RESEARCH ARTICLE

Effect of Age on Blood Biochemical Profile in Growing Indigenous Kangayam Calves

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Abstract

The study was conducted to establish base line data about blood biochemical profile of growing indigenous Kangayam calves from 3-12 month of age and to compare the values with adult Kangayam cattle. A total of 20 calves were selected under field conditions of native tract of Sathiyamangalam, Erode and Namakkal districts of Tamil Nadu and grouped into two groups, I (male calves) and II (female calves) with 10 calves in each group. The blood samples were collected from these calves at 3-, 6-, 9- and 12-months age to estimate all possible biochemical parameters. Blood samples were also collected from adult male and female Kangayam cattle (n=10) to compare their profile with calves. The results showed that the sex of calves did not influence any of the constituents studied. The blood glucose and calcium were significantly higher ($p < 0.05$) during first 3 months of age than other age groups and from adult cattle. Total cholesterol and ALT were lower ($p < 0.05$) in calves from 3-12 months of age than adult cattle, whereas, total protein, albumin, globulin, triglyceride, blood urea nitrogen, creatinine, AST, ALP, GGT, phosphorus, potassium, magnesium, sodium and chloride were found almost similar among all age groups. These findings established baseline values of blood biochemistry for growing and adult indigenous Kangayam cattle, which is useful to understand the changes of blood biochemistry during different growing period and to diagnose the disease conditions for clinicians when dealing with treatment of this native breed.

Keywords: Age, Biochemical parameters, Calves, Kangayam.

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Introduction

The registered 43 native or indigenous cattle breeds in India are broadly classified into dairy, draft and dual-purpose breeds depending upon their utility (Savalia *et al.,* 2019). Indigenous breeds are well known for their draft efficiency, heat tolerance and resistance to infectious diseases. Tamil Nadu possesses five indigenous breeds namely, Kangayam, Bargur, Pulikulam, Alambadi and Umbalachery. Among these, Kangayam is one of the popular draught purpose indigenous breeds of Tamil Nadu.

Research studies on the Kangayam breed, so far have been focused on breed characterization and other production parameters, still many of the biochemical parameters have not been studied in detail in calves. The biochemical values provide valuable baseline information and help in realistic evaluation of management practices, nutritional and physiological, and health status of animals. During diagnostic procedure, it is very useful to compare the values obtained from ill animals to those of healthy animals (Jezek *et al.,* 2006). The biochemical parameters are influenced by many factors like breed, age, sex, seasonal variation, lactation, pregnancy, health, and nutritional status of the animal. Biochemical values are considered as tools in assessment of health and disease in any species. The aim of this study was to determine the biochemical parameters of male and female calves and adult cattle of Kangayam breed to differentiate the age and sex variations.

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Materials and Methods

The blood samples were collected from 20 Kangayam calves (10 male and female each) at the age of 3-, 6-, 9- and 12-months and at 3 to 5 years age group of adult (10 each male and female) Kangayam cattle. The blood samples (10 mL) were drawn by venepuncture from jugular vein into K_3EDTA tubes. The blood samples for glucose estimation were collected in separate test tubes containing sodium fluoride as anticoagulant. All samples were tested on the same day

of collection to avoid variations in blood metabolites by oxidation of blood constituents. Proper aseptic measures were taken at the time of analysis in the laboratory.

Collected blood was centrifuged at 1000 x g for 30 min at 2-8°C. Plasma was aspirated and stored at -20°C until analysis. Biochemical parameters like blood glucose, and plasma total protein, albumin, globulin, albumin: globulin ratio, triglycerides, total cholesterol, blood urea nitrogen (BUN), creatinine, alanine aminotransferase (ALT), aspartate aminotransferase (AST), Lactase dehydrogenase (LDH) and gamma glutamate transferase (GGT) were estimated using complete biochemical auto-analyzer (Bio systems®). The minerals like calcium, phosphorus, magnesium, and electrolytes like potassium, sodium and chloride were estimated by Spectrophometric (Systronics, Model 2202) method using commercial kits (Span®).

The data was analysed using one-way ANOVA and an independent't' test using SPSS software version 21.0. Results are presented as means with standard error of means.

Results and Discussion

Plasma Glucose

The glucose content in male and female calves at 3 months of age was found to be significantly ($p<0.05$) higher, thereafter the values were reduced and were comparable in other age groups, without statistical difference between male and female sex (Table 1). These findings on the blood glucose trend at different age groups in Kangayam calves were in alignment with observations of Kumar *et al.* (2018) in calves aged 0-1 year of Sahiwal, Hardhenu and Hariana breeds than adults of respective breeds (43-65 mg/dL). They also noted that the glucose concentration was significantly higher ($p<0.05$) in Sahiwal (66.28 mg/dL) than Hardhenu of same age groups. This variation may be breed specific. The glucose concentration in adult Kangayam cattle was in alignment with reports of Sreedhar *et al.* (2013) and Rajamanikam *et al.* (2018) in 3-5 years old lactating Kangayam cows (47.24 mg/dL). The elevated level of glucose during early phase of growth could be due to closure of oesophageal groove in young calves, so milk intake by the calves directly enters into the abomasum. Also, there is more synthesis of glucose from propionate during early phase of growth before introduction of the solid feed (Kaba *et al.,* 2018).

It is also noted that higher mean glucose level was observed in Sahiwal heifers, cows and Jersey X Sahiwal cows (69, 65 and 72 mg/dL, respectively), when they got exposed to different temperature range (25-45˚C). This could be due to increased respiratory rate and low feed intake and high energy demand to cope up with new environment, which leads to excess mobilization of fat to increase glucose level (Sreedhar *et al.,* 2013). The reason for the lowered level of glucose at later stage of growth phase could be due to the development of rumen and volatile fatty acid production, thereby reducing the need for glucose production as an energy source. The energy requirement is met-out by volatile fatty acids for normal physiological activities.

Table 1: Mean (±SE) blood biochemical profile in male and female Kangayam animals of different age groups

Biochemical Parameter	Sex	Age in months (n=10 each)				
		3	6	9	12	Adult
Glucose (mg/dL)	Male	87.90^{b}±3.30	60.00^{a}±5.60	56.15^{a}±3.70	49.30^{a}±4.50	52.00^{a}±3.00
	Female	91.20^{b}±10	52.80^{a}±8.40	58.25^{a}±3.40	52.81^{a}±5.80	48.00^{a}±2.00
Total Protein (g/dL)	Male	7.35±0.40	7.90±0.20	8.02±0.20	8.41±0.30	8.60±0.20
	Female	7.27±0.20	7.53±0.20	8.10±0.40	8.56±0.20	8.53±0.20
Albumin (g/dL)	Male	2.55±0.10	3.10±0.10	3.23±0.20	3.53±0.10	3.82±0.10
	Female	2.82±0.04	2.74±0.10	3.54±0.20	3.84±0.10	3.88±0.10
Globulin (g/dL)	Male	4.80±0.30	4.80±0.20	4.79±0.20	4.82±0.20	4.81±0.20
	Female	4.45±0.20	4.48±0.10	4.55±0.30	4.59±0.10	4.62±0.10
Albumin: Globulin	Male	0.50^{a}±0.08	0.65^{b}±0.05	0.67^{b}±0.07	0.73^{b}±0.04	0.79^{b}±0.03
	Female	0.67±0.05	0.68±0.07	0.77±0.07	0.83±0.04	0.83±0.02
Triglycerides (mg/dL)	Male	12.70±1.10	16.50±3.50	14.2±3.1	15.45±2.00	16.00±1.50
	Female	12.50±2.00	14.77±2.10	15.16±4.9	16.12±4.60	15.00±4.10
Total cholesterol (mg/dL)	Male	128.0^{a}±18.0	126.0^{a}±11.0	128.0^{a}±12.0	129.0^{a}±6.80	140.0^{b}±5.00
	Female	127.0^{a}±16.0	125.0^{a}±10.00	127.0^{a}±12.0	130.0^{a}±15.0	148.0^{b}±12.0
BUN (mg/dL)	Male	16.38±3.30	22.91±2.80	21.28±3.00	21.25±3.10	21.00±3.10
	Female	14.98±2.90	17.34±3.70	23.21±3.90	22.58±4.10	21.00±2.32
Creatinine (mg/dL)	Male	1.31±0.10	1.36±0.10	0.88±0.20	0.77±0.10	0.77±0.10
	Female	1.42±0.40	0.66±0.20	0.93±0.10	0.67±0.20	0.50±0.10

Means with different superscripts in same row differ significantly ($p<0.05$)

Plasma Protein, Albumin, and Globulin

There was neither significant difference in total protein, albumin, and globulin level among all age groups nor between sexes, although there was an increasing trend especially in total protein and albumin values with advancing age. The globulin concentration, however remained constant with relatively higher values in all groups of males than in females. This resulted in higher A:G ratio with advancing age in both the sexes with significant difference only in males (Table 1). These findings were in agreement with the reports of Kumar *et al.* (2018) and Sumitha *et al.* (2015) in 0-1 year calves and 3-4 year-old Burgur cattle. Further, Abera *et al.* (2021) observed seasonal variation in total protein content with values of 6.6±0.1, 7.9±0.2 and 8.0±0.3 g/dL during dry, short rainy and long rainy season, respectively. On contrary to present observations, Mahima *et al.* (2013) reported slightly lower serum total protein level (5.34±1.0 g/dL) in healthy Hariana heifers of one-year age. However, Kalyani *et al.* (2018) reported the highest protein value of 9.7 g/dL in Rathi breed.

The albumin and globulin values in present study concurred with observations of Mahima *et al.* (2013) in Hariana cattle (3.5 g/dL) and Mili *et al.* (2020) in Manipuri cattle (2.75 g/dL). In contrast, Kapale *et al.* (2008) observed lower level of globulin concentration (4.14 g/dL) in Gaolao calves than in adult (4.8 g/dL) cattle.

Plasma Total Cholesterol and Triglycerides

The total cholesterol in both male and female animal was comparable at 3-, 6-, 9- and 12-month age group. However, it was significantly (P<0.05) elevated in adult animals. The present findings were in alignment with Mili *et al.* (2020), who reported a total cholesterol concentration of 143±9.78 mg/dL in Manipuri cattle, but it was lower than the values (mg/dL) reported by Kapale *et al.* (2008) in female Gaolao calves (174.74± 12.17), heifers (189.53±11.02) and adult cows (195.26±11.90). Cholesterol is not just mere waste product of metabolism, but serves as the cell protective barrier to dehydration and infection (Jeremy, 2010).

There was no significant difference in triglyceride concentration among different age groups or gender, though the values were lower in 3-months age group than the other groups. Contrary to this, Kumar *et al.* (2018) reported higher range of triglycerides (21.00-40.58 mg/dL) in Sahiwal, Hardhenu and Hariana calves (0-1 year of age), as compared to higher age group (>3 years). The higher triglycerides level for Sahiwal calves could be breed specific as mentioned by them. Sumitha *et al.* (2015) also reported elevated levels of triglycerides (35.89±3.05 mg/dL) in Burgur cattle of 3-4 years of age.

Blood Urea Nitrogen and Creatinine

The BUN was apparently lower during 3-month age group than other age groups whereas creatinine was higher in the 3-month age group as compared to all other age groups. However, statistically there was no significant difference in levels of BUN and creatinine among different age groups or sexes. These findings concurred with reported BUN value of Rajamanikam *et al.* (2018) and Mili *et al.* (2020) in adult Kangayam (17.57 mg/dL) and Manipuri (14.96 mg/dL) cattle, respectively. However, Mahima *et al.* (2013) and Sumitha *et al.* (2015) observed higher BUN value in Hariana (34.26±0.9 mg/dL) and Bargur (34.10±1.86 mg/dL) cattle, respectively.

Kumar *et al.* (2018) reported creatinine levels of 0.93±0.04 to 1.44±0.03 mg/dL in 0-1 year old Hardhenu, Sahiwal and Hariana cattle, and the values were higher in adult animals than young animals. On the contrary, Kalyani *et al.* (2018) reported higher (1.87 mg/dL) creatinine level in Sahiwal cattle.

Plasma Enzyme Profile

The mean values of plasma enzymes concentration in different age groups of male and female Kangayam cattle are presented in Table 2. The data showed non-significant differences between male and female sex. The ALT was lowest

Table 2: Mean (±SE) plasma enzymes concentration (IU/L) of male and female Kangayam calves of different age groups and adults

Enzymatic Parameters	Sex	Age in months (n=10 each)				
		3	6	9	12	Adult
ALT (IU/L)	Male	13.64^{a}±3.50	41.69^{b}±10.00	45.15^{b}±4.70	43.09^{b}±6.40	44.00^{b}±6.30
	Female	13.00^{a}±3.60	43.19^{b}±9.50	48.07^{b}±2.00	47.57^{b}±10.00	45.00^{b}±10.00
AST (IU/L)	Male	64.31±3.40	69.94±5.40	61.20±3.20	66.62±3.10	68.00±6.20
	Female	67.07±8.0	60.25±2.60	67.53±6.80	69.71±4.60	66.00±2.40
ALP (IU/L)	Male	123.00±4.00	122.00±7.60	118.00±6.30	124.00±3.70	123.00±3.50
	Female	116.00±6.70	123.00±5.90	125.00±2.70	124.00±1.90	123.00±3.50
LDH (IU/L)	Male	772.0±38.78	828.50±30.18	793.90±27.79	799.60±41.95	798.56±33.52
	Female	782.40±9.20	842.0±31.18	816.90±35.18	797.30±37.12	803.48±41.50
GGT (IU/L)	Male	32.99±1.50	33.66±1.70	35.14±1.80	34.54±0.90	34.66±2.00
	Female	34.18±1.50	35.13±1.60	35.30±1.20	34.66±2.00	34.54±0.90

Means with different superscripts in the same row differ significantly (p<0.05).

Table 3: Mean (±SE) blood mineral and electrolyte profile of male and female Kangayam calves of different age groups and adults

Minerals & Electrolytes	Sex	Age in months (n=10 each)				
		3	6	9	12	Adult
Calcium (mg/dL)	Male	10.58^{c}±0.6	10.57^{c}±0.6	9.13^{b}±0.3	9.16^{b}±0.4	7.30^{a}±0.4
	Female	10.28^{c}±0.6	10.62^{c}±0.7	9.39^{b}±0.5	9.13^{b}±0.5	7.30^{a}±0.5
Phosphorus (mg/dL)	Male	6.75±0.3	5.80±0.4	6.14±0.4	6.55±0.3	6.20±0.3
	Female	6.13±0.6	6.04±0.4	5.88±0.4	6.19±0.5	5.80±0.5
Magnesium (mg/dL)	Male	2.15±0.4	2.32±0.4	2.02±0.4	2.32±0.4	2.20±0.4
	Female	2.14±0.5	2.07±0.5	2.10±0.5	2.13±0.5	2.00±0.5
Potassium (mEq/L)	Male	3.49±0.4	3.57±0.2	4.74±0.9	3.58±0.4	3.40±0.4
	Female	3.97±0.5	4.55±0.7	3.35±0.5	3.07±0.3	2.90±0.3
Sodium (mEq/L)	Male	141.0±3.7	145.0±5.2	148.0±3.8	140.0±3.3	133.0±3.1
	Female	142.0±5.4	146.0±2.1	142.0±3.0	141.0±3.7	134.0±3.5
Chloride mEq/L)	Male	99.28±2.7	100.0±2.8	100.0±3.1	101.0±2.3	96.0±2.2
	Female	101.0±2.7	99.79±3.2	99.26±0.6	99.38±1.8	94.0±1.7

Means with different superscripts in a same row differ significantly ($p<0.05$).

in 3 month age group than all other age groups of calves and adult, while other enzymes like AST, ALP, GGT and LDH did not show any change among the age groups. However, Kumar *et al.* (2018) reported higher average ALT value of 56 and 52 IU/L in Hardhenu and Hariana calves of 0-1 year of age than in the present study (35.5 IU/L), which might be a breed specific. Similarly, Mahima *et al.* (2013) found lower ALT value (30 U/L) in Hariana heifers.

The main indicator of hepatic disorder in large ruminants is AST. The value of AST in present study concurred with reports of Rajamanikam *et al.* (2018) and Mahima *et al.* (2013) in adult Kangayam cattle (61.44±1.94 IU/L) and Hariana heifers (66.63±2.38 IU/L), respectively. On the contrary, Kumar *et al.* (2018) observed higher AST value (IU/L) in Hardhenu (97.26), Sahiwal (100.86) and Hariana (102.94) calves of 0-1 year of age than in the present study (64.00) which may be again breed specific in nature.

The ALP values of present study concurred with the findings of Kumar *et al.* (2018), who also reported no change in values of ALP in Sahiwal, Hardhenu and Hariana calves. Moreover, no change was noted in concentration of LDH, GGT among all age groups. Mohri *et al.* (2007) observed a declining trend of ALP level in Holstein calves from birth to 30 days of age and then rise on day 70.

Blood Mineral and Electrolyte Profile

The mean blood profile of minerals and electrolytes is presented in Table 3, with insignificant effect of sex. The plasma calcium was significantly ($p<0.05$) higher in early stage of growth, thereafter gradually reduced in other age groups and was quite lower in adults. However, there was no significant change in other minerals and electrolytes concentration between different age groups or gender of Kangayam calves and adults.

The serum calcium concentration observed in the present study is in alignment with reports by Kumar *et al.* (2018) and Kalyani *et al.* (2018) in Sahiwal and Deoni cattle. On the contrary, Mili *et al.* (2020) reported the higher calcium content (11.23 mg/dL) in adult Manipuri cattle. It might be due to difference in endocrine and metabolic function among different breeds of cattle (Sartori *et al.*, 2016). The phosphorus content agreed with reports of Kalyani *et al.* (2018) and Rajamanikam *et al.* (2018) in Deoni and Kangayam breeds, respectively. The potassium content in present study was similar to reports of Sumitha *et al.* (2015) and Rajamanikam *et al.* (2018) in Burgur and Kangayam cows, respectively. In contrary to the above findings, Kumar *et al.* (2018) reported the higher level of potassium in Hardhenu (5.18 mmol/L) Hariana (5.25 mmol/L) and Sahiwal (4.98 mmol/L) cattle.

The magnesium content of present study was quite lower than that reported by Sumitha *et al.* (2015) in adult Bargur cattle (3.92±0.12 mg/dL) and by Rajamanikam *et al.* (2018) in adult Kangayam cattle (8.52 mg/dL). The sodium and chloride content also concurred with report of Rajamanikam *et al.* (2018) in lactating Kangayam cows, while Sumitha *et al.* (2015) reported lower chloride (89.36±1.15 mmol/L) content in 3-4 year old Bargur cattle.

Conclusion

The findings of present study on blood biochemical, minerals and enzyme profile in Kangayam cattle of different age groups and sex established baseline data for the breed, which would be helpful to understand the changes of blood biochemistry with respect to age and sex, and to ensure the heat tolerance ability of native breed, and help clinicians when dealing with treatment of native breed.

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