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Serum Immunoglobulin Concentrations of Brown Swiss and Holstein Friesian Calves and Their Relationship with Growth Characteristics*

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ABSTRACT : Serum IgG and IgM concentrations of Brown Swiss and Holstein Friesian calves at 2 days of age, weaning, 1 and 4 months of ages were determined in the study. The effect of breeds on the concentration of serum immunoglobulins at various ages was statistically insignificant except for IgM concentration at 2 days of age. Sex had only significant influence ($P<0.01$) on the IgM concentration obtained at weaning, and female calves had higher IgM concentration than male ones. The correlation ($r = -0.39$) between IgG concentration and daily weight gains in the period from birth to weaning was found to be negative and highly significant ($P<0.01$). Also, highly significant and negative relationships between IgM concentration determined at weaning and weights obtained at different stages of growth were determined.

Key Words: Immunoglobulins, Calves, Brown Swiss, Holstein Friesian, Growth

Esmer ve Siyah Alaca Buzağıların Serum İmmunoglobulin Konsantrasyonları ve Bunların Büyüme ve Gelişme Özellikleri ile İlişkileri

ÖZET : Bu çalışmada, 2 günlük, sütten kesim, 1 ve 4 aylık yaşlardaki Esmer ve Siyah Alaca buzağıların serum IgG ve IgM konsantrasyonları saptanmıştır. İki günlük yaştaki IgM konsantrasyonu hariç, farklı yaşlardaki serum immunoglobulin konsantrasyonları üzerine ırkın etkisi istatistiksel olarak önemsiz bulunmuştur. Sadece, cinsiyetin sütten kesimdeki IgM konsantrasyonu üzerine etkisi önemli olmuş, dişi buzağıların IgM konsantrasyonu erkeklerden daha yüksek bulunmuştur. Doğumdan sütten kesime kadar olan dönemde günlük canlı ağırlık artışı ve IgM konsantrasyonu arasında negatif ve çok önemli derecede ($P<0.01$) bir korelasyon ($r = -0.39$) saptanmıştır. Ayrıca, sütten kesimde ölçülen IgM konsantrasyonu ile büyümenin farklı dönemlerinde belirlenen ağırlıklar arasında çok önemli negatif bir ilişki belirlenmiştir.

Anahtar Kelimeler: İmmunoglobulinler, buzağılar, Esmer, Siyah Alaca, Büyüme

INTRODUCTION

The primary classes of immunoglobulins (Ig) produced by cattle are IgG, IgM, IgA, IgT and IgD. IgG and IgM had four (IgG_1, IgG_2, IgG_3, IgG_4) and two (IgM_1, IgM_2) subclasses respectively (Muz and Bolat, 1993).

Serum immunoglobulin and serum complement levels are important measures of health status of calves. These variables can be used as indirect indicator of disease resistance (Sangwan et al. 2002). The importance of low Ig and its relationship to disease were emphasized by many studies (Cowan and Wagner, 1972; Norman et al. 1981; Mallard et al. 1983; Muggli et al. 1984). Robinson et al. (1988) indicated that calves having adequate Ig levels will continue to grow normally and may develop more efficient system that contribute to growth and production. However, there are inconsistent findings concerning the association between concentration of immunoglobulin and calf growth traits. Halliday et al. (1978) found that calf serum IgG_1, IgG_2 and IgM concentrations at 48 h of age were significantly correlated with calf growth from birth to 42 days of age, while phenotypic correlations of IgG_1 concentration with daily weight gains were determined as 0.26 by Muggli et al. (1984). In contrast to the findings of these studies, Gilbert et al. (1988) reported that genetic and phenotypic correlations among calf serum IgG_1 at 36 h and at weaning, birth weight and weaning weight were not significantly different from zero.

The objectives of this study were to determine serum concentrations of IgG and IgM isotypes of Holstein Friesian and Brown Swiss calves and to find out relationships between growth characteristics of calves and Ig concentrations.

MATERIAL AND METHODS

A total of 40 calves (20 Brown Swiss and 20 Holstein Friesian) reared in the Research Farm of Agricultural College at Atatürk University were used in this study. The calves were kept with their dams to receive colostrum for 3 days. Then, the young animals

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were housed in the individual pens furnished with feeders and water-milk buckets. Whole milk was fed by using buckets, and calf starter and dried hay in good quality were available in the pens after one week of age. The calves were weaned at 53 days of age, and the experiment lasted for 6 months. The young animals were weighed at 2 days, 53 days (weaning), 4 and 6 months of ages.

Blood samples were collected by jugular puncture into sterol tubes at 2 days, 1 month, weaning and 4 months of ages. The blood samples were centrifuged at 4500 rpm for 5 min. Then, serum was harvested and stored at -20 ° C until it was assayed in duplicate by nephelometric procedure as described by Akcay et al. (1998).

Statistical analysis was carried out by least squares analysis of variance for completely randomized factorial (2x2) design, with effects of breeds and sex. Simple correlations were also calculated by using SAS computer package program (SAS, 1986).

RESULTS AND DISCUSSION

Least squares means for serum IgG concentration of Holstein Friesian and Brown Swiss calves are presented in Table 1. Serum IgG levels were in the range of 16.18-20.67 mg/ml, and the finding is an accordance with result of Bradley et al. (1979) who reported 18.6 mg/ml in Hereford calves. In another study, levels of IgG_1 in calves from Hereford x Friesian herds were reported as 20.7 mg/ml by Halliday et al. (1978). Mazengera et al. (1985) and Gilbert et al. (1988) indicated that average serum IgG_1 concentrations were 21.6 mg/ml for Holstein Friesian cattle and 24.0 mg/ml for Simmental calves at 36 hours of age respectively. On the other hand, concentration of IgG for Holstein Friesian x Hariana calves was determined as 11.8mg/ml by Sangwan et al. (2002). Sex of calves was not significant source of the variation in serum IgG concentrations. The finding is in agreement with results of Norman et al. (1981), Muggli et al. (1984) and Gilbert et al. (1988). Also, no significant difference existed in IgG concentrations for breed of calf (Table 1).

Least squares means for IgM concentrations obtained at different ages are presented in Table 2. As could be seen from the Table 2, the overall IgM concentrations ranged from 2.85 to 4.01 mg/ml. The result is in accordance with findings of Norman et al. (1981) who reported that average IgM concentration in calves was 3.18 mg/ml. Sex of calves did not significantly influence concentrations of IgM obtained at various stages of the calf growth except for weaning. The result is compatible with findings of Norman et al. (1981).

Table 1. Least squares means for serum IgG concentrations (mg/ml) at different ages of calves

Trait Effect	N	2 Days of age $X\pm S_x$	1 Month of age $X\pm S_x$	Weaning $X\pm S_x$	4 Months of age $X\pm S_x$
Overall mean	27	19.50 ± 1.08	20.67 ± 0.86	18.17 ± 0.81	16.18 ± 1.23
Breeds					
Brown Swiss	15	20.61 ± 1.62	21.26 ± 1.30	18.54 ± 0.92	15.91 ± 1.45
Holstein Friesian	12	18.13 ± 1.30	19.99 ± 1.13	17.56 ± 1.56	17.57 ± 2.33
Significance		NS	NS	NS	NS
Sex					
Male	17	20.67 ± 1.30	20.88 ± 4.67	19.30 ± 4.96	16.51 ± 5.08
Female	10	17.54 ± 1.64	20.35 ± 4.99	16.09 ± 3.65	16.45 ± 7.68
Significance		NS	NS	NS	NS

NS: Non-significant $X\pm S_x$: Least Squares Mean ± Standard Error

Table 2. Least squares means for serum IgM concentrations (mg/ml) at different ages of calves

Trait Effect	N	2 Days of age $X\pm S_x$	1 Mon. of age $X\pm S_x$	Weaning $X\pm S_x$	4 Mon. of age $X\pm S_x$
Overall mean	40	2.85 ± 0.14	3.23 ± 0.12	3.76 ± 0.12	4.01 ± 0.28
Breeds					
Brown Swiss	20	2.50 ± 0.18	3.17 ± 0.16	3.36 ± 0.15	3.68 ± 0.24
Holstein Friesian	20	3.18 ± 0.20	3.30 ± 0.18	4.24 ± 0.51	4.45 ± 0.55
Significance		*	NS	NS	NS
Sex					
Male	26	2.71 ± 0.93	3.13 ± 0.75	3.25^a ± 0.75	4.25 ± 1.72
Female	14	3.11 ± 0.85	3.38 ± 0.56	4.48^b ± 1.86	3.65 ± 1.16
Significance		NS	NS	*	NS

NS: Non- significant, * : ($P<0.05$), $X\pm S_x$: Least Squares Mean ± Standard Error.

In this study, correlations of IgG and IgM levels at different ages with weights and daily weight gains are examined and results are tabulated in Table 3. The results of the phenotypic correlations in the present study revealed that there was no significant relationship between IgG and weights and daily weight gains at various ages of the calves. In contrast to results of the present study, Halliday et al. (1978) found significant correlation between serum IgG concentration of 48 hours of age with birth weight. The finding is in agreement with results of Gilbert et al. (1988). However, IgM concentrations measured at weaning were significantly ($P<0.01$) correlated with weights at birth, weaning, 4 and 6 months of ages (Table 3). Similarly, daily weight gains of the calves had significant and negative relationship with IgM concentrations determined at weaning. The association had disappeared by 4 months of age.

The results of the study suggested that average serum IgG and IgM concentrations of the calves were in accordance with other reports. No correlations were significant relating IgG levels to calf growth parameters. However, negative and significant relationships were found between IgM concentrations determined at weaning and weights and gains of the calves.

Table 3. Correlations between calf serum immunoglobulin isotypes and weights and daily weight gains at various stages of the calf growth

	IgG levels at;			IgM levels at;		
	2 Days of age n=27	Weaning n=27	4 Months of age n=17	2 Days of age n= 40	Weaning n= 40	4 Months of age n=40
Weights at;						
2 Days of age	0.20	0.14	-0.09	-0.29	-0.51**	0.22
Weaning	0.02	0.00	-0.13	-0.11	-0.44**	0.19
4 Months of age	0.19	-0.01	-0.02	-0.08	-0.45**	0.16
6 Months of age	0.10	-0.08	-0.10	0.02	-0.50**	0.17
Daily Weight Gains Between;						
Birth and weaning	-0.39**	-0.22	-0.10	0.26	-0.06	0.00
Birth and 4 months of age	0.14	-0.10	0.02	0.05	-0.30*	0.08
Birth and 6 months of age	0. 05	-0.14	0.09	0.12	-0.43**	0.13
Weaning and 4 months of age	0.33	-0.02	0.05	-0.03	-0.30*	0.07
Weaning and 6 months of age	0.14	0.09	-0.07	0.07	-0.44**	0.13

* : $P<0.05$, ** : $P<0.01$

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