UTILIZATION OF DIET CONTAINING POULTRY EXCRETA BY CATTLE AND BUFFALO RUMEN MICROORGANISMS *IN VITRO*

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(Received 27 November 2012, Accepted 8 APRIL 2013)

Keywords; poultry, Ammonia , wheat straw

ABSTRACT

A trail was conducted to determine utilization of diet containing poultry excreta with different sources of nitrogen by cattle or buffalo rumen microorganisms *in vitro*. The aim was to find alternative sources of protein and low prices ruminant diets. Commercial broiler house excreta were used as 10% of a ration. Supplemented diets were basal diet with 10% poultry excreta alone or either with 3 g/kg yeast or 1.5 g urea/kg feed or both as well as 2% molasses. The basal diet comprised 40% concentrates and 60% wheat straw on dry matter (DM) basis as a control diet. All diets were inoculated with rumen fluid of cattle or buffalo. Digestibility of DM was not significantly influenced by both species and diets. However, organic matter (OM) digestion varied significantly with different diets, the highest value was obtained by yeast, urea, poultry excreta and molasses group (64.70%). Species and diets showed significant differences in neutral digested fiber (NDF) digestion. The highest values were obtained by buffalo and the yeast, urea, poultry excreta and molasses group (65.09%). Ammonia production was significantly increased by adding urea to the diet (12.64 and 13.79). Total volatile fatty acid and acetic acid % were produced significantly higher by cattle and the group of poultry excreta only. A buffalo rumen fluid produced higher propionic acid% and less acetic: propionic percent than cattle. The total number of microorganisms influenced significantly by diet only, as yeast, urea, poultry excreta and molasses group obtained the highest number.

INTRODUCTION

Since the major problem in developing countries is the rising cost of animal feeds, therefore a need to search for alternative feed ingredients that can lead to a reduction in the cost of feed and hence the total cost of production. Poultry litter is cheap and consider as protein source, which can replace expensive protein sources (soya bean meal) in rabbit diets (1). USA considered poultry litter as an alternative source of nitrogen in ruminant nutrition since 1950's (2).

Poultry litter is generally high in protein (25%) of which approximately 45% is true protein and 55% is non-protein nitrogen (NPN, 3). It contains approximately 60% of the total N in fresh poultry excreta is uric acid (4), which may be less soluble than urea in the rumen, resulting in slower hydrolysis to ammonia and may increase total N fixation from NPN into microbial protein and enhance substrate digestion by ruminal microorganisms. However, diet degradation rate decreased as poultry litter inclusion rates increased, the rates reported values as 24.06, 22.80, 26.25 and 19.20 for diets containing 0%, 10%, 20% and 30% poultry litter (5).

Nutritive value of feedstuffs influenced high and efficient rumen functions (6). These functions include high rumen fermentation, microbial growth and type of volatile fatty acids (VFA) produced (6).

Concentration and different hays were highly degradable in the rumen of both buffalo and cattle especially significantly higher in buffalo than in cattle fluid (7). Furthermore, buffalo utilize feed more than cattle especially roughages with digestibility of feed 3-5% more than cattle (8).

The effect of poultry excreta alone or mixed with other sources of nitrogen on buffalo and cattle *in vitro* digestion was the aim of this study. Microbial cell yield and extent of fermentation, as indicated by diet digestibility and amounts of fatty acids were determined at several diets.

MATERIALS AND METHODS

Feed Formulation: Commercial broiler house excreta was sun dried, ground and stored for using it as 10% of a ration. Supplemented diets were basal diet with 10% poultry excreta alone or either with 3 g/kg yeast or 1.5 g urea/kg feed or both as well as 2% molasses. The basal diet comprised 40% concentrates and 60% wheat straw on DM basis as a control diet. Chemical composition of different diets (9) was shown in table (1).

***In vitro* procedure:** The *in vitro* procedure was modified from that reported by (10). Ruminal fluid was collected from three local cattle and buffalo slaughtered at municipality abattoir. The fluids were homogenized in a laboratory blender, filtered through four layers of cheesecloth, which was maintained in a water bath at 39 ºC. 40 ml of McDougall's artificial saliva (11) and 10 ml of strained ruminal fluid were added to each tube. About 500 mg experimental samples (1.0 mm screen) were mixed with McDougall buffer in a ratio 1:4. After gasifying with CO2, tubes were incubated at 39 ◦C. After 48 h the fermentation, 6 ml of HCl solution (20 %) and 5 ml pepsin solution were added and the incubated for 48 h stimulating post-ruminal degradation.

Chemical Analysis: After incubation, the residual substrates were collected from each tube, after washing twice with distilled water followed by filtration using grade 1 sintered glass crucibles. They were then dried in oven to constant weight for DM and OM determination. The dry matter disappearance of each sample was calculated as the difference between initial and the residual weight of the dried substrate. Content of neutral detergent fiber (NDF) of samples were determined from the dried samples using the method of (12), and losses of each sample were calculated as the difference between initial and the residual weight of the dried substrate.

Table (1) Composition of basal and commercial broiler house waste diets added to ruminal cultures

Item	Basal diet (control)	Control+10% PE*	Control+ yeast+10% PE	Control+ urea+2%molasses	Control + yeast +urea+2%molasses
Dry matter	92.32	92.10	91.92	92.10	92.12
Organic matter	86.98	86.64	86.19	86.59	86.63
Crude protein	7.07	8.72	8.92	15.72	15.92
NDF	41.80	40.88	40.88	40.88	40.88
ADF	53.26	49.55	49.55	49.55	49.55
ADL	25.23	24.43	24.43	24.43	24.43
GE (MJ/KG)	10.28	10.29	10.29	10.46	10.46

- PE = Poultry Excreta

Statistical analysis: Data were analyzed as a completely randomized design two factors (species, 2; treatment, 5) using the General Linear Model (GLM) procedure of (13). Duncan's multiple range test was used to compare treatment means at ($P<0.05$).

RESULTS AND DISCUSSION

Neither treatments nor species exhibited significant effect on dry matter digestibility (table, 2). Whereas, the digestibility of organic matter was significantly ($P<0.05$) influenced by treatments only (table, 3). All treatments showed higher organic matter digestibility than that of basal diet group. Highest value was shown by the diet consist of basal diet, yeast, urea, poultry excreta and molasses. Furthermore, NDF digestibility was significantly ($P<0.05$) influenced by both species and treatments (table, 4). Buffalo digested NDF more efficiently than cattle. Basal diet supplemented with yeast, urea, poultry excreta and molasses showed highest NDF digestion rate. All treatments exhibited higher NDF digestion than control group. Interaction between species and treatment did not show significant differences on dry matter, organic matter and NDF digestion. These may be attributed to the increases of microbial populations caused by supplemented nutrients.

Table (2) Dry matter digestibility

Species	**Treatments**					**Species mean**
	Basal diet (control)	**Control+10% PE***	**Control+ yeast+10 % PE**	**Control+ urea+2%molasses**	**Control + yeast +urea+2%molasses**	
Buffalo	59.5	60.8	64.2	60.8	66.9	62.4
Cattle	60.9	62.7	63.4	62.1	64.5	62.7
Treatments mean	60.2	61.8	63.8	61.4	65.7	62.6

*PE= poultry excreta

Table (3) Digestibility of organic matter

Species	Treatments					Species mean
	Basal diet (control)	Control+10% PE*	Control+ yeast+10% PE	Control+ urea +2%molasses	Control+yeast+ urea +2%molasses	
Buffalo	50.38	60.67	62.50	59.51	65.83	59.78
Cattle	52.74	61.39	65.56	60.04	63.57	60.56
Treatments mean	51.56c	61.03ab	63.17a	59.77b	64.70a	60.17

[a, b, c] Means with different letters within the same rows differ significantly at the 5% level.

Table (4) Digestibility of NDF

Species	Treatments					Species means
	Basal diet (control)	Control+10% PE*	Control+ yeast+10% PE	Control+ urea +2%molasses	Control+yeast + urea +2%molasses	
Buffalo	59.59	63.92	64.40	64.16	66.56	63.72a
Cattle	58.57	62.34	63.83	61.56	63.62	61.98b
Treatment means	59.08d	63.13bc	64.11ab	62.86c	65.09a	62.85

[a, b, c] Means with different letters within the same rows differ significantly at the 5% level.

Increase in nitrogen supply or sparing effects of the branched amino acids increased in the numbers of cellulolytic bacteria and fiber digestion (14). Protozoa may also be responsible for an efficient fiber digestion (15) by themselves or by a higher growth rate of cellulolytic bacteria in presence of protozoa which increases ammonia level in the rumen liquid (16). There were significant improvements of DM, OM and NDF diet digestibility as well as of DM and OM rice straw digestibility for the supplemented diets compared to the un-supplemented diet *in vivo* (17). Urea-mineral lick blocks improved the digestion of fiber in lambs on low quality roughage, even though the blocks did not greatly influence the rumen degradation of either dry mater or crude protein (18). As well as there was no difference in the degradable fiber fraction of oat straw by the supplementation with urea; molasses, urea and starch; casein; or fish and maize gluten meal (19).

Ammonia production influenced significantly (P<0.05) by different supplements in comparison with basal diet only, while species showed similar ammonia level (table, 5). However, differences in ammonia production among treated groups were not significant. Supplementation of swamp buffaloes and beef cattle with a high quality feed block that included molasses, urea, cassava, oil seed meals, minerals, and sulfur markedly enhanced ruminal NH3-N concentration at 0 h, 3 h and 6 h post-feeding (20). Optimum rumen NH3-N concentration in swamp buffaloes is higher than 13.6 mg/100ml for microbial protein synthesis, digestibility and rice straw intake (21). Increasing the rumen NH3-N concentration in swamp buffalo increased total bacteria and protozoa populations (22).

Table (5) Ruminal NH3-N concentration (mmol) of buffalo or cattle after inoculation different treatments

Species	Treatments					Species mean
	Basal diet (control)	Control+10% PE[*]	Control+ yeast+10% PE	Control+ urea+2%molasses	Control + yeast +urea+2%molasses	
Buffalo	9.92	10.93	13.02	13.02	15.18	12.41
Cattle	8.77	12.50	11.38	12.27	12.39	11.46
Treatments mean	9.34b	11.71a	12.20a	12.64a	13.79a	11.94

[a, b, c] Means with different letters within the same rows differ significantly at the 5% level.

Total amount of volatile fatty acid was significantly (P<0.05) differ among treatments and between species (table, 6). Group treated with either yeast or urea or both exceeded those of basal diet or basal diet with poultry excreta alone. Highest production of volatile acid was shown by the group supplemented with urea only (64.05 mmol). Supplementing molasses, urea and starch increased total VFA concentration of rumen fluid in cattle (19). Total VFA concentration in rumen fluid is also increased when lambs consumed urea-molasses blocks with or without additional by-pass protein (23). Similarly, in the present study the supplemented diet enhanced the rumen fermentation as compared to the basal diet group due to the additional protein N supplementation energy.

Table (6) Total volatile fatty acids (mmol) of different treatments inoculated into either buffalo or cattle ruminal cultures

Species	Treatments					Species means
	Basal diet (control)	Control+10 % PE*	Control+ yeast+10% PE	Control+ urea+2%molasses	Control + yeast +urea+2%molasses	
Buffalo	50.60	48.63	54.37	56.07	61.23	54.18b
Cattle	67.20	61.60	65.63	72.03	66.37	66.57a
Treatment means	58.90bc	55.12c	60.00ab	64.05a	63.80a	60.37

[a, b, c] Means with different letters within the same rows differ significantly at the 5% level.

Different treatments and species caused significantly ($P<0.05$) differences in acetic acid percentages (table, 7). Buffalo produced less acetic acid percent than cattle. Highest percentage was produced by the group of basal diet and poultry excreta only, which was similar to that of control group. Groups showed lowest percentage from acetic were supplemented with either yeast or urea and yeast.

Table (7) Acetic acid (%) of different treatments inoculated into either buffalo or cattle ruminal cultures

SPECIES	Treatments					Species mean
	Basal diet (control)	Control+10% PE	Control+ yeast+10% PE	Control+ urea+2%molasses	Control + yeast +urea+2%molasses	
Buffalo	61.80	62.90	60.63	59.67	58.47	60.69b
Cattle	72.27	74.67	70.97	73.27	70.80	72.39a
Treatment mean	67.03ab	68.78a	65.80bc	66.47b	64.63c	66.54

[a, b, c] Means with different letters within the same rows differ significantly at the 5% level.

Propionic acid proportion influenced by different species only (table, 8) with buffalo showed highest levels. Different diets had no significant effect of propionic acid percent. On the other hand, butyric acid did not influenced by both species and different diets (table, 9).

Table (8) Propionic acid (%) of different treatments inoculated into either buffalo or cattle ruminal cultures

SPECIES	Treatments					Means of species
	Basal diet (control)	Control+10 % PE*	Control+ yeast+10% PE	Control+ urea+2%molasses	Control + yeast +urea+2%molasses	
Buffalo	23.60	22.77	24.07	23.90	24.47	23.76a
Cattle	17.93	17.00	17.00	18.00	17.97	17.58b
Treatment means	20.77	19.88	20.53	20.95	21.22	20.67

[a, b, c] Means with different letters within the same rows differ significantly at the 5% level.

Acetic: propionic percent was significantly influenced by species (table, 10). Cattle showed highest percentage. However, different diet did not affect acetic: propionic percent. The higher concentration of VFA is an indication of a better fermentation which might be due to an improved degradation of the lingo-cellulosic feed (24).

Table (9) Butyric acid (%) of different treatments inoculated into either buffalo or cattle ruminal cultures

SPECIES	Treatments					Species mean
	Basal diet (control)	Control+10% Poultry Excreta	Control+ yeast+10% Poultry Excreta	Control+ urea+2%molasses	Control + yeast +urea+2%molasses	
Buffalo	14.63	14.33	15.27	18.17	13.67	15.21
Cattle	14.70	13.13	15.77	15.53	12.80	14.39
Treatments mean	14.67	13.73	15.52	16.85	13.23	14.80

Table (10) Acetic: propionic percent of different treatments inoculated into either buffalo or cattle ruminal cultures

SPECIES	Treatments					Species mean
	Basal diet (control)	Control+10% PE*	Control+ yeast+10% PE	Control+ urea+ 2% molasses	Control+yeast + urea+ 2% molasses	
Buffalo	2.6	2.8	2.5	2.5	2.4	2.6b
Cattle	4.0	4.4	4.2	4.1	3.9	4.1a
Treatments mean	3.3	3.6	3.4	3.3	3.2	3.3

[a, b, c] Means with different letters within the same rows differ significantly at the 5% level.

Total number of microbes increased significantly ($P<0.05$) in both buffalo and cattle with different supplement in comparison with basal diet or basal diet and urea alone (table, 11). The highest value was shown by the combination of yeast, urea, poultry excreta and molasses. Urea alone produces similar number of microbes with that produced by basal diet. Therefore, mixing different sources of protein increased the number of microbes which reflected in an increase in digestion, ammonia and volatile fatty acids. Increases in rumen bacteria and protozoa populations were also found when rice straw and grass-fed swamp buffaloes were supplemented by a urea-molasses cake (25).

The principle cellulolytic bacteria species utilize ammonia as the main source of nitrogen (26) whereas for microbes utilizing sugars or starches there is an apparently high requirement for preformed amino acids and peptides (27). Chowdhury and Huque (28) found that microbial protein synthesis was better in the combination of urea and molasses than that of urea and rice soup. Thus, in the present study energy from molasses and N from urea and yeast of the supplements may be available for microbial protein synthesis. Leng and Nolan (29) stated that, depending on the efficiency of utilization of ATP, the carbohydrate converted to microbial cells could approach the amount fermented to VFA.

Table (11) Total number ($x10^8$ cfu) of rumen microbes of buffalo and cattle treated with different treatments

species	Treatments					Species mean
	Basal diet (control)	Control+10 % PE*	Control+ yeast+10 % PE	Control+ urea+2%molasse	Control + yeast +urea+2%molasse	
Buffalo	8.07	8.12	8.65	7.99	10.09	8.58
Cattle	7.11	8.06	9.21	7.49	10.24	8.42
Treatments mean	7.59d	8.09bc	8.93b	7.74cd	10.16a	8.50

In vitro activity of rumen protozoa of Khuzestan water buffalo in fiber digestion and gas production under the same diet was higher in compared with Holstein cow (30).These results clearly indicate that under high roughage-based fattening rations, young crossbred water buffalo are better able to utilize the roughage and they perform better in terms of feed intake and live weight gains than the crossbred cattle in the Philippines (31).

In conclusion there is ability to use poultry excreta (10%) with both urea (1.5%) and bread backing yeast (3 gm. /kg feed) in improving rumen parameters of cattle and buffalo. It also clear that buffalo is better in utilize this kind of rations especially NDF and ADF fibers.

الاستفادة من العلائق الحاوية على فضلات الدواجن من قبل الاحياء المجهرية لكرش الابقار والجاموس مختبريا

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الخلاصـــة

أجريت الدراسة الحالية لتحديد الاستفادة من الاعلاف التي تحتوي على فضلات الدواجن مع مصادر مختلفة من النيتروجين من قبل الاحياء المجهرية في كرش الماشية أو الجاموس في المختبر. وكان الهدف إيجاد مصادر بديلة للبروتين لتغذية المجترات وباسعار منخفضة. استخدم فضلات افراخ اللحم التجارية وبمستوى 10٪ من العليقة. وشملت الاضافات الغذائية اضافة الى العليقة الرئيسية لفضلات الدواجن 10٪ لوحدها أو مع كل من 3 غم من الخميرة / كغم علف او اليوريا 1.5 غم / كغم علف أو كليهما اضافة الى 2% من المولاس. تتألف العليقة الرئيسية من 40٪ مركز و 60٪ تبن الحنطة على أساس المادة الجافة كعليقة السيطرة. خلطت

جميع العلائق مع سائل الكرش من الابقار أو الجاموس. لم يتاثر هضم DM تأثرا معنويا باختلاف العلائق او الاتواع الحيوانية. فيما اختلف معامل هضم OM معنويا باختلاف العليقة، اذ تم الحصول على أعلى قيمة له من العليقة التي احتوت الخميرة واليوريا وفضلات الدواجن (64.70٪). وأظهرت الأنواع والعلائق الغذائية اختلافات كبيرة في هضم NDF، بالحصول على أعلى القيم من الجاموس والخميرة واليوريا وفضلات الدواجن (65.09٪). وحدثت زيادة كبيرة في انتاج الامونيا من خلال إضافة إنتاج اليوريا إلى العلائق (12.64 و 13.79). انتجت الابقار اعلى مستوى من الاحماض الدهنية الطيارة وحامض الخليك من الجاموس لاسيما عتد استخدام العليقة التي تحوي فضلات الدواجن فقط. إنتج محلول كرش الجاموس أعلى نسبة من حامض البروبيونيك واقل نسبة من حامض الخليك : البروبيونيك من الماشية. تأثر العدد الكلي للاحياء المجهرية تأثرا معنويا بنوع العليقة فقط، أذ اعطت العليقة الحاوية على الخميرة واليوريا وفضلات الدواجن أكبر عدد.

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