Effects of different levels of sugar beet roots based concentrates on the performance of *Tagger* male kids

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ABSTRACT

High meat demand in the Sudan enhanced improvement of goat meat production. *Tagger* is a promising meat breed due to good conformation and high meat quality. Nutrition is a main constraint for goat meat production. Sugar beet is introduced into the Gezira State with no information on effects of dried sugar beet roots (DSBR) based concentrates level on *Tagger* kids performance, carcass characteristics and meat composition. Twelve *Tagger* males of 6 months old were housed in individual pens, divided into 3 groups, each with 4 animals and allocated at random to the experimental diets. They were weighed weekly for 8 weeks with a two weeks preliminary period. They were fed groundnut haulm (GNH) *ad lib*. in two equal meals at 8.0 am and 4.0 pm and refusals were collected and weighed daily. The animals were fed different levels of DSBR based concentrates: 0 (control), 150g and 300g, in two equal parts before GNH meals. The concentrates contained 68% DSBR,15% groundnut cakes, 15% sunflower cakes, 1% salt and 1% oyster shell. Samples of feeds and refusals were stored for laboratory analysis. Resultd showed that groundnut haulm **(**30% CP, 8.8% CF, 4.8% ash and 48.2% NFE) had better proximate analysis than refusals which generally improved with concentrates levels. Dried sugar beet had 12.9% CP, 11.0% CF and 59.25% NFE and the concentrates had 42.25% CP, 2.0% CF and 49.5% NFE. Overall mean BW generally increased with concentrates level (10.78, 10.9 and 12.19kg at 0, 150 and 300g, respectively), but not significantly different. Overall mean daily feed intakes varied with concentrates level and were 1550.89, 1187.46 and 1545.67g at 0, 150 and 300g concentrates, respectively, and were significantly least in animals fed 150g concentrates. Weekly weight gain generally increased with concentrates level in all weeks and was highest in animals fed 150g concentrates with no significant effects for concentrates level. It was 0.55, 0.68 and 0.60 kg at 0, 150 and 300g concentrates, respectively. It is recommended to use DSBR based concentrates in fattening *Tagger* kids.

INTRODUCTION

Meat demand and prices increased substantially in the Sudan in the last decades due to increased human population, urbanization and improved education, living standards and nutritional awareness (Ahmed, 2014). Consequently, it is not afforded by a high percentage of the population with serious nutritional consequences on the poor, especially children. It is important to produce high quality meat at low prices and exploit less utilized meat resources. Goat production is important in the Sudan due to high goat population, wide distribution and production of high quantities of high quality milk, meat and skin (Ministry of Animal Resources and Fisheries, MARF, 2011). Sheep meat is the most preferred and goat meat is the least preferred and is mainly consumed as kids meat. Goat meat has high nutritive value and muscles and low fat (Devendra and Mc Leroy, 1992). The disputed correlation between cardiovascular diseases and cholesterol and saturated fatty acids increased the demand for low fat meats including goat meat. Goat meat production in the Sudan is mainly traditional based on rangeland which deteriorated for many factors and the animals are generally neglected with low inputs and outputs (Devendra and Mc Leroy, 1992). Sudan ranked 6th in world goat population and goat meat production**,** but is not among the world main goat meat exporters (FAOSTAT, 2008). Improving goat meat production will make it competitive locally and abroad and increase demands, exports, other types of meat exports and the national income. Goat meat production could be improved by improving yields and quality via improving health, genetic constitution, nutrition, management, marketing and capacity building. There are many goat breeds in the Sudan and the Nubian is the main dairy breed and the others are considered meat breeds (Devendra and Mc Leroy, 1992). *Tagger* is a promising meat breed and is found mainly in Nuba Mountains in South Kordofan State and is dwarf, compact and adapted to harsh environments (Mudawi, 2002).

Nutrition is a main constraint for goat production in the Gezira State due to rangeland deterioration (Abusuwar and Darrag, 2002) and seasonal variations in feeds quantity and quality with serious shortages and effects on animal health and performance in the dry season (Elhag, 1992). Crop residues are important in filling the nutritional gap, but generally have low nutritive value limiting dry matter intake and animals performance (Hamed, 2007). Sugar beet (*Beta vulgaris*) is recently introduced into the Gezira State and by products are valuable feeds (Harland *et al.*, 2006). However, there is no available information on sugar beet and by products exploitation in goat nutrition in the Sudan. Consequently, this study was conducted to study effects of different levels of dried sugar beet pulp based concentrates on the performance of *Tagger* kids fed groundnut haulm *ad lib.*

MATERIALS AND METHODS

The experiment was conducted in the Goat Research Centre premises in *Elneshasheba* farm, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Gezira State, Sudan.

Animals

Twelve *Tagger* males of 6 months old were selected at random from the *Tagger* flock bought from Eldaleng area in the Nuba Mountains, South Kordofan State, Sudan in 2006. The animals were well fed and managed and housed in an open corral shaded with corrugated iron. They were regularly vaccinated against prevalent diseases and injected with Intermectin (InterchemieWerken, Harjumaa, Estonia) against internal and external parasites. The animals were weighed at the

beginning of the experiment, ranked according to body weight (BW) and divided into three groups, each with four animals, with almost similar BW using a completely randomized design. The groups were allocated at random to the experimental feeds and weighed weekly till the end of the experiment using a 100 kg capacity hydrologic weighing machine.

Housing

The animals were housed in individual wire pens (1.5x2 m) in an open corral shaded with corrugated iron sheets. Each pen had roughages, concentrates and drinking water buckets.

Feeds and feeding

The animals were fed the experimental diets for 8 weeks including a two weeks preliminary period. They were fed groundnut haulm (GNH) *ad lib*. in two equal meals at 8.0 am and 4.0 pm and the refusals were collected and weighed before the next morning meal for each animal. Groundnut haulm samples and refusals were stored in polyethylene bags for laboratory analysis. The animals were fed different levels of dried sugar beet roots based concentrates (DSBR) at 0 (control), 150g and 300g in two equal meals before GNH meals. It was chopped using knives, air dried, crushed in a mill and then mixed with the concentrates ingredients. The concentrates contained 68% DSBR, 15% groundnut cakes, 15% sunflower cakes, 1% salt and 1% oyster shell. Samples of DSBR and concentrates were stored in polyethylene bags for laboratory analysis. The animals were offered clean drinking water. Parameters studied were feeds proximate analysis, weekly BW and weight gain and daily feed intake.

Laboratory analysis

Feeds samples were analyzed in triplicates for DM, EE, CF, CP and ash as described by AOAC (1990).

Statistical analysis

Data were statistically analyzed using ANOVA. Duncan's Multiple Range Test was used for means separation.

RESULTS

Table 1 shows feeds proximate analysis. Groundnut haulm had higher CP and EE and lower CF, ash and NFE than refusals and the variations were significant (P<0.05) for EE and not significant (P≥0.05) for NFE and CF. Refusals proximate analysis were generally increased with concentrates level and this effect was not significant (P<0.05) for CF and NFE. Crude protein, EE and ash were highest in animals fed 300g concentrates and least in the control. Crude fibre was highest in the control and least in animals fed 150g concentrates. Nitrogen free extract was highest in animals fed 150g and least in the control.

Table 1. Proximate analysis (%) of feeds fed to *Tagger* males in the Gezira State, Sudan.

Feeds	DM	CP	EE	CF	Ash	NFE
Groundnut haulm	93.05^{b}	30.80^{b}	7.40^{a}	08.80^{b}	4.80^{d}	48.20^{b}
Refusals:	92.16^{c}	27.75^{c}	7.10^{a}	09.20^{b}	7.25^{b}	48.80^{b}
Control						
150g	92.71^{c}	27.15^{c}	6.95^{b}	08.9^{b}	7.05^{b}	50.00^{b}
300g	91.69^{d}	28.60^{c}	6.55^{b}	08.95^{b}	6.30^{c}	49.60^{b}
DSBR	94.00^{a}	12.90^{d}	2.60^{d}	11.00^{a}	8.40^{a}	59.20^{a}
Concentrates	94.00^{a}	42.25^{a}	3.00^{c}	02.20^{c}	3.05^{d}	49.50^{b}

Means in columns followed by the same letter (s) are not significantly different at P= 0.05.

Table 2 shows the effects of different levels of DSBR based concentrates on weekly BW in *Tagger* males. Body weight generally increased with weeks in all concentrates levels, but not significantly different. Overall mean BW increased with weeks and was significantly (P<.0.05) least in the first week. Mean BW generally increased with concentrates level and was highest in animals fed 300 g concentrates in all weeks. There were no significant differences among concentrates levels in mean BW (P≥0.05) in all weeks. Overall concentrates mean BW increased

Table 2. Effects of different levels of dried sugar beet roots based concentrates on weekly body weight (kg) in *Tagger* males fed groundnut haulm *ad lib.* in the Gezira State, Sudan.

Weeks	Concentrates level (g/ day)			
	0	150	300	Overall mean BW
1	09.50	08.88	10.12	09.50
2	09.93	09.44	11.13	10.17
3	10.40	10.38	11.56	10.79
4	10.81	10.81	12.25	11.29
5	11.69	12.19	13.25	12.37
6	11.94	12.50	13.44	12.62
7	11.13	12.13	13.56	12.27
Mean	10.78	10.90	12.19	11.29

Table 3 shows the effects of different levels of DSBR based concentrates on daily dry matter intake in *Tagger* males. Mean daily DMI varied with concentrates level in all weeks and was highest in the control and least in animals fed 150g concentrates in the first three weeks. It was highest in animals fed 300g concentrates and least in animals fed 150g concentrates in the 4th, 6th and 7th weeks. It was highest in animals fed 300g concentrates and least in the control in the 5th week. Overall daily DMI means were significantly least in animals fed 150g concentrates and were not significantly different between the other two concentrate levels. Concentrates level had no significant effects on DMI in the 5th week. Mean DMI was significantly least in animals fed 150g concentrates with no significant differences between the other two concentrates levels in the 1st and 7th weeks. It was significantly ($P<0.05$) highest in the 2nd and 3rd weeks with no significant differences between the other two concentrates levels. In the 4th and 6th weeks DMI was significantly ($P<0.05$) higher in animals fed 300g than animals fed 150g concentrates, but not significantly higher than in animals fed no concentrates. Overall weeks mean DMI varied among weeks and was highest in the 5th week. The highest daily DMI week varied among concentrates levels and was in the 3rd, 5th and 6th weeks in animals fed 0, 150 and 300 g concentrates, respectively. Mean daily intake generally decreased with concentrates level in the first three weeks and then increased with concentrates level.

Table 3. Effects of different levels of dried sugar beet roots based concentrates on daily dry matter intake (DMI) in *Tagger* males fed groundnut haulm *ad lib.* in the Gezira State, Sudan.

Weeks	Concentrates (g/ day)			Overall
	0	150	300	mean DMI
1	1711.75^{a}	1177.25^{b}	1666.50^{a}	1518.50^{a}
2	1532.20^{a}	1010.50^{b}	1185.00^{b}	1242.50^{a}
3	1603.00^{a}	1040.50^{b}	1167.00^{b}	1270.16^{a}
4	1470.25^{ab}	1197.25^{b}	1717.00^{a}	1461.50^{a}
5	1500.60^{a}	1553.25^{a}	1665.00^{a}	1574.75^{a}
6	1495.00^{ab}	1209.50^{b}	1737.50^{a}	1480.66^{a}
7	1538.25^{a}	1124.00^{b}	1681.75^{a}	1448.00^{a}
Mean	1550.89^{a}	1187.46^{b}	1545.67^{a}	1428.01

Means in rows with different letters in a raw were significantly different at P=o.o5.

Table 4 shows the effects of different levels of DSBR based concentrates on weekly weight gain in *Tagger* males. Weekly weight gain and overall mean weekly weight gain varied among weeks and were highest in the 4th week and least in the 5th one in all concentrates levels. Weekly weight gain generally increased with concentrates level in all weeks, except the 6th one where it declined. It was highest in the 1st and 3rd weeks in animals fed 300g concentrates and in the 2nd, 4th and 5th weeks in animals fed 150g concentrates. It was highest in the 6th week in animals fed no concentrates. It was significantly (P<0.05) highest in animals fed 300g concentrates in the 1st week. Overall weekly weight gain was least in animals fed no concentrates and highest in animals fed 150g concentrates with no significant (P>0.05) differences among concentrates levels.

Table 4. Effects of different levels of dried sugar beet roots based concentrate on weekly weight gain (kg) in *Tagger* males fed groundnut haulm *ad lib.* in the Gezira State, Sudan.

Weeks	Concentrates level (g/ day)			Overall mean
	0	150	300	weight gain
1	0.44^{b}	0.56^{b}	1.00^{a}	0.67^{b}
2	0.63^{ab}	0.94^{a}	0.44^{b}	0. 67^{b}
3	0.38^{a}	o.44^{a}	0.69^{a}	0.50^{b}
4	0.88^{b}	1.38^{a}	1.13^{a}	1.13^{a}
5	0.25^{a}	0.31^{a}	0. 19^{a}	0.25^{b}
6	0.75^{a}	0.44^{a}	0.19^{b}	0.46^{b}
7	0.55^{a}	0.68^{a}	0.60^{a}	0.61^{a}
Mean	0.44^{b}	0.56^{b}	1.00^{a}	0.67^{b}

Means with different letters, in a raw, were significantly different at P=o.o5.

DISCUSSION

Groundnut haulm proximate analysis varied from values reported in the Sudan due to genetic and environmental factors. Groundnut haulm in this study had higher EE, CP and NFE and lower CF and ash compared to that reported by Sulieman and Mabrouk (1999). It had higher EE, CP and NFE and lower CF and ash than values reported by Elimam *et al.* (2003) and higher EE and CP and lower CF, ash and NFE than values reported by Mohamed (2003) in the Gezira. It had higher CP and EE and lower CF and ash than in Elmanagel (Mohamed, 2005). Groundnut haulm refusals lower CP and EE and higher CF, ash and NFE than GNH reflected reduced nutritive value as the animals selected better parts (Babiker, 1998; Elimam *et al*., 2003). Refusals low nutritive value was also reported for different feeds (Hamed, 2007; Ahmed, 2014).

The variations in GNH refusals proximate analysis with concentrates level reflected variations in animals feed selection with concentrates level. The highest refusals CP, EE and ash in animals fed 300g concentrates and least in the control showed that refusals proximate analysis improved with concentrates level. The highest CF in the control and least in animals fed 150g concentrates and highest NFE in animals fed 150g and least in the control were mainly due to improved feed selection with concentrated level. Groundnut haulm refusals proximate analysis generally improved with concentrates level.

Dried sugar beet roots had higher CP than that reported by Harland *et al*. (2006) and higher CP, EE and ash and lower CF than values reported by Feedipedia (2012-2013). The high ash was mainly due to soil contamination and should be reduced. The non significant differences in mean BW among concentrates levels were mainly due to GNH high nutritive value or CP was limiting.

Tagger daily and weekly variations in DMI were also reported by Ahmed (2014) and were mainly associated with environmental factors. It was reported that goat feed intake was affected by many factors including breed, age, season, production type and environment (Devendra and Mc Leroy, 1992). The highest DMI in animals fed no concentrates was mainly due to GNH higher nutritive value enhancing rumen fermentation, feeds digestibility and outflow rates through the alimentary tract. It was also due to reduced available rumen volume with concentrates addition. Nitrogen supplementation improved microbial fermentation rates and DMI in protein deficient diets. Digestive tract distension and volatile fatty acids production are involved in feeding cessation or delaying the next meal (Forbes, 1983). The significantly least DMI in animals fed 150 concentrates could be mainly due to the high energy feed and N deficiency with negative effects on rumen environment, microbial fermentation and feeds digestibility. It was expected that concentrates will increase DMI as reported in sheep in the Sudan (Altayeb, 2010) and was mainly attributed to improved rumen fermentation and roughages digestibility, degradation and rumen outflow rates. Concentrates increased rumen outflow rates, total VFA and hemicellulose and lignin digestion in sheep (Kennedy, 1992) and digestibility (Dessie *et al.*, 2009). *Tagger* males DMI was higher than *Tagger* does fed sorghum straw supplemented with Acacia pods (Ahmed, 2014) and Nubian goats fed sorghum stover (Hamed, 2007). This was mainly due to GNH and concentrates higher nutritive value.

The weekly variations in *Tagger* males weight gain at different concentrate levels were associated with weekly variations in DMI and were mainly due to environmental factors. Similar weekly

variations in weight gain were found in *Tagger* males at 6 and 12 months old fed GNH and concentrates in the Gezira State (Elimam *et al.*, 2010). The highest weight gain in the 4th week in all concentrate levels was mainly due to optimum environmental factors and the least weight gain in the 5th week in all concentrate levels was due to unfavourable environments. The highest weekly weight gain in different concentrates levels were not associated with the highest DMI and may be associated with variations in digestive efficiency. The least weekly weight gain in animals fed no concentrates was due to low feed intake and nutritive value as found by many workers (Liu *et al.*, 2005; Dessie *et al.*, 2009). Increasing concentrates level improved weight gain and feed conversion efficiency in Ethiopian sheep fed hay (Dessie *et al.*, 2009). The highest weekly weight gain in animals fed 150g concentrates than 300g concentrates suggested that N was limiting as the concentrates had high energy. Liu *et al.* (2005) attributed the least weight gain in animals fed 250g concentrates to the least urinary N: digestible N and the highest weight gain in animals fed 350g concentrates than 450g concentrates was due to sufficient N in the former and limiting N in the latter. They reported that rumen outflow rates were increased and corn effective degradability decreased with concentrates level. It was concluded that there was an optimum concentrates level for a straw with the highest DMI and feed efficiency. High concentrate levels may improve feed efficiency and decrease feed: gain in animals fed 350 and 450g concentrates. It was reported that increasing concentrates level in lambs linearly reduced rumen pH and hemicellulose and lignin digestion and increased rumen outflow (Kennedy, 1992). The higher weight gain in *Tagger* fed 150g than 300g was similar to that in Desert lambs fed 600 g than 900g (Altayeb, 2010). *Tagger* males weekly weight gain in this study was within the range for *Tagger* males fed GNH *ad lib*. and concentrates (Elimam *et al.*, 2010).

CONCLUSION

Dried sugar beet roots had high energy and generally *Tagger* males mean BW and weekly weight gain increased and mean daily feed intake decreased with levels of concentrates based on DSBR.

RECOMMENDATIONS

It is recommended to use DSBR based concentrates in fattening *Tagger* kids. Urea could be added. More precise research is required to find the appropriate non-protein nitrogen in form of urea as a source of highly available N and different cakes levels in DSBR based concentrates.

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أثر المستويات المختلفة من عليقة مركزة ترتكز على جذور بنجر السكر الجافة على أداء جديان التقر

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الخلاصة

حفز ارتفاع الطلب على اللحوم وأسعارها في السودان تحسين لحوم الماعز. تعتبر التقر سلالة واعدة لإنتاج اللحوم لجودة القوام ونوعية اللحم. إلا أن التغذية من المعوقات الرئيسة لإنتاج لحوم الماعز. أدخل بنجر السكر لولاية الجزيرة ولا تتوفر معلومات عن أثر مستوى جذر البنجر الجاف (ج ب ج) على أداء جديان التقر وصفات الذبيحة وتركيب اللحم. وضعت 12 من ذكور جديان التقر بعمر 6 أشهر في حظائر فردية وقسمت الى 3 مجموعات بكل منها 4 حيوانات ووزعت عشوائيا على أعلاف الدراسة. وزنت الحيوانات أسبوعيا لمدة 8 أسابيع منها أسبوعين فترة إعدادية. أعلفت الحيوانات تبن الفول السوداني (ت ف س) حسب الرغبة في وجبتين متساويتين عند الثامنة صباحا والرابعة مساء وجمع ووزن العلف المتبقي . كما أعلفت الحيوانات مستويات مختلفة من عليقة مركزة ترتكز على(ج ب ج) عند صفر(الشاهد), 150 و300جم في جزئين متساويين قبل وجبتي ت ف س. احتوت العليقة المركزة على 68% ج ب ج و 15% امباز فول سوداني و 15%تبن زهرة الشمس و 1%ملح و 1% صدف حفظت عينات من الأعلاف والعلف المتبقي للتحليل المعملي. حُللت المعلومات إحصائيا باستخدام تحليل التباين واستخدم اختبار دنكن لفصل اختلافات المتوسطات. كان ت ف س (30% بروتين خام ، 8.85 ألياف خام، 4.8% رماد و 48.2% جزء خالي من النتروجين) أحسن في التحليل التقريبي من المتبق.والذي تحسنت نوعيته بارتفاع مستوى العليقة المركزة. كان تركيب ج ب ج % 12.95 بروتين خام ، 11% الياف خام و 59.25% جزء خالي من النتروجين. وتركيب العليقة المركزة % 42.25 بروتين خام ، 2% ألياف خام و 49.5% جزء خالي من النتروجين . زاد متوسط الوزن الكلى مع زيادة العليقة المركزة (10.78 ، 10.9 و 12.19عند صفر و 150 و 300 جم عليقة مركزة على التوالي بدون فروقات معنوية (P>.05) . تباين متوسط المتناول من العلف تبعاً لمستوي المركزات وكان 1550.89 و 1187.46 و 1545.67 جم عند صفر و 150 و 300جم عليقة مركزة ، علي التوالي وكان أقل معنوياً للحيوانات التي غُذيت علي150 عليقة مركزة . تباينت زيادة الوزن الأسبوعي بزيادة مستوي العليقة المركزة في كل الأسابيع وكانت الأعلى للحيوانات عند 150 جم بدون زيادة معنوية. وكانت 0.55 و 0.68و 0.60كجم عند صفر و 150 و 300جم عليقة مركزة، علي التوالي .يوصي باستخدام علائق جذور بنجر السكر المجففة لتسمين جديان التقر.