Pakistan J. Zool., vol. 51(2), pp 503-509, 2019. **DOI**: http://dx.doi.org/10.17582/journal.pjz/2019.51.2.503.509

Growth Performance and Hair Mineral Status of Marecha (*Camelus dromedarius*) Calves Reared under Different Management Systems

Asim Faraz[1,*], Muhammad Younas[2], Abdul Waheed[1], Muhammad Yaqoob[2] and Kashif Ishaq[3]

[1]*Department of Livestock and Poultry Production, Faculty of Veterinary Science, Bahauddin Zakariya University, Multan*
[2]*Institute of Animal and Dairy Sciences, Faculty of Animal Husbandry, University of Agriculture, Faisalabad*
[3]*Department of Livestock Production and Management, PMAS-Arid Agriculture University, Rawalpindi*

Article Information
Received 13 June 2017
Revised 19 July 2018
Accepted 01 August 2018
Available online 06 February 2019

Authors' Contribution
AF planned and executed the experimental work. All authors contributed to make the completion of this manuscript possible. M Younas and M Yaqoob supervised this research and helped in write up while. AW helped in completion of analyses and write up of the article.

Key words
Growth, Hair minerals, Camel, Management system.

ABSTRACT

Current study was executed at Camel Breeding and Research Station (CBRS) Rakh Mahni, to examine the growth performance and hair mineral status of Marecha calves (*Camelus dromedarius*) reared under intensive (IMS) and semi-intensive management systems (SIMS). Twelve Marecha calves were randomly allotted to two comparable groups of 6, (3 ♂ and 3 ♀). First group animals were reared under IMS, fed concentrate @ 1 kg/h/d plus crop residues of gram (*Cicer arientinum*) *ad lib* while in second group, calves were reared under SIMS, sent for grazing 8 hours daily plus gram crop residues *ad lib*. Twice watering was done in both the groups. At end of trial mean body weight and ADG of male and female calves was significantly increased (P<0.05) in IMS (80.83±2.7, 77.83±2.7 kg and 0.674±0.02, 0.649±0.02 kg/d) than SIMS (50.33±2.7, 45.16±2.7 kg and 0.419±0.02, 0.376±0.02 kg/d), respectively. Intake of crop residues varied (P<0.05) between groups (6.93±0.45, 6.37±0.45; 4.09±0.46, 3.83±0.46 kg/d in male and female calves, respectively). Available species for grazing/browsing were kikar, phulai, beri, siras, jand, khagal, dhaman, persain, khawi, bui, bhakra, kari, laana, phog, karir and khar laana. Regarding hair mineral status Ca, Mg, Cu, Zn, Fe and Mn concentrations were found to be significantly different (P<0.05) between calf groups being higher in IMS as (685.07±15.86, 595.67±15.86; 104.33±5.12, 101.17±5.12; 7.08±0.34, 6.73±0.34; 65.33±2.25, 59.33±2.25; 322.20±8.67, 311.10±8.67; 46.53±1.83, 40.67±1.83 mg/dL in male and female) than SIMS (523.18±15.86, 486.98±15.86; 80.58±5.12, 78.21±5.12; 5.56±0.34, 4.33±0.34; 55.53±2.25, 43.83±2.25; 294.20±8.67, 239.93±8.67; 31.23±1.83, 25.40±1.83 mg/dL in male and female).

INTRODUCTION

Growth is defined by Schloss (1911) as a "correlated increase in the mass of the body in definite intervals of time, in a way characteristic of the species". In normal life of an adult animal, its optimum performance depends upon its optimum growth. Meat animals will make economic gains only in that condition if they are raised well. If the breeding females have not been grown properly they might have impaired breeding ability. It is obvious that one cannot expect the satisfactory yields and performance from cattle, buffalo, sheep, goat and camel unless they were well fed and well developed during their growing period (Ensminger, 1991).

Several studies have indicated the potential of rapid growth rate in early life of camel calves under various conditions (Degen *et al*., 1987). The species which provide milk or meat like camels are considered having natural phenomena of efficient daily weight gain in their early life. This intrinsic ability of animal is governed by its genetic makeup and can be supplemented by adequate feeding and management.

Camel is a favorable source of meat in many areas of world such as Egypt, Libya, Sudan and Gulf countries (Turki *et al*., 2007). The demand for camel meat appears to be increasing due to health reasons since it produces carcasses with less lipids (1.2-1.8% vs. 4.0-8%), less cholesterol, high water contents (5-8%more) and relatively higher polyunsaturated fatty acids (PUFA) than other meat (Kadim *et al*., 2008; Mohamed and Manal, 2012; Mounir *et al*., 2012; Ahmed and Yetim, 2012). It is being used as remedial purposes in the treatment of many diseases such as hypertension, hyperacidity, pneumonia, respiratory diseases and as an aphrodisiac (Kurtu, 2004). It is an

* Corresponding author: drasimfaraz@gmail.com
0030-9923/2019/0002-0503 $ 9.00/0

important staple and essential component of the life of pastoralists. There is an emerging interest in slaughtering of young camel calves (around 1-2 year of age). Camel meat has been scored as better than beef by taste panels in Arab states. Lucrative export opportunities to Sudan, Kingdom of Saudi Arabia, Libya, Egypt and Gulf states do exist.

Mineral estimation in camel hair is comparatively a newer concept in Pakistan. The study of mineral profile gives fruitful information about the general health status of the animal so could be used as an indirect tool for evaluation of nutritional status and well-being of an animal. Camel hair accumulates all important minerals and is commonly available tissue which can easily be collected, stored, transported and if needed can easily be resampled. Present study was conducted with the objective to investigate the influence of management systems on growth performance and level of important macro and micro minerals in hair of camel calves.

MATERIALS AND METHODS

Study area

The study was undertaken during the year 2014 at Camel Breeding and Research Station (CBRS), Rakh Mahni, Tehsil Mankera, District Bhakkar, Punjab. The CBRS is located in Thal area between 31° 10' and 32° 22' North Latitude and 70° 47' and 72° East Longitude. Most of the area lies in the desert plain of the Thal. This area is included in the Agro Ecological Zone-III A and B (sandy desert area) having narrow strips of sand ridges and sand dunes. The climate is arid to semi-arid subtropical continental and means monthly highest temperature goes up to 45.6 ºC, while in winter it goes from 5.5 to 1.3 ºC. Mean annual rainfall in the region ranges from 150-350 mm, increasing from South to North (Rahim *et al*., 2011).

Experiment plan

Twelve Marecha calves (*Camelus dromedarius*) around 330±30 days of age (born during months of January to March 2013) were allotted randomly to two comparable groups of 6, each containing 3 males and 3 females so the group was composed on homobreed and heterosex calves. The animals in the first group were fed concentrate @ 1 kg/h/d along with crop residues of gram (*Cicer arientinum*) round the clock, considered as IMS. The DM, CP, TDN, NDF and ADF of concentrate were 90.32, 18, 66, 29, 14.41 % while ME was 2.41 Mcal/kg DM, respectively. In second group all animals were sent for grazing/browsing daily for about 8 h (8-16 h) while rest of the time were stall-fed with the gram crop residues *ad lib* and considered as SIMS. Water was provided twice a day in both the systems.

Animal management and data collection

Before the start of the experiment all the calves were marked for identification and were dewormed to reduce the parasitic load. Calves were housed in semi-open pens throughout the trial. Initial body weight of the camel calves were recorded before shifting these calves to the respective treatment groups and thereafter all the experimental calves were weighed fortnightly before morning feeding. The calves were weighed on a set date before morning feeding on computerized weighing scale. The growth rate of the calves was calculated from fortnightly weighing by using the formula as (current weight-previous weight/15). The feed intakes of stall fed animals were calculated as the difference between the residual amount of feed and the amount offered. The average dry matter values of feed were measured and the dry matter intake was then determined.

Laboratory analysis

The crop residues and herbage samples of the grazing/browsing material were analyzed for percent dry matter, crude protein, crude fiber, ether extract and ash (AOAC, 1990). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) was also determined (Van Soest *et al*., 1991). Hair samples were collected from shoulder, neck, hump and mid region of body of camel calves. The hair was cut with the stainless steel scissors into pieces of about 1 cm length from each region and mixed well to ensure homogeneity. The skirting of sample was done properly. Samples were washed with acetone and filtered, rinsed with plenty of water. These were dried in hot air oven and 0.5 g of dried mass was taken for further processing. Concentrated nitric acid (2 ml) was added to each hair sample and was kept at 100 °C until half of the total volume evaporated. The samples were taken out and cooled. Concentrated perchloric acid (2 ml) was added and again the sample was kept until half of the total volume evaporated. After this procedure, distilled water was added to give a total volume of 10 ml (Bhakat *et al*., 2009). The solution was used for determination of important macro-minerals and micro-minerals. The concentration of macro (Ca, Cu, Mg) and micro (Fe, Mn, Zn) minerals was determined by atomic absorption spectrophotometer (AOAC, 1990).

Statistical analysis

Data collected on different parameters were analyzed by Fisher's analysis of variance technique having 2×2 factorial arrangements of treatments under CRD using SPSS software (SPSS, 2008). Tukey's test at 0.05 levels of significance was used to compare the differences among the treatment means (Steel *et al*., 1997).

Table I.- Overall weight gain (kg) and growth rate (kg/d) of male and female camel calves in IMS and SIMS.

Parameter	IMS		SIMS	
	Male	Female	Male	Female
Growth at 30 d	21.67±0.97 [a]	20.33±0.97 [a]	12.83±0.97 [b]	10.50±0.97 [b]
Growth at 60 d	20.17±0.61 [a]	19.67±0.61 [a]	13.17±0.61 [b]	11.00±0.61 [b]
Growth at 90 d	19.67±0.68 [a]	19.17±0.68 [a]	12.67±0.68 [b]	11.83±0.68 [b]
Growth at 120 d	19.33±0.63 [a]	18.67±0.63 [a]	11.67±0.63 [b]	11.83±0.63 [b]
Overall weight gain	80.83±2.7 [a]	77.83±2.7 [a]	50.33±2.7 [b]	45.16±2.7 [b]
Daily weight gain	0.674±0.02 [a]	0.649±0.02 [a]	0.419±0.02 [b]	0.376±0.02 [b]

IMS, intensive management system; SIMS, semi intensive management system. Means having different superscript in columns are significantly different ($P<0.05$).

RESULTS AND DISCUSSION

Growth rate

The calves of similar weight and size were selected in both management systems for this study. After 120 days of trial period overall weight gain was 80.83, 77.83 and 50.33, 45.16 kg in male and female calves reared under IMS and SIMS, respectively. The daily weight gain (growth rate) was 0.674, 0.649 and 0.419, 0.376 kg/d in male and female calves reared under IMS and SIMS, respectively. Overall weight gain and growth rate of male and female calves in IMS and SIMS are presented in Table I. The average growth rate was significantly higher ($P<0.05$) in calves of IMS as compared to the calves of SIMS. These findings are in line with the findings of Bhakat *et al*. (2008) who studied the effect of management systems on growth performance of dromedary camel calves in India, they used 10 camel calves aged between 7-10 months old in their study and divided them randomly into two comparable groups of 5 each. The average initial body weight of both groups was almost similar. The groups were of hetero breed and hetero sex combinations, each group contained 3 Jaisalmeri, 1 Bikaneri, 1 Katchi breed and 4 males and 1 female. At end of the trial, average total gain was almost double in ISM than SISM group. The average growth rate was significantly higher in ISM (611 g/d) than SISM (319 g/d).

In present study, male calves attain higher weights in both the systems, may be due to the reason that more receptors are present on muscle cells for androgens that accelerates the growth (Hossner, 2005). These findings are supported by the findings of Knoess (1977) and Qureshi (1986) who reported average daily weight gain as 1.4 kg in male, 0.95 kg in female; 1.5 kg in male, 1 kg in female camel calves, respectively in Pakistan. Musavaya (2003) reported weight gain in calves as 0.41 kg/d in males and 0.38 kg/d in females while weight gain after the sexual maturity as 0.12 kg/d in males and 0.06 kg/d in females. Kurtu (2004) reported that mature male calves were heavier than female calves by 38%. Indian scientists Sahani *et al*. (1998) reported average daily gain in 0-3 (0.63, 0.58); 3-6 (0.64, 0.62); 6-9 (0.37, 0.39); 9-12 (0.23, 0.23); 18-24 (0.16, 0.20); 24-30 (0.16, 0.17) and 30-36 months (0.18, 0.14) kg in male and female calves, respectively. Male calves weighed more than females. A significant contribution of sex and year in Bikaneri camels has also reported by Baniwal and Chaudhary (1983). Khanna *et al*. (2004) reported average daily gain (ADG) as 0.7 and 0.77 kg in Jaisalmeri and Bikaneri Indian camel breeds from birth to 3 months of age, respectively. However, no significant difference was found to be in male and female calves regarding their daily weight gain. Ouda *et al*. (1992) observed that regarding growth sex and year affects significantly after two years of age.

Current findings are in accordance with the findings of Saini *et al*. (2014) who also reported higher total and average daily gain (kg) in stall fed pre-pubescent camels as compared to grazing group. In Sudan, Mohamedain *et al*. (2015) studied growth performance in dromedary camels under two feeding regimen. First was zero browsing group (15 Darfuri and 10 Butana) fed complete ration (sorghum 50%, groundnut cake 15%, wheat bran 5%, molasses 10%, dura husk 5%, bagas 12%, urea 2% and common salt 1%) to provide ME @ 11 MJ/kg DM and 16% CP. Second was free browsing group with same breeds without any supplement. The trail was of 120 days with two weeks as adaptation period. The average total weight gain was almost double in zero browsing group (96±17.3 kg) than free browsing group (42±19.5 kg). ADG was 800 g in zero browsing group as compared to 350 g in free browsing group. While in present study, lower daily weight gain was observed in IMS due to the limited supply of concentrate.

Current findings are not in line with the findings of Bhakat *et al*. (2009) who reported that the average daily gain (g/d) differed significantly among two systems, being higher in semi-intensive system of management as (325 and 476 g/d) than intensive system of management

as (278 and 331 g/d) with guar phalgati (*Cyamopsis tetragonoloba*) and moth chara (*Phaseolus aconitifolius*) feeding, respectively. Bakheit *et al*. (2012) reported significant differences in the mean daily weight gain (grams) under semi-intensive (535±9.83) and traditional management systems (TMS) (317±5.46), respectively. In Kenya the calves under TMS gained 222 g/d to 6 months age in dry season and 655 g/d in wet season (Field, 1979) while Zeleke and Bekele (2001) reported range for average daily growth rates of camel calves as 0.72-0.86 kg. Under proper nutrition ADG in camel calves has been reported as 0.87 and 0.57 kg from birth to 30 days and from birth to 180 days, respectively by Wilson (1992) while El-Badawi (1996) reported ADG as 0.83-0.97 kg from birth to 180 days in Egyptian dromedary calves.

The findings of the present study are supported by Hammadi *et al*. (2001) who reported 580 grams daily growth rate between births to 90 days age, while Bissa *et al*. (2000) reported growth rate as 733 g/d from birth to 180 days in Indian dromedary camels. The average daily gains in 2 months old Bikaneri and Jaisalmeri calves were 553.3 and 546.6 g, respectively as observed by Sahani *et al*. (1992) in India under TMS. Nagpal *et al*. (2005) reported ADG as 377.6-420.9 g/d in Indian camel calves at 10-12 months age under TMS. Kamoun (1995) reported a daily growth rate of 260 g/d in camels fed only on mangroves and 550 g/d in camels fed on high dietary protein and energy diet. Average daily weight gain was 0.74 kg during 90 days in Saudi camel calves when they were fed 75% concentrate and 25% hay (Al-Saiady *et al*., 2006).

Feed intake

Average daily intake was found to be significantly varied (P<0.05) among calf groups between intensive and semi-intensive management system (6.93±0.45, 6.37±0.45 and 4.09±0.46, 3.83±0.46 kg) in male and female calves, respectively (Table II). These findings are in line with the findings of Bhakat *et al*. (2008) who studied the effect of management systems on growth performance of Indian camel calves and reported that the crop residue intake was significantly varied between two groups, 5.53 vs. 4.37 kg/calf/d in intensive system of management (ISM) and semi-intensive system of management (SISM), respectively. Moreover, Saini *et al*. (2014) reported higher DMI (kg/d) in stall fed pre-pubescent camels as compared to grazing group. The proximate analysis of crop residues and herbage samples available for grazing/browsing is shown in Table III.

Hair mineral status

The mean values were found to be significant (P<0.05) for calcium, magnesium, copper, zinc, iron and manganese in male and female calves under intensive and semi-intensive management system, respectively (Table IV).

It is an indirect tool for measuring the general health status of the animal. As the animal gained higher weight, definitely there will be higher mineral accumulation in wool. Very less work has been done on wool mineral analysis in camel calves. Indian scientist Bhakat *et al*. (2009) determined hair mineral status of camel calves reared under different management systems and reported higher concentrations of macro and micro minerals in calves of semi-intensive management system. They reported calcium (549.60±74.45, 434.40±60.21 and 719.72±78.62, 476.00±127.98), magnesium (88.92±2.41, 67.60±6.33 and 77.48±3.67, 69.84±3.18), copper as (6.16±0.72, 4.30±0.44 and 7.36±0.66, 5.72±0.99), zinc (66.04±4.38, 57.56±2.33 and 64.25±2.04, 54.76±1.46), iron (285.72±26.55, 216.08±30.89 and 319.36±27.91, 261.92±33.37) and manganese (21.56±3.65, 20.60±1.02 and 45.80±1.83, 32.92±4.36) mg/dL in calves reared under semi-intensive and intensive management system with guar phalgati (*Cyamopsis tetragonoloba*) and moth chara (*Phaseolus aconitifolius*) feeding, respectively. Furthermore, Chattergee *et al*. (2005) found different status of manganese in hairs of Yak. In horse, levels of some elements were affected to a higher or lower degree by nutritional differences as reported by Or *et al*. (2004).

Table II.- Average male and female camel calves' intake of crop residues (kg) on DM basis in IMS and SIMS.

Parameter	IMS		SIMS	
	Male	Female	Male	Female
ADI in 30 d	6.50±0.44 [a]	5.92±0.44 [a]	3.90±0.44 [b]	3.65±0.44 [b]
ADI in 60 d	6.98±0.45 [a]	6.40±0.45 [a]	4.10±0.45 [b]	3.82±0.45 [b]
ADI in 90 d	7.45±0.46 [a]	6.83±0.46 [a]	4.30±0.46 [b]	4.05±0.46 [b]
ADI in 120 d	7.93±0.45 [a]	7.35±0.45 [a]	4.50±0.45 [b]	4.27±0.45 [b]
Daily feed intake/animal	6.93±0.45 [a]	6.37±0.45 [a]	4.09±0.46 [b]	3.83±0.46 [b]

ADI, Average daily intake; Means having different superscript in columns are significantly different (P<0.05).

Table III.- Proximate analysis (%) of crop residue and different grazing/browsing species.

Feed/Forage Species	DM	CP	EE	CF	NDF	ADF	Crude ash
Gram Straw (*Cicer arientinum*)	93.53	9.72	2.60	44.4	68.7	47.6	7.83
Kikar (*Acacia nilotica*)	28.5	16.71	1.79	25.08	55.4	25.4	5.94
Phulai (*Acacia modesta*)	53.4	13.23	2.21	35.40	46.6	28.78	6.94
Beri leaves (*Ziziphus mauritiana*)	40.2	15.52	5.77	28.02	48.3	26.9	8.48
Siras (*Albizia labbek*)	37.3	16.17	6.58	27.25	43	29	16.33
Jand (*Prosopis cineraria*)	46.15	16.86	6.52	19.14	47.5	29	4.95
Khagal (*Tamarix aphylla*)	31.9	12.81	3.25	17.32	42.4	31.6	13.03
Dhaman (*Cenchrus ciliaris*)	31.9	14.69	3.94	26.51	38.53	18.15	15.71
Persain (*Suaeda fruticosa*)	30.3	10.57	5.52	33.14	48.7	27.6	7.54
Khawi (*Cymbopogon schoenanthus*)	34.6	9.53	2.01	35.67	62.1	43.5	7.14
Kali Bui (*Kochia indica*)	33.78	10.80	4.91	27.61	58.6	39.76	13.32
Bhakra (*Tribulus terrestris*)	32.1	8.76	4.58	32.63	46.7	35.4	9.64
Kari (*Capparis spinosa*)	36.7	17.84	1.18	30.75	51.8	33.5	6.97
Laana (*Haloxylon salincornicum*)	34.2	15.85	3.09	32.33	51.34	37.5	11.93
Phog (*Calligonam polygonoides*)	34.7	8.95	4.82	23.42	49.6	31.9	8.76
Karir (*Capparis decidua*)	49.4	16.75	1.52	24.64	53.6	37.8	14.76
Khar Laana (*Haloxylon recurvum*)	47.9	12.36	3.32	24.95	49.2	31.3	12.15

ADF, Acid detergent fiber; CP, Crude protein; CF, Crude fiber; DM, Dry matter; EE, Ether extract; NDF, .Neutral detergent fiber

Table IV.- Wool mineral analysis (mg/dL) of male and female camel calves in IMS and SIMS.

Parameter	IMS		SIMS	
	Male	Female	Male	Female
Calcium	685.07±15.86 ^{a}	595.67±15.86 ^{b}	523.18±15.86 ^{c}	486.98±15.86 ^{cd}
Magnesium	104.33±5.12 ^{a}	101.17±5.12 ^{a}	80.58±5.12 ^{b}	78.21±5.12 ^{b}
Copper	7.08±0.34 ^{a}	6.73±0.34 ^{a}	5.56±0.34 ^{b}	4.33 ±0.34 ^{c}
Zinc	65.33±2.25 ^{a}	59.33±2.25 ^{ab}	55.53±2.25 ^{b}	43.83±2.25 ^{c}
Iron	322.20±8.67 ^{a}	311.10±8.67 ^{ab}	294.20±8.67 ^{b}	239.93±8.67 ^{c}
Manganese	46.53±1.83 ^{a}	40.67±1.83 ^{b}	31.23±1.83 ^{c}	25.40±1.83 ^{d}

Means having different superscript in columns are significantly different (P<0.05).

CONCLUSION

Internal metabolic environment like blood, lymph and extra cellular fluids plays role in the development of camel hairs, as all the constituents enters into body accumulates in hairs and reflect exposure record of nutritional and toxic metals intake. The mineral status of camel hair can efficiently be used as tool indicator of mineral deficiency in soil. Also the level of these minerals could be used in the diagnosis of various diseases, metabolic disorders and nutritional status of the camel calves. The findings of present study indicated that higher growth rate was achieved in intensive management system than semi-intensive management system. Regarding sex, male claves were found to be heavier than female calves in both management systems. Along with that, the hair mineral status also confirmed the results. It is concluded that Pakistani camel calves has great potential that could be exploited by modern husbandry practices according to scientific lines that will be a useful addition to the food chain.

ACKNOWLEDGEMENTS

The help and support by management of Camel Breeding and Research Station (CBRS) Rakh Mahni, Tehsil Mankera District Bhakkar and financial support of Higher Education Commission (HEC) Islamabad, Pakistan, for this study are gratefully acknowledged.

Statement of conflict of interest

Authors have declared no conflict of interest.

REFERENCES

Ahmed, A.M. and Yetim, H., 2012. *A review of camel meat as a precious source of nutrition*. Proc. 3rd ISOCARD Int. Conf. Sultan Qaboos Univ. Muscat, Sultanate of Oman, pp. 204-206.

Al-Saiady, M.Y., Mogawer, H., Al-Showeimi, T.A., Sheikuddi, A., Dirar, A. and Al Marshed, M.A., 2006. *Effect of fattening period on growth rates and carcass characteristics in* Majaheem *camels fed Arasco concentrates with Alfalfa and Rhodes hay*. Int. Sci. Conf. on Camels. May, 9-11, Al-Qassim, Kingdom of Saudi Arabia, pp. 250.

AOAC, 1990. *Official methods of analysis*, 15th ed., Vol. 1. Association of Official Analytical Chemists, Virginia, USA.

Bakheit, S.A., Idris, A., Faye, B. and Abdelhadi, O., 2012. *The effect of management system on camel's milk yield and calve growth rate in North Kordofan, Sudan*. Conf. Int. Res. on Food Security, Natural Resource Management and Rural Development, Sept, 19-21, Tropentag, Gottingen, Germany.

Baniwal, B.K. and Chaudhary, A.L., 1983. Factors affecting body weights at different ages in Bikaneri camels (*Camelus dromedarius*). *Indian J. Anim. Sci*., **53**: 300-304.

Bhakat, C., Saini, N. and Pathak, K.M.L., 2008. Effect of management systems on the performance of dromedary camel calves reared under organized farm condition. *Indian J. Anim. Sci*., **78**: 1023-1027.

Bhakat, C., Saini, N. and Pathak, K.M.L., 2009. Growth characteristics, economics and hair mineral status of camel calves reared in different systems of management. *Indian J. Anim. Sci*., **79**: 932-935.

Bissa, U.K., Yadav, S.B.S., Khanna, N.D. and Pant, K.P., 2000. Body weight and dimensions at birth in three breeds of Indian camel. *Int. J. Anim. Sci*., **15**: 253-257.

Chatterjee, A., Raquib, M., Sheikh, I.U. and Bhattacharya, M., 2005. Elemental status in Yak hair. *Indian Vet. J*., **82**: 526-528.

Degen, A.A., Elias, E. and Kam, M., 1987. A preliminary report on the energy intake and growth rate of early-weaned camel (*Camelus dromedarius*) calves. *Anim. Prod*., **45**: 301-306. https://doi.org/10.1017/S0003356100018870

El-Badawi. A.Y., 1996. *The possibilities of using camels in new reclaimed lands*. Proc. The first meeting of the National Committee for Camel Research in the Arab republic of Egypt, Nov, 16, Cairo.

Ensminger, M.E., 1991. *Animal science*. The Interstate Publishers, Inc. Danville, IL, USA.

Field, C.R., 1979. *Ecology and management of camels, sheep and goats in northern Kenya*. UNESCO, Nairobi, Kenya.

Hammadi, M., Khorchani, T., Khaldi, G., Majdoub, A., Abdouli, H., Slimane, N., Portetelle, D. and Renaville, R., 2001. Effect of diet supplementation on growth and reproduction in camels under arid range conditions. *Biotech. Agron. Soc. Environ*., **5**: 69-72.

Hossner, K.L., 2005. *Hormonal regulation of farm animal growth*. CABI Publishing, 875 Massachusetts Avenue, 7th Floor, MA 02139, Cambridge, USA. https://doi.org/10.1079/9780851990804.0000

Kadim, I.T., Mahgoub, O. and Purchas, R.W., 2008. A review of the growth, and of the carcass and meat quality characteristics of the one-humped camel (*Camelus dromedarius*). *Meat Sci*., **80**: 555-569. https://doi.org/10.1016/j.meatsci.2008.02.010

Kamoun, M., 1995. Dromedary meat: production, qualitative aspects and acceptability for transformation. *Option Mediterr. Ser. B, Etud. Res.*, **13**: 105-130.

Khanna, N.D., Rai, A.K. and Tandon, S.N., 2004. Camel breeds of India. The Camel Applied Research and Development Network (CARDN). *J. Camel Sci*., **1**: 8-15.

Knoess, K.H., 1977. The camel as a meat and milk animal. *World Anim. Rev*., **22**: 39-42.

Kurtu, M.Y., 2004. An assessment of the productivity for meat and carcass yield of camels (*Camelus dromedarius*) and of the consumption of camel meat in the eastern region of Ethiopia. *Trop. Anim. Hlth. Prod*., **36**: 65-76. https://doi.org/10.1023/B:TROP.0000009520.34657.35

Mohamed, H.K. and Manal, Y.I., 2012. *Comparative chemical composition and quality attributes of camel meat and beef*. Proc. 3rd ISOCARD Int. Conf. Sultan Qaboos Univ. Muscat, Sultanate of Oman, pp. 193-195.

Mohamedain, N.M., Fadlalla, I.M.T., Barri, M.E. and Abdel-Aziz, B.E., 2015. *Growth performance in dromedary camels under two feeding regimen*. The Regional Conference of Camel Management and Production under Open Range System (RCCMPR), Khartoum-Sudan, March, 2-4, 2015.

Mounir, K., Lasaad, T., Mustapha, B.R., Arfaoui, Z., Borni, J. and Ridha, B., 2012. *Nutritional value and organoleptic qualities of camel meat marketed by butchers in Tunisia*. Proc. 3rd ISOCARD Int. Conf.

Sultan Qaboos Univ., Muscat, Sultanate of Oman, pp. 200-201.

Musavaya, K., 2003. *Weight development in camels of different age and sex classes under field conditions in a semi-arid area in northern Kenya*. Master thesis. Available at: http//www.troz.uni-hohenheim.de/research/Thesis/MScAP.

Nagpal, A.K., Qrora, M. and Singh, G.P., 2005. Nutrient utilization of gram straw (*Cicer arietinum*) based complete feed blocks in camel calves. *Indian J. Anim. Sci*., **75**: 64-68.

Or, M.E.K., Maden, A., Gulyasar, D., Tosun, R. and Dourka, C., 2004. Determination of trace elements (Fe, Cu and Zn) in serum and tail hair of healthy horses as a function of nutritional differences in certain months. *Nigerian Vet. J*., **25**: 9-13.

Ouda, J.O., Mbni, M.K. and Woie, B.M., 1992. *Production performance of Somali and Rendille camels and their crossbreeds in northern Kenya*. Paper presented at all African Conference on Animal Agriculture, Nairobi, Kenya.

Qureshi, M.H., 1986. *The camel*. A paper presented at a seminar on the camel, Kuwait, Oct, 20-23, FAO, Rome, pp. 1-35.

Rahim, S.M.A., Hasnain, S. and Farkhanda, J., 2011. Effect of calcium, magnesium, sodium and potassium on farm plantations of various agroecological zones of Punjab, Pakistan. *Afri. J. Pl. Sci*., **5**: 450-459.

Sahani, M.S., Khanna, N.D. and Tandon, S.N., 1992. *Studies on quantitative and qualitative genetic parameters in Indian camels*. Annual Report, NRCC, Bikaner, pp. 31-42.

Saini, N., Kiradoo, B.D. and Bohra, D.L., 2014. Impact of feeding on growth performance, blood biochemical and mineral profiles of pre-pubescent camels under pastoral management in arid western Rajasthan. *Trop. Anim. Hlth. Prod*., **46**: 987-994. https://doi.org/10.1007/s11250-014-0589-2

Schloss, E., 1911. *Pathologie des Wachstums*. S. Karger, Berlin, Germany.

SPSS, 2008. *SPSS statistics for Windows*, Version 17.0. SPSS Inc., Chicago, USA.

Steel, R.G.D., Torrie, J.H. and Dicky, D.A., 1997. *Principles and procedures of statistics. A biometric approach*, 3rd ed. McGraw Hill Book Co., New York, USA.

Turki, I.Y., Ahmed, R.M., Agab, H. and Tageddin, M., 2007. Feedlot performance of dromedary camel (*Camelus dromedarius*) calves fed different dietary regimes. *J. Sci. Tech*., **8**: 102-114.

Van Soest, P.J., Robertson, J.B. and Lewis, B.A., 1991. Method for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *J. Dairy Sci*., **74**: 3583-3597. https://doi.org/10.3168/jds.S0022-0302(91)78551-2

Wilson, R.T., 1992. *Factors affecting weight and growth in one humped camels*. Proc. of the First Int. Camel Conf., Feb, 2-6, Dubai, pp. 309-312.

Zeleke, M. and Bekele, T., 2001. Effects of season on the productivity of camels (*Camelus dromedarius*) and the prevalence of their major parasites in Eastern Ethiopia. *Trop. Anim. Hlth. Prod*., **33**: 321-329. https://doi.org/10.1023/A:1010540120119