BLOOD METABOLITES LEVELS IN RELATION TO AGE AND LIVE WEIGHT IN YOUNG BUFFALO CALVES

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Summary

Thirty buffalo calves were randomly categorised into three groups on the basis of age, i.e. birth to 6 months; 6 to 12 months and 12 24 months. Blood samples were collected to monitor certain vital metabolites in relation to age and prediction of performance in growing buffalo calves. Amongst the various blood parameters estimated the serum glucose, cholesterol and gamma globulins have shown highly significant correlations with age and live weight-gain of the animal as well. However, the multiple regression analysis clearly indicated the influence of age and live body weight on blood metabolites in buffalo calves.

(**Key Words**: Buffalo Calves, Blood Metabolites, Age, Body Weight, Correlations)

Introduction

Genetic make up of an individual influence the blood composition to such an extent that selection in desirable direction is possible (Wiener, 1979) and correlation of some blood metabolites with general health status, reproduction characteristics and milk production are also indicated in dairy cows. However, reports on buffaloes are very scanty. An attempt has been made in the present study, to estimate the levels of few blood metabolites in young buffalo calves and to find the effect of birth weight and live body weight on these metabolites.

Materials and Methods

Thirty animals were selected from the institute herd and were categorised into 3 groups depending upon the age of the animals as i) Birth to 6 months ii) 6 to 12 months and iii) 12 to 24 months of age. These animals were fed as per the feeding schedule e.g. whole milk from birth to 1 month, skim milk from 1 to 4 months of age and *ad lib* green fodder and dry roughage. The quantity of concentrate was limited to 1 kg from 6 months to 12 months and 2 kg from 12 to 24 months of age. Higher feeding standards are likely to influence total serum proteins, cholesterol, glucose and total lipids in circulation. Lower dietary levels than the actual standards might enhance total lipids and cholesterol in circulation with hypoglycemia symptoms (Maynard et al., 1985). The live body weight of these animals was recorded on the day of collecting the blood sample. The average age and body weight of these animals in various groups was recorded as under.

Groups	Average age (days)	Average body weight (kg)
1. Birth-6 months	139 ± 44.7	114 ± 23.7
2. 6-12 months	308 ± 39.6	137 ± 29.6
3. 12-24 months	504 ± 95.2	197 ± 69.0

Blood metabolites as haemoglobin (g%), serum protein (g%), gamma globulins (g%), albumins (g%), cholesterol (mg%), glucose (mg%) and lipids (mg%) were spectrophotometrically measured as per reference methods. Means and standard errors for various blood metabolites in each group were estimated. Analysis of variance of the data on various metabolites were conducted to find out the effect of age on blood metabolites. Correlation coefficients were estimated among various blood metabolites and with age and body weight of the calves to find out the association among these traits. Traits having significant correlation with age were used for multiple regression analysis

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Received July 20, 1993
Accepted December 7, 1993

so as to predict the level of metabolites on the basis of age and body weight.

Results and Discussion

Blood metabolites

Blood metabolites indicated spectacular changes with advancement of age. The averages and standard errors of blood metabolites estimated in the three age groups on haemoglobin, serum protein, gamma globulins, Albumins, Cholesterol, glucose and lipids are presented in table 1. The analysis of variance of the data on blood metabolites indicating the significance of differences among groups are presented in table 2.

Gamma globulin levels indicate the level of immunity in young animals. Animals after achieving the age of 12 months indicated declining trend of gamma globulins (g%) which almost remained consistant (3.10 ± 0.24 to 3.29 ± 0.31) upto 12 months of age, thereafter it decreased to 2.30 ± 0.60 as recorded in the third group with 12-24 months of age. Differences among the groups were significant. The findings are similar to the results available in cattle (Rowland et al., 1983). Gamma globulins are comparable in buffalo calves of 1-1.5 yrs. age (Paliwal et al., 1989). However values are lower than in cows (Osman et al., 1991).

Albumins (g%) indicated increasing trend with advancement of age which increased from the level of 1.60 ± 0.30 in first group to $2.27 + 0.41$ in second group after which the level sustained in the third group (2.30 ± 0.70) with 12-24 months of age. Serum albumins are slightly lower than reported values in buffalo calves (Paliwal et al., 1989) but levels are in accordance with reported values of Baranow-Baranowski and Piech (1980) in cattle.

Total lipids (mg%) and glucose (mg%) were estimated to be higher (721.0 ± 246.0 and 127.4 ± 20.1 mg% respectively) in second age group (6 to 12 months) however the level of these metabolites decreased substantialy ($518 + 131.5$ and 61.1 ± 8.6 respectively) from 12 months onwards. The differences among groups for both metabolites were statisticaly significant. Serum lipids levels are also in accordance with reported levels of Baranow-Baranowski and Piech (1980).

The level of cholesterol (mg%) declined from 180.0 ± 26.9 in first group to 86.1 ± 22.4 in the second group (6-12 months) and then slightly increased (93.3 ± 26.1) in the third group with 12-24 months of age. Overall serum cholesterol levels are very well accorded with many earlier reports (Paliwal et al., 1989; Akbar and Gupta, 1991; Singh and Eapen, 1980; Edfors-Lilja et al., 1978).

TABLE 1. MEANS AND S.E. FOR VARICUS METABOLIC TRAITS IN BUFFALO CALVES

Age groups	Hb. (g%)	Serum proteins (g%)	Gamma globulins (g%)	Albumins (g%)	Cholesterol (mg%)	Glucose (mg%)	Lipids (mg%)
1	12.1 ± 1.5	5.80 ± 1.30	3.10 ± 0.24	1.60 ± 0.30	$180.0 + 26.9$	100.7 ± 7.4	594.6 ± 26
2	11.9 ± 0.9	5.14 ± 0.69	3.29 ± 0.31	$2.27 + 0.41$	86.1 ± 22.4	127.4 ± 20.1	721.0 ± 246
3	12.1 ± 0.9	4.70 ± 1.00	2.30 ± 0.60	2.30 ± 0.70	93.3 ± 26.1	61.1 ± 8.6	518.6 ± 131

TABLE 2. ANALYSIS OF VARIANCE OF BLOOD METABOLITES AMONG AGE GROUPS

Source	d.f.	Mean Squares						
		Hb	Serum proteins	Gamma globulins	Albumins	Cholesterol	Glucose	Lipids
Between groups	2	0.0988	2.7677	2.3279*	1.5871*	27,333.98*	11,122.13*	104,769.1*
Within groups	27	1.3158	1.2072	0.1955	0.2616	707.229	197.845	29,094.61

* ($p < 0.05$).

Haemoglobin (g%) and serum protein (g%) did not show much variation with the advancing age. Though level of serum protein slightly decreased from 5.80 + 1.30 in first group to 4.70 ± 1.00 in the third group but the differences were statisticaly non-significant. The findings in buffalo calves are in contrast with the findings of Rowland et al. (1983) in cattle. Serum protein levels are slightly lower than earlier reports probably due to the lower dietary proteins offered to these animals.

Correlation among various metabolites

Linear correlation coefficients estimated on the basis of level of concentration among various metabolites are presented in table 3. Blood haemoglobin was found to have statisticaly non-significant and negative correlation with serum protein and albumin and positive correlation with gamma globulins ($r = 0.194$, $p <$ ns) cholesterol ($r = 0.108$, $p <$ ns) glucose ($r = 0.001$, $p <$ ns) and total lipids ($r = 0.121$, $p <$ ns) though statisticaly non-significant.

TABLE 3. CORRELATIONS OF BLOOD METABOLITES WITH AGE AND BODY WEIGHTS

	Hb	Serum protein	Gamma globulins	Albumins	Cholesterol	Glucose	Total lipids	Present B. weight
Age	0.00284	−0.342	−0.526*	0.440*	−0.610*	−0.570*	−0.175	0.742*
Hb	1	−0.350	0.194	−0.078	0.108	0.0095	0.121	0.148
Serum proteins		1	0.375*	0.106	0.128	−0.178	0.122	−0.384*
Gamma globulin			1	0.022	0.143	0.631*	0.379*	−0.509*
Albumins				1	−0.421*	−0.183	−0.073	0.221
Cholesterol					1	0.105	−0.0078	−0.488*
Glucose						1	0.465*	−0.481*
Total lipids							1	- 0.134

* ($p < 0.05$).

The level of serum protein was found to have statisticaly significant and positive correlation with gamma globulins ($r = 0.375$, $p < 0.05$), but statisticaly non-significant with albumins ($r = 0.106$, $p <$ ns), cholesterol ($r = 0.128$, 33. $p <$ ns), and with total lipids ($r = 0.122$, $p <$ ns) and negative correlation with glucose levels ($r = -0.178$, $p <$ ns).

Gamma globulins had statisticaly significant and positive correlation with glucose level ($r = 0.631$, $p < 0.05$). Though correlation with all other blood metabolic traits were positive but statisticaly non-significant. This indicates linear association of gamma globulin with other blood metabolic parameters especially with blood glucose.

Blood albumin had statisticaly non-significant and negative correlation with most of the traits except serum protein ($r = 0.106$, $p <$ ns) and gamma globulins ($r = 0.022$, $p <$ ns). Serum cholesterol was found to have statisticaly non-significant correlation with all other blood metabolites studied in this experiment.

Blood glucose had very high and positive correlation with gamma globulins ($r = 0.631$, $p < 0.05$) and total lipids ($r = 0.465$, $p < 0.05$). With all other traits under study the correlation coefficients were statisticaly non-significant.

Correlation with age and body weight

Age of the animal had statisticaly significant and negative correlation with gamma globulins, cholesterol and glucose. Though with all other traits the correlation coefficients were statistically non-significant and negative except with albumin content. This trend of results suggest that with increasing age the level of these metabolites decrease except albumin. Similar findings have also been reported by Kitchenham et al. (1977) and Little et al. (1977) in cattle.

Since body weight is highly associated with age of the animal ($r = 0.742$, $p < 0.05$), therefore correlation coefficients estimated with body weights were also found to be statisticaly significant and negative with all the traits except albumins ($r = 0.221$, $p <$ ns) and haemoglobin ($r = 0.148$, $p <$ ns). The study suggests that blood metabolites and age may have a promising potential in monitoring the growth rate of buffalo calves

which is an important production trait.

Multiple regression analysis

The multiple regression of blood metabolites as dependent variable (y) on age (X1) and body weight (X2) as independent variables representing the source of contribution to y are presented in table 4.

TABLE 4. MULTIPLE REGRESSION ANALYSIS OF BLOOD METABOLITES ON AGE AND BODY WEIGHTS

Sr. No.	Blood metabolites (yi)	Multiple regression			R square
		Constant	Coefficients ± SE		
			Age	B. weight	
		(a)	(b1)	(b2)	
1.	Haemoglobin	11.48	−0.0021 ± 0.0018	0.0078 ± 0.0057	0.07
2.	Serum protein	6.49	−0.0007 ± 0.0018	−0.0066 ± 0.0056	0.15
3.	Gamma globulins (6.02)*	3.74	−0.0012 ± 0.0008	−0.0028 ± 0.0026	0.31
4.	Albumins (4.09)*	1.82	0.0024 ± 0.0009	0.0029 ± 0.0028	0.23
5.	Cholesterol (8.12)*	184.65	−0.1702 ± 0.0692	−0.0677 ± 0.2124	0.38
6.	Glucose (9.46)*	148.93	−0.0468 ± 0.0405	−0.2426 ± 0.1242	0.42
7.	Lipids	570.31	−0.1720 ± 0.3732	0.4915 ± 1.1447	0.01

Figures in parenthesis are significant F value * ($p < 0.05$).

The analysis of variance due to regression involving the above traits was statisticaly significant for gamma globulins (6.02), albumins (4.09), cholesterol (8.12) and glucose (9.46) and statisticaly *non-significant* for haemoglobin, serum protein and lipids.

Very low R square values were obtained for the multiple regression equations on haemoglobin, serum protein and lipids which ranged from 0.01 to 0.15. However, for other traits the R square values ranged from 0.23 to 0.42

From the coefficients of multiple regression equations on various blood metabolites it was evident that age contributed as a major source for prediction of blood cholesterol level only whereas body weight contributed as a major source to influence the prediction of all other blood metabolic traits.

Literature Cited

Akbar, M. A. and P. C. Gupta. 1991. Effect of feeding different levels of FABA BEANS Seed meal on different blood biochemical constituents of Buffalo calves. Ind. Vet. Journal, 68:531.

Baranow-Baranowski, S. and H. Piech. 1980. Formation of some physiological and Biochemical indices in blood of calves. III Blood Serum proteins Roczniki Nauk Rolniczuch. Seria B, Zootechnicz na 1980. 104:29.

Edfors-Lilja, I., R. Gahne, K. Lundstrom, K. Darelius and Lars-Erik Edqvist 1978. Repeatability and genetic variation of cholesterol concentration in bovine blood plasma, correlation with growth rate, carcass quality and milk production Swedish J. Agril. Res. 8:113

Kitchenham, B. A., G. J. Rowlands, R. Manston and A. F. Baldry 1977. Individuality and relationships with growth rate observed in the concentrations of certain blood constituent of bulls and steers reared on three systems of beef production Br. Vet. J. 133:1/5.

Little, W., R. M. Kay, R. Manston, G. J. Rowlands and A. J. Stark. 1977. The effects of age, liveweight gain and feed intake on blood composition of young calves. J. Agric. Sci. 89:291

Maynard, A. B., J. K. Loosli, H. F. Hintz and R. G. Warner. 1985. Animal Nutrition. pp. 105 135. Tata McGrow-Hill publishing company limited N. Delhi

Osman, A. M., M. A. F. L-Naggar and S. H. Shehala. 1991. The significance of certain blood parameters to predict the condition of delivery and subsequent fertility in imported Friesian cows. In 11th International Congress on Animal Reproduction, University college Dublin. Ireland. June 26-30, 1988. Vol. 4. Brief communication publication.

Paliwal, V. K., A. B. Mandal, K. R. Yadav, N. Singh and G. Krishna 1989. Effect of Industrially Discarded Guar seed vis a vis protected Guar Meal on Rumen Metabolic profile and blood biochemical constituents in growing buffalo calves Ind. Vet. J. 66:149.

Rowlands, G. J. 1980. Concentrations of glucose, albumins, inorganic phosphates and sodium in blood of beef calves at 2.5 months of age and

their relationship with subsequent weight gain. J. Agric. Sci. 94:95

Rowlands, G. J., R. Manston, K. J. Bunch and P. A. Brookes. 1983. A genetic analysis of concentrations of blood metabolites and their relationships with age and live weight gain in young British Friesian Bulls. Livestock Production Science 10: 1.

Singh, S. R. and K. J. Eapen. 1980. A study on the effect of age and heredity on serum cholesterol in growing crossbred females. Ind. J. Anim. Sci. 50:321.

Wiener, G. 1979. Review of genetic aspects of mineral metabolism with particular reference to copper in sheep. Livest. Produ. Sci. 6:223.