Studies on methane production from cattle and goats in Sikkim

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ABSTRACT

The contribution of the domestic animals towards the global methane production is increasing at the rate of 1 percent annually (Mc Allister et al,1997).The present study was conducted to study the fodder utilization pattern and methane production (in vitro) in goats reared in the state of Sikkim, India.

Key words: Cattle, digestibility, goats and methane

Methane is an important green house gas which is leading to global warming. Preston and Leng,1989 observed that methane contributed roughly 18 percent of the total green house gases. It was estimated that the contribution of India was roughly 27.2milliion tones of green house gases while the annual global production was 225 million tones. The ruminants contributed significant amount of green house gases inform of methane Goats are termed as the poor mans cow they provide a dependable source of income to nearly 40 percent of the rural population in India (Anon 2002).The population of the goats are increasing at the rate of 3.4 percent annually (Anon 2002).

This accumulation of green house gases is of importance in the high altitude regions as it may lead to depletion of the ozone layer, thereby leading to various ailments in man and animals alike. The present study was conducted in all the four districts of the state to estimate the methane gas (in vitro) and total gas production besides the analysis and digestibility of commonly available feed and fodder fed to the cattle and goats reared in the state of Sikkim.

MATERIALS AND METHODS

Rumen liquor was collected from the slaughtered animals keeping into account all the necessary precautions needed. The in vitro digestibility was estimated as per the methodology suggested by Tilley and Terry (1963).The in vitro total gas production was estimated according to the methodology suggested by Menke *et.al*.(1979).The total volatile fatty acid was estimated by the methods proposed by Barnett and Reid (1957).The dry matter (DM),organic matter (OM),crude protein (CP),ether extract(EE) and crude fiber(CF) were estimated as per the methods suggested by AOAC(1984).Statistical analysis of the data were carried out as per the methods suggested by Snedecor and Cochran (1986).

RESULTS AND DISCUSSION

The results as perceived from the table-1 indicate that the average crude protein content of *Ficus hookeri* and the jungle grass is better in the monsoon months in comparison to the winter months. The results may be attributed to the succulence of the grasses in the monsoon season when new leaves sprout.

The in-vitro digestibility of fodder fed to the goats are presented in table-2 It is apparent from the table that the values pertaining to organic matter (OM), crude protein (CP) and ether extract did not vary significantly between seasons in cattle. However, the values pertaining to dry matter (DM) and crude fiber (CF) digestibility varied significantly. The in vitro digestibility of DM, OM, CP, EE and CF were higher in the monsoon in comparison to the winter season, though not significantly except for CP .In the winter months the goats are primarily reared on the tee leaves, the tree leaves have high cellulose content therefore have poor digestibility. These findings are in consonance with the results as obtained by De and Singh, (2002) .The values pertaining to the total volatile fatty acid content (TVFA) have been presented in table 3(a,b).It transpires from the table that the results are in consonance with the findings of Das and De (1999).The values regarding the in vitro digestibility of fodder has been presented in table - 2(a,b) the total volatile fatty acid production (TVFA) production after 24 hours of incubation was higher in the monsoon season in comparison to the winter season. The increase may be attributed to better DM, OM, CP and CF digestibility. The values' pertaining to in vitro total gas production was higher ($P<0.01$) in the monsoon season. The values pertaining to total gas production show that total gas production was higher ($P<0.01$) in the monsoon months.

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Table 1: Proximate analysis of feed and fodder commonly fed to the cattle in Sikkim

Sl. No	Feed and fodder	Percentage						
		DM	OM	CP	EE	CF	NFE	Ash
1	*Ficus hookeri* (leaves), Monsoon	25	85.9	16.0	3.0	21.4	45.4	14.1
2	*Ficus hookeri* (leaves), Winter	31.0	85.0	14.5	3.1	23.0	44.4	15.0
3	Forest grass, Monsoon	15.0	89.8	8.0	2.1	21.5	56.2	12.1
4	Forest grass, Winter	20.0	86.0	5.5	2.0	29.6	48.8	14.0
5	*Pennisetum purpureum*	20.0	80.9	7.9	2.0	22.3	48.7	19.0
6	*Oryza sativa,* (straw)	90.5	89.3	3.8	0.8	39.5	45.1	10.7
7	*Zea mays,* (maize)	90.3	98.3	10.1	2.5	5.5	80.0	1.7
8	*Triticum aestivum,* (grains)	91.2	98.7	9.8	2.0	5.7	81.1	1.3
9	Millet waste	69.3	94.4	9.1	2.4	7.1	75.7	5.5
10	Vegetable waste	11.0	88.5	9.5	4.5	8.0	56.5	11.5
11	Concentrate	90.0	90.8	17.2	2.7	12.3	58.5	9.1

Table 2 (a): In vitro digestibility of green fodder fed to the cattle

Digestibility	Monsoon	Winter	SEM	Probability
Dry matter(DM)	41.2± 0.53*	50.68± 0.5	0.51	0.49
Organic matter(OM)	53 58± 0.55	52.79± 0.54	0.55	0.32
Crude protein(CP)	56.48± 0.68	56.12± 0.58	0.63	0.69
Ether Extract(EE)	54.58± 0.17	53.02± 0.73	0.53	0.06
Crude Fiber(CF)	50.11± 0.44*	48.09± 0.25	0.33	0.02

Table 2(b) : Invitro digestibility of green fodder fed to the goats

Digestibility	Monsoon	Winter	SEM	Probability
Dry matter(DM)	47.91±1.43	45.8 ± 0.92	1.20	0.24
Organic matter(OM)	51.64 ± 1.49	48.51 ±.097	1.26	0.11
Crude* protein(CP)	55.01 ± .0.77	50.75 ±1.38	1.12	0.02
Ether Extract(EE)	55.70 ± 1.20	53.58± 0.77	1.01	0.17
Crude Fiber(CF)	47.08 ± 1.37	43.87 ± 0.89	1.16	0.07

Table 3(a): In vitro volatile fatty acid, total gas and methane production in cattle

Sl. No.	Parameter	Monsoon	Winter	SEM	Probability
1	TVFA(Mmole/100ml rumen liquor)	8.59± 0.15	8.11± 0.16	0.16	0.06
2	Total gas(ml/0.5g of dry matter)	42.92± 0.71*	37.42± 1.07	0.91	0.0
3	Methane(ml/0.5g of dry matter)	9.58± 0.35	10.71± 0.16	0.27	0.02
4	Methane(% of the total gas)	22.32 ± 1.32	28.62±0.7 8**	0.30	0.0
5	Methane(l/kg of dry matter)	19.17± 0.7	21.42± 0.3	0.55	0.02

Table-3(b) In vitro volatile fatty acid, total gas and methane production in goats

Sl. No.	Parameter	Monsoon	Winter	SEM	Probability
1	TVFA(Mmole/100ml rumen liquor)	7.79 ± 0.12	7.71± 0.14	0.13	0.7
2	Total gas(ml/0.5g of dry matter)	22.67± .56**	18.92± 0.52	0.54	0.0
3	Methane(ml/0.5g of dry matter)	5.13 ±0.33	5.79± 0.33	0.28	0.13
4	Methane(% of the total gas)	22.58± 1.16	30.7±0.68**	0.95	0.0
5	Methane(liters/kg of dry matter)	10.25 ± 0.66	11.58 ±0.45	0.56	0.13

**$P<0.01$, *$P < 0.05$

These findings find consonance with the results obtained by Das and De (loc.cit).The gas production was initially slower in the first 24hours which however increased significantly after the first day; similar results were obtained by De (1998). This may be attributed to microbial fermentation of the substrate having better nutrient content during the monsoon season. Similar observations too were obtained by Das and De (1998).The gas production was relatively slower in the first 24 hours which however became rapid during the subsequent period. The findings are in consonance with the results obtained by De (1998). The amount of methane production as a percent of total gas production as well as methane production per kilogram of dry matter consumed was lower in the monsoon season. Srinivas (1991) observed a negative correlation between methane production and dry matter digestibility; however the findings as obtained in the present study find consonance with results obtained by Johnson and Johnson (1995), Singh (1996) and De (1998).The increase in production of methane gas (in the winter season) can be attributed to consumption of poor quality forage. The annual methane production by cattle reared in the state of Sikkim has been presented in table 4. The total cattle population in Sikkim has been accessed to be 149775 heads, Anon (2001). The annual methane production from the cattle reared in the state of Sikkim has been presented in table - 4. The annual methane production by the cattle reared in the state as estimated was 2814.27 million tones per year during the monsoon season and 4019.96 million tones in the winter season. The annual methane production has been estimated to be around 6834.23 tones annually. Khan (1996) estimated that the annual methane production from the cattle reared in India was $5.8X10^{12}$ grams; therefore the contribution of the cattle (Sikkim) towards the methane pool of the country is roughly 11.77.

Table 4: Annual estimated methane production by goats reared in Sikkim

SNo	Season	Goat population	Methane production (l/animal/year)	Methane production (l/animal/year)	Annual methane production(t/year)
1	Monsoon	82938	10.46	1.37	113.62
2	Winter	82938	12.74	1.66	137.67
3	Monsoon+Winter	82938	23.2	3.03	251.29

The total goat population in Sikkim has been accessed to be 82,938 heads, Anon (2001).

The annual methane production from the goats reared in the state of Sikkim has been presented in table 4.The annual methane production by the goats reared in the state as estimated was 0.867 million liters per year during the monsoon season and 1.056 million liters in the winter season. The annual methane production has been estimated to be around 251.29 tonnes annually. Khan (1996) estimated that the annual methane production from the goats reared in India was $0.5X10^{12}$ grams; therefore the contribution of the goats (from Sikkim) towards the methane pool of the country is roughly 0.05 percent.

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