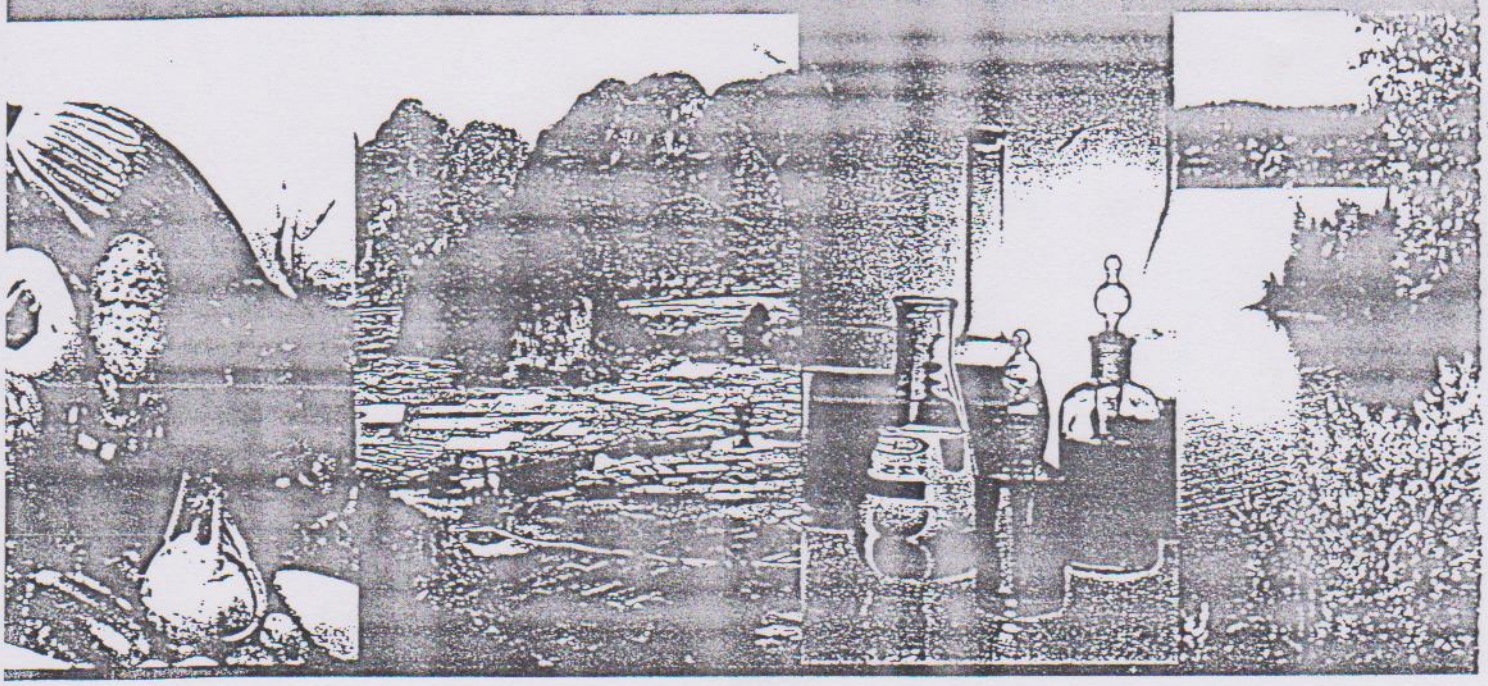
world-food.net

Vol.4, No.2, April 2006

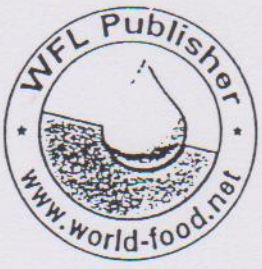
Journal of Food Agriculture & Environment

SCIENCE AND TECHNOLOGY



WFL PUBLISHER

No 2



HELSINKI, FINLAND

JRNAL OF FOOD, AGRICULTURE & ENVIRONMENT

WFL Publisher
Science and Technology

www.world-food.net

Vol. 4, No.2 | ISSN: 1459-0255 | April 2006

General Information

Aims and Scope: The Journal of Food. Agriculture & Environment publishes peer-reviewed original research, critical reviews and short communications on food science and technology, agriculture, animal science, human nutrition or human health, with particular emphasis on interdisciplinary studies that explore the intersection of food, agriculture, and the environment. The journal also considers a limited number of relevant scholarly manuscripts addressing ethical or socioeconomic issues related to modern agricultural and environmental sciences. The journal offers advertisement space for special announcements.

Subscription: Orders are accepted on a prepaid and calendar-year basis. Issues are sent by standard mail (surface within Europe, air delivery outside Europe). Priority rates are available upon request. Please find subscription rates and ordering details in detachable form included in this issue of the Journal, or request from the office:(info@world-food.net).

Important Note: If you are not a member of ISFAE yet, please visit our homepage: http://www.isfae.org and register to benefit from special rates when purchasing scientific journal, plus access to online journals or to benefit of some free services. Kindly contact ISFAE Secretariat at: isfae@isfae.org

Abstracting: JFAE is abstracted in Chemical Abstracts - CAS, Scirus Elsiever, Med Bioworld, Index Copernicus, Apic abstract, IFIS, FSTA, CABI, FAO-Agris-Caris and under process with ISI. Pascal Database and CSA.

WFL Publisher
Science and Technology
www.world-food.net
ol. 4, No. 2 April 2006

CONTENTS

Commentary

Food & Health

Agriculture

WFL Publisher
Science and Technology

Journal of Food, Agriculture & Environment Vol.4 (2) : 234-236. 2006 www.world-food.n

Mineral status of forages and grazing goats in West Sumatra, Indonesia: 1. Macro minerals

Lili Warly [1,3], A. Fariani [2], Evitayani [1,3], M. Hayashida [3] and T. Fujihara [3]*

[1]Faculty of Animal Science, Andalas University, Padang, Indonesia, [2]Faculty of Agriculture, Sriwijaya University, Palembang, Indonesia, [3]Laboratory of Animal Science, Faculty of Life and Environmental Science, Shimane University, Matsue-shi-690-8504, Japan. *e-mail: fujihara@life.shimane-u.ac.jp

Received 28 November 2005, accepted 22 March 2006.

Abstract

This experiment was conducted to study macro mineral status of forages and grazing goats in West Sumatra, Indonesia. The forages evaluate consisting 13 species of grass and 7 species of legume were harvested from 5 different locations during dry and rainy seasons. Blood samples c goats were collected at the same locations through jugular puncture to determine macro mineral status of the animals. Results of the study indicate that mineral concentrations of forages varied widely among species and seasons. Calcium concentration of forages both in dry and rainy season was above the critical value for deficiency. However, percentage deficiency of forage phosphorus was found either in dry season (85.7% for legum and 30.8% for grass) or rainy season (71.4% for legume and 30.8% for grass). Average concentration of forage magnesium in dry season was abov the critical level, while in rainy season percentage of Mg deficiency was 28.6% for legume and 23.1% for grass. Percentage of sulfur deficienc in dry season was 42.9% for legume and 46.2% for grass, and these values were higher compared to those of rainy season (14.3% for legume an 30.8% for grass). Data on mineral status of grazing goats showed that in overall the incidence of Ca, P and Mg deficiencies were 4.6, 7.7 and 5.7% respectively. This experiment is a part of a series of experiments on the study of mineral status of forages and grazing goats in West Sumatr Indonesia.

Key words: Macro mineral status, forages, goats, West Sumatra.

Introduction

Deficiency or imbalance of certain minerals of the forages in tropical countries have been reported by several researchers and suggested as one of the limiting factors for improvement of animal productivity in this region [1]. In most situations of the countries, sheep and goats are commonly raised by small farmers in rural areas under traditional system with native grass, tree leaves and agriculture by-products as main sources of feeds. Consequently, the grazing ruminants receive all nutrients as well as minerals only from the forages consumed in the field because normally no minerals and feed supplements are given to the animals. Ideally, minerals intake must be sufficient to ensure the maintenance of adequate amounts for growing and reproduction of animals. According to McDowell [2], the animals receiving forages only as a main source of their feeds are usually deficient in certain minerals due to the forages rarely contain all the minerals required by the grazing animals.

Underwood and Suttle [3] reported that the availability and concentration of minerals in crop and forage plants are influenced by environmental factors such as climate and seasonal conditions during growth, amount of rainfall, the type and soil fertility on which the forages grows, stage of maturity, genus and species or strain (variety) of the forages. High concentration of fiber, especially lignin, can also reduce the availability of minerals for the animals. In Indonesia, land allocated for food crop is not available for forage production, therefore only land not suitable for food crop production with low fertility is used for forage, and consequently the production and quality of the forage are ver low. In general, forage grown in marginal lands has lower nutrie contents than forage grown at high fertility lands. Study Prabowo *et al.* [4] showed that Ca and P are the most deficie minerals of forages in some parts of Indonesia, such as in Sou Sulawesi.

Limited information exists concerning mineral content of t forages and mineral status of grazing goats in West Sumat Therefore, the present experiment was aimed to investigate t macro mineral composition of some common forages and mine status of grazing goats in West Sumatra during dry and rai seasons. This work should be valuable for the provision a strategic use of mineral supplementation for small ruminar especially goat in West Sumatra, Indonesia.

Materials and Methods

Investigation area: This study was conducted in five region West Sumatra province, namely Padang, Solok, Tanah Da Pariaman and Sawahlunto Sijunjung. The province is locate tropical and monsoon region, lies between 0°54'N to 3°30'S 98°36' to 101°53'E. There are two seasons during the year, season from February to September and rainy season fr November to March. The temperature is nearly constant, diffe only a few degrees among the dry and rainy seasons with d temperature ranges from 23 to 31°C. The mean of monthly rair

. seasons was 195 and 233 mm respectively, with ,infall was 2570 mm.

, and blood samples collection: The forage evaluated ,isted 13 species of grass (*Axonopus compressus, ,nnisetum purpuphoides, Pennisetum purpureum, Setaria sphacelata, Cynodon plectotachyus, Panicum maximum, Paspalum notatum, Paspalum dilatatum, Brachiaria decumbens, Euchlaena mexicana, Andropogon gayanus, Havea hexandra* and *Cynodon dactylon*) and 7 species of legumes (*Leucaena leucocephala, Gliricidia maculata, Calopogonium mucunoides, Centrosema pubescens* and *Mimosa pudica*). Immediately after harvesting, representative samples were dried at 60°C for 24 hours, ground in a Wiley mill through 1–mm screen and kept for further analyses. At the same time, blood samples were collected by jugular puncture from about 30 goats at each season and region. Mineral concentration in forages and blood plasma were analyzed by Inductively Coupled Plasma Emission Spectrometer (ICPS-2000, Shimadzu, Japan). The difference of the average mineral concentration between dry and rainy season was determined using Student's t-test [5].

Results and Discussion

As shown in Table 1, the mineral concentration of grass significantly was affected ($p<0.05$) by species and season. Between forages evaluated, *P. maximum* contained highest Ca concentration (avg. 9.6 g/kg) while the lowest concentration was found in *P. purpuphoides* (avg. 5.9 g/kg). The mean concentration of P varied from 2.1 (*E.mexicana*) to 4.7 g/kg (*S. sphacelata*), Mg from 2.3 (*C. dactylon*) to 4.2 g/kg (*A. compressus*) and S ranged from 1.7 (*P. purpuphoides, E. mexicana*) to 6.9 g/kg (*A. compressus*). The difference of mineral contents between species could be caused by genetic factors, botanical composition and characteristics of growth as suggested by Underwood and Suttle[3] and Jumba *et al.*[6]

Table 1. Concentration of Ca, P, Mg and S of grass harvested at dry and rainy seasons (g/kg DM).

Species	Season	Ca	P	Mg	S
Critical level*	---	3.0	2.5	2.0	2.6
A. compressus	Rainy	7.4	3.6	4.4	7.5
	Dry	7.1	2.6	4.0	6.3
P. purpuphoides	Rainy	5.3	3.8	2.2	1.6
	Dry	6.5	4.6	2.8	1.8
S. sphacelata	Rainy	7.0	6.2	3.5	4.7
	Dry	6.6	3.3	2.1	2.1
C. plectostachyus	Rainy	7.7	4.7	2.0	5.0
	Dry	9.0	4.4	3.5	2.5
P. purpureum	Rainy	6.0	5.9	3.2	3.6
	Dry	6.1	2.8	2.3	1.9
P. notatum	Rainy	5.9	2.0	2.2	4.1
	Dry	8.5	2.5	3.3	2.9
P. maximum	Rainy	10.7	4.3	3.5	2.6
	Dry	8.5	2.5	3.3	2.9
B. decumbens	Rainy	7.4	2.0	3.8	1.7
	Dry	6.8	2.3	3.2	1.9
E. mexicana	Rainy	3.9	1.7	1.7	1.7
	Dry	10.1	2.5	4.0	1.7
A.gayanus	Rainy	8.9	2.4	3.3	1.4
	Dry	6.6	4.1	2.8	3.6
H. hexandra	Rainy	6.1	3.8	2.2	3.2
	Dry	5.7	4.5	2.7	4.2
P. dilatatum	Rainy	8.8	3.5	3.2	4.0
	Dry	6.4	4.3	2.1	3.2
C. dactylon	Rainy	5.9	2.2	1.4	4.0
	Dry	6.9	2.7	3.2	5.6
Mean	Rainy	7.2	3.5	2.9	3.3
	Dry	7.0	3.6	2.8	3.4
	Overall	7.3	3.3	3.0	3.1
Deficiency (%)	Rainy	0	30.8	23.1[a]	30.8[b]
	Dry	0	30.8	0.0[b]	46.2[a]
	Overall	0	30.8	11.6	38.5

*Concentration below the critical level is deficient
a, b : significantly different ($p < 0.05$).

Percentage deficiency of P, Mg and S was significantly affected by season ($p<0.05$). Deficiency of P, Mg and S in rainy season was 30.8, 23.1 and 30.8%, while deficiency of P and S in dry season was 30.8 and 46.2%, respectively. Deficiency of Mg in the present study was slightly higher compared to the results of Minson [7] who obtained less than 14% of tropical forages deficient in Mg and thus suggested that Mg was not limiting element in tropical forages, the mean Mg concentration being 3.6 g/kg. Among the minerals evaluated, the highest availability was observed for Ca in almost all grasses observed, concentration being above the critical level, 3.0 g/kg [1]. On the other hand Prabowo *et al.* [4] reported that Ca and P were deficient in most forages grown in South Sulawesi, Indonesia. In comparison with our study, lower nutrient levels in their study might be caused by dissimilarities in forage species evaluated, climate and soil type and fertility.

Table 2 shows macro mineral concentrations of legume forages. The concentration of Ca in all species of legumes was higher than that of critical level [1] with the average value ranging from 13.0 g/kg in *M. pudica* to 16.4 g/kg in *G. maculata*. The mean concentration of Ca in legumes was higher compared with Ca concentration in grass (13.8 vs 7.3 g/kg), while concentration of P in legumes was lower compared with that of grass (2.4 g/kg vs 3.5 g/kg). These findings are in agreement with the results obtained by Minson [7] and Serra *et al.* [8]. As shown in Table 2, effect of season was significant on concentration of P, Mg and S

Table 2. Concentration of Ca, P, Mg and S of legumes harvested at dry and rainy seasons (g/kg DM).

Species	Season	Ca	P	Mg	S
Critical level*	----	3.0	2.5	2.0	2.6
L. leucocephala	Rainy	15.5	2.7	2.7	4.4
	Dry	15.0	2.4	3.7	3.3
G. maculata	Rainy	16.9	2.4	2.5	3.4
	Dry	15.9	1.8	3.6	2.6
C. mucunoides	Rainy	16.1	2.4	3.5	3.0
	Dry	14.7	1.8	5.2	2.4
M. pudica	Rainy	13.9	2.0	1.6	3.0
	Dry	12.1	2.4	2.7	2.8
C. pubescens	Rainy	14.8	2.5	1.8	3.0
	Dry	12.0	2.4	2.6	2.3
M. Invisa	Rainy	16.7	2.1	2.2	2.0
	Dry	15.1	2.1	3.6	2.2
S. glandiflora	Rainy	15.8	4.5	3.9	3.8
	Dry	11.9	3.8	2.6	3.7
Mean	Rainy	14.7	2.4	3.0	3.0
	Dry	15.7	2.7	2.6	3.2
	Overall	13.8	2.1	3.4	2.8
Deficiency (%)	Rainy	0.0	71.4[a]	28.6[b]	14.3[a]
	Dry	0.0	85.7[b]	0.0[a]	42.9[b]
	Overall	0.0	78.6	14.3	28.6

*Concentration below the critical level is deficient
a, b : significantly different ($p < 0.05$).

es ($p<0.05$). Percentage deficiency of P, Mg and S in eason was 71.4, 28.6 and 14.3%; while in dry season iency of P and S was 85.7 and 42.9%, respectively. Within same species of forage, variability of mineral concentration ither in dry or rainy season was higher in grass than in legumes. Concentration of Ca and P in the present study was higher in dry season than in rainy season. Although this finding was opposite with the result of Underwood and Suttle [3], Minson [7] suggested that at the fast growing period of plants during rainy season, concentrations of Ca and P tend to be lower and then increase at the slow growing period during dry season. Moreover, leaching of the top soil organic material during rainy season will reduce uptake of minerals by plants.

As shown in Table 3, harvesting location and season had no significant effect on concentration of blood macro minerals in grazing goats. Although the average concentrations of Ca, P, Mg and S both in dry and rainy seasons were above the critical level, several goats observed were deficient of these elements. In overall, the incidence of Ca, P and Mg deficiencies were 4.6, 7.7 and 5.7%, respectively. The percentage deficiency of these elements in the present study were lower compared to the results of Prabowo *et al.* [4]. In their study on grazing cattle in South Sulawesi, the deficiency percentages during rainy and dry season were: Ca 11 and 10%, P 17 and 23% and Mg 13.3 and 2.0%, respectively.

Table 3. Concentration of macro mineral in blood plasma of goats at several regions in West Sumatra during rainy and dry seasons (mg/l).

Region	Season	Ca	P	Mg	S
Critical level :	—	70	40	15	10
Padang	Rainy (30)	100.8±1.9	75.1±2.8	23.5±0.6	90.4±0.4
	Dry (41)	89.5±1.8	71.9±1.9	22.5±0.7	83.4±2.0
Pariaman	Rainy (15)	96.7±1.7	79.7±2.8	24.0±0.6	93.0±2.5
	Dry (25)	83.4±1.3	76.3±2.1	23.1±0.4	93.7±2.7
Solok	Rainy (14)	88.4±3.1	57.8±3.0	26.3±1.4	88.9±4.0
	Dry (12)	96.0±3.2	71.8±4.4	26.3±1.9	79.0±2.6
Sawahlunto	Rainy (28)	96.9±1.0	66.3±1.6	26.7±0.4	91.3±1.3
	Dry (27)	88.1±0.8	61.2±1.1	22.1±0.3	89.1±1.2
Tanah Datar	Rainy (33)	97.5±2.9	81.1±2.2	25.9±0.8	81.4±1.8
	Dry (36)	95.4±3.0	76.4±2.0	24.8 + 0.8	81.1±1.7
Mean:	Rainy	93.3±2.1	71.8±2.4	24.5±1.1	89.0±2.0
	Dry	96.1±2.1	72.0±2.5	25.3±0.8	85.3±2.0
	Overall	90.5±2.0	71.5±2.3	23.8±0.8	87.1±2.0
Deficiency (%)	--	4.6	7.7	5.7	0.0

Conclusions

From the above results, it could be concluded that Ca was the most abundant element, while P, Mg and S were relatively low in the forages harvested in West Sumatra, Indonesia. The incidence of Ca, P and Mg deficiencies in grazing goats were 4.6, 7.7 and 5.7%, respectively.

Acknowledgements

This study was supported by a Grant-in-Aid for Scientific Research (B-2, 11695076) from the Japan Society for the Promotion Science. The authors are very grateful to Dr. T. Ichinohe, M. Gothoh and S. Hamada for their helpful assistance during the course of experiment.

References

[1]McDowell, L.R.1985. Nutrition of Grazing Ruminants in Warm Climates. Academic Press, Orlando.

[2]McDowell, L.R. 1992. Minerals in Animal and Human Nutrition. Academic Press, Inc.

[3]Underwood, E.J. and Suttle, N.F. 1999. The Mineral Nutrition of Livestock. CABI Publishing.

[4]Prabowo, A., McDowell, L.R., Wilkinson, N.S., Wilcox, C.J. and Conrad, J.H. 1991. Mineral status of grazing cattle in South Sulawesi, Indonesia. 1. Macro minerals. AJAS 4(2):11–120.

[5]Steel, R. G D and Torrie, J. H. 1980. Principles and Procedures of Statistics. A Biometrical Approach 2nd Ed. McGraw-Hill, Inc., New York.

[6]Jumba, I.O., Suttle, N.F., Hunter, E.A. and Wandiga, S.O. 1996. Effects of botanical composition, soil origin and composition on mineral concentrations in dry season pasture in Western Kenya. Environmental Geochemistry and Health. Geological Society, Special Publication. No. 113, London, pp. 39-45.

[7]Minson, D.J. 1990. Forages in Ruminants Nutrition. Academic Press. San Diego, California, pp. 208-229.

[8]Serra, S.D., Serra, A.B., Ichinohe, T., Harumoto, T. and Fujihara, T. 1995. Amount and distribution of dietary minerals in selected Philippine forages. AJAS 5(2):139-147.