Intake and digestibility of organic matter and nitrogen in *Chromolaena odorata* leaf meal-based diets by sheep

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ABSTRACT

Twenty-seven West African dwarf wethers (sheep) were used in a completely randomised design to study feed intake and digestibility of nutrients in diets incorporating *Chromolaena odorata* leaf meal. *C. odorata* leaf meal (COLM) was incorporated at levels of 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5 and 20 per cent to replace wheat bran in nine rations. *C. odorata* in the rations did not significantly ($P < 0.5$) influence dry matter intake (78.1 - 104.1 g/kg $W^{0.75}$/day), true digestibility of nitrogen (58.1-66 per cent), and organic matter digestibility (46.8 - 54.1 per cent). However, digestible organic matter intake (g/kg $W^{0.75}$/day) and apparent nitrogen digestibility increased significantly ($P<0.05$) from 33.8 to 44.3 and 32.7 to 39.9, respectively, as *C. odorata* content in rations increased above 5 per cent.

Original scientific paper. Received 20 Dec 99; revised 7 Feb 01.

RÉSUMÉ

APORI, S. O., ODOI, F. N. A. & GANYO, E.: *La consommation et la digestibilité de la matière organique et l'azote dans les régimes basés sur la farine de feuille de* Chromolaena odorata, *par le mouton.* Vingt six béliers châtrés de West Africa Dwarf étaient utilisés dans un dessin complet choisi au hasard pour étudier la consommation de ration et la digestibilité de substance nutritive dans les régimes incorporant la farine de feuille de *C. odorata* (COLM). La farine de *C. odorata* était incorporée aux niveaux de 0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5 et 20.0 pour cent pour remplacer le son de blé en neuf rations. *C. odorata* dans les rations n'a pas influencé considérablement ($P < 0.05$) la consommation de matière sèche (78.1 - 104.1 g/kg $W^{0.75}$/jour), la digestibilité véridique d' azote (58.1 - 66.0 pour cent) et la digestibilité de matière organique (46.8 - 54.1 pour cent). Neanmoins, la consommation de matière organique digestible (g/kg $W^{0.75}$/jour) et la digestibilité apparente d' azote augmentait considérablement ($P < 0.05$) et respectivement de 33.8 à 44.3 et 32.7 à 39.9, comme le contenu de *C. odorata* dans les rations augmentait au-dessus de 5 pour cent.

Introduction

Studies previously carried out in Ghana with cocoa pod husk (CPH) as feedstuff for ruminant livestock (Tuah, Adomako & Dzoagbe, 1985; Tuah *et al.,* 1995) showed that the usefulness of CPH was limited by its low nitrogen content (1.78 per cent) and degradability. *Chromolaena odorata* has colonised several open fields (Apori *et al.*, 1998) on agricultural lands in Ghana and other tropical areas of the world, as a weed. The plant has high biomass production of about 15 tonnes DM/ha (Oyen, 1995). It is not normally grazed by livestock. *In vitro* and *in sacco* studies by Apori *et al.* (1998), however, indicated that *C. odorata* leaf meal (COLM) was high in nitrogen (4.12 per cent) of high rumen degradability (47.2 g N/kg DOM), with *in sacco* organic matter degradability of 90.9 at 24 h, and was not toxic to rumen microbes. The high N content suggests that COLM might be used as supplementary nitrogen source in feeds containing CPH. This *in vivo* digestibility study was therefore carried out to investigate the possible use of COLM, as a nitrogen source, in diets for wethers.

Materials and methods

Animal management and feeding

Chromolaena odorata leaves were harvested

from slashed pasturage at the Teaching and Research Farm of the University of Cape Coast (UCC) from plant 8 - 10 weeks old. The leaves were separated from the stalk and oven dried at 40 °C for 48 h. The leaves were coarsely milled (3 mm) and incorporated into nine different diets in which inclusion level of COLM varied from 0 to 20 per cent (at incremental levels of 2.5 per cent) COLM replaced equal amounts of wheat bran in the diets (Table 1). The diets were fed *ad libitum* to 27 West African dwarf wethers confined in metabolism cages, in a completely randomised design. The wethers were aged 10 - 12 months, and averaged 18-22 kg live weight, at the start of the feeding trial. There were three animals per treatment. The partial collection method was used for the feeding trial.

The wethers were allowed 10 days to adjust to the feed, followed by 7 days faecal collection period. Salt lick and water were provided *ad libitum*. The wethers were introduced to the COLM-incorporated diets gradually. The wethers on diets with higher contents of *C. odorata* were initially fed with lower levels of COLM, gradually increasing *C. odorata* content until the maximum level in the study (20 per cent) was attained, over a 10 - day period. One hundred-gramme samples of individual feedstuffs, faeces, and formulated diets were taken and analyzed for dry matter, total ash and N, according to AOAC (1984) methods.

Apparent digestibilities of organic matter and nitrogen were calculated as the difference between values in feed consumed and that appearing in the faeces. True digestible co-efficient of nitrogen (N) was calculated with the following formula:

$$\frac{[100 \text{ Feed N} - (\text{Faecal N} - \text{MFN})]}{\text{Feed N}}$$

where value of MFN (metabolic faecal nitrogen) was estimated as 5gN/kg DM Feed (Pond, Church & Pond, 1995).

The data collected were analyzed statistically with the one-way analysis of variance. Differences between treatment means were separated by the Duncan's Multiple Range Test (Steel & Torrie, 1981).

Results and discussion

It was observed that once wethers had adjusted to diets containing 10 per cent *C. odorata*, they easily accepted diets with higher levels of COLM. Table 2 presents values for mean daily dry matter, organic matter and digestible organic matter intakes (g/kg $W^{0.75}$), for apparent organic matter and nitrogen digestibilities, and for true digestibility co-efficients of nitrogen. Generally,

TABLE 1

Percent Composition (g/100 g) and Nutrient Analysis (on % DM basis) of the Different Rations Fed

Constituents	*Rations*								
	F1	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*	*F8*	*F9*
Cocoa pod husk	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Maize	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Palm kernel cake	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Wheat bran	20.0	17.5	15.0	12.5	10.0	7.5	5.0	2.5	0.0
Chromolaena odorata leaf meal (COLM)	0.0	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0
Chemical analyses of rations (on % DM (basis)									
Dry matter	87.0	87.1	87.2	87.3	87.3	87.5	87.3	87.3	87.4
Ash	8.4	8.4	8.6	8.4	8.9	8.5	8.7	8.8	8.6
Nitrogen	1.90	1.95	1.95	2.10	2.13	2.20	2.30	2.30	2.30

Analysed contents of crude protein for cocoa pod husk, maize, palm kernel cake, COLM and wheat bran were 10.1 (1.60); 10.6 (1.70); 12.3 (1.96); 25.0 (4.10); 20.8 (3.30); respectively. Values in brackets are % N levels.

TABLE 2

Mean Feed Intake, Apparent Digestibilities of Organic Matter and Nitrogen, and True Digestibility Coefficient of Nitrogen in Diets with Different Levels of Chromolaena odorata *Leaf Meal (COLM)*

	Rations									
	F1	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*	*F8*	*F9*	*SE*
Level of COLM in ration	0	2.5	5.0	7.5	10.0	12.5	15.5	17.5	20.0	-
Mean daily dry matter intake (g/kg $W^{0.75}$)	78.1	84.8	99.7	104.1	96.5	98.1	85.7	102.7	95.2	2.98
Mean daily organic matter intake (g/kg $W^{0.75}$)	71.6	77.6	91.1	95.3	87.9	89.7	78.2	93.7	86.9	2.71
Mean daily digestible organic matter intake (g/kg $W^{0.75}$)	33.8^{a}	37.7^{a}	44.3^{b}	48.6^{b}	42.8^{ab}	48.3^{ab}	39.9^{b}	45.8^{b}	40.7^{b}	1.74
Apparent organic matter digestibility (%)	49.1	47.2	48.5	50.9	48.7	54.1	47.2	48.9	46.8	0.76
Apparent nitrogen digestibility (%)	32.7^{a}	36.3^{a}	37.6^{ab}	39.9^{b}	41.7^{b}	44.0	40.5^{b}	38.5^{b}	38.9^{b}	1.08
True digestibility of nitrogen (%)	58.1	58.9	60.3	62.6	66.6	66.2	62.3	60.0	60.0	1.00

Means in same row with different letter superscripts are significantly different ($P<0.05$)

the incorporation of COLM into diets to replace wheat bran did not significantly ($P<0.05$) affect dry matter and organic matter intakes, or true digestibility of nitrogen. However, intake (g/kg $W^{0.75}$) and apparent nitrogen digestibility were significantly increased ($P<0.01$) when the level of COLM exceeded 5 per cent. Values for mean daily dry matter, organic matter (g/kg $W^{0.75}$), and for true digestible coefficient of nitrogen tended to increase, with increasing levels of COLM in the diet.

These observations are due to higher intakes of nitrogen associated with increasing levels of COLM in diets. A major benefit of using a high quality forage feed ingredient, such as COLM, is the supply of rumen degradable nitrogen which is deficient in poor quality feedstuffs. The additional nitrogen supplied by the high quality forage feed ingredient stimulates rumen digestion, resulting in an increase in feed intake (Orskov, 1994). COLM contains high rumen degradable nitrogen (Apori *et al.*, 1998), and this enhanced microbial activity, giving rise to the degradation of other dietary components, leading to a faster rate of passage through the gastro-intestinal tract, culminating in higher intakes.

The mean daily dry matter intakes (range 78.1 to 102.7 g/kg $W^{0.75}$) in this study were similar to earlier observations (80.6 to 105.8 g/kg $W^{0.75}$) by Tuah *et al.* (1995), using wheat bran and cotton seed cake as nitrogen sources. This study suggests that when COLM is incorporated into diets, it is neither detrimental to the well being of sheep nor negatively influences feed intake and the degradability of feed constituents.

Studies by Peyraud, Astigawaga & Faverdin (1997) on digestibility of diets with varying nitrogen contents (range 1.71 to 2.4 per cent) indicated that increased nitrogen intakes led to increases in organic matter digestibility and organic matter intake. The low values recorded for apparent organic matter and nitrogen digestibilities and for true nitrogen digestibility in this study is due to the high content of CPH (60 per cent) in the diets used. Tuah *et al.* (1995) explained that the smaller particle size of CPH resulted in reduced rumen retention times of feed, as does the low dry matter degradability of the CPH component of feed. Wong & Hassan (1998) suggested that sun-drying of CPH resulted in Maillard reaction (which leads to the formation of non-digestible complex between feed nitrogen and easily digestible carbohydrates). It is also possible that the palm kernel meal, included in the diets as a nitrogen source (obtained from heat extraction of palm kernel oil), contained Maillard reaction products. All the above arguments accounted for the low apparent digestibility values recorded in this study.

Conclusion

This study concludes that *C. odorata* leaf meal can be incorporated into diets for sheep up to 20 per cent of the total dry matter content of the diet without any adverse effects.

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