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Seasonal variations in the blood serum levels of sodium and potassium in crossbred dairy cattle under different housing systems of Tamil Nadu

KEYWORDS: Sodium, potassium, housing system, crossbred cattle.

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ABSTRACT *Biochemical tests are useful in determining the blood components. Variations in the results of these tests from optimum levels give information with regard to the corrective measures in nutrition and management. A study was undertaken at the four agro-climatic regions of Tamil Nadu with the objective to assess the changes in sodium and potassium levels in blood serum of crossbred cattle during the four seasons kept under five housing systems. Based on preliminary survey animals from five housing systems with thatch, tile, cement sheet, metal sheets and open housing systems were selected for assessing the sodium and potassium status. A total of 120 samples (five housing types with six replicates from each agro-climatic region) were collected for each season with a grand total of 480 samples during the whole experimental period. There was no significant difference ($p<0.05$) in the mean concentration of either of the electrolytes between different housing systems in any of the seasons in the agro-climatic zones under study. The lowest serum concentration of sodium (mEq/l) during South West monsoon was recorded under open housing of Western zone (112.65±8.28). However, during North East monsoon, cold and summer season lowest level was recorded in animals kept in open system in North Eastern zone (122.15±6.35, 123.36±6.40 and 113.78±5.90). The lowest serum concentration of potassium (mEq/l) during South West monsoon was recorded under metal sheet roofed housing of North Western zone (4.33±0.40). However, during North East monsoon, cold and summer seasons it was recorded in animals kept under tile housing in Hilly zone (4.13±0.38, 3.86±0.35 and 4.39±0.40). The results of the blood serum levels of sodium and potassium showed that many of the crossbred cattle were having sodium levels lower than the recommended range, especially the animals kept in the open system. Sodium supplementation is essential in such animals for improving the health and production.*

INTRODUCTION

Animal comfort and welfare are considered as the important points in dairy herd management. Though India is having the world's largest cattle population, the average milk production of the cattle is very low. Improving the health and comfort of the animals is one of the ways to improve the production and farm economics. Achieving the above targets is possible by the modifications in the existing systems through education, legislation or through encouragement (Whay and Main, 2010). A thorough understanding of the interaction between animals and environment is essential for making the management strategies for maximizing the production. Measure of blood electrolytes is an indication of environmental stress and the effectiveness of management measures followed through feeding and housing of the animals. Biochemical tests are useful in determining the blood components. Variations in the results of these tests from optimum levels give information with regard to the corrective measures in nutrition and management.

Thermal stress results in diurnal variations in blood electrolytes Banerjee and Ashutosh (2010). Yokus and Cakir (2006) also found the seasonal variations in sodium and potassium in cattle. The present study was undertaken at the four agro-climatic regions of Tamil Nadu with the objective to assess the changes sodium and potassium levels in blood serum of crossbred cattle during the four seasons kept under five housing systems.

MATERIALS AND METHODS

The study was conducted in the four agro-climatic regions of Tamil Nadu viz. North Eastern zone, North Western zone, Western zone and Hilly zone. Out of this, the first three agro-climatic regions have the highest cattle population and the Hilly zone has the cattle with high productivity. Based on a preliminary survey, the major housing patterns existing in the four agro-climatic regions were identified and categorized for further detailed investigation. Farmers with at least five cows were selected from each agro-climatic zone with the major types of housing pattern identified for conducting the field investigation. The study was conducted for one year duration and the period was divided into four seasons as per Shanmugasundaram et al. (1973) as South West monsoon (June – August), North East monsoon (September-November), cold season (December-February) and summer season (April-May). In each sampling season the number of animals sampled in each group was always greater than five recommended by Whitaker (2000).

A total of 120 blood samples (five housing types with six replicates from each agro-climatic region) were collected for each season with a grand total of 480 samples dur-

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ing the whole experimental period. Whole blood was collected between 12.00 noon to 2.00 pm from each cow through jugular vein puncture into plain tubes as described by Grunwaldt et al. (2005). After clotting the blood, the tubes were centrifuged (1000 rpm for 30 min) and serum was stored at –36°C for electrolyte (sodium and potassium) analysis. The serum was examined for the electrolytes with semi-auto analyzer (Accurex, AT – 200D) by standard methods described by Miller (1984) with the available commercial kits (SPAN diagnostics Ltd., Surat). The collected data were statistically analyzed by one way analysis of variances (ANOVA) for finding the difference between the groups by using statistical package SPSS 17.

RESULTS AND DISCUSSION

From the survey, it was observed that mostly the farmers were using thatch, tile, cement sheet (CC), metal sheets and open housing systems for rearing the animals. Hence these five types of housing systems were selected for the study. The mean ± S.E of serum concentration of sodium and potassium (mEq/l) in cows under various housing types in the four agro-climatic zones under the study are presented in Tables 1- 4.

Table 1. Mean ± SE of serum concentration of sodium and potassium during South West monsoon

Sl No	Agro-climatic region	North Eastern Zone Housing Types					North Western Zone Housing Types				
	Parameter (n=6)	Thatched	Tile	Metal	CC	Open	Thatched	Tile	Metal	CC	Open
1	Na^+ (mEq/l)	137.43 ±3.88	134.12 ±11.70	125.29 ±10.11	127.28 ±14.72	118.13 ±6.13	132.18 ±3.78	130.32 ±10.59	124.69 ±5.49	136.74 ±6.85	125.46 ±9.08
2	K^+ (mEq/l)	4.97 ±0.55	5.59 ±0.62	5.50 ±0.77	5.39 ±0.47	4.92 ±0.21	5.54 ±0.43	4.89 ±0.57	4.33 ±0.40	4.98 ±0.44	5.09 ±0.39

Sl No	Agro-climatic region	Western Zone Housing Types					Hilly Zone Housing Types					Over all	F value	P Value
	Parameter (n=6)	Thatched	Tile	Metal	CC	Open	Thatched	Tile	Metal	CC	Open			
1	Na^+ (mEq/l)	134.98 ±6.58	145.52 ±12.53	133.65 ±3.56	141.69 ±13.56	112.65 ±8.28	130.02 ±6.61	125.42 ±6.42	130.19 ±7.56	156.75 ±7.14	130.30 ±8.35	131.64 ±1.98	1.20	0.27
2	K^+ (mEq/l)	5.00 ±0.77	5.39 ±0.37	6.06 ±0.44	5.00 ±0.59	5.79 ±0.49	4.94 ±0.55	4.35 ±0.40	4.87 ±0.49	4.95 ±0.40	5.07 ±0.25	5.13 ±0.11	0.74	0.77

Table 2. Mean ± SE of serum concentration of sodium and potassium during North East monsoon

Sl No	Agro-climatic region	North Eastern Zone Housing Types					North Western Zone Housing Types				
	Parameter (n=6)	Thatched	Tile	Metal	CC	Open	Thatched	Tile	Metal	CC	Open
1	Na^+ (mEq/l)	142.10 ±4.01	138.68 ±12.10	141.14 ±4.90	131.61 ±15.21	122.15 ±6.34	134.55 ±3.84	138.50 ±9.90	135.83 ±1.77	139.20 ±6.98	127.72 ±9.24
2	K^+ (mEq/l)	4.82 ±0.54	5.42 ±0.60	5.33 ±0.75	5.23 ±0.45	4.77 ±0.20	5.32 ±0.41	4.69 ±0.55	4.15 ±0.38	4.78 ±0.42	4.89 ±0.38

Sl No	Agro-climatic region	Western Zone Housing Types					Hilly Zone Housing Types					Over all	F value	P Value
	Parameter (n=6)	Thatched	Tile	Metal	CC	Open	Thatched	Tile	Metal	CC	Open			
1	Na^+ (mEq/l)	136.29 ±6.64	146.93 ±12.65	134.94 ±3.59	132.61 ±8.05	128.73 ±3.01	133.82 ±6.09	131.44 ±5.02	137.55 ±5.77	143.23 ±1.93	131.41 ±8.42	135.42 ±1.65	0.58	0.91
2	K^+ (mEq/l)	4.65 ±0.71	5.00 ±0.34	5.63 ±0.41	4.65 ±0.55	±5.38 ±0.45	4.70 ±0.53	4.13 ±0.38	4.62 ±0.47	4.70 ±0.38	5.04 ±0.37	4.89 ±0.10	0.70	0.81

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Table 3. Mean ± SE of serum concentration of sodium and potassium during cold season

Sl No	Agro-climatic region	North Eastern Zone Housing Types					North Western Zone Housing Types				
	Parameter (n=6)	Thatched	Tile	Metal	CC	Open	Thatched	Tile	Metal	CC	Open
1	Na^+ (mEq/l)	139.72 ±3.40	139.70 ±12.05	140.29 ±3.80	132.91 ±15.37	123.36 ±6.40	135.48 ±3.87	139.46 ±9.97	136.77 ±1.78	130.32 ±3.82	128.60 ±9.31
2	K^+ (mEq/l)	4.96 ±0.55	5.59 ±0.61	5.49 ±0.77	5.38 ±0.47	4.91 ±0.21	5.50 ±0.42	4.66 ±0.43	4.29 ±0.40	4.95 ±0.44	5.05 ±0.39

Sl No	Agro-climatic region	Western Zone Housing Types					Hilly Zone Housing Types					Over all	F value	P Value
	Parameter (n=6)	Thatched	Tile	Metal	CC	Open	Thatched	Tile	Metal	CC	Open			
1	Na^+ (mEq/l)	134.52 ±6.56	145.02 ±12.48	133.19 ±3.55	130.88 ±7.95	127.05 ±2.97	130.85 ±5.95	128.52 ±4.90	134.50 ±5.64	137.64 ±1.49	132.47 ±6.16	134.06 ±1.58	0.52	0.95
2	K^+ (mEq/l)	4.80 ±0.74	5.17 ±0.36	5.81 ±0.42	4.80 ±0.56	5.55 ±0.47	4.39 ±0.49	3.86 ±0.35	4.32 ±0.43	4.39 ±0.35	4.48 ±0.22	4.92 ±0.11	1.24	0.24

Table 4. Mean ± SE of serum concentration of sodium and potassium during summer season

Sl No	Agro-climatic region	North Eastern Zone Housing Types					North Western Zone Housing Types				
	Parameter (n=6)	Thatched	Tile	Metal	CC	Open	Thatched	Tile	Metal	CC	Open
1	Na^+ (mEq/l)	128.88 ±3.14	128.86 ±11.12	129.40 ±3.50	122.59 ±14.17	113.78 ±5.90	128.17 ±3.66	131.93 ±9.43	129.38 ±1.69	123.28 ±3.61	121.66 ±8.80
2	K^+ (mEq/l)	5.42 ±0.61	6.11 ±0.67	6.01 ±0.84	5.89 ±0.51	5.37 ±0.22	5.73 ±0.44	5.06 ±0.59	4.48 ±0.41	5.16 ±0.46	5.27 ±0.41

Contd-----

Sl No	Agro-climatic region	Western Zone Housing Types					Hilly Zone Housing Types					Over all	F value	P Value
	Parameter (n=6)	Thatched	Tile	Metal	CC	Open	Thatched	Tile	Metal	CC	Open			
1	Na^+ (mEq/l)	129.00 ±6.29	139.07 ±11.97	127.73 ±3.40	125.52 ±7.62	121.85 ±2.85	134.25 ±6.11	131.87 ±5.03	132.63 ±2.37	136.41 ±1.68	131.83 ±8.45	128.40 ±1.53	0.69	0.82
2	K^+ (mEq/l)	5.13 ±0.79	5.53 ±0.38	6.21 ±0.45	5.13 ±0.60	5.94 ±0.50	4.99 ±0.56	4.39 ±0.40	4.91 ±0.50	4.99 ±0.40	5.33 ±0.38	5.35 ±0.12	0.94	0.54

There was no significant difference ($p<0.05$) in the mean concentration of either of the electrolytes between different housing systems in any of the seasons in the agro-climatic zones under study. The highest serum concentration of sodium (mEq/l) during South West monsoon was recorded under cement sheeted housing of Hilly zone (156.75±7.14). However, during North East monsoon, cold and summer seasons it was recorded in animals kept in tile roofed housing in Western zone (146.93±12.65, 145.02±12.48 and 139.07±11.79).

The lowest serum concentration of sodium (mEq/l) during South West monsoon was recorded under open housing of Western zone (112.65±8.28). However, during North East monsoon, cold and summer season lowest level was recorded in animals kept in open housing in North Eastern zone (122.15±6.35, 123.36±6.40 and 113.78±5.90). These levels were below the recommended level of sodium in cattle by Kaneko et al. (2008). Hence supplementation of sodium is essential for improving the health and production.

The variations in serum concentration of sodium between different housing systems were earlier reported by Jat et al. (2002). There was reduction in the mean concentration of sodium during summer, the effect of thermal stress on

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serum concentration of sodium was earlier observed by Banerjee and Ashutosh (2010).

The highest serum concentration of potassium (mEq/l) during South West monsoon, North East monsoon, cold and summer seasons were recorded under metal sheeted housing of Western zone (6.06±0.44, 5.63±0.41, 5.81±0.42 and 6.21±0.45).

The lowest serum concentration of potassium (mEq/l) during South West monsoon was recorded under metal sheet roofed housing of North Western zone (4.33±0.40). However, during North East monsoon, cold and summer seasons it was recorded in animals kept under tile housing in Hilly zone (4.13±0.38, 3.86±0.35 and 4.39±0.40). These levels were within the normal recommended level of potassium in cattle by Kaneko et al. (2008). The variations in serum concentration of potassium between different housing systems were earlier reported by Jat et al. (2002).

CONCLUSION

The results of the blood serum levels of sodium and potassium in crossbred cattle during the four seasons kept under different housing systems showed that many of the animals were having sodium levels lower than the recommended range, especially the animals kept in the open system. Sodium supplementation is essential in such animals for improving the health and production. Hence farmers should be made aware of the benefit of feeding common salt to animals in deficient systems.

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