Biochemical, Haematological and Thyroid Hormone Profile in Healthy Indian Kathiawari Horses

A. K. Gupta*, Sanjay Kumar and Yash Pal

National Research Centre on Equines, Sirsa Road, Hisar-125 001 (Haryana), India

ABSTRACT : Normal haematological and biochemical indices along with thyroid hormone status were studied in healthy Kathiawari horses of different age groups (yearling, young stock, adults and old stock) belonging to either sex. Effect of both age and sex was observed on thyroid hormone levels, haematological and biochemical indices. In females, hemoglobin levels was significantly lower in yearlings than adult animals while total leukocyte counts were higher in yearlings than equids of other age groups. Sex had effect only on total erythrocyte counts, mean corpuscular hemoglobin concentration and mean corpuscular hemoglobin in horses of 1-3 years age group (young stock) and on packed cell volume in adult female and male equids. Among biochemical indices, activities of enzymes were observed to be influenced both by age and sex. Creatine kinase, gamma glutamyl transferase, glutamate pyruvate transaminase, glutamic oxaloacetate transaminase and lactate dehydrogenase activities were significantly higher in young and adult equids than animals of other age groups in Kathiawari horses while activity of alkaline phosphatase was significantly higher in yearlings than equids belonging to other age groups in both male and females. However, activity of sorbitol dehydrogenase was unaltered due to both sex and age factor. Albumin, bilirubin direct, bilirubin total, cholesterol, creatinine, protein, triglyceride and uric acid were statistically different in various age and sex groups of horses. Calcium, magnesium and chloride contents were almost same in various age groups of male horses. Significantly higher levels of T_3 and T_4 were observed in both male and female yearlings as compared to equids of other age groups in both the sexes. ***(Asian-Aust. J. Anim. Sci. 2002. Vol 15, No. 8 : 1215-1221)***

Key Words : Kathiawari, Breed, Horses, Biochemical, Haematology, T_3, T_4, Indices

INTRODUCTION

Biochemical and haematological values are widely used in veterinary clinics for disease prognosis, differential disease diagnosis, nutritional and therapeutic monitoring, evaluation of the vaccination and feed stress as well as in understanding of the disease process in farm animals including equines (Archer, 1959; Allen and Archer, 1973; Schlam et al., 1975; Saror, 1976; Mason and Kwok, 1977; Lumsden et al., 1980; Gupta and Varshney, 1993, 1998; Gupta et al., 1993a,b, 1999). These indices assume much more significance in horses owing to be used as indicator of their physical fitness and performance (Snow, 1985; Snow and Harris, 1985). It is also well established that the standard values of these indices referred for a particular breed of horses may not hold good for other breeds as these have been reported to vary in different breeds (Syozi et al., 1975; Gupta et al., 1994a,b). Further, recent studies had also shown that the values of these parameters once obtained can not remain standard forever and needs re-evaluation from time to time (Kieferndorf and Keller, 1990; Kollakowski and Keller, 1990; Sommer and Styrie, 1990a,b). The present study was therefore undertaken to evaluate the normal values of some of the haematological and biochemical indices along with thyroid hormone profile in Kathiawari horses reared under normal managemental conditions at organized farms, as very limited studies have been carried out and data available is very scanty on this as well as other breeds of horses available in India (Srivastava and Singh, 1991; Gupta et al., 1992, 1994a,b; Varshney et al., 1993; Madan et al., 2001; Singh et al., 2001). Kathiawari is one of the important breed of horses in India known for its swiftness, speed, sturdiness and docileness.

* Corresponding Author: A. K. Gupta. E-mail: akguptanrce@hotmail.com

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MATERIALS AND METHODS

Animals

About 109 healthy Kathiawari horses maintained at three different organized farms were included in this study for evaluating their biochemical and haematological indices and thyroid hormone status. These animals of both sexes belonging to different age groups namely yearlings (6 months to 1 year of age), young stock (1 to 3 years of age), adults (3 to 10 years of age) and old stock (more than 10 to 16 years of age) were clinically healthy and apparently free from important viral and bacterial diseases including equine infectious anaemia, equine herpes virus-1, glanders, Brucellosis, *Salmonella Abortus equi* and helminths etc.

Blood and serum samples

Blood sample (15 ml) was collected early in the morning before feeding and watering from the jugular vein of all the horses. Blood was divided into two parts, one part (1.0 ml) was mixed with EDTA for haematological studies

while the second part was used for serum separation for biochemical and hormonal evaluations. Both haematological and biochemical indices were evaluated immediately while for hormone assay, serum samples were kept at -35°C till further use.

Parameters

Haematological analysis : Blood samples were processed manually for various haematological indices mainly hemoglobin (Hb), total erythrocyte counts (TEC), total leukocyte count (TLC), mean corpuscular value (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), packed cell volume (PCV) using standard protocols as described by Schalm et al. (1975).

Biochemical analysis : Serum samples were analyzed for various biochemical indices viz., enzymes namely creatine kinase (CKN), gamma glutamyl transferase (GGT), glutamate pyruvic transaminase (GPT), glutamic oxaloacetate transaminase (GOT), lactate dehydrogenase (LDH), sorbitol dehydrogenase (SDH), isocitrate dehydrogenase (ICDH), serum alkaline phosphatase (SAP) and metabolites namely glucose, total serum protein, albumin, cholesterol, blood urea nitrogen (BUN), HDL-cholesterol, uric acid, bilirubin direct (BID), bilirubin total (BIT) and creatinine and ions namely calcium, magnesium, phosphorus and chloride using a single step reagent kit in Auto Chemistry Analyser (Model Polimak M10/2, Italy).

Thyroid hormone analysis : Serum samples were also analyzed for their thyroid hormone activity in terms of Triiodothyronine (T3) and Thyroxine (T4) levels using ELISA based diagnostic kits procured from M/s Novum Diagnostica (GmbH), Germany.

Statistical analysis

Data was subjected to statistical analysis for finding the significant difference in the values of various biochemical, haematological and hormonal indices among equids of different age groups within the same sex as well as in same age groups in both the sexes with the help of windows based statistical programme SPSS 7.5 using GLM General factorial methods. The analysis was done at 95% level of significance.

RESULTS

Data (tables 1-5) presents the range, mean±SEM and significant differences in various biochemical, haematological and thyroid hormone levels in Kathiawari horses of same sex but belonging to four different age groups namely yearlings, young stock, adults and old stock equids as well as of same age group in both the sex.

Haematological indices

Comparative study revealed that among female horse belonging to different age groups, hemoglobin level in yearlings was significantly ($p<0.05$) lower than adult and old stock equids while in male equids, no such difference was observed due to age. Further among female equids, TLC content was significantly higher in yearlings while MCH and MCHC were significantly higher in young ones than other female groups. TEC was observed to be significantly lower in young ones than other female horses. Among male horses, except PCV and TLC, no significant difference were observed in other indices in different age groups. PCV was significantly high in adults than yearlings while TLC was significantly higher in yearlings than equids belonging to old stock group.

In the same age group, sex seemed to have effect only on TEC, MCHC and MCH in equids of 1-3 year age (young stock). TEC was significantly ($p<0.05$) higher in males than females young stock while reverse was noted for MCH and MCHC. PCV was observed to be higher in adults males than females.

Biochemical indices

Enzymes : Activities of different enzymes were observed to be affected by age in both the sex groups. In female equids, activities of almost all the enzymes except SDH differed significantly ($p<0.05$) in different age groups while in male Kathiawari horses such significant differences ($p<0.05$) were observed only in the activities of enzymes namely GGT, LDH and alkaline phosphatase (table 2). Further activities of all the enzymes except SAP and GGT were comparatively high in female adults than other female Kathiawari horses. However, no such pattern, due to age factor, was observed in the activities of enzymes in male Kathiawari equines. Activity of alkaline phosphatase was observed to be maximum i.e., 187.82 IU/L and 171.50 IU/L in both female and male Kathiawari yearlings, respectively than the animals of other age groups in their respective sex groups.

Significant differences ($p<0.05$) due to sex were also observed in activities of various enzymes in horses belonging to same age groups (table 2). Activity of GGT was significantly higher in male yearlings (19.20 IU/L) than female yearlings (11.27 IU/L). Similar differences were also observed in the activities of CKN, GOT and LDH in different sex belonging to same age groups. However, activity of SDH was almost at par in different age groups in both the sexes.

Metabolites : Levels of all the metabolites except HDL-cholesterol and glucose contents differed significantly ($p<0.05$) in female Kathiawari equids belonging to different age groups. (table 3). Among female equids, level of albumin and protein contents, in general, were significantly

Table 1. Haematological indices in Kathiawari equids of different age and sex groups

Sex	Female (Mean±SEM)				Male (Mean±SEM)			
Parameters/ age groups	Yearlings (n=9)	Young stock (n=22)	Adults (n=20)	Old stock (n=11)	Yearlings (n=11)	Young stock (n=15)	Adults (n=11)	Old stock (n=10)
Hb (g/dl)	11.32[a]±0.57 (9.50-12.00)	12.29±0.29 (9.69-12.94)	12.56[b]±0.24 (10.89-12.99)	12.80[b]±0.22 (11.40-13.23)	11.30±0.50 (10.23-12.14)	12.20±0.31 (10.60-13.00)	12.49±0.29 (11.60-13.20)	11.90±0.15 (10.97-13.20)
PCV (%)	32.25±1.26 (29.00-35.00)	31.71±2.15 (24.00-38.00)	35.12*±2.15 (25.00-44.00)	37.45±1.39 (30.00-45.00)	32.50[a]±4.03 (21.00-40.00)	36.33±1.55 (30.00-46.00)	41.11[b]±1.90 (32.00-50.00)	40.71±2.17 (38.00-45.00)
TLC ($\times10^3$) cmm	18.50[a]±1.16 (15.40-21.00)	14.09[b]±1.02 (10.20-18.40)	12.72[b]±0.87 (6.40-22.00)	11.22[b]±0.76 (8.40-17.00)	15.60[b]±0.67 (13.40-19.00)	15.27±1.67 (13.60-18.00)	13.40±0.76 (9.60-17.20)	11.90[a]±1.83 (7.20-14.80)
TEC ($\times10^6$) cmm	5.60±0.42 (4.50-6.50)	4.82[a]*±0.53 (2.65-6.30)	5.89[b]±0.18 (4.30-7.40)	6.03[b]±0.27 (5.00-8.00)	5.70±0.38 (5.00-6.45)	5.93±0.12 (5.50-6.50)	6.47±0.24 (5.25-7.40)	6.73±0.32 (6.10-7.10)
MCV (fl)	59.01±0.83 (52.72-63.33)	70.04±12.29 (41.66-139.62)	63.49±1.80 (48.21-74.13)	59.14±4.82 (18.33-83.33)	59.90±6.47 (41.17-70.40)	65.88±4.93 (50.84-98.28)	58.10±5.80 (77.40-71.66)	63.16±0.59 (62.29-64.28)
MCHC (g/dl)	29.94±1.96 (24.28-33.33)	33.53[a]*±2.60 (24.21-41.66)	29.08[b]±0.81 (23.20-34.40)	28.02[b]±1.07 (20.57-33.33)	31.40±4.23 (22.72-42.85)	28.46±1.48 (22.17-36.66)	25.82±1.07 (22.72-31.25)	23.78±1.00 (22.66-25.78)
MCH (pg)	18.07[b]±2.39 (13.07-24.44)	22.85[a]*±2.93 (15.87-37.73)	18.74[b]±0.52 (15.38-24.44)	17.99[b]±0.70 (14.00-20.80)	18.03±1.00 (16.00-20.80)	17.27±0.67 (13.84-20.00)	16.41±0.51 (14.80-19.80)	15.51±0.47 (14.57-16.06)

[a,b] Denotes significant difference ($p<0.05\%$) among different age groups in a particular parameters in each sex.

* Indicates that particular parameter differs significantly ($p<0.05\%$) in the same age group in both the sex.

Data in parenthesis denotes the range.

n Denotes the number of animals.

Table 2. Activities of various enzymes in the blood of Kathiawari equids of different age and sex groups

Sex	Female (Mean±SEM)				Male (Mean±SEM)			
Parameters /age groups	Yearlings (n=9)	Young stock (n=22)	Adults (n=20)	Old stock	Yearlings (n=11)	Young stock (n=15)	Adults (n=11)	Old stock (n=10)
CKN (IU/L)	158.75[a]±6.69 (70.21-186.40)	182.26[b]±9.10 (103.30-242.40)	231.36[b]*±10.64 (98.03- 409.10)	177.65±7.86 (114.72-361.40)	148.06± 10.08 (99.75- 191.23)	147.91±9.53 (89.70-198.70)	157.29±10.48 (115.20- 217.20)	143.46±15.70 (117.20- 171.50)
GGT (IU/L)	11.27[b]*±1.99 (8.35-17.13)	20.07[a]±0.73 (12.42-26.56)	11.43[b]±0.91 (4.49-20.77)	9.90[b]±0.97 (3.21-15.20)	19.20[b]±3.86 (8.35-25.77)	19.52[b]±1.28 (13.06-30.10)	12.08[a]±1.25 (5.57-19.49)	16.01±1.64 (13.06-18.71)
GOT (IU/L)	338.00±7.58 (301.90-374.20)	300.54[a]*±8.67 (124.70-379.00)	359.53[b]±9.47 (250.80-491.60)	308.19*±10.22 (244.70- 434.8)	322.22±13.16 (298.76-401.80)	355.77±10.58 (301.60-411.30)	338.71±13.06 (279.44- 412.70)	379.70±7.33 (346.00- 408.90)
GPT (IU/L)	33.77[b]±3.71 (25.66-40.61)	19.19[a]± 0.83 (14.90-33.78)	35.32[b]*±4.05 (11.60-55.50)	31.38[b]±2.57 (17.22-46.36)	26.70±4.11 (10.30-58.29)	14.69±3.01 (9.00-23.18)	17.85±3.49 (6.10-47.03)	23.09±3.82 (16.56-29.80)
LDH (IU/L)	394.32±17.08 (312.80-511.90)	341.89[a]*±5.00 (226.20-494.90)	429.29[b]±7.67 (374.50-518.70)	385.09±9.11 (253.40- 552.60)	327.57[a]±8.18 (250.78-456.60)	462.36[b]±19.42 (313.80-581.40)	420.20±12.23 (341.00- 589.30)	463.56[b]±11.12 (407.10- 502.00)
ALP (IU/L)	187.82[a]±7.17 (146.9-229.4)	161.92*±5.83 (111.80-239.80)	152.25*±6.27 (107.00- 209.50)	144.58[b]±10.08 (100.50-191.40)	171.50[a]±8.46 (149.57-204.30)	137.90±6.18 (99.27-174.20)	128.73[b]±4.00 (97.68- 156.40)	121.33±3.19 (109.50- 143.70)
SDH (IU/L)	29.49±2.69 (22.27-34.79)	31.37±1.28 (21.00-44.94)	32.38±1.82 (16.97-47.94)	31.63±2.61 (23.54-54.96)	31.45±2.23 (26.52-37.34)	34.60±1.22 (24.82-41.37)	34.78±1.49 (25.88-51.10)	32.46±1.72 (29.49- 35.43)

[a,b] Denotes significant difference ($p<0.05\%$) among different age groups in a particular parameters in each sex.

* Indicates that particular parameter differs significantly ($P<0.05\%$) in the same age group in both the sex.

Data in parenthesis denotes the range.

n Denotes the number of animals.

higher in young stock (1-3 years) than yearlings, adults and old stock horses while BID, BIT, triglyceride and uric acid contents were maximum in yearlings than females belonging to other age groups. Further in old stock females, levels of blood urea nitrogen and creatinine were maximum while albumin, cholesterol, triglyceride, BIT and BID contents were minimum in them. Similarly significant differences were also observed in the levels of various metabolites except HDL-cholesterol and glucose in male Kathiawari equids. It was interesting to observe that in male Kathiawari yearlings, uric acid contents were about two times higher than males belonging to old stock equids.

Significant ($p<0.05$) differences due to sex were also observed in the levels of various metabolites except BUN and glucose in equids of the same age groups. Levels of albumin, BID, BIT, cholesterol, creatinine and protein were

Table 3. Levels of various blood metabolites in Kathiawari equids of different age and sex groups

Sex	Female (Mean±SEM)				Male (Mean±SEM)			
Parameters/ age groups	Yearlings (n=9)	Young stock (n=22)	Adults (n=20)	Old stock (n=11)	Yearlings (n=11)	Young stock (n=15)	Adults (n=11)	Old stock (n=10)
Albumin (g/dl)	3.24[b]±0.24 (2.52-3.69)	3.43[a]±0.06 (2.99-3.85)	3.13[b]*±0.08 (2.51-3.65)	3.04[b]*±0.08 (2.57-3.41)	3.22[b]±0.19 (2.83-3.74)	3.42[b]±0.11 (2.73-4.38)	4.05[a]±0.06 (3.77-4.35)	3.50[b]±0.41 (2.68-3.79)
BID (mg/dl)	0.67[b]±0.05 (0.52-0.75)	0.46[b]*±0.04 (0.14-0.78)	0.47[b]*±0.05 (0.11-1.04)	0.21[a]*±0.03 (0.08-0.48)	0.56[a]±0.13 (0.31-0.92)	0.76±0.08 (0.45-1.84)	0.91[b]±0.05 (0.71-1.30)	0.87±0.08 (0.73-1.00)
BIT (mg/dl)	1.22[b]±0.22 (0.84-1.66)	1.09[b]*±0.09 (0.10-1.85)	1.03[b]*±0.07 (0.59-1.80)	0.76[a]*±0.06 (0.45-0.94)	1.26[a]±0.16 (0.95-1.72)	1.54[c]±0.07 (0.87-1.91)	2.01[b,d]±0.10 (1.65-2.83)	2.11[b,d]±0.30 (1.66-2.68)
BUN (mg/dl)	24.61[a]±1.81 (19.70-27.55)	24.88[c]±0.83 (19.87-31.44)	29.44[d]±1.02 (24.27-44.41)	32.75[b,d]±1.60 (22.99-38.37)	22.12[a]±3.10 (13.78-27.31)	24.09[c]±0.55 (21.42-27.42)	27.99[b,d]±1.27 (22.70-36.63)	32.67[b,d]±3.96 (27.20-40.36)
Cholesterol (mg/dl)	75.48[b,d]*±10.39 (54.06-98.38)	79.62[b,d]±2.46 (59.10-93.90)	59.15[c]*±2.37 (45.14-81.79)	54.38[a]*±1.89 (43.64-65.86)	95.26[a]±6.45 (81.13-112.40)	83.14±2.84 (59.32-98.87)	75.40[b]±2.81 (60.69-93.48)	75.88[b]±7.97 (59.95-84.52)
Creatinine (mg/dl)	0.91*±0.03 (0.84-0.97)	0.85[a]±0.05 (0.42-1.30)	0.95*±0.03 (0.78-1.29)	1.09[b]*±0.05 (0.83-1.29)	1.35±0.16 (1.12-1.82)	0.94[a]±0.09 (0.37-1.83)	1.25[b]±0.09 (0.79-1.88)	1.44±0.34 (0.96-2.09)
Glucose (mg/dl)	102.30±3.49 (87.23-124.40)	101.11±2.56 (81.30-138.1)	104.22±3.00 (72.10-1445.1)	99.35±4.33 (80.27-140.57)	111.20±17.59 (65.99-139.60)	94.29±2.35 (76.23-105.80)	98.38±14.14 (62.52-222.00)	105.74±9.76 (89.43-123.20)
HDL -cholesterol (mg/dl)	25.56±1.23 (22.00-27.40)	26.48±0.55 (21.53-29.75)	26.64*±0.161 (24.63-28.31)	26.59*±0.06 (26.28-27.04)	28.12±1.705 (24.97-32.78)	26.72±1.47 (21.31-44.81)	23.32±0.95 (19.28-31.21)	22.11±1.79 (19.34-25.46)
Protein (g/dl)	7.60[b]±0.82 (6.07-9.89)	9.02[a]±0.15 (6.48-9.98)	7.95[b]*±0.18 (6.86-9.98)	7.59[b]±0.13 (6.81-8.16)	8.91[b]±1.03 (6.29-9.78)	8.86±0.11 (8.14-9.64)	9.45[a]±0.26 (8.67-10.88)	8.02±0.27 (6.84-9.96)
Triglyceride (mg/dl)	44.37[a]*±5.79 (34.07-57.80)	30.40±1.51 (16.53-44.49)	29.62[b]±3.48 (10.93-68.79)	23.77±4.21 (14.11-34.24)	29.57[b]±5.56 (17.94-42.20)	28.21[b]±1.74 (15.51-43.23)	18.14±0.97 (10.95-22.67)	17.59[a]±0.71 (10.43-21.77)
Uric acid (mg/dl)	0.55[b]±0.16 (0.28-1.02)	0.28[a]±0.02 (0.07-0.54)	0.48[b]*±0.05 (0.07-1.13)	0.43[b]±0.03 (0.29-0.57)	0.61[a]±0.12 (0.31-0.88)	0.30[b]±0.03 (0.11 – 0.64)	0.27[b]±0.07 (0.03-0.94)	0.29[b]±0.13 (0.12-0.54)

[a,b] Denotes significant difference (P<0.05%) among different age groups in a particular parameters in each sex.
[c,d] Also denotes significant difference (P<0.05%) in a particular parameters between different age groups in each sex.
* Indicates that particular parameter differs significantly (P<0.05%) in the same age groups in both the sex.
Data in parenthesis denotes the range.

significantly (p<0.05) higher in male adult and old stock horses then their female counter parts. However, reverse was observed for uric acid and HDL-cholesterol contents in equids of these age groups. In yearlings, levels of almost all the metabolites except cholesterol, creatinine and triglyceride were at par in both the sexes. Further, cholesterol contents were appreciably higher in yearlings and young ones than horses of other groups in both the sexes.

Ions : Among the four nutrients studied (table 4), levels of calcium and magnesium were significantly (p<0.05) higher in adult female horses (1-3 age group) while phosphorus was significantly (p<0.05) lower in old stock animals than females belonging to other age groups. Chloride contents ranged from 102.47 to 106.40 mEq/L in female Kathiawari horses and no significant difference was observed in them due to age. In male horses, no such significant difference in the levels of any ion was observed in any of the age groups. However, significant differences in levels of calcium and phosphorus contents were observed in horses belonging to same age groups but belonging to different sex. Calcium content was significantly (p<0.05) higher in young females (10.42±0.20 mg/dl) than males (9.65±0.32 mg/dl) while reverse was true for phosphorus contents.

Thyroid hormone status

Levels of both T_3 (Tri-iodothyronine) and T_4 (Thyroxine) hormones were observed to be maximum and significantly (p<0.05) higher in yearlings than horses of other age groups in both the sex groups (table 5). Beside this, levels of T_4 in young ones were also significantly (p<0.05) higher than both adult and old stock female Kathiawari horses. Effect of sex was observed in T_4 levels only. Levels of T_4 were significantly higher in female yearlings (88.39 ng/ml) than male yearlings (64.07 ng/ml).

DISCUSSION

In India, Marwari, Kathiawari, Manipuri, Spiti, Bhutia and Janskari are the important breeds of equids. These breeds are well adapted in their agro-climatic zones and are known for their sturdiness and other genetic characteristics

Table 4. Levels of ions in the serum of Kathiawari equids of different age and sex groups

Sex	Female (Mean±SEM)				Male (Mean±SEM)			
Parameters/ age groups	Yearlings (n=9)	Young stock (n=22)	Adults (n=20)	Old stock (n=11)	Yearlings (n=11)	Young stock (n=15)	Adults (n=11)	Old stock (n=10)
Calcium (mg/dl)	8.76^{b}± 0.61 (7.76-10.45)	10.42^{a}*± 0.20 (7.76-11.63)	9.20^{b}± 0.18 (7.12-10.65)	9.54^{b}± 0.20 (8.25-10.65)	9.19± 0.32 (8.64-10.12)	9.65± 0.32 (7.83-11.56)	9.58± 0.39 (6.59-10.89)	9.59± 0.34 (9.08-10.23)
Chloride (mEq/L)	104.38±1.61 (98.24-118.10)	102.47*± 1.98 (77.90-115.20)	106.40*± 2.43 (96.99-129.80)	105.09*± 1.16 (97.58-113.90)	110.72± 0.94 (98.89-121.40)	116.36± 1.30 (109.30-139.70)	116.23± 0.76 (112.70-121.80)	113.77± 1.26 (109.18-125.00)
Magnesium (mg/dl)	1.92± 0.67 (0.92-3.88)	2.68^{a} ± 0.17 (0.64-4.18)	1.66^{b}± 0. 20 (0.59-3.54)	1.51^{b}± 0.21 (0.58-2.89)	1.84± 0.08 (1.64-2.11)	2.18± 0.20 (1.62-4.47)	2.17± 0.20 (1.29-3.39)	1.93± 0.09 (1.79-2.09)
Phosphorus (mg/dl)	3.88^{b}± 0.57 (2.50-5.16)	3.74^{b}± 0.11 (2.71-4.56)	3.72^{b}± 0..69 (3.12 -4.25)	2.84^{a} ± 1.17 (1.16-4.76)	4.09± 0.65 (2.58-5.75)	4.11*± 0.81 (3.75-4.98)	3.42^{b}± 0.20 (2.49-4.76)	3.68± 0.38 (2.99-4.31)

^{a,b} Denotes significant difference (p<0.05%) among different age groups in a particular parameters in each sex.
* Indicates that particular parameter differs significantly (p<0.05%) in the same age groups in both the sex.
Data in parenthesis denotes the range.

Table 5. Tri-iodothyronine (T3) and Thyroxine (T4) contents in the serum of Kathiawari equids of different age and sex groups

Sex	Female (Mean±SEM)				Male (Mean±SEM)			
Parameters/ age groups	Yearlings (n=9)	Young stock (n=22)	Adults (n=20)	Old stock (n=11)	Yearlings (n=11)	Young stock (n=15)	Adults (n=11)	Old stock (n=10)
T3 (nmol/L)	2.813^{a}±0.58 (1.65 - 4.40)	1.815±0.33 (1.04 - 3.70)	1.80^{b}±0.19 (0.74 - 3.90)	1.68^{b}±0.16 (1.05 - 2.70)	2.45^{a}±0.22 (1.65 - 3.15)	2.15±0.17 (1.35 - 2.80)	1.67^{b}±0.19 (0.80 - 3.00)	1.35^{b}±0.13 (1.16 - 1.60)
T4 (nmol/L)	88.39^{a}*±2.57 (62.30-102.60)	44.54^{b,c}±1.19 (34.39 - 50.70)	34.68^{b,d}±1.74 (21.78 - 53.20)	30.83^{b,d}±1.67 (24.03 - 39.98)	64.07^{a}±1.72 (56.54 - 95.26)	42.51^{b}±1.03 (35.64 - 53.92)	32.87^{b}±0.96 (29.87 - 36.18)	34.70^{b}±0.74 (31.29 - 37.12)

^{a,b} Denotes significant difference (p<0.05%) among different age groups in a particular parameters in each sex.
^{c,d} Denotes significant difference (p<0.05%) in particular parameters between different age groups in each sex.
* Indicates that particular parameter differs significantly (P<0.05%) in the same age groups in both the sex.
Data in parenthesis denotes the range.

(Tandon, 2001). However a little information is available on various biochemical, physiological and haematological indices in equids of these breeds (Varshney et al., 1993; Madan et al., 2001; Singh et al., 2001). National Research Centre on Equines, Hisar, has initiated systematic work on these aspects to generate base line data of healthy horses for the benefit of clinicians as this information is of utmost importance in appreciating deviations from physiological norms for disease prognosis, its diagnosis and monitoring during the course of therapy. This study is also of great significance as normal values of these indices reported for other foreign breeds of equines can not be used for horses of Kathiawari breed because of appreciable differences in these indices due to breed, sex and age factors (Syzoi et al., 1975; Gupta et al., 1992; Gupta et al., 1994b; Gupta et al., 1993a).

In Kathiawari horses, effect of both age and sex was observed on various hematological indices. PCV value in general, was low in yearlings and young stock than adults and old stock equids in both the sex groups. Jain (1986) also reported low haemoglobin and PCV values with high TLC count in hot blooded horses of 8-18 months age group as compared to those in higher age groups (2 years, 3-4 years and more than 5 years of age). Significantly higher TLC contents in yearlings than other age groups may also be due to aging (Dinev and Houbenov, 1986). Kieferndorf and Keller (1990) and Kollakowski and Keller (1990) had reported the dependency of various haematological indices due to breed and sex as well as the effect of age on almost all the haematological indices except RBC in equids. In this study, effect of age was more pronounced in females than males while sex factor mainly affected the TEC, MCHC and MCH levels in young horses. Hemoglobin and TEC contents in equids of different age groups in both male and females were at par but these values were a little lower than those reported earlier in Kathiawari yearlings and adults only (Singh et al., 2001; Madan et al., 2001). In present study, no significant difference due to sex was observed in these indices except PCV value in adult groups. Different workers had also observed little effect of sex on various haematological indices in adult and old stock equids (Gupta et al., 1992; Harvey et al., 1984a,b; Sharma et al., 1981).

It is well established that higher or lower activity/ level of any particular enzyme, metabolite or ions alone may have little significance but evaluation of a group of

enzymes, metabolites and ions together helps in correct diagnosis and prognosis of a particular problem. In present study, some of the enzymes either related to different metabolic activities or a specific organ were evaluated. In horses, creatinine phosphokinase (CKN) is known to be a relatively specific and very sensitive indicator of muscle damage both of heart and skeleton muscle (Gerber, 1969). In present study, its mean activity was quite high in Kathiawari horses than that reported for Thoroughbreds (Blackmore and Brobst, 1981). Similarly, the range and mean values of other enzymes viz., GGT an important indicator in pancreatitis and hepatic insufficiency (Blackmore and Brobst, 1981), SAP important in osteoblasts and osteoclasts, biliary obstruction (Gerber, 1969), SGPT important in liver problems along with skeletal muscle disease (Blackmore and Brobst, 1981), LDH a non specific but an important enzyme in myocardial infection, hepatitis, pancreatitis, muscle damage etc. were observed to be quite different than those reported earlier for other breeds of horses (Al-Izzi et al., 1989; Blackmore and Elton, 1975; Syozi et al., 1975).

In female Kathiawari horses, activities of most of the enzymes except SDH and SAP were observed to be maximum either in young (1-3 years old) or adult (3-10 years) horses than old stock (>10 years) equids in both the sex which indicated that with age, rate of various metabolic activities slows down. In male horses also, age had effect on the activities of GGT, LDH and SAP. Such difference in the activities of different enzymes due to age factor had already been observed in horses of other breeds including Thoroughbred horses maintained in India (Gupta et al., 1994b; Syozi et al., 1975; Sommer and Styrie, 1990a). All these changes directly or indirectly reflected varied requirement of these enzymes at a particular age. Further significantly high activity of serum alkaline phosphatase in both male and female Kathiawari yearlings than equids of other age groups may possibly be due to its metabolic requirement during this developing phase in yearlings as bone metabolism is generally at a higher rate along with calcium phosphate exchange in osteoblasts. In horses, less than one year old, SAP activity had also been reported to be two to three times higher than older horses (Coffman, 1981). Significant differences due to sex factor were also observed in the activity of almost all the enzymes but only in one or two age groups, indicating that these differences were not absolute and may be due to physiological requirements.

Like enzyme activities, levels of various metabolites were also affected by the age which could possibly be due to their requirement or may be due to higher or lower rate of body organ functioning. Values of most of the metabolites including albumin, cholesterol, HDL-cholesterol, protein and triglyceride were maximum in yearlings or young Kathiawari horses than old stock equids in both the sex groups indicating their varied metabolic requirement in them. Higher levels of BUN and creatinine in old stock equids as compared to yearlings and young stock indicated their decreased excretion from body which further reflects kidney functioning (Ju et al., 1993). In yearlings and young one, levels of almost all the metabolites were at par in both the sex groups which further support the above observations. Glucose, being the immediate source of energy in all the equids, its level was almost same in equids of all the age groups in both the sexes. Effect of sex on the levels of various metabolites was also clear as significant ($p<0.05$) differences were observed BID, BIT, cholesterol, creatinine and uric acid in both adult and old stock animals in both the sex groups.

In general, significantly higher ion contents in young one than old stock equids in both the sex groups also indicated that with age levels of these ions decreases which in turn may be due to their lower requirement or mobilization. Calcium contents were observed to be similar in yearlings and adult Kathiawari horses as reported earlier (Varshney et al., 1993; Singh et al., 2001).

Like other animals, the proper functioning of thyroid gland is also of great importance in equines because the thyroid hormones viz. Thyroxine (T_4) and Triiodothyronine (T_3) are the major regulators of various metabolic functions in body. In this study, higher levels of both the hormones in yearlings and young ones than adult and old stock equines in both the sex indicated high basal metabolic rates in these growing equids. Similar observations had also been reported in Thoroughbred equids (Blackmore and Brobst, 1981). Further like Thoroughbreds, no significant difference due to sex was observed in levels of T_3 in these Kathiawari equids of different age groups.

As very little information is available in literature on haemato-biochemical and hormonal indices of Kathiawari breed of Indian horses, this work would help the clinician and epidemiologists in proper diagnosis and prognosis of various disease conditions, their therapeutic monitoring and other farm managemental monitoring of these Kathiawari horses.

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