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Feedlot performance and carcass characteristics of Sudan dromedary camels (*Camelus dromedarius*) fed on molasses and sorghum grain based diets

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Abstract

This study aimed to evaluate the feedlot performance and carcass characteristics of Sudan dromedary camels under a controlled management system. Twenty Arab-type camels were fed *ad libtium* for 98 days on iso-caloric and iso-nitrogenous molasses and sorghum grains based diets (n=10 animals/diet). The differences between the two treatments in feedlot and slaughtering traits were examined for significance by Student t-test. No significant differences (P>0.05) were observed between the molasses and sorghum diet groups in feed intake (8.06 ± 1.38 vs. 7.82 ±1.12 kg/day), liveweight gain (0.62 ± 0.18 vs. 0.61 ± 0.20 kg/day), feed conversion ratio (13.87 ± 4.51 vs. 12.82 ± 5.77 kg feed/ kg body gain), final weight (319.95± 75.50 vs. 322.30± 68.01 kg), dressing percentage (57.85 ± 1.41 vs. 54.42 ± 2.10% of slaughter weight), rib eye muscle area (51.18 ± 8.79 vs. 48.92 ± 8.27 cm^2), fat thickness (1.03 ± 0.53 vs. 1.12 ± 0.55 mm), total (35.47 ± 8.08 vs. 35.11 ± 7.89%), external (15.55 ± 1.54 vs. 15.13 ± 1.10%) and internal (19.92 ± 7.75 vs. 19.98 ± 7.17%) non-carcass components. It is concluded that molasses-based diets are comparable to sorghum-based diets for camel meat production systems in Sudan, and that the inclusion of molasses in diets is preferred as it will reduce human-animal competition for cereals.

Key words: camel, carcass, feedlot, molasses, sorghum

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Introduction

Camels in Africa were bred and selected as pack animals and for riding characteristics rather than for meat (Mukasa-Mugerwa, 1981). Mukasa-Mugerwa (1981) also noted that Somalia had the worlds' largest population of camels, followed by the Sudan. MARF (2009) reported that the Sudan had approximately 4.25 million head of camels (17.09% of world total). Mason and Maule (1960) reported that among the Sudan camels, the Anafi and Bishareen types were prized for their racing and riding capabilities, and the Rashaidi, Lahaween, and Arab types were used for transportation and suited to meat production.

The demand for camel meat appears to be increasing due to health reasons, as they produce carcasses with less fat, less cholesterol and relatively high polyunsaturated fatty acid content compared with other meat animals (Mukasa-Mugerwa, 1981; Dawood and Al-Alkanhal, 1995). Camel meat is also used for remedial purposes in the treatment of diseases, such as hyperacidity, hypertension, pneumonia and respiratory diseases, and as an aphrodisiac (Kurtu, 2004).

Camels are primarily browsers. Although supplementary feeding is rare, it is not altogether unknown. Hashi et al. (1982) noted that the nutrient requirements of cattle have sometimes been adopted as standards for use in camel studies. They assumed that digestibility of feed by camels and their nutrients' utilisation efficiency for various functions does not differ significantly from those of true ruminants. The special features of camel's digestive system have led some authors to describe it as a pseudo-ruminant. According to Mukasa-Mugerwa (1981), as a ruminant, camel has a stomach with four chambers, although there are some reservations as to whether the last two chambers should be classified as separate entities. The rumen (first compartment) continues to be a source of controversy owing to its additional anterior and posterior water sacs. The mucosal surface of the reticulum (second compartment) is fairly similar to that of other ruminants but differs in being glandular. The omasum (third compartment) of the camel does not have the extensive mucosal folds characteristics of the bovine. It is difficult to distinguish the omasum externally from the abomasums (the fourth glandular compartment).

The most recognised beneficial use of molasses is its addition to diets based on low quality roughages to improve palatability and provide a readily available source of energy. Feeding a molasses-based diet compared to a grain-based diet could also reduce feeding cost, provided fattening performance and carcass characteristics were similar (Atta and El Khidir, 2006; Adam et al., 2010). The objective of this experiment was to make recommendations on the best feeding strategy for rearing camels under an intensive management system in Sudan. Live weight gain, dry matter intake, feed conversion efficiency and carcass characteristics were measured in camels fed molasses or sorghum grain-based diets.

Materials and methods

The experiment was conducted at the Animal Production Research Centre, Khartoum North. Twenty intact male, one-humped Sudan-Arab-type camels, approximately 18 months of age, were purchased from the Omdurman Livestock Market for use in the experiment. On arrival at the research centre, they were rested, ear tagged, treated with Ivomic inter-muscular injection (1 ml/50 kg live weight) and sprayed with Gamatox solution. The animals were then weighed after an overnight fast, except for water, and grouped into 10 subgroups (two animals each) of matching average body weight. Each subgroup was accommodated in a separate pen with watering and feeding facilities. The subgroups were allocated randomly into two diet groups (five subgroups per diet). The first group was fed a molasses-based diet *ad libitum* which consisted of 52% molasses, 41% wheat bran, 5% ground nut cake 1% urea and 1% common salt. The second group was fed a sorghum grain-based diet *ad libitum* which consisted of 40% crushed sorghum grains, 26% wheat bran, 23% ground nut hulls, 10%

groundnut cake and 1% common salt. All animals received sorghum straw *ad libitum*. The two diets were iso-caloric and iso-nitrogenous (Table 1). Proximate analysis of the experimental diets was performed according to the AOAC (1980). Nitrogen free extract was calculated by subtracting the summation of ash, crude protein, ether extract and crude fibre from 100.

Table 1. Chemical composition of the experimental diets.

Items (%)	Molasses based diet	Sorghum based diet	Sorghum straw
Moisture	9.10	6.60	4.30
Ash	8.68	7.49	14.50
Crude protein	13.78	13.98	3.22
Crude fibers	12.40	26.80	41.00
Ether extract	2.00	3.40	1.20
Nitrogen free extract	54.04	41.73	35.78
Metabolisable energy* (MJ/Kg.DM)	10.5	9.9	6.9

*Metabolisable energy calculated according to MAFF (1975):
For sorghum and molasses based diets:
ME (MJ/kg DM) = 0.012CP + 0.031EE + 0.005CF + 0.014NFE.
For sorghum straw:
ME (MJ/kg DM) = 13.9 – 0.017CF.

The experiment consisted of two weeks pre-experimental period followed by a 14-week experimental period. Feed intake of each subgroup was recorded daily. The animals were weighed weekly before the morning meal and after an overnight fast except for water. Animals were slaughtered at a target time of 98 days. Animals destined for slaughter (six animals from each group) were offered water but no feed for 14 hours before slaughter. After dressing and eviscerating, the internal organs and offal were removed and weighed. The kidney and kidney knob channel fat were left intact in the carcass. The carcass was weighed before and after chilling at 4^{o}C for 24 hours. *Longissmous dorsi* muscle area was obtained by cutting at a right angle on the longitudinal axis between 12th and 13th rib. The muscle area was traced on a transparent paper and measured by a plani-meter (cm^{2}). Fat thickness was measured perpendicular to the external fat surface (using Vernier scale) and constituted the average measurement of fat thickness at points (¼, ½ and ¾) of the lateral length of the *logissimous dorsi* muscle.

The data of feedlot and slaughtering performance were examined by student t-test for independent samples (StatSoft, 2010) to test the significance of differences between the two diet treatments.

Results and discussion

Results of feedlot performance of Sudan Arab camels fed on molasses-based and sorghum grain-based diets are shown in Table 2. The average initial and final weights of the two groups were not significantly (P>0.05) different. The live weight gain was also not affected significantly (P>0.05) by dietary treatments. Diet treatment had no effect in most traits of feed intake. However, molasses diet group camels consumed more sorghum straw than their sorghum diet mates (P<0.01). Similar observations were reported for desert sheep (El Khidir et al., 1988), Nilotic sheep (Atta and El Khidir, 2006) and Nilotic goats (Adam et al., 2010); where the molasses-based diet induced feedlot performance similar to its iso-caloric and iso-nitrogenous sorghum grain-based diet.

Table 2. Feedlot performance of camels fed molasses or sorghum based diets

Traits	**Molasses based diet**	**Sorghum based diet**	**Significance of difference**
Number of animals	10	10	-
Period on feed (days)	98	98	-
Initial live weight (kg)	258.80 ± 60.11	261.44 ± 63	NS
Final live weight (kg)	319.95± 75.50	322.30± 68.01	NS
Total body weight gain (kg)	61.13 ± 17.59	60.36± 19.82	NS
Daily weight gain (kg/ day)	0.62 ± 0.18	0.61 ± 0.20	NS
Concentrate intake (kg/ day)*	6.30 ±1.23	6.49 ± 0.96	NS
Roughage intake (kg/ day)*	1.75 ± 0.14	1.33 ± 0.16	**
Total feed intake (kg/ day)*	8.06 ± 1.38	7.82 ±1.12	NS
Feed conversion efficiency (kg DM feed/kg live weight gain)*	13.87 ± 4.51	12.82 5.77	NS

*Number of observations = 5; NS = not significant (P > 0.05); ** = significant (P < 0.01)

The significantly higher roughage consumption of camels offered molasses-based diet may be due to the fact reported by Foreman and Herman (1953), that addition of readily fermentable carbohydrate increased digestibility and thus consumption of fibrous materials. They found that daily feeding of up to 1 kg of molasses tended to increase the digestibility of crude fibre. The daily total dry matter intake (DMI) of the camels in this study as percentage of body weight (about 2.52% and 2.43% for molasses and sorghum groups, respectively) was similar to the 2.5% estimated by Field (1979). He reported 9.1 kg dry matter intake per day for a Kenyan work camel averaging 363 kg live weight. Small percentages of DMI were reported by Turki et al. (2007). They reported 3.99, 4.53 and 4.42 kg DMI for Sudanese dromedary camel calves of 217.58, 233.28 and 221.56 kg live body weights, respectively. Gihad et al. (1989) reported that camels had the lowest DMI expressed as g per kg body weight, while goats showed the highest DMI. Babiker et al. (2009) reported DMI percentages for Sudan Baggara cattle (2.4–3.6%) which are comparable to that of the present camels. The present daily weight gain was within the range (0.59–0.82 kg/ day) reported by Turki et al. (2007) for Sudan Arab camel of approximately the same age (two years old) but lighter initial live body weight (175.75 ± 0.25 kg), fed intensively on three iso-caloric and iso-nitrogenous complete concentrate diets. The feed conversion ratio (FCR) of the present dromedary camels was poorer than that (6.86 – 9.98 kg DMI /kg gain) reported by Turki et al. (2007).

The data pertaining to empty body weight (EBW) and dressing percentages are given in Table 3. There was no difference in dressing percentages measurement; empty body weight, hot carcass weight, carcass shrinkage, gut fill, rib eye and fat thickness between camels offered a molasses-based diet compared to a sorghum-based diet. The dressing-out percentage in the present study was within the range 55 – 70% reported by Kamoun (1995) for one-humped camels. The present results were also similar to that reported by Babiker and Yousif (1987) for Sudanese camels (54.4% for cold carcasses and 55.9% for hot carcasses) and that reported by Kurtu, (2004) for Ethiopian male camels (54%).

Table 3. Carcass yield and characteristics of camel fed molasses- or sorghum-based diets

Traits	Molasses-based diet	Sorghum-based diet	Significance of difference
Number of animals	6	6	-
Slaughter weight (kg)	334.60 ± 65.36	325.26 ± 47.89	NS
Empty body weight (EBW) (kg)	294.98 ± 58.51	278.62 ± 43.15	NS
Hot carcass weight (kg)	192.59 ± 37.39	176.86 ± 29.22	NS
Chilled carcass weight (kg)	188.57 ± 38.13	171.55 ± 27.37	NS
Chiller shrinkage (%)	2.21 ± 0.20	2.92 ± 0.38	NS
Dressing % of hot carcass weight	57.85 ± 1.41	54.42 ± 2.10	NS
Dressing % of chilled carcass weight.	56.57 ± 1.30	52.68 ± 2.28	NS
Dressing % of hot carcass on EBW basis	65.36 ± 2.45	63.41± 1.58	NS
Dressing % of chilled carcass on EBW basis	63.92 ± 0.64	61.57 ± 0.95	NS
Rib eye area (cm^2)	51.18 ± 8.79	48.92 ± 8.27	NS
Fat thickness (mm)	1.03 ± 0.53	1.12 ± 0.55	NS

NS = not significant (P > 0.05)

The values of fat thickness were comparable to that reported by Al-Azraqi (2007) for camels of age range 4–9 months and body weight range 120–180 kg (a range of 1.8–4.4 mm). Dietary treatment had no effect (p > 0.05) on external or internal non-carcass components (Table 4) and values found in the present study were comparable to those elsewhere (Kadim et al., 2008; Wilson, 1978).

Table 4. Non-carcass components of camels fed molasses- or sorghum-based diets (as % of empty body weight)

Trait	Molasses based diet	Sorghum based diet	Significance of difference
Number of animals	6	6	-
Head	3.87 ± 0.32	3.66 ± 0.27	NS
Hide	7.70 ± 0.62	7.46 ± 0.32	NS
Four feet	3.80 ± 0.57	3.85 ± 0.50	NS
Stomach weight (empty)	4.90 ±0.60	5.45 ± 0.69	NS
Intestine weight (empty)	2.8 ±0.64	2.8 ± 0.47	NS
Mesentric fat	0.56 ± 0.08	0.32 ± 0.13	NS
Omental fat	0.14 ± 0.09	0.18 ± 0.08	NS
Kidney weight	0.62 ± 0.05	0.64 ± 0.18	NS
Kidney fat	1.24 ± 0.29	1.12 ± 0.13	NS
Liver	2.09 ± 0.20	2.00 ± 0.27	NS
Heart	0.45 ± 0.21	0.46 ±0.10	NS
Reproductive organ	0.28 ± 0.16	0.24 ± 0.05	NS
Tail	0.18 ± 0.03	0.16 ± 0.01	NS
Lung and trachea	1.71 ± 0.31	1.70 ± 0.16	NS
Diaphragm	1.3 ± 0.50	0.97 ±0.30	NS
Spleen	0.13±0.07	0.12 ± 0.09	NS
Blood	3.70 ± 0.63	3.80 ± 0.84	NS
External non carcass components	15.55 ± 1.54	15.13 ± 1.10	NS
Internal non carcass components	19.92 ± 7.75	19.98 ± 7.17	NS
Total non carcass components	35.47 ± 8.08	35.11 ± 7.89	NS

NS = not significant ($P > 0.05$)

In conclusion, feeding a molasses-based diet to camels increased rough intake above that of a sorghum-based diet. There were no differences between the treatments in terms of live weight gain or carcass composition, suggesting that molasses may be a suitable alternative to sorghum-based diet for intensive camel meat production. A shift from sorghum- to molasses-based diets would reduce human-animal competition for cereal grains. It is noteworthy to mention that this study gave good highlights on the potential of the Sudanese Arab camel for meat production.

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