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Blood biochemical profile in relation to age and reproductive status of Holstein Friesian cattle reared under tropical climate

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ABSTRACT

This study was planned to evaluate haemoglobin content and certain blood biochemical constituents of HF cattle reared under tropical climate in relation to different age groups and physiological status. All 72 female animals (6 in each group) were selected at random from the HF herd according to their age and physiological status, viz., 1-2 weeks, 2-3 months, 5-6 months, 8-9 months, 11-12 months and 17-18 months old and of varied reproductive status, viz., cyclic/early pregnant heifers (22-24 months old), advanced pregnant heifers (30-36 months old), recently calved cows (0 day), cyclic/lactating cows (2 months postpartum), anoestrus cows (5-6 months post-partum) and repeat breeder cows (6-9 months postpartum). Heparinized venous blood samples were obtained once from all animals at specified age/status for this study. The mean Hb content of blood varied from 9.00±0.43 to 11.03±0.22 g% (P<0.01) with a pooled mean of 9.91±0.16 g%. Similarly, the mean values of different biochemical constituents, viz., plasma total protein, triglycerides, calcium phosphorus and Ca:P ratio varied between different groups from 6.02±0.35 to 9.63±0.78 g% (P<0.05), 9.56±2.16 to 28.94±4.05 mg% (P<0.01), 9.92±0.59 to 12.16±0.73 mg% 8.57±0.31 to 12.15±0.47 mg% (P<0.01) and 0.95±0.03 to 1.42±0.18 (P<0.05), with an overall mean of 7.25±0.19 g%, 19.17±1.15 mg%, 11.53±0.17 mg%, 10.19±0.24 mg% and 1.18±0.04, respectively. Hb content was lowest in young calves and increased with advancing age to reach highest level at puberty. Total protein content, which was lowest in 1-2 weeks old calves, increased gradually with advancing age till maturity/calving and lactation, but was significantly low in anoestrus and repeat breeding cows. Triglycerides dropped drastically from highest level at birth to lowest level by 3 months of age and thereafter fluctuated in narrow range only, and it was lowest in lactating, anoestrus and repeat breeding cows. Both calcium and phosphorus levels were found lowest in recently calved cows compared to other age groups or reproductive status. The Ca:P ratio, which was wider (1.4:1) in the early age, reduced with advancing age till maturity to almost 1:1, again rose in pregnant and parturient animals, and dropped in anoestrus/repeat breeders cows.

Key words : Biochemical profile, age, reproductive status, Holstein Friesian cattle, tropical climate

Growth and reproductive processes in animals are directly or indirectly influenced by nutritional factors through metabolic and ovarian derangement. Macro-minerals like calcium, phosphorus and magnesium, apart from forming building blocks, also influence the ability of animal to utilize other micro-minerals (Dutta *et al.*, 2001). It is known that the requirements of various nutrients vary with the age and physiological stage of the animal (McDowell and Conrad, 1990), which need to be supplemented through ration. Holstein Friesian cattle raised under tropical climate are observed to have slow growth rate, poor heat tolerance and disease resistance, and even low productive and reproductive efficiency. There are several reports on blood biochemical profile of growing calves (Van Aken *et al.*, 1990; Das *et al.*, 1997; Sarmah *et al.*, 1999; Dandopath *et al.*, 2002) and in animals with different reproductive disorders for indigenous and crossbred cattle and buffaloes (Sharma *et al.*, 1984; Kumar *et al.*, 2000; Dutta *et al.*, 2001). But, studies on these aspects of HF cattle born and brought up under tropical climate are very meagre. Hence, this invesigation was planned to evaluate haemoglobin content and certain blood biochemical constituents of HF cattle in relation to different age groups and reproductive status.

MATERIALS AND METHODS

This study was undertaken on HF cattle of an organized herd of IDC Unit, GAU, Anand during Nov-Dec., 2002. Weaning right from birth followed by whole milk feeding @ 10% of body weight to calf up to 3 months of age was the common practice on the farm. After that milk was replaced by reconstituted skim milk till 6 months of age. Young calves were also offered a handful quantity of pelleted compounded

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Table 1. Haemoglobin content and blood plasma biochemical profile of HF cattle of different age groups and physiological status (Mean±SE)

Sl. No.	Age/Status (Group)	n	Haemoglobin (g%)	Total protein (g%)	Triglycerides (mg%)	Calcium (mg%)	Phosphorus (mg%)	Ca : P ratio
1.	1-2 wks old calves	6	9.00±0.43^{a}	6.02±0.35^{a}	28.94±4.05^{d}	12.16±0.73	8.99±0.66^{abc}	1.42±0.18^{c}
2.	2-3 months old calves	6	10.45±0.27^{cd}	6.91±0.59^{abc}	12.18±2.01^{abc}	12.04±0.56	8.72±0.33^{ab}	1.39±0.09^{cde}
3.	5-6 months old calves	6	9.03±0.16^{a}	7.23±0.58^{abcd}	19.76±2.52^{cd}	11.57±0.53	9.29±0.27^{abcd}	1.25±0.06^{bcde}
4.	8-9 months old heifers	6	9.13±0.29^{ab}	7.21±0.22^{abcd}	16.82±2.94^{abc}	10.75±0.66	10.05±0.61^{abcdef}	1.15±0.10^{abcde}
5.	11-12 months old heifers	6	10.03±0.42^{bcd}	6.83±0.62^{ab}	18.75±2.70^{bc}	11.62±0.55	11.06±0.78^{efg}	1.06±0.05^{abc}
6.	17-18 months old heifers	6	11.03±0.22^{d}	7.73±0.21^{abcdef}	15.03±2.30^{abc}	11.92±0.47	12.15±0.47^{g}	0.99±0.02^{ab}
7.	22-24 months old (cyclic/ early pregnant heifers)	6	10.10±0.32^{bcd}	8.21±0.69^{bcdefg}	14.42±1.51^{abc}	11.18±0.45	11.07±0.60^{efg}	1.04±0.09^{abc}
8.	30-36 months old (Adv pregnant heifers)	6	10.53±0.54^{cd}	7.82±0.55^{bcdefg}	17.46±3.41^{abc}	11.02±0.32	10.17±0.57^{abcdef}	1.13±0.07^{abcd}
9.	Recently calved cows	6	10.58±0.43^{d}	9.32±0.64^{gh}	15.98±1.99^{abc}	9.92±0.59	8.57±0.31^{a}	1.31±0.06^{cde}
10.	Lactating cows (2 mo PP)	6	10.68±0.26^{d}	9.63±0.78^{h}	11.76±2.32^{ab}	10.37±0.66	9.87±0.48^{abcde}	1.21±0.07^{abcde}
11.	Anoestrus cows (5-6 mo PP)	6	9.50±0.18^{abc}	8.76±0.98^{cdefgh}	10.00±3.28^{ab}	10.14±0.77	10.79±0.71^{defg}	0.95±0.03^{a}
12.	Repeat breeding cows (6-9 mo PP)	6	10.12±0.37^{bcd}	7.65±0.61^{bcde}	956±2.16^{a}	10.38±0.48	11.02±0.56^{rfg}	0.97±0.04^{a}
	Overall	72	9.91±0.16	7.25±0.19	19.17±1.15	11.53±0.17	10.19±0.24	1.18±0.04

n = Number of animals/observations

concentrate mixture (Amul Dan) along with tender green fodder at around 15 days of age and then gradually increased to 0.5 kg and *ad libitum* quantity, respectively, by 6 months of age. The growing, cycling and pregnant heifers and lactating cows were fed mixed fodder of legume-nonlegume and green-dry apart from concentrate mixtures and 25-30 gm mineral mixture daily as per routine protocol. Deworming and spraying of insecticides was also practiced as and when required. All the animals of the herd were hosued and managed hygienically in different sheds according to their age and physiological status.

For the present study, 12 groups of 6 animals each (72 females) were selected at random from the herd as per their age and reproductive status, which include young calves 1-2 weeks old (Group I), 2-3 months old (Group II), 5-6 months old calves (Group III), 8-9 months old heifers (Group IV), 11-12 months old (Group V), 17-18 months old pubertal (Group VI), 22-24 months old cyclic/early pregnant (Group VII), 30-36 months old advanced pregnant heifers (Group VIIi), recently calved cows (on day of parturition; Group IX), cycling/lactating cows (at peak of production 2 months postpartum; Group X), anoestrus cows 5-6 months postpartum (Group XI) and repeat breeder cows 6-9 months postpartum (Group XII).

From all the animals blood samples were collected from jugular vein in heparinized vials once at specified age/status. Following estimation of haemoglobin content by acid haematinic method, the samples were centrifuged at 2500 rpm for 20 minutes and the plasma were stored in deep freeze at -20°C till analyzed. The levels of total protein, triglycerides, calcium and inorganic phosphorus were determined as per standard procedures by using auto-analyzer (Model BT 214, Rome) and diagnostic kits (Span Diagnostics, Udhna, Surat) and the Ca:P ratio was worked out for each sample. The data were anlyzed statistically using CRD and critical difference test to know the variation, if any, between groups in any of the constituents studied (Steel and Torrie, 1981).

RESULTS AND DISCUSSION

The group-wise findings on various constituents studied are presented in Table 1 and its ANOVA is shown in Table 2.

The mean Hb concentration in the peripheral blood of HF cattle varied significantly ($P < 0.05$) from 9.00±0.43 to 11.03±0.22 g% between different age and reproductive status groups, with an overall mean of 9.91±0.16 g%. It was lowest in young calves and increased with advancing age to rich highest level in pubertal heifers and then remained more or less at constant level in all the groups of varying reproductive status (Table 1). These findings compared well with the reports of Patel *et al.* (1965) and Das *et al.* (1997; 2002) in indigenous and crossbred cattle. Sarmah *et al.* (1999) also reported gradual and significant rise in Hb concentration with advancing age from calves, heifers, pregnant to lactating cows. This low Hb content in calves might be due to lower Fe intake, as they are exclusively maintained on milk, which is naturally deficient in iron. With the increase in age feeding habit changes which perhaps explain the rise in Fe and thereby Hb content of blood in heifers and adults. The low Hb content may also be due to poor managerial care of calves and heifers compared to pregnant and lactating cows. Further a high Hb content in lactating cows indicated that for excessive metabolic activity like milk production, as Hb concentration might play some supportive role by carrying greater amount of $O_2^{\cdot}$ to the target tissues of mammary gland.

The mean concentration of plasma total protein in different groups of HF cattle varied significantly ($P < 0.05$) from 6.02±0.35 to 9.63±0.78 g% with an overall mean of

Table 2. ANOVA showing the effect of groups (age/reprodutive status) on haemoglobin and blood plasma biochemical constituents in HF cattle

Source of variance	d.f.	Mean sum of squares and statistical significance					
		Hb	TP	TG	Calcium	IP	Ca : P ratio
Groups	11	3.59**	3.83**	418.35**	1.55^{NS}	8.36**	0.15*
Error	60	0.74	1.03	62.54	1.80	1.89	0.06
Total	71	–	–	–	–	–	–
SEm		0.35	0.51	3.20	0.55	0.56	0.10
CD		1.00	1.42	9.15	–	1.60	0.28
CV%		8.66	14.07	40.91	11.64	13.50	20.15

d.f. : Degree of freedom; * $P < 0.05$; ** $P < 0.01$; NS : Non-significant

7.25±0.19 g%. It was lowest in 1-2 weeks old calves. Total protein content then increased gradually with advancing age till maturity/calving and during lactation, but was significantly low in anoestrus and repeat breeding cows. High total protein in parturient and lactating cows observed may be due to increased biosynthesis of the same to be added to milk or due to misappropriate feeding of high protein diet to this category of animals (Setia *et al.*, 1994). Kumar *et al.* (2000) also reported the mean plasma total protein concentration of 10.33±0.71 and 9.35±0.26 g/dl during advance pregnancy and within a week postpartum in cows. Sharma *et al.* (1984) noted significantly low plasma total protein in anoestrus than cyclic cows. However, Cetin *et al.* (2002) reported almost identical serum total protein levels in repeat breeder and fertile cows.

The mean levels of tri-glycerides in the peripheral blood plasma of HF cattle varied significantly ($P < 0.01$) from 9.56±2.16 to 28.94±4.05 mg% among different groups, with an overall mean of 19.17±1.15 mg%. The mean level of triglycerides dropped drastically from highest level at birth to lowest level by 3 months of age and thereafter fluctuated in narrow range only, and it was lowest in lactating, anoestrus and repeat breeding cows. Mesaric *et al.* (1997) and Guedon *et al.* (1999) noted higher levels of plasma tri-glycerides in advanced pregnant/dry cows compared to early and late lactating phase with or without reproductive disorders. The present findings thus to some extent agree to these reports. Ambore *et al.* (2001) observed significantly higher plasma triglycerides in sub-clinical ketotic than the healthy buffaloes (89.87±4.84 vs 61.82±1.18 mg/dl). The highest level of triglycerides found in very young calves might be related to their monogastric-type stomach and metabolic activities, which change very fast after about 3 months of age when they start taking roughage *ad libitum*.

The mean calcium concentration in the peripheral blood plasma of HF cattle varied non-significantly from 9.92±0.59 to 12.16±0.73 mg% among different age/ reproductive status groups, with an overall mean of 11.53±0.17 mg%. Apparently the value of calcium was highest in young calves (12.16 mg%) and it declined with advancing age till maturity/pregnancy, but droppd abruptly to 9.52 mg% soon after calving and then fluctuated around 10.5 gm% amongst lactating, anoestrus and repeat breeding cows. Elthohamy *et al.* (1989 and Sharma *et al.* (1999) also noted similar trend for calcium in cyclic, anoestrus and suboestrus cattle. Kumar *et al.* (2000) observed the mean values of blood plasma calcium and phosphorus to be lower during advance pregnancy than at one week postpartum in cows.

Inorganic phosphorus content on the other hand was significantly ($P < 0.01$) higher with lower Ca:P ratio in pubertal heifers and adult animals as compared to calves. The mean values ranged rom 8.57±0.31 to 12.15±0.47 mg% among different groups, with an overall mean of 10.19±0.24 mg%. The level was lowest in recently calved cows and in very young calves as compared to other age groups or reproductive status. Excessively low or high inorganic phosphorus leads to imbalance of Ca:P ratio in the peripheral blood plasma of HF cattle under study varied significantly ($P < 0.05$) from 0.95±0.03 to 1.42±0.18 among different groups, with an overall mean of 1.18±0.04. The Ca:P ratio, which was wider (1.4:1) in the early age, reduced with advancing age till maturity to almost 1:1, again rose in pregnant and parturient animals and dropped in anoestrus and repeat breeders.

Van Aken *et al.* (1991), Das *et al.* (2002) and Dandopath *et al.* (2002) reported plasma calcium and phosphorus levels to decline gradually or significantly ($P < 0.05$) with advancing age from the calves/heifers to the milch/ dry cows, and the anoestrus cows had significantly lower levels than all other categories of animals. This trend, however, was not evident in our study in farm raised HF cattle. Although a comparatively high calcium level in calves might be related to extensive osteoblastic activity in them, which require AKP as the key enzyme that also contains calcium and phosphorus as integral constituents. Further, extensive drainage of both calcium and phosphorus during muscular contractions at calving and then in milk may be attributed to their low levels observed in freshly calved cows.

Sharma *et al.* (1999) noted significantly low IP in anoestrus/infertile than the fertile cows, respectively. Dutta *et al.* (2001) found significantly higher circulatory levels of serum calcium and inorganic phosphorus in normal cyclic cows than anoestrus or repeat breeding cows. The higher levels of serum calcium found in cyclic cows might be due to fluctuating levels of estrogen, and low level in postpartum anoestrus and repeat breeder cows due to failure of endocrine system to mobilize the body calcium, which leads to reproduction failure.

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