Study on Certain Blood and Serum Parameters of Camel *Camelus dromedarius* Maintained on Different Diets

Rakesh Poonia¹, Aakash Srivastava², Suchitra Sena³, Meera Srivastava¹

¹Post-Graduate Department of Zoology, Govt. Dungar College, Bikaner 334001, Rajasthan, India
²SP Medical College, Bikaner, Bikaner 334001, Rajasthan, India
³National Research Centre on Camel, Bikaner, Bikaner 334001, Rajasthan, India

Abstract

Animals including camel (*Camelus dromedaries*), have been domesticated by man since ancient times especially in Rajasthan. Due to harsh climatic conditions there is often scarcity of grazing pastures in this area and therefore during summers camels are fed roughages and concentrates, as there remains no option to the local farmers. As a result, the proportion of the concentrate and roughage in the complete ration is expected to change the microbial population in the rumen, which in turn is expected to affect their capacity to colonize feed particles and may influence the nutrient utilization from the feed. Cluster bean (guar) belonging to family Leguminosae is one of the most suitable feed in arid areas. Besides, camels are also fed some millet flour or barley flour and gur (molasses) 1g/kg body weight. If this molasses is given in excess amount, it causes gastrointestinal disorders. Due to introduction of new feed resources, this study was an attempt to investigate certain blood and serum parameters of camels maintained on different diets. An experimental trial was conducted in three groups of camels aged 3-4 years, each group comprising of 4 camels. Three experimental groups were framed Group 1 camels were fed guar phalgati (*Cyamopsis tetragonoloba*) and ground nut (*Arachis hypogaea*) chara in 1:1 ratio. Group 2 camels were provided ground nut chara alone while, to Group 3 camels jaggery 50% w/v was administrated orally at the dose 15 g/kg body weight apart from feeding of ground nut chara. The blood samples were collected for hematological, serum biochemical and enzymatic variations. Based on biochemical and enzymatic profile comparison, in the Group 3 camels a significant change in the digestive pattern leading towards acid indigestion was noted. There was an insignificant variation among the enzymatic and biochemical profile of Group 1 and Group 2. From the above blood and serum biochemical and enzymatic changes noticed in different groups fed with different diets, it can be envisaged that there exists a significant role of plan of nutrition on digestive pattern.

1 Introduction

The camel *Camelus dromedaries* due to its adaptation to hot and arid environment have been domesticated by the farmers of Rajasthan. It is classified as pseudo-ruminant because it differs from true ruminants in structure of its compound stomach being two-chambered, with a fore stomach (comprising the reticulo-rumen) and a tubular stomach with the presence of glandular sacs as differentiating character from the true ruminant stomach. Rumen fermentation can supply 70-100% of ruminant animals amino acid supply and 70-85% of the energy supply can be absorbed as volatile fatty acids, the main end product of microbial fermentation. More than 70% and often as much as 95% of the feed selected by camel is composed of dicotyledons (plants with broad leaves including browse and legumes). Cluster bean (guar) is a crop belonging to family Leguminosae.
which is drought resistant and most suitable in arid areas. After screening of seeds popularly known as guar phalgatti (which includes stem and empty pods of the plant), an appreciable amount of edible biomass is obtained as waste or byproduct. As there remains no option to the farmers, the camel under conditions of scarcity of grazing, especially in summer, is fed roughages and concentrates. Dry roughages consist of bhoosa (straw), leaves and pods collected during previous productive seasons. Chaffed grass also admixed with straw sometimes of more than one crop to feed the camels. It is expected that the proportion of the concentrate and roughage in the complete ration would change the microbial population in the rumen, which in turn would affect their capacity to colonize feed particles and will then influence the nutrient utilization from the feed. The nutritional value of feed is influenced by the feed characteristics, and their influence on rumen microbial characteristics, knowledge of both, and their interaction can contribute to a better understanding of the nutritional qualities of ruminant feed stuffs.

In developing countries like India where economy is growing, the supply of well established diet to the cattle is not possible for poor animal holders, especially to the camel because it needs so much dry matter and concentrates to fulfill its daily feed requirements. So common keepers most often do not feed concentrate to their camels, unless they become rundown. In that case, they feed some millet flour or barley flour and gur (molasses) 1g/kg body weight for a few days till the camel regains his condition. If this molasses is given in an excess amount, it causes gastro-intestinal disorders. As of blood, the rumen fluid profiles too are important diagnostic tools and definitely are important in adjudging the health status of animals including camel. These have been used widely to identify problem and to indicate dietary causes of diseases or low production. Due to introduction of new feed resources, this study was an attempt to investigate the effect of different diets on certain blood parameters of camels. Besides, the authors have also conducted studies on serum proteins and rumen enzymes of camel12.

2 Materials and Method

2.1 Administration of dietary food

The present investigation was carried out in three groups of four camels each, at National Research Center on Camel, Bikaner, maintained on different diets. Group 1 camels were given guar phalgatti (Cyamopsis tetragonoloba) and ground nut (Arachis hypogaea) chara in 1:1 ratio. To Group 2 camels ground nut chara alone was fed while to Group 3 camels jaggery 50%w/w was provided as a single dose orally at the dose 15g/kg body weight apart from these being fed with ground nut chara. To confirm the clinically healthy status of camels of all the three groups, de-worming was done with a broad spectrum anti-helminthes prior to the start of the experiment. All three groups of camels were given ad lib water. Groups 1 and 2 camels were maintained on the above said diet for a period of one month. The blood samples were collected for hematological, serum biochemical and enzymatic variations. In group 3 animals the blood samples were collected after 24 hrs of administrating jaggery.

2.2 Collection of blood sample

The blood samples were collected from jugular vein in heparinized glass vials for estimation of Packed Cell Volume (PCV), Haemoglobin (Hb), Total Leucocyte Count (TLC) and Differential Leucocyte Count (DLC). 5ml of blood sample was collected in clean glass tubes and allowed to clot for separation of serum. The serum samples were stored at -20°C for use at convenience. The haematological parameters were estimated within 5-6 hours of collection of sample. All biochemical estimations were done on the same day of collection of samples. Packed cell volume was assessed following Microhaematocrit method, and haemoglobin, TLC and DLC were estimated as given by Schalm et al.12 For estimation of total protein concentration in the serum sample, kit method was adopted based on Biuret procedure4. The concentration of glucose in serum was determined by kit method, based on GOD/POD method6.

The activity of serum glutamate pyruvate transferase (Alanine Aminotransferase (ALT)) enzymes was estimated by kit method9. Serum calcium was estimated employing Kit method based on the principle that calcium with Arsenazo 3, 6 disulpho-2, 7 napthalene-bis (azo)- dibenzenearsionic acid) at neutral pH, yields blue colored complex. The colour intensity is indicative of calcium concentration in the sample. Similarly, serum inorganic phosphorous was also assessed using Kit method, which was based on the principle that inorganic phosphorous reacts in acidic medium with ammonium molybdate to form a phosphor-molybdate complex of yellow color. The intensity of color formed is proportional to the inorganic phosphorous concentration in the sample.

2.3 Statistically analysis

3 Results

Hematological Parameters

The results of hematology in different groups of camels are presented in tables 1 and 2. Haemoglobin concentration (Hb)

The mean haemoglobin concentration of Group 1, Group 2 and Group 3 were 12.40, 12.60 and 12.05 g/dl, respectively. The result indicates that there was no significant variation in
haemoglobin concentration among the three groups of camels. The result of hemoglobin concentration is presented in table 1.

**Packed Cell Volume (PCV)**

The mean packed cell volume levels of Groups 1, 2 and 3 were 37.00±0.57, 33.00±0.57 and 39.50±0.95 percent, respectively. The mean packed cell volume of Group 3 was higher as compared to Group 1 and Group 2. The difference between PCV values between these groups was found to be significant (P<0.01). The results of PCV of all the three groups are presented in table 1.

**Total leukocyte count (TLC)**

The mean values of TLC in camels of Group 1, Group 2 and Group 3 camels were 9.97±0.23, 10.15±0.08 and 11.65±0.25 thousands/cum, respectively. The mean values of TLC in these groups were increased subsequently from Group 1 to Group 3. The difference in TLC between these groups was found to be significant (P<0.01). The results of these values are presented in table 1.

**Differential Leucocyte Count (DLC)**

The mean values of neutrophils in Group 1, Group 2 and Group 3 camels were 52.75±1.10, 52.25±0.85 and 59.5±0.86 percent whereas the mean eosinophils level in Group 1, 2 and 3 camels was 7±0.57, 6.5±0.64 and 3.75±0.47 per cent respectively. The basophils and lymphocyte levels in Group 1, 2 and 3 were 0.25±0.25, 0.5±0.25 and 3.5±0.64 per cent, and 35±1.29, 34.25±1.37 and 28.25±0.85 per cent respectively. The mean per cent of monocytes in Group 1, Group 2 and Group 3 animals were 5±0.40, 6±0.86 and 5±0.40 respectively. In Group 3 a significant (P<0.01) high percentage of neutrophils and basophils was found in respect to Groups 1 and 2 and also a significant (P<0.01) low level of eosinophils and lymphocytes was noted. No significant variation was found in monocytes among these three groups of animals. The results of DLC are presented in table 2.

### Table 1: Hematological parameters (*) in different groups of camels fed with different diets

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hb (g/dl)</td>
<td>12.40±0.29a</td>
<td>12.60±0.36b</td>
<td>12.05±0.27ab</td>
</tr>
<tr>
<td>PCV ** (%)</td>
<td>37.00±0.57a</td>
<td>33.00±0.57a</td>
<td>39.50±0.95a</td>
</tr>
<tr>
<td>TLC** (thousands/ccm)</td>
<td>9.97±0.23a</td>
<td>10.15±0.08b</td>
<td>11.65±0.25ab</td>
</tr>
</tbody>
</table>

*values given are Mean±SE.; ** (P<0.01: significant at 1% level; Figures with similar superscripts reveal significant difference between groups). Similar superscripts in group 3 and group 1 for Hb level mean that it showed significant difference. While group 2 and group 3 have similar superscripts means they showed significant difference. Group 1 and group 2 have different superscripts for Hb levels it means that they do not showed significant difference. For PCV level all groups have similar superscripts it means that they showed significant difference with each other. For TLC same condition persists as for Hb level.

### Table 2: DLC (*) values in different groups of camels fed with different diets

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrophils**</td>
<td>52.75±1.10a</td>
<td>52.25±0.85b</td>
<td>59.5±0.86ab</td>
</tr>
<tr>
<td>Eosinophils**</td>
<td>7±0.57a</td>
<td>6.5±0.64b</td>
<td>3.75±0.47ab</td>
</tr>
<tr>
<td>Basophils**</td>
<td>0.25±0.25a</td>
<td>0.5±0.28b</td>
<td>3.5±0.64ab</td>
</tr>
<tr>
<td>Monocytes</td>
<td>5±0.40</td>
<td>6.5±0.86</td>
<td>5±0.40</td>
</tr>
<tr>
<td>Lymphocytes**</td>
<td>35±1.29a</td>
<td>34.25±1.37b</td>
<td>28.25±0.85ab</td>
</tr>
</tbody>
</table>

*values given are Mean±SE.; ** (P<0.01: Significant at 1% level; Figures with similar superscripts reveal significant difference between groups). For neutrophils group 1 and group 3 have similar superscripts means they showed significant difference. Group 2 and 3 also have similar superscripts so they also showed significant difference. While group 1 and 2 have different superscripts so they do not showed significant difference. Same conditions occur for eosinophils, basophils and lymphocytes. Monocytes level do not show any significant difference among groups.

### Serum Biochemical Parameters

**Total protein**

The result of total serum protein levels in three groups are presented in Table 3. The mean value of serum total proteins in camels of Group 1, 2 and 3 were 6.79±0.11, 6.15±0.10 and 6.92±0.04 g/dl respectively. The mean values of serum total proteins were high in Group 3, followed by Group 2 and Group 1. The increase in the levels of total serum protein profile between the groups was significant (P<0.01).

**Serum glucose**
The mean values of serum glucose in Group 1, Group 2 and Group 3 animals were 71.42±1.26, 64.54±0.93 and 52.50±2.07 mg/dl, respectively as presented in table 3. The mean values of serum glucose levels in these groups decreased gradually towards Group 3. The decrease in serum glucose level was significant (P<0.01). Even though there was a decrease, the serum glucose levels were in the normal range in all the groups.

**Serum Enzyme levels (ALT and AST)**

The mean values of serum ALT in Groups 1, 2 and 3 were 12.5±1.44, 13.5±1.70 and 26.5±2.10 U/L respectively. The AST concentration in serum of Group 1, Group 2 and Group 3 were 131.75±5.66, 137.25±8.63 and 230.75±15.97 U/L, respectively. These results show higher activity of both serum ALT and serum AST in Group 3 camels in comparison to Groups 1 and 2. There was significant (P<0.01) change in the Group 3 as compared to both Group 1 and 2. The results of these findings are presented in table 4.

**Serum macro minerals (Calcium and Phosphorus)**

The concentration of calcium and phosphorous in Groups 1, 2 and 3 were 10.28±0.27, 9.85±0.38 and 8.45±0.19 mg/dl, and 4.47±0.19, 4.44±0.18 and 2.81±0.17 mg/dl respectively. Low concentration of both calcium and inorganic phosphorous was found in serum of Group 3 camels in comparison to Groups 1 and 2. The results of both parameters are presented in Table 5. There was significant variation in calcium and phosphorus levels in between the groups (P<0.01).

**Table 3: Serum protein profile (*) and glucose (*) in different groups of camels fed with different diets**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group-1</th>
<th>Group-2</th>
<th>Group-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Protein** (g/dl)</td>
<td>6.79±0.11</td>
<td>6.15±0.10</td>
<td>6.92±0.04</td>
</tr>
<tr>
<td>Albumin** (g/dl)</td>
<td>3.3±0.04</td>
<td>3.06±0.04</td>
<td>3.37±0.01</td>
</tr>
<tr>
<td>Globulin** (g/dl)</td>
<td>3.48±0.06</td>
<td>3.09±0.05</td>
<td>3.55±0.02</td>
</tr>
<tr>
<td>A : G ratio**</td>
<td>0.94±0.005</td>
<td>0.98±0.002</td>
<td>0.94±0.004</td>
</tr>
<tr>
<td>Glucose** (mg/dl)</td>
<td>71.42±1.26</td>
<td>64.54±0.93</td>
<td>52.50±2.07</td>
</tr>
</tbody>
</table>

*values given are Mean±SE; **(P<0.01: significant at 1% level; Figures with similar superscripts reveal significance between groups). For total protein group 1 and group 2 have similar superscripts it means that they showed significant difference. Group 2 and group 3 also have significant difference because they have similar superscripts. While group 1 and 3 have different superscripts it means they do not show significant difference. Same conditions persist for all the table 3 parameters.

**Table 4: Serum ALT and AST values (*) in different groups of camels fed with different diets**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALT** (U/L)</td>
<td>12.5±1.44</td>
<td>13.5±1.70</td>
<td>26.5±2.10</td>
</tr>
<tr>
<td>AST** (U/L)</td>
<td>131.75±5.66</td>
<td>137.25±8.63</td>
<td>230.75±15.97</td>
</tr>
</tbody>
</table>

*values given are Mean±SE; **(P<0.01: significant at 1% level; Figures with similar superscripts reveal significant difference between groups). Similar superscripts in group 3 with group 1 and group 2 of ALT level means that they showed significant difference among each other while group 1 and group 2 have different superscripts for ALT levels so they did not show significant difference. Same condition persists for AST level.

**Table 5: Serum calcium and phosphorous values (*) in different groups of camels fed with different diets**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium** (mg/dl)</td>
<td>10.28±0.27</td>
<td>9.85±0.38</td>
<td>8.45±0.19</td>
</tr>
<tr>
<td>Phosphorous** (mg/dl)</td>
<td>4.47±0.19</td>
<td>4.44±0.18</td>
<td>2.81±0.17</td>
</tr>
</tbody>
</table>

*values given are Mean±SE; **(P<0.01; significant at 1% level; Figures with similar superscripts reveal significant difference between groups). Groups with similar superscripts showed significant difference. For eg. In above table phosphorous level in group 1 and 3 showed significant difference while group 1 and 2 showed no significant difference because they have different superscripts. Similarly group 2 showed significant variations with both group 3. For calcium level group 1 and 3 have similar superscripts so they showed significant difference. Group 2 showed no significant difference with group 1 and group 3.

**4 Discussions**

There was a significant variation in the mean haematological profile of PCV, TLC, neutrophils, eosinophils, basophils and lymphocytes among the three groups (P<0.05). The mean values of hemoglobin (Hb) and monocytes showed no significant changes among the three groups of camels. The mean TLC, DLC except monocytes showed a significant change in the Groups 1 and 2 as well as Groups 2 and 3 based on a
paired t-test. The mean PCV revealed a significant change in the Groups 1 and 2 as well as 2 and 3. There was a significant change in the haemoglobin content (P<0.05) of Groups 1 and 3. The increase in PCV was in agreement with earlier observations. Lal et al. observed a higher value of PCV in acidosis in camels induced by administrating jaggery at the dose 15gm/kg body weight. Mishra et al. found high PCV in Rathi calves when they fed 'Pala' (Ziziphus numelaria) ad lib and moth churi concentrate at the dose 1kg/calf. An increase in PCV was noticed in camels fed with seasonal roughage diets (ground nut chara, guar phalgati, mothchara and channa chara). On the contrary, Turker et al. found reduction in PCV during omal impaction in cattle. During the present study, the higher PCV was observed in Group 2 camels fed with groundnut chara alone and varied significantly with both the groups. The increase in PCV in acidic camels was apparently due to hemoconcentration associated with dehydration.

An increase in total leucocyte count (TLC) of Group 3 camels in the present study was found similar to the earlier reports. In this study, Group 3 camels were found to have significant increase in neutrophils and basophils and significant decrease in lymphocytes, which is similar to the findings of Mishra et al. and Turker et al. in respect to neutrophil and basophil levels. On the contrary Mali et al. revealed that lymphocytes, monocytes, basophils and eosinophils increased and neutrophils decreased in cattle suffering from acid indigestion. This might be due to first line of defence. The haemoglobin levels were in normal range in all the three groups of camels during the present study and these results are supported by the earlier observations. On other hand slight increase but not significant elevation in haemoglobin concentration has also been also documented. This elevation may be accounted for dehydration due to impaction, induced intraruminal pressure in intestine and resultant outpouring of extracellular fluid.

The serum biochemical changes in the present investigation showed that in Groups 1 and 2 camels the levels were in the normal range. While in Group 3 camels the serum glucose was decreased and revealed a significant change in comparison to Groups 2 and 3. The hypoglycemic condition of camels during the present study is consistent with the earlier findings. On the contrary, feeding of clusterbean straw based complete feed in loose and compressed form had no adverse effect on the serum glucose level in sheep suggested by Saini et al. Even though the serum glucose were in the normal range in all the groups in the present study, the animals fed guar phalgati and groundnut chara showed higher glucose levels and the animals administered jaggery showed slightly lower levels. The present findings are in contradiction to the reports of previous studies in which hyperglycemic effect was observed in animals with acid indigestion, and this effect arose when wheat flour at the dose 30mg/kg body weight, sucrase at the dose 23.5g/kg body weight and crushed rice at the dose 40g/kg body weight were administered in animals. The reduction in serum glucose might be because of the fact that few of the camels developed vomition and enteritis and didn’t take a feed. The samples were collected once the clinical condition of the animal became abnormal that’s why the transient changes might have been noticed.

There was a significant change (P<0.01) in the protein levels among Group 1 and 2 and Groups 2 and 3. The concentration of protein was also in the normal range, but the mean levels were higher in Group 3 followed by Groups 1 and 2. In Group 3 camels the changes can be attributed to decreased catabolism of protein. Among the groups, optimum protein levels were seen when camels were maintained on guar phalgati and groundnut chara in comparison to ground nut chara alone, revealing that combination is better. Similar observations were also made by Coffman, Kumar et al. and Khalfipour et al. This significant increase in protein profile was suggested to be due to hemoconcentration and uncompensated dehydration which also seemed to be true for the present findings.

The serum enzyme levels of GOT and GPT showed highly significant variation (P<0.01) between the three groups based on ANOVA. Paired t-test of these data showed that in Groups 1 and 2 there was no significant variation in all the biochemical parameters whereas a highly significant variation (P<0.01) was seen among Groups 1 and 3 and 2 and 3. The mean values of ALT enzyme showed the highest activity of enzyme in Group 3 camels among the three groups in which was almost similar to the findings of Bengoumi et al. and Shukla et al. Bengoumi et al. suggested that ALT activity increased but not significantly in camels during dehydration, and this may be due to the reason that ALT enzyme activity was not affected by the hemoconcentration. Sandhu et al. administered oxytetracycline at the dose 20 mg/kg body weight in buffalo’s calves and observed significant elevation (P<0.05) in serum alanine aminotransferase activity.

High activity of AST enzyme in serum of Group 3 camels were found during the present study which was similar to some earlier observations. Increased ALT activity could be due to hepatic damage as a result of absorption of toxic products from rumen or alimentary tracts. The higher AST activity could be assigned to the hemoconcentration.

The mean levels of calcium also were in the normal range in Group 1 and 2. In Group 3 camels a decline in calcium levels were noticed as compared to Groups 1 and 2 but significant (P<0.05) decline was noticed in comparison to Group 1. Hypocalcaemic effect in Group 3 during the present study is
similar to the earlier findings of Baraka et al., Nikolov et al., Pourjalaf et al., Turkar et al. and Mali et al. Hypocalcemia effect could be attributed to its excretion in urine as observed by Nikolov et al. The changes in blood serum concentration of calcium may be due to both, intake and absorption of electrolytes due to anorexia, or gastrointestinal atony usually associated with primary indigestion.

The mean content of phosphorus in Groups 1 and 2 were in the normal range and there was no significant variation between these groups. There was significant (P<0.01) hypophosphataemia in both the groups. The low level of inorganic phosphorous was observed in Group 3 camels in comparison to Groups 1 and 2 which corroborate with the earlier reports of Baraka et al., Turkar et al. and Mali et al. Higher urinary excretion of inorganic phosphorus about 165 times might be responsible for this effect. High rate of excretion and impaired absorption of the electrolytes during digestive orders might have contributed for the decrease in phosphorus content.

5 Conclusions

It can therefore be concluded that in Group 3 camels, which were given jaggery in addition to groundnut chara showed a significant change in the digestive pattern leading towards acid indigestion based on biochemical and enzymatic profile comparison to Group 1 and Group 2 camels. There was an insignificant variation among the enzymatic and biochemical profile of Group 1 and Group 2. From the above blood and serum biochemical and enzymatic changes noticed in different groups fed with different diets, it can be envisaged that there exists a significant role of a plan of nutrition on digestive pattern.

6 Acknowledgements

The authors thankfully acknowledge the help rendered by the Director, National Research Centre on Camel, Bikaner and Principal, Govt. Dungar College, Bikaner.

7 Conflicts of Interests

We have not declared any conflict of interest.

8 Author's contributions

Rakesh Poonia carried out the complete work, Aakash Srivastava helped in compilation, while Suchitra Sena supervised the work. The entire work was carried out under the Supervision of Meera Srivastava.

9 References


15. Nikolov Y. Bio-chemical alterations in rumen liquor, blood, cerebrospinal fluid and urine in experimental UK J Pharm & Biosci, 2016: 4(6); 17


