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IMPROVING DIGESTIBILITY OF BIOGAS PLANT WASTE

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Biogas plant waste (BPW) was treated with 1-5% (w/w) urea or aqueous ammonia and 20% added water for 30 days at ambient temperature in a confined system. Under these conditions, the *in vivo* dry mater digestibility of BPW increased from 30. 13 to 42.25% and 45.12% on treatment with 4% urea or 3% aqueous ammonia respectively. 50.34 - 64.93% increase in non-proteinous nitrogen of BPW was also observed after both the treatments.

Key words: Biogas plant waste, Urea, Ammonia, Digestibility.

Introduction

Agricultural animal and domestic wastes form a useful raw material for the production of biogas by anaerobic fermentation [1-2]. The effluent coming out of biogas digestor has been reported to be a good source of fertilizer, fish feed and rich nutrient for the growth of algae [2-4]. The scum which skims to the top of the effluent contains 21% protein [4]. It could be used as ruminant feed after improving its digestibility by treatment with ammonia or urea because the ruminants can convert these non-protein nitrogenous compounds into useful microbial protein which partially meet the protein requirement of the ruminants [5]. Thus the scum, a cheaper source of protein would help to replace commonly used costly protein ingredients e.g. grains, oilseed cakes etc. from the feed of livestock.

Many researchers have attempted to increase the digestibility of agricutural wastes by subjecting them to various chemical and biological treatments [6-9]. The present work was undertaken to study the effect of ammonia and urea treatment on the *in vivo* degestibility of the biogas plant waste i.e. sun dried scum.

Materials and Methods

Four biogas plants of two cubic meter gas capacity each are working at PCSIR Laboratories Complex, Lahore. A charge of 35 kg cow dung and water (1:2 w/w basis is charged every plant daily). The effluent coming out of these four plants in form of slurry (80-90 kg/day) is collected in a septic tank. The scum, a biogas plant waste (BPW), which skims on the top of the effluent was removed, filtered through a thick muslin cloth and dried in sun. Sun-dried BPW was ground to 16 mesh and mixed with 1-5% (w/w) urea or aqueous ammonia. The substrate with 20% added water was incubated at ambient temperature(ranging from 16 to 40°) for 30 days in 500 ml size canning jars. The ammoniated or urea treated BPW was dried in a vacuum oven at 60° to moisture level below 20%.

Moisture, nitrogen, lipids, ash and lignin contents of untreated, treated and rumen digested BPW were determined according to methods described elsewhere [10]. Cellulose was determined according to the procedure of Kurshner and Hanak [11]. *In vivo* deigestibility trials were carried in nylon bags (six replicates) as described by McAnally [12]. Results of digestibility were analysed statistically and standard deviation of each sample was also calculated according to Snedecor method [13].

Results and Discussion

The effect of ammoniation or urea treatment on the chemical composition of BPW is given in Table 1-2. A gradual increase of 20.83-50.34 and 26.04-64.93% in nitrogen contents was observed when BPW was treated with 1-5% (w/w) ammonia or urea respectively. The increase in nitrogen content of ammoniated /urea treated was due to the formation of ammonium salts i.e. combination of ammonia with organic acids, in the BPW during its fermentation in a confind system. These ammonium salts are metabolised to form amino acids and cellular proteins by micro organisms in cattle rumen [14]. Thus increase in nitrogen level of BPW would help to improve the nutritional value of BPW when fed as feed material to the cattle. Cellulosic contents of BPW showed maximum increase of 4.41 and 3.25% whereas lignin contents showed a maximum decrease of 21.41 and 12.89% over the control after treatment with 5% ammonia or urea respectively. This is in accordance with the observation of Garrett *et al.* [15] who observed an increase in nitrogen and cellulose contents with a decrease in lignin after ammoniation of cereal straws. The rise in nitrogen content and decrease in lignin content may be viewed as important development in enhancement of the nutritive value of the BPW. Other constituents

TABLE 1. CHEMICAL COMPOSITION* OF BIOGAS PLANT WASTE AFTER AMMONIATION.

Treatment	Dry matter (%)	Nitrogen (%)	Increase in nitrogen (%)	Lipids (%)	Ash (%)	Cellulos (%)	Lignin (%)
Biogas plant waste (untreated)+	83.72	2.88	–	1.08	16.75	24.62	4.81
1% Ammonia	82.22	3.48	20.83	0.95	16.75	24.85	4.68
2% Ammonia	81.49	3.71	28.82	0.88	16.80	24.97	4.56
3% Ammonia	81.86	3.83	32.29	0.86	16.78	25.20	4.32
4% Ammonia	82.15	3.98	38.19	0.85	16.85	25.51	4.15
5% Ammonia	28.12.	4.33	50.34	0.81	16.88	25.72	3.78

* On dry matter basis - average of three replicates, +Control

TABLE 2. CHEMICAL COMPOSITION* OF BIOGAS PLANT WASTE AFTER TREATMENT WITH UREA.

Treatment	Dry matter (%)	Nitrogen (%)	Increase in nitrogen (%)	Lipids (%)	Ash (%)	Cellulose (%)	Lignin (%)
Biogas plant waste (untreated)+	83.72	2.88	–	1.08	16.75	24.62	4.81
1% Urea	81.15	3.63	26.04	0.98	16.78	24.16	4.65
2% Urea	80.22	3.74	29.86	0.95	16.85	25.02	4.45
3% Urea	81.34	4.41	53.12	0.84	16.92	25.08	4.38
4% Urea	81.00	4.68	62.50	0.78	16.92	25.25	4.22
5% Urea	80.88	4.75	64.93	0.72	17.12	25.42	4.19

* On dry matter basis - average of three replicates, +Control

TABLE 3. *IN VIVO* DIGESTIBILITY* OF BIOGAS PLANT WASTE AFTER AMMONIATION.

Treatment	Digestibility (%) after 48 hrs.			
	Dry matter	Cellulose	Minerals	Organic matter
Biogas plant waste (untreated)+	30.13±1.25	32.25±2.11	45.85±1.48	28.25±1.09
1%Ammonia	38.82±2.14	41.58±2.14	52.34±2.88	39.15±2.47
2%Ammonia	43.25±1.12	48.02±1.85	59.16±2.38	41.88±3.11
3%Ammonia	45.12±1.78	44.88±2.08	61.52±2.48	47.05±1.26
4%Ammonia	40.45±1.57	42.75±1.36	58.25±2.49	41.12±1.39
5%Ammonia	37.95±2.18	40.80±1.48	53.08±3.12	39.20±2.50

+ Control· *Average of six replicates alongwith standard deviations.

TABLE 4. *IN VIVO* DIGESTIBILITY* OF BIOGAS PLANT WASTE AFTER TREATMENT WITH UREA.

Treatment	Digestibility (%) after 48 hrs.			
	Dry matter	Cellulose	Minerals	Organic matter
Biogas plant waste (untreated)+	30.13±1.25	32.25±2.11	45.85±1.48	28.25±1.09
1%Ammonia	34.45±1.74	34.12±2.32	47.32±1.36	34.95±2.12
2%Ammonia	37.56±1.88	35.85±1.75	50.28±2.45	38.88±2.29
3%Ammonia	39.79±2.11	37.08±2.29	52.75±2.75	39.55±1.39
4%Ammonia	42.25±2.22	38.92±1.91	54.12±2.37	43.61±2.85
5%Ammonia	38.54±1.98	37.35±1.24	51.35±0.43	38.92±1.28

+ Control; * Average of six replicates alongwith standard deviations.

of BPW i.e. lipids and ash showed non-significant change after different treatments.

In vivo digestibility of BPW treated with 1-5% (w/w) ammonia is given in Table 3. It is evident from the results that BPW treated with 3% ammonia showed maximum digestibility of dry matter (45.12%), Cellulose (44.88%), minerals (61.52%) and organic matter (47.05). A decrease *in vivo* digestibility of BPW was observed when the amount of ammonia was gradually increased to 4 and 5 %.

The decrease appeared to be due to increase in pH due to the excessive amount of ammonia absorbed by BPW during ammonia treatment which inhibited the growth of the rumen microflora. The observations are in line with the findings of Gill [14] who reported increase in pH and ammonia poisoning in case of dry ammoniated roughages.

In vivo digestibility of BPW treated with different concentration of urea (1-5%, w/w) is presented in Table 4. Maximum dry matterm, cellulose, minerals and organic matter digestibility was found to be 42.25, 38.92, 54.12 and 43.61% respectively when BPW was treated with 4% urea. Further increase in urea to 5% decreased the *in vivo* digestibility of treated BPW. Maximum increase *in vivo* digestibility of 4% urea treated BPW seemed to be due to better growth conditons for ruminal microflora and hence effective utilization of treated agricultural wastes as reported by Garrett *et al.* [15] and Panjarathinam and Luximinarayan [16].

From the findings of the experiment, it is evident that Biogas plant waste which may cause pollution problem, can be converted into a nutritive feed after proper treatment with ammonia or urea.

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