Pakistan J. Zool., vol. 53(4), pp 1441-1447, 2021 DOI: https://dx.doi.org/10.17582/journal.pjz/20190312110359

Growth Response and Economics of *Camelus dromedarius* Calves Fed Isocaloric and Anisonitrogenous Rations

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ABSTRACT

Marecha camel has good potential for commercial camel farming and it could be the source for future food production especially in arid and semi-arid areas of Pakistan. Research work on production potential of Marecha camel is scanty. In the current study, 10 male Marecha calves (*Camelus dromedarius*) around 300±30 days of age were weaned at 9 months age and used in 90 days trial to study their growth rate. Calves were raised in two groups with 5 each under stall-fed conditions (intensive management system, IMS). They were offered roughage+concentrate at the ratio of 60:40. In 60 proportions the ratio between fodder (lucerne) and crop residues (gram crop residues) was 70:30. They were fed two isocaloric diets with different protein levels viz: one group with 18% CP and other group with 22% CP. Daily feeding allowance (@ 3% body weight) was calculated and adjusted according to fortnightly live weights. Water was provided twice a day. Daily weight gain was 953±50 and 996±40 g/d with 18% and 22% levels of protein ration, respectively while average DMI of concentrate, fodder and crop residues was 2.93±0.15, 3.00±0.16 and 1.31±0.08; 2.94±0.07, 3.03±0.07 and 1.31±0.03 kg/d, respectively with 18% and 22% levels of protein rations. These findings did not differ significantly (P>0.05). The calves gained 85.8 and 89.6 kg over 90 days with feed efficiency of 7.08 and 6.83 fed 18% and 22% levels of protein ration, respectively. The mean values of body condition scoring (BCS) and back fat layer measurement (BFLM) in five male camel calves of different weights, fed 18% and 22% CP ration were 4.4±0.9, 4.8±0.4 and 4.6±0.5, 4.9±0.3, respectively. The results indicated that weaning was more economical and resulted in savings of PKR 16,137 and 15,213 in calve groups fed with 18% and 22% levels of protein, respectively.

Article Information
Received 12 March 2019
Revised 23 May 2019
Accepted 02 October 2019
Available online 04 June 2021

Authors' Contribution
AF conducted research and wrote the paper. MSN helped in experimental work. AW helped in data analysis. HMI helped in writing of article.

Key words
Growth, Condition scoring, Back fat layer, Camel calves, Economics

INTRODUCTION

Proteins are an important part of the food and come through plant and animal origin. Camel meat is an excellent source of protein (Raiymbek *et al*., 2015). Meat is the prime in food chain for human body development and growth of brain cells. It is rich in phosphorus, iron, nicotinic acid, ascorbic acid, cysteine, lysine, methionine, lucein, tryptophan, riboflavin, choline and vitamin B_{12}, which proves a better protein source than that of plant origin. Camel meat is important staple and essential component of the life of pastoralists. There is an emerging interest in slaughtering of young camel calves (around 1-2 years of age) as a favorable source of meat in countries such as Libya, Egypt and in the Arabian Peninsula (Turki *et al*., 2007). Camel meat has been scored as better than beef by taste-panels in Arab states. Lucrative export opportunities from Horn of Africa to Saudi Arabia, Libya, Egypt and Gulf states do exist (Faye, 2013). A total of 46.242 thousand tons of red meat (beef, mutton and camel meat) was exported from 2015-16 (July-March) and fetched US $144.864 million. At constant cost factor the gross value addition of livestock sector has increased from PKR 1247 billion (2014-15) to 1292 billion (2015-16) showing an increase of 3.63% than previous year (GOP, 2017-18). The future plan of Government of Pakistan for livestock sector is to persuade the policies to achieve 5% or more growth in meat production through shifting from subsistence livestock farming to commercial and market-oriented farming. It is expected that share of camel meat will also increase.

The basic factors in the growth of camel calves are availability of milk from dam and skilled management of calves. Production in the traditional system is mainly geared to milk production. Male calves face a stiffer competition with the herders for their dam's milk than female calves.

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0030-9923/2021/0004-1441 $ 9.00/0

They are often allowed to one teat only or given access to dam's udder after milking. As a consequence, pre-weaning survival is less and hence lesser weaning weights are achieved. Male calves deprived of their due share of milk, exhibit detrimental effects on their growth, leading to a downward trend in their meat production potential (Khan *et al*., 2003). On the other hand, milk off take from dam with male calf is 80% and from dam with female calf is 30%, respectively. Approximately, 55% of the total milk production of camels is taken by the calf (Faye, 2005). By minimizing this percentage, we can increase camel milk yield. Weaning of calf could be the possible solution for these problems. So, after weaning we can fatten the calves and better growth rates can be achieved which could be helpful in reducing the protein deficiency in the country. The present study thus was planned to evaluate the growth performance, feed intake, feed efficiency, body condition scoring, back fat layer measurement by ultrasonography and economics of weaned Marecha calves fed two protein levels reared under intensive management system at Thal desert.

MATERIALS AND METHODS

Metrological conditions of study area

The study was conducted at Camel Breeding and Research Station (CBRS) Rakh Mahni, Tahsil Mankera, District Bhakkar in the Punjab province of Pakistan. Most of the area lies in the deserted plain of the Thal. The climate is arid to semi-arid subtropical continental and mean 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).

Animal management

Before the start of experiment, Marecha calves were color marked on neck region for identification and were dewormed by Ivermectin @ 1ml/50kg bodyweight to reduce the parasitic load. Calves were housed in semi-open pens throughout the trial. Initial body weights of the camel calves were recorded before shifting them to the respective treatment groups and thereafter all the experimental calves were weighed fortnightly on digital weighing scale (Impressum Pakistan) before morning feeding. The trial continued for 90 days with additional 15 days as adaptation period.

Experimental animals and feeding plan

Ten male Marecha calves (*Camelus dromedarius*) around 300±30 days of age were weaned at 9 months of age. They were used in 90 days trial to study their growth rate and were raised in two groups with 5 calves in each group under stall-fed conditions (intensive management system, IMS) up to 1 year of age. They were offered roughage+concentrate at the ratio of 60:40. In 60 proportions the ratio between fodder (lucerne) and crop residues (gram crop residues) was 70:30. The DM, CP, EE, CF, NDF, ADF and Crude Ash values of gram straw (*Cicer arientinum*) were 93.53, 9.72, 2.60, 44.4, 68.7, 47.6 and 7.83 %. The DM, CP, EE, CF, NDF, ADF and Crude Ash values of lucerne (*Medicago sativa*) were 18.2, 22.5, 1.7, 24, 42.4, 29.6 and 12.4 %. They were offered water twice daily and fed two isocaloric rations with different protein levels, one group with 18% and other with 22%, the ingredient and chemical composition is given in Table I. Daily feeding allowance (@ 3% B.Wt.) was calculated and adjusted according to fortnightly live weights.

Table I. Ingredients and chemical composition of experimental rations.

Ingredients (%)	Ration-I	Ration-II
Maize grain	9	14
Rice polishing	-	15
Wheat bran	24	15
Cotton seed cake	25	14
Rape seed cake	6	6
Corn gluten 30%	20	17
Cotton seed meal	-	5
Molasses	14	12
DCP	1	1
Salt	1	1
Parameters (%)		
DM	90.32	91.19
CP	18.06	22.09
TDN	66	70.06
ME (Mcal/kg DM)	2.41	2.56
NDF	29.09	20.57
ADF	14.41	11.63

DCP, Di-calcium phosphate; DM, dry matter; CP, crude protein; TDN, total digestible nutrients; ME, mobilizable energy; NDF, neutral detergent fiber; ADF, acid detergent fiber.

Data collection

The growth rate of the calves was calculated. The calves were weighed on 15 d interval before their morning feeding on computerized digital scale. The feed intake of stall-fed animals was calculated. The average dry matter values of feed were measured and the DMI was then determined. Feed efficiency was determined and economics was calculated by considering the feed costs and savings of milk. BCS in camel calves was performed

by using the condition score scale which is from 0 to 5 just like dairy cattle scale (Faye *et al*., 2001) while back fat thickness was measured by ultrasonography using Shimasonic (Japan) Ultrasonography Machine. Sternal recumbency is the most suitable position to perform ultrasonographical examination; technique is non-invasive and could be applied on non-tranquilized camels (Elnahas, 2008).

Laboratory analysis

The concentrate, crop residues and fodder samples of the grazing/browsing material were analyzed for % DM (Method 930.15), % crude protein (Kjeldahl Method 955.4), % crude fiber (Method 962.9), % ether extract (Soxhlet Method 920.39), % ash (Method 942.5) as described in AOAC (1990). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) was determined by the method of Van Soest *et al*. (1991).

Statistical analysis

Data collected on different parameters were analyzed statistically by applying t-test using SPSS (SPSS, 2008) software (Steel *et al*., 1997).

Table II. Overall weight gain (kg) and growth rate (g/d) of male camel calves fed with 18% and 22% CP ration.

Parameter	18% CP ration	22% CP ration
Growth at 30 d	28.90±1.40	30.80±1.24
Growth at 60 d	29.00±1.44	29.90±1.03
Growth at 90 d	27.90±1.47	28.90±1.03
Overall weight gain (kg)	85.8±4.21	89.6±3.20
Daily weight gain (g/d)	953±50	996±40

CP, crude protein

RESULTS AND DISCUSSION

Growth rate and feed intake

Overall weight gain (kg) and growth rate (kg/d) of male camel calves fed with 18% and 22% CP ration of weaned Marecha male calves attained 85.8 and 89.6 kg weight in 90 days with growth rate of 953 and 996 g/d (Table II). The difference in growth rates of two groups was non-significant. Dry matter intake (DMI) of concentrate, fodder and crop residues of two groups on DM basis was 2.93, 3.00, 1.31 and 2.94, 3.03, 1.31 kg/d with 18% and 22% levels of protein ration, respectively which also differed non-significantly (Table III). The relationship between growth of weaned calves and dry matter intake was positively correlated like findings of Singh *et al*. (2000) while Tandon *et al*. (1993) found that dry fodder intake and water intake was also positively correlated in their study.

Current growth rate findings agree with the reported range for average daily weight gain in camel calves of different ages and breed by many workers (500-1500 grams in Pakistan). Growth rate in male and female calves were found to be 1400 and 950 g (Knoess, 1977), 1500 and 1000 g (Qureshi, 1986) in Pakistani male and female camel calves, respectively of different ages and breeds. In Pakistan the growth rate in government and private farmer's camel calves at 7 days age was 750 and 820 g (Iqbal *et al*., 2001). Present findings are supported with the results of El-Badawi (1996) who reported 830-970 g daily weight gain from birth to 180 days in Egyptian dromedary calves.

Present results are not in line with the findings of Wilson (1992) who reported that in Kenya under proper nutrition average daily weight gain in camel calves was 870 and 570 g from birth to 30 days and from birth to 180 days, respectively. Average daily weight gain was 740 g during 90 days in Saudi camel calves when they were fed 75% concentrate and 25% hay (Al-Saiady *et al*., 2006). Turki *et al*. (2007) reported average daily gain as 810, 590 and 670 g/d and dry matter intake as 4.53, 3.99 and 4.42 kg with Kenana pellets, cotton seed cake and ground nut cake based diets, respectively.

Nagpal *et al*. (2012) reported very low values of growth rate as 402.8 g/d in weaned camel calves (weaned at 9 months age) fed *ad lib* with dry chaffed *Cyamopsis tetragonoloba*, weighed quantity of *Cynodon dactylon* grass and concentrate mixture. Khanna *et al*. (2004) reported average daily gain as 700 and 770 g in Jaisalmeri and Bikaneri Indian camel breeds from birth to 3 months of age, respectively. While Chibsa *et al*. (2014) defining the weaning age of camel calves in eastern Ethiopia concluded that weaning calves at 8 months of age and supplementing with concentrate to the age of 12 months resulted in good post weaning growth rate and survivability of calves.

Current findings are supported by those of Mohamed (2007) who randomly divided 12 Maghrebi camels into 2 equal groups (6 in each) with 2 dietary treatments. The first group was offered complete rations at 3% body weight containing mainly corn 20%, wheat bran 20%, soybean meal 15%, groundnut hay 40% and the second group was offered ration containing black cumin seed-cake (35%), mixture of different straws (45%) and molasses (18%) at 3% body weight. Camels fed on experimental ration were superior in average weight gain compared to the control ration (930 g vs. 880 g) while the DMI did not differ significantly among the two groups (8.97 kg and 8.95 kg/animal daily, respectively). Eltahir *et al*. (2011) studied growth performance of Sudanese camel fed molasses and sorghum grain based diets and found non-significant

Table III. Average male camel calves' feed intake (kg) on dry matter basis fed with 18% and 22% CP ration.

Parameter	18% CP ration			22% CP ration		
	Concentrate	Fodder	Crop residue	Concentrate	Fodder	Crop residue
ADI in 30 d	2.59±0.14	2.64±0.14	1.13±0.08	2.57±0.06	2.68±0.05	1.15±0.03
ADI in 60 d	2.93±0.14	2.97±0.16	1.32±0.08	2.94±0.07	3.02±0.07	1.33±0.03
ADI in 90 d	3.29±0.16	3.38±0.17	1.48±0.08	3.32±0.08	3.40±0.09	1.46±0.04
Daily feed intake/h	2.93±0.15	3.00±0.16	1.31±0.08	2.94±0.07	3.03±0.07	1.31±0.03

CP, crude protein; ADI, average daily intake.

differences regarding daily weight gain between two the feeding systems. Reported daily gain was 620 and 610 g/d in camels fed molasses and sorghum grain based diets, respectively. It was concluded that the molasses is a cheaper source that can substitute sorghum grains while reducing the competition between humans and animals regarding grains. Saini *et al*. (2014) studied the impact of feeding on growth performance of pre-pubescent camels under pastoral management in western Rajasthan and reported that higher total and average daily gain in stall fed camels than grazing group.

In Sudan Mohamedain *et al*. (2015) studied growth performance in dromedary camels under two feeding regimes. Camels were divided in two groups. 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 (11 Darfuri and 9 Butana) 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 former as compared to 350 g in later group.

In recent studies, Faraz *et al*. (2018) compared the intensive management system (IMS) with semi-intensive management system (SIMS) regarding growth rate of Marecha camel calves and found higher growth rate about 674 g/d in male calves of 11-12 months age reared under IMS and 419 g/d in SIMS. In another study, in Marecha camel calves of 11-12 months age reported values are 397 g/d in SIMS and 539 g/d in extensive management system (EMS) by Faraz *et al*. (2017). Faye *et al*. (2018) studied the effect of date-urea blocks as supplementary feeding on growth of young camels and reported daily weight gain 509 g/d in control group and 414 g/d in treated group in 3 years old camels.

Feed efficiency

Total dry matter intake was found to be 607.82 and 611.66 kg resulted in body weight gain as 85.8 and 89.6 kg over 90 days period having feed efficiency of 7.08 and 6.83 fed with 18% and 22% CP ration, respectively (Table IV). There are very few reports on feed efficiency in camels. Nagpal and Sahani (1999) reported range of feed gain ratio as 7.5-8.4 in 1.5 years old growing camel calves weighing 186-196 kg given guar phalgati and concentrate mixture. While in later study, Nagpal *et al*. (2012) determined voluntary feed intake and growth performance of weaned camel calves and found feed efficiency as 8.78. Feed efficiency found in present study (in both groups fed 18% and 22% CP ration) is better than previously reported results.

Table IV. Feed efficiency of male camel calves fed with 18% and 22% CP ration.

Parameter	18% CP ration	22% CP ration
Total DMI (kg) (a)	607.82	611.66
Body weight gain (kg) (b)	85.80	89.60
Feed efficiency (a/b)	7.08	6.83

For abbreviations, see Table III.

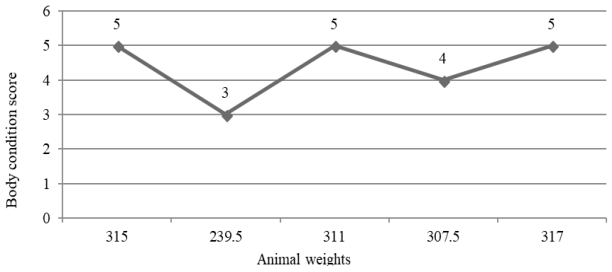
Body condition scoring and back fat layer measurement by ultrasonography

Body condition scoring of all Marecha calves was done on 0-5 points scale as described by Faye *et al*. (2001). The lumber area is the best place to assess the fat deposition and muscle mass of animal. Muscle mass storage can also be assessed by inner thigh's shape. BCS seems a better tool for the assessment of health status in animals. Whereas, ultrasonography has offered the potential to produce accurate and quick measurement at lower cost. In tracking the carcass merit, ultrasonography used to be a substitute for serial slaughtering. It is a very simple and reliable technique for subcutaneous fat measurement (Suzuki *et al*., 1993; Tornaghi *et al*., 1994). Rump fat

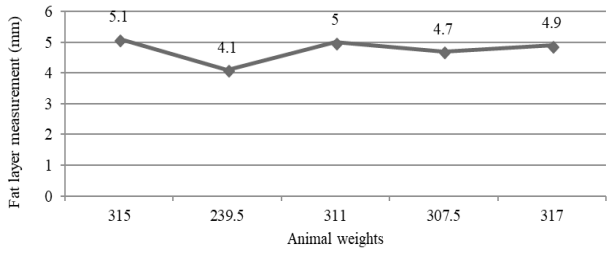
depths can be measured very accurately (about 85%) by ultrasonography (Robinson *et al*., 1992). The mean values of BCS and Back fat layer measurement (BFLM) in five male camel calves of different weights, fed 18% and 22% CP ration were 4.4±0.9, 4.8±0.4 and 4.6±0.5, 4.9±0.3, respectively (Table V) while individual BCS and BFLM of all the ten animals is shown in Figures 1-2. It is found that the animals in both groups attained smooth weight and along with this their BCS has been grown and also the back fat layer measurements in a linear fashion. Actually the stock used being breeding stock; the authors can't perform slaughtering. So to compare the weight gains with carcass traits was difficult. Such relatively newer idea was introduced to check the growth indirectly by assessing the back fat layer by ultrasonography examination. This technique could be used very easily in the breeding stock or in the animals where slaughtering is difficult and would be a useful addition in the field of science.

Table V. BCS and BFLM of male camel calves fed with 18% and 22% CP ration.

Parameter	18% CP ration	22% CP ration
BCS	4.4±0.9	4.6±0.5
BFLM	4.8±0.4	4.9±0.3

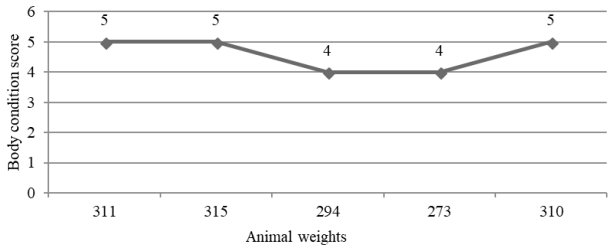


A

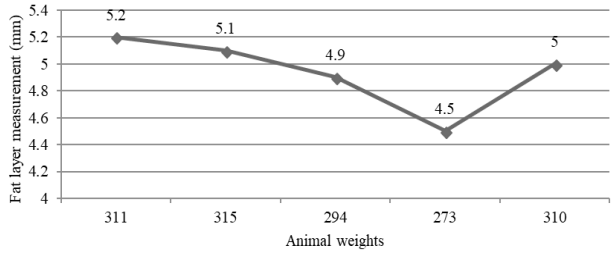


B

Fig. 1. BCS (A) and back fat layer measurement by ultrasonography (B) in 5 male camel calves of different weights fed 18% CP ration.



A



B

Fig. 2. BCS (A) and back fat layer measurement by ultrasonography (B) in 5 male camel calves of different weights fed 22% CP ration.

Table VI. Economics of male camel calves fed with 18% and 22% CP ration.

	18% CP ration	22% CP ration
Cost of concentrate @ PKR 24/kg	PKR 7042	PKR 7849
Cost of fodder @ PKR 5.88/kg	PKR 8795	PKR 8912
Cost of crop residues @ PKR 3.38/ kg	PKR 426	PKR 426
Total feed cost	PKR 16263	PKR 17187
Milk saved @ 6 kg/d over 90 days (540 kg) milk cost PKR 60/kg	PKR 32400	PKR 32400
Saving (milk cost-feed cost)	PKR 16137	PKR 15213

Economics

Economics of weaned Marecha calves rearing was calculated by considering the costs of concentrate, fodder, crop residues and by milk saved. Total feed cost in 18% CP group was PKR 16,263 while milk saved @ 6 kg/d over 90 days with cost PKR 60/kg resulted in the savings of PKR 16,137. On the other hand, total feed cost in 22% CP group was PKR 17,187, while milk saved @ 6 kg/d over 90 days with cost PKR 60/kg resulted in the savings of PKR 15,213 (Table VI). There is no big difference in the weight gain on feeding 18% and 22% CP rations in camel calves. But the 22% CP ration costs Rs. 800 more than 18% CP ration. So it is

recommended that, for weight gain in feedlot in camel calves the 18% protein is enough than using higher protein rations, which will add in the cost of feeding.

CONCLUSION

Offering two levels of protein (18% and 22% CP) to Marecha camel calves indicates that calves can attain a growth rate of ~1 kg/d. If given better facilities and care, this growth rate can be even higher. This indicates a great potential of feedlot and become a good candidate for feedlot system in desert conditions.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the support of management of Camel Breeding and Research Station (CBRS) Rakh Mahni and financial support of Higher Education Commission (HEC) Islamabad, Pakistan, for completion of this study.

Statement of conflict of interset

The authors declare there is no conflict of interset.

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