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Research Article

Some Feedlots Do Not Change Biochemical and Wool Mineral Profile in Dromedary Calves

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All authors contributed to make the completion of this manuscript possible. AF conducted research and wrote the paper. AW and NAT helped in analysis. MSN and NUK helped in conducting the research. AP helped in write-up. ABM reviewed the article.

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Camel calves, Serum profile, Blood biochemicals, Wool minerals, Feedlot

Abstract | The present study was undertaken to evaluate the blood biochemical and wool mineral profile of Marecha dromedary camel calves reared in intensive management system (IMS) by feeding two different dietary regimes. The study was conducted at camel breeding and research station (CBRS) Rakh-Mahni tahsil Mankera of district Bhakkar-Punjab, Pakistan. Ten male calves of 310±35 days of age were raised in stall-fed conditions. They were fed two isocaloric diets with different protein levels as 18% (G1) and 22% (G2). Regarding roughage proportion lucerne and gram crop residues were fed. Daily feeding allowance was offered as 3% body weight. Water was provided twice a day. In blood-biochemical analyses, level of Hb (hemoglobin) concentration ($P<0.05$) was found to be significantly different as 16.4±0.14 and 16.8±0.09 (g/dL) with G1 and G2, respectively. The concentration levels of cholesterol, triglycerides, urea, creatinine, albumin, total-protein, glucose, Ca and P were found significantly ($P<0.05$) varied among groups. Regarding hair mineral profile, concentrations of Cu and Mn were found non-significantly ($P>0.05$) varied among the groups while concentrations of Ca, Mg, Zn and Fe were found non-significantly ($P>0.05$) varied between groups fed with ration I and II.

Novelty Statement | The blood and wool mineral study is an indirect tool for assessing the general health status of animal. But unfortunately, a little is known about blood biochemicals and wool mineral profile of camel calves in Pakistan. This is the first study in respect which gives picture about these parameters in intensive conditions. It will be a useful addition to build the country's primary database for future studies of this field.

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Introduction

Pakistani camels perform very well in harsh and hostile deserts due to their adaptation in native environment by providing milk and meat in pastoral areas (Faraz *et al.*, 2019a). The cameleers are always in move over large areas for water and food for camels which are mostly raised in extensive management system (Omer *et al.*, 2008). Now days the pastorals are shifting to intensive systems from their traditional practices resulting in flux of camel husbandry system. Due to this changing scenario there is a

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need to take multi disciplinary studies for overall evaluation (Khan *et al*., 2003) and to assess the metabolic changes by studies under intensive management. Such studies have to be realized to obtain the primary data on Pakistani camels and their production potential in more intensive context. Biochemical parameters in camel were widely investigated, at least for blood chemicals (Faye and Bengoumi, 2018). The investigation of wool mineral analysis as indicator of feeding status of camel was less studied. At any case, there are few data in Pakistan regarding the variability of blood biochemistry according to the feeding system in intensive conditions. Realizing this, the present study was designed and executed to know about blood biochemicals and wool minerals profile of Marecha camel calves in feedlot.

Materials and Methods

Metrological conditions of study area

The CBRS is located in the deserted plain of Thal. There is subtropical, continental, and arid to semi-arid climate having mean summer temperature as 45.6 ºC and winter as 5.5-1.3 ºC. Annual mean rainfall is 150-350 mm increasing from South to North (Rahim *et al*., 2011).

Experimental animals management

Ten male dromedary calves of Marecha breed aged about 310±35 days were used to study blood biochemical and wool mineral profile. Before the start of experiment, all calves were marked by color demarcations on neck region and were dewormed with 1% Ivermectin @ 1ml/50kg bodyweight. The trial was of 90 days with 15 days as adaptation period and the calves were housed in semi-open pens.

Feeding plan

Calves were reared in feedlot conditions in 2 groups having five each under IMS. Calves were fed at ratio of 60:40 with roughage and concentrate. The 70:30 was ratio between lucerne (*Medicago sativa*) and gram straw (*Cicer arientinum*) in 60 proportion. The proximate analysis including dry matter, crude protein, ether extract, crude fiber, neutral detergent fiber, acid detergent fiber and crude ash values of gram straw and lucerne were 93.53, 18.2; 9.72, 22.5; 2.60, 1.7; 44.4, 24; 68.7, 42.4, 47.6, 29.6 and 7.83, 12.4 %, respectively. They were watered twice daily and fed two isocaloric rations with different levels of protein, G1 and G2 with 18 and 22 % (Table 1). Daily feeding allowance @ 3% body weight was adjusted fortnightly as per calculated live weights. The calves were weighed on Impressum computerized digital weighing scale.

Data collection

As initially the calves were of same age and condition so blood samples taken towards end of experiment by jugular puncture for hematological analysis in two sets contained EDTA and without for serum separation. Hair sampling was performed from neck, shoulder, hump and mid-region of body. The stainless-steel scissors were used to clip hair into pieces of one-centimeter length from all parts by well-mixing for homogeneity.

Table I. (a) Ingredients of experimental rations (b) chemical composition of experimental rations

(a) 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
(b) Parameters (%)	**Ration-I**	**Ration-II**
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

Laboratory analysis

The concentrate, gram straw and fodder samples of the browsing material were analyzed for percent dry matter, crude protein, crude fiber, ether extract and ash by using standard procedures as described in AOAC (1990). Neutral detergent fiber and acid detergent fiber was determined by the methods of Van Soest *et al*. (1991). The blood samples were studied for hematological and biochemical analysis like Hb, triglycerides, cholesterol, urea, albumin, total-protein, Ca and P. The 2 ml of plasma with equal volume of nitric acid was mixed in Kjeldhal digestion tube. The samples were kept for overnight and heated over the digestion bench at below 90 ºC up to half. After that 5 ml of the double acid mixture containing 3 parts of nitric acid with 1 part of 70% per-chloric acid were added to it and again digested, till white fumes were emanated and the volume was reduced to 0.5 ml only. The digested sample was cooled and diluted to 50 ml with distilled water. The calcium and phosphorus concentrations were determined by atomic absorption spectrophotometer (Method 965.9A) as described in AOAC (1990). Hemoglobin in blood sample while triglyceride, cholesterol, urea, albumin and total-protein in serum samples were estimated by using standard kits by Spin-react, Spain in hematology (BC 2300, Mindray Germany) and biochemistry (DL 9000, Italy) analyzers, respectively.

The hair samples were mixed properly, washed with

acetone, filtered and rinsed by water. After drying in hot air oven, 0.5 g sample was used for the further processing. The 2 ml concentrated nitric acid 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 per-chloric 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 make a total volume of 10 ml. The solution was used for determination of important macro-minerals and micro-minerals. The concentrations of Ca, Mg and Cu (macro) and Zn, Fe and Mn (micro) minerals were determined by using atomic absorption spectrophotometer (Method 965.9A) as described in AOAC (1990).

Statistical analysis

The SPSS (SPSS, 2008) software was used to analyze the data statistically by applying t-test on different parameters (Gecer *et al*., 2016).

Results and Discussion

Current study was limited to the evaluation of biochemical status in blood and wool at the end of experiment. For different reasons, it was not possible to have a starting point at the beginning of the trial. However, this study was aimed to assess the status after 3 months of feeding at 2 different protein levels. The blood-biochemicals like Hb, triglycerides, cholesterol, albumin, total-protein, creatinine, urea, glucose, calcium and phosphorus were determined in this trial (Table 2).

Hemoglobin

The Hb mean values were found significantly different (P<0.05) as to be 16.4±0.14, 16.8±0.09 between groups. Higher value of Hb was found in G2 probably due to increased testosterone effects to produce ↑ erythropoietin which accelerates erythropoiesis in kidneys (Murphy, 2014). Hb concentration varies in range of 13-16 g/dl, which is relatively higher compared to other domestic animals. It is recognized that the camel's hemoglobin has higher affinity for oxygen (Bogin, 2000; Ouajd and Kamel, 2009).

The mean values of Hb was found 13.3±0.6 in dry-adult, 12±0.2 in lactating and 10.1±0.8 g/dl in calves of Saudi dromedary camel (Al-Busadah and Osman, 2000). Hassan *et al*. (1968) reported Hb concentration as 8.9-15 g/dl, 7.8-15.9 g/dl by McGrane and Kenyon (1984), 11.4-14.2 g/dl by Higgins and Cock (1984) and 11.5 g/dl by Omer *et al*. (2006). In 2008, Sudanese scientist Omer with his coworkers investigated the hematological parameters of *camelus dromedarius* calves and found higher Hb concentration (P<0.05) in suckling-calves as 11.42±1.20 compared to their lactating-dams as 10.69±0.62 g/dl.

Table II. Blood biochemicals of male camel calves fed with 18% and 22% CP ration

Parameter	Ration-I (n=5)	Ration-II (n=5)
Hemoglobin (g/dL)	16.4.±0.14 [a]	16.8±0.09 [b]
Cholesterol (mg/dL)	46.7±3.28	49.3±2.40
Triglycerides (mg/dL)	39.0±1.92	40.4±2.40
Urea (mg/dL)	36.9±0.60	37.4±0.81
Creatinine (mg/dL)	1.9±0.11	2.2±0.18
Total Protein (g/dL)	6.3±0.20	6.6±0.16
Albumin (g/dL)	1.3±0.12	1.4±0.09
Sugar (mg/dL)	128.6±4.51	150.2±9.47
Calcium (mg/dL)	9.6±0.66	10.4±0.60
Phosphorus (mg/dL)	4.7±0.26	4.8±0.24

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

In Pakistan, reported range of Hb was 7-17 g/dl in dromedary males in Cholistan desert (Farooq *et al*., 2011). The reported concentration of Hb was found to be varied in majority of the cases between 9.3 and 15.5 g/dl by Faye and Bengoumi (2018). Reported Hb concentration was 14.80±1.15 g/dl in male dromedary camels (Al-Harbi, 2012). Hb concentration of dromedary camels in Bangladesh was 10.4 g/dl (Islam *et al*., 2019). Ghafoor *et al*. (2018) studied prevalence of hemoparasites of camels (*Camelus dromedarius*) in Thal desert Pakistan in winter and reported average negative concentration of Hb as 11.78±0.57 g/dl.

Elitok and Cirak (2018) reported Hb concentration as 12.43±0.19, 12.43±0.18 g/dl in pregnant and non-pregnant she-camels while 14.20±1.55 and 14.80±1.15 g/dl in males of rut and non-rut season, respectively. Abdalmula *et al*. (2018) checked blood profile of normal Libyan dromedary camel and reported Hb concentration and range as 12.55±0.27 and 7.28-17.70 g/dl, respectively. Abdalmula *et al*. (2019) studied effect of sex on blood profile of normal Libyan dromedary camel and reported hemoglobin concentration as 11±0.41 and 13.44±0.27 g/dl respectively, in males and females.

Energetic parameters

The mean values of cholesterol, triglycerides and glucose were found to be varied (P>0.05) between G1 and G2. All values found in higher normal range as the calves were in active metabolic state. Osman and Al-Busadah (2003) reported that the higher lactic acid contents found in blood of camels may be due to the increased level of glucose. Contrary to these findings Bhakat *et al*. (2008) reported significant values (P<0.05) for triglycerides as 34.8±3.7, 19.1±2.9 mg/dl respectively, in IMS and SIMS. Lower glucose concentration (P<0.05) was found in pre-pubescent grazing dromedary camels than stall-fed under traditional management system (TMS) in arid western

Rajasthan-India (Saini *et al.*, 2014). The serum profile of Indian weaned dromedary calves was determined by Nagpal and co-workers (2012) and reported glucose, cholesterol and triglycerides concentration was 110.5±3.7, 105.5±0.8; 35.8±3.4, 28.0±1.4; 28.3±1.3, 48.4±2.8 mg/dl respectively, at 6 and 9 months age.

Normal serum biochemical concentrations of Saudi Arabian dromedary camel were investigated by Osman and Al-Busadah (2003) and found values for glucose, cholesterol and triglycerides as 134.4±11, 58.4±8.6 and 31.4±3 mg/dl, respectively. In other reports about Saudi dromedary camel cholesterol range was found to be 34.2-75.6 mg/dl (Sarwar *et al.*, 1992; Al-Busadah, 2007). Reported normal plasma glucose concentration varied between 60-140 mg/dl (Faye and Bengoumi, 2018).

Protein parameters

The mean values of urea, creatinine, total-protein and albumin were found to be different (P>0.05) between G1 and G2. Creatinine – an anhydride of creatine phosphate, is a routine product which is excreted on regular basis formed due to muscle metabolism (Brar *et al.*, 2000). The values of albumin and total-protein were found to be ↑ because animals showed ↑ growth rate being in active fattening condition. Furthermore, the serum electrolytes were found higher and their ratio related with age-factor being higher in growing and early age (Faye and Bengoumi, 2018). Both energetic and protein parameters testify the highest proteo-energetic value of camel diet in intensive system.

Blood biochemical parameters of Indian dromedary calves were determined by Bhakat *et al.* (2008) and reported differences (P<0.05) for total-protein as 6.3±0.3, 4.7±0.4 g/dl respectively, in IMS and SIMS, while differences found for albumin and urea were non-significant. In another study, Saini *et al.* (2014) found (P<0.05) ↑ urea concentration in pre-pubescent grazing dromedary camels than stall-fed under traditional management system (TMS) in arid western Rajasthan-India

The normal serum biochemical values of Saudi Arabian dromedary she-camels were determined and reported concentration of urea, creatinine as 49.8±5.5, 1.5±0.1 mg/dl and total-protein, albumin as 7.1±0.3, 3.7±0.3 g/dl, respectively. Reported values for albumin were 2.5-5.2, 3-4.4, 3.3 and 4.5 g/dl respectively (McGrane and Kenyon, 1984; Higgins and Cock, 1984; Omer *et al.*, 2006; Osman and Al-Busadah, 2000), respectively in dromedary camels. In addition to this, reported creatinine concentration was 0.16-0.5 mmol/L in dromedary camels of KSA (Sarwar *et al.*, 1992; Al-Busadah, 2007). In another study, Nagpal and co-workers (2012) determined the serum profile of Indian weaned dromedary calves and found total-protein and albumin as 5.7±0.2, 5.1±0.2 and 3.7±0.1, 3.7±0.1 g/dl and urea as 20.0±1.1, 25.4±1.7 mg/dl at 6 and 9 months age, respectively. Reported range of normal urea and creatinine concentrations in blood varied between 5-40 and 0.8-2 mg/dl while serum albumin concentration 25-45 g/l in camels (Faye and Bengoumi, 2018).

Minerals

The mean values of Ca and P were found to be different (P>0.05) between G1 and G2. All values were found to be higher. The importance of calcium and phosphorus losses in lactating or pregnant adult camels to milk or fetus explains obviously the sex difference in those minerals status. Regarding the young camel calves, the growth of males being globally higher than for females, calcium metabolism under hormonal regulation of thyroid and parathyroid is more active in male than in female (El-Khasmi *et al.*, 2000). In 2008, Indian scientist Bhakat with co-workers determined the blood mineral profile of dromedary calves in response to management system and found (P>0.05) differences regarding calcium and phosphorus. The blood values of Saudi Arabian dromedary camel were determined by Sarwar *et al.* (1992) and Al-Busadah (2007) and reported calcium was 7.6-13.1 mg/dl. In 2012, Nagpal with co-workers studied the serum profile of Indian weaned dromedary calves and found calcium and phosphorus as 10.9±0.3, 11.1±0.5 and 8.7±0.4, 7.0±0.6 mg/dl respectively, at 6 and 9 months age. Reported reference values of calcium and phosphorus varied between 8.4-12.4 and 4.8-8.4 mg/dl, respectively in camels (Faye and Bengoumi, 2018).

Hair mineral analyses

The mean values of macro minerals (Ca, Mg), and trace elements (Cu, Fe, Zn, Mn) of male dromedary camel calves in G1 and G2 (Table 3) were found to be different (P>0.05) except Cu and Mn. The general health status of animal could be assessed by the determination of mineral hair composition which is an indirect tool and an accumulative mineral nutrition witness. The observed differences reflect the better mineral nutrition in intensive system. Little work has been reported on wool mineral analyses of Pakistani camel calves yet. Faraz *et al.* (2019b) determined the growth performance and hair mineral analyses of Marecha dromedary calves in response to management system and reported ↑ weight gain and mineral concentrations in calves of IMS than semi-intensive (SIMS) management system. In 2009, Indian scientist Bhakat with coworkers studied hair mineral profile of dromedary calves in response to management system and found higher values of minerals (macro and micro) in SIMS reared calves. The reported concentrations of calcium, magnesium, copper, zinc, iron and manganese were 549.6±74.5, 434.4±60.2 and 719.7±78.6, 476.0±128.0; 88.9±2.4, 67.6±6.3 and 77.5±3.7, 69.8±3.2; 6.7±0.7, 4.3±0.4 and 7.4±0.7, 5.7±1.0; 66.0±4.4, 57.6±2.3 and 64.3±2.0, 54.8±1.5; 285.7±26.6, 216.0±30.9 and 319.4±27.9,

261.9±33.4; 21.6±3.7, 20.6±1.0 and 45.8±1.8, 32.9±4.4 mg/dl in calves of SIMS and IMS with *Cyamopsis tetragonoloba* and *Phaseolus aconitifolius* feeding, respectively. Moreover, relationship between physical, chemical and industrial characteristics of different dromedary camel's hair types was studied by Helal (2015) who reported higher concentrations of B, Cd, Co, Cr, Fe, Mn, Ni and S in fine hairs of Maghrebi camels while Mo, Pb and Zn were higher in coarse fibers. Furthermore, the similar studies done on horses (Or *et al*., 2004) and yaks (Chattergee *et al*., 2005) revealed that level of some mineral elements were affected by nutritional differences.

Table III. Wool mineral analysis of male camel calves fed with 18% and 22% CP ration.

Parameter (mg/dL)	Ration-I (n=5)	Ration-II (n=5)
Calcium	677.0±22.87	718.6±29.50
Magnesium	107.4±3.08	114.9±3.14
Copper	7.4±0.23 [a]	8.1±0.19 [b]
Zinc	68.5±1.78	74.0±1.79
Iron	329.4±4.92	342.6±5.91
Manganese	48.4±1.06 [a]	54.0±1.48 [b]

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

Conclusion

The deviation from normal limits for a certain blood parameter could be used as guide for disease diagnosis. Constituents entering into body are accumulated in hairs also reflect the nutritional status of the animal. These levels could be used in diagnosis of disease condition and metabolic disorders in animal. In addition to nutritional status of animal the mineral accumulation in the soil can be judged by these means very easily. This paper describes the hemoglobin, serum biochemicals and hair minerals status of young dromedary calves which did not change in feedlot system under desert conditions and could be used as primary data base for the future studies of this field.

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Conflict of interest

The authors have declared no conflict of interest.

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