BAP -16

In Sacco Nutrients Disappearance of Rice Straw Supplemented with Cattle Manure Vermicast

Aminu Nasiru[1], Maryam Badamasi[1] and Mahamad Hakimi Ibrahim[2]
[1]Department of Animal Science, Faculty of Agriculture, Bayero University Kano, Nigeria
[2]Environmental Technology Division, School of Industrial Technology, UniversitiSains Malaysia, Malaysia
Corresponding author: Aminu Nasiru; E-mail: anasiru.asc@buk.edu.ng; +234 703 355 0966

Abstract
The term by-pass protein describes dietary protein that is resistant to rumen microbes degradation. Undegraded dietary protein would by-pass the rumen and would act upon by host enzymes. The aim of the study was to determine *in sacco* nutrient disappearance of rice straw supplemented with cattle manure vermicast. *In sacco* nutrient disappearance was investigated using rumen fistulated Kajang goats. The results showed that dry matter (DM) disappearance decreases with cattle manure vermicast (CMV) inclusion, rice straw had the highest DM disappearance of 73% and CMV had the least with 62%. Organic Matter disappearance follows the same pattern with DM disappearance. CMV inclusion has no significant ($p>0.05$) effect on Crude Protein (CP) disappearance although, CMV inclusion reduces CP disappearance. However, CMV inclusion increases Nutrient Detergent Fiber (NDF) disappearance with CMV (58%) having higher disappearance compared with Rice Straw (51%). In conclusion, CMV supplementation with rice straw reduces DM, OM and CP disappearance, while it increases NDF disappearance. This indicates that CMV inclusion can be considered as an agent of by-pass protein. It is recommended that further research should be conducted on other crop residues using varying inclusion levels of CMV.

Keywords: by-pass protein, disappearance, cattle manure vermicast, *in sacco*, ruminants

Introduction

Ruminant livestock has the highest contribution to environmental pollution among livestock (Zervis and Tsiplakou, 2012). Poorly managed manure contributes to environmental pollution (Menzi *et al*., 2010). Ruminant manure can be recycled as animal feed. Different processing methods have been used to developed ingredients for ruminants' feedstuff from manure. Different treatment methods were employed in recycling manure to feed. Among them is vermicomposting. Vermicomposting is a mesophilic bio-oxidation and stabilisation process of biomass that involves the joint action of earthworm and microorganism.

The term "bypass protein" describes dietary protein that, either by some means of alteration or because of type of protein, is resistant to degradation by the rumen microbes. This undigested dietary protein would "bypass" the rumen and would be potentially available to meet the protein needs of the host. Bypass protein reduces microbial protein synthesis and its flow to the duodenum, and increase the flow of non-ammonia, non-microbial Nitrogen in duodenum (Santos *et al*., 2008). Vermicomposting help coat the biomass thereby making product difficult to be utilised by microorganism. This makes the vermicast a potential agent of by-pass protein.

The aim of the study was to determine the effect of rice straw treated with cattle manure vermicast on *in sacco* nutrients disappearance.

Materials and Methods

The study was approved by Animal Ethics Committee of Universiti Sains Malaysia. Vermicomposting was performed according to Nasiru, *et al*. (2014). Three male Kajang goats weighed 40Kg on average fitted with a permanent rumen canula were used as described by Nasiru *et al*. (2016).The diet (Table 1) was offered in a 3×3 Latin square experimental design. *In sacco* procedure was as described by Orskov *et al*. (1980).Samples were mixed thoroughly and about 3 g samples were weighed into nylon bags and incubated in the rumen of each goat for 8, 12, 24 and 48 h.

Dry matter disappearance (DMD) was estimated as described by (Osuji *et al*., 1993):

$$DMD = \frac{(SWa - BW) \times DMa - (SWb - BW) \times DMb}{(SWa - BW) \times DMa}$$

Where: SWa = weight of original sample + nylon bag
BW = weight of empty nylon bag

SWb = weight of the sample + nylon bag after incubation
DMa = dry matter of feed sample
DMb = dry matter of residue sample

The difference between the amount of DM, OM, N and NDF in the original sample and that remaining in the nylon bag after incubation, was expressed as a percentage of the initial sample as a measure of the fraction of DM, OM, N and NDF that was truly water-soluble (TWS). Particle loss was calculated as the difference between the fraction of feed lost through the pores during washing and the TWS fraction. Disappearance was assumed to be due to degradation in the rumen.

Samples of vermicast and rice straw were analysed for proximate composition according to AOAC (2005). The Neutral Detergent Fibre (NDF) and Acid Detergent Fibre (ADF) were analysed according to Van Soest *et al*. (1991).

Table 1: Composition of experimental diets containing varying level of cattle manure vermicast (%)

	Diets				
Item	CMV 0%	CMV 10%	CMV 20%	Rice straw	CMV
CMV	0	10	20		
Corn grains	32	27	20		
Bran	49	45	43		
Soy bean meal	18	17	16		
Minerals and vitamins	0.5	0.5	0.5		
Salt	0.5	0.5	0.5		
			Chemical composition		
Dry matter	88.0	85.4	79.0	-	14.8
Organic matter	93.6	89.2	87.2	85.3	86.2
Crude protein	16.8	17.1	17.0	4.3	9.2
NDF	50.1	53.7	55.4	75.1	58.9
Ash	6.5	10.8	12.9	14.7	13.8

CMV: cattle manure vermicast incorporated at 0, 10, and 20%; NDF: neutral detergent fibre

Results and discussion

Nutrients disappearance shows the possible degradation of nutrients incubated *in sacco* after certain period of time. CMV inclusion to rice straw decreases DM disappearance (Figure Ia). No significant difference was observed between 10 % CMV inclusion (70.52%) and 20% CMV (68.14%) on dry matter disappearance. However, the *in sacco* DM disappearance of rice straw was greater compared with CMV (72.88 vs 62.29 % respectively). OM disappearance follows the same pattern with DM disappearance (Figure Ib). Figures Ic shows crude protein (CP) disappearance from rice straw, treated rice straw with CMV at 10 and 20 % respectively and cattle manure vermicast (CMV) during *in sacco* rumen incubation. CMV inclusion on rice straw has no significant effect on *insacco* rumen CP disappearance (76.2, 74.17 and 72.75 % for rice straw, CMV10 and CMV20 respectively), although CMV inclusion reduces *in sacco* rumen disappearance, but the disappearance was much negligible. However, rice straw has higher CP disappearance compared with CMV (74.12 vs. 60.89 %). Figure Id shows that additional increase of CMV inclusion on rice straw increases *in sacco* rumen NDF disappearance. CMV has higher NDF disappearance compared with rice straw (58.38 vs. 51.37 % respectively).

Increase inclusion of CMV on rice straw reduces dry matter (DM), organic matter (OM) and crude protein (CP) disappearance as incubation period increased. This is due to the increase of vermicast which has humus. Humus resists microbial colonisation as reported by Bernal *et al*. (2009). Pawelek *et al*. (2008) found out that browse plants with high amount of condensed tannins had lowest disappearance. Condense tannins formed indigestible cell wall fibre-bacterial enzymes complex thereby reducing plant cell wall digestibility (Reed, 1995). However, additional inclusion of CMV increases neutral detergent fibre (NDF) disappearance. Inclusion of CMV on rice straw reduces NDF proportion. Chaudhry (2000) reported treating wheat straw with chemical modified cell wall composition. This facilitates and increases the enzymatic hydrolysis of cellulose (Gollipalli *et al*. 2002). This reduces NDF content and increases NDF disappearance.

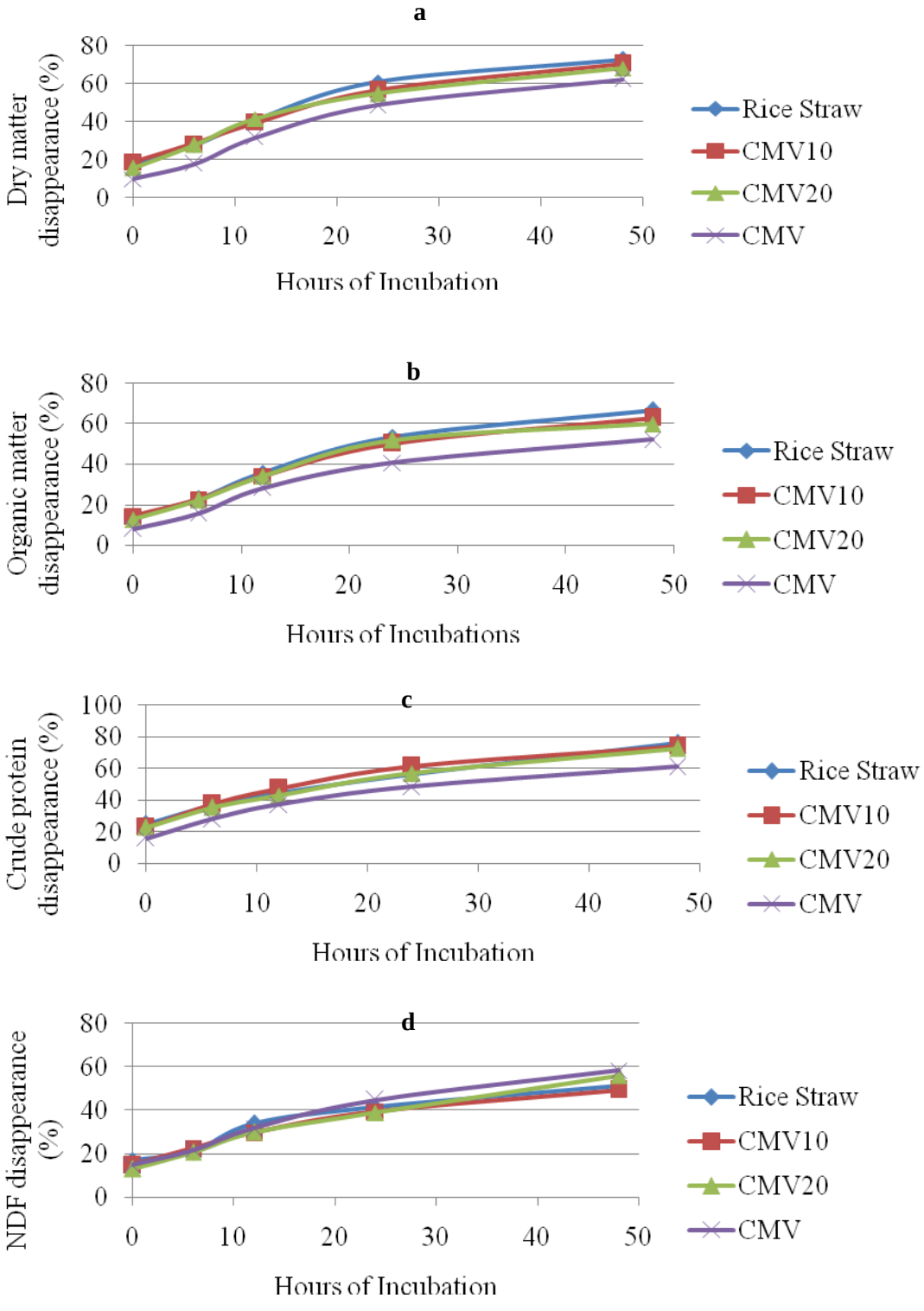

Fig.I: Pattern of disappearance of a) dry matter b) organic matter c) crude protein and d) neutral detergent fibre from rice straw, 10% CMV inclusion on rice straw (CMV10), 20% CMV inclusion on rice straw (CMV20) and cattle manure vermicast (CMV) during rumen incubation for various times in goat.

Conclusion and recommendation

CMV inclusion reduces DM, OM, and CP disappearance while it increases NDF disappearance. CMV inclusion has the potential of by-pass protein. More research should be conducted to ascertain the suitability of using vermicast as by-pass protein.

Acknowledgements

The study was funded through UniversitiSains Malaysia (USM) grant (Grant no: 304/PTEKIND/6730067). The authors acknowledge Department of Animal Science, Universiti Putra Malaysia (UPM) for providing research facilities.

References

AOAC (2005). The official methods of analysis. Association of Official Analytical Chemist, 16th Edn., Washington DC.

Bernal, M.P., Alburquerque, J.A. and Moral, R. (2009). Composting of animal manures and chemical criteria for compost maturity assessment. A review. *Bioresource Technology*, 100(22): 5444 - 5453.

Chaudhry, A.S. (2000). Rumen degradation i*n sacco* in sheep of wheat straw treated with calcium oxide, sodium hydroxide and sodium hydroxide plus hydrogen peroxide. *Animal Feed Science and Technology,* 83(3–4): 313-323.

Gollapalli, L., Dale, B. and Rivers, D. (2002). Predicting digestibility of ammonia fiber explosion (AFEX)-treated rice straw. *Appl Biochem Biotechnol.,* 98-100 (1-9): 23-35.

Menzi, H., Oenema, O., Burton, C., Shipin, O., Gerber, P., Robinson, T., Franceschini, G., Steinfeld, H., Mooney, H. and Schneider, F. (2010). Impacts of intensive livestock production and manure management on the environment. In: Henning Steinfeld, Harold A. Mooney, Fritz Schneider, Neville LE (eds). *Livestock in a changing landscape drivers, consequences and responses*, vol 1. Island Press. Pp: 139-163.

Nasiru, A., Alimon, A. R., Ismail, N. and Ibrahim, M.H. (2014). Nutritive value of cattle manure vermicast and its effect on *in vitro* ruminal gas production. *International Journal of Recycling of Organic Waste in Agriculture,* 3: 1-6

Nasiru, A., Alimon, A.R., Ismail, N. and Ibrahim, M.H. (2016). In sacco rumen degradability of rice straw treated with cattle manure vermicast. *Journal ofDryland Agriculture,* 2(1): 44 -54

Ørskov, E., Hovell, F. and Mould, F. (1980). The use of the nylon bag technique for the evaluation of feedstuffs. *Tropical Animal Production,* 5: 195-213

Osuji, P., Nsahlai, I. and Khalili, H. (1993). Feed evaluation. ILCA Manual 5. International Livestock Centre for Africa, Addis Ababa, Ethiopia

Pawelek, D.L., Muir, J.P, Lambert, B.D. and Wittie, R.D. (2008). *In sacco* rumen disappearance of condensed tannins, fiber, and nitrogen from herbaceous native Texas legumes in goats. *Animal Feed Science and Technology, 1*42 (1–2):1-16.

Reed, J.D. (1995). Nutritional toxicology of tannins and related polyphenols in forage legumes. *J. Anim. Sci.,* 73:1516-1528

Santos, F.A.P., Santos, J.E.P., Theurer, C.B. and Huber, J.T. (2008). Effects of Rumen-Undegradable Protein on Dairy Cow Performance: A 12-Year Literature Review1. *Journal of Dairy Science,* 81(12): 3182-3213.

Van Soest, P.J., Robertson, J.B. and Lewis, B.A. (1991). Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *J Dairy Sci.,* 74(10): 3583-3597.

Zervas, G., Tsiplakou, E. (2012). An assessment of GHG emissions from small ruminants in comparison with GHG emissions from large ruminants and monogastric livestock. *Atmospheric Environment,* 49 (0):13-23.