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Effect of betaine supplementation on growth performance and feed intake of gir calves

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Abstract
The present study was carried out with the objective of investigating the effects of betaine supplementation on feed intake and growth performance of Gir calves. A total sixteen Gir calves were randomly divided into four groups, *viz.* T_1 (Control), T_2, T_3 and T_4. Calves in T_1 group were fed basal diets without betaine supplementation and treatment groups were fed basal diets plus betaine @ 10, 15 and 20 grams in T_2, T_3 and T_4 groups, respectively for a period of 90 days. Average dry matter intake (kg/d, kg/100 kg body weight and g/kg $BW^{0.75}$) was not affected by betaine supplementation. Statistical analysis of data revealed that average daily gain was significantly ($p<0.05$) higher in animals of T_4 group as compared to other (T_1, T_2 and T_3) groups and the difference between T_1, T_2 and T_3 was non-significant ($p>0.05$). Average body weight (kg) and feed conversion ratio were non-significant ($p>0.05$) among treated group.

Keywords: Betaine, Gir calves, growth performance

1. Introduction
India is the fastest-growing country, in which the majority of the people are financially depend on agriculture and animal husbandry. Gir is a famous milch cattle breed of India from Gujarat. Calves play an important role in the development of dairy sector, as the future of the dairy herd merely depends upon the successful raising of young calves.

The first step in running a successful dairy is starts with proper nutritional care (Anonymous, 2012) [22]. The reduced growth rate during hot and cold seasons in 1 to 1.5 years age of calf. To achieve maximum growth of calf, feed must be balanced. Increasing the nutrient availability for better utilization of crop residue has been a primary focus of farmers for sustainable profit of farms. Feed additives in diet use to improve the overall digestibility of feed have been tried over the years.

Betaine (BET) is a feed additive and trimethyl derivative of the amino acid glycine and is widely found in a variety of plants. Betaine is extracted from sugar beet molasses. There is increasing evidence that it is a highly valuable feed additive and produces positive effects on animal performance (Shakkarpude, 2023) [23].

2. Materials and Methods
The study was conducted on Gir calves at Cattle Breeding Farm and Department of Animal Nutrition, College of Veterinary Science and A.H., Kamdhenu University, Junagadh, Gujarat. Junagadh is located at 70.5˚ east longitude and 21.4˚ north latitude and is about 60 meter above mean sea level. The annual temperature varies between a minimum of 6.5 °C and a maximum of 43.5 °C.

2.1 Experimental details
Sixteen Gir calves of around one year of age were randomly selected from cattle breeding farm. They were assured of their health and disease. Selected calves were randomly divided into four groups with four calves in each, considering their body weight.

The duration of the experiment was 90 days. Experimental calves were randomly divided into four groups with four calves in each using a completely randomized design (CRD). The nutrient requirements of the calves in terms of DCP and TDN were met as per ICAR (2013) feeding standards. The roughage part consisted of seasonal green fodder (Green sorghum, Super Napier and sorghum Sudan) and dry fodder (Groundnut haulms). The concentrate part consisted of compound cattle feed (BIS type-II), (Table 1). Feed additive as betaine powder. The experiment consisted of four dietary treatments: T_1=Basal diet fed without supplementation of Betaine. T_2=Basal diet fed with supplementation of Betaine with 10 gram/animal/day. T_3=Basal diet fed with supplementation of Betaine with 15 gram/animal/day. T_4= Basal diet fed with supplementation of Betaine with 20 gram/animal/day.

2.2 Feed intake and growth performance
Daily intake of feed was recorded for the individual calf. Weighed quantities of feed was offered to calves as per the protocol and the leftover was collected on the next day in the morning and weighed. The daily records of feed offered and residue left were maintained to calculate the feed consumption per calf per day in term of kg/day. Individual body weights of all the calves were recorded at the commencement of the experiment and subsequently at fifteen-day intervals during the entire experimental period. The average daily gain was calculated by the standard formula using total weight gain of calf divided by number of experimental days. The feed conversion ratio (FCR) was calculated by the standard formula using total feed consumed (kg) in a particular time period divided by total body weight gain (kg) during the same period.

3. Results and Discussion
3.1 Body Weight Changes (kg) and Average Daily Gain (g/d)
The changes in body weight, total weight gain and average daily gain of Gir calves under different treatments over the 90-day experimental period are presented in Table 2.
Final body weights of Gir calves at end of the 90-day experimental period were 183.00±18.66, 183.37±14.76, 186.12±5.87 and 194.00±6.76 (kg) in T_1, T_2, T_3 and T_4 groups, respectively. The mean value of total weight gain (kg) of Gir calves during this period was 46.12±2.43, 45.50±2.82, 46.00±1.69 and 56.37±2.43 with an average daily gain (g/d) of 512.50±27.06, 505.55±31.42, 511.11±18.83 and 626.38±27.06 in T_1, T_2, T_3 and T_4 groups, respectively. Statistical analysis revealed that the average final body weight had no significant difference between control and treatment groups. Total body weight change was found significantly ($p<0.05$) increased with 20 gram/d betaine supplemented (T_4) group than 10, 15 gram betaine treated (T_2 and T_3) groups and control group (T_1). Difference among T_1, T_2 and T_3 was non-significant to each other. This inconsistency may be due to differences in the form and availability of the betaine at rumen, the supplemented doses, the content of crude protein in the basal diet and amino acid status of the animals.
The overall average daily gain was significantly higher ($p<0.05$) in T_4 group compared to other groups, which were non-significant to each other. Similarly, betaine supplementation had a significant effect ($p<0.05$) on average

daily gain at the 90th day of total 90-day experimental period at the dose rate of 20 gram/d of betaine.
Similar findings were reported by Bock *et al*. (2004) [26] found significantly improved ADG in betaine-supplemented groups compared to control but no change was found in finishing phase on final body weight at the dose rate of 20 gram/d of betaine. While, Lakhani *et al*. (2020) [27], Wang *et al*. (2020) [28] and Kumar *et al*. (2021) [29] found significantly increased average daily gain and final body weight change in betaine supplemented group. However, Loest *et al*. (2002) [30] found no significant difference in average daily gain and final body weight changes.

3.2 Feed conversion ratio
Mean feed conversion ratio (FCR) in terms of kg feed consumed per kg body weight gain was calculated at fifteen-day intervals during entire experimental period of 90 days and the values are given in Table 2. Overall mean values of FCR of experimental calves were 12.26±0.58, 12.57±1.15, 11.94±0.46 and 9.66±0.76 under treatments T_1, T_2, T_3 and T_4, respectively. Statistical analysis revealed that betaine supplementation had a non-significant effect ($p>0.05$) on feed conversion ratio during experimental period.
Similar findings were reported by many workers. We should compare their findings. Huang *et al*. (2007) [24] and Mishra *et al*. (2022) [25] reported non-significant effects ($p>0.05$) of the betaine supplementation on feed conversion ratio. However, Yang *et al*. (2009) [31], Wang *et al*. (2020) [28] and Hussain (2021) [32] reported significantly improved ($p<0.05$) FCR on the betaine supplementation.

3.3 Dry Matter Intake
The average values of DMI, percent DMI, g/kg $BW^{0.75}$ DMI were calculated at fifteen-day intervals (kg/d) and have been presented in Table 2. The results showed that average DMI in terms of kg/day by experimental Gir calves under T_1, T_2, T_3 and T_4 groups were 5.40±0.29, 5.56±0.15, 5.54±0.14 and 5.58±0.13, respectively, average dry matter intake in terms of kg/100kg BW was 3.38±0.21, 3.45±0.29, 3.31±0.14 and 3.32±0.12, for calves under T_1, T_2, T_3 and T_4 groups, respectively and dry matter intake in terms of g/kg $BW^{0.75}$ was 119.69±4.57, 122.61±7.26, 119.03±4.43 and 119.39±3.30 for calves under T_1, T_2, T_3 and T_4, respectively for 90 days of experimental period. Statistical analysis revealed that betaine supplementation had a non-significant effect ($p>0.05$) on DMI in terms of kg/d, kg/100kg BW and g/kg $BW^{0.75}$ but numerically higher DMI as kg/d was observed in betaine-treated groups than the control group.
Similar finding were reported by many workers, Loest *et al*. (2002) [30], Bock *et al*. (2004) [26], Wang *et al*. (2020) [28] and Liu *et al*. (2021) [33] reported non-significant effects ($p<0.05$) of the betaine supplementation on DMI. In contrast, Lakhani *et al*. (2020) [27] and Hussain (2021) [32] observed significantly improved effects of betaine supplementation ($p<0.05$) on DMI.

4. Conclusion
The average daily gain was improved upon betaine supplementation @ 20 gram/day in Gir calves. Based on the overall results of the present experiment, it is concluded that betaine supplementation @ 20 gram/day in Gir calves improves growth performance and nutrient utilization without any adverse effect on the health status of Gir calves.

Table 1: Proximate composition and cell wall fractions of different feeds and fodders used in the experiment (% DM basis)

Ingredients and Attributes	Green Sorghum	Green Super Napier	Green Sorghum Sudan grass	Groundnut haulms	Compound cattle feed
DM	28.02	34.59	30.05	92.00	90.00
OM	90.30	92.66	90.24	88.28	93.37
CP	6.09	5.55	7.92	10.85	20.87
EE	2.46	2.31	1.51	2.16	2.98
CF	32.06	29.57	33.11	41.38	10.03
NFE	49.69	55.23	47.70	33.89	59.49
Total Ash	9.70	7.34	9.76	11.72	6.63
NDF	63.68	64.69	65.97	70.63	34.91
ADF	51.86	52.57	52.34	50.77	18.52
Hemicellulose	11.82	12.12	13.63	19.86	16.39
Cellulose	38.09	39.37	37.67	35.26	12.33
Lignin	2.96	2.52	2.77	3.54	2.62

DM, dry matter; OM, organic matter; CP, crude protein; EE, ether extract; CF, crude fibre; NFE, nitrogen-free extract; NDF, neutral detergent fibre; ADF, acid detergent fibre

Table 2: Effect of betaine supplementation on growth performance of Gir calves

Variable	Days	Treatment				SEM	'P' Value
		T_1	T_2	T_3	T_4		
	0	136.87	137.87	140.12	137.62	12.28	0.99
	15	144.00	145.75	149.25	146.37	12.70	0.99
	30	152.38	154.50	157.62	155.62	12.27	0.99
Body Weight, kg	45	159.62	162.75	164.12	164.00	11.86	0.99
	60	167.25	167.62	172.25	172.75	11.44	0.98
	75	175.25	176.62	179.75	182.87	11.79	0.97
	90	183.00	183.37	186.12	194.00	11.51	0.92
	Mean	159.76	161.21	164.17	164.75	11.93	
	15	4.84	4.73	4.72	4.75	0.18	0.96
	30	4.91	4.89	4.97	5.04	0.19	0.94
DMI, kg/day	45	5.51	5.96	6.13	6.09	0.26	0.56
	60	5.66	6.18	5.81	6.03	0.27	0.68
	75	5.88	5.75	5.79	5.79	0.14	0.98
	90	5.60	5.90	5.82	5.76	0.08	0.16
	Mean	5.40	5.56	5.54	5.58	0.18	
	15	3.47	3.34	3.18	3.26	0.22	0.85
	30	3.33	3.23	3.16	3.26	0.20	0.96
DMI, kg/100kg BW	45	3.42	3.76	3.75	3.73	0.21	0.77
	60	3.39	3.77	3.38	3.50	0.19	0.55
	75	3.44	3.31	3.23	3.18	0.19	0.81
	90	3.16	3.28	3.14	2.97	0.19	0.96
	Mean	3.38	3.45	3.31	3.32	0.19	
	15	118.75	114.82	111.15	113.37	5.52	0.82
	30	115.65	112.96	112.11	114.97	5.39	0.96
DMI, g/ kg $BW^{0.75}$	45	122.83	133.06	134.26	133.31	6.16	0.57
	60	121.71	134.75	122.54	126.97	5.91	0.45
	75	124.14	120.15	118.20	116.72	5.05	0.77
	90	115.04	119.90	115.90	111.02	5.29	0.94
	Mean	119.69	122.61	119.03	119.39	4.89	
	15	475.00	525.00	608.33	583.33	78.54	0.70
	30	558.33	583.33	558.33	616.66	91.41	0.96
ADG, g/day	45	483.33	550.00	433.33	558.33	73.61	0.68
	60	508.33	325.00	541.66	583.33	67.23	0.11
	75	533.33	600.00	500.00	675.00	58.06	0.32
	90	516.66[a]	450.00[a]	425.00[a]	741.66[b]	43.11	0.001
	Mean	512.50[a]	505.55[a]	511.11[a]	626.38[b]	26.09	
	15	13.28	9.31	8.52	8.20	1.84	0.44
	30	9.68	10.98	10.53	9.13	1.86	0.92
FCR	45	13.21	11.19	14.27	11.97	1.69	0.65
	60	12.83	19.38	11.32	11.16	2.14	0.07
	75	12.69	9.76	11.70	8.67	1.15	0.22
	90	11.87	14.79	15.29	8.82	1.51	0.06
	Mean	12.26	12.57	11.94	9.66	0.74	

SEM, standard error mean.

Note: Means superscripted with different superscripts within a row differ significantly from each other or $p<0.05$.

Conflict of Interest
Not available

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Not available

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