Chemical composition, in vitro dry matter digestibility, gas production and methane emission of maintenance, growth and production diets/rations of buffaloes

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Introduction

- Ruminants are the primary contributor of anthropogenic greenhouse gas (GHG) emission.
- Methane is an important GHG in ruminants.
- Several variables influence enteric methane production in ruminants.
- Numerous studies have shown that diet composition plays an important role in methane production.
- Reducing GHG emission in ruminants will save at least 2 to 12% of dietary gross energy (Johnson and Johnson, 1995).
- Our objective was to evaluate the effects of dietary modification in reducing methane production using inoculum form buffaloes.

Materials and Methods

- Formulated thirty diets to meet the nutrient requirements of buffaloes for maintenance, growth and production.
- Ten diets were formulated for each of these requirements.
- The study was arranged in a completely randomized design.
- The diets were analyzed to determine their chemical composition.
- The Cornell Net Carbohydrate and Protein System was used to estimate the carbohydrate and protein fractions.
- The *in vitro* batch technique was used to evaluate the diets.

Results

Table 1 Cumulative gas production (GP), *in vitro* DM digestibility (IVDMD), carbohydrate and protein fractions of maintenance (MD), growth (GD) and production (PD) requirements for buffaloes.

Diets	GP	CH_4	IVDMD	TCHO	NSC	SC	P_A	P_{B1}	P_{B2}	P_{B3}	P_C
Maintenance											
MD_1	164.25	20.68	421.9	768.2	160.8	607.4	35.6	101.4	357.9	236.9	268.2
MD_2	153.81	23.45	401.5	750.6	128.5	622	18.1	95.3	286.9	300.6	299.1
MD_3	162.94	39.85	481.7	821	185.1	635.9	194.5	194.9	233.3	157.1	220.2
MD_4	167.88	40.42	410.5	818.6	188.7	629.9	187	185.1	327.6	88.8	211.5
MD_5	164.44	25.66	425.9	769.8	214.7	555.1	172.9	213.1	429.6	48.9	135.5
MD_6	159.69	33.31	552	823.8	300.3	523.5	123.5	129.9	576.1	70.9	99.6
MD_7	178.31	28.35	359.9	831.8	157.5	674.3	187.6	217.9	24.3	425.2	145
MD_8	164.44	22.42	354.7	753.1	195.8	557.3	14.9	67.8	485.2	257.3	174.7
MD_9	155.50	23.91	473.5	816.9	300.5	516.4	74.4	158.9	411.9	209.3	145.5
MD_{10}	160.38	25.94	346.3	739.2	199.5	539.7	47.7	138	440	260.7	113.7
Growth											
GD_1	163.88	22.47	507.8	776.1	196	580.2	310.3	212.9	228.2	125.5	123.2
GD_2	162.06	33.62	488.9	725.6	237.9	487.7	27.8	85.4	547	194.2	145.6
GD_3	166.75	36.91	530.1	742.7	88.9	653.8	171.3	213.6	359.2	137.7	118.2
GD_4	166.13	42.61	690.4	734.8	141.9	592.9	172	202.4	385	154.9	85.7
GD_5	163.19	26.96	435.5	778.8	192.1	586.6	167.4	295.5	336	113.9	87.2
GD_6	166.13	23.63	529.6	780.4	247.9	532.5	140.7	292.3	428.9	28.4	109.6
GD_7	173.31	32.23	408.9	775.8	217.8	558	203.1	192.1	356.8	100.5	147.5
GD_8	166.56	21.56	354.5	786.6	124.9	661.6	109.6	218.2	416	146.3	109.8
GD_9	159.38	29.21	468.6	783.2	320	463.2	50.8	188.2	489.7	141.8	129.6
GD_{10}	160.50	26.64	363.4	706.8	231.9	474.8	15.9	146.7	550.6	195.4	91.4
Production											
PD_1	161.00	41.14	621.4	752.2	288.5	463.8	123.6	242.4	423.1	95.2	115.7
PD_2	162.44	34.31	680.4	707	237	470.1	49.4	146.5	364.4	291.4	148.3
PD_3	164.44	38.06	599.8	745.8	143.6	602.2	249.3	279.3	174.9	186.8	109.7
PD_4	168.31	40.94	502.7	765.3	203.5	561.8	158.2	296.4	304.5	132.9	108
PD_5	167.63	34.69	447	740.7	231.2	509.5	134.4	258.9	463.9	55.5	87.4
PD_6	165.25	33.39	563.4	764.3	333.5	430.8	96.9	208.1	508.5	113.1	73.4
PD_7	169.69	30.40	460.4	762.3	233	529.3	71.3	171.1	595.1	72.1	90.4
PD_8	152.56	18.66	381.3	744.8	133.1	611.7	101.5	223.6	492.5	65.6	116.8
PD_9	161.94	32.68	533.9	778.7	262.5	516.2	143.5	228.4	431.6	88.3	108.2
PD_{10}	159.13	27.02	532.8	687.4	253.2	434.1	20.2	119.6	364.3	413.6	82.3
SEM	1.60	2.13	28.19	8.9	19.2	20.4	20.2	18.1	37.2	36.7	6.8
P value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 2 Correlation between *in vitro* methane production and chemical composition of the diets/rations

Chemical composition	CH_4 g/g DDM	Protein fractions	CH_4 g/g DDM	CHO fractions	CH_4 g/g DDM
CP	-0.134	NDIP	-0.448**	TCHO	0.353**
OM	0.266**	ADIP	-0.272**	NSC	0.115
EE	-0.422**	SP	0.387**	SC	0.083
NDF	-0.009	NPN	0.450**	Starch (% NSC)	-0.104
ADF	-0.127	P_A	0.412**	C_c DM	-0.365**
Cellulose	-0.073	P_{B1}	0.284**	C_{B2}DM	0.278**
Hemi cellulose	0.130	P_{B2}	-0.053	C_{B1}DM	0.031
Lignin	-0.365**	P_{B3}	-0.341**	C_ADM	0.091
Energy	-0.032	P_C	-0.145		

- Production diets crude protein and ether extract contents were (P<0.001) higher (126.8 and 32.2 g/kg DM) than maintenance diets (82.0 and 21.0 g/kg DM).
- The fiber components were (P<0.001) lower in production (546.3, 332.8 and 244.8 g/kg DM) than maintenance diets (617.6, 395.5 and 293.0 g/kg DM).
- Protein fractions PB1 and PB2 of maintenance diets were lower (P<0.001) than growth and production diets, while protein fractions (PB3) and Pc were (P<0.001) higher in maintenance than growth and production diets.
- Mean values of PA was (P<0.001) higher in growth diets (136.9) than production (114.8) and maintenance diets (105.6 g/kg DM).
- The carbohydrate fractions followed similar trend as noted in the protein fractions.
- In vitro gas production at different time periods (12, 24 and 48 h) was similar for maintenance (63.04, 51.98 and 48.15 ml/g DM), growth (63.83, 52.73 and 48.250) and production diets (63.51, 52.54 and 47.21 ml/g DM).
- *In vitro* methane production as a proportion of degraded DM (ml/g DDM and g/kg DDM) were similar for maintenance (14.21 and 29.53), growth (42.19 and 30.25) and production diets (41.26 and 29.58), respectively.
- Dietary chemical constituents viz. EE, lignin, NDIN, ADIN and PB3 and Cc DM were (P<0.05) negatively associated with methane production, while OM, NPN, SP, PA and PB1, TCHO and CB_2 contents of the diets were positively (P<0.05) correlated with methane production.
- In conclusion, the diets formulated in the present study may not be sufficient to reduced methane production in buffaloes.