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USE OF BAGASSE IN DIETS FOR FATTENING CATTLE

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SUMMARY

This study aimed towards utilization of bagasse in diets for fattening cattle by the addition of supplements containing crude protein, starch and fat. Sixty entire feeder bulls (Sudan Baggara type) aged two to three years and averaged live weight of 166 Kg were used. Animals were divided into four groups of equal average live weight and number. Each group sub-divided into three groups of five animals each. Four iso-caloric and iso -nitrogenous diets containing 0%, 10%, 20% and 30% raw bagasse were computed and offered to animal groups.

Total live weight gain, final body weight and daily gain were insignificantly decreased by inclusion of bagasse level in the diet. Daily dry matter intake increased as bagasse increase and this was significant (P<.05) at 20% and 30% levels. Feed conversion efficiency deteriorated but not significantly with the increase of bagasse. Slaughter and carcass weights were insignificantly decreased with the increase of bagasse level in the diets. Carcass muscles fats was significantly (P<.05) decreased. Dressing percentage decreased and chiller shrinkage increased but not significantly with the increase of dietary bagasse. Non carcass components were significantly differed among treatments and only omental, mesenteric and kidney fats insignificantly decreased as dietary bagasse increased.

Diet digestibility revealed significantly (P<.001) high decreases in the digestibility of dry matter, organic matter, crude protein, nitrogen free extract and crude fiber.

Keywords: Fattening, Sugar byproduct (bagasse), Sudanese Baggara bulls

INTRODUCTION

Sugar cane bagasse annual production in Sudan is more than three million tons and is expected to increase due to the expansion in sugar industry. The shortage and high cost of conventional animal feed ingredients necessitate the use of agricultural residues as bagasse in animal feed. The high lignin content, low level of soluble carbohydrates and relative absence of both fermentable nitrogen and by-pass protein in addition to the low availability of sulphur are responsible for the low digestibility and low nutritional value of untreated agricultural residues (Preston and Leng 1987 and Sarwar *et al*., 2004). Plane (1984) indicated that the use of fibrous residues as bagasse in basal diets for ruminants necessitated addition of fermentable nitrogen and by-pass protein to provide essential amino acids, dietary by- pass starch to provide extra glucose and dietary fat to provide long chain fatty acids for synthesis of body tissues and milk.

Ammunition by ammonia gas, ammonium hydroxide or urea to add nitrogen to roughages is also used to increase their digestibility. Fermentation of sugar cane bagasse with chicken manure was reported to increase its digestibility (Mahala *et al.*, 2007). Ruminant urine was also used to improve the digestibility of low quality roughages as rice straw and was also found to improve its chemical composition (Fadel Elseed, 2003). Physio -chemical treatments are not easily available and safe to farmers in developing countries and the only alternatives are fermentation or the addition of feed supplements to fibrous residues to improve their utilization by ruminants. The objective of this research is to utilize bagasse in diets for fattening cattle by the addition of supplements containing urea, crude protein, starch and fat.

MATERIALS AND METHODS

Sixty entire feeder zebu bulls (Baggara type) ranging in age from two to three years and having an average live weight of 166 kg were used for this study. These animals were raised on natural pastures. Animals were vaccinated against epidemics, drenched against internal parasites and sprayed against external parasites and rested for a period of two weeks. During the rest period they were given a molasses based diet containing 52% molasses, 5% groundnut cake, 38% wheat bran, 3% urea, 1% limestone and 1% salt plus two kg of sorghum straw daily. At the end of the adaptation period, animals were divided into four groups of equal average weight and number. Each group was then sub-divided into three groups of five animals which were kept in a separate pen with watering and feeding facilities. Four iso-caloric, iso-nitrogenous diets, A, B, C and D containing 0%, 10%, 20% and 30% bagasse, respectively, were computed (Table 1). Ingredient proportions and chemical composition of these diets are given in Table (1).

Diets were randomly divided among the major four animal groups and offered daily in one morning meal during a feeding period of 67 days. Live weight growth was determined weekly by weighing the animals following an overnight fast expect for water. Food intake was determined daily as the difference between amount of feed offered and refusals. At the end of the feeding period, seven animals were randomly selected from each group for slaughter. Animal were only allowed water for 12 hours and slaughtered by severing jugular vessels, esophagus and trachea without stunning. After dressing and evisceration, the head, hide, four feet, visceral and thoracic organs were weighed. The hot carcass was weighed and allowed 24 hours at 4^0C to shrink. Cold carcass weight was then obtained. The carcass was split along the midline. The left side was cut into wholesale cuts according to specification of the meat and large stock commission (M LC 1976). Cuts were dissected into muscle, bone and fat and each tissue was weighed separately. The total weight of each tissue was poled to give totals for the side. Digestibility of experimental and digestibility Coefficient diets were then calculated. All excremental data were analyzed according to simple randomize design Duncan multiple rang test was used to detect differences between means (Snedecor and Cochran, 1980).

Table 1. Ingredients proportion and chemical composition of experimental diets

Ingredients %	Experimental Diets			
	A	B	C	D
Bagasse	0.0	10.0	20.0	30.0
Wheat bran	38.0	28.0	10.0	12.0
Dec groundnut cake	5.0	5.0	10.0	10.0
Molasses	52.0	40.0	40.0	25.0
Sorghum grain	0.0	12.0	15.0	18.0
Urea	3.0	3.0	3.0	3.0
Limestone	1.0	1.0	1.0	1.0
Salt	1.0	1.0	1.0	1.0
Calculated ME*(MJ/Kg)	10.4	10.5	10.6	10.0
CP (%)	21.8	22.4	22.3	21.9

*Calculated according to MAFF (1976).

A (0% bagasse diet), B (10%bagasse diet), C (20%bagasse diet), and D (30% bagasse diet).

RESULTS

Feed lot performance data given in (Table, 2) indicated that total live weight gain and the final body weight, though not significantly different, decreased with the increase of bagasse level in the diet. Average daily gain decreased with the increase of bagasse level in the diet that contain 30% bagasse resulted in the minimum rate of gain which was significantly (P<.05) lower than that achieved by the other diets that contained 0% and 20% bagasse. Daily dry matter intake increased significantly (P < .05) with the increase of bagasse level in the diet and the increase was only significant (P < .05) between the diet that contained 20% or 30% and those that contained 0% or 10% bagasse. Daily dry matter intake per metabolic body size also increased none significantly with the increase of bagasse dietary level.

Table 2. Feedlot performance of bulls fed bagasse diets

Parameters	Treatments					
	A	B	C	D	SE	P-value
Number of animals	15.00	15.00	15.00	15.00		
Period of experiment (day)	67.00	67.00	67.00	67.00	-----	----
Initial body weight (kg)	167.00	167.00	167.00	166.00	15.58	NS
Final body weight (kg)	230.00	228.00	226.00	218.00	43.42	NS
Total live weight gain (kg)	63.33	61.79	59.33	52.64	31.40	NS
Daily gain(kg)	0.97^{a}	0.96^{a}	0.91^{ab}	0.81^{b}	0.17	*
Daily feed intake(kg/head)	7.92	8.28	9.60	9.46	1.77	NS
Daily DMI (kg/head)	4.82^{a}	5.31^{a}	6.09^{b}	6.10^{b}	1.12	*
Daily DMI (%metabolic body size)	3.72	3.81	3.88	4.11	1.40	NS
Feed conversion ratio (kg DM/ kg gain)	5.15	5.02	6.06	6.35	2.68	NS

NS = not significant; * =P<.05; SE = standard error.

A (0% bagasse diet), B (10%bagasse diet), C (20%bagasse diet) and D (30% bagasse diet).

Gut fill increased none significantly and feed conversion efficiency deteriorated with increase of bagasse level in the diet. As seen in Table (3) slaughter weight, empty body weight and both hot and cold carcass weights decreased, but not significantly so, with the increase of dietary bagasse level. L. dorsi area decreased significantly *(*P<.001) with the increase of bagasse level in the diet. Carcass composition showed slight progressive non significant decrease in muscle and fat proportions as dietary bagasse level increased. The decrease in fat was only significant (P<.05) among the diets that contained bagasse and the control diet. Dressing percentage decreased none significantly and chiller shrinkage increased slightly with the increase of dietary bagasse level. Muscle: bone ratio decreased and muscle: fat ratio increased as the level of bagasse increased in the diet.

Table 3. Carcass yield and characteristics of bulls fed bagasse diets

Parameter	Experimental diets					
	A	B	C	D	SE	P-value
Slaughter weight (Kg)	241.00	233.00	235.00	227.00	22.73	NS
Empty body weight (Kg)	217.00	212.00	209.00	198.00	24.98	NS
Hot carcass weight (Kg)	126.00	124.00	122.00	115.00	17.73	NS
Cold carcass weight (Kg)	123.00	122.00	119.00	113.00	17.63	NS
Total carcass muscles %	65.05	64.11	63.99	63.53	3.77	NS
Total carcass bone %	20.50	19.60	20.84	20.98	2.77	NS
Total carcass fat %	8.78^{a}	7.05^{b}	6.50^{b}	6.41^{b}	1.41	*
Total carcass connective tissue %	6.94	7.01	7.16	6.72	1.32	NS
L. dorsi area (cm2)	53.36^{a}	48.29^{b}	45.76^{c}	39.76^{d}	2.77	***
Dressing percentage (hot carcass weight/slaughter weight)	54.31	53.43	52.54	52.48	10.95	NS
Dressing percentage (hot carcass weight/empty body weight)	59.16	58.68	58.51	58.06	2.15	NS
Dressing percentage (cold carcass weight/slaughter weight)	52.56^{a}	51.22^{ab}	51.06^{ab}	50.03^{b}	2.15	*
Dressing percentage (cold carcass weight/empty body weight)	56.83	55.94	55.16	54.60	3.12	NS
Chiller shrinkage%	2.00	2.29	2.44	2.67	0.77	NS

NS = not significant; * =P<.05; *** P<.001; SE = standard error.
A (0% bagasse diet), B (10%bagasse diet), C (20%bagasse diet), and D (30% bagasse diet).

Proportions of the different non carcass components of bulls fattened on diets containing graded levels of bagasse were shown in Table (4). The head, hide, four feet, heart, liver, spleen, lungs and trachea, diaphragm, pancreas and tail showed non significant changes with the increase of bagasse level in the diet. The genitalia and fat depots of the kidneys, omentum and mesentery showed progressive non significant decrease as bagasse level increased in the diets. The weight of intestine and rumen, whether empty or full, increased with the increase of dietary bagasse level.

Table 4. Non –carcass components of bulls fed bagasse diets (as % of EBW)

Parameter	Experimental diets					
	A	B	C	D	SE	P-value
Blood	3.43	3.52	3.58	3.34	0.65	NS
Head	6.56	7.14	6.91	7.27	0.87	NS
Hide	8.50	8.76	8.58	9.27	1.32	NS
Four feet	2.41	2.62	2.78	2.82	0.59	NS
Heart	0.38	0.54	0.44	0.45	0.13	NS
Liver	1.50	1.37	1.56	1.39	0.39	NS
Spleen	0.39	0.42	0.42	0.39	0.17	NS
Lung+ trachea	1.46	1.49	1.47	1.50	0.21	NS
Diaphragm	0.63	0.64	0.61	0.61	0.09	NS
Pancreas	0.10	0.10	0.11	0.10	0.04	NS
Genitalia	1.10	0.95	0.86	0.87	0.21	NS
Kidneys	0.28	0.31	0.29	0.28	0.07	NS
Kidney fat	2.20	1.85	1.62	1.44	0.97	NS
Omental fat	1.25	1.15	1.13	1.00	0.39	NS
Mesenteric fat	0.62	0.59	0.56	0.54	0.19	NS
Tail	0.38	0.40	0.37	0.39	0.06	NS
Intestine full	11.14	12.07	12.14	12.20	3.03	NS
Intestine empty	5.14	5.24	5.35	5.44	1.15	NS
Rumen full	19.82	21.21	23.16	24.00	7.52	NS
Rumen empty	5.15	5.25	5.36	5.46	1.22	NS

NS = not significant; EBW= Empty Body Weight.
A (0% bagasse diet), B (10%bagasse diet), C (20%bagasse diet), and D (30% bagasse diet).

Diet digestibility appeared in Table (5) revealed that there was a high (P < .01) significant decrease in the digestibility of dry matter, organic matter, crude protein, nitrogen free extract and crude fiber as the level of bagasse increased. In fact the decrease in crude fiber digestibility was the most significant (P < .001). Fat digestibility was not affected by changes in dietary bagasse level. Dietary digestible nutrients as crude protein, crude fiber ether extract and nitrogen free extract decreased significantly (P<.001) as the level of dietary bagasse increased and resulted in a significant (P<.05) decrease in total digestible nutrients.

Table 5. Effect of bagasse on diet digestibility and digestible nutrients content (%)

Source of variation	Experimental diets					
	A	B	C	D	SE	P-value
Apparent digestibility:						
Dry matter (DM)	76.19	75.25	74.48	66.80	1.81	***
Organic matter (OM)	78.23	76.67	75.73	71.01	2.04	**
Crude protein	92.84	90.47	89.87	85.45	0.65	***
Crude fiber (CF)	47.21	28.28	24.09	20.16	3.26	***
Ether extract (EE)	83.40	83.33	83.17	83.80	1.81	NS
Nitrogen free extract (NFE)	77.50	76.84	76.66	70.36	5.79	**
Digestible nutrients:						
Crude protein	23.00	21.38	19.41	18.84	3.29	***
Crude fiber	5.47	3.17	3.10	2.99	2.07	***
Ether extract	3.74	3.14	2.69	1.87	1.37	***
Nitrogen free extract	39.25	36.80	36.42	33.00	4.45	***
Total digestible nutrients	71.46	64.49	61.63	56.70	13.96	*

NS = not significant; * =P<.05 ** = P<.01; *** P<.001; SE= standard error.
A (0% bagasse diet), B (10%bagasse diet), C (20%bagasse diet), and D (30% bagasse diet).

DISCUSSION

The decrease in total live weight gain and final body weight with increase of bagasse level in the diet could be ascribed to the decreased rate of gain. These growth changes in body weight coincided with the significant decrease in the digestibility of dry and organic matter and the decrease in total digestible nutrients. Reddy *et al* (2001) found a significant reduction in the rate of diet digestibility as the level of bagasse increased from 40% to 60%. De Medrios and Machados (1993) found that the inclusion of raw bagasse in ruminants diets lowered total volatile fatty acid concentration as well as the concentration of individual volatile fatty acids (acetic, propionic and butyric) than the inclusion of treated bagasse. Dietary dry matter intake increase with the increase of dietary bagasse level could be attributed to an attempt by the animal to meet its nutrient requirements as the total digestible nutrients decreased. Similarly, many workers found a slight non significant increase in dry matter intake as bagasse level increased in diets for cattle as reported by Chin *et al.* (2001). Steers fed sugar cane as roughage in high concentrate diet consumed more dry matter and were less efficient (Patel *et al*., 2005). The fact that gut fills increased as the level of bagasse increased in the diet might be explained mainly by the poor diet digestibility particularly the decreased digestibility of crude fiber.
The increase in level of bagasse in the diet was associated with the decrease in feed conversation efficiency and here the decrease in growth rate and the increase in dry matter intake were the possible reasons.

Dressing percentage decreased as the level of bagasse in the diet increased could possibly be due to the decreased live weight gain, increased gut fill and increased weights of head, hide, four feet, rumen and intestines and decreased degree of fatness as indicated by a decreased proportion of omentum and mesentric fat depots. The growth rates of non-carcass components as head, hide, four feet and lungs and trachea were less affected by dietary bagasse level as these are early maturing body parts which are least penalized by diet quality or quantity. While kidney, omentum and mesenteric fat depots decreased in weight due to the decrease in total digestible nutrients with the increase in bagasse level in the diet.

The deterioration in diet digestibility and the decrease in digestible dietary nutrients as crude protein, ether extract, crude fiber and nitrogen free extract as the level of dietary bagasse increased could be due to the close association of cellulose, lignin and hemi – cellulose that would limit the efficiency by which ruminants could degrade these nutrients (DE La Cruz, 1990 and McDonald *et al*., 1995).

CONCLUSIONS

Present study concluded that inclusion of raw sugarcane bagasse as a part of the concentrate diet for Sudanese desert bulls was insignificantly decrease diet digestibility and animal's performance and carcass weights.

More investigation must be carried out to know the best way to use bagasse from a technical and economic point of view, appropriate dietary levels and the necessary physical or chemical treatments.

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إستخدام بقايا قصب السكر (البقاس) في علائق تسمين الأبقار

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هدفت هذه الدراسة إلى الإستفادة من بقايا قصب السكر(البقاس) في علائق تسمين الماشية عن طريق إضافة مكملات تحتوي على البروتين الخام والنشا والدهون. تم إستخدام ستين ذكرا كامل النمو من الأبقارالسودانية (نوع البقارة) تتراوح أعمارهم بين ٢ إلى ٣ سنوات ومتوسط وزن حي ١٦٦ كجم .تم تقسيم الحيوانات إلى أربع مجموعات متساوية في متوسط الوزن الحي والعدد .تم تقسيم كل مجموعة إلى ثلاث مجموعات من خمس حيوانات. تم اعداد أربع علائق متساوية السعرات الحرارية والنيتروجين تحتوي على صفر٪ و١٠٪ و٢٠٪ و٣٠٪ من بقايا قصب السكر (البقاس) وتقديمها لمجموعات الحيوانات .نقص إجمالي الوزن الحي ووزن الجسم النهائي والزياده بشكل غير ملحوظ عند اضافة بقايا قصب السكر(البقاس) الي النظام الغذائي. زاد تناول المادة الجافة اليومي مع زيادة بقايا قصب السكر(البقاس) وكان هذا معنويا عند مستويات ٢٠٪ و.٣٠٪ تدهورت كفاءة تحويل الأعلاف ولكن ليس بشكل ملحوظ مع زيادة بقايا قصب السكر(البقاس). إنخفضت أوزان الذبح والذبيحة مع زيادة مستوى بقايا قصب السكر (البقاس) في الوجبات. إنخفضت دهون عضلات الذبيحة بشكل معنوى. كانت المكونات غير الذبيحة مختلفة بشكل ملحوظ بين المعاملات وإنخفضت فقط الدهون فى القناة الهضمية والكلى بشكل طفيف مع زيادة بقايا قصب السكر (البقاس) في الوجبات الغذائية. كشفت قابلية هضم النظام الغذائي عن إنخفاض كبير معنوى في قابلية هضم المادة الجافة والمادة العضوية والبروتين الخام والمستخلص الخالي من النيتروجين والألياف الخام.