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Mineral Profile of Feeds, Fodders and Blood Plasma of Dairy Animals in KVK Adopted villages of Ranga Reddy District in Andhra Pradesh

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ABSTRACT : A study was conducted to assess the mineral profile of feeds, fodders and blood plasma of dairy animals in KVK (Krishi Vignana Kendhra) adopted three villages (Tallaplli, Bobbiligam and Muddemguda) in Shabad mandal, Ranga Reddy district. Fifteen farmers from each village were randomly selected for collection of information on available feeds and fodder and feeding practices followed in cattle and buffaloes. Samples of green and dry fodder, concentrate ingredients, home made and commercial concentrate mixtures were collected randomly (n=15) from farmers in each village. Similarly blood samples from different categories of livestock were also collected. The dry and green fodders on average were deficient to excess in Ca, adequate in Mg, Co, optimum in Mn and excess in Fe content, while deficient in Cu and P. The dry roughages were deficient in Zn, while greens were adequate. The brans were rich in P, Fe, Mn and Co content, moderate in Cu, Zn and Mg. Concentration of Ca, P and Zn were low in blood plasma of grazing animals. Hence, there is a need to supplement specific mineral mixture to mitigate the deficiencies in dairy animals.

Key words: Mineral content, Feeding practices, Plasma

Dairy animals in rural areas largely depend upon grazing and crop residues and a little extent on supplemented concentrates to fulfill their nutritional requirements. These resources rarely provide all the needed mineral requirements of dairy animals (McDowell, 1985). It has been reported that mineral concentrations in both soils and plants affect the mineral status of animals (Towers and Clark, 1983). Micronutrients, particularly the mineral elements are considered to be inevitable for the normal metabolic and physiological processes of dairy animals. Mineral deficiencies and imbalances have long been held responsible for low production among cattle and buffaloes fed on crop residues in tropical agro-climatic condition. It would be useful to know the mineral status of feeds, fodders and blood plasma of animals to ascertain the extent of deficiency or excess (Hinders, 1999; Garg *et al.,* 2002). The micronutrient profile in blood plasma is fairly a good indicator for assessing the mineral status in animals, inspite of the homeostatic mechanism in the system. Mineral status in animals depends on the level of intake, physiological status and type of accompanying feed. Keeping in view the above facts the current investigation was carried out in Tallapalli, Bobbiligam and Muddemguda villages in Ranga Reddy district of Andhra Pradesh, India.

Materials and Methods

The study was conducted in KVK (Krishi Vignana Kendhra) adopted three villages (Tallaplli, Bobbiligam and Muddemguda) in Shabad mandal, Ranga Reddy district. Fifteen farmers from each village were randomly selected for collection of information on available feeds and fodder and feeding practices followed in cattle and buffaloes. The quantity of feed and fodder available and offered for milch cattle and buffaloes during different months of a year were recorded through well structured and pre tested survey questioner. Representative samples of green fodder, dry fodder and individual concentrate ingredients, home made concentrate mixtures and compounded cattle feeds were collected. They were initially air dried and then oven dried at 60 ± 5°C. Dried samples were ground to pass a 1mm sieve in a Wiley Mill. These samples were analyzed for Ca and P (Talapatra *et al*., 1940 and AOAC 1980, respectively). The Mg and trace minerals

(Cu, Zn, Fe, Mn and Co) were analyzed by using tri-acid digestion (9:3:1, HNO_3:H_2SO_4:$HClO_4$) method using atomic absorption spectrophotometer (AAS).

Blood samples were collected at random (n=15) from in each category of animals (calves, heifers, pregnant-dry, grazing-milch and stall-fed milch animals in both cattle and buffaloes). These blood samples were centrifuged at 3000 rpm for 20 minutes to separate plasma and the separated plasma was stored at -20^{0}C for subsequent analysis of major (Ca, P and Mg) and trace (Fe, Cu, Zn, Mn and Co) elements. Ca and P in plasma were estimated as per method described by Pattanaik *et al.* (1999). Mg, Cu, Zn, Fe, Mn and Co were estimated by digesting the plasma with tri-acid and analyzed the minerals in extractable aliquot using AAS.

Data were subjected to analysis of variance according to the procedure described by Wilkinson *et al.,* (1996). The species differences were separated using Duncan's multiple range test (Gomez and Gomez, 1984).

Results and Discussion

Existing Feeding Practices

Most of the farmers in Tallaplli, Bobbiligam, Muddemguda villages are used to take their dairy animals for grazing on available grazing /forest/waste lands. Few farmers kept their animals stall fed either at home or at farm nearby their cultivated lands. Paddy straw was the most common basal feed, followed by stovers of sorghum and maize. The sorghum (especially SSG-59-3 variety) was most cultivated green fodder followed by para grass, hybrid napier (CO-1) and *Lucerne* and local mixed grasses. The usage of concentrate ingredients *viz.,* rice bran, cottonseed cake, wheat bran, ground nut cake, gram chuni, maize grain, horse gram being practiced by few farmers and restricted to productive animals only and maximum 1kg per head irrespective of milk yield. The farmers supplemented rarely mineral mixture.

Availability and Intake of Feed Resources

The feed availability and intake seems to be optimum from July to December. The feed (DM) intake irrespective of milk yield, type of the animal was lower in all the cases from January to June due to lesser green fodder availability and the extent of deficiency in milch cattle and buffaloes ranged from 13.22 to 48.56 and 15.27 to 60.50%, respectively.

Mineral Content of Feeds and Fodders

Most of the straws and stovers available in the study area (Table 1) contained Ca above critical level (>0.3%). Among the cultivated green fodders, the Ca content was marginally deficient in sorghum green (0.19–0.27%), while the para grass (0.37%), hybrid napier (0.43–0.45%) were moderate in Ca and *Lucerne* was rich in Ca (1.31%), similar results are reported by Shinde *et al.* (2009). Among the concentrate ingredients, horse gram was a good source of Ca (0.75%) and others like maize grain, groundnut cake, gram chunni, rice bran were marginally sufficient (0.19–0.40%). Although the Ca content of most of the straws appeared to be above critical level, the bio-availability to the animals may be less due to presence of substantial amounts of oxalates and high silica in straws.

The P in most of the dry and green fodders was lower than the critical level of 0.21% and it could be due to low P content in soil and subsequent low uptake by the plants (Blake *et* al., 2000). Concentrate ingredients were moderate to good sources of P. The brans of rice (1.19-1.51 %) and wheat (1.41 %) were good in P. Though P was adequate in the concentrate feeds, almost all samples of dry and green fodders were deficient in P. This corroborates with the characteristic feature of tropical forage resources (McDowell *et al*., 1983).

Most of the straws and stovers contained Zn well below the critical level (<30ppm) and it is reported to be most deficient in many geographical zones of India (Garg *et al.,* 2005). Among the concentrate ingredients, except horse gram (37.12 ppm) and maize (31.68 ppm), other ingredients like rice bran, wheat bran, groundnut cake and cotton seed were good sources of Zn (44.37 –66.92 ppm). The average Mg in dry and green roughages ranged from 0.23 to 0.34 and 0.20 to 0.39 %, respectively and the values were comparable with Ramana *et al.* (2000) findings.

Table 1 : Mineral composition (on DM basis) of various feeds and fodders offered to the dairy animals

Ingredient	Ca (%)	P (%)	Mg (%)	Cu (ppm)	Zn (ppm)	Fe (ppm)	Mn (ppm)	Co (ppm)
Critical level[1]	***< 0.3***	***< 0.25***	***< 0.20***	***<8.0***	***< 30.0***	***< 50.0***	***< 40.0***	***< 0.1***
Paddy straw	0.34 ± 0.03	0.15 ± 0.03	0.23 ± 0.03	3.16 ± 0.15	28.22 ± 0.28	242.30 ± 8.92	152.42 ± 13.56	0.23 ± 0.05
Sorghum Stover	0.32 ± 0.01	0.14 ± 0.05	0.34 ± 0.05	5.06 ± 0.22	17.84 ± 0.36	288.72 ± 14.26	32.12 ± 7.98	0.31 ± 0.05
Maize Stover	0.41 ±0.04	0.20 ± 0.03	0.29 ± 0.02	6.33 ± 0.11	18.68 ± 0.22	242.40 ± 15.30	40.26 ± 6.26	0.18 ± 0.02
Ragi straw	0.83 ± 0.03	0.21 ± 0.01	0.32 ± 0.01	1.48 ± 0.26	17.08 ± 0.41	101.20 ± 6.78	75.02 ± 8.48	0.21 ± 0.03
Lucerne	1.31 ± 0.09	0.23 ± 0.01	0.39 ± 0.03	9.94 ± 0.16	40.36 ± 0.24	531.30 ± 20.42	140.12 ± 9.62	0.49 ± 0.03
Fodder Sorghum	0.23 ± 0.02	0.17 ± 0.03	0.36 ± 0.02	6.72 ± 0.09	37.52 ± 0.76	512.22 ± 18.46	27.96 ± 6.84	0.34 ± 0.06
Para grass	0.37 ± 0.05	0.22 ± 0.04	0.20 ± 0.06	9.32 ± 0.24	43.72 ± 0.84	311.10 ± 18.22	39.62 ± 7.68	0.28 ± 0.02
Hybrid napier	0.44 ± 0.01	0.30 ± 0.06	0.34 ± 0.03	7.46 ± 0.41	56.46 ± 0.56	398.62 ± 14.24	65.82 ± 8.72	0.19 ± 0.05
Grazing grass	0.34 ± 0.09	0.19 ± 0.02	0.28 ± 0.05	4.30 ± 0.38	26.08 ± 1.32	412.84± 15.32	52.86 ± 11.32	0.26 ± 0.09
Maize grain	0.32 ± 0.02	0.33 ± 0.01	0.21 ± 0.01	3.32 ± 0.12	31.68 ± 0.72	70.10 ± 5.78	19.20 ± 3.52	0.48 ± 0.08
Horse gram	0.75 ± 0.03	0.40 ± 0.02	0.29 ± 0.02	8.28 ± 0.09	37.12 ± 0.38	168.26 ± 11.12	29.72 ± 4.28	0.29 ± 0.09
Rice bran	0.31 ± 0.07	1.35 ± 0.05	0.46 ± 0.03	16.20 ± 1.09	44.37 ± 1.06	288.88 ± 14.78	117.12 ± 7.22	0.35 ± 0.03
Wheat bran	0.25 ± 0.01	1.41 ± 0.03	0.43 ± 0.03	20.16 ± 1.02	63.42 ± 2.68	334.06 ± 13.26	103.02 ± 6.94	0.45 ± 0.08
Gram chunni	0.28 ± 0.04	0.27 ± 0.02	0.35 ± 0.02	11.68 ± 0.74	33.66 ± 1.68	482.24 ± 17.52	93.56 ± 7.22	0.42 ± 0.07
Groundnut cake	0.40 ± 0.03	0.68 ± 0.03	0.49 ± 0.04	17.84 ± 0.62	64.18 ± 3.12	856.80 ± 22.36	49.12 ± 5.02	0.32 ± 0.09
Cotton seed cake	0.26 ± 0.03	0.48 ± 0.02	0.33 ± 0.01	13.58 ± 0.32	66.92 ± 1.02	218.16 ± 10.38	50.46 ± 8.22	0.29 ± 0.12
Con. mix	1.76 ± 0.12	1.31 ± 0.01	0.66 ± 0.01	17.82 ± 0.28	55.82 ± 3.02	555.25 ± 14.74	138.24 ± 9.42	1.58 ± 0.18
HMCM	0.42 ± 0.08	1.12 ± 0.09	0.49 ± 0.06	10.26 ± 1.17	41.56 ± 4.22	232.12 ± 18.42	66.32 ± 7.38	0.44 ± 0.14

[1] McDowell (1985)

Con. Mix: Commercial concentrate mixture; HMCM: Home made concentrate mixture of rice bran, maize, horse gram and cakes of cotton and groundnut

Copper content was consistently low in almost all the feed samples analyzed and it could be due to low Cu content in soil. In dry fodders (straws of paddy, ragi and stovers of maize and jowar) and green fodders except *Lucerne* and para grass, the quantities were below the critical level. Fe is reported to be most abundant element in soil in many geographical regions of India (Ramana *et al.,* 2001; Yadav *et al.,* 2002; Garg *et al.*, 2005). The samples of straw (101.2 to 288.7ppm), green fodder (311.12 to 531.3 ppm) and other concentrates ingredients (218.16 to 567.22ppm) were rich in Fe.

Most of the green (39.62–140.12 ppm) and dry roughages (75.02 – 152.42 ppm) except sorghum green, stovers of maize and jowar offered to the animals contained optimum content of Mn and a similar findings were earlier reported by Garg *et al.* (2003). The cobalt content in most of the feeds and fodders was found to be above the critical level and were comparable with the reported Co content of feedstuffs available in Dahod and Panchamahal districts of Gujarat (Garg *et al.* 2004).

Metabolic Profile of Dairy Animals

The plasma Ca (mg%) concentration (Table 2) in calves, heifers, pregnant-dry, grazing-milch and stall-fed milch buffaloes ranged from 9.11 to 9.82, 9.23 to 9.32, 8.72 to 9.02, 9.04 to 9.28 and 8.53 to 8.74, respectively and the corresponding values in cattle were 9.08 to 9.80, 9.08 to 9.26, 8.96 to 9.31, 8.68 to 9.06 and 9.11 to 9.46 mg%. Grazing animals have significantly ($P<0.05$) lower plasma Ca concentration as the availability of sufficient quantity and quality of fodder is the limiting factor under grazing conditions. The Ca content was higher in calves, which might be due to intake of milk being a rich source of Ca and increased osteoblastic activity during growth period (Maynard *et al*. 1979).

The plasma P (mg%) concentration in stall fed milch, grazing milch, pregnant-dry, heifers and buffalo calves was 6.11 to 6.23, 5.01 to 5.12, 4.86 to 5.08, 4.68 to 5.17 and 5.22 to 6.48 mg %, respectively and the corresponding values in cattle were 5.26 to 6.58, 4.72 to 5.16, 4.64 to 5.22, 5.03 to 5.18, and 5.24 to 6.60 mg %. Significantly higher ($P<0.05$) plasma P was observed in stall fed milch animals compared to grazing animals, which might be due to supplementation of home made or commercial concentrate mixture containing brans (rice/wheat) being rich in P. This corroborates with the findings of Mandal *et al*. (1996).

Plasma Mg concentration was above critical level in all categories of animals due to adequate levels of Mg in feedstuffs available in the study area. Significantly ($P<0.05$) higher plasma Zn concentration was observed in calves compared to all other categories of animals due to intake of milk being good source of Zn. Plasma Zn concentration was low in adult animals either allowed for grazing or stall fed with much of stovers/ straws, which are poor source of Zn. A similar finding has been reported earlier by Kumar *et al*. (2005) in Agra region of Uttar Pradesh.

Higher plasma Mn concentration in stall fed milch animals was attributed to their higher intakes through roughage and concentrate feed, where as the lowest level in calves was due to their maximum dependence on dam's milk, which is a poor source of Mn. Das *et al.* (2002) and Biswas and Samantha (2002) reported a similar low plasma Mn levels in calves. A similar trend was observed in plasma cobalt concentration due to higher intakes through feed, fodder and grazing resources.

Plasma Fe concentration was comparable among the cattle and buffaloes. Higher plasma Fe concentration in stall fed milch animals was due to regular intake of Fe rich sources (straw/green fodder/concentrates ingredients). Milk being the poor source of Fe, plasma Fe concentration levels was low in calves. The results are in agreement with Das *et al.* (2003).

The study revealed that most of the straws and stovers available in the study area are deficient in phosphorus, zinc and cobalt and the deficiency of calcium, phosphorus and zinc is widespread among the grazing animals. Hence, there is a need to supplement specific mineral mixture to mitigate the deficiencies in dairy animals.

Table 2 : Plasma mineral profile of dairy animals

Category	Ca	P	Mg	Cu	Zn	Mn	Fe	Co
	mg%				ppm			
Critical Level[1]	**<8.0**	**<4.5**	**<1**	**<0.65**	**<0.8**	**<0.02**	**<0.10**	**<0.2**
				Buffaloes				
Stall-fed-milch	$9.15^{b}\pm0.07$	$5.86^{a}\pm0.09$	$2.57^{a}\pm0.03$	$1.26^{a}\pm0.03$	$1.32^{c}\pm0.05$	$0.67^{a}\pm0.02$	$6.02^{a}\pm0.02$	$0.84^{a}\pm0.02$
Grazing-milch	$8.64^{c}\pm0.06$	$4.92^{b}\pm0.05$	$2.31^{b}\pm0.05$	$1.22^{a}\pm0.05$	$1.27^{c}\pm0.03$	$0.52^{b}\pm0.01$	$5.70^{b}\pm0.03$	$0.72^{b}\pm0.01$
Pregnant-dry	$8.89^{c}\pm0.08$	$4.97^{b}\pm0.11$	$2.42^{b}\pm0.02$	$1.03^{b}\pm0.03$	$1.42^{b}\pm0.04$	$0.58^{b}\pm0.03$	$5.46^{c}\pm0.03$	$0.58^{c}\pm0.03$
Heifers	$9.28^{b}\pm0.10$	$5.10^{b}\pm0.10$	$2.28^{b}\pm0.03$	$1.10^{b}\pm0.06$	$1.29^{c}\pm0.05$	$0.55^{b}\pm0.01$	$4.27^{d}\pm0.05$	$0.55^{c}\pm0.01$
Calves	$9.54^{a}\pm0.09$	$6.17^{a}\pm0.09$	$2.16^{c}\pm0.03$	$0.86^{c}\pm0.05$	$1.86^{a}\pm0.02$	$0.44^{c}\pm0.01$	$3.88^{e}\pm0.04$	$0.35^{d}\pm0.03$
				Cattle				
Stall-fed-milch	$9.28^{a}\pm0.07$	$5.87^{a}\pm0.07$	$2.50^{a}\pm0.04$	$1.20^{a}\pm0.05$	$1.23^{b}\pm0.05$	$0.63^{a}\pm0.01$	$5.88^{a}\pm0.05$	$0.83^{a}\pm0.02$
Grazing-milch	$8.89^{c}\pm0.07$	$5.09^{b}\pm0.07$	$2.35^{b}\pm0.04$	$1.12^{a}\pm0.05$	$1.18^{b}\pm0.05$	$0.55^{b}\pm0.01$	$5.71^{a}\pm0.05$	$0.64^{b}\pm0.02$
Pregnant-dry	$9.13^{b}\pm0.10$	$4.91^{b}\pm0.09$	$2.40^{b}\pm0.05$	$1.16^{a}\pm0.07$	$1.23^{b}\pm0.07$	$0.57^{b}\pm0.01$	$5.46^{b}\pm0.06$	$0.56^{b}\pm0.02$
Heifers	$9.16^{b}\pm0.11$	$4.93^{b}\pm0.11$	$2.25^{c}\pm0.06$	$1.06^{a}\pm0.08$	$1.30^{b}\pm0.08$	$0.53^{b}\pm0.01$	$4.45^{c}\pm0.07$	$0.48^{c}\pm0.03$
Calves	$9.32^{a}\pm0.11$	$5.93^{a}\pm0.10$	$2.19^{c}\pm0.06$	$0.78^{b}\pm0.08$	$1.84^{a}\pm0.08$	$0.40^{c}\pm0.01$	$3.74^{d}\pm0.07$	$0.29^{d}\pm0.03$

[1]McDowell (1985) and Blood *et al.* (1983). Means with different superscript in a sub column differ significantly ($P<0.05$)

References

AOAC. 1980. Official Method of Analysis 18th ed., Association of Official Analytical Chemicals, Washington, D C.

Biswas, R. and Samanta, G. 2002. Mineral status of cattle and goats in relation to feeds and fodders of old alluvial zone of West Bengal. Indian Journal of Animal Sciences 72 (1): 104 – 106.

Blake, L., Mercik, S., Koerschens, M., Goulding, K.W.T., Stempen, S., Weigel, A., Poulton, P.R. and Powlson, D.S. 2000. Potassium contentent in soil, uptake in plants and the potassium balance in three European long-term field experiments. Plant and Soil, 216:1-14

Das, A., Biswas, P. and Rajendran, D. 2003. Micronutrient profile of feeds fodders and animals in hill zone of West Bengal. Animal Nutrition and Feed Technology 3 : 9 – 16.

Das, P., Biswas, S., Ghosh T. K. and Hladar, S. 2002. Micronutrient status of dairy cattle in new alluvial zone of West Bengal. Indian Journal of Animal Sciences 72 (2) : 171 – 173.

Garg, M. R., Bhanderi, B. M. and Sherasia, P.I. 2003. Micro mineral status of feeds and fodders in Kutch district of Gujarat. Animal Nutrition and Feed Technology 3 : 179 – 188.

Garg, M. R., Bhanderi, B. M. and Sherasia, P.L. 2002. Trace mineral status feeds and fodder in Dahod and Panchmahal districts of Gujarat. Animal Nutrition and Feed Technology 3: 27-33

Garg, M. R., Bhanderi, B. M. and Sherasia P.L. 2004. The status of certain trace minerals in feeds and fodders in Kutch district of Gujarat. Indian Journal of Animal Nutrition 20(1): 8-12

Garg, M.R., Bhanderi, B.M. and Sherasia, P.L. 2005. Assessment of Adequacy of macro and micro mineral content of feedstuffs for dairy animals in semi-arid zone of Rajasthan. Animal Nutrition and Feed Technology 5: 8-20

Gomez, K.A. and Gomez, A.A. 1984. Statistical procedures for agricultural research. A Book of International Rice Research Institute (IRRI), Manila, Philippines. Wiley/Interscience, Singapore.

Hinders, R. 1999. Research needed to determine correct trace mineral levels. Feed Stuffs, 71 : 10.

Kumar Pankaj, Sharma M.C. and Chinmay Joshi 2005. Status of micro-minerals, hormone and vitamin profile in buffaloes (Bubalus bubalis) of Agra region of Uttar radesh. Indian Journal of Animal Sciences 75(8): 909 – 914

Mandal, A. B., Yadav, P. S., Sunaria, K. R., Kapoor, V. and Maan, N. S. 1996. Mineral status of buffaloes in Mahindergarh district of Haryana. Indian J. Anim. Sci., 66 : 849 – 851.

Maynard, L.A., Loosli, J. K., Hintz, F.H. and Warner, G. R. 1979. Animal Nutrition. 7th edn. McGraw-Hill Book Co., Inc. New York.

Mcdowell, L.R., Conard, J.H., Ellis, G.L. and Loosli, J.K. 1983. Minerals for grazing ruminants in tropical regions. Animal Science Department, Centre for tropical Agricultural, University of Florida, Florida. p – 89.

Pattanaik, A.K., Sastry, V.R.B. and Katiyar, R.C. 1999. Effect of different degradable protein and starch sources on the blood metabolites and rumen biochemical profile of early weaned crossbred calves. Asian Australian Journal of Animal Sciences 12: 728-734

Ramana, J.V., Prasad, C. S. and Gowda, S. K. 2000. Mineral profile of soil, feeds fodders and blood plasma in southern transition zone of Karnataka. Indian Journal of Animal Nutrition 17 (3) : 179 – 183.

Ramana, J.V., Prasad, C.V., Gowda, N.K.S. and Ramachandra, K.S., 2001. Levels of micronutrients in soil, feed, fodder and animals of North East transition zone of Karnataka. Indian Journal of Animal Nutrition 18 (3) : 235 – 242.

Shinde, A.K., Sankhyan, S.K. and Karim, S.A. 2009. Mapping of minerals in common feed resources and animal's diet of tribal belt of Rajasthan. Indian J. Anim. Nutr. 26:135-141.

Snedecor, G.W. and Cochran, W.G. 1980. Statistical methods, 7th ed. Lowa State Univ. Press, Ames, Lowa, U.S.A.

Talapatra, S.K., Ray, S.C. and Sen, K.C. 1940. Estimation of phosphorus, chloride, calcium, sodium and potassium in foods stuffs. Indian J. Vet. Sc. And Anim. Husbandry, 10 : 249 – 246.

Tiffany, M.E., Mcdowell, L.R., Martin, F.G., Walkilson, N.S., Cordoso, E.C. and Rabiansky, P.A. 2000. Effects of pasture applied bio solids on performance and mineral status of grazing beef heifers. Journal of Animal Science 78 – 1331.

Wilkinson, L., Hill, M., Welna, J.P. and Birkenbevel, B.K. 1996. Systat for windows, 6th Edition. SPSS Inc., Evanston, IL, USA.

Yadav, P.S., Mandal, A.B. and Dahiya, D.V. 2002. Feeding pattern and mineral status of buffaloes in Panipat district of Haryana state. Animal Nutrition and Feed Technology 2 : 127 – 138.