

THE RELATION BETWEEN THE CRUDE PROTEIN CONTENT AND THE DIGESTIBLE CRUDE PROTEIN CONTENT OF TROPICAL PASTURE PLANTS

R. MILFORD AND D. J. MINSON

*C.S.I.R.O. Cooper Laboratory, Division of Tropical Pastures,
Lawes, Queensland, Australia*

The digestible crude protein percentage (DCP) of 218 different feeds derived from 16 tropical grasses and 8 tropical legumes containing 2.2 to 25.3% crude protein (CP) was measured with sheep. DCP was closely related to CP ($r = +0.979$) and could be predicted from the equation $DCP = 0.899 CP - 3.25$ (SE estimate ± 0.84). Predicted values for tropical grasses and legumes were similar to, but more variable than, those calculated from a similar equation derived from temperate pasture species. It was suggested that CP *per se* is a useful criterion for selecting tropical pasture plants when direct *in vivo* measurements of DCP cannot be obtained.

INTRODUCTION

Crude-protein (CP) content is the most common chemical component measured in plant assessment studies. The simplest measure of the nutritional value of CP is its apparent digestibility and a close correlation between CP content and the apparent digestibility of CP has been reported (Mitchell, 8; Glover *et al.* 2; McDonald and Purves, 4; Butterworth, 1; Milford and Haydock, 6). Glover *et al.* (2) showed that the apparent relationship was similar for East African, European and American herbage and can be expressed by the general equation $Y = 70 \log X - 15$, when $Y = \text{CP digestibility}$ and $X = \text{CP content}$. However, Milford and Haydock (6) obtained a formula for tropical grasses and legumes ($Y = 68.03 - 284.9 \exp. (-0.3604X)$) which differed from the general equation of Glover *et al.* (2) at the lower levels of CP content.

Because of the close relationship between CP content and CP digestibility it is apparent that there must also be a close relationship between CP content and digestible crude protein (DCP) content of a feed. Thus Holter and Reid (3) obtained a high correlation between CP content and DCP content ($r = 0.995$). The standard error of their equation was low (± 0.46) and it was suggested that chemical analysis could be used to predict DCP content with considerable accuracy.

Calculations from the equation of Glover *et al.* (2) for East African grasses and hays, viz. $\text{CP digestibility} = 72.57 \log \text{CP} - 15.8$, indicate that the relationship between CP and DCP for tropical pasture plants is similar to that for temperate pastures derived by Holter and Reid (3).

The objective of the present study was to determine whether the same applied for a wide range of tropical and subtropical grasses and legumes grown in south-east Queensland.

EXPERIMENTAL

Herbage was cut from pure swards of tropical pasture species and each was fed either green (Milford, 5) or dried (Milford and Minson, 7) to 3 sheep in metabolism crates. The CP percentage ($N \times 6.25$) of oven-dried feed and faeces were determined by the Kjeldahl method.

Data from 218 different feeding experiments were included in this study. These were derived from 16 tropical grasses and 8 tropical legumes which ranged in CP content from 2.2% to 25.3% (Table 1).

RESULTS

The relationship between CP content and DCP content is linear for both the fresh and the dry tropical herbage, as is the Holter and Reid (3) relationship for temperate herbage (See Fig. 1).

Table 1. Pasture species, number of samples and range of protein used in digestion experiments

	No. of feeds	CP percentage		
Fresh				
<i>Cenchrus ciliaris</i> L. Eyles	13	7.1	—	13.8
<i>Chloris gayana</i> Kunth. var. Commercial	8	4.2	—	13.8
<i>Desmodium uncinatum</i> (Jacq.)—D.C.	3	10.9	—	18.2
<i>Lotononis bainesii</i> Baker.	1		19.3	
<i>Medicago sativa</i> L.	1		20.8	
Native pasture	5	2.2	—	5.5
<i>Panicum maximum</i> var. <i>trichoglume</i> (K. Schum)	13	4.4	—	14.4
<i>Panicum</i> spp.	2	3.9	—	4.6
<i>Paspalum</i> spp.	40	2.8	—	10.3
<i>Pennisetum purpureum</i> Schum.	1		7.3	
<i>Phaseolus lathyroides</i> L.	7	7.6	—	19.2
<i>Stylosanthes gracilis</i> H.B.K.	1		11.8	
<i>Urochloa pullulans</i> Stapf.	8	4.6	—	14.1
<i>Vigna vexillata</i> Benth.	2	16.2	—	20.3
Dried				
<i>Cenchrus ciliaris</i> var. Molopo	19	3.2	—	15.2
<i>Chloris gayana</i> var. 16144	12	6.4	—	12.8
<i>Digitaria decumbens</i> Stent.	13	2.4	—	14.8
<i>Glycine javanica</i> L.	4	13.9	—	16.3
<i>Medicago sativa</i>	1		25.3	
Native pasture	1		3.8	
<i>Panicum maximum</i>	1		6.6	
<i>Pennisetum clandestinum</i> Hochst.	16	9.8	—	20.8
<i>Phaseolus atropurpureus</i> D.C. var. Siratro	12	12.2	—	18.7
<i>Setaria sphacelata</i> (Schum.) var. Nandi	8	6.4	—	12.6
<i>Sorghum almum</i> Parodi	32	6.1	—	20.3
Total	218	2.2	—	25.3

Regression equations (Snedecor, 9) for fresh, dry and fresh+dry herbage are presented in Table 2 with the equation derived by Holter and Reid (3). Also shown are the predicted DCP values at the 5, 10 and 15% levels of CP for the four equations. These values have also been calculated from CP digestibility equations

for herbage grown in East Africa (Glover *et al*, 2) and in Trinidad (Butterworth, 1).

DISCUSSION

There is close agreement between the equations and predicted values presented in Table 2. This is further confirmation that the relation

Table 2. Relationship between the apparently digestible protein (Y) and the percentage crude protein (X) in pasture

Feed	No. of samples	r	Regression equations	S.E. of estimate	Predicted Y when X=		
					5	10	15
Fresh	104	0.979	$Y=0.957 X-3.75$	0.85	1.03	5.82	10.65
Dried	114	0.980	$Y=0.850 X-2.72$	0.78	1.53	5.78	10.03
All feeds	218	0.979	$Y=0.899 X-3.25$	0.84	1.24	5.74	10.23
Temperate (Holter and Reid, 3)	79	0.995	$Y=0.929 X-3.48$	0.46	1.16	5.81	10.46
East African (Glover <i>et al</i> , 2)	114	*	*	*	1.75	5.68	10.43
Trinidad (Butterworth, 1)	27	*	*	*	1.74	5.94	11.06

* Not published

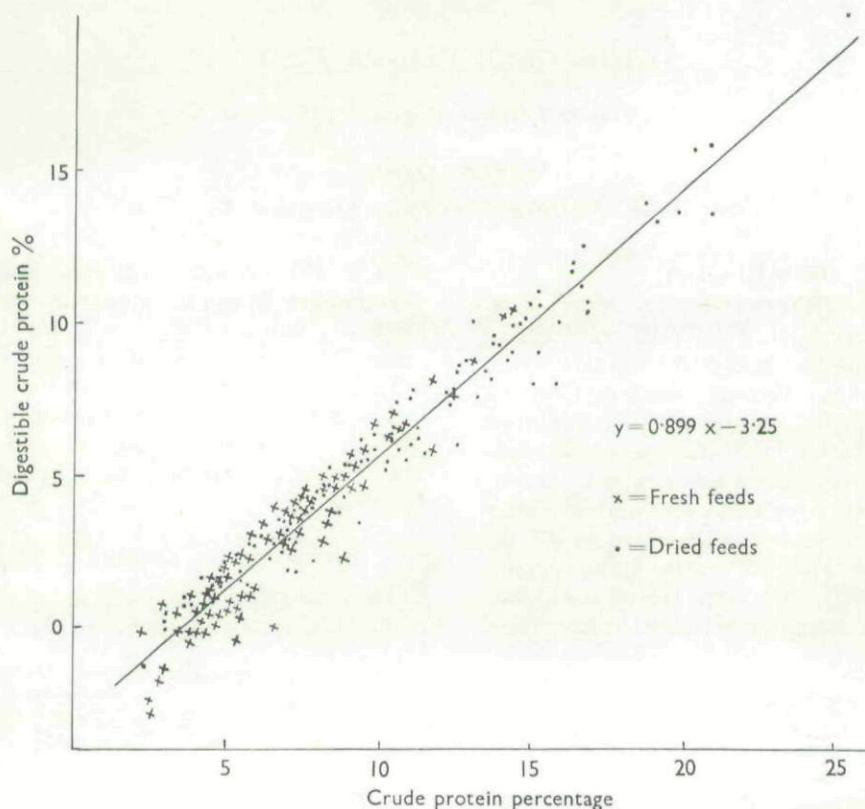


Fig. 1. Relationship between digestible crude protein and crude protein percentage.

between CP content and DCP content is similar for tropical and temperate herbage and, in addition, extends the findings to a wider range of tropical species.

A major difference between our results for tropical pasture species and those studied by Holter and Reid (3) is that the standard errors of the estimates are larger for the equations calculated for the tropical species. The reason for this is not apparent, but preliminary evidence suggests that this may be due partly to the large differences between the dry-matter digestibilities of tropical species of the same CP content.

Although the standard error of estimate associated with the equations for tropical pasture species is higher than that for temperate species, it is suggested that the CP content *per se* is a useful criterion of DCP in tropical pastures when direct measurements of DCP cannot be obtained.

REFERENCES

1. BUTTERWORTH, M. H. 1963. Digestibility trials on forages in Trinidad and their use in the prediction of nutritive value. *J. agric. Sci.* Vol. 60, pp. 341-6.
2. GLOVER, J., DUTHIE, D. W. and FRENCH, M. H. 1957. The apparent digestibility of crude protein by the ruminant. I. A synthesis of the results of digestibility trials with herbage and mixed feeds. *J. agric. Sci.* Vol. 48, pp. 373-7.
3. HOLTER, J. A. and REID, J. T. 1959. Relationship between the concentration of crude protein and apparently digestible protein in forages. *J. Anim. Sci.* Vol. 18, pp. 1339-49.
4. McDONALD, P. and PURVES, D. 1957. The estimation of feed intake by sheep on a silage diet. *J. Brit. Grassl. Soc.* Vol. 12, pp. 22-9.
5. MILFORD, R. 1960. Nutritional values for 17 subtropical grasses. *Aust. J. agric. Sci.* Vol. 2, pp. 138-48.
6. MILFORD, R. and HAYDOCK, K. P. 1965. The nutritive value of protein in subtropical pasture species grown in south-east Queensland. *Aust. J. exp. Agric. Anim. Husb.* (In Press).
7. MILFORD, R. and MINSON, D. J. 1964. Intake of tropical pasture species. *Proc. 9th internat. Grassl. Cong., Sao Paulo* (In press.)
8. MITCHELL, H. H. 1942. The evaluation of feeds on the basis of digestible and metabolizable nutrients. *J. Anim. Sci.* Vol. 1, pp. 159-73.
9. SNEDECOR, G. W. 1940. *Statistical Methods*. Iowa State Coll. Press.

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