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Carcass Yield and Characteristics of Sudan Baggara Zebu Bulls Finished on Urea-Treated Sugar-Cane Bagasse

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Abstract

This study investigated the carcass yield and characteristics of Sudan Baggara bulls fed increasing levels of urea treated sugar-cane bagasse.Thirty six Baggara bulls of a live weight that ranged from 165 to 185 kg were divided into four groups of equal live weight and number. The experimental diets were randomly divided among the four bull groups and the feeding was extended for 70 days. A total of twenty four animals (six from each group) were slaughtered. Carcass measurements, carcass yield and characteristics, wholesale cuts and sirloin composition except leg length and empty body weight were not affected by treatments. Intestine (empty), gut fill and gastrointestinal tract (empty) increased significantly ($P<0.05$) with increasing level of treated sugarcane bagasse in the diet.

Keywords

Slaughtered, Carcass, Wholesale Cuts, Sirloin

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1. Introduction

Cattle population in Sudan is estimated to be around 29.6 million heads according to the Ministry of Livestock, Fisheries and range lands of the Sudan 2012. These animals are owned mainly by nomadic groups who depend on poor range land for their feeding. Feeding concentrate in Sudan is out of reach for more farmers therefore fattening cattle is practiced in small scale feedlots around the urban areas and generally fattening depends totally upon agro-industrial by-products. These by-products are also used in drought season for feeding ruminants in rural areas when forage is in short. Sugar-cane bagasse is one of these agro-industrial by-product in Sudan but there were many factor limited utilization of it that due to their bulkiness that hinders their transport to areas of consumption and their poor digestibility, palatability and low nutritive value due to their high content of fiber which contain more than 60% of its dry matter in the form of cellulose and hemicelluloses.Urea treatment is found to be used to improve nutritional characters of poor quality agro-industrial by-products. The present study aimed to evaluate the effect of urea treated sugar-cane bagasse on carcass yield and characteristics.

2. Materials and Methods

2.1. Animals

Thirty six Baggara Zebu bulls (Nyalawi type) with an

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average initial live weight of 170kg were used for this study. The study was conducted at the animal production research centre, (Helat Kuku) Khartoum North, Sudan. The animals were weighed and divided into four groups 9 animals each. The groups were of equal average weight. Each group was kept separately in a pen provided with water and feed facilities.

2.2. Feed and Feeding

sugar-cane bagasse was sprayed with solution prepared of (7% molasses, 10% urea, 2% limestone, 0.5% common salt and 1% sodium bicarbonate (atroon) dissolved in one liter of water kg^{-1} DM) then ensiled for 3 weeks ,dried and used to prepare the fattening diets.

The diet contained increasing levels of treated bagasse (0, 10, 20 and 30%) in addition to other feed ingredients table (1).

Table (1). Ingredients proportion of the experimental diets

Experimental diets				
Ingredients	**A (%)**	**B (%)**	**C (%)**	**D (%)**
Treated Bagasse	0	10.00	20.00	30.00
Wheat bran	39	29.00	24.00	18.00
Groundnut cake	5	10.00	10.00	10.00
Molasses	52	39.00	33.00	27.00
Sorghum grain	0	8.00	10.00	12.00
Urea	3	1.00	1.00	1.00
Limestone	0	2.00	1.00	1.00
Salt	1	1.00	1.00	1.00
*Calculated ME (MJ/kg)	10.21	10.79	10.52	10.13
Calculated CP (%)	16.84	16.65	16.72	16.61

* Calculated according to MAFF (1976)

Animals in the first group (control) were given 80% of diet A in addition to 20% sorghum straw. The second, third and fourth groups of animals were given diets B, C and D which respectively contained 10, 20 and 30% of treated bagasse. In addition all animals were offered green fodder *Medicago sativa* at the rate of 2kg / head / week. Water and salt lick were available all the times. The experimental period lasted for 70 days after the adaptation period.

At the end of the experiment a total of twenty four animals (six from each group) were randomly selected for slaughter. The animals were overnight fasting (about 12 hours) except for water. They were weighed prior slaughter to obtain slaughter weight. The procedure of slaughter followed local Muslim practice where animals were bled by cutting the carotid arteries and jugular veins on sides as well as the oesophagus and trachea, using a sharp knife without stunning. When complete bleeding was effected, the head was removed at the atlanto-occiptal joint.

2.3. Non –Carcass Components

After complete bleeding the head, hide, tail, fore and hind feet, genitals all these parts were removed manually and weighed.The blood also collected and weighed. The internal offal's, stomach and intestine were weighed full and empty. Other internal organs included heart, liver, spleen, lungs and trachea, diaphragm, Omental fat, mesenteric fat and pancreas were removed and weighed hot. All the internal and external non-carcass components weights were expressed as percentage of empty body weight. The pelvic fat, the kidney and the surrounded fat of it were left attached to the carcass.

2.4. Carcass Data

After removal of external and internal non-carcass components the carcass then weighed to obtain the hot carcass weight. The carcass was delivered in chilling room at 4°C for 24 hrs, and then weighed and the child weight was recorded to obtain cold carcass weight. Then the carcass was cut along the vertebral column into two halves. The left side of carcass was prepared for cutting according to Mohammed (2004). The pelvic fat, the kidney and the kidney fat were removed and weighed separately.

2.5. Carcass Wholesale Cuts

The left side of each carcass was separated into wholesale cuts according to (M. L.C., 1974) method for cutting and preparing beef. Each wholesale cut was weighed and expressed as percentage of carcass side weight bases.

2.6. Sirloin Dissection

Each sirloin of carcass was separated into bone, muscle, fat and trimmings. Each component was weighed using (OHAUS) balance of 20kg maximum capacity load to the nearest (gm) and expressed as percentage of joint basses.

2.7. Statistical Analysis

Data were analyzed by analysis of variance (ANOVA) according to Gomez and Gomez (1984) for a complete randomized design. When the F test was significant, the means were compared using least significant difference (LSD).

3. Results

3.1. Carcass Measurements

Table (2) Showed no significant difference of data related to carcass measurements for all bull groups fed different levels of treated sugar-cane bagasse except for the leg length which significantly ($P<0.05$) longer in group A than in group D. Generally all other carcass measurements of bull groups fed on diets containing treated bagasse are either equal to or greater than those of the control group. The picture is very clear in back fat thickness and eye muscle area.

Table (2). Means values of carcass measurements (cm).

Parameter	Treatment				SE
	A	B	C	D	
Leg length	40.92[a]	39.92[ab]	39.42[ab]	38.33[b]	1.13
Leg circumference	91.83	91.83	89.25	89.00	3.07
Abdominal circumference	147.33	153.67	147.57	149.67	6.53
Chest circumference	126.33	128.67	130.33	130.83	5.71
Shoulder circumference	72.83	72.17	74.00	73.33	1.93
Neck length	37.50	37.50	37.42	37.08	0.53
Shin length	37.42	36.50	36.17	36.75	0.72
Waist circumference	65.50	67.17	68.83	67.17	3.19
Carcass length	114.58	115.33	112.83	115.75	1.50
Back fat thickness	0.34	0.37	0.39	0.41	0.08
Eye muscle area (cm^2)	39.27	45.04	42.03	41.66	3.41

3.2. Non-Carcass Components

Data in table (3) showed no significant differences in most parameters except for genitalia, pancreas, stomach full, intestine empty, gut fill and empty gastro-intestinal tract. The results showed that the pancreas, stomach full and gut fill increased with increase of the level of treated sugar-cane bagasse in the diet. The weight of liver tended to increase with increasing level of treated sugar-cane bagasse in the diet in comparison to control diet (A). Messentric, kidney and pelvic fat deposit, though not significant, but were greater in the control diet than in the diets that contained treated sugar-cane bagasse.

Table (3). Means weight of non-carcass components (% of EBW) for different treatments.

Parameter	Treatment				SE
	A	B	C	D	
Blood	4.76	4.57	4.64	4.76	0.44
Four feet	2.52	2.36	2.46	2.39	0.09
Genitalia	1.24[ab]	1.11[b]	1.23[ab]	1.26[a]	0.07
Head	6.44	6.37	6.41	6.13	0.18
Hide	9.11	8.31	8.58	8.43	0.47
Spleen	0.48	0.46	0.47	0.45	0.03
Heart	0.39	0.39	0.39	0.37	0.03
Liver	1.68	1.73	1.70	1.85	0.14
Pancreas	0.13[a]	0.14[ab]	0.13[a]	0.17[b]	0.02
Omental fat	1.38	1.40	1.41	1.50	0.22
Tail	0.38	0.36	0.38	0.38	0.03
Diaphragm	0.64	0.67	0.62	0.61	0.04
Lungs & trachea	1.61	1.42	1.44	1.44	0.08
Stomach full	10.17[b]	10.29[b]	11.21[ab]	12.41[a]	0.80
Stomach empty	3.95	4.37	4.02	4.23	0.20
Intestine full	4.73	4.71	4.28	4.85	0.33
Intestine empty	2.58[b]	3.03[a]	2.64[ab]	2.99[ab]	0.21
Gut fill	8.36[ab]	7.60[b]	8.83[ab]	10.04[a]	0.91
Gastro-intestinal tract empty	6.53[a]	7.40[b]	6.66[a]	7.22[ab]	0.35
Mesenteric fat	1.61	1.42	1.44	1.44	0.08
Kidney fat	1.54	1.41	1.42	1.51	0.14
Pelvic fat	0.35	0.28	0.25	0.34	0.04
Kidney	0.30	0.28	0.25	0.28	0.04

3.3. Carcass Yield and Characteristics

The parameters related to Carcass yield and characteristics of bulls are presented in table (4). Slaughter weight was the same for all groups of animals, indicating no effect of increasing level of treated sugar-cane bagasse in the diets. Empty body weight decreased with increasing level of treated sugar-cane bagasse in the diets, however the differences among the treatment groups were not significant ($P>0.05$). Empty body weight percent of slaughter weight were significantly ($P<0.05$) affected by treatment and decreased with increasing level of treated sugar-cane bagasse in the diet. Cold carcass weight and dressing percentage either hot or cold on live weight or empty body weight bases were not influenced by treatments. The statistical analysis also showed no significant differences between treatments ($P>0.05$) in carcass shrinkage although carcass from treatment (C) where bulls received 30% treated sugar-cane bagasse in their diets had the minimum shrinkage.

Table (4). Effect of treatments on carcass yield and characteristics.

Parameter	Treatment				SE
	A	B	C	D	
Slaughter weight (kg)	255.83	254.83	255.00	255.83	6.81
Empty body weight (kg)	236.08	236.80	234.34	232.43	5.59
Empty body weight (%)	92.29[ab]	92.95[a]	91.91[ab]	90.90[b]	0.77
Hot carcass weight (kg)	138.31	138.25	135.06	136.83	3.55
Cold carcass weight (kg)	134.47	135.43	131.31	134.20	3.44
Hot dressing percentage of (LW)	54.11	54.23	52.97	53.52	0.83
Cold Dressing percentage of (LW)	52.60	53.13	51.50	52.51	0.86
Hot Dressing percentage of (EBW)	58.63	58.36	57.64	58.88	0.84
Cold Dressing percentage of (EBW)	56.99	57.17	56.04	57.76	0.83
Shrinkage (%)	2.78	2.04	2.78	1.92	0.46

LW: Live weight
EBW: Empty body weight

3.4. Wholesale Cuts Yield

Table (5). Means value of wholesale cuts (%) for different treatments.

Parameter	Treatment				SE
	A	B	C	D	
Shin	3.23	3.30	3.36	3.16	0.12
Neck	7.07	6.55	6.57	6.89	0.58
Clod	6.02	6.16	6.48	6.08	0.35
Chuck and blade	10.92	11.59	10.98	10.65	0.73
Extended roasting ribs	6.49	6.30	6.54	6.75	0.41
Thick rib	6.01	6.64	6.54	6.03	0.37
Extended thin rib	3.16	3.25	3.28	3.28	0.17
Brisket	7.93	8.12	7.93	7.73	0.40
Thick flank	4.72	4.91	4.86	4.83	0.19
Leg	5.20	5.19	5.29	5.00	0.16
Sirloin	6.32	6.69	6.70	6.59	0.31
Rump	6.33	6.42	6.47	6.15	0.23
Top and silver side	17.16	17.24	17.31	16.95	0.52
Hindquarter flank	6.48	6.80	6.62	6.77	0.23

Table (5) shows the average percentage of wholesale cuts from the left side of each carcass from bulls. There were no significant differences in the percentage of wholesale cuts from the different treatment. High price wholesale cuts as thick rib, thick flank, sirloin, and top and silver side were greater in bull groups fed diets containing treated sugar-cane bagasse than in the control group.

3.5. Sirloin Composition

Table (6) shows the effect of the level of treated sugar-cane bagasse on the distribution of muscle, bone and fat rate using the sirloin joint for each group. The total percentage of muscle tissue in the sirloin seemed to be stable around 64.5% for the three levels (10, 20 and 30% treated sugar-cane bagasse) in the diets, while the control diet (A) contained least muscle values. The fat and bone percentage were the same for all groups. Meat from bulls fed 10% treated sugar-cane bagasse showed the least amount of connective tissue percentage (9.4%) while the highest connective tissue percentage was (9.4%) that showed for bulls fed the control diet. The results also showed that muscle:fat ratio ranged from 3.22 to 4.08 for all treatments. The least score 3.22 was observed for meat produced form bull fed 20% treated sugar-cane bagasse followed by 3.32, 3.96 and 4.09 for bulls fed 10, 0 and 30% treated sugar-cane bagasse respectively. The differences of muscle, fat and bone percentage appeared to be the same with no significant (P>0.05) differences observed. Muscle:bone ratio and muscle:fat ratio showed no significant (P>0.05) differences between treatment groups.

Table (6). Composition of sirloin cut from the different treatments.

Parameter	Treatments				SE
	A	B	C	D	
Sirloin weight (kg)	4.30	4.53	4.41	4.48	0.25
Muscles (kg)	2.59	2.84	2.74	2.87	0.19
Fat(kg)	0.31	0.28	0.30	0.32	0.05
Bone(kg)	0.89	0.91	0.88	0.86	0.10
Trim(kg)	0.39	0.37	0.33	0.38	0.06
Trim+ fat(kg)	0.70	0.64	0.63	0.69	0.10
Muscles%	61.88	64.80	64.55	64.84	2.70
Fat%	7.40	6.27	7.03	7.13	1.01
Bone%	21.32	20.57	20.88	20.80	1.08
Trim%	9.40	8.37	7.54	8.83	1.22
Trim+ fat%	16.80	14.64	15.23	16.29	1.85
Muscle : bone ratio	3.96	3.32	3.22	4.08	0.51
Muscle : fat ratio	8.61	11.56	9.62	9.78	1.88
Muscle : (fat+trim) ratio	3.81	4.68	4.63	4.40	0.69

%: Percentage of sirloin cut weight

4. Discussion

4.1. Carcass Measurement

Carcass measurement of slaughtered bulls showed no significant difference among the different treatments of studied parameters. And *longissimus dorsi* muscle area was not affected significantly by treatments. While bulls fed treated sugar-cane bagasse had larger *longissimus dorsi* muscle area than those fed control diet (0% sugar-cane bagasse) and *longissimus dorsi* muscle area within animals fed treated sugar cane bagasse in their diets decreased with increasing levels of treated sugar-cane bagasse. The *longissimus dorsi* muscle areas of bulls fed control diet was similar to that obtained by Mohammed (2004) with bulls of 200kg slaughtered weight finished on the same diet and inferior than that of Eltahir (1994) who reported 55.17 and 53.36 cm^2 for the same breed finished on the same diet. This discrepancy might be due to different slaughter weight of Eltahir (1994) study (273.92kg) compared with 248.33kg for the bulls under this study. The *longissimus dorsi* muscle areas of bulls finished on increasing levels of treated sugar-cane bagasse were in agreement with Mohammed (2004) when slaughtered at weight of 250 to 300kg and Elkhidir (2004) who finished bulls on 20% raw sugar-cane bagasse. Finishing bulls on 30% raw sugar-cane bagasse decreased the *longissimus dorsi* muscle area in comparison to the same level of treated sugar-cane bagasse in this study. This might be due to improvement of digestibility and nutrient content of sugar-cane bagasse treated with urea. Many authors suggested that *longissimus dorsi* muscle area was affected by the nutrient content of the diet (Elbukhary, 2005).

The data in this study showed that back fat thickness was not affected by the type of the diet used. Yet back fat thickness was slightly thicker in bulls fed diet that contained treated sugar-cane bagasse than those on control diet. These results disagreed with Elkhidir (2004) who reported that back fat thickness from bulls fed control diet (0% bagasse) were greater than those from bulls finished on increasing levels of raw sugar-cane bagasse. These findings might explain that urea treatment of sugar-cane bagasse increased digestibility which increased total nutrient in the diet and might have affected the increased carcass fat. Back fat thickness obtained from carcass of bulls fed the diet that containing different levels of treated sugar-cane bagasse in this study was in line with those indicated by Mohammed (2004) when slaughtered bulls on 250kg and those of bulls fed 20% raw sugar-cane bagasse (Elkhidir, 2004).

Other linear carcass measurement as chest circumference, carcass length, leg circumference, abdominal circumference and shin length showed no significant differences. Most results of linear carcass measurement were similar to those reported by Elkhidir (2004) and Mohammed (2004) in similar slaughter weight. Linear carcass measurement is affected by muscle development and fat deposition (Buttefield, 1965).

4.2. Non-Carcass Components

Non-carcass components of different treatments groups indicated no significant differences among the most parameters studied. The liver weight increased with increase of treated sugar-cane bagasse level in the diet in comparison with the control animals. This could be related to more energy stored as glycogen in the liver. The weight of feet, head and skin showed no significant differences. Bulls in this study were almost equal in their age, initial and final weight. Owen and Norman (1977) reported that the weight of head, skin, lungs and feed were affected by age of animal.

There were no significant differences between groups in empty stomach and full intestine, yet the stomach full, intestine empty, gut fill and empty gastrointestinal tract increased significantly ($P<0.05$) with increased level of treated sugar-cane bagasse in the diet. These findings were in agreement with Elkhidir (2004) who reported that with increasing level of sugar-cane bagasse in the diet crude fiber content increased which extended the size of elementary tract and increased rumen and intestine weights. Also the reduction in the weight of the mentioned parts in control animals might be due to the reduced bulkiness of the diet due chopping of the sorghum straw used.

The fact that visceral fat depots as mesenteric, pelvic and kidney were not significantly different between the treatments could be due to the fact that the diets were iso-caloric.

The values of the non-carcass components weight of Baggara bulls in this study differed than that obtained by many authors as Mohamed (1999), Elkhidir (2004) and Mohammed (2004). These differences might be due to slaughter weight difference of bulls, age of the bulls and dietary levels and type. Owen et al. (1982) indicated that percentage of offals and internal organs were affected by slaughter weight and Owen and Norman (1977) stated that the effect of age on non-carcass components was a positive relationship. While wise et al. (1961) and Elbukhary (2005) indicated that animal on high plane of nutrition had heavier visceral organs.

4.3. Carcass Yield and Characteristics

Data related to carcass yield as slaughter weight, empty body weight as well as hot and cold carcass weight did not show significant differences among all treatment groups. Bulls fed 30% treated sugar-cane bagasse had least empty body weight. This might be due to gut fill which was higher in this group D (table 3). Increasing level of treated sugar-cane bagasse might be increased crude fiber (CF) content of the diet. Stobo (1994) stated that the gut fill increased with increasing dietary fiber level and that high roughages content lowered the passage of feed through elementary tract. The current results of empty body weigh were slightly higher for the same breed as reported by Mohammed (2004) and Elkhidir (2004). Also the present finding was lower than those reported by Eltahir (1994), Guma (1996) and Mohamed (1999) for the same breed. This might be related to the type of diet used and slaughter body weight.

The dressing percentages of hot and cold carcass on live weight base as well as the dressing percentage of hot and cold carcass on empty body weight base (EBW) showed no significant ($P>0.05$) differences for all treatments. Preston and Willis (1975) indicated that nutrition, age, live weight, sex and breed are factors affecting dressing percentages. Dressing percentages in the present work were in line with those reported for the same breed by many authors (Ahmed, 2003 and Elkhidir, 2004) and higher than those reported by Eltahir (1994) and Mohamed (1999) and lower than the findings by Mohammed (2004). The discrepancy of these results for the same breed could be due to type of diets used and degree of fattening of finish bulls.

Shrinkage percentage was calculated as the loss of weigh after chilling in related to hot carcass weigh. In this study the results of shrinkage showed no significant differences between treatments. Bulls fed 30% treated sugar-cane bagasse in the diet had remarkedly lower value for shrinkage followed by the diet contained 10% treated sugar-cane bagasse. High shrinkage was observed with control group (A) and bulls fed 20% treated sugar-cane bagasse. Shrinkage values obtained in the present study was lower than that obtained by Eltahir (1994) and Mohamed (1999) and within the range that stated by Elkhidir (2004). Mohammed (2004) reported the same findings for the heavier slaughtered bulls. The differences in shrinkage values were due to fat deposition in carcass. Mohamed (1999) stated that moisture evaporation was reduced with increasing fat deposition in the carcass and that will affect chilling shrinkage.

4.4. Wholesale Cuts Yield

In this work the wholesale cuts yield was not affected by the type of diet used and the differences were found to be not significant ($P>0.05$). This finding was in agreement with Berg and Butterfield (1976) who found no effect of different planes of nutrition on cuts proportion of Hereford, dairy Shorthorn and Friesian steers. The present findings indicated that the yield of high price wholesale cuts as thick ribs, thick flank, sirloin, top and silver side were slightly greater in bulls group fed the diet that contained treated sugar-cane bagasse than in the control group. These discrepancies might be due to final body weigh which was higher in the groups fed treated sugar-cane bagasse than in control group.

Means values of wholesale cuts reported for Baggara bulls in this study were in line with that reported by Elkhidir (2004). On other hand cuts as chuck and thick rib were similar to those given by Guma (1996), Mohamed (1999) and Ahmed (2003). For the same breed Eltahir (1994) reported slightly lower values than those in the preset study. These differences might be due to slaughtered weight of animals or could be attributed to muscles development and fat depots in the wholesale cuts or might be due to breed of bulls as El Kalifa et al. (1985) stated that Baggara cattle is not a uniform breed.

4.5. Sirloin Composition

In this study the values of muscles, bone and fat distribution of sirloin were not affected by level of treated sugar-cane bagasse in the diet and the values obtained were similar for the three levels of treated sugar-cane bagasse while the control group (0% treated sugar-cane bagasse) was slightly lower in muscle content. The reduction of muscle might be due to nutritional level. Muscle to bone ratio and muscle to fat ratio were found to be not significantly different, but there were slight difference between treatment groups. The differences might be due to slaughter weight and fat depots.

Values for Muscles, fat and bone percentage in this study were similar to that obtained by Eltahir (1994) Mohammed (2004) and Elkhidir (2004) and were higher than those obtained by Turke (2002) and Babiker (2008). The differences in theses findings might be due to degree of fattening, slaughter weight and age of slaughtered animal as fat is late developing tissue.

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