JOURNAL 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 modem agricultural and environmental sciences.The journal offers advertisement space for special announcements.

Editorial office

Director : Ramdane Oris PhD.
Editor in Chief : Raina Kiskanen PhD.
Associate Editor : Jorg R. Aschenbach PhD.
P.G Rajendran PhD.
Gary Hausman PhD.
Andrew Reynold Ph.D.
Assistant Editor : Pirina Halnu
Technical Assistant : Marja Rauta la, Nora Dietrich
Address : JFAE-Editorial Office,
Meri-Rastilaruie 3 C,
FN-009S0 Helsinki.Finland
E-mail : info@world-food.net'
Tel/fax : 00 35S 9 759 2775
Website : www.world-food.net

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 ofISFAE yet, please visit our homepage: http://www.isfae.org and register to benefit from special rates when purchasing scientific journal, plus access to on line 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.

Advertising: Inquiries and correspondence regarding advertisements or announcements should be sent to WorlJ Food RD Ltd. Meri-R.astilantie 3 C, FI-00980, Helsinki, Finland. Tel:+358 9 75 92 775 or+358 50 505 I 135, e-mail: info@world-food.net

Agriculture

WFLPublisher
Science and Technology

Journal of Food, Agriculture & Environment

Mineral status of forages and grazing goats in West Sumatera, Indonesia : 2. Micro minerals

Lili Warly [1], A. Fariani [2], Evitayani [1], 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, Japan *e-mail: fujihara@life.shimane-u.ac.jp

Received 29 November 2005, accepted 12 March 2006.

Abstract
This study is a second part of a series experiments conducted to evaluate mineral status of forages and grazing goats in West Sumatra, Indonesia. Forages species, harvesting locations and animals used were the same as reported in the previous study. The results showed that concentration of micro minerals in forages were significantly affected by species and season. Concentration of iron (Fe) and selenium (Se) in dry and rainy seasons was higher than the critical level suggested for deficiency of goats. Deficiency of forages copper (Cu) was found in both seasons; of which in dry season the deficiency was 84.6% for grass and 71.4% for legume, while in rainy season the deficiency was 84.6% for grass and 85.7% for legume. In overall, deficiency of zinc (Zn), molybdenum (Mo) and cobalt (Co) for grass was 15.4, 11.5 and 42.5%; while the deficiency in legume was 42.9, 42.9 and 50%, respectively. Data on micro mineral status of grazing goats showed that in overall the incidence of Cu, Mo and Se deficiencies were 16.5, 17.0 and 33.0%, respectively. This finding suggested that supplementation of these elements are required for ruminants grazing in native pasture of West Sumatra.

Key words: Micro mineral status, forages, goats, dry and rainy season.

Introduction

In animal industry, mineral deficiency or toxicity is one of the limiting factors to support production. Mineral status of the animals closely related with the amount of forage mineral consumed. Results of the experiments conducted in tropical countries showed that incident of mineral deficiency or toxicity commonly occurred in grazing ruminants with forage as a main feed. Study of Mc Dowell *et al.* [1] on grazing cattle in South America showed that Na, K, Ca, P, Mg, Zn, Cu, Co and I are minerals frequently deficient, while Fe and Se are minerals frequently toxic. Deficiencies of Cu, Co and Se have been also reported for grazing sheeps in Australia and New Zealand [2]. Espinoza *et al* [3] reported that the forages grown in warm areas of Florida are deficient in minerals Co, Cu, Fe, Zn and Se; while study of Fujihara *et al.* [4] showed goats grazed in Central Luzon, Philippines were deficient in Cu and Se.

Results of the study in Indonesia showed that concentrations of Cu and Zn in forages and grazing cattle in Java Island were lower than the critical levels[5], Deficiencies of Ca, P, Cu, Zn and Se in forages and grazing cattle also have been reported by Prabowo *et al.* [7, 8] in South Sulawesi. In North Sumatra, Hayashi *et al.* [9] reported that Ca, P, Mg and K were deficient minerals in the forages. According to Underwood and Suttle [10] several factors affect mineral contents of forages including species, soil fertility, climates and plant maturity. In dry season, mineral concentrations of tropical forages generally decrease which associated by mineral deficiency in animals grazed in the area. A high fiber and lignin content of tropical forages could reduce minerals availability for ruminants. Objective of the present study was to evaluate micro mineral concentration of several commonly forages and micro mineral status of grazing goats in West Sumatra during dry and rainy seasons

Materials and Methods

Investigation area: This study was conducted in five regions of West Sumatra province, namely Padang, Solok, Tanah Datar, Pariaman and Sawahlunto Sijunjung. The province is located in tropical and monsoon region, lies between 0°54'N to 3°30'S and 98°36' to 101°53'E. There are two seasons during the year, dry season from February to September and rainy season from November to March. The temperature is nearly constant, differing only a few degrees among the dry and rainy seasons with daily temperature ranges from 23 to 31°C. The mean of monthly rainfall in dry and wet seasons is 195 and 233 mm respectively, with the annual rainfall being 2570 mm.

Collection of forage and blood samples: The forage evaluated consisted 13 species of grass (*Axonopus compressus, Pennisetum purpuphoides, Pennisetum purpureum, Setaria sphacelata, Cynodon plectostachyus, 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).* The forage samples were collected during dry and rainy seasons. Immediately after harvesting, representative samples were oven-dried at 60°C for 24 hours, ground in a Wiley mill through 1-mm screen and kept for further analyses. Blood samples were collected through jugular

(om about 30 goats at each season and region. Micro oncelltrations (Cu, Zn, Mn, Fe, Mo, Co and Se) in the nd blood plasma were analyzed by Inductively Coupled mission Sp,.:cl,omc!cr(!CPS-21)()(), Shimadzu, Japan). The ferences of mineral concentration in forages and blood between the dry and rainy season were determined using $ i-tcst [11].

Results and Discussion

wn in Table I, conccnrrarion of micro minerals of grass among species and season. The concentration of Cu, Zn. Co were lower than requirement of sheep and goat (critical vhile concentration of Mn, Fe and Se were above the critical

suggested by McDowell'!. In rainy season, concentration varied from 2.3 to 11.9 mg/kg, while in dry season the entration ranged from 3.3 to 14.4 mg/kg. The lowest entration of Cu was obtained in If. hcxandra and the highest found for P. maximum both in dry and rainy seasons. Grass iency of Cu in both dry and rainy seasons was 84.6%. Though oncentration did not differ among the season, deficiency of element in dry season was significantly higher ($p<0.05$) pared to rainy season (23.1 vs 7.7%). The concentration of Cu he present study was similar with the result of Hayashi *et al.* [9]

Table 1. Micro mineral concentration of grass in rainy and dry seasons (mg/kg DM).

Species	Season	Cu	Zn	Mn	Fe	Mo	Co	Se
Critical level#	--	11	33	40	50	0.5	0.2	0.2
Toxic level	--	25	750	1000	500	10	10	[illegible]
compressus	Rainy	11.3	45.6	77.3	417.0	0.78	0.16	0.73
	Dry	7.9	30.3	92.4	411.2	1.19	0.54	0.42
purpuphoides	Rainy	10.8	40.6	48.5	203.3	0.05	0.23	0.94
	Dry	8.7	29.0	83.2	331.8	0.67	0.02	0.51
sphacelata	Rainy	9.9	52.7	150.5	338.7	1.62	0.12	0.64
	Dry	10.5	37.2	96.2	125.5	0.91	0.32	0.57
lectostachyus	Rainy	8.2	50.1	49.0	267.3	1.25	0.53	1.04
	Dry	9.1	34.5	40.9	223.2	1.97	1.54	0.42
purpureum	Rainy	9.4	38.5	45.1	243.7	1.30	0.17	0.50
	Dry	7.4	42.1	105.5	101.1	1.76	0.33	0.30
notatum	Rainy	10.0	58.9	96.9	1591.7	0.60	0.42	0.46
	Dry	11.5	66.3	135.3	239.3	2.10	0.43	0.26
maximum	Rainy	11.9	38.6	132.0	453.4	0.16	0.05	0.70
	Dry	14.4	[illegible]	125.7	397.5	0.70	0.53	0.21
decumbens	Rainy	5.0	[illegible]	119.7	241.7	0.85	0.28	0.58
	Dry	6.3	36.1	119.6	211.9	1.74	0.73	0.27
mexicana	Rainy	6.8	36.5	41.2	373.2	0.54	0.14	0.60
	Dry	7.5	32.8	145.3	1438	0.60	nd	0.42
gayanus	Rainy	6.5	32.2	101.9	[illegible]	0.18	0.04	0.56
	Dry	6.9	111.1	67.4	214.4	0.50	0.12	0.30
hexandra	Rainy	2.3	100.0	80.6	284.0	3.58	0.11	0.71
	Dry	3.3	113.0	70.2	307.8	1.10	0.46	0.63
dilatatum	Rainy	9.2	47.0	55.6	341.4	1.07	0.32	0.51
	Dry	4.2	62.7	41.4	103.2	2.35	0.19	0.53
dactylon	Rainy	9.3	156.4	90.3	160.0	1.42	0.26	0.90
	Dry	7.8	113.2	83.7	118.4	0.48	0.46	1.10
Mean	Rainy	8.9	56.3	83.7	389.2	1.03	0.25	0.68
	Dry	8.2	57.8	93.1	295.3	1.24	0.51	0.47
	Overall	8.6	57.1	88.8	342.3	1.14	0.38	0.58
Deficiency (%)	Rainy	84.6	7.7	0.0	0.0	23.1	53.8	0.0
	Dry	84.6	23.1	0.0	0.0		30.8	0.0
	Overall	84.6	15.4	0.0	0.0	11.5	42.3	0.0

.. "J 'S o,.c
lh.: ..) fc-.cl NC .k-(0CW"f\1°:
tp "OOH.'-'" J.. (K'J

who obtained Cu content of grass in North Sumatra being 8.99 ± 4.6 mg/kg, but it was relatively lower than result of Kumagai *et al.* and Prabowo *et al.* According to Kumagai *et al.*, Cu concentration of forages in Java Island during rainy season varied from 3.9 to 36.1 mg/kg and from 4.3 to 8.2 mg/kg during dry season. Study of Prabowo *et al.* in South Sulawesi, Indonesia, found that Cu concentration of grass was 8.7–15.9 mg/kg in dry season and 9.9–22.9 mg/kg in rainy season; while deficiency of Cu was 33.3% in dry season and 30% in rainy season.

There was a great variation of Zn concentration of grass, ranging from 32.2 to 100.0 mg/kg in rainy season and from 29.0 to 113.0 mg/kg in dry season. The wide variation of Zn content in grass has been reponcd by Hayashi *et al.* in North Sumatra (9.5-462.5 mg/kg) and in Java Island by Kumagai *et al.* who found that Zn conccntrauon varied from 10.9 to 56.5 mg/kg in dry season and from 20.6 to 69.5 mg/kg in rainy season. Study of Prabowo *et al.* showed that mean Zn concentrauon of forages in three regions of South Sulawesi during dry season was 30-48 mg/kg, decreased during rainy season to 25–38 mg/kg with percentage deficiency being 31.7% in dry season and 51.7% in rainy season. The other experiment of the tropical forages showed that Zn concentration in Thailand during dry and rainy season was 34.5–55.7 mg/kg and 40.2–51.8 mgkg. respectively [11]. In Phihppine Fujihara *et al.* reported that Zn concentration of forages was 2SA:::/ I mg kg.

Concerurauon of Mo, Co and Se were greatly affected by season and forage species. In rainy season, mean conccnrraiion of Mo and Co were 1.03 and 0.25 mg kg, respectively. These values were significantly lower ($p<0.05$) than concentration of Mo and Co in dry season (1.24 and 0.51 mg/kg). It was noted that 30.8% of grass were deficient in Mo during dry season, while during rainy season 23.1% of grass was deficient in Co and 53.8% deficient in Mo. However, the result was in the range of the data reported by Prabowo *et al.* that Co concemraiion of the forages grown in South Sulawesi at dry season varied from 0.34 to 0.42 mg/kg, while in rainy season the Co concentration ranged from 0.31–0.44 mg/kg. Furthermore, they reported that concentration of Mo in dry season ranged from 0.26 to 1.25 mg/kg and from 0.42 to 1.75 mg/kg in rainy season. The Mo concentration found in the present study was also comparable with the result of Kumagai *et al.* in Thailand that grass contained higher Mo in dry season compared to rainy season (2.09–3.39 mg/kg vs 0.89–1.66 mg/kg). Data on Java Island of Indonesia showed that concentration of Mo in dry season varied from 0.33–2.03 mg/kg and in rainy season ranged from 0.27–3.06 mg/kg. In rainy season, concentration of Se was significantly higher ($p<0.05$) than in dry season (0.68 vs 0.47 µg/kg), the values were above the requirement of Se for sheep and goats. The average Se concentration in the present study was relatively higher compared to the results of previous studies.

Table 2 shows concentration of micro minerals in legume forages. It is clear that except for Se, concentration of nucro minerals was lower in legumes

compared with grass. The changes of season significantly affected concentration of Zn, Fe, Co and Se and percentage deficiency of Cu, Zn, Mn, Mo and Co ($p<0.05$). In the rainy season, the average concentration of Zn, Fe, Co and Se was 37.2, 255.2, 0.17 mg/kg and 1.0 µg/kg, while in dry season the concentration was 27.3, 191.6, 0.27 mg/kg and 0.52 µg/kg, respectively. There was no significant difference among the seasons for concentration of Cu, Mn and Mo, the average values being 7.4, 49.5 and 0.77 mg/kg. However, the deficiency of Cu, Zn, Mn, Mo and Co significantly differed among rainy and dry season. In dry season, percentage deficiency of Zn, Mn and Mo of legumes was 71.4, 28.6 and 57.1%; these values were higher compared to rainy season (42.9, 14.3 and 28.6%). Conversely, deficiency of Cu and Co in rainy season was higher compared to dry season (85.4 and 71.4% Vs 71.4 and 28.6%).

Table 3 shows micro mineral concentration of blood plasma goats grazed in several regions of West Sumatra. It can be set that plasma concentrations of Cu, Mo and Se of several goa were lower than the normal level of these elements in blood plasm of goats. Concentration of plasma Cu [illegible] season varied fro [illegible] 0.70 mg (Solok) to 0.997 mg/l (Pariaman) with the average value 0.829 mg/l, this level was lower compared to plasma C concentration in rainy season that varied from 0.798 mg/l (Tanah Datar) to 1.329 mg/l (Solok) which the average of 0.996 mg/l. In dr season, the range of plasma Mo concentration was 0.084 mg (Sawahlunto) – 0.154 mg/l (Padang), the average value being 0.12 mg/l. These values were similar to those of rainy season which [illegible] ranged from 0.076 mg/l (Padang) to 0.147 mg/l (Pariaman) Concentration of Se in rainy season varied from 16.9 µg/l (Tanal

Table 2. Micro mineral concentration of legumes in rainy and dry seasons (mg/kg DM)

Species	Season	Cu	Zn	Mn	Fe	Mo	Co	Se
Critical levels	–	11	33	40	50	0.5	0.2	0.2
Maximum level	–	25	750	1000	500	10	10	2.0
L. leucocephala	Rainy	10.2	34.5	42.4	239.9	0.18	0.13	1.33
	Dry	10.3	31.5	50.4	131.2	0.43	0.41	0.41
G. [illegible]	Rainy	3.4	19.6	32.9	121.3	0.53	0.08	1.29
	Dry	11.2	20.4	48.9	330.3	0.42	0.26	0.52
C. mucunoides	Rainy	4.7	27.7	40.6	569.2	0.70	0.16	0.73
	Dry	7.1	25.3	49.0	405.8	1.12	0.32	0.80
M. pudica	Rainy	7.7	44.4	42.1	295.1	1.95	0.33	0.87
	Dry	8.5	35.9	73.5	139.1	0.32	0.26	0.46
C. pubescens	Rainy	14.5	39.7	49.0	282.8	0.36	0.21	0.75
	Dry	10.5	34.1	78.9	103.8	1.20	0.51	0.27
M. invisa	Rainy	9.0	67.4	60.1	107.2	0.51	0.16	1.14
	Dry	5.7	22.3	38.4	96.3	1.64	0.01	0.20
S. glandulosa	Rainy	3.8	27.0	48.0	171.2	1.67	0.15	0.88
	Dry	3.1	21.5	38.1	135.0	0.27	0.12	0.95
Mean	Rainy	7.6	37.2 a	45.0	255.2 a	0.76	0.17 a	1.00 a
	Dry	8.1	27.3 b	53.9	191.6 b	0.77	0.27 b	0.52 b
	Overall	7.4	32.3	49.5	223.4	0.77	0.22	0.76
Deficiency (%)	Rainy	85.7 a	42.9 b	14.3 b	0.0	28.6 b	71.4 a	0.0
	Dry	71.4 b	71.4 a	28.6 a	0.0	57.1 a	28.6 b	0.0
	Overall	78.6	57.1	21.4	0.0	42.9	50.0	0.0

[illegible]
The values [illegible] (P< 0.05).

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

Location	Season	Cu	Zn	Mn	Fe	Mo	Co	Se
Critical level		0.65	0.4	0.002	1.6	0.05	–	0.02
Padang	Rainy (30)	0.885	2.05	0.048	6.72	0.076	0.030	111.2
	Dry (41)	0.820	1.27	0.056	7.08	0.154	0.063	159.8
Pariaman	Rainy (15)	1.031	1.12	0.072	9.71	0.147	0.036	21.2
	Dry (12)	0.997	1.24	0.065	8.12	0.135	0.027	20.1
Solok	Rainy (14)	1.329	1.78	0.049	8.20	0.085	0.068	78.7
	Dry (12)	0.700	2.05	0.107	14.20	nd	0.027	63.4
Sawahlunto	Rainy (28)	0.936	1.06	0.036	4.64	0.093	0.039	35.7
	Dry (24)	0.897	0.95	0.027	5.01	0.084	0.035	30.2
Tanah Datar	Rainy (35)	0.798	0.98	0.052	6.21	0.124	0.062	16.9
	Dry (36)	0.730	0.93	0.041	6.06	0.137	0.053	16.7
Average	Rainy	0.996 a	1.44	0.051	7.10 b	0.105	0.047	52.7 a
	Dry	0.829 b	1.29	0.059	8.09 a	0.127	0.041	58.0 b
	Overall	0.912	1.36	0.055	7.59	0.116	0.044	55.3
Deficiency (%)	Rainy	16.0	0	0	0	20.0 a	–	26.0 a
	Dry	17.0	0	0	0	14.0 b	–	40.0 a
	Overall	16.5	0	0	0	17.0	–	33.0

[illegible]

fr) to 1 : 1.2 µg/1 (Padang), significantly lower compared to ues in dry season from 16.7 µg/1 (Pariaman) to 159.8 µg/1 dang).

In overall, the amount of goals deficiency in Cu, Mo and Se nfir.g dry season was 17, ?i: and 10%, while in rainy s-ason the rcentage deficiency was 16, 20 and 26 %, respectively. Study of rabowo *ct al.* - found that the ranges of Cu, Zn and Se concentn:ti.::i of cattle blood in dry season was 0.61–0.76, 1.67–0.84 and 0.05–0.11 µg/ml; while in dry season the concentration was 0.61-0.S0 pg/ml for Cu, 0.90-1.15 µg/ml for Zn and 0.11- 0.!!! µg/ml for Se, respectively. They also reported that pcrccntag:: of !l:c animals deficiency in Cu, Zn and Se during dry season was 4 /, 20 and 3%. while in rainy season the percentage deficiency of Cu and Zn was 30 and *5%*, respectively.

It can be seen that although Cu, Zn, Mo and Co concentrations of the forages were lower than the critical level, only Cu, Mo and Se were deficient in the experimental goats. This suggested that utilization of minerals by animal was affected by both concentration and bioavailability of the minerals.

Conclusions

Based on the above results, it could be concluded that the availability of copper (Cu). zinc (Zn), molybdenum (Mo) and cobalt (Co) was deficient in the forages; while Cu. Mo and selenium (Se) were the elements deficient in goats grazed in West Sumatra, Indonesia.

Acknowledgments

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

'McDowell, L.R., Conrad. J.H. and Hembry, F.G. 1993. Minerals for Grazing Ruminants in Tropical Regions. Univ. Florida, Gainesville.

lSmith, R.M. 1987, Cobalt. In Mertz.. W. (ed.). Trace Elements in Human and Animal Nutrition. Volume 2. Fifth revised edition. Academic Press, San Diego, California, pp. 153.

lLe, ander, O.A. 1987. Selenium. In Menz, W. (ed.). Trace Elements in Human and Animal Nutrition, Volume 2, Fifih revised edition. Academic Press, San Diego, California, pp. 229.

'Espinoza, J.E., McDowell. L.R., Wilkinson, N.S., Conrad, J.H. and Martin, F.G. 1991. Forage and soil mineral concentrations over a three-year period in warm region of central Florida. II. Trace minerals. Livestock Research for Rural Development. 3(1): 1–6.

'Fujihara, T, Matsui, T., Hayashi, S., Robles, A.Y., Serra, A.8., Cruz, 1–C. and Shimizu, H. 1991. Mineral status of grazing Philippine goats. II. The nutrition of selenium, copper and zinc of goats in Luzon island. AJAS 5(2):)89-395.

•Kumagai, H., Ishida, N., Katsurnata, M., Yano, H., Kawashima, R. and Jachja, J. 1990. A study on nutritional status of trace mineral of cattle in Java, Indonesia. AJAS J(I): 15-20.

,Prabowo. A.• McDowell. LR.. Wilkinson, N.S.. Wilcox, C.J. and Conrad, J.H.1991. Mioeral status of grazing cattle in South Sulawesi, Iodonesia.. I. Macro minerals. AJAS .i(2): 11–120.

'Prabowo, A., McDowell, LR.. Wilkinson, N.S., Wilcox.. CJ. and Conrad, J.H. 1991. Mineral status of grazing cattle in South Sulawesi. Indonesia. 2. Micro minerals. AJAS 4{2):121–130.

'Hayashi, M.• Ogura, Y., Koike, I., Yabe, N., Mudigdo. R. and Parangin Angin. A. 1985. Minerals concentrations in serum of canle and buTalo and some herbages collected from pasture around Medan, Indon•ia Bulletin of National Institute of Animal Health 88:35·41.

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

"Steel. R. G. D. and Torrie, J. H. 1980. Principles and Procedures of Srarisrics. A Brometricai Approach. 2.,. Ed., McCrJw-H(II Inc.. New York.

·:McDowell, L.R. 1985. Nutrition of Grazing Ruminants in Wann Climates. Academic Press, Orlando.

"Kumagai, H., Swadiphanich, S., Prucsasri, P.• Yimmongkol. S., Rengsirikul. B. and Thamrnagceratuwong, P. 1996. A study on the mineral status of beef and dairy cattle and buffalo in Central Thailand. AJAS 9(5).525-531.

LEMBAR HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*
KARYA ILMIAH : *JURNAL ILMIAH*

Judul Jurnal Ilmiah (Artikel) : Mineral Status of Forages and Grazing Goats in West Sumatra, Indonesia: 2. Micro minerals

Penulis Jurnal Ilmiah : Lili Warli, **Armina Fariani,** Evitayani, M. Hayashida and T. Fujihara

Identitas Jurnal Ilmiah :
a. Nama Jurnal : JFEA
b. Nomor/Volume : 4/2
c. Edisi (bulan/tahun) : April 2006
d. Penerbit : WFL Publisher
e. Jumlah halaman : 4 halaman

Kategori Publikasi Jurnal Ilmiah: (beri V pada kategori yang tepat)
☑ Jurnal Ilmiah Internasional
☐ Jurnal Ilmiah Nasional Terakreditasi
☐ Jurnal Ilmiah Nasional Tidak Terakreditasi

Hasil Penilaian Peer Review :

Komponen Yang Dinilai	Nilai Maksimal Jurnal Ilmiah			Nilai Akhir Yang Diperoleh
	Internasional ☑	Nasional Terakreditasi ☐	Nasional Tidak Terakreditasi ☐	
a. Kelengkapan unsur isi buku (10 %)	4,0			
b. Ruang lingkup dan kedalaman pembahasan (30 %)	11,4			
c. Kecukupan dan kemutahiran data/ informasi dan metodologi (30 %)	11,7			
d. Kelengkapan unsur dan kualitas penerbit (30 %)	12,0			
Total = (100 %)	39,1			39,1

Mlg, 28 Sept '12

Reviewer 1.,

Prof.Dr.Ir. Lukman Hakim
NIP 19501213 198002 1002
Unit kerja : F.PETERNK.UNIV.BRAWIJAYA

LEMBAR HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*
KARYA ILMIAH : *JURNAL ILMIAH*

Judul Jurnal Ilmiah (Artikel) : Mineral Status of Forages and Grazing Goats in West Sumatra, Indonesia: 2. Micro minerals

Penulis Jurnal Ilmiah : Lili Warli, **Armina Fariani,** Evitayani, M. Hayashida and T. Fujihara

Identitas Jurnal Ilmiah :
a. Nama Jurnal : JFEA
b. Nomor/Volume : 4/2
c. Edisi (bulan/tahun) : April 2006
d. Penerbit : WFL Publisher
e. Jumlah halaman : 4 halaman

Kategori Publikasi Jurnal Ilmiah: (beri V pada kategori yang tepat)
☐ Jurnal Ilmiah Internasional
☐ Jurnal Ilmiah Nasional Terakreditasi
☐ Jurnal Ilmiah Nasional Tidak Terakreditasi

Hasil Penilaian Peer Review :

Komponen Yang Dinilai	Nilai Maksimal Jurnal Ilmiah			Nilai Akhir Yang Diperoleh
	Internasional ☐	Nasional Terakreditasi ☐	Nasional Tidak Terakreditasi ☐	
a. Kelengkapan unsur isi buku (10 %)	40			4
b. Ruang lingkup dan kedalaman pembahasan (30 %)	40			12
c. Kecukupan dan kemutahiran data/ informasi dan metodologi (30 %)	40			12
d. Kelengkapan unsur dan kualitas penerbit (30 %)	40			12
Total = (100 %)				40.

....., 1-10-2012

Reviewer 2.,

Prof.Dr.Ir. R.A. Muthalib
NIP
Unit kerja : F.PETERNK.UNIV.JAMBI