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Effect of dried sugar cane tops on feedlot performance and Carcass characteristics of hybrid Friesian calves

Amani Alsadig Mohamed[1], Yagoub Magboul Yagoub[1*] and Khalid Abderhman Gadein[2]
[1]Faculty of Agricultural Technology and Fish Sciences, Al Neelain University, Khartoum, Sudan.
[2]Agricultural Analysis Lab., Ministry of Agriculture and Animal Resources and Irrigation. Khartoum State, Sudan
[*]Corresponding author E-mail: d.yagoub@hotmail.com

Abstract
This study was conducted to assess the performance and meat quality attributes of Friesian calves fed diets containing different sugar cane tops levels. Thirty Friesian calves (age one to one and half year) were purchased from the Fab Company, Shendi city and transported to the ruminant pens at Tayba Alhasnab village at Khartoum state. After the adaptation period of two weeks calves were weighed and divided randomly into three groups (A, B, and) C, 10 heads / group of the same initial weight and each group was separately penned. Three iso-caloric and iso-nitrogenous diets, containing graded levels of sugar cane tops (0%, 20%, and 40%) were formulated. The calves groups were fed these diets for 63 days. Performance and feedlot parameters as feed intake, feed conversion ratio, live weight gain, live body measurement were studied. At the end of the experiment three calves from each group were randomly selected and slaughtered to study carcass characteristics, meat chemical composition, meat quality attributes. The study indicated that final body measurements and feedlot performance data were not significantly ($P < 0.05$) affected by the levels of sugar cane tops. The non-carcass components, were not affected by sugar cane tops levels except livers, Spleen, and Empty intestine which were significantly affected. Meat chemical composition was not affected by levels of sugar cane tops except total solids which were significantly affected

Keywords: Sugar cane tops, hybrid Friesian calves, Performance and Carcass Characteristics.

Introduction
Sudan is considered to be one of the richest African and Arab countries with regard to cattle population estimated as 103,278,000 which included 28,618,000 cattle 39,296,000 sheep, 30,649,000 goats and 4.715,000 camels (MARF 2011).

Agriculture is the major source of income in Sudan. There are different agro climate zones, soil types and available water resources.

Sudan produces all the raw material necessary for feeding cattle and small ruminants on feedlots and dairy farming systems. The agro-industrial by-products of the country include molasses cottonseed cakes, groundnut cakes, sesame cakes, sun flower cakes and wheat bran.

In spite of the great potential of livestock and Sudan's self-sufficiency in meat and other livestock products many constraints on production were recognized, the most important of them is the seasonality of animal feeds and lack of processing of feeds and exports of by-products. About 90% of livestock are raised in traditional pastoral systems, mainly in the western states of Kordofan and Darfur. Rangelands occupy an area of 110 million hectares. Sudan also produces about 18.6million tones of crop residues. Green fodder cultivation, however, is less than 126,000 ha. Rangelands provide about 86% of feed for livestock, crop residues and agricultural byproducts 10%, and irrigated forage and concentrates 4%. Drought and war have depleted most of these feed resources, therefore, improved animal feed and feeding practices can play in the long-term alleviation of rural poverty and their specific benefits to the rural poor such as increased livestock productivity, household food security and income, beside peacemaking in the Sudan (Babiker, 2015). Because of the growing demand for animal feed, new feed sources and techniques need to be continuously developed and transferred in order to avoid environmental deterioration or increases in the prices of food products. Research and technology generation seeking ways to overcome food insecurity and poverty are therefore essential for agricultural and rural development.

Animal feed industry is one of these solutions suggested to alleviate this problem (Babiker, 2015).

Sudan is one of the main sugar growing countries in Africa possessing five factories that produce sugar. Through this industry many byproducts are available, namely, sugarcane tops, bagasse, molasses, press mud and condensed molasses soluble. Sugarcane tops are available in abundance in all the sugar growing countries. One hectare of sugarcane yields 30 tons of tops. But only a limited fraction of the total produce is utilized as feed for livestock. Cane tops are palatable and cattle can be maintained entirely on can tops with little supplement of protein either as concentrates mixture or leguminous feeds. The sugarcane leaves must be taken in consideration, since it is a part of the sugarcane tops. This part have a high crude fiber content (40-42%of dry matter), and the leaves are also rich in soluble carbohydrates. Therefore they are a potential feed resource for ruminant in the dry season (Mahala *et al.,* 2013).

The main objective of this study is to highlight the possibility of introducing the sugarcane tops as part of a fattening ration for ruminant, at levels of 20% and40% in terms of feed intake. Live body weight gain, feed conversion ratio, carcass weight and dressing percentage

The specific objectives of the study are:-

1- To evaluate the nutritive value of the sugar cane top.

2- To study the effect of sugar cane tops on feedlot performance and meat quality characteristics of Sudanese hybrid Friesian bulls.

3- Encourage the use for the agricultural by-products (sugar cane tops) and turn them to useful nutritious profitable commodity through the fattening of cattle.

Materials and Methods

Study area: This study was conducted at Tayba Alhasnab village at Khartoum state.

Experimental animals: Thirty Friesian bulls of 1 to1.5 year old were used. The bulls were purchased from Fab Company, Shendi city; they were trekked to the experiment and accommodated into three feeding groups of ten animals each, each in shaded pens (4x3meters). The pen's side were made of two inches iron pipes, the pens were equipped with feeding trough attach to the outer side of the pens to facilitate easy feeding,

water troughs were placed inside the pens under the shade, protected from sun heat and dirt, clean fresh water was available all over the day and night. The animals were identified by ear tags on arrival they were dosed against internal and external parasites using anathematic (ivermectin).

Feed and feeding:

Sugar cane tops source: Sugar cane tops was brought from Algunaid Sugar Factory. After sun drying a sample was taken and subjected to a proximate analysis according to (AOAC 1990) (Table1). According to this analysis three iso-caloric diets and iso- nitrogenous diets were formulated (Table2).These diets contained graded levels of sugar cane tops (0, 20%, and 40%). The ingredient proportions of experimental diets are given in table (2).

During the feeding period animals were fed the assigned diets *ad-libitum*. The diets were offered in one morning meal at 8a.m. throughout the study period. The experiment lasted for 63 days.

Data recorded: Feed intake, live weight gain and carcass data were recorded. Live body measurements were taken according to Brown et al (1973).

Data analysis: Experimental data were analyzed by analysis of variance techniques applicable to completely random design (C.R.D).

Results and Discussion

Performance and Feedlot : The Average Initial and final body weights, weight gain and weight Daily of the calves presented in table 4.1.

There were no significant difference (P>0.05) in final live weight, total live weight gain and daily weight gain although they increase with increase of Sugar cane tops levels in the diet up to 20% S.C.T in group B and then dropped in group C, where Sugar cane tops resemble 40%. The 20% Sugar cane tops in the diet (group B) show the high score in the above mention parameter, the results obtained here were in the close to those obtained by Julião *etal*.,(2016) who stated that partial or total substitution by

sugarcane tops in high concentrate diets did not affect productive performance of feedlot bulls. However, the inclusion of sugarcane tops reduced production costs, with positive net margin when totally substituting.

Effect of sugar cane tops on feed intake: The Average Total Feed Intake is not significantly (P>0.05) affected by introducing Sugar cane tops to the experimental diets. Live animal performance data indicated that feed intake increased as the level of Sugar cane tops in the diet increased from 0% S.C.T (group A) up to 20% (group B) and then decreased to a minimum level at the 40% S.C.T in the diet (group C). The drop in feed intake in group (C) that received (40% Sugar cane tops) in the diet might be due to low palatability, effect of feeding different levels of Sugar cane tops in the diets (0%, 20% and 40% Sugar cane tops) to calves reveals that high level of Sugar cane tops decrease significantly (P>0.05) feed intake,

These results are in agreement with results of Daniel *et al.,* (2018) who reported that sugarcane tops based diets had low NDF digestibility, high rumen retention time and reduced feed intake in dairy cattle.

Effect of sugar cane tops on weight gain: Total live weight gain and Daily weight gain of the calves were presented in (table 3). There were no significant difference (P>0.05) among these parameters. Group (B) with 20% S.C.T had the highest value for both of Total live weight gain and Daily weight gain.

These results can be compared with those of Julião *et al.,* (2016) who suggested that the poor performance may be related to the lesser capacity of sugarcane top fiber (NDF) to maintain a more stable rumen environment because of its reduced effectiveness.

Effect of sugar cane tops on feed conversion ratio: Feed Conversion Ratio of the calves (table 3) were not significantly (P>0.05) affected by Experimental diets. These results disagreed with those of Cláudio *et al.,* (2019) who reported that the feed conversation ration decrease with the decrease of Sugar cane tops ratio in feed, the substitution by sugarcane tops by 0%, 33%, 67% and 100% had significantly decrease the feed conversion ratio.

Effect of feeding sugar cane tops on measurement parts of calves' body: Initial and final body measurements of experimental calves taken after the adaptation period was presented in (Table 4).

There were non-significant differences among the body measurements.

These results were comparable with results recorded b, Julião *et al.,* (2016) reported the partial (33-66%) substitution of sugarcane by SCT on high concentrate diets for feedlot Nellore bulls did not affect the growth performances and body measurements.

Effect of feeding sugar cane tops on Non-carcass components of calves: Non-carcass components as Head, Legs, Empty stomach, Intestine, Heart, Kidney, Diaphragm and lung and skin were stated in (Table 5). These parameters showed no significant differences between animal groups with the increase of Sugar cane tops levels.

The results obtained here were in the same trend with those obtained by Suliman *et al.,* (2013) who observed that no difference in the proportion of lean meat, fat, bone and DP among Saidi rams fed Sugar cane tops silage and Barseem hay with concentrate supplementation.

Effect of feeding sugar cane tops on Meat chemical composition of calves: Meat chemical composition data of the experimental calves are shown in (Table 6). There were significant differences (P < 0.01) between the experimental groups in Meat chemical composition.

There were non-significant different (P < 0.01) in meat chemical composition between group C 40% Sugar cane tops and group A and B were group A and B. These results were in agreement with Yadete (2019) who stated that the chemical composition of meat (L. dorsi muscle) samples from the experimental lambs was not influenced by Sugar cane tops hay or silage inclusion as a partial replacement for natural pasture hay. Beukes (2013) reported a non-significant difference in meat moisture, fat, ash and protein contents among Merino sheep finished on diets containing 0, 20, 50 and 70% of Sugar cane tops silage.

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Table.1. Chemical Analysis of sugar cane tops:

Ingredient	D.M	C.P	C.F	E.E	Ash	N.F.E
sugar cane tops	86.45	4.23	13.66	1.42	15.12	52.04

Table.2. Ingredient proportions of experimental diets (as fed %)

Item	A	B	C
Sorghum seed	27	37	39
Groundnut cake	12	12	19
Wheat bran	32	26	0
Groundnut hull	23	0	0
Urea	1	0	0
molasses	3	3	0
Lime	1	1	1
Salt	1	1	1
Sugar cane top	0	20	40
Protein	15.78	15.79	15.78
Energy	10.36	10.32	10.31

Table.3. Feedlot Performance of calves fed diet containing different levels of Sugar cane tops.

Item	Animal group			S.E	S.L
	A	B	C		
Number of animal/lot	10	10	10	-	-
Feed lot period (days)	63	63	63	-	-
Initial live weight (Kg)	116.5	116.5	116.5	-	-
Final live weight (Kg)	175.00±29.308	189.12±25.343	183.38±27.885	±0.802	N.S
Total live weight gain (Kg/head)	58.50±9.407	72.62±6.350	66.88±2.998	±0.422	N.S
Daily weight gain(g)	0.929±0.147	1.15±0.096	1.062±0.038	±0.025	N.S
Total feed intake(Kg/head)	1190.35±36.75	1233.49±36.66	932.7±34.858	±0.284	N.S
Feed conversion ratio(Kg/DMI/Kg gain)	20.34±3.261	16.80±2.539	13.95±5.417	±0.143	N.S

Table.4. Live Body measurements of calves fed diet containing different levels of Sugar cane tops.

Measurements	Item	Animal group			S.E
		A 0%	B 20%	C 40%	
Height at Wither	Initial (cm)	98.1^{a} ± 5.012	97.2^{a} ± 4.341	94.0 ^{a} ± 4.333	±0.532
	Final (cm)	108.1^{a} ±12.44	116.3^{a} ±10.456	105.9 ^{a} ±9.003	±0.345
Chest Circumference	Initial (cm)	120.1^{a} ±7.945	112.0 ^{a} ±6.783	123.8^{a} ±5.674	±0.912
	Final (cm)	128.0^{a} ±3.453	123.0 ^{a} ± 7.241	133.4^{a} ± 9.346	±0.232
Loin Circumference	Initial (cm)	139.67^{a} ±2.195	132.00 ^{a} ±3.812	155.33^{a} ±6.218	±0.567
	Final (cm)	161.00 ±3.192	169.67 ^{a} ±8.131	171.00^{a} ±7.431	±0.234
Back Length	Initial (cm)	123.00 ^{a} ±13.762	136.00^{a} ±17.929	137.33^{a} ±16.342	±0.231

Table .5. Non carcass components of calves fed diet containing different levels of Sugar cane tops.

Item	Animal group			S.E
	A0%	B 20%	C 40%	
Head	8.32^{a} ±2.855	10.49^{a} ±2.016	9.23^{a} ±1.517	±0.020
Legs	4.98^{a} ±1.754	5.82^{a} ±1.120	5.2^{a} ±0.854	±0.007
livers	2.42^{a} ±0.851	2.81^{a} ±0.547	1.93^{b} ±0.316	±0.015
Stomach	27.66^{a} ±9.407	33.11^{a} ±6.350	24.79^{b} ±2.998	±0.833
Empty stomach	5.46^{a} ±1.865	4.82^{a}±0.930	4.91^{a} ±0.807	±0.842
Spleen	0.431^{a} ±0.147	0.499^{a} ±0.096	0.178^{b} ±0.038	±0.015
Intestine	18.89^{a} ±5.417	17.03^{a} ±3.261	15.49^{a} ±2.539	±0.184
Empty intestine	9.52^{b} ±3.218	10.17^{a} ±1.950	10.29^{a} ±1.692	±0.032
Heart	1.00^{a}±0.001	1.00^{a} ±0.001	1.00^{a} ±0.001	±0.077
Kidney	1.26^{a} ±0.464	1.35^{a} ±0.233	0.66^{a} ±0.131	±0.016
Diaphragm and lung	3.86^{a} ±1.3415	4.31^{a} ±0.836	3.82^{a} ± 0.629	±0.015
skin	8.80^{a} ±2.972	9.20^{a} ±1.757	8.73^{a} ±1.430	±0.017

Means with different superscript capital letters in the same row significantly (p≤0.05) different
**n=3. (n=number of observation)*
S.E: Standard error

Table.6. Meat chemical composition of claves diet containing different levels of Sugar cane top

Item	Animal group			S.E
	A 0%	B 20%	C 40%	
Moisture %	29.30[a] ±0.147	26.70[a] ±0.147	19.00[a] ±0.147	±0.883
Solids %	70.70[b] ±7.880	73.30[b] ±9.034	81.00[a] ±2.672	±0.842
Ash %	0.70[a] ±0.542	1.00[a] ±0.324	0.01[a] ±0.00	±0.375
Fat %	6.70[a] ±3.546	5.30[a] ±1.432	4.70[a] ±5.246	±0.375
Protein %	16.00[a] ±9.548	16.70[a] ±7.973	15.80[a] ±5.732	±0.196
Carbohydrate %	66.60[a] ±22.762	77.00[a] ±23.547	79.50[a] ±44.325	±0.203
Energy (cal) %	390.70a ±78.543	422.50[a] ±99.453	423.50[a] ±89.464	±0.883
Total weight	77.48[a] ±26.168	89.40[a] ±17.077	85.89[a] ±14.124	±0.122
Weight before slaughter	175[a] ±58.642	199.5[a] ±38.039	183[a] ±30.116	±0.136

Means with different superscript capital letters in the same row significantly (p≤0.05) different
**n=3. (n=number of observation)*
S.E: Standard error

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