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Rumen degradability and kinetic properties of deep stack broiler litter

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Abstract

Fresh broiler litter was collected from a commercial broiler house that uses wood shavings as bedding material in Khartoum state, Sudan. Chemical composition, rumen degradation and kinetic properties of broiler litter (BL) and three deep stack broiler litters (DSBL) was investigated. Deep stacking was done in underground silo pits 1.5×1.5×1.5 m (DSBL 1), 1.75×1.75×1.75 m (DSBL 2) and 2×2×2 m (DSBL 3) to guarantee using it as feed ingredient for ruminants. Deep stacking lasted for one month after that representative samples were taken for chemical analysis and rumen degradation trials.

Deep stacking had no significant effect on the chemical composition of BL. Crude protein contents and cell wall components did not change significantly within the three silo pits of deep stacked litter. There were significant ($P < 0.05$) differences in the readily degradable fraction among BL and DSBL, but for other kinetic fractions there were no significant ($P < 0.05$) differences found. Degradability of crude protein increased for the deep stacking treatments ($P < 0.05$) during incubation in the rumen of fistulated buffalos from 35.8% at 3 h of incubation to 81.6% at 96 h, from 40.7 to 82.3%, from 32.5 to 79.3% and from 35.4 to 81.3% for BL, DSBL 1, DSBL 2 and DSBL 3, respectively. Degradability of neutral detergent fibre was increased ($P < 0.05$) by deep stacking treatments during incubation from 17% at 3 h to 71.1% at 96 h, from 17.3 to 64.8%, from 18.16 to 65.3% and from 16.6 to 63.9% for BL, DSBL 1, DSBL 2 and DSBL 3, respectively. The rate of degradable fraction for neutral detergent fibre showed no significant difference ($P > 0.05$) among all broiler litter and deep stack litter, whereas, the readily degradable fraction, slow degradable fraction, potential degradability and the effective degradability in different rate of outflow showed a significant difference ($P > 0.05$) among all broiler litter and deep stack litter.

The study explored the practical possibility of incorporating deep stacked broiler litter into animal feeds hence reducing the cost of production of feed and consequently reducing the unit cost of animal products.

Key words: Broiler litter, composition, deep stacking, degradability.

Introduction

Byproduct feedstuffs are very important in ruminant production systems throughout the world, and will continue to be so in for the future. Broiler litter is a byproduct of poultry production, is high in crude protein rapidly degraded in the rumen and variable but generally low to moderate in available energy concentration (Saleh et al 2003).

Poultry litter has a potential use as a ruminant feed in addition to its traditional use as fertilizer and more valuable as a feed ingredient than as a fertilizer. The use of poultry litter as a dietary supplement in ruminant ration could have a considerable effect on reducing costs, insufficiency of protein in diet and on solving disposal problems.

The treatment of broiler litter by deep stacking was effective in the destruction of pathogens (Elemam et al 2010).

The productivity of livestock in terms of milk yield or the annual red meat off-take from an animal unit in Africa including Sudan is considerably low, when compared to other developed countries. Poor nutrition, both in quantity and quality and poor reproductive performance are recognized as major factors limiting animal production.

Materials and Methods

Deep stacking was prepared in underground silo pits (1.5x1.5x1.5, 1.75x1.75x1.75 and 2x2x2 m). The collected litter was spread on a plastic sheet and water was added to bring its moisture contents to about 30% using garden sprayer. Then, the sprayed litter was stacked in the underground silo pit surrounded with plastic sheet and pressed manually. The pressed litter was covered using plastic sheet. A thin layer of soil (3 – 5 cm) was placed over the covered plastic sheet. The preparation of the underground silo pit was made in two days and was opened after a period of at least one month. Representative samples of broiler litter and deep stacked litter were taken and proximate analysis was made on dried ground samples as outlined by (AOAC 1990). Degradability study of broiler litter and deep-stacked broiler litter was carried out in a fistulated buffalo according to the nylon bag technique described by Ørskov *et al*., (1980). The buffalo was fed at maintenance level on a balanced roughage concentrate diet with free access to water and mineral blocks. Nylon bag (80 × 140 mm; pore, size 45µ) weighing 1- 2.5 g each were used for incubation of experimental sample. The bags were incubated for different period of time 4, 8, 16, 24, 48, 72 and 96hrs.

The data were treated with the analysis of variance with the general linear model procedure of (SAS 1994).

Results and Discussion

The results of chemical composition for broiler litter and deep stacked broiler litter was shown in table 1. However, according to these compositions there are no differences between broiler litter and three deep stacked litters. Crude protein content of broiler litter is similar to the value reported by Chaudhry et al (1998), and is lower than the value reported by Saleh et al. (2003). Also no difference was observed for cell wall constituents between the broiler litter and three deep stacked litter samples. The higher value of NDF compared to the value reported by Abdelmawla et al (1988), could be attributed to the high quantity of bedding material used.

Degradability of CP increased after 12 hour among all three deep stack litters compared to broiler litter as shown in Figure (1). The soluble fraction (a) as shown in Table (2) increased significantly for DSBL1 compared to other, but degradable in the rumen constant (b), rate (c) of degradability, potential degradability (PD) and The effective degradability in different rate of outflow showed no significant difference among all broiler litter and deep stack litter. The soluble fraction (a) of crude protein for BL, DSBL1 and DSBL3 were higher than the findings of Muia et al (2001) and lower for DSBL2. Degradable in the rumen constant (b) of crude protein for BL and three DSBL were higher than the finding of Muia et al (2001). Rate (c) of degradability of crude protein for BL and three DSBL were lower than the finding of Muia et al (2001). The effective degradability of crude protein in the current study was higher than the finding of Melotti et al (1998) and Muia et al (2001).

Broiler litter showed a relatively superior NDF degradability in the rumen at 48, 72 and 96 h figure (2). The rate of degradation (fraction c) for NDF showed no significant difference ($P>0.05$) among all broiler litter and deep stack litter, whereas, the soluble fraction (a), slow degradable fraction (b), potential degradability (PD) and the effective degradability in different rate of outflow showed a significant difference ($P>0.05$) among all broiler litter and deep stack litter (Table 3). Broiler litter showed a relatively superior NDF degradability in the rumen at 48, 72 and 96 h figure (2). However the effective degradability of NDF for BL was higher than the value reported by Mthiyane et al (2001) and lower than the value reported in the current study for three DSBL.

Table 1. Chemical composition (%) of broiler litter and deep stacked broiler litter.

	CP	NDF	ADF	HC	Cellulose
BL	28.13	41.13	31.63	9.82	18.32
DSBL1	25.72	40.60	30.94	9.73	18.14
DSBL2	26.73	40.91	33.22	8.91	17.92
DSBL3	27.01	41.12	34.73	8.72	17.74
SEM	0.013	0.006	0.011	0.014	0.011

BL: Broiler litter. DSBL1, DSBL2 and DSBL3: Deep stacked broiler litter in silo pits at (1.5x1.5x1.5 m, 1.75x1.75x1.75m and 2x2x2 m) respectively. NDF: Neutral detergent fiber.ADF: Acid detergent fiber. HC: Hemicelluloses. SEM: standard error of the mean. Each value represents the mean of three samples

Table. 2 CP degradability kinetics of broiler litter and deep stack broiler litter:

	a	b	c	PD	ED		
					2%	5%	8%
BL	33.01^{ab}	56.26	0.02	89.27	69.30	64.10	63.05
DSBL1	37.61^{a}	54.49	0.02	92.11	69.70	64.10	63.05
DSBL2	21.70^{b}	58.68	0.05	80.39	70.15	65.20	63.66
DSBL3	32.46^{ab}	53.50	0.03	85.96	69.80	64.45	63.20
SEM	2.93	4.14	0.01	3.73	0.61	0.51	0.26

In this table and below *(a)Readily degradable fraction; (b) Slow degradable fraction; (c) Rate of degradable fraction; (PD) Potential degradability; (ED) Effective degradability; (SEM) Standard Error of The Mean;$^{a-b}$ means with different superscript in the same row were significantly different ($P < 0.05$). BL: Broiler litter. DSBL1, DSBL2 and DSBL3: Deep stacked broiler litter in silo pits at (1.5x1.5x1.5 m, 1.75x1.75x1.75m and 2x2x2 m) respectively.*

Table. 3 NDF degradability kinetics of broiler litter and deep stack broiler litter:

	a	b	c	PD	ED		
					2%	5%	8%
BL	8.19^{b}	61.84^{a}	0.05	70.03^{a}	65.00^{a}	63.15^{a}	62.05^{a}
DSBL1	8.98^{ab}	56.61^{b}	0.06	65.59^{b}	63.45^{b}	62.80^{b}	61.09^{b}
DSBL2	9.86^{b}	55.27^{b}	0.05	65.13^{bc}	63.25^{b}	62.75^{b}	61.08^{b}
DSBL3	7.16^{c}	56.59^{b}	0.06	63.76^{c}	62.90^{b}	62.70^{b}	61.08^{b}
SEM	0.26	0.57	0.01	0.40	0.18	0.06	0.06

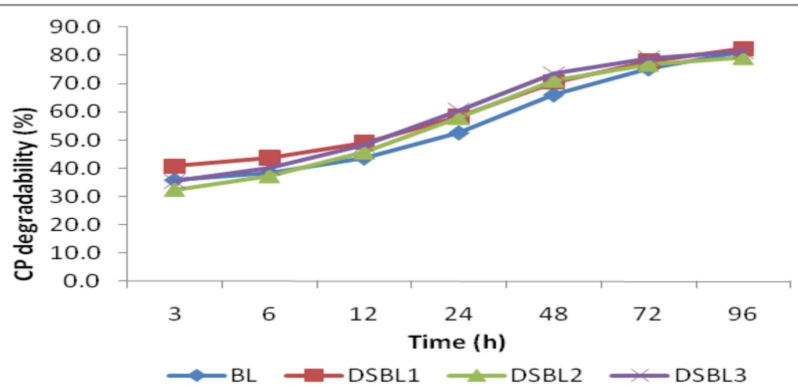

Figure. 1. Rumen degradation of CP% of broiler litter and deep stack broiler litter.

In this figure and below BL: Broiler litter. DSBL1, DSBL2 and DSBL3: Deep stacked broiler litter in silo pits at (1.5x1.5x1.5 m, 1.75x1.75x1.75m and 2x2x2 m) respectively.

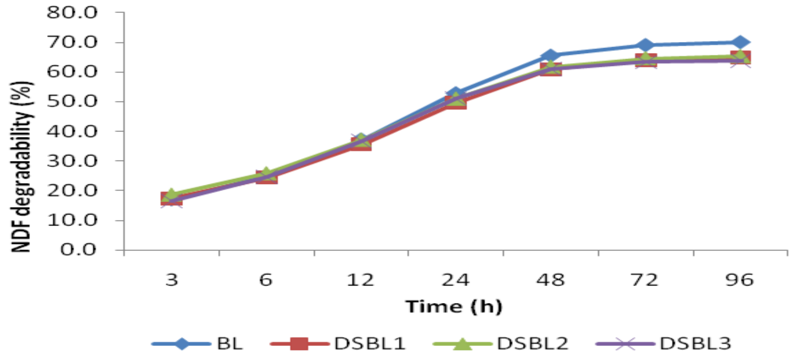

Figure. 2. Rumen degradation of NDF (%) of broiler litter and deep stack broiler litter.

Conclusions and Outlook

The results of this study indicate the possibility of incorporating deep stacked broiler litter into their animal feeding system in order to reduce costs and it will enable the farmers to explore a feasible method of waste management and also to develop their own complementary system of animal production.

References

Abdelmawla S M, Fontenot J P and El-Ashry M A 1988 Composted, deep stacked and ensiled broiler litter in sheep diets: chemical composition and nutritive value study. Virginia Polytechnic Institute and State University. Animal Science Research. Report. No. 7: 127-129.

AOAC 1990 Official Methods of Analysis. Association of Official Analytical Chemistry (15th Ed). Washington D.C. U.S.A.

Chaudhry S M Fontenot J P and Naseer Z 1998 Effect of deep stacking and ensiling broiler litter on chemical composition and pathogenic organisms. Animal Feed Science and Technology. 74: 155-167.

Elemam M B, Fadelelseed A M and Salih A M 2010 The effect of deep stacking broiler litter on chemical composition and pathogenic organisms. Livestock Research for Rural Development. **22(4)**: http://www.lrrd.org/lrrd22/4/elem22065.htm

Melotti, L, C S Lucci and S C F Morgullis. 1998. Poultry litter ruminal degradability through *in situ* nylon bag technique with heifers. Braz. J. Vet. Res. Anim. Sci. 35(2): 92-95

Mthiyane D M N, I V Nsahlai and M I K Bonsi (2001). The nutritional composition, fermentation characteristics, in sacco degradation and fungal pathogen dynamics of sugarcane tops ensiled with broiler litter with or without water. Animal Feed Science and Technology 94: 171-185.

Muia, J M K, Tamminga, S, Mbugua, P N and Kariuki J N. 2001. Rumen degradation and estimation of microbial protein yield and intestinal digestion of napier grass and various concentrates. Animal Feed Science and Technology. 93: 177-192

Orskov, E. R., F. D. Deb Hovell and F. Mould. 1980. The use of the nylon bag technique for the evaluation of feedstuffs. Tropical Animal Production. 5:195-213.

Saleh H.M., K.M Elwan, H.A El-fouly, I.I Ibrahim, A.M Salama and M.A Elashry, 2003 The use of poultry waste as a dietary supplement for ruminants. Egyptian Journal of Nutrition and Feeds, 3: 1-8.

SAS 1994. Statistical Analytical Systems, Users guide (Version 6), SAS Institute Inc., Cary, North Carolina, USA.