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Preparation of wastelage using poultry droppings with maize stover and its nutrient content as ruminant feed

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Abstract

An experiment was undertaken with caged layer excreta (CLE) treated maize stover and ensiled to investigate its potentiality as ruminant feed. Chopped maize stovers were preserved in plastic containers under airtight condition at room temperature based on the treatments as T_0 (0% CLE), T_1 (20% CLE), T_2 (40% CLE) and T_3 (60% CLE) to investigate physical quality, chemical composition, in vitro organic matter digestibility (IVOMD) and metabolizable energy (ME) content at 0, 30, 60 and 90 days. The CP and Ash were increased (P<0.01) and DM, OM and CF were decreased (P<0.01) in all the treatments (T_1, T_2 and T_3) compared to controlled T_0. The OM content was decreased numerically with the ensiling time. The EE content was not significant (P>0.01) with the treatments and ensiling time. The OMD and ME content were increased (P<0.01) with the ensiling time from 0 to 90 days. The physical quality (color, smell, and hardness) of maize stover were improved by CLE added treatments (T_1, T_2 and T_3) after ensiling but 60% CLE treatment had some pungent smell in 90 days and less OMD and ME value was observed than that of T_2. Considering all the physical and chemical properties, among all the treatments, 40% and 60% CLE are acceptable for preparing wastelage. By comparing physical quality, nutritive value and chemical composition between 40% and 60% CLE treatments, the 60% CLE was better. Thus wastelage prepared from 40% CLE, 55% maize stover along with 5% molasses will be a potential source of ruminant feed as well as reduce the environment pollution by utilizing CLE.

Key words: wastelage, caged layer excreta, maize stover, ruminant feed

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Introduction

Now a day, poultry industry is the most rapidly growing industry in Bangladesh. Total poultry population was 337.99 million in the year 2017-2018 (DLS, 2018). Poultry droppings increases simultaneously with the increase of poultry population. However, these droppings are not disposed properly which results environmental and health hazards near the farm and adjoining area. Most effective and easy solution of these problems is to use the excreta for feeding animals either by drying or ensiling with poor quality forages. Poultry wastes are higher in nutrient content and can be a good source of feed for ruminants (Fontenot *et al.,* 1971). It contains about 28-30% crude protein out of which 36-50% is true protein (Bhattacharya and Taylor, 1975). Poultry waste can be free of pathogens by ensiling (Hadjipanayiotou, 1982; Daniels *et al.,* 1983) and deep stacking (Strickler, 1977). Properly utilized of animal wastes are valuable resources of nutrients which includes: sources of plant nutrients (Hossain *et al.,* 2010), feed ingredients for farm animals, poultry and fish (Lu and Kevern, 1975), substrate for methane generation (Islam *et al.,* 2013; Rathi, 2006), and substrate for microbial protein synthesis (Cook *et al.,* 2011; Ritz *et al.,* 2004). Utilization of animal wastes to produce microbial or insect protein is feasible technically but not economically. On the other hand, methane generation from animal wastes is technically feasible (Smith *et al.,* 1989), but the wastes possess low monetary value for this purpose. Thus, the most feasible methods of recycling animal wastes are as sources of nutrients for animals. Nutrient content and digestibility of maize stover is more than any other straws. It contains about 6% crude protein and metabolizable energy (ME) value of about 9 MJ/Kg DM (McDonald *et al.,* 1995).

Maize stover are being used as ruminant feed in some developing and developed countries. In our country, use of maize stover as ruminant feed is rarely seen. If it does the nutritional requirement of ruminant will be fulfilled in a great extent. It

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also decreases the environmental hazard and soil pollution. Maize stover may be chopped, ensiled and can be fed in a similar way to maize silage (McDonald *et al.* 1995). Agro-industrial wastes (cow-dung, poultry droppings, sugarcane bagasses, wood pulp, slaughter house waste and municipal waste) have attracted the attention to the nutritionists for their economical and nutritional potentialities for the feeding of animals (EI-Sabban *et al.* 1970; Reddy and Reddy, 1980). Wastelage is a fermented product produced by blending animal waste with a fermentable product and storing to ensile. When properly ensiled, wastelage is free of salmonella type microorganisms and parasitic nematodes, free of noxious odors, palatable to livestock, and economically competitive as an animal feed**.** (Mavimbela, 2000; Islam *et al.,* 2018).

Ensiling of chopping maize stover along with poultry droppings and molasses may produce a good quality wastelage for feeding cattle having desire palatability, nutrient content and digestibility**.** (Harmon *et al*., 1975; Khatun *et al*., 2013). Panna *et al.* (2019) found that 30% and 45% poultry dropings are acceptable for preparing wastelage. So, ensiling maize stover with poultry excreta and molasses will increase crude protein and other nutritive value of the diet lowering the pH value and produce lactic acid producing bacteria which will facilitate the natural preservation. The aims of the study are to know the nutritive value of wastelage prepared from caged layer excreta (CLE) with maize stover and also to find out a convenient option of disposing poultry droppings.

Materials and Methods

Collection of experimental materials

Caged layer excreta (CLE) was collected from Poultry Farm, Bangladesh Agricultural University (BAU), and Maize stover was collected from farmer's field, Mymensingh. For collection of layer droppings, polyethylene sheet was placed under the cage of birds. During collection enough care was taken so that the droppings would be free from feather, sand or other materials. Molasses and air tight plastic container (30L size) were purchased from local market.

Preparation of wastelage

Maize stover was collected just after collection of corn cobs. After collecting, stovers were chopped about 3-4 cm long. Then wastelage was prepared by mixing chopped stover with fresh poultry litter and molasses according to treatment formula. For proper mixing, first caged layer excreta and molasses were mixed then finally mixed with chopped stover.

Treatments:

T_0= 0% caged layer excreta + 5% molasses + 95% maize stover

T_1= 20% caged layer excreta + 5% molasses + 75% maize stover

T_2= 40% caged layer excreta + 5% molasses + 55% maize stover

T_3= 60% caged layer excreta + 5% molasses + 35% maize stover

Then these mixture groups were placed into air-tight plastic containers which were previously marked according to the treatment. Finally plastic containers were kept in a room for 90 days for successful ensiling.

Physical and organoleptic test of wastelage

Texture (hardness), color and smell of samples were recorded. The results of these parameters were summarized according to the opinions of farms attendants, laboratory students of Department of Animal science, Bangladesh Agricultural University.

Chemical analysis

The samples of different treatments for wastelage were subjected to chemical analysis for organic matter (OM), crude protein (CP), crude fibre (CF), ether extract (EE) and total ash (TA) following the procedure of AOAC (2004) at Animal Science laboratory, Bangladesh Agricultural University, Mymensingh. Dry matter was determined by oven drying method. In vitro organic matter digestibility (IVOMD) and metabolizable energy (ME) content of wastelage were done following the method described by Menke *et al.* (1979).

Statistical analysis

The experiment was laid out in a 4×4 Factorial Design with 3 replicate in each treatment**.** Data were statistically analyzed using SAS Statistical Discovery Software, NC, USA and differences among the treatment means were determined by Duncan's Multiple Range Test (DMRT).

Results

Physical properties and pH of wastelage

The physical properties of wastelage of different treatments (T_0, T_1, T_2 and T_3) at different ensiling period (0, 30, 60 and 90 days) are shown in

Table 1. After 90 days of ensiling period, the color of different treatments (T_0, T_1, T_2 and T_3) were light brown, brown, light chocolate and chocolate, respectively. The color of wastelage became deeper with the increasing level of CLE. Among all the treatments, T_1 and T_2 had good smell at 90 days of ensiling but T_3 had pungent smell which was not acceptable by cattle. Controlled treated wastelage remained hard after 90 days of ensiling but T_1, T_2 and T_3 became soft after 90 days of ensiling. Fungus propagation was not observed in poultry dropping treated wastelage but some seen in controlled treatment.

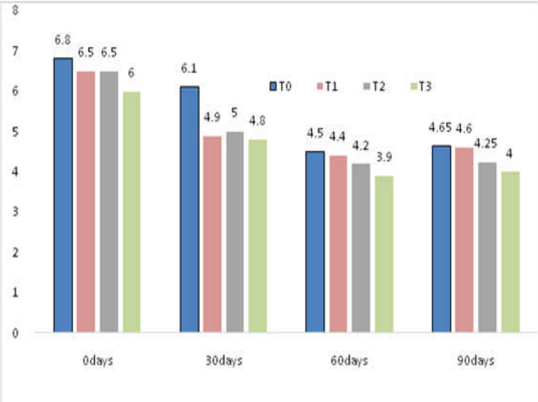

Figure 1: Effect of different treatments on pH of wastelage

The pH is shown in Figure 1. Significant differences ($P<0.05$) were observed among the treatments. The highest pH value was observed by treatment T_0 followed by T_1, T_2 and T_3. It was observed that pH value decreased with the increase level of CLE. The pH value was decreased significantly ($P<0.05$) from 0 to 60 days with a slight increase in 90 days of ensiling which was statistically ($P>0.05$) identical to 60 days.

Chemical composition of wastelage

Dry Matter

The dry matter content of wastelage of different treatments and different ensiling time is shown in Table 2. It was observed that Dry Matter (DM) content (g/100g) of wastelage differ significantly ($P<0.01$). The highest DM was obtained by T_0 followed by T_1, T_2 and T_3. The reason of decreasing the DM content in the study may be due to fermentation with the higher level of CLE. Irrespective of treatment the DM at 0, 30, 60 and 90 days ensiling time were found 48.04%, 41.38%, 39.20% and 36.67%, respectively. It was observed that DM content was decreased with the ensiling time from 48.04% to 36.67% with the increase of duration from 0to 90 days ($P<0.01$).

Table 1: Effect of different treatments on physical quality of wastelage

Characteristics	**Observation**	**Treatment**			
		$\mathbf{T_0}$	$\mathbf{T_1}$	$\mathbf{T_2}$	$\mathbf{T_3}$
Color	30 Days	Straw	Light brown	Brown	Light chocolate
	60 Days	Light brown	Brown	Light chocolate	Light chocolate
	90 Days	Light brown	Brown	Light chocolate	Chocolate
Smell	30 Days	Straw	Bad odor	Bad odor	Bad odor
	60 Days	Straw	Bad odor	Bad odor	Bad odor
	90 Days	Straw	Acceptable smell	Good	Pungent
Softness	30 Days	Hard	Hard	Hard	Hard
	60 Days	Hard	Hard	Moderate soft	Soft
	90 Days	Hard	Soft	Soft	Soft
Fungus	30 Days	Absent	Absent	Absent	Absent
	60 Days	Present	Absent	Absent	Absent
	90 Days	Present	Absent	Absent	Absent

Table 2: Effect of different treatments and different ensiling time on the dry matter of wastelage

Parameters	Days	Treatments				Mean	SEM
		T_0	T_1	T_2	T_3		
Dry Matter	0	60.9	53.7	41.48	34.1	48.04[a]	0.028
	30	52.9	39.84	41.06	31.72	41.38[b]	0.033
	60	49.4	41.2	37.82	28.34	39.20[c]	0.035
	90	46.28	40.84	34.58	24.98	36.67[d]	0.037
	Mean	52.36[a]	43.90[b]	38.74[c]	30.29[d]		
	SEM	0.026	0.031	0.035	0.045		

Means with different superscripts within row and column are significantly different (P<0.01); SME: standard error of mean

The organic matter (OM) content of the treatments (T_0, T_1, T_2 and T_3) were 83.90%, 86.01%, 80.22% and 74.27%, respectively which is shown in Table 3. In the present experiment the OM content was highest (86.01%) in T_1 and decreased (P<0.01) with the increasing level of caged layer excreta and lowest (74.27%) in T_3. The OM content of wastelage in different ensiling period (0, 30, 60, and 90 days) were 85.44%, 78.36%, 78.09% and 82.51%, respectively. The present study indicates that the OM content was decreased (P<0.01) from 85.44% to 78.36% at 30 days. There was no significant difference (P>0.01) among 30, 60 and 90 days, although there was a slight increase in 90 days.

Crude Protein

The crude protein (CP) content of different treatments (T_0, T_1, T_2 and T_3) of wastelage were 9.979%, 13.41%, 17.17% and 22.65%, respectively has been shown in Table 4. The highest (22.65%) CP content was found in T_3 and lowest (9.79%) CP content was found in T_0. The CP content differ with the addition of caged layer excreta (CLE) (P<0.01). The CP content of wastelage in different ensiling period (0, 30, 60, and 90 days) were 13.49%, 16.03%, 16.37% and 17.11%, respectively. It was observed that CP content was increased with the ensiling time from 13.49% to 17.11% with the time of 0 days to 90 days, respectively (P<0.01).

Crude Fibre

The crude fibre (CF) content of wastelage of different treatments and different ensiling time are shown in Table 5. The CF content of different treatments (T_0, T_1, T_2 and T_3) of wastelage was 25.13%, 22.64%, 19.98% and 14.79%, respectively. In the present experiment the value of CF was significantly higher (25.13%) in controlled T_0 than treated (T_1, T_2 and T_3) maize stovers. The CF content was decreased significantly (P<0.01) from 25.13% to 14.79% with the addition of CLE (0 to 60%). The CF content of wastelage in different ensiling period (0, 30, 60, and 90 days) were 21.52%, 20.12%, 20.34% and 20.55% respectively. It was observed that CF was decreased with ensiling period (P<0.01) but again increased in 90 days (20.55%) which was not statistically significant (P>0.01).

Ether Extract

The ether extract (EE) content of wastelage of different treatments and different ensiling period are shown in Table 6. Irrespective of ensiling period the EE content of different treatments (T_0, T_1, T_2 and T_3) of wastelage were 3.38%, 3.37%, 3.33% and 3.40%, respectively. There were no significant differences (P>0.01) among treatments. EE content was also similar with increase the ensiling period up to 90 days.

Ash

The ash content of wastelage of different treatments and different ensiling period are shown in Table 7. The Ash content of different treatments (T_0, T_1, T_2 and T_3) of wastelage was 13.84%, 13.99%, 19.78% and 25.68%, respectively. The Ash content was not varied significantly (P>0.01) between T_0 and T_1. The ash content was increased significantly (P<0.01) with the increase of poultry litter percentage. The highest (25.78%) ash content was found in T_3 and lowest (13.84%) ash content found in T_0. But the Ash content was increased significantly (P<0.01) from T_1 (13.99%) to T_3 (25.68%). Irrespective of treatments, the Ash content of wastelage in different ensiling period (0, 30, 60, and 90 days) were 14.56%, 21.58%, 19.66%

and 17.49%, respectively. It was observed that the ash content of wastelage with CLE and maize stover decreased with the increase of ensiling period from 30 to 90 days, although the value of 0 day was lower than that of 30 days (P<0.01).

Table 3: Effect of different treatments and different ensiling time on the organic matter of wastelage

Parameters	Days	Treatments				Mean	SEM
		T_0	T_1	T_2	T_3		
Organic Matter	0	87.44	86.31	86.64	80.41	85.44[a]	0.012
	30	85.25	84.89	76.18	67.34	78.36[b]	0.013
	60	85.67	86.17	78.01	71.56	78.09[b]	0.013
	90	86.26	86.73	80.10	76.95	82.51[ab]	0.012
	Mean	83.90[ab]	86.01[a]	80.22[b]	74.27[c]		
	SEM	0.012	0.011	0.012	0.013		

Means with different superscripts within row and column are significantly different (P<0.01); SME: standard error of mean.

Table 4: Effect of different treatments and different ensiling time on the crude protein of wastelage

Parameters	Days	Treatments				Mean	SEM
		T_0	T_1	T_2	T_3		
Crude Protein	0	9.31	10.12	15.38	19.09	13.49[d]	0.055
	30	11.43	14.43	15.17	22.79	16.03[c]	0.047
	60	9.83	14.29	17.61	23.75	16.37[b]	0.046
	90	8.12	14.78	20.53	24.94	17.11[a]	0.044
	Mean	9.797[d]	13.41[c]	17.17[b]	22.65[a]		
	SEM	0.077	0.056	0.044	0.033		

Means with different superscripts within row and column are significantly different (P<0.01); SME: standard error of mean.

Table 5: Effect of different treatments and different ensiling time on the crude fiber of wastelage

Parameters	Days	Treatments				Mean	SEM
		T_0	T_1	T_2	T_3		
Crude Fibre	0	27.95	24.15	17.35	16.65	21.52[a]	0.028
	30	25.25	21.25	20.15	13.85	20.12[c]	0.030
	60	24.2	22.15	20.85	14.15	20.34[bc]	0.029
	90	23.1	23.05	21.55	14.50	20.55[b]	0.029
	Mean	25.13[a]	22.64[b]	19.98[c]	14.79[d]		
	SEM	0.024	0.026	0.030	0.040		

Means with different superscripts within row and column are significantly different (P<0.01); SME: standard error of mean.

Table 6: Effect of different treatments and different ensiling time on the ether extract of wastelage

Parameters	Days	Treatments				Mean	SEM
		T_0	T_1	T_2	T_3		
Ether Extract	0	3.39	3.38	3.39	3.38	3.38[a]	0.015
	30	3.38	3.37	3.25	3.40	3.35[b]	0.016
	60	3.38	3.36	3.36	3.41	3.37[a]	0.016
	90	3.39	3.40	3.35	3.42	3.37[a]	0.016
	Mean	3.38[ab]	3.37[b]	3.33[c]	3.40[a]		
	SEM	0.015	0.016	0.017	0.014		

Means with different superscripts within row and column are significantly different (P<0.01); SME: standard error of mean.

Nutritive value of wastelage

In vitro organic matter digestibility (IVOMD)

The *in vitro* organic matter digestibility (OMD) of wastelage at different treatments (T_0, T_1, T_2 and T_3) and at different ensiling period (0, 30, 60 and 90 days) are shown in Table 8. Irrespective of ensiling period, the OMD of different treatments were 59.28%, 58.51%, 63.91% and 63.86%, respectively. The OMD increased significantly (P<0.01) with the increase of CLE. Irrespective of treatments, the OMD in different ensiling period (0, 30, 60 and 90 days) were 58.74%, 61.02%, 62.45% and 63.36%, respectively. The OMD was increased statistically (P<0.01) with the increase of ensiling period.

Metabolizable Energy (ME)

The Metabolizable Energy (ME) content (MJ/Kg DM) of wastelage at different treatments (T_0, T_1, T_2 and T_3) and at different ensiling period (0, 30, 60 and 90 days) are shown in Table 9. Irrespective of ensiling period, the ME content of different treatments were 7.83, 8.02, 8.70 and 8.60 MJ/Kg DM, respectively. The ME content was statistically (P<0.01) increased with the increase of CLE. The highest (8.70) ME content was found in T_2 which was statistically (P>0.01) identical to T_3. The lowest (7.83) ME content was found in controlled treatment (T_0). Irrespective of treatments, the ME content (MJ/Kg DM) in different ensiling period (0, 30, 60 and 90 days) were 8.01, 8.09, 8.43 and 8.62 MJ/Kg DM, respectively. The highest (8.62) ME content was found in T_3 followed by T_2, T_1 and T_0.

Table 7: Effect of different treatments and different ensiling time on the ash content of wastelage

Parameters	Days	Treatments				Mean	SEM
		T_0	T_1	T_2	T_3		
Ash	0	12.56	13.69	13.36	19.59	14.56[d]	0.060
	30	14.75	15.11	23.82	32.66	21.58[a]	0.040
	60	14.33	13.83	21.99	28.44	19.66[b]	0.044
	90	13.74	13.27	19.90	2305	17.49[c]	0.050
	Mean	13.84[c]	13.99[c]	19.78[b]	25.68[a]		
	SEM	0.063	0.062	0.044	0.034		

Means with different superscripts within row and column are significantly different (P<0.01); SME: standard error of mean.

Table 8: *In vitro* organic matter digestibility (IVOMD) of wastelage at different treatments and different ensiling period

Parameters	Days	Treatment				Mean	SEM
		T_0	T_1	T_2	T_3		
Organic Matter Digestibility (OMD)	0 days	55.08	56.75	61.03	62.09	58.74^d	1.68
	30 days	60.63	56.45	63.24	63.74	61.02^c	1.67
	60 days	60.66	59.26	65.35	64.51	62.45^b	1.47
	90 days	60.74	61.56	66.03	65.09	63.36^a	1.30
	Mean	59.28^b	58.51^b	63.91^a	63.86^a		
	SEM	1.40	1.20	1.13	0.65		

Means with different superscripts within row and column are significantly different (P<0.01); SME: standard error of mean.

Table 9: Metabolizable energy (ME) content of wastelage at different treatments and different ensiling period

Parameters	Days	Treatment				Mean	SEM
		T_0	T_1	T_2	T_3		
Metabolizable Energy (ME)	0 days	7.57	7.80	8.20	8.46	8.01^b	0.20
	30 days	7.70	7.74	8.40	8.52	8.09^b	0.22
	60 days	7.95	8.10	9.03	8.63	8.43^{ab}	0.25
	90 days	8.10	8.42	9.15	8.79	8.62^a	0.23
	Mean	7.83^c	8.02^b	8.70^a	8.60^a		
	SEM	0.12	0.16	0.23	0.07		

Means with different superscripts within row and column are significantly different (P<0.01); SME: standard error of mean.

Discussion

At different level of layer excreta and ensiling period, prepared wastelage had different physical qualities. Good color and aroma was obtained when poultry manure was ensiled with maize forage (Harmon *et al.,* 1975), citrus pulp or weeds (Hadjipanayiotou, 1982). Bostami *et al.* (2009) reported that maize stover ensiled with urea had no fungal growth but observed in untreated maize stover silage. Schroeder (2013) reported that properly ensiled silage had good color and desirable smell. The lower P^H of wastelage indicates good fermentation quality which was due to presence of higher water soluble carbohydrates in fodder that enhanced lactic acid production (Yunus *et al.,* 2000). Roothaert *et al.* (1992) indicated that ensiled materials should reach a PH of less than 5 in order to destroy Salmonella and other pathogens. Lower pH level helps to facilitate preservation of the silage and faster fermentation of the silage helps to retain more nutrients in the silage (Schroeder, 2013). In the present studies, pH values lower than 5 were attained in all wastelage indicated that they are highly fermented and lactic acid production is higher which will help to conserve more nutrients in the wastelage.

The reason of decreasing the DM content in the study maybe due to fermentation with the higher level of CLE. The DM loss also found by Otieno *et al.* (1986); Hiep and Man (2003); Man and Wiktorsson (2003). There some experiments where same findings were also obtained. It was observed that DM decreased in ensiled maize stover from 22.58 to 20.83% (Otieno *et al.,* 1986), from 29.1 to 26.5% (Hiep and Man 2003). Snijder and Wonters (2004) reported DM loss in ensiled maize stover was 81%. DM content of maize stover was reduced from 28.0 to 26.4%, with increasing the ensiling time from 2 to 4 months (Man and Wiktorsson, 2003). Losses of DM may come from run off, oxidation and loss of volatile organic compounds (Kung, 2010).

This study showed the decrease of OM in wastelage with ensiling period and higher level of layer excreta. Similarly, OM was decreased with the urea treatment of maize stover (Smith *et al.,* 1989). With caged layer waste (nitrogen source) ensiling of maize stover, wheat straw and maize cobs the OM content was decreased (Kayongo *et al.,* 1986).OM content slightly increased with increasing time when maize stover ensiled with caged layer waste (nitrogen source) (Kayongo *et al.,* 1986). Due to ensiling time in the presence or absence of additives, organic matter may be increased or decreased, which may be depends on different factors such as biochemical or microbial reactions during ensiling period.

With different treatment and ensiling time the CP increase with the increase of poultry droppings and with time. Daniels *et al.* (1983) reported that maize stover ensiled broiler litter for 6 weeks and found that CP was increased with increased proportion of poultry litter. The crude protein of sorghum forages ensiled with broiler litter increased with increased proportion of poultry litter (Al-Rokayan *et al.* 1988; Flachowsky and Henning 1990). Ngele *et al.* (2006) ensiled rice straw with poultry litter at different ratios and recorded highest crude protein in ratio 50:50. Ensiling time increase the CP content when maize stover ensiled with nitrogen source (caged layer waste) (Kayongo *et al.,* 1986). Similar results have been reported by Daniels *et al.* (1983) and Hadjipanaytou (1984). The result supported by Mohanta (2005), who stated that, in different days (7, 15 and 21 days) of ensiling CP content were different and were highest in 21 days.

Decrease in CF had been found from the present study. Baba *et al.* (2010), who reported that when Kyasuwa hay (*Pennisetum pedicellatum*) ensiled with poultry litter at treatment 80:20 and 50:50 the CF was decreased from 20.46% to 15.95%. Magar and Fontenot (1988) and Rasoolo *et al.* (1996) also observed a similar trend in rice straw ensiled with poultry litter. CF decreased with the level of caged layer waste (nitrogenous source) in the maize stover (Kayongo *et al.,* 1986). The reason of CF decrease may be due to the lower CF content of CLE and also decomposition of silage materials.CF was reduced with increasing the ensiling time, when ensiled with caged layer waste (nitrogenous source) (Kayongo *et al.,* 1986). CF reduced with ensiling time (Man and Wiktorsson 2003). Baba *et al.* (2010) reported that when Kyasuwa hay (*Pennisetum pedicellatum*) ensiled with poultry litter, EE declined with increased proportion of poultry litter. Variation of the present observation may due to the variation of poultry litter and ensiling materials.

Variation in ash content of wastelage was shown with different treatments in this study. This result is supported by Al-Rokayan *et al.* (1988) and Flachowsky and Hennig (1990), who observed a linear increase in ash with increased proportion of broiler litter. Kim *et al.* (2014), who indicated that ash content of silage increase up to 28 days of ensiling.

Organic matter digestibility of our study significantly increased with the time of ensiling period. On the other hand, first two treatments had significance difference with last two treatments. This result is partially supported by Reddy and Reddy (1980), who reported that *in vitro* organic matter digestibility of rice straw increase when ensiled with rumen digesta and animal excreta. Saylor and Long (1972) reported that *in vitro* organic matter digestibility of ensiled crop residue and poultry manure positively increased with the level of poultry manure. Predicted OMD was increased in maize stover ensiled with caged layer waste (Kayongo *et al.,* 1986). Boever *et al.* (2013) reported that in vitro organic matter digestibility of ensiled grass was 82.3% and 83.9% after 60 and 150 days of ensiling, respectively.

The result of ME of wastelage of our study is supported by Ali *et al.* (1994), who reported that ME were increased in treated compared with untreated stover after ensiling. Bostami *et al.* (2009) also reported that ME content was increased in treated ensiled maize stover than untreated ensiled maize stover. Cone *et al.* (2007) reported ensiling period has no significant (P>0.01) effect on ME content of silage.

Conclusion

The results suggested that ensiling of maize stover with 40% poultry droppings had significant improvement of nutritional values of wastelage and may be a feasible means of converting layer excreta into a palatable and nutritious feed for cattle. Besides feed preparation, this approach may also solve the disposal problem of poultry droppings in large poultry industries by utilizing it as an animal feed which in terms contribute in environment-friendly animal production systems.

Conflict of interest

The author has no conflict of interest to declare.

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