign Body in the Rumen and Reticulum of Small Ruminants Slaughtered at Mogadishu, Somalia

 Mohamed A. Yusuf-Isleged, MSc¹;  Yasin H. Sh Hassan, MSc²;  Moktar O. S. Mohamed, MSc²;  Omar M. Salah, MSc²;  Sayidali M. Abdulle, BSc³;  Bashir O. Mohamed, MSc³

¹Department of Veterinary Medicine, University of Somalia (UNISO), Mogadishu, Somalia

²Department of Clinics, Teriogenology and Surgery, University of Somalia (UNISO), Mogadishu, Somalia

³University of Somalia (UNISO), Mogadishu, Somalia

***Corresponding author**

Mohamed A. Yusuf-Isleged, MSc

Department of Veterinary Medicine, Faculty of Veterinary Medicine and Animal Husbandry, University of Somalia (UNISO), Mogadishu, Somalia;

E-mail: m.aliyusuf@uniso.edu.so

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ABSTRACT**Background**

The majority of the sheep and goats that live in Somalia are among the continent's largest animal populations. A significant portion of the Somali population relies on them as a means of sustenance and financial support. A small ruminant after eating foreign materials can have ruminal impaction, a condition in which indigestible foreign bodies accumulate in the rumen of ruminants, leading to ruminal impaction indigestion, recurrent tympany, and many other adverse health effects.

Study

A cross-sectional method was used to conduct this study. In the data gathering procedure, researchers did a sieve on random selection for the study in order to record the data. The data gathered were specifically tailored to the animal's sex, age, species, body score, and origin. Foreign bodies were examined in the rumen and reticulum during the post-mortem examination of small ruminants at Kawaanbari slaughterhouse.

Objectives

The main objective of this study was to examine the prevalence of foreign bodies in the rumen and reticulum of small ruminants and identify associated risk factors in Kawaanbari Slaughterhouse, Mogadishu, Somalia.

Results

The study's results showed that of the 384 small ruminants examined for foreign bodies, 154 (40.1%) were found to have foreign bodies in their rumen or reticulum. Seventeen (4.4%) had foreign bodies located in the reticulum, while 137 (35.7%) animals were found to have foreign bodies present in the rumen of the 104 sheep examined; 52 (13.5%) had foreign bodies; and of the 280 goats examined, 102 (26.6%) tested positive for foreign bodies. It was found that the body condition score had a statistically significant association ($p < 0.05$) with the presence of foreign bodies.

Conclusion

In conclusion, the current study found that approximately 40.1% of various types of undigested objects were present in the rumen and reticulum of sheep and goats from different areas in the Benadir and Shabelle regions, which were destined for slaughter at the Kawaanbari Abattoir on the outskirts of Mogadishu. The majority of these foreign bodies were found in animals that were in poor physical condition.

Recommendation

The study recommends that pastoralists and farmers ensure a consistent availability of feed for ruminants throughout all seasons as a preventive measure against the ingestion of indigestible foreign bodies.

Keywords

Foreign body; Plastic bags; Rumen and reticulum; Small ruminants; Somalian.

INTRODUCTION

The main production community of the Somalian people, who rear their animals under a severe production system known as pastoralism, depends on livestock as the foundation of their economy.¹ Pure pastoralism provides a means of subsistence for more than 70% of Somalis. In the pastoral livestock production system, animals make up 60% of the nation's GDP and 80% of the value of its exports. Since it derives from rangeland resources that are generated and sold with little help from outside the system, its contribution is a net value addition to the GDP.^{1,2}

The majority of the sheep and goats that live in Somalia are among the continent's largest animal populations.¹ Most livestock farmers in Somalia use a free-range management system where their animals, mainly sheep and goats, scavenge for food and frequently enter the refused lumps that are located around the towns,³ despite the fact that pasture and supplemental concentrate feed for intensive livestock management are scarce and expensive in Somalia. However, compared to cattle, sheep and goats are much more discriminating feeders and consume far fewer foreign objects.⁴

A small ruminant after eating plastic materials can have ruminal impaction, which is a condition in which indigestible plastic foreign bodies accumulate in the rumen of ruminants, leading to ruminal impaction in digestion, recurrent tympany, and many other adverse health effects.⁵

The disease is predominantly observed in stray animals living in urban areas of developing nations. Plastic materials ingested in the rumen release chemicals into the rumen fluid, which subsequently enter the food chain through milk and meat products. These chemicals have adverse effects on human health and can cause mortality in small ruminants.⁵

During periods of drought, when there is a lack of rain and limited food availability, the vulnerability and likelihood of consuming inedible substances increase. Animals may resort to eating from garbage dumps, which become their primary source of food. This behavior can result in rumen impaction, a condition where the digestive system becomes blocked.⁶

The problem with plastic bags that are not disposed of properly and the consequences that come after polluting the environment with it, is the chances and risk of incidents that small ruminants can ingest the bags are very high, and once ingested the plastic bags it difficult to break apart during the digestion process and cannot be digested or to become part of animal waste or excretion, so it lingers in the gut, plastic bags damages, disruptive food digestion process, in the gut, they obstruct and block the passageways between lower abdominal organs whether is different passageways between large intestines and small intestines, the passageways between small intestines and rumen and the passageways of different chambers of the rumen, With these obstructions, no matter how small or big they are, they will have a damaging effect on the homeostasis of the animal. This will create a situation where physiological dysfunction, notable infections that lead

to blood poisoning by toxins (toxaemia or septicaemia), or worse, conditions like death, will occur. Similarly, death will occur when obstructions in the passageway of the feces occur. All these come in their first stages: reduction or loss of appetite, malnutrition, and emaciation, which results from decreased ruminal or stomach capacity.⁷

Despite their problem, no information is available regarding the prevalence of foreign bodies in small ruminants in the study area.^{8,9} As a result of the limited information regarding plastic bags, this study was designed to determine the prevalence and associated risk factors of foreign bodies in the rumen and reticulum of small ruminants in Mogadishu, Somalia (Figure 1).¹⁰

Figure 1. Examining Rumen and Reticulum of Small Ruminants, Mogadishu



MATERIALS AND METHODS

Study Area

This study was conducted in the Benadir region of Somalia. With its seventeen districts, the Benadir Region is one of Somalia's major administrative divisions. Its geographical borders are the wide stretch of the Indian Ocean to the south, lower Shebelle to the west, and middle Shebelle to the north and east. Strategically located between latitude 2.0469° N and longitude 45.3182° E, Mogadishu, the region's capital and primary hub, is a prominent coastal city with access to maritime trade and commerce. The study was especially carried out at the Kawaanbari slaughterhouse in Mogadishu. Situated within the Kaaran District's suburban sector, this slaughterhouse is a part of Mogadishu's larger urban landscape. This slaughterhouse is located in the suburban area of the Kaaran district, which is part of the broader urban landscape of Mogadishu. In the vibrant urban setting of Kaaran district, which is recognized for its varied blend of commercial, industrial, and residential activity, the Kawaanbari slaughterhouse plays a crucial role in the processing and preparation of meat products.

Study Design

A cross-sectional study was conducted over eight months, from

March 2021 to April 2022, to determine the prevalence of foreign bodies in the rumen and reticulum of small ruminants at Kawaanbari Slaughterhouse.

Study Population

Small ruminants from Kawaanbari local slaughterhouse were examined to investigate the prevalence of foreign bodies in the rumen and reticulum of small ruminants slaughtered at Kawaanbari Abattoir. During the investigation, the study gave particular attention to the animal's origin, sex, age, species, and body score.

Sample Size Determination

Sheep and goats slaughtered during each visit day were selected by simple random sampling, and all the necessary data were recorded. A simple random sampling technique was used, and the sample size was determined by using the formula given by Thrusfield.¹¹ To calculate the sample size, 50% prevalence, 95% confidence level, and 5% desired absolute precision ($d=0.05$) were used. According to the above formula, a minimum of 384 should be sampled.

$$n = \frac{1.962 \times P_{exp} (1 - P_{exp})}{d^2} = 384$$

Where n =sample size, d =absolute precession, P =expected prevalence

Research Instruments

Tools: knives, forceps, scalpel blades, rumen holders

Safety: masks, safety eyeglasses, gloves (both short and long), plastic apron

Recording: camera to record (digital) and touching for examination and gathering samples.

Data Collection Procedure

In the data gathering procedure, researchers sieved on random selection for the study in order to record the data. The data gathered were specifically tailored to the animal's sex, age, species, body score, and origin. In order to obtain more knowledge about risk factors like origin and production system, the species and sex were also recorded.

Post-mortem Examination

Foreign bodies in the rumen and reticulum were examined during the post-mortem assessment of small ruminants. Immediately after slaughter, in the evisceration stage, the stomach was carefully removed from the open abdominal cavity and explored for the presence of any non-dietary foreign material through visualization and palpation. During the inspection, any obtained foreign objects were rinsed with water to eliminate attached feed material and identify the type of foreign bodies. If the finding was positive, the location of the foreign bodies was recorded; otherwise, it was marked as negative in the post-mortem Microsoft Excel spreadsheet.

Data Analysis

To determine the prevalence of foreign bodies in the rumen and reticulum of small ruminants slaughtered at Kawaanbari, the collected data was organized and entered into a Microsoft Excel spreadsheet and then exported to the statistical package for the social sciences (SPSS). For social research, descriptive analysis was used to examine the data. A cross-tabulation was performed to investigate the relationship between the animal's origin, age, species, sex, body condition, and the risk associated with the presence of foreign bodies.

RESULTS

A total of 384 small ruminants were examined in the presence of foreign bodies in the rumen and reticulum. The data was analyzed using descriptive statistics. A cross-tabulation was used to examine the relationship between the prevalence of foreign bodies and risk factors (Table 1).

Table 1. Overall Prevalence and Species Examined Foreign Materials in the Small Ruminant			
Species Examined	No. of Examined	No. of Positive Animals	Prevalence (%)
Sheep	104	52	13.5%
Goats	280	102	26.6%
Total	384	154	40.1%

Table 1 shows that when we examined small ruminants for the presence of foreign bodies, among the 104 sheep, 52 (13.5%) had foreign bodies inside. Out of the 280 goats, 102 (26.6%) tested positive for having foreign bodies inside them. This table also shows that the overall prevalence of foreign bodies found inside the rumen and reticulum was 40.1%.

Table 2 shows that of the 384 small ruminants examined, it was discovered that foreign material was present in a significant proportion of those in poor condition, specifically 130 (33.9%) of them. Additionally, out of the animals classified with a medium body condition, 16 (4.2%) tested positive for foreign bodies, while among the fat body score group consisting of 100 animals, 8 (2.0%) were found to have foreign bodies inside.

Table 2. Animal's Body Condition Foreign Materials Found in the Animals			
Body Condition	No. of Examined	No. of Animals	Positive Prevalence (%)
Poor	201	130	33.9%
Medium	83	16	4.2%
Good	100	8	2.0%
Total	384	154	40.1%
Significant difference at $p < 0.05$			

The animals examined in the study were categorized into

different age groups, specifically those less than three years old, those aged 3 to 4-years, and those five years old and older. Among the animals less than three-years-old, comprising 102 individuals, it was found that 6 (1.6%) of them had foreign bodies inside. Out of the 90 animals in the 3 to 4-year-old group, 13 (3.4%) were reported to have foreign bodies. The majority of the animals, totaling 192 individuals, were five-years-old and older, and among them, 135 (35.1%) were found to have foreign bodies. The study indicates that there was a higher occurrence of foreign bodies in older animals compared to those in younger age groups (Table 3).

Table 3. Age of the Examined Small Ruminants

Age of the Animal	No. of Examined	No. of Animals	Positive Prevalence (%)
3-years<	102	6	1.6%
3 to 4-years	90	13	3.4%
5-years and above	192	135	35.1%
Total	384	154	40.1%

Significant difference at $p < 0.05$

Based on the aforementioned table, it can be observed that out of the 102 male animals examined, 32 (8.3%) were found to have foreign bodies present. On the other hand, out of the 282 female animals examined, a higher proportion of 122 (31.8%) were reported to have foreign bodies inside. Consequently, the occurrence of foreign bodies was more prevalent in females compared to males (Table 4).

Table 4. Animal Sex and Foreign Materials Found in the Animals

Animal Sex	No. of Examined	No. of Positive Animals	Prevalence (%)
Male	102	32	8.3%
Female	282	122	31.8%
Total	384	154	40.1%

Significant difference at $p > 0.05$

Out of the total 384 animals that were examined, it was found that 17 (4.4%) of them had foreign bodies located in the reticulum. Additionally, a significant proportion of the 137 (35.7%) animals that were part of the study were found to have foreign bodies present in the rumen (Table 5).

Table 5. Location of the Ingested Foreign Bodies Found in the Small Ruminants

Location of the Ingested Foreign Body	No. of Animals	Positive Prevalence (%)	p value
Reticulum	17	4.4%	0.02
Rumen	137	35.7%	
Total	154	40.1%	

Significant difference at $p < 0.05$

The association between risk factors and the presence of foreign bodies in small ruminants shows a great deal of significance. According to age, there is a significant association between the presence of foreign bodies and age; the old age (5-years and older) animal is more likely to eat foreign materials than the young age animal ($p = 0.000$) (Table 6).

Table 6. The Association between Risk Factors and the Ingestion of Foreign Bodies in Small Ruminants

Risk Factors	No. of Examined	Prevalence (%)	p value
Sex	Male	102	8.3%
	Female	282	31.8%
Age	3-years<	102	1.6%
	3-4 years	192	3.4%
	5 years and above	90	35.1%
Body condition	Poor	39	33.9%
	Medium	100	4.2%
	Good	245	2.0%
Species	Goat	302	26.6%
	Sheep	82	13.5%
Sources	Urban	135	20.8%
	Rural	154	19.3%

According to the body condition of an animal, the poor-condition animal is significantly more at risk than the medium- and fat-condition animal ($p = 0.000$). The species of an animal also has no significant association with the presence of foreign bodies, with a p value of 0.85.

According to the sex of an animal and the presence of foreign bodies, there is no association between whether the animal is male or female ($p > 0.05$).

According to the source of an animal, there is a significant association between the presence of foreign materials and the source of ruminants, as indicated by the p value < 0.05 (Figure 2).

Figure 2. Removing Foreign Materials from Rumen and Reticulum in Local Slaughterhouses, Mogadishu



DISCUSSION

The current study revealed that 40.1% of the small ruminants examined had foreign bodies in their rumen and reticulum. The prevalence closely aligns with the results of an earlier study by Omer¹² which documented a 33% incidence of foreign bodies in small ruminants. Another study conducted by Duresa et al¹³ also reported a close prevalence of 30.7% in domestic ruminants. This result disagrees with the studies reported by Tesfaye et al,¹⁴ Tesfaye et al,¹⁵ 23.9%; Tegegne et al⁴, 13.22%; and Roman et al¹⁶ 9.2%. Differences in the presence of indigestible foreign bodies across various regions may be attributed to variations in environmental conditions. These conditions encompass factors such as the animals' origin, husbandry practices, feeding behavior, waste management systems, and the level of environmental pollution at the source. These factors seem to exert a more significant influence on the prevalence of foreign bodies than those originating directly from the animals themselves.¹⁷

The present study revealed a significant occurrence of foreign bodies in elderly animals, with a prevalence rate of 35.1% in the rumen and reticulum and higher than that observed in other examined ruminants. This result aligns with the findings reported by Duresa et al,¹³ who found a prevalence rate of 39.3% in the rumen and reticulum of aged animals. Additionally, this study supports the reports of Abebe et al¹⁹ regarding sheep and goats, suggesting that the accumulation of undigested consumed items over an extended period may be the underlying cause.

Furthermore, the study revealed the presence of non-digestible foreign bodies in small ruminants with poor body condition, accounting for 33.9% of cases, as well as in animals with a medium body score (4.2%) and fat animals (2.0%). This result is consistent with the findings of Rahel,²⁰ who found a higher incidence of foreign bodies in animals with poor body condition. The compromised physical state of these animals may be attributed to the presence of foreign materials, which can hinder the absorption of volatile fatty acids and disrupt efficient feed conversion.

The study found that foreign bodies were more common in the rumen (35.7%) than in the reticulum (4.4%) among all ruminants, and this difference was statistically significant ($p < 0.05$). This finding was strongly consistent with the results reported by Roman et al,¹⁶ Negash et al,¹⁸ Abebe et al¹⁹ and Tesfaye et al¹⁵. Several factors may contribute to this observation, including the larger capacity of the rumen, the cumulative size and composition of the foreign objects, and the diverse range of materials involved. This disagrees with previously reported a higher prevalence in the reticulum than in rumen.²¹

The current study found that the occurrence of foreign bodies in the rumen and reticulum was more prevalent in female animals compared to male animals in both species. However, this difference did not reach statistical significance with a p -value greater than 0.05. Physiological distinctions between males and females could be a contributing factor to this difference. Females typically have higher nutritional requirements during pregnancy, which may

increase their risk of consuming foreign bodies in order to meet those increased dietary needs. While the study did not establish a statistically significant association, this explanation offers a potential rationale for the observed trend.

The relationship between the presence of foreign bodies and various risk factors varied across different categories. Statistically significant associations were observed in terms of body condition score, age, and the origin of the animals that had foreign bodies in their rumen and reticulum.

Based on the data from the study, there is a notable correlation between the origin of the animals and the presence of foreign bodies, with a statistically significant p -value of less than 0.05. This association can be attributed to variations in the management practices of foreign bodies within different communities. The study observed diverse methods of foreign bodies, like plastic disposal, but it was noted that urban areas tended to neglect proper disposal. Additionally, the availability of recycling industries for plastics in Mogadishu is limited.

CONCLUSION

In conclusion, the current study showed that foreign bodies have an impact on small ruminants. The current study found that approximately 40.1% of various types of undigested objects were present in the rumen and reticulum of sheep and goats from different areas in the Benadir and Shabelle regions, which were destined for slaughter at the Kawaanbari Abattoir on the outskirts of Mogadishu. The majority of these foreign bodies were found in animals that were in poor physical condition. This finding indicates that the consumption of undigested foreign objects is common and primarily linked to deteriorating physical conditions. Moreover, this issue is also linked to limited availability of feed, particularly during the dry season, as well as inadequate management practices, low biodegradability, improper disposal of waste such as plastic bags into the environment, and insufficient growth of recycling industries. Consequently, this problem results in significant economic losses to the national economy due to its impact on animal and environmental health.

RECOMMENDATIONS

- The study recommends that pastoralists and farmers ensure a consistent availability of feed for ruminants throughout all seasons as a preventive measure against the ingestion of indigestible foreign bodies.
- It is important to educate and raise awareness among pastoralists and farmers about keeping their animals away from contaminated areas with foreign bodies like plastic bags.
- Authorities should take steps to promote public awareness regarding best practices for waste management to prevent animals from ingesting indigestible foreign bodies.
- The municipality in the study area should prioritize finding sustainable and environmentally-friendly packaging solutions.
- Extensionists and animal health organizations have a responsibility

to educate the public and raise awareness among pastoralists about the proper disposal of waste.

- It is crucial to make every effort to gather and eliminate all plastic bags in Mogadishu city and its nearby regions. Once these non-biodegradable bags are regulated or completely banned, it is important to offer the public environmentally suitable alternatives.

DATA AVAILABILITY

The data sets used and analyzed during the current study are accessible from the consequent author on request.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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