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Prevalence of Foreign Bodies in the Rumen and Reticulum of Goats Slaughtered at Herat Governmental Slaughterhouse, Afghanistan

Tahier Abdullah[1], Saddiqi Mohamad Ehsan[1]*, Mohammadi Nooria[1], and Esmaeil Moradi[2]

[1]Department of Clinic, Faculty of Veterinary Sciences, Herat University, Herat, Afghanistan
[2]Graduate of Veterinary Science Faculty
*Corresponding author: m_saddiqi@yahoo.com

ABSTRACT

Goat rearing plays a crucial role in fighting poverty and food insecurity in Afghanistan. However, devastating droughts and poor environmental management systems cause various health issues, such as the ingestion of indigestable foreign bodies (IFBs). The ingestion of IFBs can have serious consequences for goats, including reduced production, weight loss, electrolyte imbalances, and even death. The current study aimed to evaluate the prevalence of IFB ingestion in goats in Herat Slaughterhouse, Herat, Afghanistan. A cross-sectional study was performed at Herat Governmental Slaughterhouse, Herat-Islam Qala Highway, Herat Province, Afghanistan, from July to September 2023. A total of 600 goats were included in this study. The age, sex, and body condition of all included goats were recorded. After the slaughter, the goats were inspected for IFBs, and their rumen and reticulum were incised and examined. Indigestable foreign body classifications were noted and analyzed using the Statistical Package for the Social Sciences version 26. out of six hundred goats (487 male and 113 female), 147/600 (24.5%) had IFBs in their rumens. No IFBs were observed in the reticulum. Plastic was the most commonly detected IFB at 86/600 (14.33%), followed by a plastic thread at 27/600 (4.5%), bag thread at 7/600 (1.16%), lather at 8/600 (1.33%), mixed at 6/600 (1%), chocolate cover at 3/600 (0.5%), balloon at 4/600 (0.66%), wood at 2/600 (0.33%), piece of cloth at 1/600 (0.16%), camel dung at 1/600 (0.16%), cotton thread at 1/600 (0.16%), and wire at 1/600 (0.16%). A total of 116/600 (19.33%) of the goats aged ≥ 1 and ≤2 years presented a high frequency of IFBs. The lowest prevalence of IFBs was detected in goats aged 6 years (1/600; 0.16%). There was no correlation between IFBs and body condition in the examined goats in the current study**.** The occurrence of IFBs was demonstrated in goats slaughtered at Herat Governmental Slaughterhouse, which can negatively affect the overall productivity and production of goats in Herat Province. In conclusion, effective environmental management systems, safe waste disposal, and prompt foreign body removal are crucial preventive measures.

Keywords: Goats, Herat Governmental Slaughterhouse, Foreign Body, Rumen, Reticulum

INTRODUCTION

Livestock play a significant role in the livelihood of the Afghan population by providing milk, meat, cashmere and wool. Goats are the most raised livestock after sheep in Afghanistan. The goat population in Afghanistan is approximately 11.3 million (FAO, 2024). Goats have numerous advantages compared to other livestock species. They have an efficient alimentary system with an ideal food conversion rate, are highly resistant to heat, can survive in harsh environmental conditions, and are resistant to various diseases (Koluman, 2023). Furthermore, goat rearing initially requires low economic investment, which is an ideal option for alleviating food insecurity and eradicating hunger and poverty (Nguyen *et al*., 2023), especially in communities such as Afghanistan. Goat

raising can be performed in hilly and mountainous areas, and since Afghanistan is a mountainous country, goats can be an optimized approach for the efficient utilization of these natural resources and can help needy families (DCA, 2019). In addition, goat milk contains highly nutritious food elements such as protein, fat, carbohydrates, vitamins, and micro- and macroelements (Idamokoro, 2023). Goat milk and its products can be used not only to improve poor rural families' hunger but also to enhance their economics (Sow *et al*., 2021). However, goats, like other livestock, are prone to many diseases as well as ingestion of indigestible foreign bodies, which can reduce their production and even cause mortality (Shair *et al*., 2023).

Ingestion of IFBs leads to negative impacts on ruminants, which are collectively referred to as foreign body syndrome (Airs *et al*., 2024). This syndrome causes enormous economic losses in terms of reduced production and productivity in livestock, specifically goats, and a high rate of mortality in developing countries (Shair *et al*., 2023). Ingestion of IFBs causes ruminal impaction, which is a condition in which ingested indigestible materials are blocked in the forestomach and do not flow to other parts of the alimentary tract, leading to impaction of the rumen, recurrent tympany, and the absence of defecation (Fasil, 2015). Furthermore, the ingestion of plastic can also affect human health since plastics release chemicals into rumen fluids, and the released chemicals can enter the human food chain via milk and meat (Yusuf *et al*., 2023). In addition, the ingestion of IFBs can cause rumenitis, hemorrhage, anemia, and ruminal acidosis, with a range of clinical consequences ranging from subclinical to lethal conditions (Airs *et al*., 2024; Priyanka & Dey, 2018; Rabana et *al*., 2022). Nutritional deficiency and contamination, poor management of feeding, and rumen and reticulum disorders are important risk factors for the IFBs (Duresa *et al*., 2022). In addition, draught, which is recognized by a scarcity of food, provokes the consumption of IFBs by goats (Shair *et al*., 2023). In addition, environmental contamination by improper recycling and disposal of human-made wastes is linked to the ingestion of IFBs (Rana & Negi, 2018). In Afghanistan, environmental contamination can be a serious issue since the free-grazing system is widely used for raising goats and as a result increases the exposure of goats to various IFBs. The most common IFBs are plastic bags, cloth, leather, rubber, twine, rope, hair, wire, and plant fibers (bezoars) (Duresa *et al*., 2022; Shair *et al*., 2023).

Many studies have been conducted on the prevalence of IFB ingestion in small ruminants, especially in goats. In a study in Ethiopia, the prevalence of IFBs was approximately 30.73% in sheep and goats (Fasil, 2015). Another study in Nigeria revealed that 67.46% of small ruminants examined had IFBs; in this study, plastic was the most exposed ingestible material in goats and sheep (Rabana et al., 2022). Yusuf and colleagues demonstrated that 40.1% of small ruminants were found to have IFBs in their rumen or reticulum (Yusuf et al., 2023). In addition, in Somalia, 36% of the goats included in the study presented IFBS in their rumen and reticulum, and plastic had the highest frequency (Shair et al., 2023). Recent research from butchers in Malawi indicated that plastic was the most commonly identified IFB (80%) during slaughter (Airs et al., 2024). Although many studies have shown the prevalence and the negative impacts of IBFs on meat production and body condition, no study has investigated the prevalence of indigestible foreign bodies in goats in Afghanistan, more specifically in Herat province. Therefore, the main aim of this study was to evaluate the prevalence of indigestible foreign bodies in the rumen and reticulum of slaughtered goats at the Herat Governmental Slaughterhouse.

MATERIALS AND METHODS

Study Period and Location

The current study was conducted in Herat Governmental Slaughterhouse, Herat-Islam Qala Highway, Herat Province, Afghanistan, from July to September 2023. The Herat Governmental Slaughterhouse performs daily slaughter of cattle, sheep, and goats.

Study Population

This study was performed on 600 goats representing both local and crossbred varieties that were slaughtered at Herat Governmental Slaughterhouse. The goats were collected from different regions of Herat province and other neighboring provinces and it was difficult to identify the exact origin of the animals. All animals were carried to the slaughterhouse using vehicles. The goats were kept under an extensive free-roaming management system.

Study Design

A cross-sectional study was performed at Herat Governmental Slaughterhouse to evaluate the prevalence and identity of IFBs swallowed by goats. All slaughtered goats were assigned a unique identifier. During the study, data such as species, sex, age, and body condition score were collected for each animal. The goats included in the study ranged in age from 1 to 6 years. To determine the age of each goat, specialized tooth examination methods were employed, similar to those described by Otesile and Obasaju (1982). This method relies on examining the development and wear patterns of the incisor teeth, which offer reliable clues about the goat's age. Body condition was recorded as poor, moderate, or good based on the goat's appearance, Poor (ribs and spinal bones readily apparent), Moderate (hips, shoulder areas noticeably padded with fat and ribs no longer visible under a thin layer of fat), or Good (they might have noticeable fat deposits around the ribs, tail base, and shoulders), as described by Steele (Steele, 1996). Prior to slaughter, all animals received a mandatory preslaughter inspection for detecting signs of illness or disease. This inspection was performed when the animals were at rest and when they were moving around. In addition to the preslaughter inspection, animal inspectors thoroughly evaluated each animal's physical condition, age, and breed before slaughtering them.

Once the goats were slaughtered, the rumen and reticulum were carefully removed from the abdominal cavity. The forestomaches were then thoroughly examined both visually and by touching to detect any foreign objects that could not be digested. This process involved opening the forestomaches and inspecting all the contents thoroughly. Meticulous records of the location and type of each foreign body discovered were kept. In the presence of foreign bodies within the forestomach compartment, the specimens were removed, rinsed, identified in terms of type and location, and documented photographically.

Sample Size Determination

The current formula was used to determine the sample size to achieve a 95% confidence interval with a 5% desired level of precision as previously described by Thrusfield (Thrusfield, 2005):

$$n = (1.96)^2 \frac{Pexpected\,(1 - Pexpected)}{d^2}$$

Where n is used to indicate the required sample size, $P_{expected}$ is the expected prevalence and d is the desired absolute precision. The sample size for this research was determined using 5% absolute precision and 50% expected prevalence at a confidence level of 95%.

$$\text{Thus,} \quad n = (1.96)^2 \frac{(0.5) * (1 - 0.5)}{(0.05)^2} = 384$$

Therefore, a minimum of 384 goats were required for this study.

Statistical Analysis

The data collected were organized into a Microsoft Excel spreadsheet. To analyze the data, we employed descriptive statistics to provide insights into the basic characteristics of the variables and to identify potential correlations between them. The Statistical Package for the Social Sciences (SPSS) software version 26 was used for the data analysis. We used a chi-square test to evaluate the associations between categorical variables such as age, sex, body condition score, and season and the occurrence of indigestible foreign materials. Statistical significance was established at a P value < 0.05. The prevalence of various types of IFBs is represented as a percentage.

RESULTS

The current study revealed different types of IFBs in the rumens of goats slaughtered at the Herat Governmental Slaughterhouse (Figure 1and 2). The overall percentage of indigestible foreign bodies was 24.5% (147/600). All IFBs were detected in the rumen of goats, and no IFBs were detected in the reticulum.

Figure 1. Reveals plastics as IFBs in the rumen of goats slaughtered at Herat Governmental Slaughterhouse, Afghanistan.

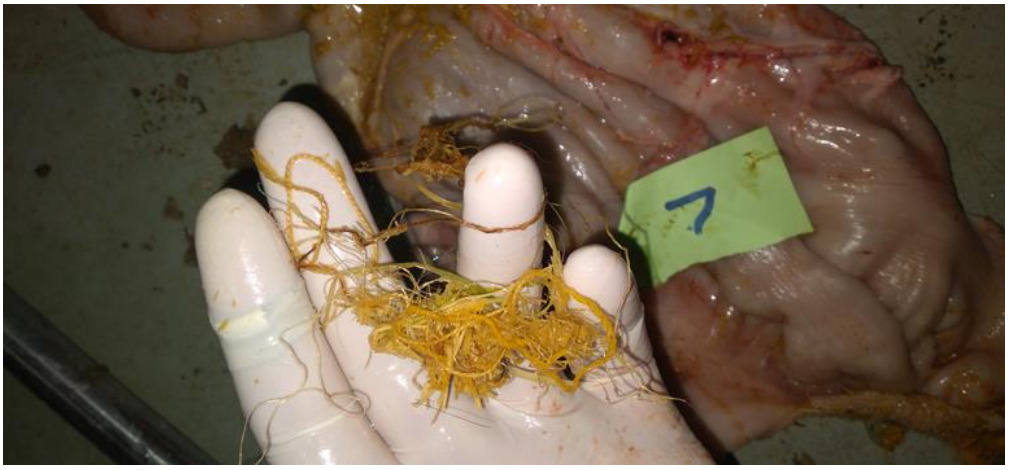

Figure 2. Reveals thread as an IFBs in the rumen of goats slaughtered at Herat Governmental Slaughterhouse, Afghanistan.

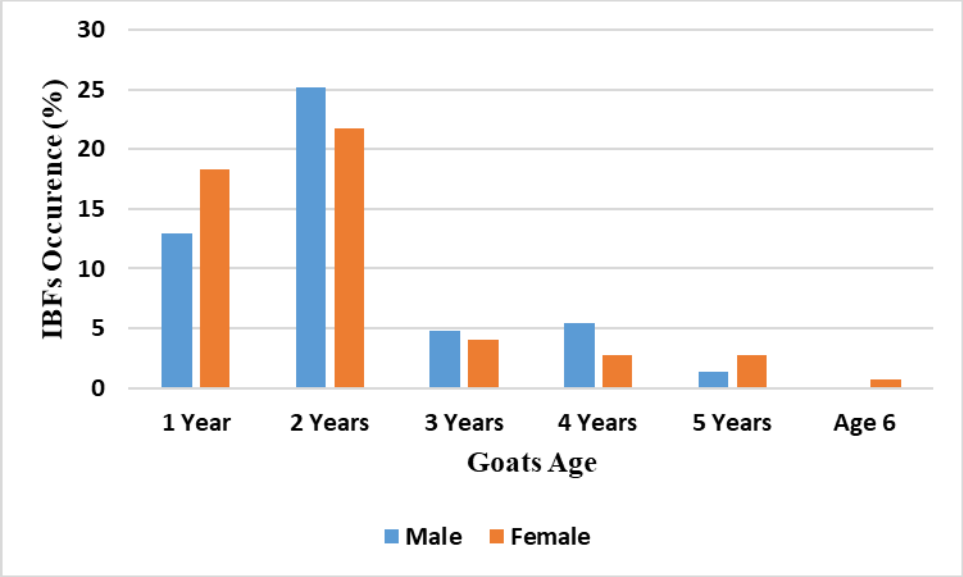

Figure 3. Indicates the occurrence of IFBs in the forestomach of goats of different ages and sexes. There was a significant difference in the incidence of IFBs among slaughtered goats of different ages ($P < 0.05$).

During the study, the occurrence of IFBs was significantly different among slaughtered goats. For instance, younger goats (aged 1 and 2) had more IFBs than older goats (aged 3, 4, 5 and 6) did ($P < 0.05$) (Figure 3). Goats aged 6 years had the lowest prevalence of IFBs (Figure 3). At the age of one year, the prevalence of IFBs was greater in female goats than in male goats, whereas it was lower at the age of two years ($P <0.05$) (Figure 3).

Body condition score was another factor assessed in this study (Table 1). The occurrence of IFBs in goats was associated with different body condition scores. Accordingly, approximately 15.47% (50/323) of IFB-positive goats were in moderate body condition, while 35% (97/274) of them were in good body condition ($P < 0.05$) (Figure 4).

The foreign bodies identified during the current study were plastic, plastic thread, bag thread, leather, chocolate cover, balloon, wood, piece of cloth, camel dung, cotton thread, and wire (Table 2). Among these IFBs, plastic materials were the most prevalent type of foreign body (approximately 58.5%, 86/600), followed by plastic thread (18.36%, 27/600), bag thread (4.76%, 7/600), lather (5.44%, 8/600), mixed (4.08%, 6/600), chocolate cover (2.04%, 3/600), balloon (2.72%, 4/600) and wood (1.36%, 2/600). The least recorded IFBs in goats were 0.68% cloth (1/600), 0.68% camel dung (1/600), 0.68% cotton thread (1/600), and 0.68% wire (1/600) (Table 2). All these indigestible foreign bodies were present in the rumen of the goats. No foreign bodies were detected in the reticulum of the slaughtered goats.

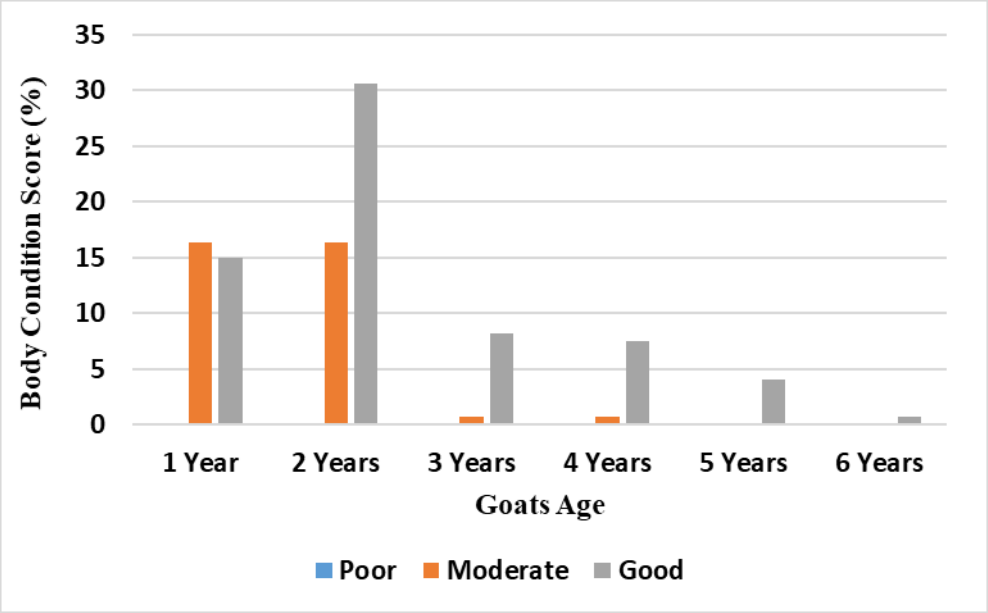

Figure 4. Demonstrates the prevalence of IFBs and body condition scores of goats at different age groups. There was statistically significant difference between the prevalence of IFB-positive patients and body condition scores ($P < 0.05$).

Table 1. Prevalence of foreign bodies according to body condition and breed of goats.

Factors	Level of factors	Goats examined	Positive	Negative	Prevalence	X^2	P -Value
Body condition	Poor	3	0	3	0	43.84	0.0001
	Moderate	323	50	272	15.78%		
	Good	274	97	177	35.4%		
Breed	Local male	299	32	267	10.7%	126.4	0.0001
	Local female	36	20	16	55.55%		
	Cross male	189	42	145	22.22%		
	Cross female	77	53	24	68.83%		

Table 2. The prevalence of various foreign bodies in the rumen of goats

Type of Foreign Body	Number of slaughtered goats	Number of Positive Goats	Number of Identified Foreign Bodies	Prevalence
Plastic	600	147	86	58.5%
Plastic Thread	600	147	27	18.36%
Bag Thread	600	147	7	4.76%
Chocolate cover	600	147	3	2.04%
Piece of Cloth	600	147	1	0.68%
Balloon	600	147	4	2.72%
Lather	600	147	8	5.44%
Camel dung	600	147	1	0.68%
Wood	600	147	2	1.36%
Cotton thread	600	147	1	0.68%
Wire	600	147	1	0.68%
Mixed	600	147	6	4.08
Total	600	147	147	100%

DISCUSSION

The current study revealed that 24.5% (147 out of 600) of the goats had indigestible foreign bodies in their rumens. However, no indigestible foreign bodies were detected in the reticulum of the slaughtered goats. Our findings are comparable to those of previous studies (Mekuanint *et al*., 2017) and (Gurara *et al*., 2020), as both studies reported an IFB prevalence of 23.4% in goats. In addition, the current findings are consistent with previous research showing that 26.6% of IFBs occur in goats (Yusuf *et al*., 2023). However, a higher prevalence (36%) of IFBs in goats was reported by Shair and colleagues (Shair *et al*., 2023). Another study that was conducted in Ethiopia indicated a prevalence of 32.75% IFBs in goats (Duresa *et al*., 2022), whereas a lower prevalence (21.32%) of IFBs in goats was reported in Ethiopia (Tolesa *et al*., 2021). In addition, Igbokwe and colleagues recorded a prevalence of 19.3% IFBs in Nigeria (Igbokwe *et al*., 2003). The current variation in the regional prevalence of IFBs may be because of the origin of the animals referred to the slaughterhouses, variations in animal management systems, improper disposal of less biodegradable wastes such as plastics and imbalances in animal nutrition, such as a lack or deficiency of mineral and vitamin supplementation, especially during periods of food scarcity. Similarly, Afghanistan experiences a long drought season and a shortage of food, and most small ruminant owners do not provide enough food or supplemental minerals or vitamins to their animals.

This study revealed the incidence of IFBs in goats at different age groups. Younger goats (1-2 years old) have a greater prevalence of IFBs than older goats. However, previous research has shown a greater prevalence of IFBs in older goats (Mekuanint *et al*., 2017). This variation is probably due to the large number of young goats slaughtered at the Herat Governmental Slaughterhouse because of the high demand for younger goat meat. In addition, the drought season causes a scarcity of food, and goat owners cannot afford additional food and supplements; therefore, drought may be another contributing factor to younger goat slaughtering at the Herat Governmental Slaughterhouse. In addition to age, a significant difference in the ingestion of indigestible foreign bodies was detected between the sexes in one-year-old goats. These results are in line with previous research showing that a greater prevalence of IFBs was detected in female goats than in male goats (Yusuf *et al*., 2023). This may be due to differences under physiological conditions between males and females. Moreover, higher nutritional requirements during pregnancy can be a potential risk factor for the ingestion of IFBs, especially in the dry season (Yusuf *et al*., 2023).

Furthermore, the present study indicated that the presence of IFBs in the rumen of goats was associated with moderate and good body condition scores. None of the examined goats with IFBs had poor body condition scores. In this study, most of the examined goats (97/600) with IFBs had good body condition scores. Our results are in agreement with the findings of Otsyina and colleagues that goats that displayed good body condition scores were more likely to have indigestible foreign bodies (Otsyina *et al*., 2015). A possible explanation could be the small size of the indigestible foreign bodies, which are unable to cause rumen disorders. Additionally, the lower prevalence of metallic materials compared to other materials might explain why the weight gain of the animals was not affected.

Our findings corroborate the results of previous studies, which have consistently identified plastic as the most prevalent indigestible foreign body found in the gastrointestinal tract of small ruminants (Igbokwe et al., (2003); Remi-Adewunmi *et al*., (2004); Roman & Hiwot, (2010); Abebe & Nuru, (2011); Saulawa *et al*., (2012); Tesfaye *et al*., (2012); Negash *et al*., (2015); Otsyina *et al*, (2015); Fasil, (2015); Mekuanint *et al*,

(2017); Rabana *et al*., (2022). This might be due to the nonbiodegradable nature of plastics, which remain intact for a long time in the forestomach of small ruminants. Moreover, the wide use of plastic for packaging and as bags for the delivery of materials in the study area, the shortage of effective recycling systems and its negligible disposal are associated with a high prevalence of these indigestible foreign bodies in the forestomach of goats.

CONCLUSION

The current study revealed the ingestion of indigestible foreign bodies in goats slaughtered at Herat Governmental Slaughterhouse, Herat, Afghanistan. Overall, 24.5% of the IFBs were detected in the rumen of slaughtered goats. The most prevalent foreign materials detected were plastic, plastic thread, bag threads, and lather. The presence of foreign bodies was associated with moderate and good body condition in goats. IFBs are associated with food scarcity, especially during the drought season, and inappropriate management systems and environmental contamination due to a lack of efficient recycling systems and negligent waste disposal. Considering the current findings, suitable control measures are needed to decrease the impact of pollution on the environment and protect our animals from indigestible foreign bodies. Accordingly, we can have healthy animals, humans and an efficient economy.

Limitations: The findings of this study may not apply to goats in other regions outside of Herat, Afghanistan, as slaughterhouses typically accept only healthy or male goats for meat processing. A more extensive survey involving no slaughtered goats is required to accurately determine the prevalence of foreign bodies among the goat population in Herat Province.

Conflict of interest: The authors declare that they have no conflicts of interest.

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Author Contributions: TA; conceptualization design: TA, SME; analysis: TA, SME; resources: TA, SME, and MN; original draft preparation: TA, SME; review and editing: SME and MN; visualization: TA, MN and SME; supervision: TA, MN; and data collection and entry: TA and IM.

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