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Serum lipid and mineral profiles during early lactation in Amrit Mahal, Holstein Friesian crossbred and jersey crossbred cows

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Abstract
The study was undertaken to determine and compare the serum lipid and mineral profiles in different breeds of cattle such as Amrit Mahal, Holstein Friesian crossbred and Jersey crossbred animals. A total of eighteen cows belonging to three breeds with six cows in each breed in their third lactation were selected for the study and were divided into three groups as Group I (Amrit Mahal), Group II (Holstein Friesian crossbred) and Group III (Jersey crossbred). Blood and milk samples obtained at 4th, 8th and 12th week were utilized for determination of lipid and mineral profiles with the help of commercial reagent kits using Microlab 300 semi-automated biochemical analyser. The serum cholesterol, triglycerides, calcium, phosphorus, sodium and potassium were significantly (P<0.05) higher in Amrit Mahal cows compared to Holstein Friesian crossbred and Jersey crossbred cows. However, non-significant (P>0.05) differences in phosphorus and magnesium levels were observed during different weeks of lactation in all the three breeds of cattle. The serum total cholesterol levels were significantly (P<0.05) higher during 12th week compared to 4th week of lactation in all breeds of cattle. However, the triglyceride levels were significantly (P<0.05) higher during 4th week compared to 12th week of lactation in Amrit Mahal and Jersey crossbred cows but not in Holstein Friesian crossbred cows. It is concluded that most of the serum lipid and mineral profile were significantly lower in crossbred cows compared to indigenous cows which could be related to their genetic potential compared to indigenous cattle or to the adaptability in the tropical climate.

Keywords: Indigenous, crossbred, lactation, lipid and mineral profile

Introduction
Lactation is regarded as the physiological mechanism that alters the body metabolism and impels stress on lactating animals. Lipid components like cholesterol and triglycerides act as important energy sources during negative energy balance at lactation. Several minerals are essential for maintenance of growth, production and reproduction in dairy animals. Calcium, phosphorus, magnesium, sodium, potassium and chloride are the primary minerals secreted into the milk from the blood stream through active transport mechanism [12]. Estimation of minerals like calcium and phosphorus during early lactation is important as their deficiency during peak milk yield affects the productivity of the dairy animal. Since there was paucity of information on the comparative studies of serum lipid and mineral profile between Amrit Mahal, Holstein Friesian crossbred and Jersey crossbred cows, the present study was undertaken. Form the study, most of the serum lipid and mineral profile components were significantly higher in Amrit Mahal cows compared to Holstein Friesian crossbred and Jersey crossbred cows indicating least metabolic disturbances during the early lactation in Amrit Mahal cows which could be due to their sustainability in these tropical conditions.

Materials and Methods
The present study was approved by the Institutional Animal Ethics Committee (VCH/IAEC/2018/57) dated 13.03.2018. A total of eighteen animals with six animals belonging to each breed such as Amrit Mahal cattle, Holstein Friesian crossbred and Jersey crossbred were selected from organized dairy farms of Chitradurga district, Bangalore Rural and Chikkaballapur districts of Karnataka, respectively. These animals were grouped into Group I (Amrit Mahal cows), Group II (Holstein Friesian crossbred) and Group III (Jersey crossbred cows).

Milk of all the selected animals was tested with California Mastitis test to rule out the sub-clinical mastitis [1]. Blood samples collected at 4th, 8th and 12th week of the lactation from March 2018 to June 2018 were utilized for determination of lipid and mineral profile. The serum lipid and mineral profile were determined using Microlab 300 semi-automated biochemical analyzer (Lab-care Diagnostics Pvt. Ltd., Gujarat, India) with the help of respective commercial reagent kits. The data obtained in the study were analyzed statistically by two way ANOVA using GraphPad Prism version 7.04 (2018) computerized software.

Results and Discussion

The serum total cholesterol level and triglycerides were significantly higher in indigenous breed (Group I) compared to crossbred cows (Group II and III) during different weeks of lactation (Table 1). These have been well recorded in crossbred cows [9, 11] and in Hallikar cattle [7]. The lower level of serum cholesterol in crossbred cows may be due to the effect of heat stress resulting in reduced feed intake and reduced dietary intake of cholesterol [9, 11]. The lower triglyceride levels in crossbred cows compared to indigenous cow to higher sensitivity of the enzyme TG-lipase resulting in more lipolysis of triglycerides during thermal stress [7].

From the present study, it is concluded that the higher serum cholesterol and triglyceride level in indigenous cows could be related to their better adaptable potential in the tropical climate and to cope up with the production of milk with higher fat percentage.

Significantly low level of serum total cholesterol during early stage of lactation and significant increase in its level with advancement of the lactation observed in the study was in accordance with the reports of in crossbred sheep [10], who attributed the lower serum total cholesterol during early lactation to the higher energy requirement for milk production and increase in its level during later stages of lactation to the increased demands for regulatory mechanism involved in milking processes.

Table 1: Serum total cholesterol and triglycerides (mg/dL) levels in different groups of lactating cows (n=6)

Parameters	Groups	Weeks of Lactation		
		4th week	8th week	12th week
Serum Total Cholesterol (mg/dL)	Group I	224.17 ± 5.53^{Ab}	232.22 ± 7.50^{ABb}	256.75 ± 14.11^{Bb}
	Group II	108.61 ± 4.47^{Aa}	133.49 ± 9.37^{ABa}	141.33 ± 11.16^{Ba}
	Group III	138.05 ± 8.71^{Aa}	154.43 ± 9.88^{ABa}	170.54 ± 9.31^{Ba}
Serum Triglycerides (mg/dL)	Group I	72.33 ± 7.08^{Bb}	64.87 ± 6.21^{ABb}	52.17 ± 2.92^{Ab}
	Group II	38.63 ± 2.39^{Aa}	35.00 ± 2.90^{Aa}	32.55 ± 2.71^{Aa}
	Group III	45.35 ± 3.21^{Ba}	28.09 ± 3.61^{Aa}	27.23 ± 3.70^{Aa}

The values with different superscripts in a row (A and B) and in a column (a and b) differ significantly ($P<0.05$).

In Group I and Group III cows, significantly higher serum triglycerides level was recorded on fourth week compared to twelfth week of lactation. Significantly lower level of serum triglycerides was observed during eighth week compared to fourth week of lactation in Jersey crossbred cows. These findings were in conformity with the reports in Ouleddjellal ewes [7] and in Mediterranean buffaloes [4]. Higher level of triglycerides during initial stages of lactation could be due to preferential utilization of adipose tissue to derive the energy resulting in higher circulating level of fatty acids which is converted in to triglycerides in the liver [8]. Higher level of triglycerides during initial stage of lactation could also be due to increased mammary lipoprotein lipase activity and fat transfer to the udder for higher milk fat synthesis [4].

Further, the higher level of serum triglycerides during initial stage of lactation in all the breed of cows could be attributed to increased hepatic fatty infiltration due to negative energy balance. Higher serum triglycerides during early part of lactation in all the groups could also be ascribed to the increased oxidation of saturated fatty acids during oxidative stress.

The serum calcium, phosphorus, potassium and sodium levels in the present study were significantly higher in Amrit Mahal cows compared to crossbred cows during different week of lactation (Table 2). Similar finding were reported in Swedish red and Swedish Holstein cows [6] and in Sahiwal, Badri, crossbred and Tulsi cows[16], who attributed the higher level of these minerals to the genotypic variation. Significantly higher level of serum magnesium and chloride was observed in Holstein Friesian crossbred cows compared to Amrit Mahal and Jersey crossbred cows during eighth week of lactation (Table 2). These findings are reported in Holstein Friesian cows [2], which is attributed to high milk producing capacity of the Holstein Friesian crossbred cows. Significantly higher serum phosphorus level in indigenous cows could be due to low level of milk yield, thereby minimizing the loss of potassium through the milk and elevating the level of these ions in the blood. Significantly higher serum magnesium and chloride level in Holstein Friesian crossbred cows during eighth week of lactation could be to meet the demand of increased minerals for high milk production.

The serum calcium levels were significantly higher during twelfth week compared to fourth week of lactation in Amrit Mahal and Jersey crossbred cows. The similar results are reported in Friesian and Ayreshire cows [13] and in crossbred ewes [5]. Lower level of serum calcium during early lactation could be due to higher drainage of calcium through the milk during this stage. The serum sodium and potassium level in Amrit Mahal cows were significantly higher during fourth and eighth weeks compared to twelfth week of lactation (Table 2) which was reported in Friesian and Ayreshire cows [13] and in dairy cows [14]. Sattler *et al*. (2001) attributed the higher potassium level during early part of lactation to the improved milk fat production, where the potassium effect on milk fatty acids is linked to biohydrogenation in the rumen. Therefore, it is concluded that the lower levels of serum sodium and potassium in crossbred cows compared to indigenous cows might be due to appreciable loss of sodium and potassium through milk in high producing crossbred cows.

Table 2: Serum mineral levels in different groups of lactating cows (n=6).

Parameters	Groups	Weeks of Lactation		
		4th week	8th week	12th week
Serum calcium (mg/dL)	Group I	7.96 ± 0.17^{Aa}	8.44 ± 0.23^{ABb}	8.98 ± 0.22^{Bb}
	Group II	7.35 ± 0.14^{Aa}	7.62 ± 0.18^{Aa}	7.99 ± 0.15^{Aa}
	Group III	7.44 ± 0.23^{Aa}	8.05 ± 0.24^{ABab}	8.47 ± 0.14^{Bab}
Serum phosphorus level (mg/dL)	Group I	2.16 ± 0.39^{b}	2.49 ± 0.35^{b}	2.69 ± 0.39^{b}
	Group II	1.07 ± 0.16^{a}	1.40 ± 0.15^{a}	1.49 ± 0.15^{a}
	Group III	1.91 ± 0.25^{ab}	2.12 ± 0.23^{ab}	2.27 ± 0.24^{ab}
Serum magnesium (mg/dL)	Group I	1.08 ± 0.06^{a}	0.90 ± 0.12^{a}	0.90 ± 0.15^{a}
	Group II	1.07 ± 0.07^{a}	1.48 ± 0.38^{b}	1.40 ± 0.06^{a}
	Group III	0.97 ± 0.13^{a}	0.86 ± 0.05^{a}	1.02 ± 0.02^{a}
Serum sodium (mmol/L)	Group I	164.51 ± 1.81^{Bb}	163.95 ± 1.98^{Bb}	153.78 ± 0.86^{Aa}
	Group II	151.50 ± 3.47^{Aa}	153.93 ± 3.66^{Aa}	153.76 ± 1.95^{Aa}
	Group III	148.66 ± 2.74^{Aa}	150.15 ± 3.55^{Aa}	147.84 ± 2.03^{Aa}
Serum potassium (mEq/L)	Group I	10.40 ± 0.73^{Bb}	9.63 ± 0.95^{Bb}	4.85 ± 0.07^{Aa}
	Group II	5.13 ± 0.87^{Aa}	4.66 ± 0.34^{Aa}	6.50 ± 0.44^{Aa}
	Group III	6.52 ± 0.97^{Aa}	5.75 ± 0.86^{Aa}	6.78 ± 0.53^{Aa}
Serum chloride (mEq/L)	Group I	123.77 ± 3.27^{Aa}	121.76 ± 2.38^{Aa}	120.13 ± 3.19^{Aa}
	Group II	125.74 ± 4.03^{Aa}	126.30 ± 2.07^{Aa}	134.50 ± 4.68^{Ab}
	Group III	117.75 ± 2.77^{Aa}	127.85 ± 2.71^{ABa}	129.33 ± 3.97^{Bab}

The values with different superscripts in a row (A and B) and in a column (a and b) differ significantly ($P<0.05$).

Conclusion

The levels of cholesterol, triglycerides, calcium, phosphorus, sodium and potassium were higher in Amrit Mahal cows compared to crossbred cows. Different weeks of lactation has significantly influenced serum cholesterol, triglycerides, calcium, sodium, potassium and chloride levels. Form the study, it is clear that most of the serum lipid and mineral profile components were significantly higher in Amrit Mahal cows compared to Holstein Friesian crossbred and Jersey crossbred cows indicating least metabolic disturbances during the early lactation in Amrit Mahal cows which could be due to their sustainability in these tropical conditions. As the native breeds are the better adapted to the adverse conditions of the tropical climate their conservation and usage for future cross breeding programmes in these regions is of immense value in the days to come.

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