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Influence of mineral supplementation on the growth performance of Madars Red lambs under different systems of management

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Abstract

Influence of mineral supplementation on the performance of Madras Red lambs reared under intensive and semi-intensive systems of management was studied. The lambs supplemented with minerals on daily or weekly basis under intensive system had significantly (P<0.05) heavier body weights than the unsupplemented group. There was no significant difference (P<0.05) in the serum albumin and total protein levels between the treatment groups. The serum cholesterol showed no significant difference (P<0.05) between treatment groups on 0 and 45th day of rearing, whereas on the 90th day the lambs maintained under intensive system had a significantly (P < 0.05) higher level of cholesterol when compared to semi-intensive system. Serum calcium and phosphorous levels had linear relationship with the supplementation of minerals. The lambs supplemented with minerals on daily or weekly basis had significantly higher serum minerals. It was concluded that the supplementation of mineral mixture had resulted in better growth rate and average daily gain than the unsupplemented groups in both the systems of management. However, mineral supplementation was found to have no influence on all the carcass traits and the blood profile studied.

Keywords : lamb growth, concentrate feed, mineral supplementation, management systems, madras red lambs

INTRODUCTION

Rearing of sheep has remained as a subsidiary occupation for a vast segment of the rural population in India and the sheap rearing ensures maximum "year-round" employment. Incidentally, these small ruminants require very little investment and provide more meat per unit weight per year than cattle and buffaloes. Sheep can thrive well in all agroclimatic zones except high rainfall areas. Sheep can subsist on low set and sparse vegetation, where other farm livestock may be struggling to thrive. This is possible only because of their inherent capacity to grazing very close to the roots of herbages.

Mineral deficiencies in native pastures have been reported to affect the productivity of grazing animals in the tropics (McDowell, 1985). Adequate mineral intake and absorption is required for a variety of metabolic functions including immune response to pathogenic challenge, reproduction and growth (Larson, 2005). As such supplementary feeding of lambs in addition to grazing could help them to achieve rapid growth rate and facilitate to reach an early slaughter weight than the lambs grown under conventional grazing system alone. This paper evaluates the influence of mineral supplementation on the growth rate and blood profile of Madras Red lambs under different management systems.

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MATERIALS AND METHODS

The study was undertaken in the sheep unit at Livestock Research Station, Kattupakkam, Kancheepuram district in Tamil nadu, South India for a period of 90 days from April 2007 to June 2007. Thirty six Madras Red lambs born during main lambing season were weaned and dewormed at the age of three months and divided into six groups comprising of six animals in each. The control groups (T_1 and T_4) were fed on concentrate feed @ 150 g per animal per day without any mineral mixture supplementation. The groups T_2 and T_5 were fed on concentrates with same quantity daily added with mineral mixture (2 %). The group T_3 and T_6 were fed on concentrate feed without mineral mixture for 6 days and mineral mixture added diet fed once in a week. The lambs under intensive system (T_1, T_2 and T_3) and semi-intensive system (T_4, T_5 and T_6) were fed on chaffed hybrid fodder *ad libitum* daily in addition to concentrate feed. The lambs under semi-intensive system were also allowed for grazing in range lands for 8 hours/day. Changes in body weight, average daily gain and body measurements of the lambs were recorded fortnightly. The blood samples were collected from animals of each group on 0, 45th and 90th days of the trial and analysed for hematological, biochemical and mineral profiles. Whole blood was collected along with EDTA and was used for measuring hemoglobin content by Acid Haematin Method, Packed Cell Volume (PCV) by Microhaematocrit Method, and total red cell count by Hemocytometer (Coles, 1986). Serum was separated from coagulated blood for analysis of albumin by BCG-BIURET method,

total protein by BCG-BIURET method, cholesterol by CHOD-PAP method, calcium by Arsenazo-HI method and phosphorous by Phosphomaldehyde method (Burtis and Aswood, 1996). The data collected were subjected to statistical analysis as per the method of Snecdor and Cochran (1994).

RESULTS AND DISCUSSION

Growth

The lambs reared under intensive management system with daily and weekly mineral supplementation along with concentrate and green fodder (T_2 and T_3) had significantly heavier (P<0.05) body weights than the lambs maintained without mineral supplement in their feed (Table 1). This higher body weight might be due to conservation of metabolic energy by the lambs under intensive system . The above treatment in semi-intensive system also resulted in heavier body weights than the lambs fed with concentrate feed without mineral supplementation. This is in agreement with reports of Shinde *et al.* (1995), Sinha and Deoghare (1996), Saini *et al.* (1988), Dimsoski *et al.* (1999) and Zervas *et al.* (1999). Lambs supplemented with minerals on daily / weekly basis had a higher body weight gain and overall daily gain than the unsupplemented groups, irrespective of the systems of management. This might be due to the enhancement of metabolic process by minerals which favoured better weight gain. This is in accordance with the findings of Aganga and Kgwatala (2005) who stated that Tswana buck fed with mineral supplemented diet had a markedly improved liveweight gain than the unsupplemented groups.

The lambs maintained with mineral supplementation along with concentrate had higher body measurements than the lambs fed without minerals (Table 2). It could be inferred from these observations that the difference in the body weight of lambs under different treatment groups were also reflected in the body measurements as well, since the body measurements are expected to have direct associations with the body weight. This present finding is in agreement with the findings of Meenakshisundaram (2001), who reported that all body measurements were higher for lambs grown under intensive system than in semi-intensive system under farm conditions. The present finding that the lambs supplemented with minerals on daily / weekly basis had higher body measurements than the unsupplemented groups irrespective of the systems of management, is in accordance with the report of Aganga and Kgwatala (2005) as well.

Blood profile

There was no significant difference in the blood profile between the treatment groups and between different days of collection (Table 3). This indicated that the grower lambs could maintain the Hamoglobin, Packed Cell Volume and Total count irrespective of the feeding regimes. It was also inferred that the sheep can thrive well under varied nutritional and management conditions. This is in accordance with the report of Misra *et al.* (2000), who studied the blood metabolites of four breeds of sheep maintained under two rearing practices (Improved *vs.* Traditional) and observed that the blood metabolites were within the normal range in all the breeds under both rearing practices.

Serum biochemical profile

Serum biochemical profile of Madras Red lambs reared under different management systems showed that there was no significant difference in the serum albumin and total protein levels between treatment groups on 0, 45 and 90 days of collection (Table 4). The serum cholesterol level showed no significant difference between treatment groups on 0 and 45th day of collection, whereas on the 90th day the lambs maintained under intensive system had a significantly higher (P<0.01) level of cholesterol when compared to semi intensive system. This increase in cholesterol level at a later stage may be probably due to lack of exercise under intensive system.

Serum minerals

Serum mineral profile of Madras Red lambs reared under different management systems revealed that there was a significantly higher level (P<0.01) of serum calcium and phosphorus in the daily supplemented group than the weekly supplemented group and they were least in the unsupplemented group irrespective of the management systems (Table 4). This is in agreement with the findings of Imbeah (1999), who studied the potential value of wood ash as a readily available source of supplementary minerals for sheep and observed significant increases (P<0.05) in calcium, magnesium, copper and zinc in serum with time. Rahnema and Fontenot (1983) also reported that the lambs supplemented with dolomitic limestone and magnesium oxide in their diet was found to have increased serum inorganic phosphorus levels.

Carcass traits

The carcass traits of Madras Red lambs reared under different management systems showed no significant differences (P>0.05) in carcass traits between treatments (Table 5). However, lambs maintained under intensive system had a higher carcass yield than in the semi-intensive system. This is in agreement with the findings of Umoh and Halilu (1992) and Meenakshisundaram (2001). They found higher dressing percentage in heavier lambs, which can be attributed to their higher body weights at slaughter.

Table 1. Body weight (kg), and average daily gain (g/day) of Madras Red lambs reared under different management systems and in different treatment groups. Values are Mean ± S.E (See "Materials and Methods" section for description of treatment groups T1 to T6)

Parameters	Management system	Treatment groups	Initial	Fortnights					
				1	2	3	4	5	6
Body weight (kg)	Intensive	T1	8.33 ± 0.36	8.90 ± 0.39	9.48 ± 0.44	10.15 ± 0.24	10.93 ± 0.24	11.60 ± 0.54	12.53 ± 0.21
		T2	8.10 ± 0.50	8.78± 0.32	9.50 ± 0.26	10.10 ± 0.14	11.00 ± 0.22	11.93 ± 0.33	13.08 ± 0.29
		T3	8.30 ± 0.59	8.93 ± 0.70	9.67 ± 0.60	10.38 ± 0.82	11.22 ± 0.69	12.32 ± 0.57	13.50 ± 0.27
	Semi-Intensive	T4	8.48 ± 0.56	9.05 ± 0.57	9.60 ± 0.70	10.25 ± 0.67	10.90 ± 0.49	11.60 ± 0.50	12.38 ± 0.73
		T5	8.23 ± 0.72	8.90 ± 0.61	9.65 ± 0.64	10.20 ± 0.71	11.05 ± 0.69	12.00 ± 0.91	13.20 ± 0.58
		T6	8.27 ± 0.32	8.98 ± 0.25	9.71 ± 0.09	10.55 ± 0.18	11.41 ± 0.69	12.30 ± 0.36	13.45 ± 0.10
Average daily gain (g/day)	Intensive	T1	37.78 ± 1.11	40.71^{a} ± 2.34	41.43 ^{a} ± 3.95	47.86 ^{a} ± 5.28	55.71 ^{a} ± 3.54	47.86 ^{a} ± 3.39	66.43^{a} ± 2.31
		T2	37.56 ± 1.28	48.51^{b} ± 4.99	51.43 ^{b} ± 3.22	60.00 ^{b} ± 4.40	64.29 ^{b} ± 5.06	66.43 ^{b} ± 4.85	82.14^{b} ± 6.22
		T3	36.22 ± 1.39	45.00^{b} ± 3.52	52.86 ^{b} ± 4.63	62.22 ^{b} ± 2.05	60.67 ^{b} ± 6.55	64.29 ^{b} ± 3.92	84.29^{b} ± 6.78
	Semi-Intensive	T4	37.11 ± 1.24	40.71^{a} ± 4.11	39.26 ^{a} ± 2.74	43.33 ^{a} ± 4.76	46.43 ^{a} ± 5.96	50.00 ^{a} ± 3.27	54.44^{a} ± 6.23
		T5	37.78 ± 1.22	47.85^{b} ± 2.73	53.57 ^{b} ± 4.95	63.33 ^{b} ± 4.36	60.71^{b} ± 4.95	67.86 ^{b} ± 3.83	85.71^{b} ± 3.69
		T6	37.01 ± 1.63	50.71^{b} ± 3.18	52.14 ^{b} ± 5.89	62.67 ^{b} ± 4.60	61.43 ^{b} ± 3.16	63.57 ^{b} ± 2.31	82.14^{b} ± 3.58

Means within each management system bearing different superscripts differ significantly (CRD – test; $P < 0.05$)

Table 2. Body measurements (cm) of Madras Red lambs reared under different management systems and in different treatment groups. Values are Mean ± S.E. (See "Materials and Methods" section for description of treatment groups T1 to T6)

Parameters	Management system	Treatment groups	Initial	Fortnights					
				1	2	3	4	5	6
Body length (cm)	Intensive	T1	40.33 ± 1.96	50.16± 1.47	60.17 ± 1.64	66.16 ± 1.51	73.16 ± 1.64	76.33±1.25	78.00± 0.68
		T2	37.66 ± 0.88	60.33 ± 1.62	65.92 ± 1.43	71.33 ± 1.11	79.91 ± 1.42	85.66±1.33	86.17 ± 0.95
		T3	39.33 ± 1.99	62.33 ± 1.30	64.17 ± 0.95	70.33 ± 0.55	78.16 ± 0.94	83.00 ± 0.58	85.50 ± 1.20
	Semi-Intensive	T4	40.17 ± 0.48	50.50 ± 1.31	59.83± 1.51	64.16 ± 1.64	72.83 ± 1.58	77.50 ± 0.92	79.00± 1.32
		T5	40.67 ± 0.95	64.16 ± 1.66	64.33 ± 0.67	70.16 ± 0.74	78.33 ± 0.66	84.83 ± 1.40	85.50 ± 1.59
		T6	41.50 ± 0.43	63.41 ± 1.31	65.67 ± 0.99	69.33 ± 1.17	77.66 ± 0.98	84.16 ± 1.01	85.83 ± 0.60
Chest girth (cm)	Intensive	T1	40.83 ± 1.08	50.66 ± 1.72	62.53± 1.91	65.83 ± 1.74	67.16 ± 2.32	68.50 ±1.68	69.33 ± 1.67
		T2	41.50 ± 1.23	58.16 ± 1.75	68.00 ± 1.55	70.16 ± 1.74	72.90 ± 2.18	73.83 ± 1.44	74.50 ± 2.20
		T3	41.33 ± 0.88	57.33 ± 0.61	69.50 ± 0.76	70.00 ± 1.14	72.91 ± 1.30	73.66 ± 1.79	75.33 ± 1.67
	Semi-Intensive	T4	40.12 ± 1.89	52.83 ± 1.04	60.33 ± 1.52	65.33± 3.13	67.50 ± 2.19	67.83 ± 2.03	68.83 ± 1.01
		T5	40.66 ± 1.40	62.66 ± 0.11	66.16 ± 0.60	69.17 ± 1.08	71.83 ± 1.14	72.83 ± 1.34	73.00 ± 1.90
		T6	41.66 ± 1.31	60.33 ± 0.30	67.25 ± 1.37	70.33 ± 0.76	72.00 ± 1.10	72.83 ± 1.24	73.50 ± 0.56
Height at withers (cm)	Intensive	T1	40.83 ± 1.17	47.66 ± 1.40	54.17 ± 0.95	60.00± 2.50	63.33 ± 0.55	65.50 ± 1.11	66.50 ± 2.50
		T2	42.67 ± 1.00	54.50 ± 1.33	59.33 ± 1.58	65.00 ± 0.68	68.33 ± 0.98	72.00 ± 1.39	70.33 ± 1.50
		T3	41.00 ± 0.58	55.50 ± 1.64	60.57 ± 1.14	64.33 ± 0.61	69.83 ± 1.60	71.50 ± 1.91	71.00 ± 1.83
	Semi-Intensive	T4	41.17 ± 1.08	48.16 ± 1.07	53.00 ± 0.73	60.17 ± 1.33	62.16 ± 1.01	65.10 ± 0.57	66.83± 1.11
		T5	43.00 ± 1.39	54.33 ± 1.42	58.33 ± 0.98	64.67 ± 0.42	69.33 ± 1.25	74.83± 1.92	75.50 ± 1.02
		T6	40.83 ± 1.28	53.16 ± 0.54	59.50 ± 0.22	64.17 ± 1.17	69.90 ± 0.70	74.00 ± 0.51	75.67 ± 0.95

Means within each management system bearing different superscripts differ significantly (CRD – test; $P < 0.05$)

Table 3. Blood profile and serum albumin level of Madras Red lambs reared under different management systems and in different treatment groups. Values are mean ± S.E. (see 'Materials and Methods' section for description of different treatment groups T1 to T6)

Parameters	Management system	Treatment groups	0 Day	45th Day	90th Day
Heamoglobin (g/dl)	Intensive	T1	8.25 ± 0.21	10.41 ± 0.50	11.66 ± 0.35
		T2	7.92 ± 0.15	10.33 ± 0.21	11.50 ± 0.36
		T3	7.92 ± 0.15	11.08 ± 0.47	11.58 ± 0.52
	Semi-Intensive	T4	8.25 ± 0.21	9.83 ± 0.33	10.75 ± 0.38
		T5	8.25 ± 0.38	10.16 ± 0.49	11.41 ± 0.56
		T6	7.87 ± 0.12	10.41 ± 0.56	11.33 ± 0.44
Packed Cell Volume (%)	Intensive	T1	26.67 ± 1.23	30.83 ± 1.68	31.83 ± 1.68
		T2	29.67 ± 0.61	30.83 ± 1.66	31.16 ± 1.22
		T3	28.83 ± 1.14	33.50 ± 1.25	34.16 ± 1.27
	Semi-Intensive	T4	29.33 ± 1.15	31.00 ± 1.15	32.83 ± 0.90
		T5	30.33 ± 0.95	30.33 ± 1.42	32.08 ± 1.29
		T6	30.17 ± 1.08	31.33 ± 1.60	32.66 ± 1.28
Total Count (1000/cumm)	Intensive	T1	6616.67 ± 442.28	6966.66± 360.24	7383.33 ± 331.07
		T2	6016.00 ± 419.85	6950.00 ± 281.365	7816.66 ± 260.09
		T3	6533.33 ± 192.64	7333.33 ± 396.37	7800.00 ± 404.14
	Semi-Intensive	T4	6250.00 ± 388.80	6853.33 ± 230.09	7016.00 ± 224.22
		T5	6400.00 ± 180.74	6966.66 ± 270.39	7650.00 ± 283.72
		T6	6966.67 ± 236.17	7100.00 ± 364.23	7533.33 ± 278.88
Albumin (mg/dl)	Intensive	T1	2.45 ± 0.08	2.53 ± 0.07	2.70 ± 0.07
		T2	2.47 ± 0.10	2.52 ± 0.10	2.62 ± 0.07
		T3	2.43 ± 0.04	2.52 ± 0.08	2.68 ± 0.07
	Semi-Intensive	T4	2.33 ± 0.08	2.55 ± 0.06	2.67 ± 0.07
		T5	2.43 ± 0.08	2.55 ± 0.10	2.73 ± 0.07
		T6	2.42 ± 0.08	2.45 ± 0.06	2.63 ± 0.06

Table 4. Serum total protein, cholesterol, calcium and phosphorus of Madras Red lambs reared under different management systems and in different treatment groups (see Materials and Methods" section for description of treatment group T1 to T6)

Parameters	Management system	Treatment groups	0 Day	45th Day	90th Day
Total protein (gm/dl)	Intensive	T1	6.17 ± 0.07	6.77 ± 0.10	7.15 ± 0.12
		T2	6.22 ± 0.07	6.77 ± 0.09	7.18 ± 0.09
		T3	6.20 ± 0.07	6.73 ± 0.08	7.22 ± 0.11
	Semi-Intensive	T4	6.20 ± 0.06	6.78 ± 0.12	7.10 ± 0.09
		T5	6.18 ± 0.06	6.68 ± 0.12	7.18 ± 0.09
		T6	6.18 ± 0.07	6.80 ± 0.09	7.15 ± 0.14
Cholesterol(mg/dl)	Intensive	T1	50.83 ± 0.95	76.33 ± 1.20	86.50^{a} ± 2.26
		T2	51.17 ± 1.05	76.50 ± 1.48	86.67^{a} ± 1.82
		T3	51.33 ± 0.09	76.33 ± 0.88	86.33^{a} ± 1.67
	Semi-Intensive	T4	52.00 ± 0.97	72.67 ± 1.41	80.17^{b} ± 1.49
		T5	52.17 ± 1.08	71.83 ± 1.51	80.17^{b} ± 1.35
		T6	52.17 ± 1.05	73.00 ± 1.39	80.00^{b} ± 1.03
Calcium (mg/dl)	Intensive	T1	11.23 ± 0.11	11.52^{b} ± 0.11	11.73^{b} ± 0.11
		T2	11.22 ± 0.07	12.03^{a}± 0.12	12.43^{a} ± 0.14
		T3	11.32 ± 0.10	11.67^{b} ± 0.11	11.87^{b} ± 0.08
	Semi-Intensive	T4	11.30 ± 0.12	11.48^{b} ± 0.12	11.87^{b} ± 0.11
		T5	11.32 ± 0.09	12.08^{a} ± 0.13	12.55^{a}± 0.13
		T6	11.32 ± 0.10	11.72^{b} ± 0.11	11.87^{b} ± 0.06
Phosphorus (mg/dl)	Intensive	T1	5.57 ± 0.10	5.70^{b} ± 0.09	5.87^{c} ± 0.07
		T2	5.57 ± 0.13	6.17^{a} ± 0.09	6.48^{b} ± 0.12
		T3	5.67 ± 0.08	5.85^{b} ± 0.06	6.12^{b} ± 0.08
	Semi-Intensive	T4	5.57 ± 0.10	5.70^{b} ± 0.09	5.87^{c} ± 0.07
		T5	5.57 ± 0.13	6.17^{a} ± 0.09	6.48^{b} ± 0.12
		T6	5.62 ± 0.06	5.87^{b} ± 0.09	6.32^{b} ± 0.14

Means within each management group bearing different superscripts differ significantly (CRD – test; $P < 0.05$)

Table 5. Carcass traits of Madras Red lambs reared in different treatment groups. Values are Mean + S.E. (See 'Materials and Methods' section for description of treatment groups T1 to T6)

Parameters	Treatment Groups					
	T1	T2	T3	T4	T5	T6
Blood	3.80 ± 0.03	3.71 ± 0.07	3.59 ± 0.01	3.98 ± 0.40	3.88 ± 0.26	3.70 ± 0.08
Lung	1.88 ± 0.03	1.69 ± 0.12	1.63 ± 0.03	1.60 ± 0.06	1.58 ± 0.01	1.81 ± 0.04
Heart	0.69 ± 0.05	0.64 ± 0.00	0.56 ± 0.03	0.64 ± 0.03	0.68 ± 0.04	0.59 ± 0.00
Liver	2.17 ± 0.05	1.98 ± 0.20	2.04 ± 0.04	1.80 ± 0.03	1.92 ± 0.21	1.93 ± 0.07
Spleen	0.50 ± 0.13	0.41 ± 0.05	0.53 ± 0.13	0.40 ± 0.02	0.57 ± 0.07	0.46 ± 0.06
Kidney	0.69 ± 0.05	3.99 ± 3.28	0.67 ± 0.00	0.68 ± 0.09	0.73 ± 0.02	0.66 ± 0.08
Head	8.41 ± 0.63	7.86 ± 0.50	6.87 ± 0.80	8.79 ± 1.21	7.77 ± 0.63	4.20 ± 3.83
Feet	3.87 ± 0.39	3.47 ± 0.52	3.61 ± 0.19	3.49 ± 0.26	4.38 ± 0.52	3.89 ± 0.03
Skin	11.38 ± 1.60	10.11± 0.75	10.48 ± 0.65	10.36 ± 2.05	12.78± 3.28	12.75± 0.09
Gut	28.47 ± 1.45	24.1 ±6.22	25.75 ± 0.08	26.57 ± 2.66	29.79± 0.00	27.43± 0.02
Dressing Percentage	45.50 ± 0.94	46.16±1.30	47.50 ± 0.83	44.74 ± 1.41	45.71± 0.15	46.73± 2.29
Shoulder	9.52 ± 0.48	9.64±0.36	10.08±0.75	9.37±0.13	8.61±0.33	9.94±0.14
Neck	3.17±0.66	3.88±0.03	3.20±0.13	3.34±0.43	3.04±0.17	3.17±0.65
Rib	8.36±1.12	6.52 ± 0.34	8.33±0.33	7.51±1.66	5.33±1.90	8.32±0.28
Loin	16.78±1.17	14.80±0.40	16.78±0.35	15.82±1.82	13.15±2.47	16.77±0.29
Breast	1.49± 0.00	1.44±0.01	1.50±0.17	2.05±0.80	1.21±0.07	1.28±0.39
Flank	3.44±0.18	3.57±0.43	3.60±0.40	3.92±0.08	3.10±0.10	4.33±0.41
Legs	10.59±0.38	11.48±0.34	11.43±0.23	11.52±0.02	10.64±0.64	11.32±0.53
Meat	12.77±1.06	13.53±2.10	13.98±2.18	14.81±0.19	12.23±0.63	13.71±0.90
Bone	9.42±0.68	7.70 ± 0.48	7.99±1.59	10.83±1.67	11.04±2.90	12.05±1.68
Fat	3.67±2.71	0.81±0.10	0.96±0.04	1.09±0.16	0.84±0.12	0.91±0.17

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