Effect of different types of roughage on feedlot performance and carcass characteristics of Baggara bulls

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Summary

Thirty six Western Sudan Baggara bulls of an average live weight of (192.92±8.90kg) and 2 years age are used in a feeding trial for 70 days. Bulls were divided into three groups (A, B and C) and each group was further divided into four animals sub groups. Different sources of roughage groundnut hay, Sorghum straw and Bagasse were randomly allocated to group A, B and C respectively. A concentrate molasses based diet (composed of 52% molasses 39% wheat bran, 5% groundnut cakes, 3% urea and 1% common salt) wase affected to all bull group. Feed intake was significantly ($P<0.01$) increased in bulls fed sorghum straw than those fed groundnut hay or Baggasse diet. Live weight gain was not significantly different between groups. There were no significant differences in total gain and hence daily weight gain between the three groups, but bulls fed Bagagasse a roughage source had the Sorghum straw higher daily gain followed by the group fed Sorghum straw and groundnut hay, respectively. Feed conversion ratio was not significantly different but the group fed sugarcane Baggasse had an improved feed efficiency than those fed groundnut hay or sorghum straw.

Carcass measurements were not affected by the type of roughage except carcass length which was significantly ($P<0.05$) higher in group A) that was given than those given the other roughage sources. Non carcass components were not affected by the type of roughages but the group fed baggasses showed higher significant ($P<0.01$) gut fill than the other groups. Carcass yield and characteristics and Sirloin cut composition was not affected by type of roughage. Meat chemical composition was not affected by type of roughage except ash which was significantly ($P<0.01$) higher in group C (Baggasse) than in the other group.

Introduction

Sudan is one of the richest African and Arab countries with regard to livestock population which is estimated as 105,858,000 heads including 30,191,000 cattle 39,846,000 sheep, 31,029,000 goats and 4.792,000 camels, (MAFR, 2014).

Beef cattle have been the main concern of the country due to their contribution to the national economy. Sudan Baggara cattle are numerically the most important beef cattle in the country and produce all beef locally consumed as well as beef and live animals for export. They are raised by nomads in the Savannah belt (10 - 16° N) that comprise Southern Darfur, Southern Kordofan, Sinnar and White Nile State (El taher, 2007).

About 86% of the feeds for animals in Sudan are derived from rangelands. Crop residues and agricultural by-products contribute 10% whereas 4% of the feed is derived from the irrigated forage and concentrates. (AOAD, 1994).

Abu Suwar and Drag (2002) estimated that natural ranges contributed about 77.6 million tons of dry matter, crop residues and by-products 22 million tons,

irrigated forages 4 million tons and concentrates 1-2 million tons to the annual feed available for livestock in Sudan.

Sudan produces all raw materials necessary for feeding cattle and small ruminants in feedlots and dairy farming systems. These materials include crop residues as straws of sorghum, ground nut, and sugar cane and agro-industrial by-products which include wheat bran, molasses and cakes of cottonseed, groundnut, sesame and sun flower. In Sudan agro-industrial by-products are commonly used as roughages source for ruminants especially at periods of green forage shortage. The seasonal changes in availability of roughages affects feed prices especially during the dry season period. During this period there is also plenty of supply of cattle for fattening which increases the demand for roughages and consequently the roughage prices increase which jeopardize the fattening operations (Elkhidir, 2004). The main objectives of the this research are:
To study the effect of Roughage source in the diet on feedlot performance and carcass characteristics of Sudan Baggara bulls.
Encourage the use of crop residues and agro - industrial by-products in cattle fattening and convert them into useful nutritious profitable commodity.

Materials and Methods

Thirty six intire male Baggara bulls (about 24 months of age) were used in the experiment. They were purchased from Omdurman local market (Elmoulih). On arrival at Kuku Research centre, they were rested, ear tagged and kept in a separate pen provided with watering and feeding facilities. The animals were kept for a pre-experimental period of two weeks during which they were treated with antiparasitic drugs for internal parasites and offered the experimental diets. They were sprayed against external parasites and also treated against blood parasites. At the end of the second week they were individually weighed after an overnight fast except for water. The experimental bulls were then grouped at random into three groups of similar live weight. Each group was kept separately and subdivided into three subgroups. The groups were randomly allocated to one of three roughage sources namely groundnut hulls, sorghum straw and sugar cane bagasse. The chemical composition of these roughage types is shown in **table 1** All the groups were fed on a molasses feed composed of 52% molasses, 39% wheat bran, 5 % ground nut cake 3% urea and 1% common salt. The roughage source was offered at 20 % allowance of the complete daily feed offered. The animals were individually weighed at weekly intervals. Weighing was done in the morning before feeding following an overnight fast except for water. Linear body measurements were taken at the beginning and the end of feedlot period according to the procedure described by Brown el al. (1973). The feed intake of each group was recorded daily. Animals were slaughtered at a target period of 70 days. Animals destined for slaughter were offered water but no

feed for 18 hours before slaughter. After dressing and eviscerating, the internal organs and offals were removed and weighed. The weight of the body components was recorded. The kidney and kidney knob channel fat were left intact in the carcass. The carcass weight was recorded and the carcass was chilled at 4^{o}C for 24 hours. After cooling the chilled carcass weight was recorded and the carcass was split into left and right side by longitudinal sawing along the middle of the vertebral column. The left side of each carcass was jointed into 14 standardized wholesale cuts according to M.L.C. (1974). Each sirloin cut was separated into muscle, bone, fat and trimming. Each component was weighed using (OHAUS) balance of 20kg maximum capacity load to the nearest (gm) and expressed as percentage of joint weight. Fat thickness was measured perpendicular to the external fat surface at point {¼, ½ and ¾} of the lateral length of *longissmiussdorsi* muscle and recorded to the nearest mm.
samples of *longissimus dorsi* were prepared for meat chemical composition according to AOAC (2000). Samples intended for color measurement were allowed to bloom for 30

minutes at 4ºC. Colour components L^*(lightness, a^* redness and b^* yellowness) were determined using Hunter lab tristmulus colourimeter model D25 14-2.
The data were subjected to Analysis of variance (ANOVA) to reveal differences between treatment means. All analyses followed the procedures described by a commercial statistical package (Stat Soft, 2001**)**.

Table 1. Chemical composition of the different ingredients and molasses feed used in the feeding trail.

Sample type	D.M%	Ash%	C.P.%	E.E%	C.F%
Groundnut Hay	94.20	8.38	7.14	1.00	43.00
Sorghum Straw	92.20	8.13	10.27	1.20	39.00
Baggasse	97.10	9.16	4.28	0.80	58.00
Molasses	96.60	9.10	20.98	1.40	7.20
Concentrate ration					

DM = Dry matter, C.P.= Crude protein , E.E. = Ether extract, C.F. = Crude fiber.

Results and Discussion

Feedlot performance of Baggara bulls presented in table (2) indicated minor non significant ($P>0.05$) differences in daily gain, total live weight gain and final live weight. Feed intake was significant ($P<0.01$) higher in group B which was given sorghum straw in their diet, while feed conversion ratio was superior in the bull group that was offered bagasse in its diet.

The finding that feed intake was significantly higher in bulls given sorghum straw in their diet could possibly be due to the low fibre content of sorghum straw as given in table (1). High fibre is known to require more chewing time and more saliva before bolus swallowing and has low digestibility (Beauchemin and Buchanan Smith, 1996)
Feed conversion ratio of the bull group fed bagasse in their diet was the most superior and could be due to their superior daily gain compared with the other groups. But generally feed conversion ratio was within the range 7.29 to 11.3 reported by Morre (1991) for Zebu cattle.
Final live weight of group B which was given sorghum straw in the diet was greater than in the other groups, and reflected their increased feed intake. Perston (1968) indicated that animals which eat more will produce more milk or meat. Daily live weight gain was greater for the group fed bagasse in its diet followed by that given sorghum straw and then groundnut hay. Elkhidir (2004) fed the same type of hulls the same concentrate diet and different levels of bagasse and found a decrease in daily gain with inclusion of bagasse in the diets.
Salim (2009) used four types of roughages (sorghum straw, groundnut hay, groundnut hulls and bagasse for fattening bagara bulls and found that daily gain was significantly ($P<0.01$) different between the bull groups on the different roughage sources. It was 1.24, 0.86, 0.57 and 0.44 kg/day for bulls fed groundnut hay, sorghum straw, bagasse and grand nut hulls respectively.

Table 2. Feedlot performance of Baggara bulls fed different sources of Roughage plus molasses feed.

Parameters	Group A Groundnut hay	Group B Sorghum straw	Group C Baggasse	Overall mean ± SD	Level of significance
No of animals	12	12	12	-	-
Initial live wt. (kg)	192.92±8.90	195.42±8.38	193.75±79	194.03±8.84	NS
Period of fattening (day)	70	70	70	70	-
Final wt. (kg)	259.58±18.02	270.00±16.09	264.58±23.78	264.72±19.49	NS
Average dailygain	0.95±0.21	1.06±0.20	1.11±0.29	1.04±0.42	NS
Daily feed intake as fed (kg / head)	8.81±0.51[b]	9.68±0.78[a]	8.86±0.49[b]	9.12±0.72	**
FCR kg feed/ kg gain	9.27±2.36	9.13±1.93	7.93±9.62	8.77±5.70	NS
Total body weight gain (kg)	66.67±15.27	74.58±14.68	70.83±20.54	70.69±16.86	NS

In this and subsequent tables means with different superscripts differ significantly.

Daily gains data in this study were in line with findings of Gumaa (1996) who reported daily weight gain that ranged from1.10 to 0.75 for Baggara and Kenana bulls, respectively. Average daily live weight gain were also in line with the finding of Mohammed (1999) for Baggara cattle.

Feed intake was significantly ($P<0.01$) different among groups. Feed intake is influence by many factors that include age, metabolic demand, thermal environment, photo-period, disease and psychosocial stress as reported by (Matteri, 2001). Feed intake increases as digestible energy increases and stops when energy requirement are fulfilled. It has been recognized that in ruminants there is positive relationship between the digestibility of foods and their intake where high digestibility, promote high feed intake (McDonald, 2011).

The finding that feed intake was lower for bulls of group C which offered Bagasse in the diet could possibly be due to the higher fiber content of Bagasse requiring more chewing and more sliver before swelling the bolus (Beauchemin and Buchanan Smith, 1996)

Feed conversion ratio in this study was not significantly ($P>0.05$) different, It ranged from 11.10 to 9.40kg DM/feed kg live weight gain. Sugarcane Baggasse improve feed conversion ratio this finding was within the range (7.29-11.3kg) reported Morre (1991) for Zebu cattle. The improved feed conversion ratio for this bull group is a result of their greater rate of gain and feed intake. Salim (2009) reported more deteriorated value of feed conversion ratio (14.66) for Baggara bulls fed treated groundnut hulls.

Carcass measurements of bulls fed different type of roughage in **Table 3** showed no significant differences except for carcass length which significantly ($P<0.05$) longer for bulls of group A.

Table 3. Effect of feeding different Roughage source type on carcass measurements (cm) of Baggara bulls

Parameter	Group A Groundnut hay	Group B Sorghum straw	Group C Baggasse	Overall Mean ± SD	Level of significance
Neck length	35.66±1.22	41.35±10.10	37.00±1.50	30.00±6.22	NS
Shin length	36.55±1.42	37.05±1.33	36.55±1.23	36.72±1.30	NS
Shoulder length	35.83±1.69	34.88±2.27	33.83±2.09	34.85±2.12	NS
Chest depth	68.44±4.50	57.27±22.43	64.94±4.11	63.55±13.77	NS
Abdominal circumference	78.33±4.84	78.89±4.31	76.11±4.31	77.78±4.49	NS
Pelvic width	33.55±2.44	33.11±3.55	32.94±1.74	33.20±2.59	NS
Carcass length	117.89±2.8[a]	114.67±3.3[b]	114.33±2.6[b]	115.63±3.33	*
Leg Circumference	91.67±6.74	90.44±3.08	88.78±2.43	90.30±4.49	NS
Leg length	41.33±1.25	40.44±1.04	41.44±2.20	41.07±1.60	NS

The mean values of non carcass components expressed as percentage of empty body weights of slaughtered bulls fed on diets that contained different source of roughage are given in **Table 4**. All components showed no significant (P>0.05) differences among treatments except gut fill which was significantly (P>0.01) heavier in group C which was fed a diet containing bagasse. Here again Baggase digestibility due to its high fiber content could be the reason.

Gaili and Osman (1977) reported that differences between non carcass components of bulls were small and non significant.

The differences between the weights of the non carcass components in this study and the values obtained for the same breed by Eltahir (2004), Gumaa (1996), Mohammed (1999), and Mohammed [2004] might be due to differences in slaughter weight of bulls used. Owen *et al*., (1982) indicated

that the percentage of offals and internal organs were affected by slaughter weight.

Table 4. Effect of feeding different Roughage sources on non-carcass component of Baggara bulls (% of empty body weight).

Parameter	Group A Groundnut hay	Group B Sorghum straw	Group C Baggasse	Overall ean ± SD	Level of significance
No. of animals	9	9	9	-	-
Blood	4.35±0.46	4.04±0.36	4.04±0.47	4.15±0.44	NS
Head	6.29±0.27	6.78±1.71	6.55±0.43	6.54±1.01	NS
Hide	9.72±4.32	8.41±0.25	8.35±0.61	8.82±2.54	NS
Four feet	2.36±0.17	2.34±0.14	2.49±0.23	2.40±0.19	NS
Genitalia	1.03±0.17	0.97±0.25	1.17±0.15	1.06±0.26	NS
Lung and trachea	1.21±0.43	1.23±0.14	1.41±0.12	1.28±0.27	NS
Pancreas	0.16±0.04	0.29±0.48	0.24±0.32	0.23±0.33	NS
Spleen	0.37±0.10	0.36±0.06	0.41±0.09	0.38±0.09	NS
Heart	0.37±0.09	0.43±0.06	0.41±0.05	0.41±0.07	NS
Diaphram	0.62±0.06	0.60±0.06	0.58±0.12	0.60±0.08	NS
Tail	0.47±0.60	0.52±0.12	0.49±0.06	0.49±0.08	NS
Rum full	9.60±2.55	10.10±2.98	11.38±1.40	10.36±2.43	NS
Rum empty	3.27±1.10	3.34±1.59	2.73±0.36	3.11±1.13	NS
Omasum full	1.23±0.18	1.32±0.19	1.84±0.46	1.37±0.33	NS
Omasum empty	0.99±0.76	0.88±0.15	2.73±0.36	3.11±1.13	NS
Abomasums full	0.79±0.17	0.88±0.13	0.83±0.12	0.83±0.14	NS
Abomasums empty	0.54±0.06	0.58±0.11	0.55±0.55	0.55±0.24	NS
Intestine full	4.48±0.46	4.64±0.59	5.13±0.78	4.75±0.16	NS
Intestine empty	2.37±0.62	2.84±0.81	2.77±0.13	2.75±0.50	NS
Liver	1.28±0.27	1.35±0.15	1.47±0.11	1.37±0.20	NS
Gut fill	9.03 ± 4.50^{b}	9.33 ± 3.32^{b}	12.17 ± 1.49^{a}	10.17±3.10	**
EBW	244.6±14.8	248.7±18.3	235.11±9.9	243.0±15.2	NS

Table 5 gives carcass yield and characteristics of bulls fed diets containing different types of roughages. Slaughter weight, empty body weight and hot carcass and cold carcass weights were lower in the bulls that fed Bagasse in their diet, but the difference were not significant between treatments. The decrease in empty body weight in the bull group fed bagasse in their diet could possibly due to increase in gut fill. Elkhidir (2004) reported a decrease in slaughter weight, empty body weight and carcass weights when bagasse was offered with molasses feed to the same type of bulls. The current findings indicated that dressing percentage of hot and cold carcasses either on live or empty body weight bases were not affected by the type of roughage. Dressing percentage decreased with inclusion of roughage baggasse and could be due to the increase in gut fill percentage and a decrease in carcass weights. The above mentioned results were in line with that reported by Ahmed (2003), Elkhidir (2004), Mohammed (2004), and Ahmed (2010) and were greater than that reported by Salim (2009).

Table 5. Carcass yield and characteristics of Sudan Baggara bulls fed different roughage source.

Parameter	Group A Groundnut hay	Group B Sorghum straw	Group C Baggasse	Overall mean ± SD	Level of significance
No. of animal	9	9	9	-	-
Slaughter wt. (kg)	266.67±15.6	268.33±11.5	264.44±8.81	266.48±11.9	NS
Empty body weight (kg)	244.57±14.8	248.7±18.3	235.77±9.85	243.0±15.2	NS
Hot carcass weight (kg)	144.10±11.9	145.08±9.6	138.26±7.15	142.8±9.85	NS
Cold carcass weight (kg)	140.24±12.3	141.82±9.18	134.91±6.68	138.99±9.75	NS
Hot dressing percent (LW)	54.09±1.24	54.06±1.18	52.28±2.38	53.47±1.93	NS
Cold dressing percent (LW)	52.58±0.88	52.85±0.76	51.17±0.17	52.20±0.90	NS
Hot dressing percent (EBW)	58.99±0.6	58.44±0.1	56.54±0.7	57.99±0.14	NS
Cold dressing percent (EBW)	57.71±0.04	57.18±1.14	57.22.38±0.63	57.75±0.16	NS

Sirloin composition and meat chemical composition:

The composition of Sirloin cut and meat chemical composition of bulls fed different sources of roughage are given in **Table 6**. There were no significant differences (P>0.05) in the weight of Sirloin cut and the percentages of cut components as muscle, bone and fat. Trimming were significantly (P<0.01) heavier in group B than those in the other groups. Trimming increase was noted to coincide with muscle and fat decrease. Muscle: bone and Muscle: fat ratios were also not significantly different. Muscle to bone ratio was similar to that reported by Ahmed (2003), Mohammed (1999), Elkhidir (2004), Fadol (2005), Salim (2009) and Ahmed (2010) for the same breed.

Table 6. Effect of feeding different Roughage on Sirloin cut composition and meat chemical composition of Baggara bulls.

Parameter	Group A Groundnut Hay	Group B Sorghum Straw	Group C Baggasse	Overall Mean ± SD	Level of significance
Sirloin (kg)	4.49±0.17	4.77±0.44	4.47±0.26	4.57±0.50	NS
Muscle %*	58.97±4.49	54.64±5.73	58.32±3.70	56.98±4.84	NS
Bone %*	28.73±7.31	29.55±2.10	29.30±3.10	29.19±6.06	NS
Fat %*	8.94±2.84	8.10±2.48	8.91±2.36	8.05±2.50	NS
Trimming%*	3.64±0.95^{b}	5.76±1.90^{a}	4.32±0.55^{b}	4.58±1.52	**
Muscle: bone ratio	2.05±0.80	1.84±0.14	1.99±0.18	1.96±0.19	NS
Muscle: fat ratio	6.59±0.72	6.74±0.26	6.54±0.11	6.62±0.19	NS
Moisture	37.85±15.42	37.84±15.50	40.27±11.04	38.65±12.84	NS
Protein	19.20±0.87	21.36±2.14	20.34±2.02	20.30±1.84	NS
Ether Extract	1.95±0.48	1.49±0.42	1.79±0.97	1.74±0.64	NS
Ash	4.33±0.24^{b}	4.31±0.34^{b}	5.08±0.32^{a}	4.57±0.46	**

*percentage of Sirloin weight

The chemical composition of *longissimus dorsi* muscle obtained from bulls fed on diets containing different sources of roughage is also presented in **table 6.**

No significant differences meat chemical composition was found except for ash percentage which was significantly (P<0.01) difference greater in group C than in the other groups.

The results obtained were higher than that reported by Mohammed (2004), Elkhidir (2004) and Ahmed (2010) for the same breed possibly due to differences in diet types.

Conclusion

It could be concluded that feeding of groundnut hay, sorghum straw and Bagasse as roughage sources in bull fattening diets produced similar feedlot performance, carcass characteristics and meat quality. Treatments to improve the nutritive value of this roughage sources could further in group feedlot performance and reduce cost of feeding.

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