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Effect of Feeding Urea-Treated Sugar-Cane Bagasse on Properties and Quality of Fresh Meat of Sudan Baggara Zebu Bulls

Mohammed H. Ahmed[1, *], Salih A. Babiker[2]

[1]Department of Animal Production, Faculty of Agriculture, University of Zalingei, Zalingei, Sudan
[2]Department of Meat Production, Faculty of Animal Production, University of Khartoum, Khartoum, Sudan

Abstract

This study was conducted to study the effect of pre-treatment of agricultural by-product on the meat quality attributes and general sensory properties. Treatment sugar-cane bagasse with urea increased the CP and reduced CF. Sudan Baggara bulls finished on three levels (10%, 20%, 30%) while other group (control group) finished on 0% treated sugar-cane bagasse. Thirty six Baggara bulls divided into four group 9 bulls foreach group were fattened for 70 days. Six bulls from each group were slaughtered at the end of fattening period. Physical and subjective meat quality attributes and meat chemical composition of *longissimus dorsi* were not affected by treated sugar-cane bagasse level in the diets.

Keywords

Slaughtered, Carcass, Wholesale Cuts, Sirloin

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1. Introduction

According to the Ministry of Livestock, Fisheries and Range lands of the Sudan 2012 the livestock population of Sudan, amount to 140 million head of which the Cattle around 29.6 million heads. Cattle have contributed in grate amount of meat for consumer and meat industries in the Sudan and for exportation. Feeding these animals really problem in Sudan because animals are owned mainly by nomadic groups who depend on poor range land for their feeding. Concentrates are very expensive and not available in great amount in production areas, so there are many difficulties that made concentrates out of reach for more farmers. In Sudan there are many sugar-cane companies producing more than one million tons of sugar-cane bagasse which can be use for fattening cattle. These by-products characterized by low content of protein, minerals and vitamins as well as high content of indigestible fibre due to lignifications of cellulose. Consequently these by-products are less palatable and of low intake by animals (Suksombat, 2004).Sundsatol (1988) and Suksombat (2004) noted that the best method for improving the digestibility and intake of straw or ligno-cellulose is through chemical treatment with alkalis. Effects of alkalis on cell wall depend on hydrolysis of cell wall components and allow ruminant micro-organisms to attack cellulose and hemicelluloses. It's commonly accepted that chemical treatments of crop residues by alkalis improved their nutritive value and made them more utilizable by animals. Alkalis based agent (lime, potassium, sodium hydroxide, and ammonia) were used for chemical treatments, they are able to hydrolyze the bond between lignin and partial polysaccharides (McDonald *et al*., 2002). Ammoniation of low quality roughages with urea or ammonia solution improved digestibility and nutritive value (Nguyen *et al*., 2002). Urea is an interesting alternative to anhydrous ammonia in the treatment of ligno-cellulose foodstuff due to its low cost, easy handling, danger-free and non toxic for

* Corresponding author
E-mail address: mhais123@yahoo.com (M. H. Ahmed)

animals when used at a dose of 5% of the ration or lower (Caneque*et al*, 1998). The urea treated is based on adequate ureolysis due to the effect of enzyme urease to release ammonia from urea and the effect of ammonia on the cell wall of straw. The ammonia thus generated provokes the (alkaline) reaction which gradually spreads and treats the mass of forage. Chenost and Kayouli (1997) stated that ammonia acts in just the same way on the vegetal matter as if anhydrous ammonia is used through dissolving the parietal carbohydrates (mainly the hemicelluloses), swelling the vegetal matter in an aqueous environment so easing access by the rumen's cellulolytic microorganisms, reducing the physical strength of the cells so easing mastication by the animal and digestion by the microbes and enriching the forage in nitrogen as is also the case if anhydrous ammonia is used. The amount of ammonia released is influenced by favorable environment condition that gives rise to the modification of the ligno-cellulosic bond, which in-turn increases its nutritional value.

This study was conducted to investigate the effect of urea-treated sugar-cane bagasse on meat quality of Baggarazebu bulls.

2. Materials and Methods

2.1. Preparation of Feed and Feeding

Solution prepared of (7% molasses, 10% urea, 2% limestone, 0.5% common salt and 1% sodium bicarbonate dissolved in one litre of water kg^{-1} DM) was used for treatment of sugar-cane bagasse and ensiled for 21 days, dried and used to formulated the diets. Three levels (10, 20 and 30%) of treated sugar-bagasse in addition to other feed ingredients (wheat bran, groundnut cake, molasses, sorghum grain, urea, limestone and salt) were used to formulate iso-caloric and iso-nitrogenous (A, B and D) diets. While the last group (control) offered D died which contained 0% treated Sugar-cane bagasse (sorghum straw instead). In addition all animals were offered green fodder *Medicagosativa* at the rate of 2kg / head / week. Water and salt lick were available all the times. The experimental period extended for 70 days after the adaptation period. At the end, six bulls from each group were slaughtered.

2.2. Samples for Chemical Analysis and Meat Quality Study

After chilling and carcass partitioning, samples were taken from *longissimus dorsi muscle* after removal of external fat and trimmings. The muscle sample was divided into two halves; one half was minced and stored at -10°C for chemical analysis and other meat quality parameters. The other half was oxygenate for 2 hrs at 4°C before color determination. Hunter color components L (Lightness), a (redness) and b (Yellowness) were recorded using Hunter lab Tristimulus colorimeter model D25 M-2. The portion of this sample was then frozen and stored for cooking loss and panel taste evaluation.

2.3. Chemical Composition of Meat

The determination of chemical composition (moisture, ash, protein, and ether extract) was done according to AOAC (2000).

2.4. Meat Quality Attributes

2.4.1. Water Holding Capacity

According to Asselbergs and Whitaker (1961) about 3grams of the minced sample was placed on a humidified filter paper (Whatman No.1) saturated on KCl solutions and pressed between two Plexiglass plates for 3 minutes at 25 kg load. The meat film area and diffused water area were traced with a ball pen and the filter paper was allowed to dry.The areas traced were measured with a compensating Plano-meter. The measured areas were used to determine water holding capacity of the meat as follows:

$$\text{Water holding capacity} = \frac{\text{Diffused water area} - \text{Meat film area}}{\text{Meat film area}}$$

2.4.2. Cooking Loss Determination

The frozen samples of *longissimus dorsi* muscles were cut into about 2.5cm steaks and thawed at 4°C for 24hrs. The samples were dried from external moisture with paper towel and weighted. Then the samples were cooked in plastic bags in a water bath at 80°C for 90 minutes. Cooked samples were cooled in running tap water for 20 minutes. The samples were then released from bags and dried with paper towel and weighed. Cooking loss was determined as the loss of weight during cooking and expressed as percentage of pre-cooking weight (El-Khidir, 1989).

$$\text{Cooking loss (\%)} = \frac{\text{Weight before cooking} - \text{weight after cookingX100}}{\text{Weight before cooking}}$$

2.5. Sensory Evaluation

The frozen samples from *longissimus dorsi* muscle were cut and allowed to thaw at 4°C for 24hrs. They were then roasted in aluminium foil in electric oven at 175-180°C for one hour (Griffiths*et al.*, 1985). The roasted samples were served to ten semi-trained panellist for the evaluation of color, flavor, tenderness, juiciness, and overall acceptability using a scale of 4 points.

2.6. 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. Meat Chemical Composition

Moisture content, crude protein, ether extract and ash content of the *longissimus dorsi* muscle from Baggara bulls fed 0, 10, 20 and 30% treated sugar-cane bagasse are represented in table (1) these parameters were not affected significantly by experimental diet, although ash percentage was observed to increase with the increase of the level of treated sugar-cane bagasse in the diets.

3.2. Meat Quality Attributes

The meat quality attributes of beef from studied bulls are shown in table (2). Water holding capacity was not significantly different among the treatment groups. Group A had the least water holding capacity flowed by group C, B and D. The best water holding capacity (1.84) was found in the group fed 30% treated sugar-cane bagasse. Cooking loss was also not significantly (P>0.05) different among the treatment groups.

Co-ordinates shown in Table (2) showed no significant difference among treatments for the degree of lightness (L), redness (a) and yellowness (b). The degree of these parameters of color seemed to be the same for all groups that fed on the diets contained treated sugar-cane bagasse. However L-co-ordinate was slightly higher in the control group (A) and a-co-ordinate which indicates the degree of redness was higher in treatment (D) which was given 30% treated sugar-cane bagasse.

3.3. Sensory Evaluation

The average scoring of the sensory evaluation of cooked meat studied is summarized in table (3). The data indicated that there were no significant differences among all groups. Group (D) which received the diet that contained 30% treated sugar-cane bagasse was the best for all eating quality attributes measured.

Table (1). Meat chemical composition of bulls fed different levels of treated Sugarcane bagasse.

Parameter (%)	Treatment				SE	SL
	A	B	C	D		
Moisture	74.88	75.35	75.27	74.28	0.68	NS
Ether Extract	2.58	2.66	2.61	2.68	0.63	NS
Crude protein	22.23	22.52	22.25	22.14	0.41	NS
Ash	0.57	0.89	0.79	0.97	0.32	NS

Table (2). Quality attributes of meat from bulls fed diets contain different levels of treated bagasse

Traits	Treatment				SE	SL
	A	B	C	D		
Water Holding Capacity (ratio)*	1.98	1.86	1.92	1.84	0.30	NS
Cooking Loss (%)	39.43	36.76	37.75	36.23	1.73	NS
Color						
Lightness (L)	28.30	27.70	27.18	27.63	1.00	NS
Redness (a)	13.97	14.12	14.50	15.65	1.03	NS
Yellowness (b)	6.33	6.17	6.45	6.90	0.60	NS

*Higher ratio indicates lower water holding capacity

Table (3). Sensory evaluation of meat from the different dietary treatment.

Traits	Diets				SE	SL
	A	B	C	D		
Color	3.05	2.97	3.00	3.17	0.13	NS
Juiciness	2.47	2.40	2.57	2.68	0.17	NS
Tenderness	3.05	2.97	2.90	3.12	0.14	NS
Flavor	2.57	2.58	2.63	2.77	0.14	NS
Overall acceptability	3.02	3.02	3.05	3.27	0.16	NS

4. Discussion

4.1. Meat Chemical Composition

The chemical composition of the *longisimusdorsi* muscle in this study represented in table (1) showed no significant differences between treatments. Moisture and protein content were in the line with the finding of Eltahir (1994) but were inferior in ether extract and ash content as reported by the same author. The present findings were in agreement with Lawrie (1991) who suggested that with decreasing dietary energy, muscle and ash content increased. Prior (1977) mentioned that high level of energy and protein content tended to decrease muscle moisture, protein and increase fat percentage of bull, heifer and steers. The result of chemical composition for the same breed obtained by Elkhidir (2004) were inferior to the present result for ether extract and crude protein and superior on ash, while moisture content was within the range with this work. The moisture content, ether extract and crude protein studied showed the same trend in beef from the four groups. This might emphasize that sugar-cane bagasse digestibility was improved due to urea treated and thus supplied nutrients in equal level for all groups of bulls finished.

4.2. Meat Quality Attributes

Data about meat quality attributes of bulls fed control diet (0% treated sugar-cane bagasse) and increasing level of treated sugar-cane bagasse (10, 20 and 30%) were as given in table (2) revealed that water holding capacity was not affected significantly by the level of treated sugar-cane bagasse but group (D) which was fed 30% treated sugar-cane bagasse had the least ratio. The results obtained for cooking loss also had no significant differences among treatments and had the same trend as water holding capacity. This might indicate that there was no effect of increasing levels of sugar-cane bagasse in the diet on these characteristics. Many authors reported that water holding capacity and cooking loss improved when bulls were finished on high dietary nutrient level (Uro*et al.* 1987; Mohamed, 1999 and Ahmed, 2003). These findings in cooking loss were inferior to those of Babiker (2008) and superior to those reported by Eltahir (1994), Elkhidir (2004) and Mohammed (2004).While water holding capacity values were slightly higher than the findings of Eltahir (1994)and lower than those obtained by Mohammed (2004), Elbukhary (2005) and Babiker (2008). These differences could be due to nutrition, age and degree of fattening.

Meat color coordinates in this study are revealed in table (2). The values of lightness (L), redness (a) and yellowness (b) were not affected significantly (P>0.05) by treatment. These results were in agreement with the findings of Eltahir (1994) Mohammed (2004) Elkhidir (2004) and Elbukhary (2005) who indicated that the color of lean of ruminant is affect by level of nutrition that low plane of nutrition produce darker meat due to decrease carcass fat. The findings that the color of lean in these treatments was not significantly different might be due to the fact that the four diets studied were nutritionally similar.

4.3. Meat Sensory Evaluation

Panellist assessment in this work reported no significant differences among color, juiciness, tenderness, flavor and overall acceptability of meat from bulls fed diets that contained different levels of bagasse. Yet color had slightly higher score for lean meat from bulls fed 30% treated sugar-cane bagasse. These findings were in disagreement with the findings obtained by Elkhidir (2004) who indicated that with increasing level of raw bagasse in the diet panellist assessment score for color was reduced. This might be due to improvement set on bagasse due to urea treatment. Also color and tenderness were not affected by the diet. Mohammed (2004) stated that color and tenderness of Baggara beef were affected by slaughter weight. In this work slaughter weights were similar for all groups. Juiciness and tenderness were affected equally by carcass fat and water holding capacity, which were similar in all groups in this study (Table 1, 2). Flavor in the present findings was not affected by type of diet and that was in agreement with Hankey and Kay (1988)who indicated that flavor of beef from Charolais and Aberdeen Angus finished on different type of diet was no significantly affected. While Lawrie (1991) stated that flavor of meat from young bulls was less strong than that from old ones.

Overall acceptability findings also had the same trend as that of the other parameters studied above. Many authors stated that meat properties were affected by plane of nutrition (Wanderstock and Miller, 1948and Bowling *et al*., 1977) which was similar in this work.

5. Conclusion

From this work it could be concluded that, urea treatment of sugar-cane bagasse for 3 weeks improved nutritive value and could be used as roughages for cattle feeding specially in dry season as well as fattening because Sugar-cane bagasse is available and cheaper than other conventional roughages as sorghum straw. Also diets containing treated sugar-cane bagasse up to 30% had no adverse effect on meat quality attributes and objective measurements of meat quality.

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