



Research Article

Prevalence of Indigestible Rumen Foreign Bodies in Sheep and Goats at Dagoretti and Kiserian Abattoirs, KenyaOtsyina HR^{1,2*}, Nguhiu-Mwangi J¹, Mogoia EGM¹, Mbuthia PG³ and Ogara WO⁴

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ABSTRACT

The study was carried out on small ruminants slaughtered at the Dagoretti and Kiserian abattoirs in Nairobi and Kajiado Counties, from April to June 2013. The objective was to determine the prevalence and types of indigestible foreign bodies in the rumen of sheep and goats and potential risk factors associated with their occurrence. A total of 1,040 sheep and goats, 520 from each abattoir were examined after selection by systematic random sampling. The sheep were 666 and the goats were 374. Of these, 112 (10.8%) had indigestible foreign bodies in the rumen. Of those with foreign bodies, 67 (10.1%) were sheep and 45 (12%) were goats. A slightly higher prevalence was found in females (12.0%) than males (10.1 %) in both animal species. Prevalence of rumen foreign bodies was higher (17.7%) in 2-3 year old sheep and goats than other age groups. The foreign bodies recovered were plastic bags (72.3%), fruit seeds (8.0%), nylon ropes (4.5%), metals wires (4.5%), clothing (1.8%), stone pebbles (0.9%) and mixture of materials (8.0%). The weight of the foreign bodies recovered from the rumen varied from 0.91g to 2.10kg. Age and body condition were found to be significantly ($P<0.05$) associated with the occurrence of foreign bodies while breed, sex and location had no association ($P>0.05$). A prevalence of 10.8% foreign bodies in sheep and goats is due to environmental pollution at the origin of the animals that may adversely affect the overall productivity and production of sheep and goats in Kenya.

Key words: Abattoir, Environmental pollution, Foreign bodies, Sheep and goats

INTRODUCTION

Kenya is listed among countries with the highest populations of small ruminants in Africa (Ozung *et al.*, 2011). The sheep and goat population in Kenya is estimated to be about 44.87 million heads (GoK, 2010). Nationally, the sheep and goat industry contributes about 30% of the total red meat consumed in the country. Small scale producers dominate the production system in which the animals mainly roam and seek their own feed (Kiptarus, 2005). Although this system of production requires less financial resources, it exposes the animals to many health challenges (Ajala *et al.*, 2008; Kagira and Kanyari, 2010).

Indigestible rumen foreign bodies are reported to be a common cause of surgical emergency in veterinary medicine (Radostitis *et al.*, 2009; Tesfaye *et al.*, 2012). Ingestion of large quantities of indigestible materials

occurs in sheep and goats during periods of drought, food scarcity, nutritional deficiency, pica and massive environmental pollution (Igbokwe *et al.*, 2003; Ghurashi *et al.*, 2009; Vijaya *et al.*, 2012). Previous reports on impaction with indigestible foreign bodies indicate that, sheep and goats reared in urban and peri-urban areas are more prone to this condition than those reared in rural areas (Abdullahi *et al.*, 1984; Remi-Adewunmi *et al.*, 2004).

Nairobi, Kenya is reported to generate about 2,400 tons of garbage daily with each average household generating about 253 kg/year, of which only 40% is collected with the remaining 60% left uncollected or disposed through open dumping (UNEP, 2005). The areas available for grazing are thus heavily polluted with indigestible and other non-biodegradable materials. Though, risk factors responsible for accumulation and impaction in sheep and goats abound, information on the occurrence and prevalence of indigestible rumen foreign

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bodies in these animals in Nairobi, Kenya is not available. This study determined the prevalence of rumen foreign bodies, their types and potential risk factors associated with their occurrence in sheep and goats in Kenya.

MATERIALS AND METHODS

Study location

The study was carried out at Dagoretti and Kiserian abattoirs located in Kajiado and Nairobi Counties of Kenya. An average of 2,845 sheep and 2,035 goats are slaughtered annually at the Dagoretti abattoir, while 3,047 sheep and 2,761 goats are slaughtered at the Kiserian abattoir annually. Animals slaughtered at both abattoirs originate mainly from the rural arid and semi-arid areas of the country.

Study design

Sheep and goats used for the study were selected through systematic random sampling technique. Each of the abattoirs was visited once a week for a period of 13 weeks (April to June, 2013). During each visit 40 animals were selected by picking every third animal to be slaughtered irrespective of species until the desired number (40) is obtained. Animals selected by this process were marked and followed through the slaughter process with the help of research assistants. The selected animals were examined to determine the sex, age, breed, the body condition and source before slaughter. Age was determined by the dentition of the animal based on the appearance (eruption) and wear of the incisor teeth as previously described (Otesile and Obasaju, 1982). The body condition score of each selected animal was evaluated by observation and feeling the level of muscling and fat deposition over and around the vertebrae in the loin region as described previously by Thompson and Meyer (1994). After slaughter, flaying and evisceration, the rumen was incised and visually examined for the presence or absence of indigestible foreign bodies. Foreign bodies recovered from each rumen was washed, identified, dried and weighed.

Sample size

The sample size was calculated using Epi Info software version 3.5.4 (Center for Disease Control (CDC), Atlanta, Georgia, USA). To calculate the sample size, 50% prevalence at 95% confidence level and 5% absolute precision ($d=0.05$) was used.

$$N = z^2 p (1-p) / d^2$$

Where N = sample size, z = risk of Type 1 error= 1.96, p (prevalence of foreign bodies) = 0.5 (arbitrary proxy), d = precision= 5%

The calculated sample size required for each slaughter house was 384, however to increase accuracy of prevalence estimates 520 animals were sampled from each abattoir studied.

Data management and statistical analysis

The animal type, its age, sex, body condition score and source were recorded along with the post slaughter findings for each slaughter house. Data were captured on data collection sheets, then stored in Microsoft Office

Excel (Microsoft 2010), cleaned, verified and validated as per the entries in the data collection sheets. All data were then imported into the Graph Pad prism software version 6.0 (Graph Pad Software Inc, California, USA) for windows 7, for analysis of the data. Descriptive statistical analysis such as means and frequencies were used to summarize and present the data. Chi square (χ^2) test was applied to determine if there were any significant associations between the various factors such as age, sex, location and body condition score considered as independent factors and the presence of ruminal foreign bodies considered as the dependent factor. Significance was determined at $P < 0.05$.

RESULTS

Overall prevalence of indigestible rumen foreign bodies found in sheep and goats at Dagoretti and Kiserian abattoirs

A total of 1040 animals (666 sheep and 374 goats) were examined at Dagoretti and Kiserian abattoirs for presence of indigestible foreign bodies in their rumen. Out of these, 10.8% (112) were found to have various types of indigestible foreign bodies in the rumen. Of the 666 sheep and 374 goats examined, 10.1% (67) and 12.0% (45), respectively, had indigestible foreign bodies in their rumen. There was no significant difference between the two animal species though goats had a higher prevalence than sheep ($\chi^2 = 0.78$, $P = 0.38$) (Table 1).

Prevalence of indigestible rumen foreign bodies in sheep and goats according to age of the animals

The animals examined at the two abattoirs were in the age categories indicated in Table 2. The highest numbers of animals examined were aged 1-2 years and 2-3 years. However, the highest prevalence rates of 17.7% and 13.5% were in animals 2-3 years and 3-4 years old, respectively. The few animals older than 4 years had no indigestible rumen foreign bodies. Significant association between age and occurrence of indigestible foreign bodies in the rumen was found in both 2-3 year old ($\chi^2 = 39.92$, $P = 0.0001$) and 1-2 year old ($\chi^2 = 9.16$, $P = 0.0002$) (Table 2). Among the sheep examined, the highest prevalence rates of 16.7% and 10.6% were in the categories of 2-3 and 3-4 years. While with the goats highest prevalence rates of 19.6% and 18.5% were observed in animals 2-3 and 3-4 years old, respectively.

Prevalence of indigestible rumen foreign bodies in sheep and goats according to body condition of the animals

The numbers of animals examined in the various categories are presented in Table 3. The highest number of animals examined had body condition score of 3 and 4. These had the highest prevalence rates of indigestible rumen foreign bodies of 9.6% and 13.3%, respectively.

Indigestible rumen foreign bodies were found to be significantly ($\chi^2 = 6.32$, $P = 0.01$) more prevalent in animals with good body condition. Sheep with a body condition score of 4 had the highest prevalence rate of 13.8%, followed by those with a body condition of 3. In goats, however, the highest prevalence of 15.1% was observed in animals with a body condition of 5.

Table 1: Overall prevalence of indigestible rumen foreign bodies in sheep and goats at Dagoretti and Kiserian abattoirs

Type of animal	Number of animals examined	Number of animals with foreign bodies	Prevalence %	Chi square (χ^2)	P-value
Sheep	666	67	10.1	-	-
Goat	374	45	12.0	0.78	0.38
Total	1040	112	10.8	-	-

P>0.05

Table 2: Prevalence of indigestible rumen foreign bodies in sheep and goats at Dagoretti and Kiserian abattoirs according to age

Age category	Number of animals examined	Number of animals with foreign bodies	Prevalence %	Chi square (χ^2)	P-value
< 1 year	101	8	7.9	0.78	0.38
>1 – 2 years	534	37	6.9	13.56	0.0002*
>2 – 3 years	322	57	17.7	18.20	0.0001*
>3 – 4 years	74	10	13.5	0.49	0.48
> 4 years	9	0	0.0	-	-
Total	1040	112	10.8	-	-

*Significant at P<0.05

Table 3: Prevalence of indigestible rumen foreign bodies in sheep and goats at Dagoretti and Kiserian abattoirs according to body condition of the animals

Body Condition Score (BCS)	Number of animals examined	Number of animals with foreign bodies	Prevalence %	Chi square (χ^2)	P-value
1	0	0	0.0	-	-
2	12	0	0.0	-	-
3	418	40	9.6	0.48	0.36
4	384	51	13.3	6.32	0.01*
5	226	21	9.3	0.53	0.47
Total	1040	112	10.8	-	-

*Significant at P<0.05

Table 4: Prevalence of indigestible rumen foreign bodies in sheep and goats at Dagoretti and Kiserian abattoirs according to sex of the animals

Sex group	Number of animals examined	Number of animals with foreign bodies	Prevalence %
Male	666	67	10.1
Female	374	45	12.0
Total	1040	112	10.8

P>0.05

Prevalence of indigestible rumen foreign bodies in sheep and goats according to sex

Among the 112 positive cases of indigestible foreign bodies in the rumen, 10.1% (67) occurred in male animals while 12.0% (45) was found in female animals (Table 4). The number of male animals slaughtered was found to be higher (666) than female (374) animals for both sheep and goats. However, no significant associations were observed between the sex of the animal and the presence of foreign bodies in both species.

Various types of indigestible rumen foreign bodies in sheep and goats at Dagoretti and Kiserian abattoirs

Types of indigestible rumen foreign materials found in sheep and goats slaughtered were plastic bags (72.3%,

81), fruit seeds (8.0%, 9), nylon ropes (4.5%, 5), metallic wires (4.5%, 5), stones pebbles (1.8%, 2), clothing materials (0.9%, 1), and mixtures of foreign materials (8.0%, 9) (Figs 1 and 2). The dry weights of the various indigestible foreign materials found in individual sheep and goats during the study ranged from 0.91 grams (g) in a sheep to 2.10 kilograms (kg) found in a goat. The most predominantly encountered foreign bodies were plastics bags mainly of the soft type. The highest percentage of plastic bags, ropes and metals were found in sheep while the highest percentage of seeds was found in goats. The percentage of plastic bags did not differ significantly between sheep and goats ($\chi^2=0.37$, P=0.54) (Table 5).

Plastic bags were most frequently encountered in sheep and goats in the 2-3 year old age group (37.5%, 42) followed by those in the 1-2 year old age group (24.1%, 27). Only few of the animals less than 1 year old and in the 3-4 year old age group had plastics bags in their rumen. None of the animals older than 4 years had rumen foreign bodies in their rumen. Those in the age group of 2-3 years had all types of indigestible rumen foreign bodies encountered in the study (Table 6). Animals with body condition score 4 had the highest number of cases (38, 33.9%) with plastic bags in the rumen. Those with score 3 had 31(27.7%) cases and those with score 5 had 12 (10.7%) cases with plastic bags, respectively (Table 7).

DISCUSSION

The overall 10.8% prevalence rate of indigestible rumen foreign bodies in sheep and goats slaughtered at the Dagoretti and Kiserian abattoirs in Kenya is relatively low compared to the 77% and 87% prevalence rates previously reported in animals in urban areas of Nigeria and South Darfur, respectively (Remi-Adewunmi *et al.*, 2004; Ghurashi *et al.*, 2009). However, a much lower prevalence rate of 6.1% was found in sheep and goats in Addis Ababa, Ethiopia (Abebe and Nuru, 2011).

Animals presented for slaughter at the two abattoirs in this study originated mainly from the rural arid and semi-arid areas of the country. In those rural areas, they grazed on natural pastures that are much less polluted than the urban and periurban areas of Nairobi where the current study was carried out. Furthermore, most of the sheep and goats reared in the urban and peri-urban areas of Nairobi perhaps do not end up at the abattoirs but may be sold to individuals who slaughter them at home during festive seasons. Hence the relatively low prevalence rate of indigestible foreign bodies in the rumen of sheep and goats observed in this study. It had been stated that, land available for grazing is generally small or non-existent in urban and peri-urban areas. As such, free roaming and scavenging sheep and goats are exposed to the high risk of ingestion of indigestible foreign materials (Hailat *et al.*, 1997; Tesfaye *et al.*, 2012). This could account for the higher prevalence rates of indigestible rumen foreign bodies reported in Sudan and Nigeria, respectively (Remi-Adewunmi *et al.*, 2004; Ghurashi *et al.*, 2009).

The absence of a significant difference in the prevalence rate of indigestible rumen foreign bodies between sheep and goats, although more sheep than goats were slaughtered was similar to findings reported previous

Table 5: Various types of indigestible rumen foreign bodies in sheep and goats at Dagoretti and Kiserian abattoirs between April 2013 and June 2013

Animal	Number of animals examined	Plastic bags % (No.)	Ropes % (No.)	Metals % (No.)	Seeds % (No.)	Cloth % (No.)	Stones % (No.)	Mixture of materials % (No.)
Sheep	666	46.4 (52)	3.6 (4)	3.57 (4)	1.8 (2)	0.0 (0)	0.9 (1)	0.9 (1)
Goats	374	25.8 (29)	0.9 (1)	0.89 (1)	6.3 (7)	0.9 (1)	0.9 (1)	7.1 (8)
Total	1040	72.3 (81)	4.5 (5)	4.5 (5)	8.0 (9)	0.9 (1)	1.8 (2)	8.0 (9)

Table 6: Occurrence of indigestible rumen foreign bodies according to age of sheep and goats at Dagoretti and Kiserian abattoirs between April 2013 and June 2013

Age of animal (years)	Plastic bags % (No.)	Ropes % (No.)	Metals % (No.)	Seeds % (No.)	Cloth % (No.)	Stones % (No.)	Mixture of materials % (No.)
<1	4.5 (5)	-	-	1.8 (2)	-	-	-
1 - 2	24.1 (27)	0.9 (1)	2.7 (3)	2.7 (3)	-	-	1.8 (2)
2 - 3	37.5 (42)	2.7 (3)	1.8 (2)	3.6 (4)	0.9 (1)	1.8 (2)	4.5 (5)
3 - 4	6.3 (7)	0.9 (1)	-	-	-	-	1.8 (2)
>4	-	-	-	-	-	-	-
Total	72.3 (81)	4.5 (5)	4.5 (5)	8.0 (9)	0.9 (1)	1.8 (2)	8.0 (9)

Table 7: Occurrence of indigestible rumen foreign bodies according to the body condition scores of sheep and goats at Dagoretti and Kiserian abattoirs between April 2013 and June 2013

BCS of animals	Plastic bags % (Number)	Ropes % (Number)	Metals % (Number)	Seeds % (Number)	Cloth % (Number)	Stones % (Number)	Mixture of materials % (Number)
1	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-
3	27.7 (31)	0.9 (1)	1.8 (2)	2.7 (3)	-	0.9 (1)	1.8 (2)
4	33.9 (38)	0.9 (1)	0.9 (1)	3.6 (4)	0.9 (1)	-	5.4 (6)
5	10.7 (12)	2.7 (3)	1.8 (2)	2.7 (2)	-	0.9 (1)	0.9 (1)
Total	72.3 (81)	4.5 (5)	4.5 (5)	8.0 (9)	0.9 (1)	1.8 (2)	8.0 (9)

(Abebe and Nuru, 2011; Omidi *et al.*, 2012; Tesfaye *et al.*, 2012; Saulawa *et al.*, 2012). However, in contrast to this finding, significantly higher prevalence rates of indigestible rumen foreign bodies in sheep than goats have been reported (Hailat *et al.*, 1997; Igbokwe *et al.*, 2003; Remi-Adewunmi *et al.*, 2004; Okai *et al.*, 2007; Roman and Hiwot, 2010, Akinrinmade and Akinrinde, 2012). It also differs from the findings of higher prevalence of indigestible foreign bodies in goats than sheep reported in Sudan (Mohammed, 2012). The differences in the prevalence of indigestible foreign bodies observed between sheep and goats may be attributed to the variations in the origin of the animals, husbandry practices, feeding behaviour and the waste management system or the level of environmental pollution at the source rather than the species of the animal being the cause (Igbokwe *et al.*, 2003; Ghurashi *et al.*, 2009; Roman and Hiwot, 2010).

Although more male sheep and goats were slaughtered in the current study, the absence of a significant difference in the prevalence of indigestible foreign bodies between different sexes agrees with the findings of Abebe and Nuru (2011) and Saulawa *et al.* (2012). However, it is in contrast with the reports of Remi-Adewunmi *et al.* (2004) who observed a significant higher prevalence in female sheep in Nigeria. They attributed their findings to hormonal changes and increased appetite due to nutritional demands during estrus, pregnancy and lactation in female animals. Similar higher prevalence rates of indigestible rumen foreign bodies in female sheep and goats have also been reported in other studies in Nigeria and Ethiopia (Igbokwe *et al.*, 2003; Roman and

Hiwot, 2010; Omidi *et al.*, 2012) with the explanation that female animals are kept longer than males for breeding. According to Hailat *et al.* (1997), ingestion of indigestible materials occurs gradually over a prolonged period of time. This implies that female animals kept for longer for periods breeding have a higher chance of ingesting indigestible foreign bodies hence higher prevalence rates. The finding in the current study could be ascribed to the relatively young age of the animals in this study compared to the previous studies. Furthermore, the few older animals without foreign bodies in this study could be due to the fact that animals are slaughtered at an earlier age or those with foreign bodies might have died before the old age.

The significantly high prevalence rate of indigestible foreign bodies in the rumen of 2 - 3 year old animals in both sheep and goats differs from the findings of previous studies that reported higher prevalence rates in older sheep and goats (Hailat *et al.*, 1997, 1998; Igbokwe *et al.*, 2003; Remi-Adewunmi *et al.*, 2004; Roman and Hiwot, 2010; Abebe and Nuru, 2011; Saulawa *et al.*, 2012; Tesfaye *et al.*, 2012). They attributed their findings to the gradual ingestion of indigestible materials over prolonged periods of time as the animal ages. The finding in the current study can probably be attributed to the fact that 82.3% of the sheep and goats examined were in the 1 - 2 and 2-3 year old, hence the significant prevalence. It could also indicate that the sheep and goats in the current study are exposed to ingestion of indigestible materials at an early age due to increased environmental pollution in recent times as suggested by Akinrinmade and Akinrinde (2013).



Fig. 1: Indigestible foreign bodies recovered from the rumen of a sheep at Dagoretti (A) and a goat at Kiserian (B) abattoirs.



Fig. 2: Indigestible rumen foreign bodies recovered from the rumen of sheep and goats at (A) Dagoretti and (B) Kiserian abattoirs.

The significantly higher prevalence rate observed in this study for indigestible rumen foreign bodies in sheep and goats in good body condition disagrees with previously reported high prevalence rates in animals in poor body condition (Hailat *et al.*, 1997, 1998; Igbokwe *et al.*, 2003; Remi-Adewunmi *et al.*, 2004; Roman and Hiwot, 2010; Abebe and Nuru, 2011; Saulawa *et al.*, 2012; Tesfaye *et al.*, 2012). The poor body condition of animals with indigestible foreign bodies was attributed to interference in absorption of volatile fatty acids in the rumen resulting in inappetence, abdominal distention, reduced weight gain, lack of defaecation with consequent emaciation and recumbency (Igbokwe *et al.*, 2003). The quantities of indigestible foreign bodies found in the rumen in the current study were perhaps not large enough to cause impaction of the rumen and hence did not interfere with weight gain of the animals, hence retention of the good body condition.

The higher prevalence of plastic bags in the rumen of sheep and goats compared to other types of foreign bodies is corroborated by similar previous findings (Hailat *et al.*, 1997, 1998; Igbokwe *et al.*, 2003; Remi-Adewunmi *et al.*, 2004; Roman and Hiwot, 2010; Abebe and Nuru, 2011; Saulawa *et al.*, 2012; Tesfaye *et al.*, 2012). This observation can be attributed to the increased usage and improper disposal of plastic waste especially in urban and peri-urban areas (Remi-Adewunmi *et al.*, 2004; Njeru, 2006; Tiruneh and Yesuwork, 2010; Ramaswamy and Sharma, 2011; Adane and Muleta, 2011). Bakhiet (2008) and Roman and Hiwot (2010) also reported that plastic bags are the most

common materials recovered from the rumen of sheep and goats in Sudan and Ethiopia, respectively. In Kenya, plastic bags are the most dominant component of household waste generated (UNEP, 2005), and hence accounts for the observations in this study.

Conclusion

The finding of 10.8% prevalence of indigestible rumen foreign bodies in sheep and goats indicates ingestion of foreign materials, particularly plastic bags by these animals due to environmental pollution. Increased ingestion and accumulation of these foreign bodies could pose serious health problems to roaming and scavenging sheep and goats, especially in urban and peri-urban areas, that could adversely affect their overall productivity and production. Proper waste disposal practices and good husbandry methods may be required to check environmental pollution and prevent animals from accessing indigestible foreign bodies.

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