Egypt. J. Anim. Prod. 21, No. 2, pp. 127—134 (1981)

Comparative Studies on Evaluating Roughages. II. Simplified and Tested Methods for Predicting the Feeding Value and the Digestible Protein with Egyptian Clover and its Hay

A.K. Abou-Raya[1], Y.I. El-Talty[2], E.A. Khafagi[3] and A.M. Makky[4]

[1,2]*Faculty of Agriculture, Cairo University,* [3,4]*Agricultural Research Centre, Ministry of Agriculture, Egypt.*

THE AIM of this study was to find out the suitability of the proximate composition for predicting the feeding value and the digestible protein of green clover (43 trials) and its hay (50 trials).

The digestible organic matter (DOM) could be used for satisfactory prediction of total digestible nutrients (TDN) using the following refined equation for both green clover and its hay :

$$TDN = DOM + 2.4$$

The percentage of dry matter (DM) in clover could be used for satisfactory prediction of TDN and starch value (SV) as follows :

$$TDN = 0.625\ DM - 0.15$$

$$SV = 0.435\ DM + 1.20$$

The percentage of crude protein (CP) could be used for satisfactory prediction of digestible protein (DCP) for clover and its hay as follows :

$$DCP = 0.803\ CP - 1.0$$

$$DCP = 0.771\ CP - 2.15$$

Testing the suitability of the multiple equations of McDowell et al. (1974) and those of Naga and El-Shazly (1971), for calculating the TDN and those of Knight and Harris (1966), for calculating DCP with green clover and its hay, appeared to be useful for prediction with a fair approximation and not to be used with comparative feeding trials.

In the last few decades, several attempts have been undertaken to produce easier, quicker and more economical methods for evaluating the feeding value and digestible protein of a feed other than the conventional methods.

This study was directed for computing useful prediction equations which could be applied to predict TDN, SV and DCP. Also, he published equations of McDowell *et al.* (1974) Naga and El-

Shazely (1971), and Knight and Harris (1966), were tested and compared with the conventional methods of evaluation.

Material and Methods

Fourty-three digestion trials with green clover and fifty digestion trials with clover hay were collected from different research sources (sixteen digestion trials were carried out by the author) and used to find out the suitability of DM, DOM and CP for predicting the feeding value and the digestible protein of clover and its hay with sheep.

Six equations were tested for calculating the TDN and DCP with the previous samples of clover and its hay as follows :

The equations of McDowell *et al.* (1974) with clover and its hay (using their chemical anlyses) :

$$TDN = 26.685 + 1.334\ (CF) + 6.598\ (EE) + 1.423\ (NFE) + 0.967\ (CP) - 0.002\ (CF)^2 - 0.670\ (EE)^2 - 0.024\ (CF)\ (NFE) - 0.055\ (EE\ (NFE) - 0.146\ (EE)\ (CP) + 0.039\ (EE)^2\ (CP) \quad \text{Eq. I}$$

$$TDN = 37.937 - 1.018\ (CF) - 4.886\ (EE + 0.173\ (NFE) + 1.042\ (CP) + 0.015\ (CF)^2 + 0.008\ (CF)\ (NFE) + 0.119\ (EE)\ (NFE) + 0.038\ (EE)\ (CP) + 0.003\ (EE)^2\ (CP) \quad \text{Eq. II}$$

The equations of Naga and El-Shazley (1971) with clover and its hay :

$$TDN = 0.87\ (OM + 1.25\ EE) - 0.72\ CP \quad \text{Eq. III}$$

$$TDN = 0.87\ (OM + 1.25\ EE) - 1.44\ CP \quad \text{Eq. IV}$$

The equations of Knight and Harris (1966) with clover and its hay :

$$DCP = 0.932\ CP\ \% - 3.01 \quad \text{Eq. V}$$

$$DCP = 0.897\ CP\ \% - 3.43 \quad \text{Eq. VI}$$

Results and Discussion

1. *A study of the interrelationshi pbetween DOM and TDN in digestion trials with clover and its hay*

The relation between digestible organic matter (DOM) and TDN for clover was studied (Table 1). Comparison between the

conventional and the predicted TDN using the calculated equation indicated that the majority of the variations were not exceeding 3% in 95% of the all samples (43 trials). These results could be expected because the TDN value exceeds the DOM value by 1.65 X digestible EE.

Table 1 : Correlation Tests and Regression Equations with TDN, SV and DCP.

Item	No of trial	Equations	Correlation (r)	$(r)^2$	SE of estimate	t-test
For clover						
TDN on DOM	43	1.0098DOM+2.0257 The refined equation DOM + 2.6	0.9720	0.9448	0.98	26.504
For clover hay						
TDN on DOM	50	1.0160 DOM + 1.3 The refined equation DOM + 2.2	0.9672	0.9355	0.96	26.321
For clover						
TDN on DM	43	0.6267DM-0.1952 The refined equation 0.625 DM - 0.15	0.9714	0.9436	0.81	26.332
For clover						
SV on DM	43	0.4347DM + 1.1944 The refined equation. 0.435DM + 1.20	0.9388	0.8814	0.85	17.458
For clover						
DCP% on CP%	43	0.8034CP-1.0671 The refined equation. 0.803 CP - 1.05	0.8989	0.8080	0.97	13.15
For clover hay						
DCP% on CP%	50	0.771 CP - 2.15	0.9607	0.9229	0.72	23.94

It was, therefore, possible to predict the TDN value of green clover by determining a very simple analysis as moisture and ash.

The prediction of TDN of clover hay by a knowledge of DOM was also studied (Table 1). Comparison between the conventional and the predicted TDN using the calculated equation indicated that

the majority of differences were not exceeding 3% in 90% of the all samples (50 trials). Thus from the data in Table 1, the two refined equations could be used for satisfactory prediction of TDN for clover and its hay.

The closeness of the two regression equations of clover and its hay suggested to use one equation for prediction TDN in both feeds. The refined equation would be :

$$TDN = DOM + 2.4$$

2. *A study of the interrelationship between DM and both TDN and SV in green clover*

The interrelationship between DM and TDN was studied (Table 1). The percentage differences between the conventional and the calculated TDN from this regression did not reach 8% in 84% of the all tested samples.

The prediction of SV by a knowledge of DM was also tested (Table 1). The differences between the conventional and the predicted SV using the calculated equation did not reach 8% in 77% of the whole 43 tested trials.

This would indicate that the previous two equations and their refined state could be used for satisfactory prediction of TDN and SV in green clover by determining DM which is a very simple analysis without the necessity of running a digestion trial.

3. *A study of the interrelationship between CP% and digestible CP% with clover and its hay*

The relation between CP% and digestible crude protein (DCP) was studied (Table 1). The percentage differences between the calculated values using this equation with the standard values did not reach 8% for 77% of the forty-three samples of clover. This would indicate that this equation could be used for satisfactory prediction of DCP.

The relation between CP% and DCP was also studied for clover hay (Table 1). The percentage differences between the conventional and the calculated DCP from this regression did not reach

8% for most samples. This would indicate that this equation could be used for satisfactory prediction of DCP.

Applying the CP as one predictor for calculating the DCP appeared to be useful in practice for determining the quality of clover and its hay.

4. *Testing the application of certain prediction equations for estimating TDN and DCP with clover and its hay*

In the present study the multiple regression equations of McDowell *et al.* (1974), and those of Knight and Harris (1966), were tested for predicting TDN and DCP respectively with both class 1 and class 2[1]. Such equations rely on a wide variety of feedstuffs and different feed preparations. How far such equations are applicable for predicting the feeding value of certain subclassed feeds ? this was studied with 43 green clover samples and 50 clover hay samples.

1. *Comparative of the conventional and the predicted TDN using the equations of McDowell et al. with clover and its hay*

The difference between the conventional and the predicted TDN using the equations of McDowell *et al.* (1974) (Eq. I and Eq. II) was highly insignificant with clover (43 trials) and insignificant with clover hay (50 trials) as shown from data in Table 2.

Table 2 The Differences between the conventional and predicted TDN using certain prediction equations with clover and its hay.

Item	For Clover				For Clover hay			
	Conv. TDN	TDN by McDowell equation	Conv. TDN	TDN by Naga& El-Shazly equation	Conv. TDN	TDN by McDowell equation	Conv. TDN	TDN by Naga&El-Shazely equation
Average	61.35 ±0.63	61.71 ±0.42	60.49	62.59	53.98 ±0.53	54.05 ±0.48	52.03	55.69
Aver.Diff. from conv.		-0.36 ±0.69		-2.10 ±0.53		0.07 ±0.48		-3.66 ±0.79
%diff. from conv.		-0.59 ±1.09		-3.62 ±1.88		-0.13 ±1.01		-7.05 ±2.39

1 The international nomenclature of feeds, cited by McDowell et al. (1974)

It could be concluded that this method appeared to be useful for predicting TDN with both feedstuffs with a fair approximation because high differences were encountered with some individual samples.

It was clear that the calculated simple equations in part 1 (in this study) from local data would be more applicable than multiple equations based on other data covering wide range of forages.

With a trial for predicting the TDN for some selected Egyptian roughages (23 samples) by using the equation of McDowell *et al.* (1974), with class 1, the percentages differences were high with individual samples. The reason for deviation with poor roughages might be attributed to the associative effect which varied according to the type of basal ration and its proportion with the tested ration in the mixture.

2. *Comparison of the conventional and the predicted TDN using the equation of Naga and El-Shazly with clover and its hay*

The two equations of Naga and El-Shazely, (1966) (Eq. III and Eq. IV) were applied with fifteen samples of clover containing (over 16.5% CP and under 30% CF on dry matter basis) and with fifteen samples of clover hay containing (12-18.5% CP and over 20% CF on dry matter basis).

The differences between the conventional and the predicted TDN with clover and its hay samples were significant, yet the averages percentages differences could be neglected (Table 2).

Thus, these equations could be used for general application but not for comparative feeding experiments.

3. *The suitability of the equations of Knight and Harris for predicting the digestible CP with clover and its hay*

The average predicted DCP by using the equation of Knight and Harris (1966) (Eq. V) was 13.78 $\pm$ 0.34 (with 43 samples of clover). The average absolute difference from the conventional DCP being -0.41 $\pm$ 0.31 while the average percentage difference

was -3.07 ± 1.16. Although such differences are highly significant, yet they are practically negligible when taking average percentage results. So this equation appeared to be suitable for practical feeding not for comparative feeding experiments.

The equation which obtained from data here (DCP = 0.8 CP-1), practically produced the same results as those of Knight and Harris. So our equation appeared to be easier for calculation and remembering.

The same results were concluded with clover hay (50 digestion trials). The predicted DCP by using the equation of Knight and Harris, (1966) (Eq. VI) was 10.23 ± 0.41 against the 9.54 ± 0.36 (conventionally obtained). The average difference between the two methods was -0.68 ± 0.12 while the percentage difference was -7.13 ± 1.51. Such difference was highly significant, although the average percentage deviation was not exceeding 8%.

The equation obtained from data here (DCP = 0.771 CP — 2.15) appeared more accurate. It was clear that prediction equation obtained from local data would be more applicable than those based on more general data particularly when covering a wide range of dry roughages other than clover hay.

References

Knight, A.D. and Harris, L.E. (1966) Digestible protein estimation for NRC feed composition tables. **J. Animal Sci. 25**, 593. Cited from Harris **et al.** (1968).

McDowell, L.R., Conrad, J.H., Thomas, J.E. and Harris, L.E. (1974) Latin American, tables of feed composition. Institute of Food and Agricultural Science, Center for Tropical Agriculture, Department of Animal Science, University of Florida.

Naga, M.A. and El-Shazly, K., (1971) The prediction of the nutritive value of animal feeds from chemical analysis. **J. Agric. Sci. Comb. 77**, 25.

دراسة مقارنة لتقييم مواد العلف الخشنة
٢ – اختيار طرق مبسطة لاستنباط القيم الغذائية والبروتين المهضوم للبرسيم المصرى ودريسة

احمد كمال ابو رية ، ويحيى ابراهيم التلتى وانشراح خفاجى

كلية الزراعة – جامعة القاهرة ومعهد البحوث الزراعية – وزارة الزراعة

الهدف من هذه الدراسة هو معرفة مدى نجاح استخدام التحليل الغذائى لاستنباط القيم الغذائية والبروتين المهضوم للبرسيم الاخضر (باستخدام ٤٣ تجربة هضم) وكذلك دريسة (من خلال ٥٠ تجربة هضم) .

وقد وجد امكانية استخدام المادة العضوية المهضومة لاستنباط رقم مناسب لمجموع المركبات المهضومة الكلية سواء للبرسيم الاخضر اودريسه من خلال المعادلة البسيطة الاتية :

مجموع المركبات المهضومة الكلية = المادة العضوية المهضومة +٢ر٤.

كما امكن باستخدام نسبة المادة الجافة فى البرسيم الاخضر استنباط مجموع المركبات المهضومة الكلية وكذلك معادل النشا من خلال المعادلتين الاتيتين :–

مجموع المركبات المهضومة الكلية = (٦٢٥ر٠× المادة الجافة) – ١٥ر٠٠

معادل النشا = (٤٣٥ر٠× المادة الجافة) + ٢٠ر١ .

وقد وجد امكانية استنباط قيمة البروتين المهضوم للبرسيم الاخضر ودريسه بمعلومية نسبة البروتين الخام عن طريق المعادلتين الاتيتين :–

البروتين المهضوم (للبرسيم) = (٨٠٣ر٠× نسبة البروتين الخام) – ٠٠ر١

البروتين المهضوم (للدريس) = (٧٧١ر٠× نسبة البروتين الخام) – ٢ر١٥