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Recycling of rumen digesta: A substitute of goat feed and means of decreasing environmental pollution

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Abstract:*Rumen digesta causes environmental pollution by entering into the rivers, streams and local free water bodies and eventually imitate methane and carbon dioxide in the air. Environment pollution could be mitigate by recycling the slaughter house waste and mix with crop residue as animal feed. Rumen digesta is a good source of beneficial micro-organism and partially digested feed material of high nutritive values. This experiment was designed to save the environment and determine the nutritional value of Dried Rumen Digesta (DRD) as well as recycle it for goat feeding. This work was done with eight number of growing female Black Bengal (BB) goat having 8.5 to 9.25kg live weight with a complete randomized block design. The animals were arranged into T_0 (Control) and T_1 (Dried Rumen ingesta fed) treated group. The T_0 ration kept 9.40 MJ ME (metabolizableenergy)/kg DM and 15.70% CP (Crude Protein)/kg DM. Meanwhile, the T_1 ration contained similar ME (9.36MJ/kgDM) but lower CP (13.82%). After a sixty days feeding trial similar growth rate (48g/d and 47g/d) was observed for T_0 (Control) and T_1 (Dried Rumen ingesta) treated group. The CP intake per kg $W^{0.75}$ was found statistically (P=0.22, P=0.18) similar amount 10.58g and 11.66g respectively. The same trend was also noticed in ME intake ($W^{0.75}$) were 0.71MJ and 0.78MJ respectively. DRD fed group showed significantly (P=0.01) better feed conversion to weight gain (9.71:1) rather than the without DRD group (15.8:1). The feed intake reduced significantly (P<0.01) in T_1 group keeping remarkable lowest feed cost. The BB growing female goat (10-15kg LW) need 500g DM feed consisted of 10MJ ME(M/D) and 14.5% CP to maintain their body (Y=11.46x+517.5, R^2=0.28). For calculating daily gain, the ME and CP might be considered Y=0.003x+4.67 and Y= 0.055x+72.86 linier equations respectively. DRD saved around 2.0 Taka/ /animal/day. Rumen digesta with goat basal feed can save environment reducing fermentation mitigating the green house gas (CH_4) production @ 3215ml/animal/day. At the same time, it may recover the feed crisis as well as will reduce the feed cost. Eventually, farmers and nation might be benefited.*

Key words: *Recycle, rumen digesta, goat feed, pollution*

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I. Introduction

Rumen digesta causes environmental pollution by entering into the rivers, streams and local free water bodies and imitate methane and carbon dioxide in the air. Environment pollution could be mitigate by recycling the slaughter house waste and mix with crop residue as animal feed. Rumen digesta is one of the by-products of abattoir, it is the partially digested forage mainly found in the rumen of ruminant animals. It is fairly rich in crude protein (18.52%) and other micro-flora such as fungi, protozoa and bacteria (Agbabiaka*et al.*, 2011; Esonu*et al*., 2006; Dairo*et al*., 2005). Recycling slaughter house wastes as feedstuff for animal and its utilization as animal feed will alleviate and maximize the economy and environmentally safe disposal of slaughter-house by-products (NAVN, 1994; Esonu*et al*., 2006). Dried rumen digesta was 5.41% moisture, 18.58% CP, 3.77% crude fat, 34.44% CF, 24.81% NFE and 18.4% TA (Agbabiaka*et al.,* 2011). In developing countries agro-industrial wastes having poorly digestible fiber and low in nutritive values contribute in ruminants feeding (Agbabiaka*et al.*, 2011). Addition of rumen digesta with goat basal feed can improve feeding method and also save our environment. The prices of animal products have soared in the last two decades; this is as a result of increases in the prices of protein feedstuffs used in livestock feed formulation (Adeniji, 2000; Esonu*et al.,* 2005). This is also mainly due to competition between human beings and livestock for the available feedstuffs. These crippling realities that are characteristics of third world countries has led to the use of locally available, and cheap industrial by-products, novel crops and animal wastes as feed ingredients. The animal by-products are blood, rumen digesta, hooves, bones etc. recycling these by-products will reduce disposal and environmental pollution problems. Different methods have been used to process bovine blood and rumen digestamixture:

application of heat (Adeniyi and Balogun, 2002), sun-drying, oven drying and open air drying (Tukur*et al.*,2001). In Sylhet town, a huge number of cattle are slaughtered daily and the butcher dump it open or throw in to the cannel/river water frequently that cause the serous pollution. This experiment was designed to save the environment and determine the nutritional value of Dried Rumen Digesta (DRD) as well as recycle it for goat feeding.

II. Materials and methods

Experimental animals and dietary preparation

Just after slaughter the fresh rumen contents were collected into polyethylene bag and carried out to the Animal Nutrition Field Laboratory, Faculty of Veterinary and Animal Science, Sylhet Agricultural University, Sylhet. Processing methods was followed According to application of heat, sun-drying, oven drying (Tukur*et al.*, 2001; Adeniyi and Balogun, 2002). It was allowed initially for sundry and stored for feeding the animal as the substitute of goat feed. At the eve of feeding the dried digesta was sterilized at 121°C using autoclave.

Fig 1.1: Rumen ingesta collection

Fig 1.2: Oven dried rumen ingesta

Fig1.3: Troughing the emitted gas

Fig 1.4: Feeding the Goat with ingesta

Feeding the animal

The animals were fed according to the following ration comprising around 9.5 MJ ME and 140 -160g CP/kg DM feed (Table 3).

Table 3: Ration supplied to the growing female Black Bengal goat

Ingredients (g/100g)	Treatments	
	T_0	**T_1**
Roughages		
Green Grass	**37.56**	31.71
Rumen Ingesta	**-**	**18.24**
Concentrate		
Maize	9.37	7.14
Wheat bran	12.49	9.51
Soya meal	9.37	7.14
Gram	6.24	4.76
Khasari bran	23.1	17.60
Molasses	-	2.48
DCP	0.94	0.71
Vit min premix	0.31	0.24
NaCl	0.62	0.48
Total	**100**	**100**
M/D (MJ/kg DM)	**9.41**	**9.36**
CP (g/100g)	**15.70**	**14.5**
T_0=Control, T_1=DRD fed group		

The animals were fed two times a day. At the morning and evening, every groups (**T_0**, **T_1**) were allowed to feed almost similar fresh roughage (4kg fresh napier grass) but incase of concentrate feeding, the control group (**T_0**) was not allowed to feed the rumen ingesta and molasses. Meanwhile, the treated group (**T_1**) was allowed to feed 92g dry matter (DM) rumeningesta (sterilized at 121°C) and 12.5g (DM) molasses (Table 3). In case of mixed concentrate feeding, the control (**T_0**) animals were supplied 315g (DM) feed comprising with maize, wheat bran, soyabean meal, gram, khasari bran and some vitamin mineral premix at morning and evening. On the other hand, for **T_1**mixed concentrate of **T_0**with rumen ingesta and molasses were supplied twice a day.

Sample collection, preparation and chemical analysis

At the eve of the experimental period, the fresh rumen ingesta, concentrate feed ingredients were collected, sundried, grinded and sterilized. The representative samples were chemically analyzed at the Department of Animal Nutrition, Faculty of Veterinary and Animal Science, Sylhet Agricultural University, Sylhet analytical laboratory.

Bio-gas production and methane estimation

Fresh rumen injesta was collected into the beaker just after slaughtering the animals from the government slaughter house of Sylhet City Corporation at the early of morning. The glass beakers were tried to maintain at anaerobic condition by wrapping the mouth with rubber gloves. Then the beakers were carried out to the Animal Nutrition Laboratory within a temperature controlled sample/tool box.The content of beakers were measured using electric balance and close observation was maintained to collect the stored emitted gas into the syringe from the fermented content gradually at 0, 1,2,4,6,8, 12,16, 24, 36, 48, 72 and 96hours intervals. The gross gas was react with $Ca(OH)_2$ to determine the CO_2 level and finally the CH_4 level.

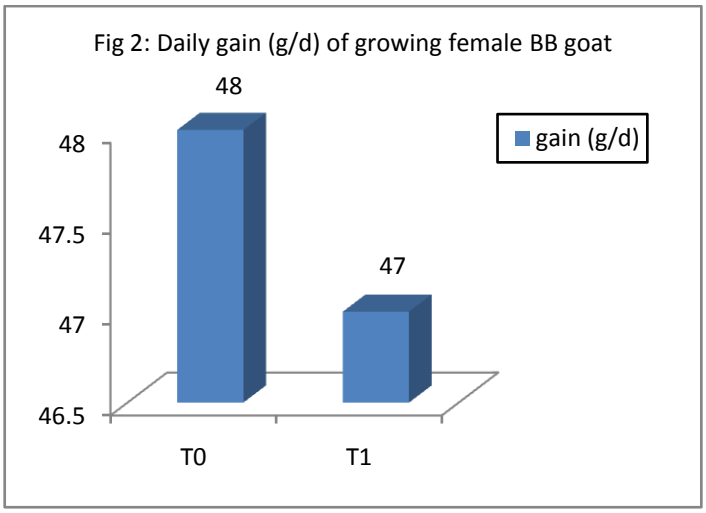
Statistical analysis

The experiment was arranged at completely randomized block design and the data were analyzed using SAS 9.1.1 computer program. The analysis of Co-variance (ANOVA) was determined and Duncan's Multiple Range Test (DMRT) was done to differentiate the variables.

III. Results and Discussion

The growth rate of Black Bengal (BB) goat was observed around 50g per day (Fig 1) both in treatment group (T_1) and control group (T_0). Usually the growth rate of BB goat ranges from 40g to 80g per day. In this work, the daily growth was found 48g (T_0) and 47g (T_1) per day respectively. The findings match with the work of Rashid (2013) who did on BB goat and had got 50.14g daily gain during the 100days feeding trial. The

treated group showed almost similar response in growth like as control or previous reviewed works. The dried rumen ingesta showed a great and alternative feeding policy of goat feeding.



Addition of rumen digesta with goat basal feed can save our environment and at the same time will recover the feed crisis as well as will reduce the feed cost according to the response of goat was found in this work. Eventually, farmers might be benefited.

Table 4: Performance of goatling between two dietary groups

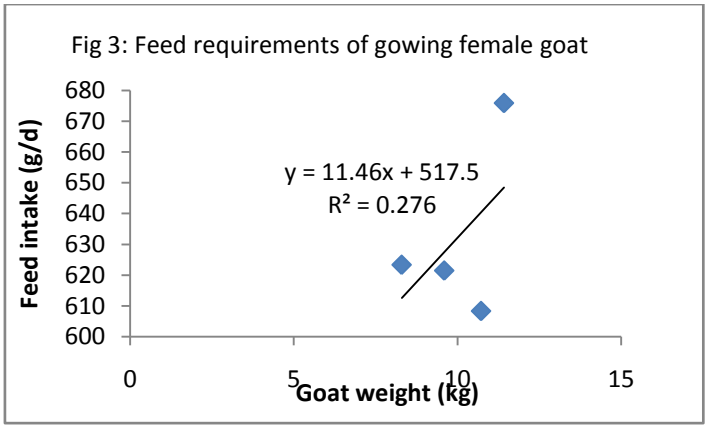
Parameters	Treatments		P value	Level of Sig.
	T_0 (Mean±SE)	T_1(Mean±SE)		
DM Feed intake (g/d)	754.42± 7.51	531.00±6.61	0.001	**
CP intake (g/d)	61.12±2.07	60.89±1.82	0.94	NS
CP intake (g/kg $w^{0.75}$/d)	10.58±0.53	11.66±0.47	0.22	NS
ME intake (MJ/d)	4.13±0.09	4.11±0.07	0.92	NS
ME intake (MJ /kg $w^{0.75}$/d)	0.71±0.03	0.78±0.02	0.18	NS
FCR	15.8±1.31	9.71±1.31	0.01	*
LWG (g/d)	48.0±5.0	47.0±5.0	0.76	NS
ILW (kg)	9.30±0.90	8.5±0.90	0.55	NS
FLW (kg)	11.42±1.16	10.83±1.16	0.72	NS
MBW (kg)	5.77±0.18	5.40±0.16	0.23	NS
Feed cost (Tk./ d)	14.47±0.36	12.68±0.32	0.003	**

T_0=Control, T_1=DRD fed group, DM= Dry matter, CP= Crude protein, ME=Metabolizable energy, FCR=Feed conversion ratio, LWG=Live weight gain, ILW=Initial live weight, FLW= Final live weight, MBW=Metabolic body weight, SE=Standard error, **=Level of significance at 1% , *= Level of significance at 5%, NS=Non significant

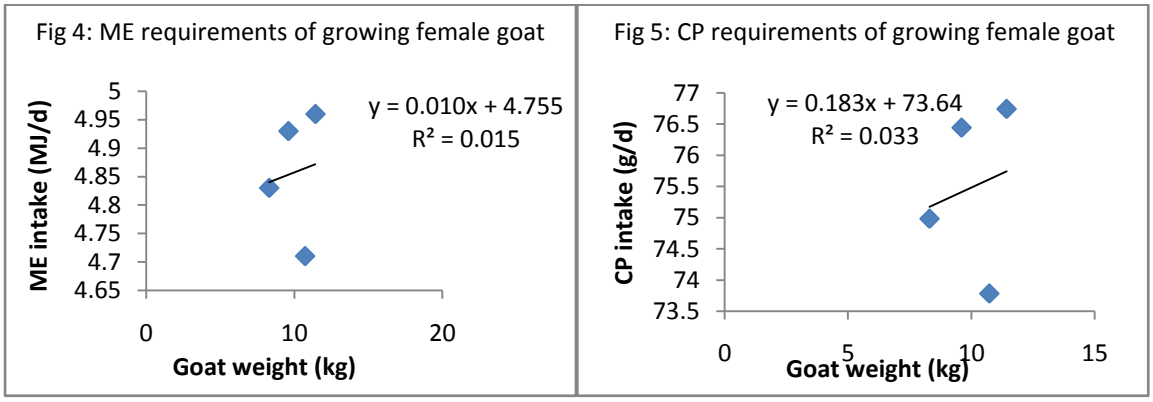
The consumption of feed by the two dietary groups of goat was showed in Table 4. The rumen ingesta fed group (T_1) consumed significantly ($P<0.01$) lower dry matter (DM) feed than that of control group (T_0). The incorporation of rumen ingesta in goat diet reduced the feed intake especially the concentrate feed. The crude protein (CP) intake (g/d/animal) and CP consumptionper kg $W^{0.75}$ was found statistically non significant ($P=0.94$) between the both group. Similarly, the energy intake (MJ/d) and MJ kg $W^{0.75}$also showed the similar trend with CP intake. The feed conversion efficiency of goat of T_1 group was found significantly better ($P<0.01$) than that of control group T_0. It could be due to replacement of concentrate feed by rumen digesta. On the other hand, the partial digested feed particles entered for better digestion and reflected the better utilization of nutrients by the animals. Recycling of feed particles increased the efficiency of animal. The initial live weight and final live weight was not found any differences. The remarkable point of this experiment was reducing the feed cost. This result (Table 4) clearly and significantly ($P<0.01$) focused the economic feeding of goat. Recycling of rumen digesta remarkable reduced the feed cost of goat. So, for better performance of goat and economic and alternative feeding could be used round the year or especially in lean period.

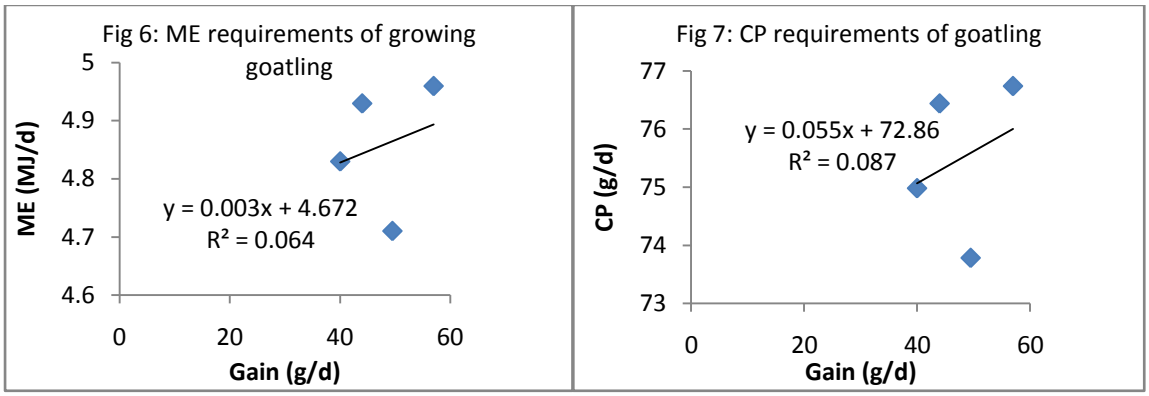
DM requirement of growing goat:

For maintenance, usually the daily consumption of feed of BB growing female goat (10-15kg LW) was 517.5g (Fig 2) reflected the required ME and CP density 4.67MJ (Fig 5) and 72.86g (Fig 6) respectively.



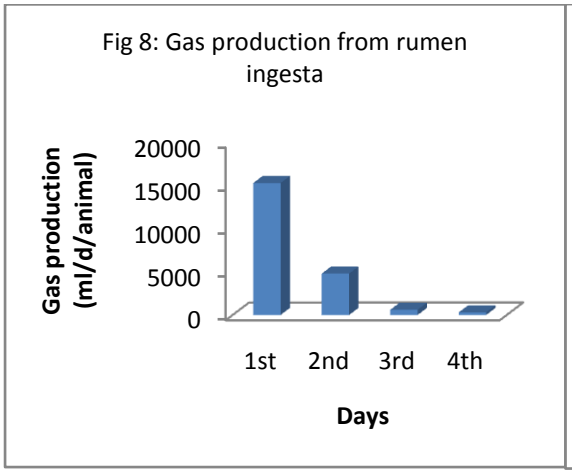
Energy and protein requirements of growing goat

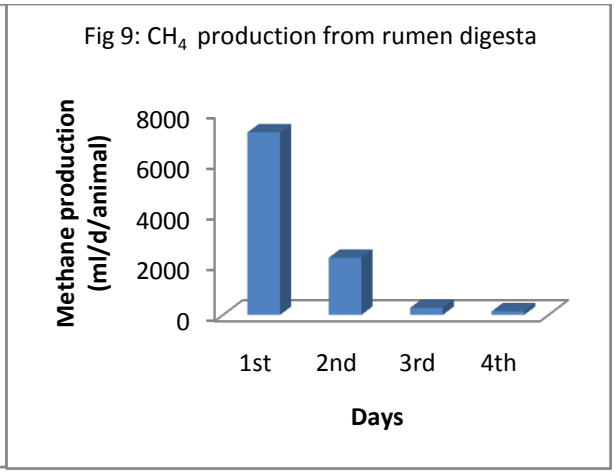


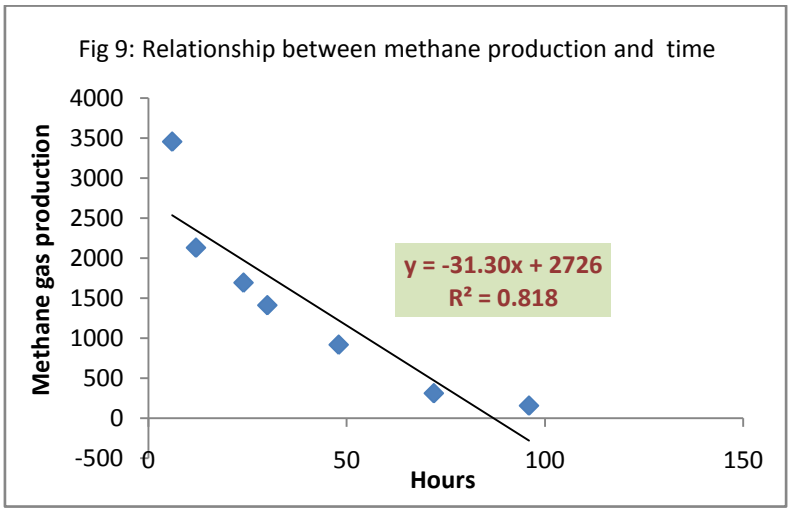


Greenhouse gas production

The green house emitting gas was observed at first day remarkably higher (>15000 ml/animal/d) than the other days. It was evident that the gas production highly correlated with the presence of moisture as well as maintaining an aerobic condition. After 4th day the gas production reduced drastically and remained tens to zero (Fig7 and 8). After slaughter of small ruminant on an average 3.0liter methane gas usually releases from rumen content up to 5 days (Fig9).







IV. Conclusion

Rumen digesta with goat basal feed can save our environment reducing fermentation and mitigating the green house gas production. At the same time, will recover the feed crisis as well as will reduce the feed cost. Eventually, farmers and nation might be benefited.

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Appendix I

Table 1: ME and CP content of supplied concentrate mixture fed to the growing goat

Ingredients	g/100g	ME(MJ/100g)	CP (g/100g)
Maize	15.0	0.180	1.575
Wheat bran	20.0	0.200	2.8
Soya meal	15.0	0.187	6.6
Gram	10.0	0.125	2.7
Khasari bran	37.0	0.3.3	6.66
DCP	1.5	-	-
Vit-Min premix	0.5	-	-
NaCl	1.0	-	-
Total	**100**	**1.025**	**20.335**

Table 2:ME and CP content of supplied grass and rumen ingesta during the experimental period of growing goat

Ingredients	ME(MJ)/kg	CP g/kg
Green grass	8	80
RumenIngesta	9	130
Molasses	13	5

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