CLINICAL MANIFESTATIONS IN SHEEP WITH PLASTIC BAGS IN THE RUMEN

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Abstract

Sixteen 1-year-old castrate Dorper sheep were used for the study. The animals were divided into four groups of four animals (n = 4). Three groups were implanted with 129 g, 258 g and 387 g of thin plastic bags into the rumen through rumenotomy, while the fourth group was subjected to rumenotomy without implanting plastic bags, and served as control. All the animals were monitored daily for 6 weeks following implantation. Presence of plastic bags in the rumen was characterized by anorexia, severe depression, discomfort, dehydration, firmness and asymmetrical distension of the abdomen, ruminal hypomotility and diarrhoea with intermittent constipation, weight loss, terminal recumbency and death. Severity of these clinical manifestations increased with increased quantities of plastic bags and their duration in the rumen. Sheep implanted with 258 g and 387 g lost 7.8 per cent and 14.2 per cent of their initial mean body weight, respectively, by the end of 6 weeks. Presence of plastic bags in the rumen could interfere with digestion, with gradual loss in body weight, productivity and occasional mortality. Plastic bags in the rumen should be considered as a differential diagnosis in sheep presenting the observed clinical signs, especially in urban and peri-urban areas.

Introduction

Sheep contribute to food security, reduction in poverty, improved soil fertility for crop production and overall improvement of livelihoods in low income households, particularly in developing countries (Lebbie, 2004). Poor health is a major constraint to small ruminant production under the traditional smallholder production systems, in which animals mainly roam and seek their own feed (Devendra, 1999). Roaming and scavenging for feed expose the animals to many health hazards including ingestion and accumulation of indigestible foreign materials in the rumen (Remi-Adewunmi, Gyang & Osunowd, 2004). The rumen is the largest compartment of the fore-stomachs of sheep (Radostitis *et al*., 2009). Over 80 per cent of the energy supply for sheep is obtained through fermentation of feed materials in the rumen (Randall, Burgren & French, 2002). When the process of fermentation and absorption of volatile fatty acids is interfered with as a result of accumulation of indigestible foreign bodies in the rumen, the animal is deprived of valuable nutrients for its survival (Igbokwe, Kolo & Egwu, 2003).

Impaction of the rumen resulting from indigestible foreign bodies is one of the common causes of gastrointestinal disorders in sheep and the root cause of various problems in different organs of the animal (Radostitis *et al*., 2009). Presence of indigestible foreign bodies in the rumen compromises ruminal space and leads to

many complications depending on the nature of the foreign body (Calfee & Manning, 2002). A number of factors have been implicated as risk factors for ingestion and accumulation of indigestible foreign materials in the rumen of sheep. These include starvation during long periods of feed scarcity (Igbokwe *et al.,* 2003), mineral and nutritional deficiencies (Radostitis *et al*., 2009), depraved appetite (Radostitis *et al*., 2009; Vijaya, Reddy & Sasikala, 2012) and increased environmental pollution with non-biodegradable materials, which prevail in the developing world (Ghurashi *et al*., 2009).

Clinical signs of indigestible foreign body impaction of the rumen of small ruminants vary widely from mild indigestion to life threatening systemic signs (Gyang, 1991). Some reported clinical presentations, associated with indigestible rumen foreign bodies, include anorexia, depression, reduced milk yield, distension of the rumen, absence of ruminal motility and defaecation, hypoglycaemia and reduced rate of fattening (Igbokwe *et al*., 2003; Remi-Adewunmi *et al*., 2004; Vanitha *et al*, 2010; Vijaya *et al*., 2012). However, the types and quantities of foreign bodies, degree of obstruction, as well as their duration in the rumen in relation to the observed clinical effects, are not documented. There has not been any reported comparison of clinical manifestations in sheep, from natural ingestion or experimental implantation of plastic bags.

Studies on waste generation have shown that plastic bags or polyethelene bags are the largest component of solid waste generated, especially in urban and peri-urban areas, and, hence, the most prevalent in polluting pastures and grazing areas (NEMA, 2003; Mangizvo, 2012). Thus, they are the most commonly ingested foreign bodies found in the rumen of sheep (Roman & Hiwot, 2010; Omidi *et al*., 2012; Sileshi *et al*., 2013, Otsyina *et al*., 2014; 2015). However, effect of the presence of plastic bags in the rumen on the physiological and nutritional aspects of sheep has not been fully elucidated and remains largely speculative. Most cases of plastic materials in the rumen of sheep are subclinical, only being encountered as incidental findings at necropsy examination or at slaughter (Hailat *et al.,* 1998; Otsyina *et al.,* 2015). The study reports on the clinical manifestations in sheep experimentally implanted with plastic bags into their rumen for a period of 6 weeks.

Experimental

The experimental animals included 16 one-year-old castrated Dorper sheep. The sheep had a mean body weight of 26.8 ± 0.3 kg with body condition score of 3.5 ± 0.5 (on a scale of 1-5). The animals were housed in groups of four for the whole period of the experiment and allowed 6 weeks to acclimatize to the environment and feed. They were fed on chopped Rhodes grass hay and supplemented with commercially produced small stock concentrate meal (UNGA® AFYA Meal, UNGA Farm Care Ltd, Nairobi, Kenya). Feed and drinking water were provided *ad libitum*. They were treated against endoparasites with 2.5 per cent Albendazole (Alfabas® Norbrook, Kenya) administered at a dose rate of 4 ml/kg of body weight and ectoparasites with 1 per cent Ivermectin at a dose rate of 1 ml/50 kg of body weight. All the animals were administered 20 per cent injectable Oxytetracycline HCl (Alamycin LA 20®, Norbrook, Ireland) intramuscularly, at a dosage of 20 mg/10 kg of body weight as a prophylactic measure against transportation stress and bacterial infection. The animals were subjected to routine physical examination over the acclimatization period.

The animals were assigned to four experimental groups (n = 4), using stratified random sampling on the basis of weight of the animals, such that the mean weight of animals in each of the experimental groups was not statistically different. The four groups of sheep were designated SE1, SE2, SE3 and SC4. Three groups (SE1, SE2 and SE3) were implanted with 129 g, 258 g and 387 g of plastic bags, respectively, into the rumen. Implantation of the plastic bags into the rumen was done through rumenotomy as previously described by Hendrickson (2007). The fourth group (SC4) served as control on which rumenotomy was done but no plastic bags

were implanted. Both test and control sheep were monitored daily for a period of 6 weeks (42 days), and all the observed clinical manifestations were recorded.

Results

Clinical manifestations

Clinical manifestations in sheep implanted with 129 g, 258 g and 387 g of plastic bags into the rumen are presented in Tables 1–3. The temperature, respiratory and heart rates remained within normal range in all the animals, except for those that died during the period of the experiment.

Sheep implanted with 129 g did not show distension or firmness of the abdomen. They had initial inappetence but their appetite significantly improved 2 weeks after implantation, with feed and water intake being restored to pre-implantation levels from week 3 onwards. They were not depressed or dehydrated and their ruminal movements remained 2 - 3 per min throughout the study period as compared to the control. Sheep implanted with 129 g also retained normal pelleted faeces similar to the control throughout the study period. They also retained their body weight and did not regurgitate any of the implanted plastic bags (Table 1).

However, the sheep implanted with 258 g plastic bags had distended abdomen with firmness on the left flank. Reduced appetite, as well as reduced water intake, were observed in all sheep in this group. They fed scantly, with little water intake, occasionally. Severe depress-ion, dehydration, rough hair coat, reduced ruminal movements (1-2 per min) and severe weight loss were observed in all the animals implanted with 258 g of plastic bags. They also showed occasional grinding of the teeth with salivation, and regurgitation of some of the implanted plastic bags (Table 2).

The sheep implanted with 387 g plastic bags also had distended abdomen with firmness on the left flank but this was more severe than those implanted with 258 g. Feed as well as water intake were markedly reduced in this group of sheep, and this trend continued over the entire period of the study. Diarrhoea with intermittent constipation was observed in three of four sheep in the group implanted with 387 g, while the fourth sheep had no feaces after day 15, following implantation of plastic bags. Persistent grinding of teeth and increased foamy saliva were observed in all the sheep implanted with 387 g plastic bags. These animals also showed severe weight loss and pale mucous membranes. They occasionally regurgitated some of the implanted plastic bags (Table 3).

Effect of plastic bags in the rumen on body weight

Mean body weights of sheep implanted with varying quantities of plastic bags into the rumen over the 6 week period as well as the control are presented in Fig. 1. There was an initial weight loss for all the groups of sheep in the first week. Mean body weight of the control increased by 1.8 kg while those implanted with 129 g increased by 0.2 kg. The sheep implanted with 258 g and 387 g had their mean body weights reduced from the initial weight of 26.8 kg to 24.7 kg (-2.1 kg) and 23.0 kg (-3.8 kg), respectively, at 6 weeks. Significant differences were observed between the mean body weight of sheep in the control group and those implanted with 258 g ($P < 0.001$) and 387 g ($P < 0.001$) of plastic bags. Mean body weight of sheep implanted with 258 g was also significantly ($P < 0.01$) higher than that of sheep implanted with 387 g of plastic bags.

Discussion

Normal body temperature, respiratory and heart rates of both sheep implanted with various quantities of plastic bags into the rumen observed in the current study is consistent with previous findings in small ruminants impacted with ingested indigestible rumen foreign bodies (Ghurashi *et al*., 2009; Mozaffari, Olomi & Vosouh, 2009; Debaris & Mousami, 2010; Pitroda *et al*., 2010; Raoofi *et al*., 2012). Similar findings have also been reported in cattle (Suthar *et al*., 2011) and buffaloes (Boodur, 2010). Presence of foreign bodies in the rumen does not

appear to exert significant pressure on the diaphragm to interfere with respiration or heart functioning.

The asymmetrical distension of the abdomen with firmness on the left side as observed in all sheep is attributed to rumen impaction with the implanted plastic bags. This is in agreement with previous reports in cases of rumen impaction (Igbokwe *et al*., 2003; Bakhiet, 2008; Mozaffari *et al*., 2009; Debaris & Mousami, 2010). The pale mucous membranes observed in animals implanted with higher quantities of plastic bags may be due to interference with rumen microbial activity and mineral imbalance, thus, influencing vitamin B12 production, which could affect haemoglobin production and result in anaemia.

Reduced feed intake and inappetence observed in sheep implanted with 258 g and 387 g of plastic bags is similar to previous findings in ruminants with indigestible foreign bodies in the rumen (Igbokwe *et al*., 2003; Baillie & Anzuino, 2006; Ghurashi *et al*., 2009; Debaris & Mousami, 2010). Factors that determine feed intake by ruminants are related to the capacity of the gastro-intestinal tract, digestibility of the feed and the rate of passage through the gastro-intestinal tract (Conrad, 1966). Intake of roughages is also reported to be related to the amount of fatty acid production in the rumen in ruminants (Blaxter, Wainman & Wilson, 1961). The presence of plastic bags in the rumen may have hindered effective fermentation and functioning of the rumen microflora (Radostitis *et al*., 2009), thus, reducing feed intake. In addition, the extent of stretching of the ruminal wall and the reduced ruminal motility due to the presence of 258 g and 387 g of plastic bags in the rumen may have stimulated the hypothalamus and satiety centre leading to loss of appetite or inappetence (Houpt & Recee, 2004; Mozaffari *et al*., 2009).

The dehydration observed in the current study concurs with previous findings in sheep (Abdullahi, Usman & Mshelia, 1984; Igbokwe *et al*., 2003) and goats (Debaris & Mousami, 2010) whose rumens were impacted with indigestible foreign bodies. The dehydration may have resulted from reduced water intake and possibly sequestration of fluid in the forestomach due to the obstructive effect of the impacted plastic bags in the rumen as well as stress. Drinking is associated with feed intake (Rossi & Scharrer, 1994), therefore, reduction in feed intake would also lead to decreased water intake, hence, the dehydration observed.

Severe depression, persistent grinding of teeth, arching of the back, rigidity of the limbs and reluctance to move suggested discomfort which could possibly have been due to pain in the abdomen. Such observations have been reported in ruminants with rumen impaction (Igbokwe *et al*., 2003; Reddy *et al*., 2004; Radostitis *et al.,* 2009; Debaris & Mousami, 2010). It is possible that impaction and distension of the rumen with the implanted plastic bags resulted in stretching of the ruminal wall causing pain, hence, the signs of discomfort. The persistent grinding of teeth seen in these animals supports this position. The foamy saliva observed in animals implanted with 258 g and 387 g of plastic bags may be a consequence of the persistent grinding of teeth as a result of the pain in the rumen, this has not been previously reported in sheep.

The change in character of faecal materials with intermittent diarrhoea and constipation has been reported previously in sheep and goats with indigestible rumen foreign bodies (Igbokwe *et al*., 2003; Debaris & Mousami, 2010). These findings may have resulted from irritation and enteritis, probably caused by chemical irritants released from the implanted plastic bags or due to hepatic complications, leading to a syndrome that caused both diarrhoea and constipation (Radostitis *et al.,* 2009). Constipation and dry pelleted faeces could also be attributed to reduced or lack of water intake, hence, dry contents in the colon.

Ruminal hypomotility of 1 - 2 weak contractions per min is consistent with ruminants having rumen impaction (Igbokwe *et al*., 2003; Reddy *et al*., 2004). The hypomotility of the rumen may have been caused by either a reduction in excitable drive to the gastric centres or an increase in inhibitory inputs (Grunberg & Cons-

table, 2009). Inhibitory inputs to the gastric centres can be caused by excessive distension of the rumen, as well as some degree of hypocalcaemia (Daniel, 1983). Excessive distension of the rumen was a main feature of sheep implanted with 258 g and 387 g of plastic bags, and may have resulted in fatigue of rumen wall musculature, hence, the hypomotility and reduced strength of contractions.

Loss of body weight in sheep implanted with quantities of plastic bags in the current study is corroborated by reports of Igbokwe *et al*. (2003), Ghurashi *et al*. (2009), Mozaffari *et al*. (2009) and Debaris & Mousami (2010). However, these authors did not report on the quantities of foreign bodies or the duration of their presence in the rumen. The weight loss in sheep in the current study can be attributed to drastic reduction in feed and water intake leading to reduction of fermentable ingesta in the rumen and possible disturbances in microbial fermentation and reduced fatty acid production and absorption (Randall *et al*., 2002). Loss of body water as well as reduction in feed intake, is associated with weight loss (Abdalla, Salwa & Yahia, 2010). The higher weight loss with increased quantities of plastic bags in the rumen over time suggests greater interference with fermentative and physiological activities in the rumen.

Conclusion

Results of the current study show that presence of plastic bags in the rumen of sheep is characterized by anorexia, depression, reduced feed and water intake, abdominal distension, ruminal hypomotility, lack of rumination and weight loss. Furthermore, these animals showed dehydration and altered faecal characteristics, with some animals having dry hard and pelleted faeces, or loose pasty or watery faeces. Other clinical signs included grinding of teeth and arched back, recumbency and death. Severity of the clinical symptoms, however, depended on the degree of impaction, and quantity and duration of plastic bags in the rumen. These have implications on overall production and productivity of the affected animal. It is recommended that plastic bags in the rumen of sheep be considered as a differential diagnosis in sheep presenting with the aforementioned clinical manifestations, especially in urban and peri-urban areas.

Acknowledgment

The authors are grateful to Transdisciplinary Training for Resource Efficiency and Climate Change Adaptation in Africa (TRECCAfrica) and the University of Ghana for providing the funds for this work, the research assistants who assisted in data collection and the University of Nairobi for providing structures and equipment for the work.

TABLE 1

Clinical findings in sheep implanted with 129 g of plastic bags into the rumen for 6 weeks

Parameters	*Clinical observat ions / Duration of implantation*					
	Week 1	*Week 2*	*Week 3*	*Week 4*	*Week 5*	*Week 6*
General body condition	1	1	1	1	1	1
Abdominal distension	1	1	1	1	1	1
Mucous membrane colour	0	0	0	0	0	0
Demeanor	0	0	0	0	0	0
Conformation	0	0	0	0	0	0
Gait	0	0	0	0	0	0
Appetite	1	1	0	0	0	0
Water intake	0	0	0	0	0	0
Dehydration	0	0	0	0	0	0
Rumen motility/min	2 - 3	2 - 3	2 - 3	2 - 3	2 - 3	2 - 3
Rumen consistency	0	0	0	0	0	0
Defaecation	1	1	1	1	1	1
Character of faeces	0	0	0	0	0	0
Appearance of hair coat	1	1	1	1	1	1
Grinding of teeth	0	0	0	0	0	0
Foamy saliva	0	0	0	0	0	0
Regurgitation of plastic bags	0	0	0	0	0	0

Key

General body condition: Good =1, fair = 2, poor = 3, very poor = 4; Abdominal distension: none = 0, moderate = 1, Severe – 2; Mucous membrane colour: normal = 0, mildly pale = 2, pale = 3; Demeanor: bright/alert = 0, slightly depressed = 1, depressed = 2, severely depressed = 3; Conformation: normal = 0, slightly ached back = 1, ached back = 2; Gait: normal = 0, ataxia = 1; Appetite: normal = 0, moderately reduced = 1, reduced = 2, markedly reduced = 3, anorexia = 4; Water intake: normal = 0, reduced = 1, markedly reduced = 2; Dehydration: none = 0, slight =1, moderate = 2, marked = 3; Rumen consistency: doughy = 0, firm = 1, very firm = 2; Defaecation: present =1, occasional =2, absent =3; Character of feaces: normal pellets = 0, hard pellets =1, loose = 2, pasty = 3, diarrhoea = 4, no faeces = 5; Appearance of hair coat: glossy = 1, rough = 2; Grinding of teeth: absent = 0, occasional = 1, continuous = 2; Foamy saliva: absent = 0, present = 1; Regurgitation of plastics bags: absent = 0, present = 1.

TABLE 2

Clinical findings in sheep implanted with 258 g of plastic bags into the rumen for 6 weeks

Parameters	*Clinical observations / Duration of implantation*					
	Week 1	*Week 2*	*Week 3*	*Week 4*	*Week 5*	*Week 6*
General body condition	1	2	2	2	2	2
Abdominal distension	2	2	2	2	2	2
Mucous membrane colour	0	1	1	1	1	1
Demeanor	1	2	2	2	1	1
Conformation	1	1	1	1	1	1
Gait	0	0	1	1	1	1
Appetite	3	3	3	3	2	2
Wat er intake	2	2	2	1	1	1
Dehydration	1	2	2	2	2	2
Rumen motility/min	1-2	1-2	1-2	1-2	1-2	1-2
Rumen consistency	0	1	1	1	1	1
Defaecation	1	2	3	2	2	2
Character of faeces	0	3	5	1	1	3
Appearance of hair coat	1	2	2	2	2	2
Grinding of teeth	0	1	2	2	1	1
Foamy saliva	0	1	1	1	1	1
Regurgitation of plastic bags	0	0	1	1	1	1

Key

General body condition: Good = 1, fair = 2, poor = 3, very poor = 4; Abdominal distension: none = 0, moderate = 1, Severe – 2; Mucous membrane colour: normal = 0, mildly pale = 2, pale = 3; Demeanor: bright/aler t = 0, slightly depressed = 1, depressed = 2, severely depressed = 3; Conformation: normal = 0, slightly ached back = 1, ached back = 2; Gait: normal = 0, ataxia = 1; Appetite: normal = 0, moderately reduced =1, reduced = 2, markedly reduced = 3, anorexia = 4; Water intake: normal = 0, reduced = 1, markedly reduced = 2; Dehydration: none = 0, slight =1, moderate = 2, marked = 3; Rumen consistency: doughy = 0, firm = 1, very firm = 2; Defaecation: present = 1, occasional =2, absent = 3; Character of feaces: normal pellets = 0, hard pellets =1, loose = 2, pasty = 3, diarrhoea = 4, no faeces = 5; Appearance of hair coat: glossy = 1, rough = 2; Grinding of teeth: absent = 0, occasional = 1, continuous = 2; Foamy saliva: absent = 0, present = 1; Regurgitation of plastics bags: absent = 0, present = 1.

TABLE 3

Clinical findings in sheep implanted with 387 g of plastic bags into the rumen for 6 weeks

Parameters	*Clinical observat ions / Durat ion of implantation*					
	Week 1	*Week 2*	*Week 3*	*Week 4*	*Week 5*	*Week 6*
General body condition	1	2	2	2	3	3
Abdominal distension	2	2	2	2	2	2
Mucous membrane colour	0	1	2	2	2	2
Demeanor	3	3	3	3	3	3
Conformation	2	2	2	2	2	2
Gait	1	1	1	1	1	1
Appetite	3	3	3	3	3	3
Water intake	0	2	2	2	1	1
Dehydration	0	2	3	3	3	3
Rumen motility/min	1-2	1-2	1-2	1-2	1-2	1-2
Rumen consistency	2	2	2	2	2	2
Defaecation	2	2	3	3	2	2
Character of faeces	0	4	5	5	1	1
Appearance of hair coat	1	2	2	2	2	2
Grinding of teeth	1	2	2	2	2	2
Foamy saliva	1	1	1	1	1	1
Regurgitation of plastic bags	1	1	1	1	1	1

Key

General body condition: Good = 1, fair = 2, poor = 3, very poor = 4; Abdominal distension: none = 0, moderate = 1, Severe = 2; Mucous membrane colour: normal = 0, mildly pale = 2, pale = 3; Demeanor: bright/alert = 0, slightly depressed = 1, depressed = 2, severely depressed = 3; Conformation: normal = 0, slightly ached back = 1, ached back = 2; Gait: normal = 0, ataxia = 1; Appetite: normal = 0, moderately reduced = 1, reduced = 2, markedly reduced = 3, anorexia = 4; Water intake: normal = 0, reduced = 1, markedly reduced = 2; Dehydration: none = 0, slight = 1, moderate = 2, marked = 3; Rumen consistency: doughy = 0, firm = 1, very firm = 2; Defaecation: present = 1, occasional =2, absent = 3; Character of feaces: normal pellets = 0, hard pellets = 1, loose = 2, pasty = 3, diarrhoea = 4, no faeces = 5; Appearance of hair coat: glossy = 1, rough = 2; Grinding of teeth: absent = 0, Occasional = 1, Continuous = 2; Foamy saliva: absent = 0, present = 1; Regurgitation of plastics bags: absent = 0, present = 1.

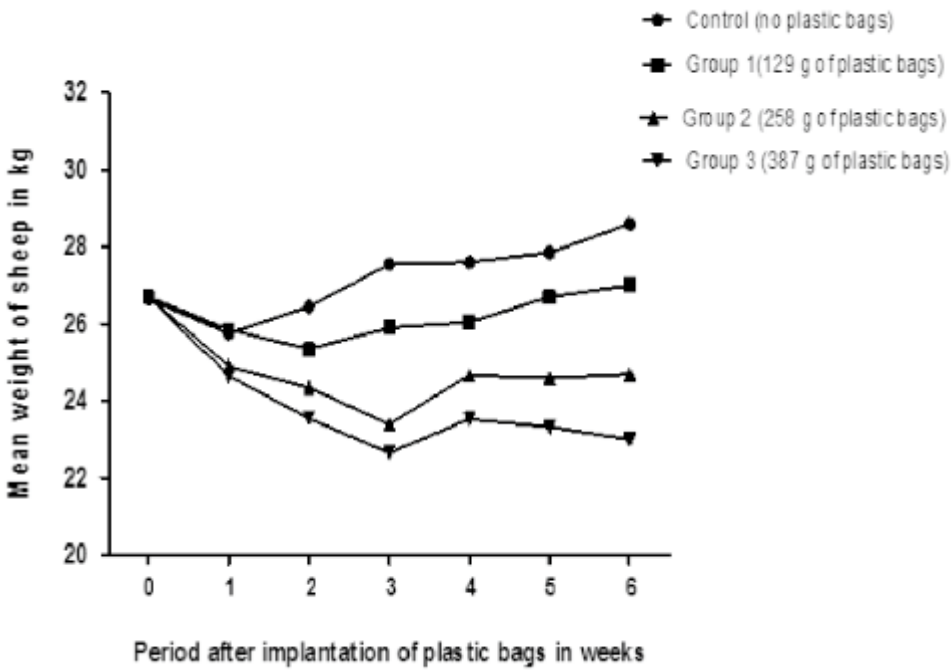

Fig. 1. *Mean weights of control sheep and sheep (n =4) implanted with 129 g, 258 g and 387 g of plastic bags into the rumen for a period of 6 weeks.*

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Received 19 Feb 16; revised 20 May 17