International Journal of Veterinary Sciences and Animal Husbandry 2025; 10(10): 170-173

ISSN: 2456-2912
NAAS Rating (2025): 4.61
VET 2025; 10(10): 170-173

www.veterinarypaper.com
Received: 05-08-2025
Accepted: 06-09-2025

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Effect of supplementing probiotic, prebiotic and synbiotic on economics in weaned Gir calves

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DOI: https://www.doi.org/10.22271/veterinary.2025.v10.i10c.2626

Abstract
Dairy calves are widely recognized as the future of the herd. Thus, management approaches have an impact on calf performance. The use of probiotic, prebiotics and synbiotic may be a viable option to increase the proliferation of commensal bacteria in the gastrointestinal tract, modulate feeding behaviour, and optimize calf health. Twenty-four weaned Gir calves (4-6 month old) were distributed into four equal homogenous groups on the basis of their live body weight and sex in completely randomized design (CRD). The control (T_1) group was offered a basal diet consisting of concentrate, green sorghum and dry fodder (Groundnut haulms) without any additional supplementation, while T_2, T_3 and T_4 groups were supplemented basal diet with probiotic @ 10 gm/calf/day, prebiotic @ 10 gm/calf/day, symbiotic @ 20 gm/calf/day, respectively, for a period of 180 days. Average cost (₹/kg body weight gain) were 122.78±13.60, 79.01±3.40, 85.37±4.90 and 82.80±6.89 in T_1, T_2, T_3 and T_4 respectively. Average costs of feeding (₹/calf/day) was non-significantly (p>0.05) affected by all the treatments. Average costs (₹/kg body weight gain) was significantly (p<0.002) affected by different treatments groups. Supplementation of probiotic has reduced cost/Kg gain by 35.64 percent, synbiotic supplementation has reduced cost/Kg gain by 32.56 percent and prebiotic supplementation has reduced cost/Kg gain by 30.46 percent as compared to control group.

Keywords: Gir calves, economics, prebiotic, probiotic, synbiotic

Introduction
Dairy calves are widely recognized as the future of the herd. Thus, management approaches have an impact on calf performance. It is important to the dairy farm economy since it raises operating expenses and lowers the animal's long-term output. Therefore, it is crucial to maintain calf health and maximize growth, particularly in the early stages of life (Ghosh and Mehla, 2012) [4]. During the weaning process, the dairy calf comes across conditions that could be stressful. Stress can lead to suppression of the immune system and increase the risk of disease in the presence of a pathogen (Johnson and McGlone, 2014) [7]. The mortality rate of calf in India ranges from 12.5 to 30% (Singh *et al.*, 2009). Mortality in Gir calves due to gastroenteritis was 19% in Cattle Breeding Farm, Kamdhenu University, Junagadh during year 2023 (Anonymous, 2023) [1]. Main cause of mortality in calves is related to an increase of Coliform bacteria counts in the intestine may produce putrefactive substance and harm the host at that time also a decrease in Lactobacilli and Bifidobacteria counts in intestine (Khare *et al.*, 2018) [8].

Since long time among the various feed additives, antibiotic is the most frequently and extensively used in livestock diets due to its therapeutic importance (Cho *et al.*, 2011) [2]. Antibiotics help in checking diarrhoea and enhance body weight gain by modifying gut micro flora in growing calves (Novak and Katz, 2006) [9]. But the growing concern of the consumers for clean and safe products have restricted the use of antibiotic as feed additive as growth promoters. The worldwide criticism over the use of antibiotics as growth promoters due to their antibiotic resistance, probiotic, prebiotic and synbiotic came up as an alternative to antibiotics.

Prebiotics are carbohydrates that must be easily available and naturally occurring since they are indigestible to animal enzymes, degraded by gut acids, and not absorbed in the upper gastrointestinal system (Gibson and Roberfroid, 1995) [5]. Fructooligosaccharide (FOS), mannan oligosaccharides (MOS) and polysaccharide-protein complexes made from the yeast *S. cerevisiae* are a few examples of common prebiotics (Xu and Gorden, 2003) [15]. Prebiotic supplements increase feed intake (Terre *et al.*, 2007) [13], average daily gain, feed efficiency (Xu and Gorden, 2003) [15], improve growth, lower the count of faecal coliform in the intestines (Ghosh and Mehla, 2012) [4], boost immunity (Fleige *et al.*, 2009) [3], and are most beneficial during stressful times or during periods when the calf is exposed to more pathogens (Heinrichs *et al.*, 2009) [6]. The microbe that supports the equilibrium of microbes in the gut is known as a probiotic. Enterococcus, Lactobacilli, Bifidobacteria, and Lactic acid bacteria (LAB) are among the microorganisms commonly employed as probiotics. Additionally, yeasts can be utilized as probiotics, and studies suggest that using these items to reduce diarrhea in calves may be beneficial (Timmerman *et al.*, 2005) [14]. The positive effects of synbiotics on feed consumption, growth performance, and gastrointestinal health are widely recognized (Sharma *et al.*, 2023) [10]. Probiotics, prebiotics, and synbiotics are three such alternatives that are thought to be safe, effective, and emerging for improving the performance of farm animals.

Materials and Methods

The present experiment was conducted on 24 weaned Gir calves, 4 to 6 months of age weighing 56 to 100 kg, at Cattle Breeding Farm, Kamdhenu University, Junagadh, Gujarat (India). The research protocol was approved by the Animal Ethics Committee of the College of Veterinary Science, Junagadh, vide protocol no KU-JVC-IAEC-LA-105-23.

Probiotic, prebiotic and synbiotic were purchased from Gujarat Enzyme, Ahmedabad and Gujarat, India. Probiotic contained *Lactobacillus sporogenes* @ $5x10^7$ C.F.U./g and yeast, *Saccharomyces cerevisiae* @ $1.5x10^8$ C.F.U./g; Prebiotic (M-MOS Powder) contained, a mannan-oligosaccharides, and Synbiotic contained *Saccharomyces cerevisiae* @ $1.5x10^8$ C.F.U./g, *Lactobacillus sporogens* @ $5x10^7$ C.F.U./g + mannan oligosaccharides.

Experimental Animals and Duration of study: The selected weaned Gir calves (N=24) were assured for the health and disease. They were randomly allotted to four equal groups with six calves in each, *viz.*, Control (T_1), Probiotic group (T_2), Prebiotic group (T_3) and Synbiotic group (T_4). Difference in mean initial body weight of experimental groups was non-significant. Duration of experiment was 180 days. Information on treatment details during the study period are provided in Table 1.

Table 1: Schedule of supplementation of probiotic, prebiotic and symbiotic

Treatment Groups	Treatment Schedule	N	Dose
Control (T_1)	Basal diet	6	No supplements
Treatment-2 (T_2)	Basal diet + Probiotic *Lactobacillus sporogenes* @ $5x10^7$C.F.U./g, *Saccharomyces cerevisiae* @ $1.5x10^8$C.F.U./g	6	10 g/day/calf.
Treatment-3 (T_3)	Basal diet + Prebiotic manna oligosaccharides	6	10 g/day/calf
Treatment-4 (T_4)	Basal diet + Synbiotic *Lactobacillus sporogenes* @ $5x10^7$C.F.U./g, *Saccharomyces cerevisiae* @ $1.5x10^8$C.F.U./g + manna oligosaccharides	6	10 g Probiotic + 10 g Prebiotic/ day/calf

Standard Managerial Practices

All the experimental animals were housed in a well-ventilated shed having tying arrangement for individual feeding and watering without having access to the other animal's diet. They were kept tied all the time and were let loose for two hours (7-9 am) in the morning for exercise in an open covered area. Each animal was given individual care. The experimental shed area was thoroughly cleaned daily in the morning. Hygienic conditions were maintained during entire experimental period to prevent any incidence of infectious and contagious diseases. Deworming of all experimental animals was carried out before start of experiment with broad spectrum anthelmintic.

Economics of Feeding

Cost of feeding per animal was calculated from the data of feed intake and prevailing procurement price of individual feed ingredients. Average actual price of feed on as such basis purchased during the experiment are given in Table 2. Cost of green and dry fodder was as per the rates decided by Junagadh Agricultural University.

Table 2: The average actual price of feeds on as such basis

Sr. No.	Feed	Price (₹/Kg)
1	Concentrate	25
2	Green Jowar	3
3	Groundnut gotar	5
4	Ground maize grain	27.3
5	Probiotic	162
6	Prebiotic	180
7	Synbiotic	171

Statistical Analysis

The data were analyzed for descriptive statistics (mean and standard error). Treatment and period effects on different parameters were analyzed by two-way analysis of variance (ANOVA) according to Snedecor and Cochran (1994) [12]. Pair-wise mean differences between groups were compared by DMRT test, and the mean differences were considered significant at $p<0.05$.

Results and Discussion

Total cost of feeding per calf was decided by using information on the amount of feed consumed and the

prevailing price of different feed ingredients used in the experiment. Average cost of feeding (₹/calf/day) was derived by subtracting total cost of feeding per calf by number of days of experiment, i.e. 182 days. Average cost (₹/kg body weight gain) was calculated by multiplying average cost of feeding (₹/calf/day) for the treatment group to 1000 gms. Divided average daily gain (gm) of the same treatment group. Average costs of feeding (₹/calf/day) were 37.42±1.26, 38.12±1.70, 37.11±1.80 and 37.82±1.41 (₹/day) in T_1, T_2, T_3 and T_4 respectively. Average cost (₹/kg body weight gain) were 122.78±13.60, 79.01±3.40, 85.37±4.90 and 82.80±6.89 in T_1, T_2, T_3 and T_4 respectively. Average cost of feeding (₹/calf/day) was non- significantly (p>0.05) affected by all the treatments. Average cost (₹/kg body weight gain) was significantly (p<0.002) affected by different treatments groups.

From the perusal of the data on cost of feeding (₹/Kg gain) it is evident that supplementation of probiotic reduced cost/Kg gain by 35.64 percent, symbiotic supplementation reduced cost/Kg gain by 32.56 percent and prebiotic supplementation reduced cost/Kg gain by 30.46 percent as compared to control group. Probiotic supplementation increased net profit (return) over control by 35.64 percent followed by synbiotic supplementation groups 32.56 percent followed by prebiotic supplementation group 30.46 percent.

Table 3: Economics of feeding probiotic, prebiotic and synbiotic to weaned Gir calves during experiment

Mean ± SE of different feeds and feed supplement intake (kg/d) during experiment (as such basis)				
Particulars	Control (T_1)	T_2	T_3	T_4
Green fodder (kg/day)	4.20±0.09	3.73±0.20	3.50±0.18	3.38±0.11
Dry fodder (kg/day)	1.29±0.09	1.09±0.14	0.99±0.07	0.98±0.06
Compound cattle feed (kg/day)	0.68±0.02	0.74±0.02	0.74±0.04	0.72±0.02
Ground maize grain (kg/day)	0.05±00	0.05±00	0.05±00	0.05±00
Probiotic (kg/day)	0	0.01±00	0	0
Prebiotic (kg/day)	0	0	0.01±00	0
Synbiotic (kg/day)	0	0	0	0.02±00
Cost of feeding experimental calves (₹/Calf) during experiment				
Particulars	Control (T_1)	T-2	T_3	T_4
Green Fodder (@ ₹ 3.0/kg)	2293.20	2036.58	1911.00	1845.48
Dry Fodder (@ ₹ 5.0/kg)	1173.90	991.9	900.9	891.80
Compound cattle feed (@ ₹ 25.0/kg)	3094.00	3367.00	3367.00	3276.00
Ground maize grain (@ ₹ 27.3/kg)	248.43	248.43	248.43	248.43
Probiotic (@ ₹ 162.0/kg)	0	294.84	0	0
Prebiotic (@ ₹ 180.0/kg)	0	0	327.60	0
Synbiotic (kg/day) (@ ₹ 171.0/kg)	0	0	0	622.44
Total (₹)	6809.53	6938.75	6754.93	6884.15
Average cost of feeding (₹/calf/day)	37.42±1.26	38.12±1.70	37.11±1.80	37.82±1.41
Average cost (₹/kg body weight gain)	122.78±13.60	79.01±3.40	85.37±4.90	82.80±6.89
Net return over control (%)		35.64 %	30.46%	32.56%

Conclusions

Supplementation of probiotic, prebiotic and synbiotic, non-significantly affected cost of feeding and cost ₹/kg body weight gain in weaned Gir calves. Supplementation of probiotic, prebiotic and synbiotic reduced cost/Kg gain by 35.64 percent, 32.56 percent and 30.46 percent respectively as compared to control in weaned Gir calves.

Acknowledgement

The Department of Livestock Production Management, College of Veterinary Science and Animal Husbandry and Cattle Breeding Farm, Kamdhenu University, Junagadh is acknowledged for providing the facilities required for the timely and successful completion of the work.

Conflict of Interest

Not available

Financial Support

Not available

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How to Cite This Article
Parmar MR, Odedra MD, Savsani HH, Karangiya VK, Gamit VV. Effect of supplementing probiotic, prebiotic and synbiotic on economics in weaned Gir calves. International Journal of Veterinary Sciences and Animal Husbandry. 2025;10(10):170-173.