暖地型牧草の蛋白質画分の生産と蓄積様式及び利用に関する研究

Ruminal Protein Fractions in Dietary Tropical Pasture Legume

Introduction

The efficiency of forage protein utilization depends on the solubility and degradation in rumen and how much microbial protein to be synthesized (Minson, 1990). Recent works for protein metabolism in rumen have quantified the degradation of forage protein within the rumen, the extent of microbial protein synthesis, and the associated changes in the quantity of amino acids absorbed from the small intestine (Nocek, 1988). But there were few works on it for tropical forages, especially tropical legumes.

The objectives of this study were to 1) investigate the variability of dietary protein fractions in forages and 2) estimate the dietary protein fractions in tropical legume material and its silage, comparing with tropical grasses.

Materials and Methods

True protein nitrogen (PN) and non-protein nitrogen (NPN) in total nitrogen(TN) were estimated according to trichloracetic acid (final conc. 5%). Dietary forage crude protein (CP) were fractionated into ready soluble and unsoluble, ruminal degradable and undegradable part, respectively. To evaluate soluble protein, two solvents (Krishnamoorthy et al., 1982) were compared: autoclaved rumen fluid (AF) solution and borate-phosphate($Na_2B_4O_7 \cdot 10H_2O$,

$NaH_2PO_4 \cdot H_2O$) buffer (BP) solution. The in situ nylon bag technique (Crawford, et al., 1978) was used to determine the extent of ruminal protein degradation. Two rumen-fistulate 790kg steers were maintained on a diet of 90% grass hay, 10% concentrate throughout the experimental period. Bags, placed in the ventral portion of the rumen, were taken at intervals of 6, 12 and 24 hours after incubation, respectively. Fermentative quality were measured with ensiled forages. All the sample were freeze-dried and grounded at 1mm and used to analyze.

The four tropical legumes and two tropical grasses and these silages was prepared to estimate the dietary protein fractions: Macroptilium lathyroides (Pb), Desmodium intortum var. Greenleaf(Gd), Macroptilium atropurpureum cv. Siratro(Si), Neonotonia wightii cv. Cooper(Gc), Pennisetum purpureum (Ne), Panicum maximum var. maximum cv. Gatton(Ga).

Results and Discussion

Fermentative quality of grass silages were good under pH 3.9-4.8, but low lactic acid fermentation was showed with legumes except Pb (Table 1).

The proportion of protein and non-protein nitrogen in forages are illustrated in Fig. 1. PN fraction in forage materials were about 90%, while these proportion ratio decreased by ensiling, especially 40-50% for legume silages. This results

Table 1 Fermentation quality of silages

Species	DM (%)	PH	TN (%)	NH_3-N /T-N	Lactic acid(%)	Acetic acid(%)	Propionic acid(%)	iso-butyric acid(%)	n-butyric acid(%)	Total acids(%)
Pb	18.47	4.65	3.59	6.93	4.19	1.96	0.05	0.68	0	6.87
Dg	21.06	5.76	3.39	8.40	0.07	1.20	0.54	0.16	0.09	2.06
Si	18.26	5.09	3.21	12.5	3.48	3.92	0.48	0.44	0.88	9.21
Gc	16.13	5.79	2.44	18.5	0.11	2.18	0.42	0.49	1.44	4.64
Ne	21.91	3.94	1.57	5.10	6.28	0.47	0.05	0.65	0.03	7.46
Ga	34.36	4.85	1.27	9.70	0.80	0.70	0.69	1.81	0.07	4.08

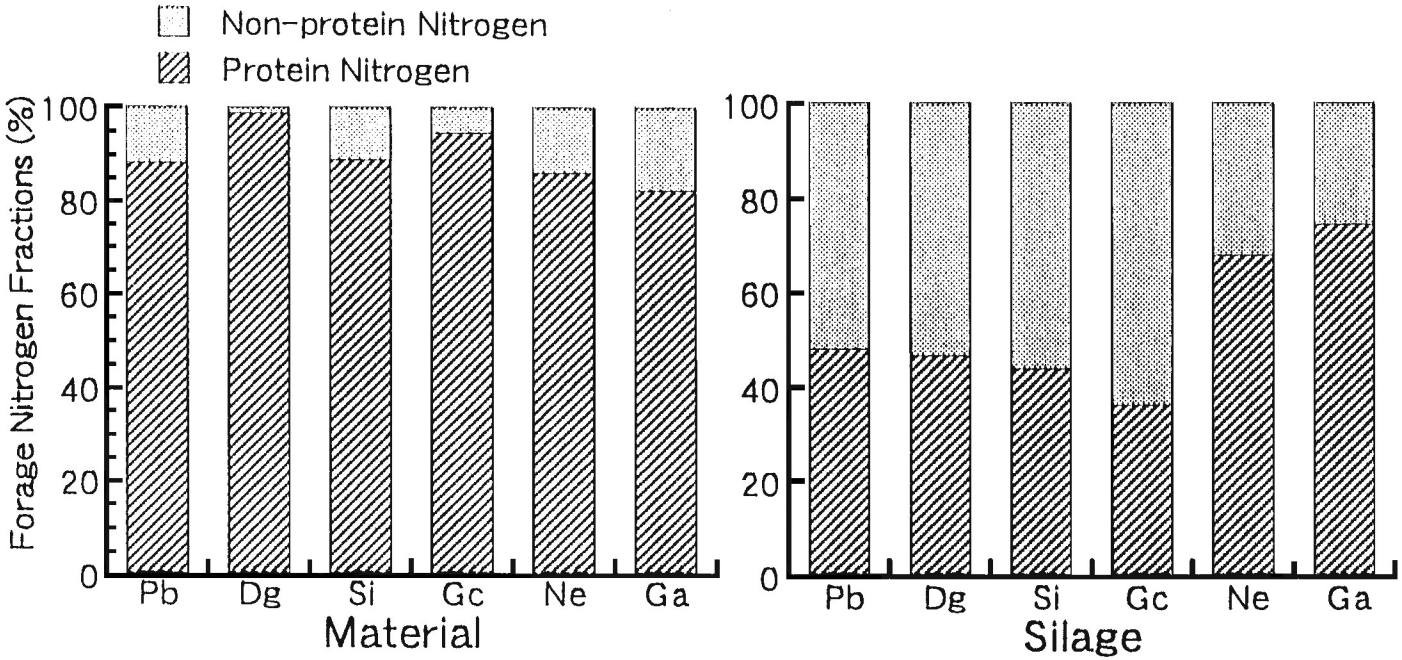

Fig. 1 Proportion of Protein and Non-Protein Nitrogen in Forages.

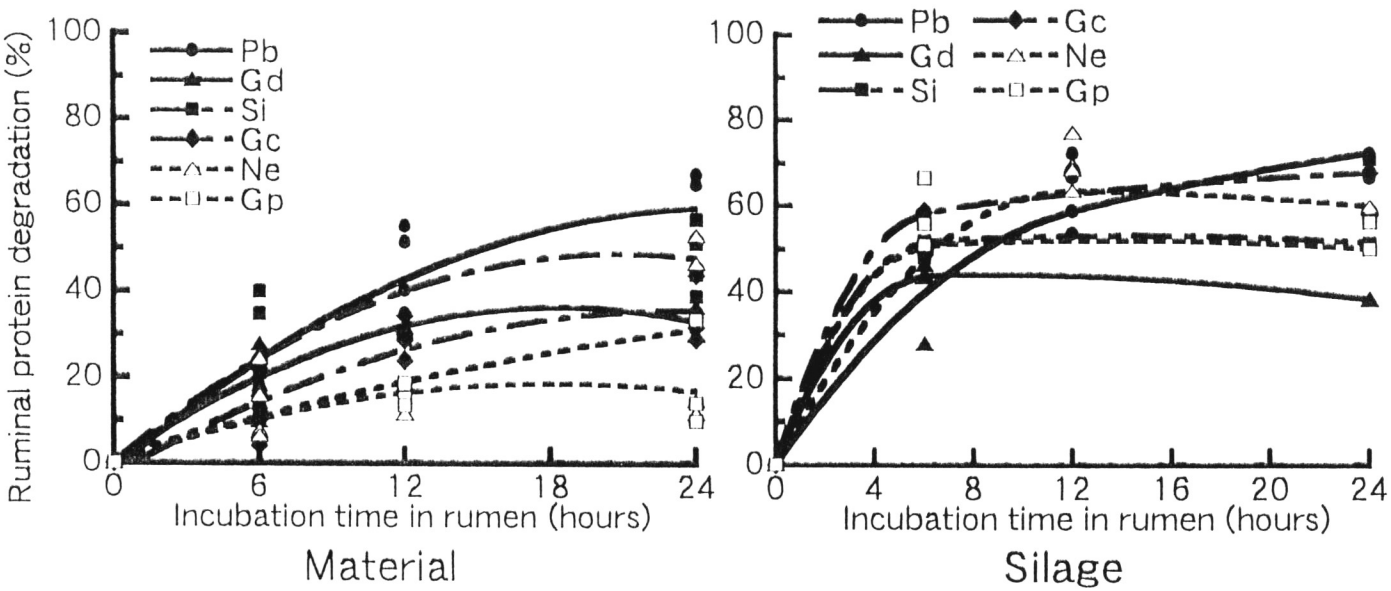

Fig. 3. Protein Degradation in Rumen with Incubation Time.

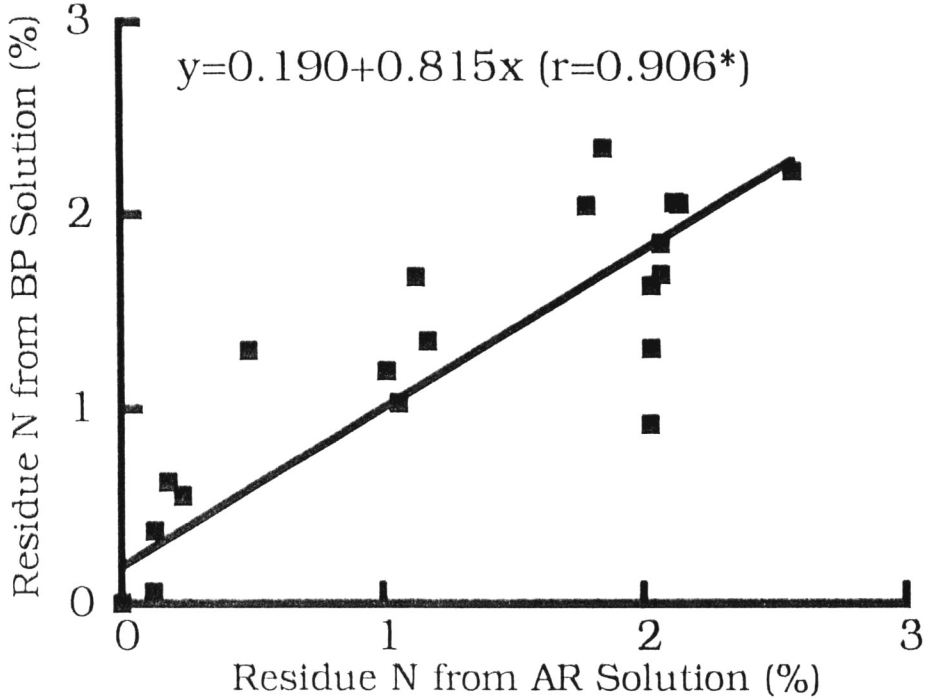

Fig. 2. Relationship between residual Nitrogens in Forage extracted by each two Solution

agree that during ensiling there is an increase in proportion of ammonia, non-protein nitrogen and free amino acids, which is taken into microbial protein.(Minson, 1990). The soluble protein fraction, extracted with AF and BP solution, respectively, were approximate each other and showed high positive correlation as described in Fig. 2. That fraction ratio came out to be higher in two grass silages, comparing with legume ones.

The protein degradation in rumen with incuvation time as shown in Fig. 3. The ruminal protein degradated fraction in forage materials were rapidly at 6 hours after and then gradually increased during the rumen incubation periods, while its fraction in these silages were rapidly increased at 6 hours after and then almost plateau. The degradated fraction in legumes were higher than in grasses. The rate was lowest in Gd among legume forages.

It is considered to be forage protein as being divided into four fractions as shown in Fig. 4. The dietary forage protein were fractionated by respective nitrogen extract methods above mentioned. The result is illustrated in Fig. 5. The non-degradable protein fraction in all the species were decreased by ensiling, which tendency was remarkable in grasses. There was about 10% decrease in non-degradable protein fraction(i.e. bypass protein) by ensiling except that no decrease was shown in Gd. The lower digestibility of Gd comparing with the other legumes, which was related with tannin containing (Fig. 6). There is a negative correlation between tannin content and protein digestibility(Mcleod,

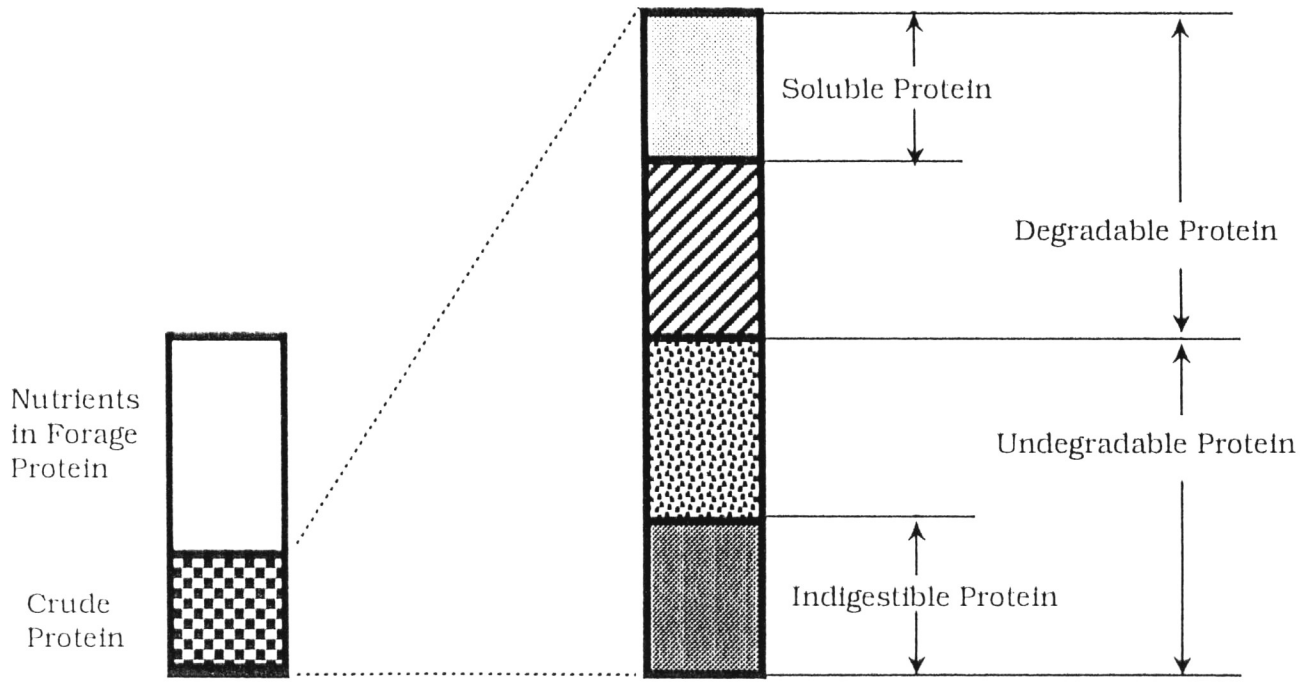

Fig. 4. Diagram of Ruminal Fractions in Forage Protein

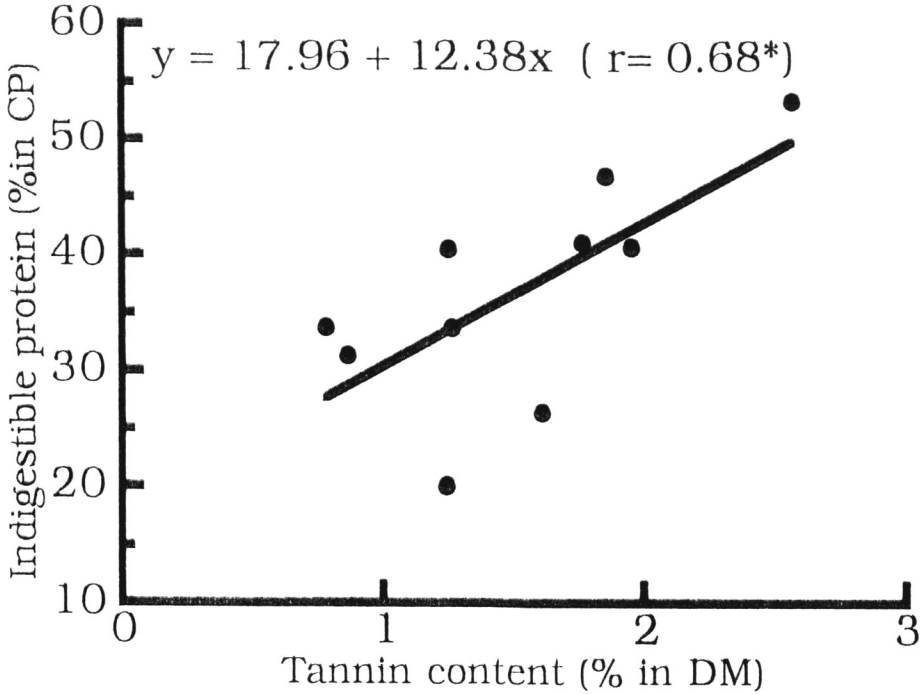

Fig.6. Relationship between indigestible protein and tannin content in tropical legumes.

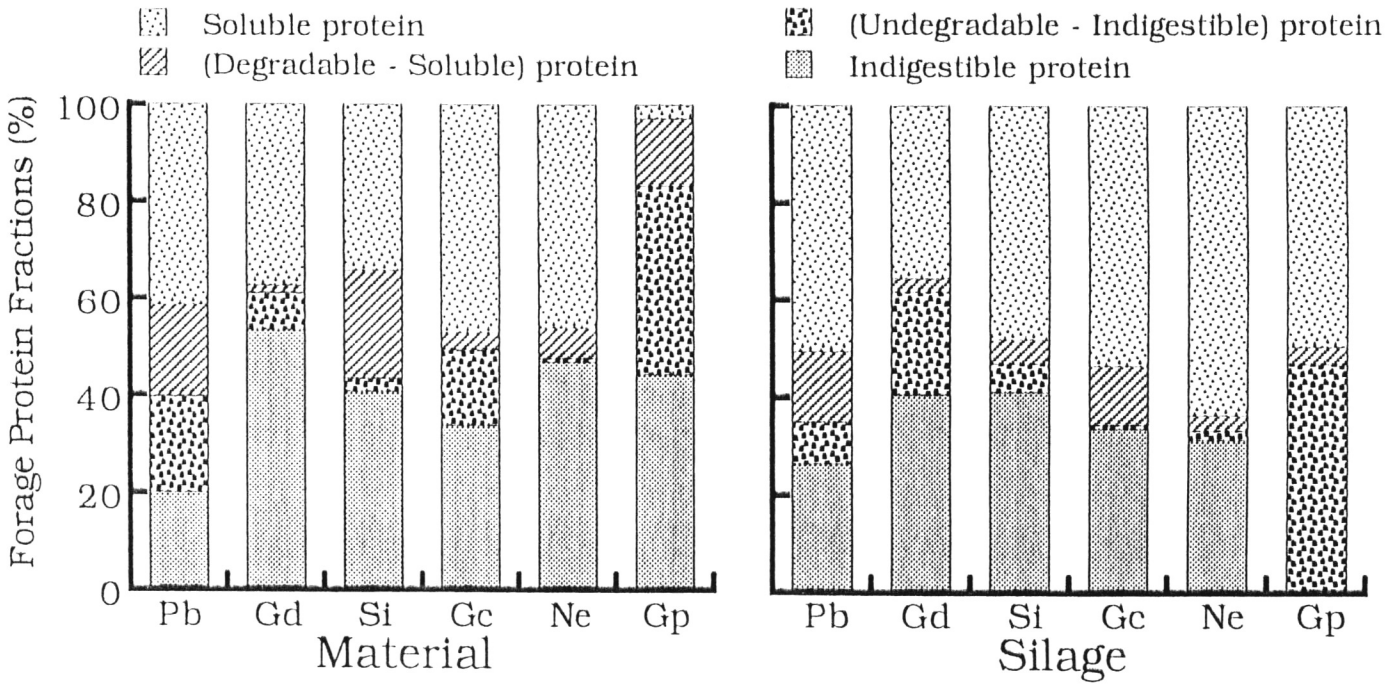

Fig.5. Protein Fractions in Dietary Forages

1974). The quantity of CP absorbed from the small intestine can sometimes be improved by the use of forages containing tannin compounds(Minson, 1990).

Furthermore, we should examine the relationships between some components containing in legumes and degradation of forage protein in rumen.

References

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