Predictions of voluntary dry matter intake by dairy cattle supplemented with differrent levels of *leucaena leucocephala* leaf meal.

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Abstract

An experiment was carried to develop an appropriate prediction equation for dry matter intake (DMI) by 20 zero grazed cows using forage degradation characteristics, body weight and dry matter yield per hectare. Cows were fed on hay and were supplemented with five rations containing. Different levels of Leucaena leucocephala leaf meal (LLM), cottonseed hulls (CSH) and maize bran (MB) in completely randomised block design. Ration 1, 2, 3 and 4 had 0, 1.2, 2.0 and 2.6 kg DM of LLM respectively. Diet 5 was a standard ration and was composed of 1.8 of cotton seed cake (CSC) and 1.8 kg DM of MB. Dry matter yield (DMY) of the grazinglands and body weights (BW) of the cows were determined using standard methods. Dry matter degradation characteristics of individual grass species composing the basal diet was determined in in-sacco in the rumen of three Boran steers fed on Brachiaria hay. DMY, degradation characteristics (a, b and c) and digestibility at 48 hours, BW were used to develop prediction equations for DMI using multiple regression analysis. Treatment diets significantly ($P<0.001$) increased DMI of the forage grass. However, there were no significant ($P>0.05$) difference in DMI between cows supplemented with ration 2, 3 and 5 (av. 14.2, 14.3 and 14.8 kg DMI/cow/day respectively. There were an increase in DMI as LLM supplementation increased in the rations with cows on treatment 4 showing significant ($P<0.001$) higher DMI than the rest of the rations and was found to be the optimal supplementation ration under the existing feeding conditions.

The washing losses (a) for the grass species composed the basal diet ranged from 100 g/kg DM for B.insculpta to 241 g/kg DM for C.ciliaris, the the insoluble fraction degradable with time (b) ranged from 468 - 611 g/kg DM for C.gayana and P.maximum respectively, the D48 ranged from 60 - 430 g/kg DM. The DMY of the grass species ranged from 2279.9 kg to 5452.2 kg for B. insculpta and C.gayana respectively. The developed DMI prediction equation using a, b, D48, BW and DMY gave better results. However, the substitution of D48 for degradation rate (c) improved the DMI prediction with an r of 0.84. The results indicate that the DMI of zero grazed and supplemented cattle could be predicted accurately thus laying a basis for the development of feeding standards for zero grazed dairy cattle in the tropics.

Keywords: ***Lactating cows, Dry matter intake, rumen degradability.***

INTRODUCTION

Milk production in most Sub-Saharan Africa is from zebu cattle kept in marginal areas or from a small herd of improved cattle of European origin. The latter are kept mostly in densely populated highland areas where the climate is conducive for their management and in urban and peri-urban areas where milk prices are high (Shem, 1996). In both areas, dairy cattle depend on forage from communal grazinglands and small private forage plots on mixed farms or within and outside the municipal boundaries under the zero grazing management system. The nutritive values of the forage are often low and do not meet the production needs dairy cattle. Concentrate feeds are often not fed due to their unavailability and their high costs. Where fed, rations are often formulated based on inappropriate feeding standards developed for temperate cattle.

There has been numerous calls for the development of feeding standards based on appropriate and inexpensive feed evaluation methods (Jackson, 1977, rskov and Ryle. 1990; Shem *et al.,* 1995, Shem *et al.,* 1999). The use of conventional feed evaluation methods (including chemical, *in-vivo* and/or *in-vitro* methods) although appropriate is hampered by financial, technical and infrastructural deficiencies in most of the developing countries. However, the use of the nylon bag technique (rskov and Ryle, 1990) which estimates the feed's degradation characteristics in the rumen has found wide use in many laboratories throughout the world. The positive relationship between degradability characteristics of feeds and rumen turnover rates allows the development of prediction equations for dry matter intake and other related parameters like digestible dry matter intake and production parameters including growth (rskov *et al*., 1988; Kibon *et al*., 1993; Shem *et al*., 1995). Other studies on the subject have since then been reported (Khazaal *et al*., 1996). In addition, rskov and Ryle, (1990) proposed and later Shem *et al*., (1995) demonstrated that the allocation of single index values to feeds allows ranking of feeds according to their nutritive value. With more research and refinement, this approach could form the basis for the development of cattle feeding standards derived from the nutritive value of locally available feed and animal resources. For example the influence of protein and energy supplements on intake of roughage and its effect on the accuracy of the several dynamic dry matter intake models so far developed need to be studied before these models are adopted for routine application in the field.

This experiment was therefore; an attempt to investigate the effect of protein and energy supplements on the predictive efficiency of voluntary intake of forages by zero grazed cattle. Factors included in the new models (in addition to those proposed by Shem *et al*., 1995) were the 48-hour degradability values of the forages, dry matter yield per unit area cut and the body weights of mature zero grazed cattle.

MATERIALS AND METHODS

An experiment was carried out in Shinyanga urban and peri-urban areas situated in the Northwest at Latitude of 20^0-50^0S and Longitude of 31^o-35^oE in the semi-arid area of Tanzania.

Forage sampling

Samples from the basal diet were collected from the 10 different grazinglands in the peri-urban areas of Shinyanga municipality. From each grazingland four sampling areas of 25m x 25m were chosen at random. Three transepts, two diagonals and one dissector were established for each sampling area. A quadrant of $1m^2$ divided into $10cm^2$ cubes was thrown at every five steps in a transept and grass was sampled by cutting it about 2 cm above the ground. Ground grass cover was then determined by estimating the percent basal area of the forage (Pieper, 1978).

From each quadrant, a composite sample was collected for dry matter yield estimation and chemical analysis. Samples for each individual grass species in each grazingland were identified and collected for chemical analysis. Each sample was put in a paper bag, labelled and weighed using a field scale. The samples were dried in the oven at 60^oc for 48h to constant weight, milled and packed ready for laboratory analysis. The forage yield (kg/ha) of grazinglands was estimated using the following formula as proposed by (Pieper, 1978):

Average DM yield x 10 000 m^2

Forage yield (ton/ha)= x % cover 25 m x 25 m

Where; ha = hectare

DM = dry matter

1 ha = 10 000 m^2

Chemical composition analysis

The chemical composition of each individual grasses, the composite sample and concentrate rations were determined according to A.O.A.C., (1990). CP (crude protein) of the feeds were determined using a semi-automatic Kjeldatech method (N x 6.25) at the department of animal science laboratories at Sokoine University of Agriculture, Tanzania. NDF (Neutral detergent fibre) and ADF (Acid detergent fibre) content were also analysed according to the method Van Soest et *al*., (1991) at the laboratory of animal Science, Shimane University, Japan. The mineral contents of the feeds were determined

Degradability study

Degradability measurements of the individual grass species, the composite samples and supplement rations were made using the nylon bag technique (Ørskov *et al*., 1980) in the rumen of three Boran steers fitted with permanent rumen cannulae. The steers were offered *Brachiaria brizantha* hay *ad libitum* plus 1 kg concentrate mixture of one part cotton seed cake and one part maize bran .The animals had free access to water throughout the day. For each feed sample 2g were weighed in duplicate into labelled nylon bags and incubated for 12, 24, 48, 72, 96 and 120 hours. After each incubation time the bags were removed from the rumen and hand washed in cold water for 15 min. Also two bags containing 2 g each feed were soaked in warm water for 1 h and then washed to determine the washing losses. The residues in the bags were then dried for 48 hours at 60^{o}c to constant weight to determine DM loss.

INTAKE STUDY

Animals and their management

A total of 20 lactating *Bos taurus x Bos indicus* cows with lactation number (s) ranging from between 1-5 and body weights ranging from 268.4 to 463.8 kg were selected randomly from five farmer's herds in Shinyanga urban and peri-urban areas. All the cows were dewormed two days before commencement of the experiment using a broad-spectrum anti-helminthic (Valbazen). Mastitis test was done using the California Mastitis Test (CMT) before the onset of the experiment and thereafter at a 7 days interval. Infected animals were treated using intra - mammary infusion antibiotics. Tick control was done twice a week at the Shinyanga Livestock Co-operative (SHILICO) dip tank using Super dip acaricide. Farmers in a farmer participatory research approach did regular management of the experimental animals. All animals had access to water *ad libitum* and were fed separately in individual pens.

Feeds and feeding

All cows were fed on a basal diet composed of a mixture of different grass species dominated by *Panicum maximum*, *Eurochloa spp.*, *Bothrochloa insculpta, Cynodon dactylon*, *Cenchrus ciliaris* and *Chloris gayana,* obtained from 10 grazinglands within the peri-urban areas of Shinyanga municipality. The grass was cut and sun dried to obtain good quality hay and fed to the experimental cows thrice a day at 9.00h, 12.00h and 15.00h. Five supplementary rations, four of which contained varying levels (0, 1.2, 2.0 and 2.6 kg DM) of *Leucaena leucocephala* leaf meal, cotton seed cake, hominy meal and cotton seed hulls were also fed to the experimental cows. Leaves and soft twigs of *Leucaena leucocephala* were harvested, sun dried and coarsely milled using a feed mill. Cows on ration 5 received 1.84 kg DM of cotton seed cake only per day. Energy requirement for maintenance and production by the experimental cows were calculated from the feed's degradation characteristics as described by Shem *et al*., (1995) and diets formulated by the trial and error method. Supplements were fed twice; one half in the morning at 8.00h and another half in the evening at 17.00h. at milking time.

Experimental design

The experiment was arranged in a completely randomised block design. Cows were grouped into five blocks of 4 animals each according to their body weights. The five supplementary rations were assigned to the blocks randomly.

Prediction of dry matter intake

Prediction equations for voluntary dry matter intake of the zero grazing lactating cows were developed using the following variables; actual dry matter intake (Y), cow body weights (BW), 48 hour degradability (D48) of forages, dry matter yield per hectare of grazingland (DMY) and the degradability characteristics (**a** and **b**,). The five separate factors, **a, b,** BW, DMY and D48 were tested in a multiple regression analysis using the following model:

$$Y = X_1a + X_2b + X_3BW + X_4D48 + X_5DMY$$

The **c** factor (Shem *et al*., 1995) in the models developed was replaced by 48h degradability due to their high positive relationship. The index value of forage from different grazinglands were calculated using the regression equation used to predict the DMI: $Y = X_1a + X_2b + X_3BW + X_4D48 + X_5DMY$. The coefficient for *a* was transformed to 1 by dividing each component of the equation by X_1a to generate coefficients for b, D48 and DMY of which the sum of *a* and the generated coefficients was the index value (Ørskov and Ryle, 1992).

Data collection

An adjustment period of 14 days was allowed to get the cows used to the supplementary rations before actual intake measurements were recorded. The basal and supplementary rations were fed in small amounts initially and were increased gradually as the preliminary period progressed. Following this, was a 15 days data collection period. Actual dry matter intake was calculated as a difference between the amount offered and the amount refused. Refusals were collected at 17.00h and weighed before the next feeding. A cow that refused less than 25% of the offer in the manger had its ration progressively increased until a minimum of 25% refusal rate was attained. Refusals were sampled from the feeding manger of each experimental animal, weighed and dried in an oven at 60^0c for 48 hours to constant weight. From each daily sampling, a bulk sample was obtained from which a 200 g samples were taken and kept for laboratory analysis.

Body weights were measured for each individual cow by using a weighbridge at the beginning and end of the experiment and averaged for each block and later used to predict dry matter intake.

Statistical analysis.

The intake data was analysed using the SAS (1988) programme using the following model:

$Y_{ijk} = \mu + T_i + B_{ij} + e_{ijk}$.

μ = General mean.

T_i = The effect of i_{th} treatment on voluntary intake.

B_{ij} = The effect of j^{th} block.

e_{ijk} = The error term.

The difference between treatment means were compared LSD as described by Senedcor and Cochran (1989).

RESULTS

Chemical composition

The chemical composition of the grass species composing the basal forage and supplementary diets is as shown in Table 1. The protein content of the grass species was above 70 g/kg DM except for *hyperrhenia ruffa*, which had a crude protein content of 41 g/kg DM. The NDF values ranged from 658 g/kg DM for *Eurochloa sp* to 704 g/kg DM for *H. ruffa.* ADF values ranged from 363 g/kg DM for *C. gayana* to 474 g/kg DM for unknown *sp*. The mineral content of the forage was as shown in Table 1. Crude protein content was highest (372 g/kg DM) for rations in treatment 5 followed by treatment 4, 3, 2, and 1 with 267, 220, 155 and 84 g/kg DM respectively. Neutral detergent fibre ranged from 197 for ration 5 to 734 g/kg DM for ration 1. Mineral composition (P, Ca, Na and Fe) for five rations are as shown in Table 1.

Table 1 Chemical composition (DM, CP, NDF, ADF, EE, P, Ca, and Na (in g/kg DM) and Iron (Fe) (in ppm) of the basal forage and supplementary rations.

Grass species:	DM	CP	NDF	ADF	EE	P	Ca	Na	Fe
Cenchrus ciliaris	949	72	676	420	14	0.57	0.39	0.47	927.8
Chloris gayana	948	74	661	363	04	2.69	3.15	0.46	469.8
C. dactylon	949	70	689	474	07	2.22	0.24	0.18	55.4

Eurochloa spp	935	74	658	400	13	3.24	1.32	0.46	469.8
Panicum maximum	939	71	678	400	14	2.38	3.27	1.81	1303.3
Hyperrhenia ruffa	942	41	704	456	12	0.93	0.97	0.02	351.0
Supplementary rations									
1	944	84	557	734	96	0.57	0.39	0.14	0.017
2	933	155	527	335	96	2.69	3.15	0.28	0.049
3	941	220	409	290	59	2.22	0.24	0.05	0.069
4	935	267	333	256	74	3.24	1.32	0.17	0.017
5	945	372	379	197	78	2.38	1.25	0.12	0.043

Voluntary dry matter intake.

The least square means for the voluntary dry matter intake of the basal forage by the experimental cows is presented in Table 2 and changes in intake over time are illustrated in Figure 1.

Table 2 Voluntary intake Least Square means (±SEM)

Treatment	Cows mean weight (kg)	DMI (kg/day)	(g/kgW$^{0.75}$)	(SEM)	Level of significance
1	455.5	13.4	135.9	0.33	*
2	396.5	14.1	158.7	0.31	*
3	365.6	14.97	159.1	0.56	*
4	463.8	17.62	176.3	0.55	**

5	447.2	14.8	152.2	0.34	*

There were no significant differences (P>0.05) in daily mean DMI between cows under treatment 1 and 2. The same trend also existed for the cows in treatment 2, 3 and 5 which showed no significant (P>0.05) difference in mean dry matter intake. Cows under treatment 4 had significantly (P<0.001) higher mean dry matter intake than the rest of the treatments. Generally, voluntary intakes increased with time (Fig.1) with significant (P<0.05) increase in voluntary intake from day 6 up to day 14.

The degradability characteristics and dry matter yield of grass species

Table 4 shows the potential degradability (**a+b**), washing loss (**a**) the rate constant (**c**), degradability at 48 incubation hour (**D48**) and dry matter yield of the grass species from which the basal forage was drawn. The washing loss varied from 241 to 100 g/kg DM for *C. gayana and B. insculpta.. P. maximum* had the highest potential degradability of 821 g/kg DM while *C. dactylon* had the lowest potential degradability value of 666 g/kg DM. The degradability at 48 hours (D48) ranged from 609 for *Eurochloa spp* to 430 g/kg DM for *B. insculpta*. The degradation rate constant was highest (0.0282) for *C. gayana* and lowest (0.0158) for *H. ruffa*. The dry matter yield ranged from 904.68 to 5452.19 kg/ha for *H. rufa* and *C. ciliaris* respectively

Table 3 Prediction of dry matter intake of lactating cows from degradation characteristics generated from the equation $P = a + b(I - e^{-ct})$ and BW of the animals, D48 and DMY of grass species

Factors	Formulae	r^2
1. (a+b)	21.81 - 0.0914 (a+b)	0.14
2. (a+b) + c	22.1 -0.0928 (a+b) -9.08c	0.14
3. (a+b) + c +D 48+ BW	-16.4 + 0.65 (a+b) +882.9c +0.01694BW +0.79D48	0.78
4. a+b + c + BW + DMY	21.6+0.0395a-0.18b-148.28c+0.01172BW+0.000464DMY	0.78
5. a + b + D 48 + BW + DMY	20.25 +0.26a +0.0824b -0.21D48 +0.0113BW +0.000466DMY	0.84

Table 4 Potential degradability (a+b), washing loss (a), 48 hour degradability (g/kg DM), rate constant (c) (h^{-}), predicted DMI (kg/day) and dry matter yield of 7 grass species ranked according to their index values

Grass species	a	b	c	D48	DM yield (kg/ha)	*DMI	**Index value
Eurochloa sp	217	574	0.0239	609	3085.46	14.1	22.9
H.ruffa	145	593	0.0158	461	904.68	14.2	22.6
B.insculpta	100	573	0.0178	430	2279.87	14.5	21.5
P.maximum	210	611	0.0166	546	2535.94	14.7	20.6
C.dactylon	145	521	0.0220	484	3799.90	15.7	17.0
C.gayana	241	468	0.0282	589	2716.83	15.9	16.1
C.ciliaris	192	553	0.0189	522	5452.19	16.6	13.4
Mean for mixed hay	179	556	0.0205	520	2967.80	14.2	19.2

D48 = 48 hours degradability

**DMI* = 20.25 + 0.26a - 0.0824b - 0.21D48 + 0.01133BW + 0.0004638DMY

***Index value* = a - 0.317b - 0.808D48 + 0.0436BW + 0.0018DMY

***Average Basal DMI/day = DMI of grass spp. * Proportion composition of grass spp. in the basal diet

DISCUSSION

Food evaluation

The mean CP concentration of the grass species composed the basal ration offered to cows in the current experiment was 67g/kg DM. These crude protein values are higher than those reported by Otsyina *et al*., (1994) from the similar area who observed crude protein contents ranging from 30 - 40 g/kg DM from reserved fodder banks during the dry season in Shinyanga. The disparity could probably be attributed to difference in stage of growth at which the forage were harvested (Gohl, 1981) and season (Crowder and Chheda, 1982) as they affect nutritive value of the forage.

Leng (1990) defined low - quality forages as those forages with CP less than 80g/kg DM and recommended supplementation of such forages with appropriate nutrient to achieve optimal levels of animal production. The mean CP concentration of supplementary diets ranged from 84 to 372 g/kg DM for diet 1 to diet 5 respectively. All supplementary diets were therefore suitable protein supplements for the low - protein basal diet.

The effect of *leucaena* leaf meal supplementation on voluntary intake

Cows supplemented with cottonseed hulls and maize bran alone consumed less total DM than the supplemented cows. Total DM intake increased with an increase in supplementation levels (Fig.1). The cows supplemented with 2.6 kg DM of *Leucaena* had highly significant (P<0.001) average voluntary intake (17.62 kg DM) per day than the cows in the rest of the treatments. The voluntary intake of cows supplemented with 1.2 and 2.0 kg DM of *Leucaena* leaf meal did not differ significantly (P<0.05) with those supplemented with 1.8 kg DM of cotton seed cake. Therefore, the LLM supplementary level from 1.2 to 2.6 kg DM can substitute 1.8 kg DM of CSC without altering the voluntary intake by cows. The higher voluntary intake attained by LLM supplemented cows could probably be due to increased availability of nitrogen to the rumen microflora, the rate of degradation and the rate of digestion and Clarence of DM from the rumen (Bamualism *et al.*, 1984). Furthermore, Muinga *et al.*, 1995 suggested that LLM supplementation might increase the amount of amino acids absorbed from the diets, which may also stimulate increase in DM intake. Also, the NDF has the negative relationship with the rate at which feeds are digested (McDonald *et al*., 1990) (i.e the lower the NDF the higher the digestibility and vice versa). The relatively lower NDF value for ration 4 (333 g/kg DM) (Table 1) could probably resulted into better digestibility of the feed that resulted into higher daily dry matter intake of the grass. However, the voluntary intake obtained are lower than that reported by Wahine *et al.*, (1982) who observed a voluntary intake increase of 26.4 kg DM by supplementing natural grass with *Leucaena leucocephala.* Similarly, Moran *et al*., (1983) observed higher voluntary intake of 18.3 kg DM of rice straw by supplementing cattle with 30% *Leucaena leucocephala*. The disparity in voluntary intake could probably be due to the level of *Leucaena* leaf meal used and the quality of the basal diet offered to the cattle. The voluntary intake in the current study are higher than those reported by Muinga *et al.*, (1995) who observed a voluntary intake in lactating cattle of 7.8, 9.3 and 10.4 kg DM by supplementing grass hay with 0, 4, and 8 kg DM of sole *Leucaena leucocephala*. The difference in intake could probably be due to difference in the supplementation levels and the state in which *Leucaena* leaf meal was supplemented to the cows (either mixed with other roughage or sole). Good animal performance are reported to be better when *Leucaena* leaf meal is mixed with other roughage's than when it is supplemented to animals as a sole ration (Muinga *et al.*, 1995).

The increase in voluntary intake as the *Leucaena* leaf meal inclusion levels were increased in the ration has practical implications to the farmer, that as more *Leucaena* is fed to dairy cows voluntary intake increases, thus, cows can eat more of the low quality roughage available in the communal grazing lands in Shinyanga during the dry season and perform at optimal level. This is of great importance in tropical regions particularly in semi - arid areas like Shinyanga where cattle graze less than six hours because of elevated temperatures.

Prediction of dry matter intake

Results in Table 3 shows a number of multiple regression equations which were developed for the prediction of DMI using different variables of free grazing lactating animals with an average body weight of 400 kg and lactation number ranging from 1 - 5. The DMI prediction equation Table 3 shows that the potential degradability (a+b) can only predict the DMI of lactating cows with an accuracy of 0.14 (14%). No improvement in DMI prediction accuracy (14%) was attained when a degradability rate constant (c) was added in the model (see eqn. 2). This observation differ from that of Ørskov *et al*., (1992) and Shem *et al*., (1995) who reported an improvement in the accuracy of DMI prediction when c was added in the model. The difference could probably be due to difference in forages used to feed the experimental animals. When 48 hour degradability which is equivalent to digestibility (Ørskov and Ryle, 1992), body weight of the cow was included in the model the DMI prediction accuracy was improved by 0.78 (78%) (eqn. 3). However, a substitution of DMY for D48 in the DMI prediction model (eqn. 4) does not bring difference in the prediction accuracy (78%). The improvement in DMI prediction accuracy was further increased to 0.84 (84%) when D48 was substituted for c (eqn. 5). Therefore, in this experiment the best DMI prediction equation is number 5.

The prediction equations for dry matter intake derived in this experiment differ from those reported by many workers (Chenost *et al*., 1970; Hovell *et al*., 1986; Ørskov *et al*., 1992 and Shem *et al*., 1995) who considered only the degradability coefficients (a, b and c) in the model. In the present study other factors thought to affect the DMI (DMY, BW and D48 = digestibility) of the free grazing cow was added in the model. The explanation of the difference could probably be due to the reason that the former DMI prediction models considered only zero grazed animals while in the present study the prediction equation was derived based on the free grazing lactating animals. Furthermore, the devised DMI prediction equation in the present study considered both the animal and feed factors affecting the DMI as recommended by Faverdin *et al*., (1995). The DMI prediction models derived in this experiment should only be applied for free grazing lactating cows supplemented with 1.2 - 2.6 kg DM of *Leucaena* leaf meal (or equivalent feed) with an average body weight of about 400 kg and lactation number ranging from 1 - 5.

The applicability of the DMI prediction equation obtained above (Table 3 eqn. 5) was tested to estimate the DMI of lactating cows (Table 4). The DMI of individual grass species ranged from 14.1 to 16.6 for *Eurochloa spp.* and *C. cirialis* respectively. However, these predicted DMI values can only be true if the cow could be offered single grass specie. Because the animals were offered a cosmopolitan grass species, thus, the actual predicted DMI was obtained through considering the proportion composition of the grass species in the basal diet. The overall mean DMI/day /cow was estimated at 14.2 kg. This DMI was sufficient for mantainence requirements of the cow with about 400 kg when it is considered that an animal eats 3% of its BW to meet the mantainence requirements (ARC, 1990). Ørskov and Ryle (1990) proposed the use of index value to describe the nutritive status of feeds. Using the index values (Table 4) the grass species composed the basal diet was ranked from the most nutritious to the least nutritious grass specie. It was observed that despite the comparatively lower predicted DMI (14.1kg) of *Eurochloa* grass specie, it ranked highest (index value 22.9) than the rest of the grass species. The comparatively highest index value of this grass specie is supported by its highest CP (74 g/kg DM), lowest NDF (658 g/kg DM) (Table 1) and highest D48 609 g/kg DM than the rest of the grass species. Probably, that is why the DMI of that grass specie was lower (14.1) compared to other grass species (Table 4) as cows had to eat comparatively lesser amount of it so as to meet their nutrient requirements.

CONCLUSION

From the results and discussion of this study the following can be concluded:

Leucaena leaf meal supplementation significantly ($P<0.01$) increased the voluntary intake of the grass obtained from communal grazing lands of Shinyanga. Cows supplemented with 2.6 kg DM of *Leucaena* leaf meal had a significantly ($P<0.001$) higher voluntary intake than cows under the rest of the treatments. The voluntary intake increased with the supplementation levels despite the limited feeding time. This was thought to be caused by good degradability of the supplementary rations, which increased with an increase in levels of *Leucaena* leaf meal inclusion in the ration. Thus, increased degradability of the forages resulted into reduced feed retention time in the rumen ultimately increased voluntary intake.

The degradability characteristics of the grass species obtained above combined with the 48 hour degradability, body weight of the cows and dry matter yield gave better (r2 = 84) DMI prediction model for the free grazing lactating cows.

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DISCUSSION

Que: Aboud

Grazing animals do not consume what they are offered in the stall. Consumption pattern under selective feeding must be taken into account.

Ans. This is true. However, under Shinyanga conditions there is little to select from. However, selectivity could be included in the model

Que: Kimambo, A

You used stall fed animals to measure actual intake for testing your model. A grazing animal will actually eat something different from what a stall fed animal will eat.

Ans: In this case we sampled the area where the feeds fed were cut. That is why we included DMY (12kg/ha). This took care of what the animal eat.

Que: Weisbjerg

How did you estimate the actual feed intake under grazing conditions?

Ans. We stallfed the animals to control error term. Again DMY measurements were considered.