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MINERAL STATUS OF CATTLE RAISED IN THE VILLAGES OF CENTRAL THAILAND

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Mineral status of forages and cattle tissues from 68 native cattle around Nakorn Prathom, Central Thailand, was evaluated during the dry and wet seasons. When compared to mineral requirements, 25 to 35% of the forages were found to be deficient in sodium, phosphorus and copper. In addition, 73, 61, 58 and 77% of the remaining forages were borderline to deficient in concentrations of calcium, phosphorus, copper and zinc, respectively. Plasma magnesium, phosphorus and zinc, averaging 2.4, 7.7 and 0.13 mg/100 ml, respectively, were not affected by season. Plasma blood hemoglobin and calcium, however, declined ($P<0.05$) from 9.1 to 8.2 g/100 ml and from 13.5 to 10.2 mg/100 ml, respectively, for the dry and wet seasons. Contrary to this, an increase ($P<0.05$) of blood hematocrit from 36.6 to 48.3% and of plasma copper from 0.02 to 0.04 mg/100 ml for the two respective collection periods were observed. Liver copper increased ($P < 0.01$) from an average of 37 µg/g in the dry season to 178µg/g in the wet season. On the basis of the forage and/or tissue analysis, minerals most likely deficient would be copper, sodium, phosphorus, calcium and zinc.

Key words: Minerals, cattle, Thailand

Cattle and buffalo production in Thailand is generally in the hands of smallholders. Animals are traditionally raised in the villages at subsistence level with negligible input. Management and feeding of animals are influenced by rain-dependent cropping and cultivation practices. As a result, animals usually show slow liveweight gains, high mortality and low fertility (Ruferner 1971; Southcombe et al 1979 and Vijchulata 1980). Under this production system, mineral deficiencies are believed to be one of the nutritional constraints limiting animal reproductivity.

Very little research has been carried out on the mineral status of grazing livestock in Thailand. Low blood hemoglobin concentrations were reported in cattle and buffalo in Ranong and Chumporn (Amasiri 1961) and in Saraburi provinces (Chitrakorn et al 1961). The latter researchers also observed an increase in blood hemoglobin in response to a complete mineral premix supplementation. While Limpoka et al (1981) found normal concentrations of serum calcium, phosphorus, copper, zinc, magnesium and manganese in cattle and buffalo from Sakomakorn, Tak and Sukothai provinces, severe phosphorus deficiency was reported in lactating buffalo around Khonkan province (Saraspun et al 1982). In addition, grazing cattle from the northern highlands of Thailand were observed to be deficient in sodium in addition to a probably borderline phosphorus deficiency (Falvey 1980). According to Tumwasorn et al (1980) and Tumwasorn (1981), mineral supplementation to cattle in certain villages in Nakorn Prathom province provided a significant improvement in terms of body weight gain and fertility. Hence, it is quite evident that imbalance or

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deficiency of minerals is, in part, responsible for the poor performance of animals in Thai villages. However, the extent of mineral deficiencies and imbalances in Thailand is still largely unknown and needs to be further evaluated.

Materials and Methods

Mineral concentrations in forages and animal tissues in Nakorn Prathom, an important agricultural province in central Thailand, were evaluated. Collections of forages and tissues were carried out during the end of the dry season (April-May) and the end of the successive wet season (November-December) of 1980-1981. Forage samples were collected using hand-pluck techniques (Fick et al 1979) after careful observation of grazing preference by cattle in the villages. Blood and liver samples from 68 cattle were collected at different slaughter centers in the villages. Selected cattle were of native breed and, as judged by dentition, were under 3 years of age. Sampling techniques, handling and minneral analysis of all forages and tissues were performed following the procedure outlined by Fick et al (1979). Analysis of blood hematocrit and hemoglobin was completed within 12 hours after sample collection using Wintrobe's and acid hematin methods, respectively. Statistical effect of season on blood and liver parameters was carried out using the t-test with unequal subclass numbers as described by Steel and Torrie (1960).

Results and Discussion

By the end of the dry season, green forages were very scarce in the investigated area. During this time, cattle must survive primarily on rice straw. Some farmers, however, fed cattle with a mixture of rice straw and chopped green forages, especially aquatic plants. Contrary to this, various types of green forages are available for cattle during the wet season. Forage mineral concentrations observed to be consumed by cattle during the two seasons are presented in Table 1. When compared to mineral requirements for beef cattle (Table 2), approximately 25 to 35% of the 25 forage species analyzed were deficient in sodium, copper and phosphorus. In addition, 73, 61, 58 and 77% of the remaining forages were borderline to deficient in concentrations of calcium, phosporus, copper and zinc, respectively.

Blood hematocrit, hemoglobin and mineral concentrations in plasma and liver during the dry and wet seasons are illustrated in Tables 3 and 4. Hematocrit level increased ($P<0.05$) from an average of 36.6% in the dry season to 48.3% in the wet season. Plasma copper also increased ($P<0.05$) from 0.02 to 0.04 mg/100 ml. Contrary to this, a decline ($P<0.05$) of blood hemoglobin from 9.08 to 8.24 g/100 ml and of plasma calcium from 13.5 to 10.2 mg/100 ml was observed. Plasma magnesium and phosphorus, averaging 2.40 and 7.69 mg/100 ml, respectively, were not affected by season ($P<0.05$). Since weight gains of cattle traditionally raised in villages occurred mostly during the wet season when green forages were available (Southcombe et al 1979), the decline of blood hemoglobin and minerals in plasma during this period is believed due to high

Table 1:
Concentration of minerals in forages (dry matter basis)

Forage	Na	K	Ca	Mg	P	Fe	Cu	Zn	Mn
			%					ppm	
Alternanthera philoxeroides	0.47	4.67	1.49	0.59	0.22	3410	11.79	49.3	1058
Alternanthera sessilis	0.57	2.51	0.32	0.75	0.23	4546	15.38	70.9	276
Alysicarpus vaginalis	0.13	2.16	1.10	0.42	0.18	897	9.43	56.1	285
Brachiaria reptans	0.02	4.70	0.51	0.46	0.49	164	5.58	50.3	93
Brachiaria mutica	0.06	2.51	0.29	0.19	0.33	353	5.40	31.0	51
Cenchus ciliaris	0.06	3.22	0.27	0.15	0.50	114	3.90	24.8	338
Cynodon dactylon	0.21	2.11	0.47	0.24	0.25	600	5.34	31.2	248
Dactyloctenium aegyptium	0.34	2.61	0.80	0.36	0.24	353	6.12	39.6	235
Dichantium carisonum	0.12	0.95	0.43	0.26	0.12	217	2.44	13.3	215
Digitaria adsendens	0.02	2.62	0.26	0.31	0.15	117	4.76	39.5	574
Ehinochloa erusgalli	0.54	1.68	0.33	0.24	0.23	404	2.47	9.4	147
Erochloa procera	0.33	2.72	0.64	0.35	0.52	154	3.83	32.0	109
Ischaemum rugosum	0.29	2.31	0.33	0.36	0.22	279	5.33	25.4	306
Leersia hexandra	0.04	1.82	0.48	0.22	0.17	324	3.90	9.4	338
Leptochloa chinensis	0.25	1.48	0.42	0.28	0.17	2542	6.76	37.3	933
Mimosa pigra	0.04	1.33	1.27	0.18	0.22	275	8.06	36.7	86
Oryza sativa, dry straw	0.09	1.65	0.36	0.17	0.07	467	1.28	13.0	444
Oryza sativa, fresh straw	0.06	2.89	0.41	0.29	0.25	338	5.44	41.6	233
Panicum repens	0.12	3.04	0.40	0.26	0.25	345	6.75	29.7	258
Paspalum conjugatum	0.14	0.94	0.31	0.19	0.18	4460	8.27	15.5	385
Passiflora foetida	0.04	2.68	1.27	0.29	0.33	801	13.6	59.2	147
Pennisetum polystachyon	0.01	2.95	0.30	0.23	0.29	236	5.4	15.4	64
Pennisetum purpureum	0.01	3.42	0.29	0.11	0.51	313	6.4	19.6	54
Phaseolus macroptilium	0.01	1.46	0.82	0.27	0.12	96	4.6	20.5	49
Portulaca oleracea	0.53	3.84	0.58	0.65	0.22	483	12.2	25.6	128
Sociolepsis indica	0.03	1.68	0.18	0.23	0.28	569	3.81	30.7	278

er requirements of nutrients for growth.

Table 2:
Mineral status of twenty-six forages collected from villages

Minerals	Requirements[a]	Deficient[b]	Borderline[c]
Macroelements	%		
Sodium	0.06 - 0.10	34.6	11.5
Potassium	0.06 - 0.80	0	0
Calcium	0.18 - 0.60	0	73.1
Phosphorus	0.18 - 0.43	23.1	61.5
Magnesium	0.04 - 0.18	0	0
Microelements	ppm		
Iron	10 - 100	3.8	3.8
Copper	4 - 10	26.9	57.7
Zinc	10 - 50	7.7	76.9
Manganese	20 - 40	0	0

[a]McDowell and Conrad (1977)

[b]Forages with mineral concentration less than minimum requirement, expressed as percent of total

[c]Forages with mineral concentration between minimum and maximum requirement, expressed as percent of total.

Relatively low forage phosphorus concentrations were not reflected by comparably low plasma phosphorus levels. Stress, exercise, hemolysis, elevated temperature and increased serum separation time are all factors that cause increases in serum P levels (Dayrell et al 1973; Fick et al 1979). Animal stress is suggested as one of the main causes for the high P levels, since this factor was difficult to control under the conditions of this experiment.

All minerals analyzed from the liver, except copper, did not vary significantly ($P < 0.01$) between the two seasons (Table 4). The overall mean liver concentrations (μg/g) for the two collection periods were 138 for calcium, 768 for magnesium, 11442 for phosphorus, 376 for iron, 135 for zinc and 11.0 for manganese. Liver copper, however, increased ($P < 0.01$) from an average of 37 to 178 μg/g for the dry and wet seasons, respectively. Higher blood hematocrit and liver copper concentration in the wet season is due to greater intake of the element as well as other nutrients from available green forages.

Except blood hemoglobin and plasma copper, concentrations of all tissue minerals of cattle in this survey are within the normal range reported elsewhere (Underwood 1971; McDowell 1976; Fick et al 1979)

Table 3:

Blood hematocrit, hemoglobin and plasma mineral concentration in cattle during the dry and wet seasons (means ± standard deviation)

Season	Number of cattle	Hematocrit %	Hemoglobin g/100ml	Ca	Mg	P	Cu	Zn
				mg/100 ml				
Dry	28	36.6^b ±6.3	9.08^a ±1.7	13.5^a ±2.7	2.50 ±0.60	7.58 ±2.0	0.02^b ±0.2	0.14^a ±0.4
Wet	40	48.3^a ±7.6	8.24^b ±1.3	10.2^b ±1.5	2.31 ±0.4	7.79 ±1.9	0.04^a ±0.2	0.12^b ±0.3

a,b Means in the same column bearing different superscripts differ (P < 0.05)

Table 4:

Mineral concentrations in cattle liver during the dry and wet seasons (means ± standard deviation)

Season	Number of cattle	Ca	Mg	P	Cu	Fe	Zn	Mn
		µg/g dry matter						
Dry	28	123 ±51	759 ±96	11161 ±2451	37^x ±65	409 ±246	125 ±30	11 ±2
Wet	40	153 ±76	777 ±120	11722 ±2594	178^y ±113	343 ±118	144 ±47	11 ±2

x,y Means in the same column bearing different superscripts differ (P < 0.01)

Blood hemoglobin, averaging 8.66 g/100 ml, is below the 10 g/100 ml critical value as recommended by McDowell and Conrad (1977) for possible iron deficiency. This observation of low blood hemoglobin agrees with the reports of low hemoglobin in cattle blood from this area (Tumwasorn et al 1980) and cattle from Saraburi, a nearby province (Chitrakorn et al 1961). In both reports, blood hemoglobin increased in response to mineral supplements. However, evidence of iron deficiency is not conclusive. Deficiency of iron, though commonly found in humans and swine, is rarely found in ruminants except where precipitated by chronic blood loss. Furthermore, most forages in the area were not deficient in iron (Table 1).

Besides low hemoglobin level, plasma copper was also observed to average only 0.03 mg/100 ml. According to Underwood (1971), plasma concentration of copper in normal sheep and cattle varies from 0.06 to 0.15 mg/100 ml while values consistently below 0.03 mg/100 ml indicate copper deficiency. The observation of deficient plasma copper concentrations is in part supported by the high incidence of low forage copper in this area and the critically low copper reserve in liver during the dry season. However, discrepancy between copper level in plasma and copper reserve pool in liver during the wet season exists and needs to be investigated further. Likewise, molybdenum and sulfur analyses would be important to assist in assessing the cooper status of grazing cattle. In agreement with copper deficiencies for grazing beef cattle, McDowell (1976) reported deficiencies for this element in 18 developing tropical countries. Hill et al (1962) reported the extent of copper inadequacy in Malaysia by noting that 80% of the surveyed cattle and buffalo were copper-deficient.

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