

1 **Indigestible Foreign Materials Impaction of Small Ruminants in**  
2 **Gombe State, Nigeria**

3

4

5 Jallailudeen Rabana Lawal<sup>1\*</sup>, Zainab Bukola Yusuf<sup>2</sup>, Muhammad Mustapha<sup>1</sup>, Lawan Adamu<sup>1</sup>,

6 <sup>1</sup>Department of Veterinary Medicine, Faculty of Veterinary Medicine, University of Maiduguri,

7 Nigeria

8 <sup>2</sup>Department of Veterinary Surgery and Radiography, Faculty of Veterinary Medicine,

9 University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State, Nigeria

10

11

12

13

14 **Abstract**

15 **BACKGROUND:** The predisposition of ruminants to indigestible foreign materials is becoming a  
16 major global problem in livestock production systems in developing countries, making  
17 gastrointestinal tract impactions severe veterinary emergencies.

18 **OBJECTIVES:** This study aimed to investigate the prevalence and type of indigestible foreign material  
19 impaction in small ruminants in Gombe State, Nigeria.

20 **METHODS:** Systematic random sampling technique and ante-mortem examination of 940 goats  
21 and 790 sheep before slaughter at major abattoirs in Gombe State. Sex, age and body condition  
22 score of each animal was noted and recorded. Post-mortem examination of the rumen and

23 reticulum was performed and foreign materials were removed from the abdominal cavity,  
24 identified and recorded.

25 **RESULTS:** Out of 1730 small ruminants examined, 1167 (67.46%) were found with various types  
26 of indigestible foreign materials in their gastrointestinal tracts. The prevalence was significantly  
27 ( $\chi^2 = 58.047$ ,  $P < 0.0001$ ) higher in goats (38.0%) than sheep (23.7%). Prevalence rates of  
28 13.6%, 12.9%, 12.1%, 11.8% and 11.4% were recorded from Gombe, Yamaltu Deba, Akko,  
29 Funakaye and Kwami LGAs respectively. Prevalence was found to be significantly ( $P < 0.0001$ ;  
30  $\chi^2 = 732.87$ ; OR = 47.009) higher in adult (59.6%) than young (2.1%), significantly ( $P < 0.0001$ ;  
31  $\chi^2 = 637.61$ ; OR = 31.145) higher in female (42.5%) than male (19.2%), higher in goats ( $\chi^2 =$   
32 177.03,  $P < 0.0001$ ) and sheep ( $\chi^2 = 191.39$ ,  $P < 0.0001$ ) with poor body condition score than  
33 those with medium and good body condition. Significantly higher proportions of indigestible  
34 foreign materials were recovered in the rumen of goats and sheep compared to reticulum. Plastic  
35 was the most commonly encountered indigestible foreign materials in goats and in sheep,  
36 followed by seed/nuts, rope and cloth.

37 **CONCLUSIONS:** This study revealed 67.46% prevalence of indigestible foreign materials in  
38 goats and sheep. Predisposing factors to indigestible foreign material in ruminants in the study  
39 area includes lack of adequate plastic waste disposal system, extensive management system and  
40 free grazing of livestock. It was therefore recommended that collaborative intervention schemes  
41 involving government's agencies and livestock farmers are required to increase public awareness  
42 about how to properly dispose domestic waste.

43 **Keywords:** Gastrointestinal tracts, Goats, Indigestible Foreign materials, Sheep

44 **Introduction**

45 Small ruminants consisting of sheep and goats are among the popular livestock reared in  
46 African developing countries, including Nigeria (Lawal-Adebowale, 2012; Unigwe *et al.*, 2016).  
47 Sheep and goats play an important socio-economic role within conventional animal husbandry  
48 systems primarily in providing high-quality animal protein and income (Ukwueze and Kalu,  
49 2015). In most parts of Nigeria the demand for sheep and goats is quite impressively high due to  
50 its common uses for rituals, sacrifices of worship and cultural festivals. This demand, in effect,  
51 has created good job opportunities for livestock farmers and increased national income  
52 (Anyanwu *et al.*, 2016). Unfortunately, low productivity of ruminants in Nigeria is limited by  
53 factors like disease risks, unsuitable breeding strategies, insufficient management systems, weak  
54 husbandry systems and poor feeding (Lawal-Adebowale, 2012). Ruminants are generally  
55 considered to be notorious for ingestion of non-dietary foreign bodies (Asrat *et al.*, 2015; Ali and  
56 Awoke, 2019). The ingestion of non-dietary (metallic and non-metallic) materials in ruminants is  
57 primarily associated with malnutrition and an unbalanced diet that may result in nutritional  
58 deficiencies resulting in pica and ingestion of non-normal animal feeding stuffs (Ghurashi *et al.*,  
59 2009; Saulawa *et al.*, 2012; Jebessa *et al.*, 2018; Amin and Fentahun, 2020) which can cause  
60 various problems in different organs of the affected animal over the long term, primarily in  
61 rumen and reticulum (Mozaffari *et al.*, 2009; Teshome *et al.*, 2017).

62 The predisposition of sheep and goats to indigestible foreign materials is becoming a  
63 major global problem in the production systems of ruminants in developing countries due to  
64 environmental contamination, making rumen and reticulum impactions with indigestible foreign  
65 bodies one of the most severe veterinary emergencies (Ghurashi *et al.*, 2009; Suthar *et al.*, 2011;  
66 Abu-Seida and Al-Abbadi, 2014; Otsyina *et al.*, 2015). Foreign body impaction have been  
67 recorded in small ruminants specifically in countries lacking adequate domestic and industrial

68 waste recycling industries (Tesfaye *et al.*, 2012a); as well as free ruminant grazing, especially in  
69 urban and suburban areas (Tirunch and Yesuwork, 2010; Fasil, 2016). Most of these ingested  
70 indigestible materials in small ruminant guts generally accumulate in the rumen or reticulum of  
71 animals where they interfere with the normal fermentation process and the mixing of contents  
72 that lead to indigestion. These may also block the orifice between reticulum and omasum and can  
73 cause various adverse effects on animal health or become fatal if not removed through surgery  
74 (Abdelaal and EL-Maghawry, 2014; Olatunji-Akioye *et al.*, 2019). Such foreign bodies cannot  
75 be digested by the infected animal or transmitted through the feces as such (Mohammed, 2012;  
76 Abdelaal and EL-Maghawry, 2014).

77         Some of the potential health hazards caused by ruminant ingestion of sharp edged non-  
78 metallic and metallic indigestible foreign materials such as plastics, nails and wires include local  
79 or diffuse peritonitis, glossitis, esophagitis, ruminitis and rumen impaction, as well as traumatic  
80 pericarditis and traumatic reticulo-peritonitis, which usually occurs when the reticulum or rumen  
81 wall is perforated by these ingested sharp objects to enter other organs (Igbokwe *et al.*, 2003).  
82 The presence of foreign bodies in the rumen and reticulum can also interfere with the adequate  
83 absorption of volatile fatty acids and hence the rate of animal fattening (Igbokwe *et al.*, 2003).  
84 The fact that the impaction of rumen and reticulum by indigestible foreign bodies is typically  
85 asymptomatic in nature besides the wasting away or progressive emaciation found in the affected  
86 animals during the terminal stages. Animals affected may also display clinical symptoms where  
87 there is severe impact and damage due to sharp object perforation (Bwala *et al.*, 2016; Alimi *et*  
88 *al.*, 2018). Diagnosis of foreign body impaction in small ruminants is usually based on  
89 abdominal palpation; in most cases it can be difficult to distinguish between pregnancy and  
90 foreign body impaction. Certain methods of diagnosis include radiography (Semieka, 2010) and

91 ultrasonography (Pitroda *et al.*, 2010; Abdelaal and EL-Maghawry, 2014); however, a major  
92 limitation is the complexity of their implementation under field conditions.

93 The occurrence of foreign bodies impaction in small ruminants has been investigated and  
94 reported in Kenya (Otsyina *et al.*, 2014, 2015); Ethiopia (Roman and Hiwot, 2010; Abebe and  
95 Nuru, 2011; Tesfaye *et al.*, 2012b), Sudan (Mohammed, 2012) and some parts of Nigeria  
96 (Igbokwe *et al.*, 2003; Remi-Adewunmi *et al.*, 2004; Saulawa *et al.*, 2012; Bwala *et al.*, 2016).  
97 There is insufficient information on the occurrence of indigestible foreign materials in small  
98 ruminants in Gombe State; therefore this study was conducted to investigate the prevalence and  
99 type of indigestible foreign material impaction in sheep and goats slaughtered at Abattoirs in  
100 Gombe State, Nigeria.

101

102

103

## 104 **Materials and methods**

### 105 **Study area**

106 The present study was conducted in Gombe State in Nigeria, located in the Northeastern  
107 part of the country and it shares common boundaries with the states of Adamawa, Bauchi, Borno,  
108 Taraba and Yobe (Figure 1). As of 2006, Gombe State has an area of 20,265 km<sup>2</sup> and an  
109 estimated human population of about 2,365,000 million people (NPC, 2006). The state is situated  
110 between latitude 9° 30' and 12° 3' N and longitude 8° 45' and 11° 45' E, it has annual rainfall  
111 ranges from 850 to 1000 mm, with two distinct seasons, with rainy season beginning from May  
112 to October and dry season starting from November to April (Anonymous, 2009). The average  
113 daily temperatures are 34°C in April and 27°C in August, the State also has a relative humidity

114 range from 70-80% in August and falls to around 15-20% in December, with the hottest months  
115 being those between March and May at 40°C and the coldest time between December and  
116 February (harmattan). Both climatic and edaphic factors favour crops and livestock farming, with  
117 most of the inhabitants mainly engaged in trading and agriculture that includes village poultry,  
118 cattle, sheep and goats under extensive and semi-intensive animal husbandry management  
119 systems. Usually, the natural vegetation is that of the Sudano-Sahelian Savannah which consists  
120 of shrubs, herbs, grasses and sparsely scattered trees. Gombe State is a multi-ethnic community  
121 comprising the dominant Fulani group inhabiting the northern part of the Gombe State, and  
122 Tangale, which occupies the southern part of the state. Major abattoir within five (Akko,  
123 Funakaye, Gombe, Kwami and Yamaltu Deba) of the eleven (Dukku, Akko, Kaltungo, Nafada,  
124 Funakaye, Balanga, Gombe, Billiri, Kwami, Shogom and Yamaltu Deba) Local Government  
125 Areas have been visited for investigation of indigestible foreign materials in the gastrointestinal  
126 track of small ruminants.

### 127 **Study Design**

128 A cross-sectional study adopting non-probability sampling techniques was used to select 5  
129 of Gombe State's 11 LGAs to examine the prevalence and types of indigestible materials consumed  
130 by sheep and goats viz: Funakaye, Kwami, Gombe, Yamaltu Deba and Akko Local Government  
131 Areas. Small ruminants (sheep and goats) transported for slaughter in large abattoirs in the study  
132 area were sourced from farms and households that used extensive management strategies, according  
133 to the information acquired.

### 134 **Sampling period and procedure**

135 Sampling was carried out between February 2019 and January 2020, sampling involving  
136goats and sheep presented in all the study locations for slaughter at the major abattoirs. However,  
137small ruminants selected for the study were selected using systematic random sampling technique,  
138pre-slaughter ante-mortem examination (such as body temperature, respiratory rate, heart rate and  
139rumen motility) of each selected animals was evaluated, the species of the animals, sex (male and  
140female), age (broadly grouped into two age groups as young (< 1 year) and adult (> 1 year).) and  
141body condition score of each animal was observed and recorded accordingly. The age of each  
142selected animal was determined according to the animal's dentition based on dental eruption and  
143wear of the incisor teeth as previously described by Pace and Wakeman (2003). The body condition  
144score for each selected animal was recorded as poor, medium and good based on the appearance of  
145the animal and the manual palpation of the muscle and fat deposition levels over and around the  
146vertebrae of the lumbar vertebrae and transverse processes as previously described by Thompson  
147and Meyer (1994). During each visit to any of the selected sample collection abattoirs, 20 small  
148ruminants were selected by targeting each second animal to be slaughtered regardless of species, sex  
149or age, until the required number (20) was obtained. With the aid of research assistants in the  
150abattoir, animals selected by this process were labeled and followed through the slaughter process,  
151while vital parameters and physical examination (such as body temperature, respiratory rate, heart  
152rate and rumen motility) of each selected animals was evaluated. The rumen and reticulum were  
153incised after slaughter, flayed, and eviscerated, and physically inspected for the presence or absence  
154of indigestible foreign materials. Foreign materials recovered were then carefully removed from the  
155abdominal cavity (rumen, reticulum or both). Types of the material were identified, washed, dried,  
156and recorded for each fore-stomach (rumen, reticulum, or both) for each goat or sheep examined.

## 157Data Analysis



158 For statistical analysis of the data gathered from the study, all data were imported into the  
159 Graph Pad prism software version 6.0 (Graph Pad Software Inc., California, USA). Chi square ( $\chi^2$ )  
160 test was used to determine if there were any significant associations between established categorical  
161 variables (age, sex, body condition scores and season) and indigestible foreign materials,  
162 significance was determined at  $p < 0.05$ . Prevalence of different indigestible foreign materials and  
163 types were presented as percentage.

## 164 Results

165 Table 1 summarizes results of the prevalence of indigestible foreign materials in small  
166 ruminants in Gombe State, Nigeria. A total of 1730 small ruminants comprising of 940 goats and  
167 790 sheep in Gombe State, Nigeria were examined for the presence of indigestible foreign materials,  
168 and 1067 (61.7%) were found to have indigestible foreign materials in their fore-stomach. Out of the  
169 total number of goats and sheep examined, 657 (69.9%) goats and 410 (51.9%) of sheep were found  
170 with indigestible foreign materials, with a prevalence rates of 38.0% and 23.7% respectively. There  
171 was significant ( $P < 0.0001$ ) association between the ruminants (sheep and goats) and the prevalence  
172 of indigestible foreign materials.

173 Prevalence of indigestible foreign materials in small ruminants based on Local  
174 Government Areas (LGAs) in Gombe State, Nigeria is graphically presented in Figure 2. The  
175 prevalence was found to be higher in goats compared to sheep in all the study LGAs, The overall  
176 prevalence rate of indigestible foreign materials in sheep and goats based on LGA was found to  
177 be higher in Gombe (13.6%) followed by Yamaltu Deba (12.9%), Akko (12.1%), Funakaye  
178 (11.8%) and Kwami (11.4%) LGAs in descending order of prevalence. However, the prevalence  
179 of the indigestible foreign materials in goats and sheep from the respective LGA was found to be



180 higher in goats (8.2%) compared to sheep (5.4%) from Gombe LGA, prevalence was also found  
181 to be higher in goats (8.0%) compared to sheep (4.9%) from Yamaltu Deba LGA, higher in goats  
182 (7.4%) compared to sheep (4.7%) from Akko LGA, higher in goats (7.6%) compared to sheep  
183 (4.2%) from Funakaye LGA and finally higher in goats (6.8%) compared to sheep (4.6%) from  
184 Kwami LGA.

185 Table 2 summarizes results of the anatomical sites of detected cases of indigestible  
186 foreign materials in small ruminants in Gombe State, Nigeria. From 1067 positive cases of  
187 indigestible foreign materials in goats and sheep in Gombe State, Nigeria, the prevalent rate in  
188 the rumen of the affected goats and sheep was 30.4% and 18.5% respectively, the association  
189 between the ruminants was statistically significant ( $P < 0.0001$ ) with an odd ratio of 0.5359  
190 indicating that the rumen in goats is significantly the likely site for accumulation of foreign  
191 materials than in sheep. Moreover, the prevalence rate of indigestible foreign materials in the  
192 reticulum of the affected goats and sheep was 5.5% and 3.9% respectively, but the association  
193 between the ruminants was not statistically significant ( $P = 0.3269$ ) with an odd ratio of 0.8377  
194 indicating the reticulum in both ruminants shared equal likelihood for dislodgement of  
195 indigestible foreign materials. However, the prevalence of indigestible foreign materials  
196 accumulated in both rumen and reticulum of the affected goats and sheep was found to be 2.1%  
197 and 1.3% respective, and the association between the ruminants was also not statistically  
198 significant ( $P = 0.2852$ ) with an odd ratio of 0.7193.

199 Table 3 summarizes results of some risk factors associated with the prevalence of  
200 indigestible foreign materials in small ruminants in Gombe State, Nigeria. From 448 young and  
201 1282 adults small ruminants examined for the cases of indigestible foreign materials, indigestible  
202 foreign materials cases were more frequently encountered in the adults 1031 (80.4%) compared

203 to the young 36 (8.0%) small ruminants with prevalence rates of 59.6% and 2.1% respectively.  
204 There was significant ( $P < 0.0001$ ) association between the age of small ruminants and the  
205 prevalence of indigestible foreign materials with as odd ratio of 47.009, indicating that the  
206 consumption of indigestible is significantly less likely to occur in young goats and sheep than  
207 adults. Also, out of 951 male and 779 female small ruminants examined for the cases of  
208 indigestible foreign materials in Gombe State, Nigeria, cases were more frequently encountered  
209 in the females 735 (94.4%) compared to the males 332 (34.9%) small ruminants, with prevalence  
210 rates of 42.5% and 19.2% respectively. There was significant ( $P < 0.0001$ ) association between  
211 the sex of small ruminants and the prevalence of indigestible foreign materials with as odd ratio  
212 of 31.145, indicating that the consumption of indigestible is significantly less likely to occur in  
213 male goats and sheep than females.

214 Table 4 shows results of the prevalence of indigestible foreign materials in small  
215 ruminants in Gombe State, Nigeria based on body condition score. Out of 413, 370 and 157  
216 goats examined with poor, medium and good body conditions, 352 (85.2%), 261 (70.5%) and  
217 44(28.0%) were found with indigestible foreign materials with a prevalence rates of 20.3%,  
218 15.1% and 2.5% respectively. There was significant ( $P < 0.0001$ ) association between the body  
219 condition score and the prevalence of indigestible foreign materials in goats in Gombe State,  
220 Nigeria. Moreover, Out of 357, 285 and 148 sheep examined with poor, medium and good body  
221 conditions, 279 (78.2%), 103 (36.1%) and 28(18.9%) were also found with indigestible foreign  
222 materials with a prevalence rates of 16.1%, 6.0% and 1.6% respectively. There was significant  
223 ( $P < 0.0001$ ) association between the body condition score and the prevalence of indigestible  
224 foreign materials in sheep in Gombe State, Nigeria.

225 The type of indigestible foreign materials found in slaughtered small ruminants in Gombe  
226 State, Nigeria were cloth, rope/thread, stone/sand, seed/nuts, plastic/leather/nylon bags,  
227 wire/metals and mixture of material. Among the whole cases of indigestible foreign materials  
228 found in the affected small ruminants, plastic/leather/nylon bags was the most common as  
229 observed in 556 (52.1%) of the affected small ruminants followed by seed/nuts 178 (16.7%),  
230 mixture of material 95 (8.9%), rope/thread 81 (7.6%), stone/sand 59 (5.5%); cloth 55 (5.2%) and  
231 wire/metals 43 (4.0). However, the result also revealed that the occurrence of the difference  
232 types of the indigestible foreign materials in the affected small ruminants is more frequent in  
233 goats compared to sheep as shown in Table 5.

#### 234 **Discussion**

235 The present study showed an overall prevalence rate of 61.7% indigestible foreign materials in  
236 the abdominal cavities in small ruminants comprising of goats and sheep slaughtered at major  
237 abattoirs in Gombe State, Nigeria. The finding of the current study is higher than 19.3% and  
238 11.0% reported by Igbokwe *et al.* (2003) and Saulawa *et al.* (2012) from Maiduguri and Kastina  
239 State respectively in Nigeria. Our finding is also higher than 10.8% reported by Otsyina *et al.*  
240 (2015) from Kenya and 30.7% and 23.4% reported by Fasil (2016) and Mekuanint *et al.* (2017)  
241 respectively from Ethiopia, and, however, lower than 97% and 87% prevalence rates previously  
242 reported in small ruminants from Nigeria and South Darfur by Remi-Adewunmi *et al.* (2004) and  
243 Ghurashi *et al.* (2009) respectively. It has been reported that ingestion of indigestible foreign  
244 materials is associated with shortage of forage and increased pollution of the grazing land with  
245 the indigestible materials (Negash *et al.*, 2015). Similarly, in Nigeria, feed shortage is  
246 predominant particularly during the long dry season and most small ruminant owners practice  
247 mainly extensive management of small ruminants and do not supply supplementary feed to their

248 animals. The findings of the current study revealed that goats are significantly more likely to  
249 consume indigestible foreign materials than sheep in the study area; this is evidenced with the  
250 prevalence rate being higher in goats (38.0%) compared to sheep (23.7%) in Gombe State,  
251 Nigeria. This finding concurs with Mohammed (2012) and Negash *et al.* (2015) who also  
252 reported higher prevalence of indigestible foreign bodies in goats than sheep. The finding of the  
253 current study contrast the reports from Remi-Adewunmi *et al.* (2004), Roman and Hiwot (2010),  
254 Akinrinmade and Akinrinde (2012; 2013), Fasil (2016) as well as Mekuanint *et al.* (2017) who  
255 previously reported significantly higher prevalence rates of indigestible rumen foreign bodies in  
256 sheep compared to goats in their various studies. However, Abebe and Nuru (2011), Tesfaye *et*  
257 *al.* (2012b), Saulawa *et al.* (2012) and Otsyina *et al.* (2015) have reported no significant  
258 difference in the prevalence rate of indigestible rumen foreign bodies between sheep and goats.  
259 The differences in the prevalence of ingestible indigestible foreign materials reported between  
260 goats and sheep might be associated with the variation in the origin of the small ruminants  
261 sampled, may also be attributed to the variations in accessibility of the animals to indigestible  
262 foreign material from domestic leftover and industrial waste materials, husbandry and  
263 management system employed in the rearing of the animals, and the waste management system  
264 of the various study areas.

265 Based on Local Government Areas (LGAs), the prevalence of indigestible foreign materials in  
266 small ruminants is higher in Gombe (8.2%) followed by Yamaltu Deba (8.0%), Funakaye  
267 (7.6%), Akko (7.4%) and Kwami (6.8%) LGAs in descending order of prevalence, and  
268 prevalence is higher in goats compared to sheep in all the study locations. The relatively higher  
269 prevalence recorded in Gombe, Yamaltu Deba and Funakaye LGAs might not be surprising  
270 being the most urban region among the five study locations. This result might be associated to

271 higher strewing of the environment with ingestible indigestible material from domestic and  
272 industrial waste dumped into the environments where grazing animals habitually have  
273 unrestricted access, such as the garbage dumps. It was observed that small ruminants sold to  
274 butchers for slaughter at all the abattoirs in this present study locations are usually sourced from  
275 the urban, rural and semi-arid areas within or those that shared boundary with Gombe State.  
276 Small ruminants in Gombe State are customarily reared extensively in the rural areas; where they  
277 are allowed to graze freely on natural pastures and leftover from farm produce which are much  
278 less contaminated with indigestible materials conflicting to the urban areas of Gombe State,  
279 where there is less forage for grazing animals and animals feeds on any ingestible material  
280 during grazing especially during the dry season. The finding of the current study concurs with  
281 Otsyina *et al.* (2015) who have also reported higher prevalence of indigestible foreign bodies in  
282 small ruminants examined from urban areas compared to rural areas in their similar studies  
283 Furthermore, probably not all the small ruminants brought for sales in the current study area are  
284 destined for the abattoirs, many might be sold to persons who slaughter them at home during  
285 sacrifices, ceremonies and festivals. The result of the present study is limited to animals  
286 slaughter at the abattoirs; this might have also contributed to the relatively lower prevalence rate  
287 of indigestible foreign materials encountered in sheep and goats recorded from the various study  
288 locations visited for sampling in the present study. The finding of the present study is consistent  
289 with Ghurashi *et al.* (2009) in Sudan and Tesfaye *et al.* (2012b) in Ethiopia who have stated that  
290 insufficient forage land obtainable for grazing in urban and peri-urban areas is generally  
291 considered as one of the major factors that exposes sheep and goats to the high risk of ingestion  
292 of indigestible foreign materials.

293 This finding of the present study considered the association between the prevalence of  
294 indigestible foreign materials in sheep and goats in the present study based on age, which  
295 revealed that the consumption of indigestible foreign materials is significantly less likely to  
296 occur in young goat and sheep than the adults of these small ruminants in the study area. This  
297 finding of the present study might partly be attributed to the gradual ingestion of ingestible  
298 indigestible foreign materials over sustained periods of time as the animal grow older as well as  
299 to meet trace minerals demand compared to young who comparatively acquires their nutrient  
300 requirements from the sucking of milk from their mother. This finding is consistent with similar  
301 study of Remi-Adewunmi *et al.* (2004), Roman and Hiwot (2010), Abebe and Nuru (2011),  
302 Saulawa *et al.* (2012), Tesfaye *et al.* (2012b), Fasil (2016) and Mekuanint *et al.* (2017) who  
303 reported higher prevalence of indigestible foreign bodies in adults than young small ruminants.  
304 The findings of this study contradict that of Otsyina *et al.* (2015) who have recovered significant  
305 higher prevalence of foreign bodies in young sheep and goats compared to adult of these small  
306 ruminants. However, Akinrinmade and Akinrinde (2013) have stated that sheep and goats are  
307 usually exposed to consumption of ingestible indigestible materials at an early age and  
308 accumulation occurs over time due to increased environmental pollution.

309 This finding of the present study also considered the association between the prevalence of  
310 indigestible foreign materials in small ruminants in the study area based on sex. Even though  
311 more males were slaughtered and samples during the present study, the finding of this study  
312 revealed that the consumption of indigestible foreign materials is significantly higher in females  
313 than in male small ruminants. This finding might be associated with the fact that explanation that  
314 the ewes and does are kept longer for breeding purposes, thus having a higher chance of gradual  
315 consumption and accumulation of indigestible foreign bodies over time, hence higher prevalence

316 rates compared to the rams and bucks. Moreover, several hormonal changes and increased  
317 appetite to meet up nutritional demands during estrus, pregnancy and lactation in female ewes  
318 and does of small ruminants. The female animals without ingestible foreign materials in this  
319 study could be associated to intensive management of such animals from birth till salvage age.  
320 The finding of the present study is in line with the report of Igbokwe *et al.* (2003), Adewunmi *et*  
321 *al.* (2004), Roman and Hiwot (2010), Negash *et al.* (2015), Otsyina *et al.* (2015), Bwala *et al.*  
322 (2016) who have also reported higher prevalence of indigestible foreign bodies in female sheep  
323 and goats compared to the male sex of the animals, however, the finding of the present study is  
324 inconsistency with the findings of Abebe and Nuru (2011), Saulawa *et al.* (2012) and Otsyina *et*  
325 *al.* (2015) that reported the absence of a significant difference in the prevalence of indigestible  
326 foreign bodies between different sexes of the animals.

327 The finding of the present study also considered the occurrences of indigestible foreign material  
328 in sheep and goats based on body condition score. This present study revealed significantly  
329 higher prevalence rate of indigestible foreign materials in sheep and goats in poor body condition  
330 compared to those with medium and good body condition scores. The finding of indigestible  
331 foreign bodies in small ruminants with poor body condition scores in the present study might be  
332 attributed to foreign bodies occupying most parts of the stomach triggering impaction of the  
333 rumen, abdominal distention and significantly interfere in adequate absorption of volatile fatty  
334 acids in the rumen leading to reduced weight gain, progressive loss of flesh and emaciation. This  
335 findings concurs with previous studies by Igbokwe *et al.* (2003), Remi-Adewunmi *et al.* (2004),  
336 Roman and Hiwot (2010), Abebe and Nuru (2011), Saulawa *et al.* (2012), Tesfaye *et al.* (2012b),  
337 Negash *et al.* (2015) and Fasil (2016) who have also reported higher prevalence of indigestible  
338 foreign bodies in sheep and goats with poor body condition scores compared to those that are



339 with medium and good body condition scores. The finding of the present study disagrees with  
340 Otsyina *et al.* (2015) who have previously reported significantly higher prevalence of  
341 indigestible foreign bodies in sheep and goats with good body condition score. The present study  
342 also considered the types and frequency of indigestible foreign materials in sheep and goats in  
343 the study area. The higher prevalence of plastic/nylon bags found in sheep and goats compared to  
344 other types of indigestible foreign material is due to the fact that plastics or nylon are non-  
345 biodegradable and have been observed to contaminate grazing fields in the study area. Its high  
346 prevalence indicates the free grazing management practice, widespread use of plastic/nylon bags  
347 in the present study area and environmental pollution due to their improper disposal. This finding  
348 buttresses reports from previous studies that have also reported plastic as the most commonly  
349 encountered foreign material in the gastrointestinal tract of small ruminants in various studies  
350 (Igbokwe *et al.*, 2003; Remi-Adewunmi *et al.*, 2004; Roman and Hiwot, 2010; Abebe and Nuru,  
351 2011; Saulawa *et al.*, 2012; Tesfaye *et al.*, 2012b, Negash *et al.*, 2015, Otsyina *et al.*, 2015, Fasil,  
352 2016, Mekuanint *et al.*, 2017). In Nigeria, plastic/nylon bags are the most dominant component of  
353 household waste (Igbokwe *et al.*, 2003), and hence accounts for the observations in this study.  
354 Based on anatomical sites of detected cases of indigestible foreign materials in small ruminants,  
355 the findings of the present study revealed that the rumen in sheep and goats is significantly the  
356 most likely site for the dislodgement of indigestible foreign materials in the affected goats  
357 (30.4%) and sheep (18.5%) and the association between the different types of ruminants was  
358 statistically significant ( $P < 0.0001$ ). This finding may be due to the fact that digestible and  
359 indigestible ingested materials are first swallowed into the rumen, therefore any foreign bodies  
360 lodge in the rumen when there is interruption in the continuous flow of the ingested materials  
361 through the digestive tract. However, 95 (10.1%) and 68 (8.6%) of the cases occurred in

362 reticulum of the affected goats and sheep with prevalence of 5.5% and 3.9% respectively, but the  
363 association between the different type of ruminants was not statistically significant ( $P = 0.3269$ )  
364 with an odd ratio of 0.8377. The finding of the present study buttress the report of Negash *et al.*  
365 (2015) who have also reported more foreign bodies in the rumen alone (87.9%) than in the  
366 reticulum alone (5.0%). However, 36 (9.4%) and 75 (9.5%) of the cases occurred in rumen and  
367 reticulum of the affected goats and sheep with prevalence of 2.1% and 1.3% respective, and the  
368 association between the different type of ruminants was also not statistically significant ( $P =$   
369  $0.2852$ ) with an odd ratio of 0.7193. This finding of this study agrees with the findings of Roman  
370 and Hiwot (2010), Abebe and Nuru (2011), Tesfaye *et al.* (2012b) Saulawa *et al.* (2012), Negash  
371 *et al.* (2015) and Fasil (2016) who have also reported more foreign bodies in the rumen  
372 compared to other anatomical site of the digestive organs. This finding may be attributed to the  
373 larger rumen volume, the cumulative size and material composition of the foreign bodies, and the  
374 types of materials, with metals and sharp objects tending to localize preferentially in reticulum.  
375 The finding of foreign indigestible materials in the reticulum might be due to withholding of  
376 these indigestible foreign bodies by the honey comb structure of the reticular mucosa.

377 **Conclusion:** The extensive management system employed in rearing small ruminants in Gombe  
378 State can be incriminated as a major predisposing factor for acquiring indigestible foreign  
379 materials. Scarcity of forage during dry season and nutritional deficiency also leads animals to  
380 find their own feed from grazing lands, which is potentially polluted with various types of  
381 indigestible foreign materials including plastics, cloth, rope, leather and metals. Extensive use  
382 and inappropriate disposal of plastic bag, lack of adequate and proper legislation on waste  
383 disposal and awareness campaign regarding small ruminant health also contributed to the high  
384 prevalence of indigestible foreign materials rumen impaction in small ruminants. The results of

385 this study have revealed that the most common indigestible foreign materials found in the  
386 affected small ruminants are plastic/nylon (polyethylene) bags. This observational study showed  
387 the importance of foreign bodies as health risk and productivity, causing weight loss by  
388 interfering with the absorption of volatile fatty acids, loss due to death and premature culling to  
389 small ruminants. This study could help environmental activist, livestock owners, veterinarians  
390 and policy makers to recognize the impact of indigestible foreign materials on ruminant's health  
391 and productivity in Gombe State, Nigeria. It was therefore recommended that government and  
392 private companies need to devise policies on how to handle waste management in the area or in  
393 the grazing sector.

394 **Recommendations:** It is recommended that livestock extension service providers should raise  
395 awareness among ruminant owners of the health consequences and risk factors associated with  
396 indigestible foreign materials in small ruminants. Small ruminant owners should be  
397 recommended to rear their animals under a semi-intensive management scheme in order to easily  
398 monitor their animal accessibility to foreign bodies. To increase public awareness about how to  
399 properly dispose of domestic waste, such as plastic bags, ropes metals and cloths, as well as the  
400 periodic cleaning of such waste in the grazing area. The government and private companies need  
401 to devise policies on how to handle waste management in the area or in the grazing sector. There  
402 is no previous research in this study area on indigestible foreign materials in sheep and goats,  
403 therefore more studies should be carried out to illustrate the relevance of the issue in other  
404 species and to discuss prevention and control steps.

405 **References**

- 406 1- Abdelaal, A. M. and EL-Maghawry, S. (2014). Selected Studies on Foreign body  
407 Impaction in Goats with special reference to Ultrasonography. *Vet World*, 7(7): 522 –  
408 527. DOI: 10.14202/vetworld.2014.522-527.
- 409 2- Abebe, F. and Nuru, M. (2011). Prevalence of Indigestible Foreign bodies Ingestion in  
410 Small Ruminants Slaughtered at Luna Export Abattoir, East Shoa, Ethiopia. *J Anim*  
411 *Vet Adv*, 10(2): 1598 – 1602. DOI: <https://dx.doi.org/10.3923/javaa.2011.1598.1602>.
- 412 3- Abu-Seida, A. M., and Al-Abbadi, O. S. (2014). Recurrent Rumen Tympany caused by  
413 Trichobezoars in Buffaloes (*Bubalus bubalis*): A Series Report. *Thai J Vet Med*,  
414 44(1): 147 – 151. <https://he01.tci-thaijo.org/index.php/tjvm/article/view/17325>.
- 415 4- Akinrinmade, J. F. and Akinrinde, A. S. (2012). Prevalence of Foreign body Rumen  
416 impaction in Slaughtered Goats in Ibadan, Southwest Nigeria. *Sahel J Vet Sci*, 11: 39  
417 – 42.
- 418 5- Akinrinmade, J. F. and Akinrinde, A. S. (2013). Foreign body Rumen impaction with  
419 Indigestible Foreign materials in Ruminants in Nigeria: A Review. *Bull Anim Hlth*  
420 *Prod Afr*, 61: 629 – 642.
- 421 6- Ali, S. F. and Awoke, Z. (2019). Study on Indigestible Foreign Body in Rumen and  
422 Reticulum of Cattle Slaughtered at Bahir Dar Municipal Abattoir, Ethiopia. *Int J Anim*  
423 *Sci Tech*, 3(3): 41-47. <https://dx.doi: 10.11648/j.ijast.20190303.12>.
- 424 7- Alimi, O. A., Buhari, S., Lawal, F. M., Abdulkadir, S. Z., Amid, S. A., Adediran, S. O.,  
425 Aliyu, A. and Asifat, D. A. (2018). Rumen Impaction in a 31/2-Year Old Balami Ewe:  
426 Case Report and Literature Review. *Sci Wld J* 13(1): 93 – 96
- 427 8- Amin, I. and Fentahun, T. (2020). Postmortem study on indigestible foreign bodies in  
428 rumen and reticulum of cattle (case: Haramaya and Awaday municipal abattoirs,

- 429 Eastern Ethiopia). Online J. Anim. Feed Res., 10(4): 172-179.  
430 <https://dx.doi.org/10.51227/ojafr.2020.24>
- 431 9- Anonymous (2009). Gombe State, Wikipedia free encyclopedia.  
432 [https://en.wikipedia.org/wiki/Gombe\\_State](https://en.wikipedia.org/wiki/Gombe_State) retrieved 2018-11-13.
- 433 10- Anyanwu, N. C. J., Iheanacho, C. N. and Adogo, L. Y. (2016). Parasitological Screening  
434 of Haemo-Parasites of Small Ruminants in Karu Local Government Area of  
435 Nassarawa State, Nigeria. Brit Microbiol Res J, 11(6): 1 – 8. DOI:  
436 [10.9734/BMRJ/2016/22358](https://doi.org/10.9734/BMRJ/2016/22358)
- 437 11- Asrat, M., Melkamu, S. and Nazi, S. (2015). Surgical Management of Ruminant Impaction  
438 due to Indigestible Foreign Bodies in Cattle. J Anim Res, 5(4): 927-929. DOI:  
439 [10.5958/2277-940X.2015.00153.9](https://doi.org/10.5958/2277-940X.2015.00153.9)
- 440 12- Bassa, K. and Tesfaye, W. (2017). Study on Rumen and Reticulum foreign bodies in  
441 cattle slaughtered at Wolaita Sodo municipal Abattoir, Ethiopia. Inter J Adv Multidiscip  
442 Res, 4(1): 11-19. DOI: <https://doi.org/10.22192/ijamr>
- 443 13- Bayne, J. E. and Edmondson, M. A. (2020). Diseases of the gastrointestinal system.  
444 Sheep, Goat, and Cervid Medicine, 2021: 63–96. DOI: [https://doi.org/10.1016/B978-  
445 0-323-62463-3.00014-1](https://doi.org/10.1016/B978-0-323-62463-3.00014-1)
- 446 14- Berrie, K. E., Berihun, T. M. and Bewuket, A. (2015). Study on rumen and reticulum  
447 Foreign body in slaughtered cattle at gonder Elfora Abattoir, Ethiopia University of  
448 Addis Ababa, College of veterinary medicine and agriculture, Debrezeit, Ethiopia.  
449 World Journal of Biology and Medical Science, 2 (4):133-150.  
450 <http://www.sasjournals.com>

- 451 15- Braun, U., Warislohner, S. and Torgerson, P. (2018). Clinical and laboratory findings in  
452 503 cattle with traumatic reticuloperitonitis. *BMC Vet Res*, 14: 66.  
453 <https://doi.org/10.1186/s12917-018-1394-3>.
- 454 16- Bwala, D. A., Peter, I. D., Eze, C. A., Bukar-Kolo, Y. M. and Bukar, M. M. (2016). A  
455 Study on Rumen Foreign Body Impaction in Sheep Slaughtered At the Maiduguri  
456 Metropolitan Abattoir, Maiduguri, Nigeria. *Inter J Livestock Res*, 6(3): 16 – 23. DOI:  
457 [10.5455/ijlr.20160311033543](https://doi.org/10.5455/ijlr.20160311033543)
- 458 17- Bwatota, S. F., Makungu, M. and Nonga, H. E. (2018). Occurrences of Indigestible  
459 Foreign Bodies in Cattle slaughtered at morogoro municipal slaughterhouse, Tanz J  
460 Vet Med, 2018:4818203. DOI: <https://dx.doi.org/10.1155/2018/4818203>.
- 461 18- Fasil, N. (2016). Assessment of Sheep and Goat Foreign Bodies in Rumen and Reticulum  
462 in the Jigjiga Municipal Abattoir. *Adv Dairy Res*, 4(3): 157.  
463 <https://dx.doi.org/10.4172/2329-888X.1000157>.
- 464 19- Ghurashi, M. A. H., Seri, H. I., Bakheit, A. H. and Ashwag, E. A. M. (2009). Effect of  
465 Surgical removal of Foreign body from Goat's rumen with special reference to the  
466 Prevalence of Foreign body in Goats in Southern Dafur. *Austr J Bas Appl Sci*, 3: 664 –  
467 668.
- 468 20- Igbokwe, I. O., Kolo, M. Y. and Egwu, G. O. (2003). Rumen impaction in cattle with  
469 indigestible foreign body in the semiarid region of Nigeria. *Small Rum Res*, 49: 141.  
470 DOI: [10.1016/S0921-4488\(03\)00074-9](https://doi.org/10.1016/S0921-4488(03)00074-9)
- 471 21- Jebessa, D., Lemma, F., Kabeta, T., Sibhat, B. and Terefe, Y. (2018). Survey on  
472 indigestible foreign bodies in the rumen and reticulum of cattle slaughtered at

- 473 Nekemte mu-nicipal abattoir, Nekemte, Ethiopia. *Ethiop. Vet. J.*, 22 (1), 11-25 DOI  
474 <https://dx.doi.org/10.4314/evj.v22i1.2>
- 475 22- Lawal-Adebowale, O. A. (2012). Dynamics of ruminant livestock management in the  
476 context of the Nigerian agricultural system. *Livestock Prod*, 4: 1 – 20. DOI:  
477 10.5772/52923
- 478 23- Mekuanint, S., Alemneh, T. and Asredie, T. (2017). Indigestible Rumen Foreign Bodies -  
479 Causes of Rumen Impaction in Cattle, Sheep and Goats Slaughtered at Addis Ababa  
480 Abattoir Enterprise, Ethiopia. *J Vet Sci Med*, 5(1): 5.
- 481 24- Mohammed, S. S. (2012). A Retrospective Study on the Prevalence of foreign body in  
482 goat, sheep and cattle in different seasons in Khartoum State, 2001-2011. *Glob Vet*, 9:  
483 732 – 737. DOI: 10.5829/idosi.gv.2012.9.6.71101
- 484 25- Mozaffari, A. A., Olomi, M. M. and Vosough, D. (2009). Unusual and Severe Ruminal  
485 Impaction in a Goat-Kid: Clinical and Radiological Findings. *Iran J Vet Surg*, 4: 115 –  
486 119.
- 487 26- National Population Commission (NPC) (2006). (Census 2006 Nigeria). Available from:  
488 <http://www.nigeriamasterweb.com/Nigeria06CensusFigs.html>. [Last accessed on 2018  
489 Nov 08].
- 490 27- Negash, S., Sibhat, B. and Sheferaw, D. (2015). A postmortem study on indigestible  
491 foreign bodies in the rumen and reticulum of ruminants, eastern Ethiopia. *Onders J Vet*  
492 *Res*, 82(1): Art. #881, 5 pages. DOI: <https://doi.org/10.4102/ojvr.v82i1.881>
- 493 28- Olatunji-Akioye, A. O., Olawoyin, C. M. and Oyeyemi, M. O. (2019). Incidence and  
494 Consequence of Surgical Removal of Gastric Foreign Bodies in West African Dwarf



- 495 Goats in Ibadan. *Anim Res Inter*, 16(3): 3478 – 3483. DOI: [10.4102/ojvr.v82i1.881](https://doi.org/10.4102/ojvr.v82i1.881)  
496 PMID: [26244677](https://pubmed.ncbi.nlm.nih.gov/26244677/) PMCID: PMC6238782
- 497 29- Otsyina, H. R., Nguhiu-Mwangi, J., Mogo, E. G. M., Mbuthia, P. G. and Ogara, W. O.  
498 (2014). A retrospective study on the prevalence of plastic materials in the rumen of  
499 Sheep and Goats in Nairobi, Kenya. *Bull Anim Hlth Prod Afr*, 62(3): 197 – 205.
- 500 30- Otsyina, H. R., Nguhiu-Mwangi, J., Mogo, E. G. M., Mbuthia, P. G. and Ogara, W. O.  
501 (2015). Prevalence of indigestible Rumen Foreign bodies in Sheep and Goats at  
502 Dagoretti and Kiserian Abattoirs, Kenya. *Inter J Vet Sci*, 4(2): 75 – 80.
- 503 31- Pace, J. E. and Wakeman, D. L. (2003). Determining the age of cattle by their teeth, CIR  
504 253 Department of Animal Science, Cooperative Extension Service, Institute of Food  
505 and Agricultural Sciences, University of Florida, Gainesville.
- 506 32- Pitroda, A. H., Tiwar, D. K., Dar, M., Patil, D. B. and Parikh, P. V. (2010).  
507 Ultrasonographic Diagnosis and Treatment of Rumen Impaction in a Goat. *Intas Poli*  
508 *Vet*, 11: 251 – 252.
- 509 33- Priyanka, M. and Dey, S. (2018). Ruminal impaction due to plastic materials - An  
510 increasing threat to ruminants and its impact on human health in developing countries.  
511 *Veterinary World*, 11(9): 1307–1315. DOI:  
512 <https://doi.org/10.14202/vetworld.2018.1307-1315>
- 513 34- Remi-Adewunmi, B. D., Gyang, E. O. and Osinowo, A. O. (2004). Abattoir survey of  
514 Foreign body Rumen Impaction Small Ruminants. *Nig Vet J*, 25(2): 32 – 38. DOI:  
515 10.4314/nvj.v25i2.3472
- 516 35- Roman, T. and Hiwot, Y. (2010). Occurrence of rumen foreign bodies in Sheep and Goat  
517 slaughtered at Addis Ababa Municipal Abattoir. *Eth Vet J*, 14(1): 91 – 100.

- 518 36- Saulawa, M. A., Ukashatu, S., Garba, M. G., Magaji, A. A., Bello, M. B. and Magaji, A.  
519 S. (2012). Prevalence of indigestible substances in the Rumen and Reticulum of Small  
520 Ruminants slaughtered at Katsina central abattoir, Katsina State, Northwestern  
521 Nigeria. *Sci J Pure App Sci*, 1(1): 17 – 21.
- 522 37- Semieka, M. A. (2010). Radiography of Unusual foreign body in Ruminants. *Vet World*,  
523 3(10): 473 – 475. DOI: [10.5455/vetworld.2010.473-475](https://doi.org/10.5455/vetworld.2010.473-475)
- 524 38- Serem, E. K., Abuom, T. O., Peter, S. G., Gakuya, D. W., Kirui, G. K. and Mbuthia, P. G.  
525 (2019). Microcardia associated with Traumatic Reticulo Pericarditis (TRP) in an adult  
526 female ayrshire cow: a case report. *Int J Vet Sci*, 8(2): 73-78. DOI:  
527 <https://dx.doi.org/10.3923/javaa.2011.1598.1602>
- 528 39- Suthar, D. N., Jhala, S. K., Bhatt, R. H., Patel, J. B. and Joy, N. (2011). Surgical  
529 Management of Ruminal impaction due to Non-penetrating Foreign body syndrome in  
530 Kankrej Cattle. *Inter J Agro Vet Med Sci*, 5(5): 477 – 480.
- 531 40- Tesfaye, D., Daba, D., Mekibib, B. and Fekadu, A. (2012b). The Problem of  
532 Environmental Pollution as Reflected in the Fore Stomach of Cattle: A Postmortem  
533 Study in Eastern Ethiopia. *Glob J Env Res* 6(2): 61 – 65. DOI:  
534 [10.5829/idosi.gjer.2012.6.2.65199](https://doi.org/10.5829/idosi.gjer.2012.6.2.65199)
- 535 41- Tesfaye, D., Yismaw, S. and Demissie, T. (2012a). Ruminal and Reticular Foreign bodies  
536 in Small Ruminants slaughtered at Jimma Municipal abattoir, Southwestern Ethiopia. *J*  
537 *Vet Adv*, 2(8):434 – 439.
- 538 42- Teshome, E., Abdela, N. and Hassan, A. (2017) Postmortem Study on Indigestible Foreign  
539 Bodies in Rumen and Reticulum of Ruminants Slaughtered at Asella Municipal

- 540 Abattoir, Southeastern Ethiopia. J Vet Sci Tech, 8: 436. [https://dx.doi: 10.4172/2157-](https://dx.doi.org/10.4172/2157-7579.1000436)  
541 [7579.1000436](https://dx.doi.org/10.4172/2157-7579.1000436)
- 542 43- Thompson, J. and Meyer, H (1994). Body Condition Scoring of Sheep. Oregon State  
543 University extension service, US Department of Agriculture. Proceedings of the  
544 Western Section. The Amen Soc Anim Sci, 43: 175 – 175.  
545 Catalog:<https://catalog.extension.oregonstate.edu>
- 546 44- Tiruneh, R. and Yesuwork, H. (2010). Occurrence of rumen foreign bodies in sheep and  
547 goats slaughtered at Addis Ababa Municipality Abattoir. Eth Vet J, 14: 91 – 100.
- 548 45- Ukwueze, C. S. and Kalu, E. J. (2015). Prevalence of haemoparasites in red Sokoto goats  
549 slaughtered at Ahiaeke Market, Umuahia, Abia State, Nigeria. J Vet Adv, 5(2): 826 –  
550 830. DOI: [10.5455/jva.20150207123646](https://doi.org/10.5455/jva.20150207123646)
- 551 46- Unigwe, C. R., Ogbu, U. M., Balogun, F. A., Orakwue, O. K., Nwufoh, O. C. and  
552 Nwachukwu, B. C. (2016). Prevalence of Small Ruminant Diseases/Disorders at  
553 Mokola Veterinary Hospital, Ibadan, Nigeria. J Biol Agric and Hlthcare, 6(1): 107 –  
554 112.

555