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# EFFECT OF DIFFERENT BEDDING MATERIALS ON THE FEEDING VALUE OF POULTRY MANURE FOR RUMINANTS

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## SUMMARY

An experiment was conducted to evaluate the effect of different bedding materials on the nutritive value of poultry manure. Four types of bedding material (maize stover, rice straw, wood shavings and rice husks) of equal weights were used in layer pens of same size and same number of birds. Manure was sampled weekly from each pen for six weeks; oven dried and stored for chemical and degradability studies. At the end of 6 weeks, the pens were cleaned and the manure was sun dried to moisture content of 12% and stored for intake studies. Chemical composition was determined for the weekly manure samples, and for the different bedding materials at the beginning and after six weeks of use. Degradability was measured for manure samples collected after 3 and 6 weeks of use, and for bedding material before and after six weeks of use. Intake of the poultry manure was measured using 16 goats. It was fed as supplement either mixed with maize bran or with salt.

The type of bedding material did not affect the CP content of poultry manure however; it increased with time of use. The 48 hour DM degradability of the manure both after 3 and 6 weeks of use was higher ($P<0.05$) for maize stover (61.9 & 68.9%) and rice straw (68.9 & 67.4%) based than wood shavings (51.52 & 55.65%) and rice husk (45.9 & 49.6%) based manure. The degradability of the selected poultry manure after 6 weeks of use was significantly higher for each type of material than before use. Dry matter intake of manure alone was higher ($P<0.05$) for maize stover and rice straw-based than that of wood shavings and rice husk based manure (601.5, 514.1, 445 and 423.9 g/d) respectively. Mixing poultry manure with maize bran gave a higher dry matter intake for all bedding materials than when fed as a sole supplement.

It can be concluded that use of rice straw and maize stover as bedding material in layer houses can improve the feeding value of the manure and the bedding material.

***Keywords: Poultry manure, bedding material, feeding value***

## INTRODUCTION

The productivity of ruminant animals during the dry season is limited due to low availability and poor quality of the feeds. Cattle rely mainly on standing hay and crop residues that are very low in nitrogen content. Crude protein content can be as low as 2%. Low N intake limits the utilisation of straws as source of energy. This is due to low supply of nitrogen to the rumen microbes. Use of urea and urea molasses mixtures have been introduced as a means of improving the nitrogen supply to the rumen microbes. However, these sources are expensive to most farmers and they impose danger of toxicity especially the use of urea. Use of poultry manure could solve this problem in Tanzania.

Poultry manure from cages as well as deep litter system has substantial nutritional value for feeding ruminants, it is rich in protein as well as minerals (Paul *et al.*, 1993).

The compounds present in urine are mainly nitrogenous, most of the urine nitrogen is in the form of uric acid (McDonald *et al.*, 1995). Uric acid is degraded more slowly than urea, creating a favourable ammonia pattern for efficient utilisation in ruminant (Oltjen *et al.*, 1968). This may prevent rapid absorption of ammonia from the rumen and thus minimise incidences of urea toxicity (McDonald *et al.*, 1995).

The limitation of using poultry manure as a source of rumen degradable protein is due to low energy content of the manure arising from the type of bedding materials used especially in deep litter systems (Paul *et al.*, 1993). The use of bedding materials, which can be utilised by the animals, will solve the problem.

The objective of the current research was therefore to evaluate the effect of using different bedding materials in layer chicken houses on the feeding value of the poultry manure.

## MATERIALS AND METHODS

Two hundred and fifty two (252), one year old layers were used in the study. Sixty (60) birds each were randomly allocated to four pens of equal size (30.5m x 6.1m). Each pen was supplied with 30kg of one of the following litter materials i.e. chopped rice straw, chopped maize stover, wood shavings and rice husks. The litter material was spread evenly in the pens. In addition 12 layers were kept in raised slat crate made of wood (145cm x 60cm x 60cm). The slat had the size of 3cm width and spaced in 3cm apart to facilitate easy collection of droppings.

All chickens were offered 120g/hen/day of layer's mash. Litter materials in the pens were sampled before introducing the birds and after six weeks when used. Poultry manure (bedding together with droppings) was sampled randomly at weekly interval for six weeks. At the end of the six- week the manure was removed from the pens and dried in the sun to moisture level of 12% and then stored until used in feeding experiment.

Sixteen female adult goats of about one year old were used in the feeding experiment and were kept in individual pens. The animals were divided into four groups each with four goats. Each animal in each group was fed 2kg basal diet of green elephant grass and supplemented with 1kg of concentrate. Two experiments were conducted. In the 1st experiment the concentrate composed of maize bran plus one of the poultry manure (i.e. manure from rice straw, maize stover, wood shaving and rice husks) compounded at a ratio of 1:1 with 0.5% salt. The dry matter intake of the supplement was measured for 10 days, 8 days preliminary and two days data collection. The amount offered each day and the refusal were weighed each day and samples taken for dry matter determination.

In 2nd experiment the poultry manure was only supplemented with 0.5% salt and fed to the same goats. Intake data was taken as described above. Dry matter intake of the supplement was obtained by subtracting the amount of DM refused from the amount of DM offered.

*Degradability studies*

Manure from the cage and poultry manure (based on maize stover, rice husks, wood shaving and rice straw) collected at different periods were measured using two fistulated steers fed brachiaria hay supplemented with composite of the four types of poultry manure.

2g of each sample was weighed into synthetic fibre bags and incubated into the rumen of the animals at a period of 12, 24, 48, 96 and 120 hrs. After each incubation interval the samples were taken out of the rumen and washed, thereafter bags with residues were oven dried at 60°C to constant weight, they were cooled in the desiccator and then re-weighed. Degradation at zero hour was determined by soaking bags with samples in water for 24 hrs. The bags were oven dry at 60°C, as for the rumen samples cooled in the desiccator and weighed. The percentage degradability of each sample at each incubation time was calculated using the following formula:

$$\text{Degradation} = \frac{\text{Weight DM incubated - Weight DM Residue}}{\text{Weight DM incubated}} \times 100$$

Then degradation characteristics of dry matter (D) were calculated using NAWAY programme according to equation proposed by Orskov and McDonald (1979).

$$P = a + b\,(1 + e^{-ct})$$

Where a = Considered being immediately degradable component.
b = potentially rumen degradable part.
c = the rate at which fraction b is degraded
a+b = potential rumen degradable part (asymptote).
e = the base of natural logaritlum.
t = time in hrs.

*Chemical analysis*

Samples were dried at 70°C and grounded to pass through a 1mm screen. Then proximate analysis to determine, dry matter (DM) by drying at 103-105°C over night in laboratory. CP were determined by Kjeldahl method.

*Statistical analysis*

The data obtained were analyzed by the General linear model (GLM) procedure of SAS (1988) statistical package. The differences between treatment means were compared using probability of difference (PDIFF) based on least Significant Difference (LSD).

## RESULTS

*The crude protein content (CP)*

The crude protein of the different litter material and at different time of use and caged poultry manure is presented in Table 1. The crude protein of the bedding material ranged from 19.5g/kg DM for rice husks to 37.4g/kg DM for rice straw. The CP for poultry manure increased with time of use in all bedding materials. The CP content of the selected bedding materials after six weeks of use was higher than before use. Its effect was more pronounced in rice straw and wood shaving and poor in rice husks (i.e. from 37.4 g/kg DM to 89.4 g/kg DM for rice straw, 28.4 g/kg DM to 81.7 g/kg for maize stover, 25.8 g/kg to 89.3 g/kg for wood shaving, and 19.5 to 51.8 g/kg DM for rice husks. The composition in caged manure was higher than their counter part (193.4 g/kg DM ).

**Table 1. The crude protein content (g/kg DM) of poultry manure for different bedding material and caged manure after different time of use**

| Time of use (wks) | Bedding material | | | | |
|---|---|---|---|---|---|
| | Rice straw | Maize stover | Wood shaving | Rice husks | Caged manure |
| Week 0 | 37.4 | 28.4 | 25.8 | 19.5 | 193.4 |
| " 1 | 117.1 | 102.3 | 96.9 | 60.2 | 193.4 |
| " 2 | 122.0 | 110.0 | 108.3 | 67.1 | 193.4 |
| " 3 | 128.5 | 115.1 | 112.0 | 76.1 | 193.4 |
| " 4 | 132.8 | 118.7 | 119.8 | 96.3 | 193.4 |
| " 5 | 137.4 | 123.8 | 125.3 | 102.5 | 193.4 |
| " 6 | 140.0 | 125.4 | 130.5 | 116.2 | 193.4 |
| Selected (week 6) | 89.4 | 81.7 | 89.3 | 51.8 | 193.4 |

*Dry matter intake*

The least square means and standard errors for Dry matter intake (DMI) of poultry manure based on different types of bedding materials after six weeks of use is presented in Table 2. The DMI of maize stover based manure when mixed with 50% maize bran was significantly ($P<0.001$) higher than the intake of all other manure. Mixing of manure with 50% maize bran gave a significantly higher intake of the supplement from all manure types than when manure was fed alone.

Intake of rice husks based poultry manure without mixing with maize bran was significantly ($P<0.001$) lower than the intake of other manure. However when mixed with 50% maize bran intake of rice husks based manure was not significantly different from wood shaving based manure (Table 2).

**Table 2. Least square means (±SE) on the effects of mixing or not mixing litter material with maize bran on DMI (g/day) of the supplement**

| Type of litter | With 50% maize bran | Without maize bran |
|---|---|---|
| Maize stover | $670.198\pm5.88^{a}$ | $601.459\pm5.88^{b}$ |
| Rice straw | $614.457\pm5.88^{b}$ | $514.075\pm5.88^{c}$ |
| Wood shaving | $526.713\pm5.88^{c}$ | $445.094\pm5.88^{d}$ |
| Rice husks | $511.021\pm5.88^{c}$ | $423.942\pm5.88^{e}$ |

$^{a,b,c,d,e}$: Means with different superscript on the column and row are significantly ($P<0.001$) different.

*Degradability assessment*

The degradability coefficients and degradability at 48 hours of different litter materials before and after 6 weeks of use are presented in Table 3 and illustrated in Figures 1 and 2.

The washing loss (a) before use ranged from 60.3 g/kg DM for rice husks to 140 g/kg DM for rice straw. After 6 weeks of use it ranged from 187g/kg for rice husks to 287g/kg for maize stover. The washing losses for maize stover and rice straw were significantly ($P<0.05$) higher than those for wood shaving and rice husks before use. However, after six weeks of use only the washing losses from rice husks was significantly

lower than the other bedding materials. A significant ($P<0.05$) difference in 48h degradability existed between the separated maize stover, rice straw, wood shavings and rice husks after 6 weeks of use. However, there was no significant difference between maize stover and rice straws in 48h degradability before use although they were significantly higher than rice husks and wood shavings. Degradation rate constant **c** was significantly ($P<0.01$) higher for maize stover and lower for rice husks both before and after 6 weeks in use (Table 3).

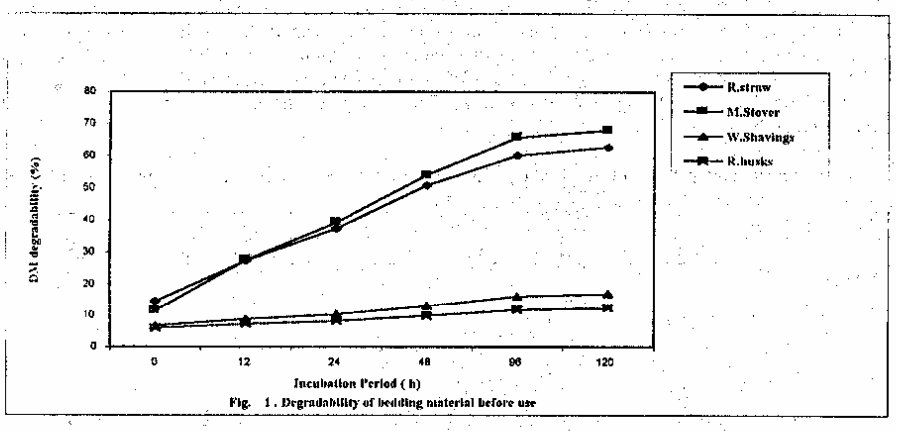


Fig. 1 . Degradability of bedding material before use

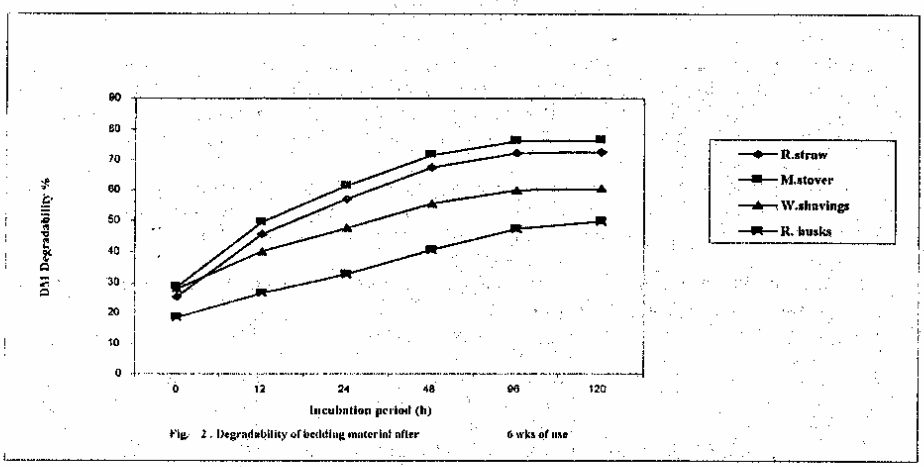


Fig. 2 . Degradability of bedding material after 6 wks of use

**Table 3. Washing loses, potential degradability, degradation rate constant (c/h) and 48 hour degradability (g/kg DM) of different bedding materials before and after 6 weeks of use**

| Time of use | Material | a | b | a+b | c | D48 |
|---|---|---|---|---|---|---|
| Before use | M. stover | $115^{a}$ | $479^{c}$ | $594^{g}$ | $0.02685^{i}$ | $540^{n}$ |
| | R. straw | $140^{a}$ | $412^{d}$ | $551^{g}$ | $0.0240^{j}$ | $499^{n}$ |
| | W. shaving | $66.8^{b}$ | $121^{e}$ | $188^{h}$ | $0.0155^{k}$ | $130^{o}$ |
| | R. husks | $60.3^{b}$ | $81.5^{f}$ | $141^{h}$ | $0.0132^{l}$ | $98^{o}$ |
| After 6 weeks of use | M. stover | $287^{a}$ | $480^{d}$ | $767^{j}$ | $0.0478^{h}$ | $719^{k}$ |
| | R. straw | $255^{ab}$ | $474^{d}$ | $729^{i}$ | $0.0458^{hi}$ | $676^{lm}$ |
| | W. shaving | $281^{b}$ | $329^{d}$ | $610^{f}$ | $0.0397^{l}$ | $556^{m}$ |
| | R. husks | $187^{e}$ | $322^{e}$ | $508^{g}$ | $0.02425^{j}$ | $406^{n}$ |

$^{abcde}$ Means bearing different superscript letters along the column are significantly different (P<0.05).

The mean degradability coefficients for poultry manure arising from using different bedding materials is presented in Table 4. The washing losses "a" was higher (P<0.01) for maize stover and rice straw based manure than rice husks. However there was no significant difference between wood shavings and rice straw based manure. All other degradability parameters were higher (P<0.05) for rice straw and maize stover than rice husks and wood shavings both at 3 and 6 weeks. Rice husk based manure ranked the lowest (P<0.05).

**Table 4. Effect of bedding material on the degradability of poultry manure after 3 and 6 weeks of use**

| Time of use | Material | a | b | a+b | c | D48 |
|---|---|---|---|---|---|---|
| 3 weeks of use | M. stover | $292^{a}$ | $414^{d}$ | $706^{f}$ | $0.03255^{h}$ | $619^{j}$ |
| | R. straw | $293^{ab}$ | $412^{d}$ | $705^{f}$ | $0.04355^{h}$ | $653^{j}$ |
| | W. shaving | $277^{b}$ | $311^{e}$ | $588^{g}$ | $0.0294^{l}$ | $515^{k}$ |
| | R. husks | $263^{e}$ | $310^{e}$ | $573^{g}$ | $0.0203^{l}$ | $459^{l}$ |
| 6 weeks of use | M. stover | $293^{a}$ | $435^{d}$ | $728^{i}$ | $0.0505^{j}$ | $690^{n}$ |
| | R. straw | $288^{ab}$ | $434^{d}$ | $722^{ij}$ | $0.0435^{kl}$ | $674^{o}$ |
| | W. shaving | $282^{b}$ | $469^{c}$ | $751^{a}$ | $0.0380^{l}$ | $697^{p}$ |
| | R. husks | $264^{c}$ | $330^{e}$ | $595^{i}$ | $0.02570^{m}$ | $496^{r}$ |

$^{abcd}$ means in the same column with different superscript letters are significantly different (P<0.05)

## DISCUSSION

The increase in CP content of poultry manure with time of use (Table1) was due to the increase in the proportion of poultry droppings. Poultry droppings are rich in both non-protein nitrogen (NPN) in the form of uric acid and true protein (Oltjen *et al.*, 1968; McDonald *et al.*, 1988 and Jakhmola, 1988). Increase in crude protein (CP) of poultry manure could also arise from spilled feed that is also rich in CP (Vogt, 1973). The CP values obtained in this study are similar to those reported by Egna *et al.* (1986).

The higher intake of maize stover and rice straw based poultry manure by goats compared to those of wood shaving and rice husks based manure (Table 2), could be due to higher degradation characteristic (Table 4). The degradation rate constant (c) and 48 hours dry matter degradability were higher for maize stover and rice straw based manure than those of wood shavings and rice husks.

The higher voluntary dry matter intake (DMI) of supplement attained by goats when manure from all types of bedding materials were mixed with maize bran 1:1 ratio might be due to improvement in palatability (Forbes, 1986). The higher intake of supplement containing maize stover and rice straw based manure (Table 2) with and without maize bran could be due to the better quality of bedding material as indicated by higher degradation rate constant (c). These findings have implication to the farmer who wants to feed his animals with poultry manure. That is to say the use of poultry manure together with maize bran in ruminant feed, increases voluntary intake and thus animal can meet its requirement for nitrogen and energy. Mixing of poultry manure with maize bran or any other cereal bran is advisable because it will supply the required easily fermentable carbohydrates for the microbes and also balance the energy/nitrogen intake by the animals.

The higher degradability of maize and rice straw based poultry manure both after 3 and 6 weeks than that of rice husks was probably due to higher degradability of the bedding materials. The potential degradability of maize stover and rice straw before use were 594 and 551 g/kg DM respectively compared

to 188 and 141 g/kg DM for wood shaving and rice husks. The increase in degradability from the initial value was due to the addition of poultry droppings that are highly degradable (Fig. 2). Increase in degradability could also be contributed by the action of ammonia that is produced in poultry houses on the bedding material. The ammonia produced in poultry houses could break the bonds between cellulose and lignin. Improvement in degradability of straws as a result of ammonia treatment has been reported by (Kumari *et al.*, 1994). Micro-organism in the poultry manure could also participate in destroying the structural organisation of the cell wall thereby accelerating their breakdown in the rumen. Improvement in the degradation of poultry manure based on pine saw dust was reported by Muller *et al.*, (1967), an increase from 11% to 72%. While wood shaving based manure in the present study increased from 18.8% before use to 62% after 6 weeks of use.

## CONCLUSION

It can be concluded that use of maize stover and rice straw as bedding material produces good poultry manure to be used as ruminant feed than use of rice husks and wood shavings. In the absence of maize stover or rice straw it is advisable to use wood shavings. Poultry manure (dropping) plus bedding can be used after 3 weeks of use in the poultry house.

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