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Comparative nutrient utilisation and methane emission in cattle and buffaloes

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Abstract
The present study was undertaken to estimate the comparative nutrient utilisation and methane emission in cattle and buffaloes fed according to their requirements as per ICAR-2013 [12] standards. Eighteen lactating animals were selected for 90 days of experimental period. Animals were divided into three groups (n=6), Group-I had buffaloes, Group-II consisted Sahiwal and Group-III consisted Karan Fries cattle. Five days metabolism trial and 5 days Methane trial using SF_6 as tracer method were conducted during last month of the experiment. However, DMI was significantly (P<0.05) different in 1st and 4th fortnights in terms of per 100 kg body weight and per kg metabolic body weight. Nutrient intake per 100 kg body weight and per kg metabolic body weight were significantly (P<0.05) higher in KF whereas CFI per 100 kg body weight was higher in buffaloes. Enteric methane emission (224.45 ± 16.12 g/d), Methane energy (Mcal/d), Methane per kg of milk (28.06 ± 3.37 g/kg), Methane per kg DDMI (8.19± 0.06 g/kg) and Methane per kg CPI (1.68 ± 0.03 g/kg) was significantly (P<0.05) higher in buffaloes compared to other two groups. Loss of CH_4 energy (%) from energy intake GEI (6.84±0.47), DEI (11.14±0.73) and MEI (13.34±0.87) was higher in buffaloes than Sahiwal and KF cattle. On the basis on result out put it can be depicted that indigenous cattle emits less methane than the crossbred cattle and buffaloes.

Keywords: methane, DMI, Karan fries, Sahiwal, GEI, SF_6

Introduction
India has world's largest livestock population, consisting of 190.9 million cattle, 108.7 million buffaloes and 300 million total bovine population (DAHDF, 2014) [6], contributing considerably to the national economy and livelihood of the people. The emission of greenhouse gases (GHG) from the vast Indian livestock population has become an increasingly important topic globally due to the effect of GHG on global warming and climate change. Among GHG, Carbon dioxide (CO_2) is the first largest gas accounting to about 76.7% of the total anthropogenic GHG emissions. Methane is the second largest anthropogenic GHG which contributes about 14.3% of total anthropogenic GHG emissions (IPCC, 2006) [2], with a global warming potential of 25 times more than that of CO_2 (USEPA, 2010) [34].
Agricultural emissions of methane, 25% of which arises from enteric fermentation in livestock, accounts for about 60% of the total methane from all anthropogenic sources (Olivier *et al.*, 2005) [21]. Worldwide, livestock produces about 13.95 percent of the total methane emission (85.63 Tg/year). In India, agriculture sector contribute 19% of GHGs emission of which the contribution from enteric fermentation of livestock and manure management is 54% and 2.7%respectively. (INCCA, 2010). Apart from enteric emission, fresh and stored dung emission gaining attention recently. Many factors like species, diet, storage temperature, type of storage and farming system influence the production of methane and nitrous oxide from manure (Nampoothri *et al.*, 2015) [20]. Among these factors, ration of animal is one of the most important factors.
Ample research has been conducted in India on individual breeds and species to know enteric and manure emissions but scanty literature is available on comparative study involving cattle (Sahiwal, Karan fries) and buffaloes (Murrah) regarding this topic with similar feeding strategy. As the differences in body weight, dry matter intake, rumen physiology and rumen microbial population are the factor which are responsible for change in fermentation and emission pattern of gases. This research will help us to estimate emission factor from the particular type of animal and herd around the year. With the aforesaid backdrop kept in mind, the present study was proposed and planned with the following objective: - To estimate nutrient utilisation and methane emission in indigenous cattle, crossbred cattle and buffaloes fed as per ICAR -2013 [12] feeding standard.

Materials and Methods

The experiment was conducted at Livestock research center of ICAR-National Dairy Research Institute, Karnal. Total eighteen apparently healthy lactating animals that are 6 Murrah buffaloes, 6 Karan fries and 6 Sahiwal of mid lactation were selected and divided in to three groups of six animals each. Grouping of animals based on their average body weight, average milk yield and average milk fat percentage. All the animals were fed as per their nutrient requirements as per ICAR (2013) [12] feeding standards starting from mid lactation stage for 90 days. Green Oat forage was supplied by farm section of the institute and chopped freshly to feed experimental animals twice a daily. Proximate analysis and estimation of cell wall constituents were done by AOAC, 2005 [5] and Von soest *et al.*, (1991) [35]. Body weights were taken fortnightly, prior to feeding and watering in morning on two consecutive days. A metabolic trial of 5 days of adaptation and 7 days for collection period was also carried for nutrient digestibility. Animals were shifted into cages two days prior to the day of trial for adaptation. Samples were conducted in morning after milking. All analyses were done in triplicates. Enteric CH4 emissions were measured for a total of 5 days, using the SF6 tracer gas technique as described by Johnson *et al.* (2007) [14]. A permeation tube containing SF6, an inert gas tracer, was placed into the rumen of each animal approximately 2 days before CH4 measurements commenced. Milk yield was recorded daily for 90 days. Fortnightly milk composition and Milk urea nitrogen were performed by automated milk analyzer and MUN kit. The data were presented as means with a pooled SE (standard error) for all parameters. Statistical analysis of data for milk parameters, DMI, BW, change in BW, digestibility and methane emission was carried out by one-way analysis of variance (ANOVA) using SPSS software version 9.3.

Results and Discussion

Chemical composition of feedstuffs

Chemical composition (% DM) of the feedstuffs is presented in Table No.1. The concentrate mixture consisted of maize grain (21.5%), paddy (1%), GNC (15%), MOC (10%), CSC (8%), Gram chunni (9%), WB (25%), RB (7%), MM (2%) and Salt (1%). It contained 19.73% CP and 25.62% NDF on dry matter basis. The CP content of WS and green oat fodder was 3.36 and 9.2%, respectively. Chemical composition of the ingredients lies in normal range as reported earlier (ICAR, 2013) [12].

Table 1: Chemical composition of feedstuffs offered to experimental animals

Parameter (% DM basis)	Concentrate Mixture	WS	Oats
DM	90.28	90.87	15.75
OM	93.37	89.17	90.25
CP	19.73	3.36	9.2
EE	4.75	0.96	2.82
NDF	25.62	77.41	56.89
ADF	12.16	55.21	43.62
CF	3.69	42.26	26.32
TA	9.7	10.83	9.75

Fortnightly body weight changes in experimental animals

The data obtained in relation to the body changes of experimental animals is presented in Table No. 2. The initial body weight (BW) of animals was 591.66 ± 24.00, 370.13 ± 18.71 and 390.62 ± 37.51 kg and after experimental feeding, BW was 604.72, 378.40 and 401.84 kg in GP-I, GP-II and GP-III, respectively. The BW of the three groups cannot be subjected to statistical analysis, due to species and breed variation. However a gradual increase in BW was observed from 1st to 6th fortnight in all the groups.

Table 2: Fortnightly average body weight (kg) of experimental animals

Fortnight	GP-I	GP-II	GP-III
1st	594.08±26.25	371.02±18.67	393.19±37.33
2nd	596.21±26.23	372.86±18.76	395.52±37.14
3rd	598.58±26.01	374.77±18.82	397.30±36.97
4th	601.26±26.52	376.43±18.96	397.36±35.83
5th	603.64±26.70	378.18±18.85	399.82±36.53
6th	604.72±26.75	378.41±19.53	401.85±36.39

Fortnightly DMI (kg) per 100kg BW

The fortnightly DMI when expressed as % BW ranged between 2.60 ± 0.15 to 2.90 ± 0.08 kg/d in GP-I, 2.02± 0.14 to 2.63 ± 0.16 kg/d in GP-II and 2.66± 0.16 to 3.13± 0.15 kg/d in GP-III during various fortnights (Table No.3) and fig.No.1. It varied significantly between 1st and 4th fortnights, which was lower in GP- II whereas it was similar in GP- I and GP-III. Our results are in line with (Gandra *et al.*, 2011) [10] who observed higher DMI per 100kg BW in Holstein cattle over that of buffaloes.

Table 3: Fortnightly DMI (kg) per 100kg of experimental animals fed as per ICAR-2013 feeding standard

Fortnight	GP-I	GP-II	GP-III	P value
1st	2.90^a±0.08	2.20^b±0.19	3.13^a±0.15	0.001
2nd	2.60±0.15	2.63±0.16	3.07±0.21	0.15
3rd	2.63±0.15	2.59±0.14	3.05±0.23	0.16
4th	2.65^a±0.14	2.02^b±0.14	2.66^a±0.16	0.01
5th	2.75±0.05	2.56±0.17	2.79±0.17	0.49
6th	2.63±0.37	2.59±0.33	3.05±0.56	0.16

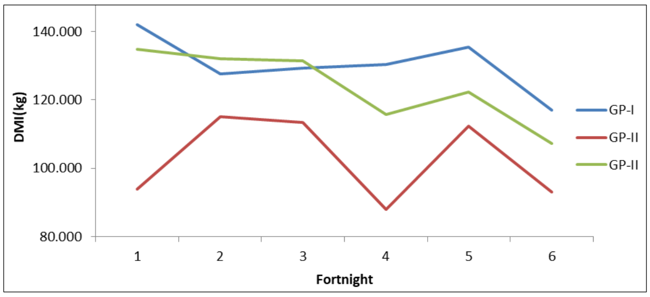

Fig 1: DMI (kg) Fornight

Plane of nutrition in three groups of animals during experiment

Intake of various nutrients during metabolism trial is presented in Table No.4. The intake of DM and OM was 13.00 ± 0.36 and 11.65 ± 0.07 in GP-1; 7.46 ± 0.33 and 6.70 ± 0.13 in GP-II and 10.63±0.99, 10.07±0.22kg/d in GP-1II, respectively. All nutrient intakes per metabolic body weight (g/kg $W^{0.75}$) except EE were also significantly higher in GP-III than other two groups.

The observed results are justified by the greater body weight in group- I (buffaloes) in relation to other two groups, which alters the result at comparison with consumption measured only in kg/day. It was observed that there was strong effect of genetic on DM consumption. (Gandra *et al.*, 2011) [10] observed that DMI as percentage of body weight (% BW) was higher in the Holstein group of cattle than in buffaloes while (Paul *et al.*, 2003) reported that DM intake was significantly (P<0.001) lower in buffaloes (2.57 kg DM per 100 kg body weight or 119.2 g/ kg $W^{0.75}$) than in cattle (3.09kg DM per 100 kg body weight or 132.0 g kg $W^{0.75}$) which is in agreement with the present study. In contrast, Buffaloes consumed more dry matter than cattle of similar age and body weight and (Chaturvedi *et al.*, 1973) [3] did not find any significant difference in cattle and buffaloes. However, (Pradhan, 1997) [23] noted that adult non-producing buffaloes consumed less feed than cattle.

Intakes of CP (kg/d) and TDN (kg/d) were 1.75 ± 0.07 and 8.88±0.13 in GP-I; 1.01±0.06 and 4.47±0.32 in GP-II and 1.49±0.17 and 6.10±0.90 in GP-III, respectively. Furthermore, the intake of EE, NDF and ADF was 0.46 ± 0.02, 5.67±0.04 and 3.56±0.05 kg/d in GP-I; 0.25 ± 0.02, 3.21±0.06 and 1.93±0.07 in GP-II and 0.40±0.04, 50.68±5.03 and 2.71±0.14 in GP-III, respectively. The intake (kg/day) of DM, OM, CP, TDN, NDF and ADF was higher in GP-I, which was obvious due to greater body weight of buffaloes in contrast to the KF and Sahiwal cattle. Lack of any effect on TDN intake per kg metabolic body agrees with the results of (Lapitan *et al.*, 2004) [4]. Moreover, CP and ADF intake per kg metabolic BW was lower (p<0.05) in GP-II in comparison to GP-II and GP-III, whereas the intake (g/kg$W^{0.75}$) of DM, OM and NDF was higher in GP-II but comparable between GP-I and GP-III.

The Holstein group showed higher nutrient intake in relation to the Nellore group (Gandra *et al.*, 2011) [10]. This result can possibly be attributed to differences in physiology, metabolism and behavior among both the groups. The Holstein animals tend to have higher energy requirements, with a dry matter intake and higher amount of nutrients (National Research Council, 2001). (Renno *et al.*, 2005) observed that zebu animals have lower dry matter intake than taurine animals when fed with high quality forage. Therefore, in diets with low quality forage, zebu cattle, generally presents higher dry matter intake.

TDNI among crossbred water buffalo was significantly higher (P < 0.05) than crossbred cattle (Lapitan *et al.*, 2004) [4] which in agreement with present study. However, in agreement to present study intake % BW or as per metabolic body size, the TDNI was not significantly different between species (Lapitan *et al.*, 2004) [18]. The crude protein digestibility (CPD) was similar for buffaloes and cattle (0·671 and 0·667 respectively) indicating that the Mediterranean buffaloes and Friesian cattle given these diets had the same CP utilization (Puppo *et al.*, 2002) [25].

Table 4: Plane of nutrition of three groups of animal during experiment

Parameter	GP-I	GP-II	GP-III	P value
DMI (kg/d)	13.00±0.36	7.46±0.33	10.63±0.99	
DMI (kg/100kgBW)	2.18^{b}±0.07	2.02^{b}±0.15	2.95^{a}±0.21	0.002
DMI (g/kg$W^{0.75}$)	107.76^{ab}±2.94	88.42^{b}±5.57	127.04^{a}±9.48	0.003
CPI (kg/d)	1.75±0.07	1.01±0.06	1.49±0.17	
CPI (kg/100kgBW)	0.30^{ab}±0.01	0.25^{b}±0.02	0.37^{a}±0.03	0.003
CPI (g/kg $W^{0.75}$)	14.94^{a}±0.48	10.76^{b}±0.60	16.11^{a}±1.17	0.001
TDNI (kg/d)	8.88±0.13	4.47±0.32	6.10±0.90	
TDNI (kg/100kgBW)	1.50^{ab}±0.06	1.21^{b}±0.12	1.74^{a}±0.16	0.024
TDNI (g/kg $W^{0.75}$)	73.83±2.40	52.97±4.75	64.34±14.64	0.289
EE intake (kg)	0.46±0.02	0.25±0.02	0.40±0.04	
EEI(kg/100kg BW)	0.08^{b}±0.00	0.07^{b}±0.01	0.10^{a}±0.01	0.021
EEI(g/kg $W^{0.75}$)	3.82±0.10	2.93±0.22	4.31±0.65	0.03
NDF intake (kg)	5.67±0.04	3.21±0.06	4.63±0.09	
NDFI(kg/100kg BW)	0.95^{b}±0.04	0.87^{b}±0.06	1.19^{a}±0.09	0.01
NDFI(g/kg $W^{0.75}$)	47.10^{ab}±1.62	37.11^{b}±1.65	50.68^{a}±5.03	0.03
ADF intake (kg)	3.56±0.05	1.93±0.07	2.71±0.14	
ADFI(kg/100kg BW)	0.60^{ab}±0.02	0.53^{b}±0.04	0.70^{a}±0.06	0.02
ADFI(g/kg $W^{0.75}$)	29.62^{a}±0.95	22.31^{b}±1.21	29.63^{a}±3.00	0.03
OM intake (kg)	11.65±0.07	6.70±0.13	10.07±0.22	
OMI(kg/100kgBW)	1.96^{b}±0.07	1.81^{b}±0.13	2.57^{a}±0.22	0.04
OMI(g/kg $W^{0.75}$)	96.58^{ab}±2.73	79.40^{b}±5.12	114.22^{a}±8.64	0.03
CF intake (kg)	2.79±0.12	1.26±0.04	1.74±0.05	
CFI(kg/100kg BW)	0.47^{a}±0.04	0.34^{b}±0.03	0.45a^{b}±0.04	0.02
CFI(g/kg $W^{0.75}$)	24.63^{a}±0.72	14.21^{b}±0.80	21.59^{a}±1.32	0.03

a,b bearing different superscripts in same row differ significantly (p<0.05)

Apparent digestibility (%) of nutrients

The digestibility coefficients of DM, OM, CP, EE, NDF and ADF are presented in Table No 5. None of the nutrients differed with regard to their digestibility among the three groups. Lack of difference in apparent digestibility of nutrients between the groups is in agreement the findings of (Pradhan *et al.*, 1997) [23] who reported similar digestibility coefficients of all the nutrients in cattle and buffaloes fed with high quality forage diet. In contrast, (Rodriguez *et al.*, 1997) [27] reported higher DM and OM digestibility in HF cows fed with diets containing different levels of concentrate in comparison to buffaloes and Nellore cattle.

Table 5: Digestibility coefficients (%) of various nutrients in the three groups of animals

Parameter	GP-I	GP-II	GP-III	P value
DM	62.14±2.50	65.79±1.47	63.90±2.53	0.52
CP	64.67±3.20	66.09±2.94	65.13±2.07	0.92
EE	73.88±1.50	76.63±1.10	75.20±2.35	0.55
NDF	57.52±3.62	53.98±2.24	50.79±2.61	0.29
ADF	48.73±4.46	44.33±3.36	41.92±6.08	0.60
OM	61.98±2.29	64.61±1.57	61.63±2.42	0.57

a,b bearing different superscripts in same row differ significantly (p<0.05)

Fortnightly average milk yield (kg) of animals

The average fortnightly yield (kg/d) of milk (Table No.6) at the beginning of the experiment was 10.23, 8.04 and 14.58, in GP-I, GP-I I and GP-III respectively. It ranged between 8.17 to 12.88 kg/d in GP-I, 4.79 to 8.04 kg/d in GP-II and 11.47 to 14.58 kg/d in GP-III during various fortnights (Table 4.10). Since all the allotted animals were of mid stage of lactation, there was a gradual decrease in milk yield, from first to sixth fortnight. Since experimental groups were of different type (breed and species variation) statistical comparison of milk yield was not possible.

Table 6: Fortnightly average milk yield (kg) of experimental animals

Fortnight	GP-I	GP-II	GP-III
1st	10.23	8.04	14.58
2nd	12.88	7.11	14.39
3rd	9.51	5.60	13.64
4th	9.51	5.50	13.06
5th	8.16	4.93	12.09
6th	8.17	4.79	11.47

Milk composition

Milk composition was studied at the beginning and the end of experiment. The effect of feeding as per ICAR-2013 [12] standard on milk composition of experimental animals is presented in Table No.7. All milk constituents were in normal range. The average milk fat percent was higher in GP-I than other two groups. The milk fat percent was 6.13, 4.89 and 4.71% in GP-I, GP-II and GP-III, respectively. All the milk composition parameters were in normal range. (Dubey *et al.*, 1997) [8] reported that average milk fat percent was 7.65% and 8.0% (Yadav *et al.*, 2013b) [37] in buffaloes while in Sahiwal; it varied from 3.33 to 4.88% at different stages of lactation (Khan *et al.*, 2007) [17]. (Yadav *et al.*, 2013) [36] Observed marked seasonal variation of milk fat (%) in buffalo milk with higher value during summer and lower during winter. (Dubey *et al.*, 1997) [8] Also observed non-significant association of season with milk fat percent. The protein content of milk was 3.45, 3.60 and 3.70% in GP-I, GP-II and GP-III, respectively. The protein percent in Jaffrabadi buffaloes was slightly higher than the Murrah buffaloes i.e. 3.5-3.8% (Dubey *et al.*, 1997, Yadav *et al.*, 2013b) [8, 36] where as it is 3.45 in present study. Overall milk protein percent was observed to be 3.4% which was within the normal range (2.7-5.2%) as reported by others in different breeds of buffaloes (AbdElSalam and El-Shibiny, 2011) [9] whereas protein percentage in indigenous breed ranged between 3.31 to 3.44 percent (Patel and Vyas, 1978 and BabuRao, 1976) [22, 1]. The lactose content was 4.86, 4.62 and 4.57%, respectively in GP-I, GP-II and GP-III, which is consistent with the reports of (Abd El-Salam and El-Shibiny 2011) [9]; (Sarsiha, 1999) [28] in cattle and (Yadav *et al.*, 2013) [37] in buffaloes. (Praphula and Anantkrishnan 1959) [24] reported 4.74 percent lactose in cow milk, for Sahiwal it was 4.62%, however lactose was found to be 4.50 and 4.52 in cross bred cattle as reported by (Mathapati and Bhat, 1988) and (Sarsiha, 1999) [28] for KF it was 4.57% in present study.

Milk SNF is not affected by single milk traits, it is rather affected by milk protein, lactose, ash etc., hence remains least variable. (Abd El-Salam and El-Shibiny, 2011) [9] reported milk SNF value as 8.3-10.4% in buffaloes and similar value was observed in our results (9.76%)., SNF values for Sahiwal was 8.87%, and (Schmidt, 1971) also found overall mean of SNF contents as 8.82 in Sahiwal cows. (Chawla, 1973) [4] reported 8.82 and (Khan *et al.*, 2007) [17] reported 8.90 percent SNF in Sahiwal cows which is closed to this present study. (Abd El-Salam and El-Shibiny, 2011) [9] reported that buffalo milk TS variation occurred between 16.3 and 18.4%, which was similar to present study 16.23%. (Chawla and Mishra, 1977) [5] reported the value as 13.37 to 14.32% in Sahiwal cows which was closely related to present study 13.57%.

Table 7: Fortnightly milk composition of animals

Parameter	GP-I	GP-II	GP-III
Fat	6.13	4.89	4.71
Protein	3.45	3.60	3.30
SNF	9.76	8.87	9.46
Lactose	4.86	4.62	4.57
TS	16.23	13.57	14.09
MUN (mg/dL)	13.42	13.24	12.85

Enteric methane emission in animals

Enteric methane (CH_4) emission and related parameters of experimental animals are presented in Table No.8 (a) & (b). CH_4 emission (g/d) was significantly (P≤0.05) lower (p<0.05) in GP-II (93.06 ± 18.47) as compared to GP-I (224.45 ± 16.12) and GP-III (150.64 ± 11.37). Methane emission per kg DMI was non- significant among GP-I (21.68 ± 1.84), GP-II (16.95 ± 2.84) and GP-III (22.80 ± 1.45), however CH_4 produced (g/kg DDMI) and g/kg milk was lower in GP-II (21.50±0.48, 19.00± 5.99) as compared to GP-I (34.96 ±2.97, 28.06 ± 3.37) and GP-III (36.20±2.31, 12.55 ± 2.68). Moreover, methane emission (Mcal /d) as well as % of GE and ME intake was also lower (P≤0.05) in GP-II in comparison to GP-I and GP-III.

Methane production in buffaloes (GP-I) per kg DMI and milk yield in the current study was within the range (23.58 to 27.30 g/kg DMI and 42.71 to 45.35 g/kg milk) as reported earlier (Singhal and Mohini, 2002) [31]. (Kannan *et al.*, 2010) [15] found methane emission 214.68 g/d in case of buffaloes which also support present study, in contrast, 195.79 g/d case of cattle which was higher in comparison to present study Methane emission from buffaloes fed on balanced diet reported 162.67 to 259.74 g/d (Singhal and Mohini, 2003) [32]. Methane production (g/kg DMI. g/kg DDM and g/kg milk) was significantly higher of Murrah (24.75, 41.88 and 49.96) than Bhadawari breed animals (21.50, 34.95 and 42.78), respectively. On roughage-concentrate diet Murrah buffaloes produced methane 20.97 g/kg DMI. (Singh *et al.*, 2018) [30] compared methane production from lactating Murrah and bhadawari breeds of buffaloes on wheat straw concentrate diet found that methane production (g/d) was significantly higher in Murrah than bhadawari buffalo which was the reflection of more dry matter intake by Murrah.

(Sinha *et al.*, 2016) [33] found that methane energy (Mcal/d) was significantly lower in crossbred cattle (1.59 Mcal/d) than buffaloes (2 Mcal/d), which in support to the current study which was 2 Mcal/d and 2.99 Mcal/d from KF and buffaloes respectively and its corresponding values were Methane energy loss/kgW$^{0.75}$ (kcal/d) was significantly in buffaloes than crossbred cattle. In contrast, (Kawashima *et al.*, 2006) [16] reported that energy loss into methane production on the basis of GE intake tended to be lower in buffalo (3.7%) than in cattle (4.4%) when fed with grass hay (*Brachiaria ruziziensis*).

Table 8(a): enteric methane emission and energy loss as methane in the three groups

Parameter	GP-I	GP-II	GP-III	P value
CH_4(g /d)	$224.45^a \pm 16.12$	$93.06^b \pm 18.47$	$150.64^{ab} \pm 11.37$	<0.001
CH_4 (Mcal /d)	$2.99^a \pm 0.09$	$1.24^c \pm 0.11$	$2.00^b \pm 0.09$	<0.001
CH_4 (g/kg milk)	$28.06^a \pm 3.37$	$19.00^{ab} \pm 5.99$	$12.55^b \pm 2.68$	0.02
CH_4 (g/kg DMI)	21.68 ± 1.84	16.95 ± 2.84	22.80 ± 1.45	0.2
CH_4 (g/kg DDMI)	$34.96^a \pm 2.97$	$21.50^b \pm 0.48$	$36.20^a \pm 2.31$	0.01
CH_4 (g/kg CPI)	100.93±21.84	119.43±27.58	146.08±25.80	0.48

Table 8(b): Loss of methane energy (%) from energy intake in the three groups

GEI	$6.84^a \pm 0.47$	$3.74^b \pm 0.19$	$4.32^b \pm 0.18$	<0.001
DEI	$11.14^a \pm 0.73$	$6.13^b \pm 0.35$	$6.8^b \pm 0.30$	<0.001
MEI	$13.34^a \pm 0.87$	$7.33^b \pm 0.42$	$8.16^b \pm 0.36$	<0.001

[a,b] bearing different superscripts in same row differ significantly ($p<0.05$)

Conclusions

KF has better nutrient utilization in terms of per 100kg body weight and whereas fiber digestion was better in case of buffaloes. Methane emission and loss of energy as methane was higher in buffaloes in comparison to indigenous and crossbred cattle.

Thus, this study indicated that although there was no variation in nutrient digestibility between groups, enteric emission of methane was higher from buffaloes in comparison to cattle. It can be concluded that indigenous cattle produce less enteric methane than crossbred cattle and buffaloes.

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