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Influence of Dietary Feeding Rumen Contents on Diet Digestibility, Performance and Carcass Characteristic of Growing Local Lambs

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Abstract:
A total of 18 lambs with initial weight of 20.0 ± 1.19 kg were used to assess the effect of dietary inclusion of rumen contents on nutrient digestibility growth performance and carcass quality. Animals were grouped into two groups and individually penned receiving their respective diets. Coarsely ground sorghum Stover was used as roughage source. Sorghum Stover-rumen contents mixture was prepared as 1:4 ratios on fresh basis. Two iso-caloric and iso-nitrogenous complete diets were formed as control diets (SS- diet) and rumen contents diets (RC- diet). The first group of lambs (n=9) received the control diet (43.5% sorghum Stover , 30% groundnut cake, 25% molasses, 0.5% common salt , 0.5% di-calcium phosphate and vitamin and mineral mix 0.5%) with calculated ME (Metabolizable Energy) content of 8.44 MJ /kg DM (Dry Matter) and CP (Crude Protein) 16.03%.The second group (n=9) received the RC-diet (43.5% sorghum Stover-rumen contents mixture, 30% ground nut cake, 25% molasses, 0.5% common salt , 0.5% di-calcium phosphate and vitamin and mineral mix 0.5%) with calculated ME content of 8.28 MJ / kg DM and CP 16.27% (1: 4 parts of the chopped Sorghum Stover and dried under direct sun light for one to two days). The results revealed that dietary inclusion of rumen contents in lambs' diets had no deteriorative effect on daily growth rate (170.0 ± 19.82 g) and 173.7 ± 23.77 g) or dressing out percentage (49.1 ± 1.45 and 48.9 ± 1.37%), digestible organic matter (669.8 ± 2.49 and 667.2 ± 4.83 g/kg) and digestible crude protein (609.4 ± 2.94 and 608.6 ± 5.68 g/kg) respectively. We concluded that rumen contents could safely be included in diets for growing lambs without any negative effect on diet digestibility or lambs' performance or even carcass quality. Also the economical study revealed that the use of rumen contents in small ruminant's diets could reduce the cost of feeding up to 22% beside reducing the total cost required to gain 1 kg body weight nearly 25%

Keywords: rumen contents, digestibility, ruminants, performance**.**

Introduction

The total livestock population in the Sudan is about 106.622 million heads of which, 40.210 million heads sheep, (MARF, 2015). In livestock production sector, nutrition of animals represents more than 70% of the total production cost. Shortage in animal feeds like fodders and the high prices of concentrates drew the attention of scientists and livestock owners to the importance of using alternative animal feeds. Animal wastes has long been known and used as additives in livestock diets (Muller, 1974 and Fontenot and Webb, 1975). Slaughterhouse wastes (offal's, rumen contents and blood) represent one of the most promising animal feed resources besides decreasing the environmental pollution. Accumulations of wastes threaten the public human health and cause gathering of rodents, insects and unpleasant smells. Rumen contents that represent 20% of the live body weight could possibly be used as a nutrient source for different classes of animals like ruminants (Khattab *et al.*, 2011) and monogastric animals (Adeniji and Jimoh, 2007 and Adeniji, 2008). Rumen contents contain 12.5 % CP and 44.3% ADF (Rios Ricon *et al.*, 2010) making it a valuable source for protein and fiber in diets of livestock, The cost of feed, as percentage of total production costs, accounts for about 50-60% of ruminant feeding systems and 65-80% in an industrial system (Khattab et al., 2009).

The objectives of this study are to make use of rumen contents in friendly environmental way as sheep diets and to decrease nutritional cost.

Materials and methods

The experiment was conducted at the Animal Production Research Centre (APRC)- Hillat Kuku of Animal Resources Research Corporation (ARRC), (Longitude 31.5 -34.45º East and Latitude 15.8 – 16.45 º North) in the period of January to June of the year 2015.

Performance and carcass quality trial

Eighteen apparently healthy weaned Sudan Desert lambs of average body weight 20.0 ± 1.19 kg were used. Two diets formulae were compounded using Sorghum (*Sorghum bicolor)* stover; SS; as conventional roughage in control diet (SS-diet) and rumen contents (RC-diet) as non-conventional roughage in test diet (Table 1, 2.). The lambs were individually penned with free access to clean water and mineral blocks receiving their respective diets. The performance trial continued for 120 days where animals were weighed weekly and feed offered and refused were also recorded daily. At the end of the 120 days fattening period five lambs from each group were randomly chosen for subsequent carcass analysis. The lambs were slaughtered at the slaughterhouse of Animal Production Research Centre (APRC) of Hillat Kuku after being fasted for 12 hours with free access to water and weighed immediately prior to slaughter. The lambs were slaughtered and dressed using standard procedures of MLC (1976). After 24 hours, chilled carcass was weighed and prepared for dissection by removing the tail at is articulation as well as kidney and kidney knob and channel fat. The carcass was split into two halves by sawing along the vertebral column. One half (left side) of the carcass was cut into six whole sale cuts of leg and chump, single short forequarter, best end of neck, breast, loin, and neck. Eye muscle area and fat depth over eye muscle were determined on the surface of the *longissimus thoracis* and *lumborum* at the level of the 12^{th} rib. Eye muscle area was traced out on parchment paper and then measured with a plan meter. Fat depth over eye muscle was the average of three fat thickness measurements over the eye muscle measured with a caliper.

Digestibility trials

Six Desert lambs of an average 23.3± 1.21kg body weight were used in the digestibility study. The lambs were randomly divided into two groups of three animals each, SS-diet group and RC-diet group. Lambs were individually placed in metabolic cages. The adaptation period was continued for fourteen days were lambs received their respective ration once a day in the morning at 8:00am *ad labium* with free excess to clean tap water. After the end of the adaptation period, lambs were equipped with harnesses and bags for collection of faeces. The collection period continued for ten days allowing the first three days for harnesses and bags adaptation and the following week for collection. Feed consumption and faecal excretions were recorded on daily basis for each lamb. The collected faeces were weighted to the nearest 1g and 10 % of the collected faeces were put in plastic bag and frozen at -4^{0}C till further analysis. Also 10% sample of feed mixture offered was retained for analysis. Apparent digestibility coefficient was calculated according to:

$$\text{Digestibility \%} = \frac{\text{DM intake (g)} - \text{Dried faeces (g)}}{\text{DM intake (g)}} \times 100$$

Results and discussion:

As shown in table 1. Except for CP contents, there was no difference in other chemical composition between sorghum stover and dried rumen contents. The higher CP contents of rumen contents may be attributed to the presence of undigested food materials or ruminal microflora. In a more recent study that was done by native scientists Osman and Abass (2015) who reported CP contents of 14.38%, CF; 24.80% and NFE of 36.20% of dried rumen contents (DRC). These variation in chemical composition of DRC may be due to several factors such as pre-slaughter feeding regimen, length of holding period between feeding and slaughter species (Abouheif *et al*.,1999; Rios-Rincon et al.,2010; Cherdthong and Wanapat, 2013 and Cherdthong *et al*., 2014) and season of the year (Rezakhani *et al*., 2008).

All lambs in the two groups fed on SS-diet and RC-diet (Table 3) performed similarly in term of daily intakes (1061.9± 7.73, 1061.3± 8.34 g/day), daily gain (170.0± 19.82, 173.7± 23.77 g/day) and feed conversion ratio (FCR) (6.3± 0.55, 6.2± 0.96 kg DM intake/kg gain) respectively. Generally incorporation of rumen contents in ruminants diets experts no negative action on their performance or causing any health problems. Similar results were reported in lambs (Salinas-Chavira *et al*., 2007; Fajemisin *et al*., 2010; Olafadehan *et al*., 2014 and Osman and Abass, 2015) and in cattle (Cherdthong *et al*., 2014) when incorporating DRC in their diets. Mondal *et al*. (2013) also observed that feeding dried rumen contents (DRC) did not show any undesirable effect on goat's health. However, in a most recent study Osman and Abass (2015) used DRC at 0, 10, and 20% inclusion rate in diets of Sudan desert lambs recorded higher daily growth rate of 204.64-209.06 g. Except for the highest inclusion rate (20%, 1.32 kg). The daily DMI (Dry Matter Intake) was not affected by the inclusion of DRC in lambs' diets (0%, 1.06 kg and 10%, 1.18 kg). The same conclusion was drawn up by (Osman *et al*., 2015) raised local lambs on diets containing increasing level of DRC (0, 5, and 10%) they reported a daily growth rate of 150, 165 and 207 g respectively. In another study Al-Wazeer (2016) raised awassi lambs on DRC diets reported growth rates of 152.22, 159.99, 153.33 g/day for 0, 10, and 20% inclusion rates. At the highest inclusion rate (30%) there was a drop in the growth rate (140.84 g/day). Those contradictory results may be attributed to higher lignin contents of DRC compared with other feed ingredients.

Generally growth rates reported in this study were in accordance with those reported by other native scientists. El khidir et al. (1989) recorded a growth rate of 130-140 g/d for desert sheep fed on molasses-urea blocks diets. Furthermore Mansour et al. (1988) studied the effect of different groundnut hay inclusion rates on the performance of local Sudan desert sheep. Those sheep recorded a daily growth rate of 120-205 g/day. Similar growth rates (161-196) were reported by El khidir et al. (1988) raising local desert lambs.

Feed conversion efficiency (FCE) recorded in this study was not significantly different ($p>0.05$) between the treatment groups. Similar results was reported by Al-Wazeer (2016) (6.64-7.17 FCE) and Mondal *et al*. (2013) who found incorporation DRC instead of wheat bran in Bengal goat diet at level 10% did not affect utilization efficiency of those diets . However, in another studies (Osman *et al*., 2015 and Osman and Abass, 2015) there was a trend for increased feed efficiency as the DCR inclusion rate increased in lambs' diets. Consistently similar results of improved feed utilization in Najdi lambs fed rumen content-barley meal diets (25 and 50%) were reported by Abouheif *et al*. (1999). In another study, Olafadehan *et al*. (2014) observed that feed efficiency was higher in lambs fed 40% DRC than those fed 0 and 20% DRC, but decreased when lambs fed 60% DRC diets. The higher feed efficiency at the higher level of DRC in lamb' diets may be due to better utilization of nutrients intake. In addition to that El Khidir *et al*. (1988) recorded higher feed conversion ratio (7.9-10.1) for desert sheep fed on variable dietary energy concentration. Those higher feed conversion ratios recorded by El Khidir *et al*. (1988) compared with that reported in this study could be attributed to the inclusion of different dietary ingredients in lamb's diets.

As shown in Table 4. carcass components of Sudan desert lambs as a percentage of slaughter weight (mainly dressing percentage 49.1± 1.45 and 48.9± 1.37), LD - muscle area (11.1± 0.45, 10.9± 0.22 cm^2) and fat thickness (0.3± 0.03, 0.3± 0.04 mm) reported in this study were also not different in lambs fed on SS-diet or RC-diet respectively. The same results were reported by Abass and Beshir (2015) substituting groundnut cake by DRC in rations for lamb fattening.

The digestibility coefficients (Table 6) (DDM, DOM and DCP) of the experimental lambs was not adversely affected by inclusion of RC in their diets (642.1± 2.69, 641.1± 5.21; 669.8± 2.49, 667.2± 4.83 and 609.4± 2.94, 608.6± 5.68 g/kg). A similar trend was noted when included DRC at different levels (0, 10, 20 and 30%) in the diet of Awassi lambs (Al-Wazeer, 2016). Similar results were reported by Mondal et al. (2013) who found that DM, OM, CP and NDF digestibility was not affected by increasing levels of DRC in the diet of Black Bengal goats (i.e.0, 5 and 10% inclusion rates).

Economical study

As shown in table 7, the economical study revealed that the use of rumen contents in small ruminants diets could reduce the cost of feeding up to 22% beside reducing the total cost required to gain 1 kg body weight nearly 25%.

Conclusions

The conclusion drawn up from this study that inclusion of rumen contents in lambs rations imposed no health problems or affecting their performance and digestibility negatively. In addition to get rid of environmental pollution, could possibly reduce the feeding cost up to 22% and

reducing the total cost required to gain 1 kg body weight nearly 25%.

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Table 1. Percent chemical composition (dry matter-basis) of Sorghum stover and rumen contents.

Feed ingredient	DM	Ash	CP	EE	ADF	NDF	ADL
Sorghum stover	94.0	9.8	1.6	1.9	53.0	20.4	12.2
Rumen contents	85.33	9.6	10.2	1.8	53.3	20.6	12.3

Table 2. Percent inclusion rates (fresh weight-basis) and chemical composition (dry matter-basis) of the experimental diets.

Ingredients:	Percentage	
	SS- diets	RC- diets
Sorghum Stover	43.5	0
Sorghum Stover-rumen contents mix	0	43.5
Ground nut cake	30	30
Molasses	25	25
Common salt	0.5	0.5
Di calcium Phosphate	0.5	0.5
Vitamins and Minerals Mix	0.5	0.5
Total	100	100
Components		
Dry matter (DM)	94.40	94.00
Ash	8.45	8.98
Crude protein (CP)	16.03	16.27
Ether extract (EE)	1.30	1.25
Crude fiber (CF)	34.00	36.00
Nitrogen free extract (NFE)	39.09	38.96
Metabolisable energy** (MJME/kg DM) calculated [1]	8.44	8.28

**Calculated according to Ellis (1981)

Table 3. Average (mean ± std.) performance values of Sudan Desert lambs fed on Sorghum stover and rumen contents-based diets for 120 days.

Item	Treatments		Significance
	SS- diets	RC- diets	
No. of animals	9	9	--
Initial live weight (kg)	21.0±1.22	20.9±1.36	**NS**
Final live weight (kg)	40.8±1.40	40.1± 1.35	**NS**
Total gain (kg)	20.1±1.76	20.7±2.83	**NS**
Daily gain (g)	170.0±19.82	173.7±23.77	**NS**
Dry matter intake (g per day)	1061.9±7.73	1061.3±8.34	**NS**
FCR (kg DM intake/kg gain)	6.3±0.55	6.2±0.96	**NS**
Crude protein intake g/day	184.2±0.47	183.6±1.44	**NS**
Organic matter intake g/day	900.6±2.32	903.6±4.11	**NS**
ME intake MJ/day	8.9±0.02	8.8±0.07	**NS**

NS= Not significant ($p>0.05$).

Table 4 Average (mean ± std.) carcass values and measurements of Sudan Desert lambs fed on Sorghum stover and rumen contents-based diets for 120 days.

Item	SS- diets	RC- diets	Significance
No. of animals	5	5	--
Slaughter weight (kg)	40.8±1.45	40.1±1.30	**NS**
Hot carcass weight (kg)	18.4±1.24	19.0±0.61	**NS**
Cold carcass weight(kg)	17.9±1.24	18.5±0.61	**NS**
Empty body weight (kg)	35.4±1.39	35.2±1.58	**NS**
Hot dressing percentage	51.9±1.84	54.0±1.52	**NS**
Cold dressing percentage	49.1±1.45	48.9±1.37	**NS**
Chilling loss (%)	2.7±0.17	2.6±0.08	**NS**
Carcass length (cm)	69.0±1.41	70.2±0.84	**NS**
Leg length (cm)	42.0±1.87	42.0±1.87	**NS**
Leg circumference (cm)	39.2±3.19	38.8±5.02	**NS**
Abdomen circumference (cm)	69.8±2.49	70.2±2.59	**NS**
Heart girth (cm)	65.6±2.07	66.4±1.52	**NS**
Shoulder length (cm)	29.6±1.14	30.6±1.34	**NS**
Neck length (cm)	26.2±0.45	26.4±0.55	**NS**
Kidney %	0.5±0.05	0.5±0.05	**NS**
LD –muscle area (cm^2)	11.1±.45	10.9±0.22	**NS**
Kidney channel and Knob fat (g)	51.0±2.24	50.0±1.00	**NS**
Mesenteric fat (g)	224.0±25.10	222.0±28.64	**NS**
Pelvic fat (g)	65.0±13.69	64.0±12.94	**NS**
Fat-thickness(mm)	0.3±0.03	0.3±0.04	**NS**

NS = Not significant ($p>0.05$)

Table 5. Commercial cuts yield expressed as percentage of the left cold carcass side weight in Sudan Desert lambs fed on Sorghum stover and rumen content-based rations for 120 days.

Item	SS-diet	RC-diet	Significance level
No. of animals	5	5	-
Left Carcass / kg	9.6±0.89	9.8±0.57	**NS**
Leg and chump	30.2±2.43	29.7±1.29	**NS**
Single short forequarter	26.9±2.02	26.4±1.85	**NS**
Lion	8.5±0.94	8.4±1.11	**NS**
Best end of the neck and breast	8.3±1.09	8.1±1.05	**NS**
Neck	6.6±0.48	6.4±0.28	**NS**
Breast	5.4±0.86	5.3±0.91	**NS**

Table 6 Average (mean ± std.) Digestible values (g/kg) of the experimental diets.

Item	Treatments		Significance
	SS- diets	RC- diets	
No. of animals	3	3	--
Daily dry matter intake (g)	1061.9±7.73	1061.3±8.34	**NS**
Digestible dry matter (DDM)	642.1±2.69	641.1±5.21	**NS**
Digestible organic matter (DOM)	669.8±2.49	667.2±4.83	**NS**
Digestible crude protein (DCP)	609.4±2.94	608.6±5.68	**NS**
Metabolizable energy (MJME/kg DM)	8.9±0.03	8.9±0.06	**NS**

Table 7. Economical study

Item	SS- diet	RC- diet	Price SDG
Sorghum Stover (kg)	43.5	0	3.2
Sorghum Stover-rumen contents mixture (kg)	0	43.5	-
Groundnut cake (kg)	30	30	10.625
Molasses (kg)	25	25	2
Common salt (kg)	0.5	0.5	3
Di-calcium Phosphate (kg)	0.5	0.5	50
Vitamins and minerals Mix (kg)	0.5	0.5	150
Total cost (SDG/ 100 kg)	609.45	470.25	--
Total cost (SDG/ 1 kg)	6.09	4.70	--
Daily dry matter intake (g per day)	1061.9	1061.3	
Cost of daily dry matter intake (SDG)	6.47	4.99	
Daily gain (g)	170.0	173.7	
Cost (SDG/ kg gain)	38.06	28.73	

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أثر استخدام محتويات الكرش في أعلاف الضان المحلي على معامل الهضم والآداء الجسماني وخصائص الذبيح

نجلاء جمال محمد إدريس، نهاء حامد طالب، بابكر عبدالرازق النذير وعفاف عبدالرحيم مبروك

مركز بحوث الإنتاج الحيواني – حلة كوكو

المستخلص

تم إستخدام حملان (18) بمتوسط أوزان 20.0 ± 1.19 كجم لدراسة أثر إضافة محتويات الكرش في أعلاف المجترات علي معامل الهضم و الأداء الجسماني و جودة الزبيح للحملان تحت الإختبار. تم توزيع الحيوانات إلي مجموعتين ، كل حيوان في حظيرة منفصلة مزودة بالعلف المعين. سيقان الزرة الرفيعة المطحونة خشنة تم إستعمالها كمصدر للأعلاف الخشنة. مخلوط سيقان الزرة _ محتوي الكرش تم تحضيرهم بنسبة 1:4 علي أساس المادة الطازجة. كما تم تحضير عدد 2 عليقة مختبرة متساوية في محتوي البروتين الخام و الطاقة التمثيلية كالآتي: عليقة الأساس و العليقة المحتوية علي محتوي الكرش ، المجموعة الأولي من الحملان(9) تناولت عليقة الأساس (43.5% سيقان الزرة الرفيعة،30% أمباز فول ، 0.5 % فوسفات الكالسيوم ، 25 % مولاس ، 0.5 % ملح طعام ، 0.5 % مخلوط الفايتمين و الأملاح) طاقة تمثيلية 8.44 ميجاجول/كجم مادة جافة ، و بروتين خام 16.03 %. و المجموعة الثانية (9) تناولت علي محتوي الكرش (43.5% سيقان الزرة الرفيعة و محتويات الكرش ،30% أمباز فول ، 0.5% فوسفات الكالسيوم ، 25% مولاس ، 0.5% ملح طعام ، 0.5% مخلوط الفايتمين و الأملاح) بواقع طاقة ممثلة 8.28 ميقاجول لكل كيلو جرام مادة جافة ، و بروتين خام 16.27% (1:4 قصب و محتويات كرش) . النتائج الموجودة أوضحت أن إستخدام محتوي الكرش في أعلاف الحملان لم يؤثر سلبا علي معدل النمو اليومي (170.0± 19.82 و7 .173± 23.77 جرام) ، أو صافي الزبيح (49.1 ± 1.45 و 48.9±1.37%) ، المادة العضوية المهضومة (669.8 ± 2.49 و 667.2 ± 4.83 جرام/كجم) ، البروتين الخام المهضوم (609.4 ± 2.94 و 608.6 ± 5.68 جرام/كجم) علي التوالي. خلصت الدراسة إلي أن إستعمال محتوي الكرش للمجترات يمكن إستعماله في تكوين أعلاف للضأن النامي مع دون تاثير سالب علي معامل الهضم لتلك الحملان أو أثر سالب علي الآداء الجسماني للحملان الصغيرة او جودة الزبيح ، أيضا خلصت الدراسة الإقتصادية أن إستخدام محتويات الكرش في عليقة المجترات الصغيرة يمكن أن يقلل من تكلفة التغذية بنسبة تصل إلي 22% إلي جانب خفض التكلفة الإجمالية المطلوبة للحصول علي وزن الجسم بوزن 1 كيلو جرام تقريبا.