RESEARCH ARTICLE

Role of Probiotic, Prebiotic and Synbiotic on Growth Performance and Biometric Development of Jaffarabadi Buffalo Calves

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Abstract

The present study was aimed to investigate the effects of probiotic, prebiotic and synbiotic supplementation on growth performance and biometric parameters in Jaffarabadi buffalo calves. A total of 24 neonatal calves were divided into four equal groups: Control (C), Probiotic (T_1), Prebiotic (T_2) and Synbiotic (T_3), each consisting of six calves. The calves were fed a restricted suckling diet, supplemented with basal feed and each group received specific additives: T_1 (probiotic), T_2 (prebiotic) and T_3 (synbiotic). The experiment was conducted for 175 days, from 8 to 182 days of age. Results showed that calves in the T_1, T_2 and T_3 groups exhibited significantly higher growth rates compared to the control group ($p<0.01$). The overall body weight gain in the early and late post-natal phases was higher by 10.17%, 8.44% and 13.50% in the probiotic, prebiotic and synbiotic groups, respectively. Synbiotic supplementation resulted in the highest average daily gain (402.71 g/d). Significant improvements were also observed in body length, height at withers and chest girth, with the T_3 group demonstrating the highest increase in chest girth. The study concludes that probiotic, prebiotic and especially synbiotic supplementation positively influence growth performance and biometric development in Jaffarabadi buffalo calves, suggesting their potential utility for improving calf health and productivity under tropical conditions.

Key words: ADG, Biometric measurements, Growth performance, Jaffarabadi buffalo calves, Prebiotics, Probiotics, Synbiotics.

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Introduction

Livestock plays a pivotal role in the Indian economy, supporting nearly two-thirds of the rural population and contributing significantly to agricultural GDP (BAHS, 2024). Among livestock, buffaloes hold a unique position in India's dairy sector, often regarded as the "bearer cheque" of rural households due to their higher milk fat content, disease resistance and superior feed conversion efficiency compared to cattle (Bandyopadhyay *et al.*, 2003). While antibiotics have traditionally been used to manage infections, growing concerns over antibiotic resistance and treatment failure (Jin *et al.,* 1996) have necessitated the exploration of safer, sustainable alternatives. In this context, probiotics, prebiotics and synbiotics have emerged as promising feed additives. Probiotics enhance gut health, improve feed efficiency and stimulate immune responses (Timmerman *et al.*, 2005), while prebiotics selectively promote beneficial gut bacteria and suppress pathogens (Deng *et al.,* 2007; Fleige *et al.,* 2009). Synbiotics, combining both, further improve nutrient utilization, growth performance and immune competence (Dar *et al.*, 2017). However, limited research has been conducted on their efficacy in Jaffarabadi buffalo calves, despite their economic importance. Therefore, this study was aimed to evaluate and compare the effects of dietary supplementation with prebiotics, probiotics and synbiotics on the growth performance of Jaffarabadi buffalo calves, with the goal of developing a cost-effective and sustainable nutritional strategy to improve calf health and productivity.

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Materials and Methods

The study was conducted at College of Veterinary Science & Animal Husbandry, Kamdhenu University, Junagadh (Gujarat, India), in collaboration with the Cattle Breeding Farm, Kamdhenu University from August 2022 to May 2024. The research protocol, No. KU-JVC-IAEC-LA-99-22, was approved by the Institute's Animal Ethics Committee.

Experimental Animals and Treatment

A total of 24 neonatal Jaffarabadi buffalo calves, free from clinical ailments, were selected from the herd maintained at the Cattle Breeding Farm. Calves were enrolled in the experiment from the 8^{th} day of age based on their birth weight (ranging from 28 to 38 kg, average birth weight of groups 34.01 to 34.61 kg) and lactation performance of their dams, which were mostly in their 2^{nd} to 4^{th} parity. The dams of these calves had average daily milk yields of 6.24 to 7.03 litters during their previous lactation and 5.10 to 5.42 litters in the first 7 days of the current lactation. Calves were blocked by sex to ensure equal representation (three males and three females per group) and were divided into four equal groups (C, T_1, T_2, & T_3) based on body weight to maintain uniformity across treatments.

All calves, under experimental age from 8 to 182 days, received a basal diet consisting of up to 3 kg of seasonal green and dry fodder offered *ad libitum* at initiation of experiment. Compound concentrate mixture was provided as per ICAR (2013) feeding standards to meet protein requirements at initiation of experiment, along with 10-15 g of mineral mixture per calf per day. Clean and fresh drinking water was available 24-h a day. The probiotic (*Lactobacillus sporogenes* 5×10^7 cfu/g and *Saccharomyces cerevisiae* 1.5×10^8 cfu/g in 1:1 ratio), prebiotic (mannan-oligosaccharides), and synbiotic (combination of pre- and probiotics) supplements were procured from Gujarat Enzyme, Ahmedabad and were administered in powder form at a fixed dose of 5 grams per day per calf by mixing with the pelleted concentrate in T_1, T_2 and T_3 groups, respectively.

All calves were individually housed in clean, well-ventilated concrete sheds with 1 m^2 floor space, non-slippery flooring and asbestos roofing, ensuring protection from weather extremes and promoting animal welfare. They were tied most of the day, let loose each morning for exercise, fed separately and maintained under strict hygiene with regular cleaning, deworming, vaccination and health monitoring. A uniform system of restricted suckling was followed across all groups to control milk intake and simulate commercial dairy practices. Calves were allowed to suckle for 50 to 60 seconds before and after milking up to 12 weeks of age and then only for 20 to 30 seconds post-milking after 12 weeks. This protocol was used to ensure consistency in milk intake and encourage concentrate consumption in later stages.

Growth parameters were recorded weekly. Body weight (kg) was measured using an electronic platform balance designed for large animals. Average daily weight gain (ADG) was calculated based on changes in weekly body weights. To estimate milk intake, weights were recorded before and after suckling. Additionally, body measurements including body length (distance from the point of shoulder to pin bone), height at withers (vertical distance from ground to the highest point of the withers) and chest girth (circumference of the chest just behind the elbows) were measured using a measuring tape. These morphometric traits were selected as indicators of skeletal development and general physical growth.

Statistical Analysis

The collected data were statistically analyzed using analysis of variance (ANOVA). Significant differences among treatment means were evaluated using Duncan's Multiple Range Test. All statistical analyses were conducted using SPSS software version 16.0 (SPSS Inc., Chicago, USA). A significance level of $p<0.05$ was used for all tests to determine statistical significance.

Results and Discussion

Changes in Body Weight of Experimental Calves

The study demonstrated that dietary supplementation with probiotics, prebiotics and synbiotics significantly improved the body weight performance of neonatal Jaffarabadi buffalo calves compared to the control group. At the beginning of the trial (8 days of age), all calf groups had similar body weights (36.15 ± 1.56 to 36.85 ± 1.06 kg). By the end of the early post-natal phase (13 weeks), body weights increased across all groups, reaching 64.53 ± 1.41 kg (Control), 67.73 ± 1.22 kg (T_1), 67.01 ± 1.90 kg (T_2) and 68.16 ± 1.80 kg (T_3), with T_3 showing the highest gain of 31.48 ± 0.59 kg, significantly greater than the control group (28.38 ± 0.39 kg). In the late post-natal phase (13-26 weeks), growth accelerated further and final weights at 26 weeks were 98.78 ± 1.39 kg (Control), 105.85 ± 1.62 kg (T_1), 104.62 ± 1.78 kg (T_2) and 107.77 ± 2.51 kg (T_3) (Table 1); here too, T_3 maintained the highest gain (39.61 ± 1.70 kg), with a 15.64% improvement over control, confirming the beneficial impact of synbiotic supplementation on long-term growth.

During the early post-natal phase (2^{nd}-13^{th} week), while weekly weight gains showed no significant differences, the supplemented groups exhibited notably higher cumulative weight gains ($p<0.01$). The synbiotic group showed the most promising results with a 10.92% increase over controls, followed by probiotic (8.0%) and prebiotic (6.80%) groups. As the calves progressed into the late post-natal phase (14^{th}-26^{th} week), the benefits became more pronounced, with statistically significant differences ($p<0.05$) emerging from the 18^{th} week onward. At the end of experiment the synbiotic group maintained its superior performance, achieving a final body weight of 107.77 kg (9.1% higher than controls), with the probiotic and prebiotic groups following closely. The net weight gain during this phase showed even greater improvements, with the synbiotic group demonstrating a remarkable 15.64% advantage over controls. When considering the entire study period (2^{nd}-26^{th} week), the synbiotic group showed the highest overall weight gain (71.09 kg), representing a 13.5% improvement

Table 1: Mean ± SE for body weight (kg) of experimental Jaffarabadi buffalo calves during early (2-13 week) and late (14-26 week) post-natal phase

Period (Wks)	Age in Days	Control	T_1	T_2	T_3	p value
Early post-natal phase (2nd to 13th weeks of age)						
Initial	8	36.15±1.56	36.85±1.06	36.70±1.82	36.68±1.60	0.96
2	14	38.38±1.57	39.11±1.07	38.98±1.82	39.01±1.63	0.96
3	21	40.62±1.52	41.55±1.08	41.28±1.84	41.40±1.62	0.94
4	28	42.87±1.48	44.05±1.12	43.68±1.86	43.81±1.61	0.90
5	35	45.15±1.50	46.58±1.58	46.16±1.87	46.31±1.61	0.86
6	42	47.48±1.48	49.11±1.13	48.65±1.89	48.88±1.60	0.83
7	49	49.83±1.46	51.73±1.16	51.23±1.90	51.56±1.61	0.79
8	56	52.27±1.43	54.28±1.16	53.76±1.91	54.23±1.65	0.78
9	63	54.73±1.44	56.88±1.17	56.31±1.90	56.93±1.79	0.76
10	70	57.15±1.42	59.55±1.19	58.90±1.90	59.70±1.71	0.72
11	77	59.57±1.41	62.23±1.23	61.58±1.90	62.56±1.73	0.69
12	84	62.02±1.43	65.00±1.24	64.25±1.91	65.36±1.78	0.62
13	91	64.53±1.41	67.73±1.22	67.01±1.90	68.16±1.80	0.60
Overall		50.05±1.46	51.89±1.14	51.42±1.88	51.90±1.66	0.81
Differences over control, kg (%)		--------	1.84 (3.67%)	1.37 (2.73%)	1.85 (3.69%)	--
Net change in b.wt. kg		28.38^{a}±0.39	30.88^{b}±0.36	30.3^{b}±0.15	31.48^{b} ±0.59	0.002
Differences over control, in net kg (%)		--------	2.5 (8.80%)	1.93 (6.80%)	3.1 (10.92%)	--
Late post-natal phase (13th to 26th weeks of age)						
13	91	64.53±1.41	67.73±1.22	67.01±1.90	68.16±1.80	0.60
14	98	67.10±1.37	70.45±1.25	69.83±1.91	71.06±1.84	0.59
15	105	69.68±1.37	73.23±1.28	72.70±1.91	73.96±1.87	0.57
16	112	72.20±1.32	76.05±1.30	75.92±1.92	76.91±1.94	0.53
17	119	74.76±1.31	78.95±1.34	78.28±1.92	79.91±2.00	0.48
18	126	77.40^{a}±1.30	81.81^{ab}±1.38	81.13^{ab} ±1.90	82.98^{b} ±2.07	0.04
19	133	79.98^{a}±1.28	84.83^{ab}±1.41	83.96^{ab} ±1.90	86.03^{b} ±2.12	0.03
20	140	82.68^{a}±1.28	87.81^{ab}±1.44	86.87^{ab} ±1.89	89.11^{b} ±2.19	0.02
21	147	85.40^{a}±1.32	90.78^{ab}±1.49	89.80^{ab} ±1.86	92.15^{b} ±2.25	0.02
22	154	88.03^{a}±1.32	93.80^{b} ±1.52	92.73^{ab} ±1.85	95.25^{b} ±2.32	0.01
23	161	90.68^{a}±1.35	96.73^{b} ±1.55	95.67^{ab} ±1.84	98.30^{b} ±2.36	0.01
24	168	93.33^{a}±1.35	99.76^{b} ±1.60	98.58^{ab} ±1.83	101.45^{b}±2.42	0.01
25	175	96.08^{a}±1.36	102.75^{b}±1.61	101.57^{ab}±1.81	104.63^{b}±2.47	0.008
26	182	98.78^{a}±1.39	105.85^{b}±1.62	104.62^{b}±1.78	107.77^{b}±2.51	0.006
Over all		81.48±1.30	89.94±6.61	83.00±1.87	84.54±1.52	0.38
Differences over control, kg (%)		-------	8.46 (10.38%)	1.52 (1.80%)	3.06 (3.76%)	
Net change in body wt. kg		34.25^{a}±0.98 (53.07%)	38.12^{ab}±0.78 (56.28%)	37.61^{ab}±0.70 (56.13%)	39.61^{b}±1.70 (58.11%)	0.01
Differences over control, kg, (%)		------	3.87 (11.30%)	3.36 (9.81%)	5.36 (15.64%)	
Pooled		65.77±1.35	70.91± 3.74	67.21±0.94	68.22±1.27	0.40
Differences over control, kg (%)		--------	5.14 (7.81%)	1.44 (2.19%)	2.45 (3.73%)	
Net change in body weight (kg)		62.63^{a}±1.14	69.0^{b} ±0.93	67.92^{b} ±0.86	71.09^{b} ±1.75	0.0007
Differences over control, in net kg, (%)		-------	6.37 (10.17%)	5.29 (8.44%)	8.46 (13.50%)	

Means with different superscripts (a,b) within a row differ significantly (p≤0.01); T1-Probiotic @ 5 g (*L. sporogenes* @ $5×10^{7}$ cfu, *S. cerevisiae* $1.5 ×10^{8}$ cfu), T2- Prebiotic @ 5 g (mannan-oligosaccharide), T3 Synbiotics (Probiotic @ 2.5 g + Prebiotic @ 2.5 g) over the control group, though these pooled results are not statistically significant.

These findings are in agreement with Jatkauskas and Vrotniakiene (2010), who observed significantly higher body weights in calves supplemented with probiotics compared to controls (p≤0.05). Agazzi *et al*. (2014) also reported significant weight gain in calves fed a probiotic-supplemented basal diet, using a combination of *Lactobacillus animalis, Lactobacillus paracasei* and *Bacillus coagulans* (p≤0.05). Similarly, Shehta *et al*. (2019) noted that calves receiving probiotics through milk replacer had significantly higher average body weights (p<0.001). Al-Saiady (2010) and Gupta *et al*. (2015) both concluded that probiotic supplementation resulted in significantly greater weight gains compared to control groups (p≤0.05). These consistent results across studies highlight the positive role of probiotic and synbiotic supplementation in enhancing calf growth and overall health. These findings strongly suggest that synbiotic supplementation offers the most comprehensive benefits for calf growth, likely due to the synergistic effects of combined probiotics and prebiotics on gut health, nutrient absorption and immune function. The results indicate that such dietary interventions can be particularly valuable for enhancing the growth and development of buffalo calves, with effects becoming more substantial as the calves mature.

Daily Body Weight Gain (g/d)

During the early post-natal phase (2^{nd} to 13^{th} weeks), calves supplemented with synbiotics (T_3) showed the highest average daily weight gain (370.33 ± 6.99 g/d), which was significantly higher (p ≤ 0.001) than the control group (335.34 ± 4.44 g/d). The probiotic (T_1: 363.92 ± 3.99 g/d) and prebiotic (T_2: 357.14 ± 3.34 g/d) groups also showed improved growth, with percentage increases of 8.51, 6.49 and 10.43 over control for T_1, T_2 and T_3, respectively. In the late post-natal phase (14^{th} to 26^{th} weeks), the treatment groups continued to show superior growth, with T_3 again recording the highest daily gain (448.02 ± 10.61 g/d), representing a 15.76% increase over control (387.90 ± 12.64 g/d). T_1 (442.86 ± 11.66 g/d) and T_2 (435.72 ± 9.58 g/d) also showed improvements of 9.92% and 11.43%, respectively. When considering the entire experimental period, pooled averages confirmed the growth-promoting effect of supplements: T_3 (402.71 ± 7.04 g/d) had the highest gain, significantly greater (13.24%) than control (355.86 ± 6.28 g/d), followed by T_1 and T_2 (Table 2-4). These results highlight that synbiotic feeding offers the most substantial improvement in growth, likely due to enhanced gut health and nutrient absorption.

The present study demonstrated that synbiotic supplementation (T_3) significantly enhanced the average daily weight gain (ADG) of Jaffarabadi buffalo calves compared to the control, as well as to probiotic (T_1) and prebiotic (T_2) groups. This improvement in growth performance is likely attributed to the synergistic effect of probiotics and prebiotics in synbiotics, which positively influence gut microbiota, enhance nutrient absorption and promote overall health. These results are in line with the findings of Sadrsaniya *et al.* (2015) who found that probiotic supplementation led to a significant improvement (p<0.001) in ADG among buffalo calves and Sharma *et al.* (2016) also reported a significant enhancement in daily gain (p<0.01) with probiotic feeding. Collectively, these findings support the conclusion that dietary supplementation, particularly with synbiotics, effectively boosts growth performance in neonatal buffalo calves by improving digestive efficiency and nutrient utilization.

Changes in Body Biometry of Experimental Calves

In the early post-natal phase, body length increased across all groups, with net gains of 10.49 cm in the control and 11.38 cm, 10.88 cm and 12.40 cm in T_1, T_2 and T_3, respectively. These differences were not statistically significant (p>0.05). During the late post-natal phase, body length continued to increase, with significantly higher gains in the treatment groups (p<0.01). Net increases were 10.93 cm (control), 13.40 cm (T_1), 14.67 cm (T_2) and 14.53 cm (T_3). Overall, the total body length gains were higher in the treatment groups, with T_3 showing the highest increase (26.93 cm), but differences were not statistically significant over the entire period (p>0.05) (Table 2-4).

In the early post-natal phase, all groups started with similar heights at withers, but from week 6 onwards, T_3 showed a significantly higher (p ≤ 0.05) increase. By week 13, T_3 reached 83.78 cm compared to 76.25 cm in the control, with T_2 and T_3 showing the highest gains (20.07% and 18.58%, respectively). Overall, treatment groups had significantly higher average heights than the control (p<0.05). In the late post-natal phase, height continued to increase, with T_3 reaching 97.16 cm and showing the most substantial growth. T_2 had the highest net gain (14.08 cm, 18.40%), followed by T_3 (13.38 cm, 15.97%) and T_1 (11.79 cm, 14.35%). Differences were highly significant (p<0.001). When pooled over both phases, T_2 showed the maximum net gain (26.87 cm, 42.18%), followed by T_3 (26.51 cm, 37.52%) and T_1 (22.84 cm, 32.11%). All treatment groups had significantly (p≤0.05) greater height at withers than the control, indicating improved skeletal growth (Table 2-4).

In the early post-natal phase, chest girth increased steadily in all groups, with T_3 showing a significantly higher (p≤0.05) value by week 13 (92.05 cm) compared to the control (83.80 cm). Net gains were highest in T_3 (14.72 cm), followed by T_1 (14.15 cm), T_2 (12.41 cm) and control (11.27 cm). During the late post-natal phase, T_3 maintained the highest chest girth, reaching 106.40 cm by week 26. The net increase over the control was 8.28 cm (9.09%) in T_3, with smaller gains in T_1 (2.14 cm) and T_2 (1.11 cm). Pooled data showed maximum chest girth in T_3 (91.90 cm), with a significant net gain of 29.07 cm (37.59%) over the control (26.27 cm). All treatment groups showed significantly higher growth (p ≤ 0.05), with T_3 having the most notable improvement (Table 2-4).

Table 2: Mean ± SEs values for weight gain, body length, height at withers and chest girth of experimental Jaffarabadi buffalo calves during early post-natal phase (2nd to 13th week of age)

Character	Group	Early post-natal phase (2nd to 13th weeks of age)													
		1	2	3	4	5	6	7	8	9	10	11	12	13	Overall
ADG (g/d)	C	319.05 ± 3.02	319.05^{a} ±7.06	321.43 ±8.03	326.19^{a} ±6.81	333.33^{a} ±7.96	338.02^{a} ±6.02	340.48^{a} ±5.73	352.38^{a} ±6.02	350.00^{a} ±8.84	350.01^{a} ±10.1	351.01^{a} ±6.11	354.76^{a} ±8.58	319.05 ±3.02	335.34^{a} ±4.44
	T_1	323.81 ±6.02	347.62^{ab} ±7.96	357.14 ±13.29	361.90^{b} ±9.52	361.90^{b} ±6.02	373.81^{b} ±7.75	364.29^{ab} ±4.87	371.43a^{b} ±5.21	380.95^{b} ±6.02	383.34^{b} ±7.75	395.24^{b} ±4.76	390.47^{b} ±6.02	323.81 ±6.02	363.92^{b} ±3.99
	T_2	326.19 ±4.38	328.57^{a} ±3.68	342.86 ±3.68	354.76^{b} ±2.38	354.77^{b} ±4.38	369.04^{b} ±7.75	361.91 ±7.06	364.28^{a} ±6.11	371.42^{a} ±6.38	380.95^{b} ±4.76	380.95^{b} ±7.96	395.17^{b} ±7.95	326.19 ±4.38	357.14^{b} ±3.34
	T_3	335.71 ±7.14	338.09^{b} ±7.06	345.24 ±10.70	357.14^{b} ±11.66	366.67^{b} ±7.96	383.33^{b} ±6.81	380.95^{b} ±12.59	385.71^{b} ±9.75	395.24^{b} ±6.02	409.53^{b} ±6.02	400.00^{b} ±5.21	400.01^{b} ±13.29	335.71 ±7.14	370.33^{b} ±6.99
Body length (cm)	C	59.16 ±3.09	59.98 ±2.92	61.20 ±3.03	61.95 ±3.00	62.78 ±3.02	63.93 ±3.01	64.85 ±3.00	65.61 ±3.06	66.53 ±2.99	67.25 ±3.02	67.80 ±3.02	68.91 ±3.04	69.65 ±3.04	64.58 ±3.01
	T_1	63.60 ±2.04	64.58 ±2.13	65.26 ±2.63	66.23 ±2.55	67.28 ±0.70	68.26 ±2.69	69.38 ±2.81	69.95 ±2.52	70.90 ±2.59	71.33 ±2.59	72.98 ±2.68	73.95 ±2.67	74.98 ±2.69	69.16 ±2.53
	T_2	59.05 ±2.33	60.40 ±2.50	60.95 ±2.39	61.65 ±2.83	62.45 ±2.99	62.18 ±3.17	63.13 ±3.19	64.43 ±3.25	65.51 ±3.36	66.66 ±3.27	67.68 ±3.32	69.00 ±3.43	69.93 ±3.36	64.03 ±2.94
	T_3	63.88 ±2.70	64.95 ±2.65	65.86 ±2.79	67.03 ±2.76	67.88 ±2.75	68.73 ±2.74	69.81 ±2.73	71.01 ±2.71	72.33 ±2.76	73.40 ±2.85	74.30 ±2.73	75.33 ±2.67	76.28 ±2.71	70.06 ±2.72
Height at withers (cm)	C	66.73 ±2.31	67.53 ±2.16	68.46 ±2.23	69.15 ±2.19	70.00 ±2.23	70.91^{a} ±2.31	71.85^{a} ±2.32	72.53^{a} ±2.29	73.25^{a} ±2.24	73.95^{a} ±2.27	74.63^{a} ±2.21	75.46^{a} ±2.24	76.25^{a} ±2.26	71.59^{ab} ±2.22
	T_1	71.11 ±2.88	72.01 ±2.97	72.91 ±2.95	73.76 ±2.88	74.71 ±2.86	75.75^{ab} ±2.79	76.86^{ab} ±2.73	77.73^{ab} ±2.59	78.70^{ab} ±2.56	79.48^{ab} ±2.60	80.46^{ab} ±2.59	81.35^{ab} ±2.56	82.16^{ab} ±2.58	76.69^{ab} ±2.73
	T_2	63.71 ±2.08	65.01 ±1.92	65.95 ±1.90	66.88 ±1.82	68.05 ±1.69	68.85^{a} ±1.68	70.06^{a} ±1.71	71.16^{a} ±1.54	72.35^{a} ±1.50	73.58^{a} ±1.46	74.43^{a} ±1.45	75.33^{a} ±1.39	76.50 ^{a} ±1.34	70.14^{a} ±1.63
	T_3	70.65 ±0.72	72.10 ±0.85	72.88 ±0.86	73.86 ±0.87	74.93 ±0.85	76.18^{b} ±0.71	77.23b ±0.77	78.41^{b} ±0.73	79.51^{b} ±0.70	80.57 ^{b} ±0.73	81.63^{b} ±0.72	82.75^{b} ±0.67	83.78^{b} ±0.63	78.37^{b} ±1.27
Chest girth (cm)	C	72.53 ±0.90	73.28 ±0.95	74.00 ±0.88	75.00 ±0.90	75.85 ±0.91	76.72 ±0.92	77.30 ±0.93	78.50 ±0.93	79.43 ±1.00	80.58 ±0.97	81.66 ±0.94	82.63 ±0.99	83.80^{a} ±1.0	77.41 ±0.87
	T_1	72.00 ±1.63	73.32 ±1.17	74.33 ±1.53	75.48 ±1.15	76.63 ±1.10	77.53 ±1.07	78.33 ±1.10	80.11 ±1.06	81.52 ±0.99	82.65 ±1.05	83.71 ±1.04	84.90 ±0.88	86.15^{ab} ±0.2	78.45 ±1.02
	T_2	72.35 ±2.42	72.65 ±2.44	73.73 ±2.45	74.76 ±2.38	75.83 ±2.46	76.86 ±2.54	78.15 ±2.50	79.18 ±2.25	80.45 ±2.56	81.60 ±2.47	82.65 ±2.52	83.80 ±2.50	84.76^{a} ±2.40	77.85 ±2.31
	T_3	77.33 ±2.75	78.45 ±2.80	79.57 ±2.76	80.72 ±2.80	81.71 ±2.73	82.80 ±2.57	84.00 ±2.70	84.95 ±2.72	86.27 ±2.68	87.40 ±2.67	88.58 ±2.79	89.76 ±2.71	92.05^{b} ±2.41	83.78 ±2.31

Table 3: Mean ± SEs values for weight gain, body length, height at withers and chest girth of experimental Jaffarabadi buffalo calves during late post-natal phase (14th to 26th week of age)

Character	Group	Late post-natal phase (14th to 26th weeks of age)													
		14	15	16	17	18	19	20	21	22	23	24	25	26	Overall
ADG (g/d)	C	366.67^{a} ±9.52	371.43^{a} ±3.68	359.52^{a} ±10.70	364.29^{a} ±15.53	376.19^{a} ±15.93	369.05^{a} ±11.90	385.71^{a} ±8.24	388.10^{a} ±12.46	376.19^{a} ±17.94	373.81^{a} ±13.51	378.57^{a} ±11.51	392.86^{a} ±13.17	387.90^{a} ±12.64	74.61 ±3.10
	T_1	388.06^{ab} ±6.81	397.62^{ab} ±8.58	402.38^{b} ±10.04	414.28^{b} ±11.66	409.53^{ab} ±7.96	430.95^{c} ±5.73	426.19^{b} ±10.70	423.81^{b} ±13.12	430.95^{b} ±10.04	420.05^{b} ±8.77	433.33^{b} ±12.04	426.19^{ab} ±12.46	442.86^{b} ±11.66	81.58 ±2.89
	T_2	402.45^{ab} ±10.02	395.24^{ab} ±7.02	402.38^{b} ±4.39	409.52^{b} ±9.52	407.14^{ab} ±4.87	404.76^{b} ±3.01	414.29^{ab} ±9.03	419.05^{ab} ±6.02	419.05^{b} ±3.01	419.05^{b} ±7.06	416.67^{b} ±6.81	426.19^{ab} ±6.81	435.72^{b} ±9.58	77.09 ±3.56
	T_3	414.29^{b} ±6.38	414.29^{b} ±12.23	421.43^{b} ±14.16	428.57^{b} ±11.06	438.10^{b} ±12.04	435.71^{c} ±10.26	440.48^{b} ±11.31	433.33^{b} ±9.52	442.86^{b} ±10.43	435.72^{b} ±8.03	449.21^{b} ±12.39	454.36^{b} ±9.57	448.02^{b} ±10.61	82.23 ±3.88
Body length (cm)	C	69.65 ±3.04	69.68 ±3.20	70.46 ±3.17	71.46 ±3.14	72.20 ±3.21	73.03 ±3.18	73.95 ±3.20	74.90 ±3.16	75.71 ±3.12	76.71 ±3.07	77.71 ±3.11	78.73 ±3.02	79.81 ±3.02	74.61 ±3.10
	T_1	74.98 ±2.69	76.03 ±2.79	76.96 ±2.78	77.95 ±2.80	79.83 ±2.84	80.20 ±2.73	80.96 ±2.80	81.97 ±2.87	82.98 ±2.90	83.91 ±2.93	85.23 ±3.02	86.30 ±3.18	87.28 ±3.20	81.58 ±2.89
	T_2	69.93 ±3.36	71.28 ±3.43	72.28 ±3.41	73.15 3.45	74.31 ±3.52	75.36 ±3.57	76.38 ±3.58	77.48 ±3.71	78.61 ±3.67	79.58 ±3.66	80.81 ±3.68	82.01 ±3.67	83.50 ±3.59	77.09 ±3.56
	T_3	76.28 ±2.71	77.25 ±2.66	78.35 ±2.63	79.16 ±2.69	80.33 ±2.74	81.38 ±2.71	83.03 ±2.85	83.85 ±2.94	85.05 ±2.87	86.30 ±2.85	87.31 ±3.02	88.43 ±2.90	89.20 ±2.95	82.23 ±3.88
Height at withers (cm)	C	76.25^{a} ±2.26	77.03^{a} ±2.28	77.98^{a} ±2.34	78.75^{a} ±2.39	79.43^{a} ±2.43	80.20^{a} ±2.48	80.96^{a} ±2.57	81.75^{a} ±2.61	82.30^{a} ±2.59	83.21^{a} ±2.78	83.95^{a} ±2.80	84.76^{a} ±2.82	85.56^{a} ±2.91	81.32^{a} ±2.57
	T_1	82.16^{ab} ±2.58	83.01^{ab} ±2.59	83.95^{ab} ±2.69	84.65^{ab} ±2.46	85.63^{ab} ±2.42	86.50^{ab} ±2.40	87.38^{a} ±2.40	88.50^{ab} ±2.39	89.31^{ab} ±2.40	90.23^{ab} ±2.39	91.15^{ab} ±2.37	92.01^{ab} ±2.43	92.95^{ab} ±2.38	87.69^{ab} ±2.43
	T_2	76.50^{a} ±1.34	77.48^{a} ±1.26	78.66^{a} ±1.15	79.68^{a} ±1.11	80.61^{a} ±1.07	81.51^{a} ±0.99	82.41^{a} ±1.02	83.55^{a} ±0.99	84.65^{a} ±0.96	86.01^{a} ±1.08	87.11^{a} ±0.93	88.25^{a} ±0.84	89.55^{a} ±0.70	83.32^{b} ±0.95
	T_3	83.78^{b} ±0.63	84.68^{b} ±0.67	85.67^{b} ±0.60	86.61^{b} ±0.64	87.70^{b} ±0.74	88.81^{b} ±0.72	89.78^{b} ±0.73	90.73^{b} ±0.77	91.71^{b} ±0.73	92.63^{b} ±0.66	93.98^{b} ±0.75	95.11^{b} ±0.84	96.25^{b} ±0.88	90.33^{b} ±0.71
Chest girth (cm)	C	83.80^{a} ±1.0	85.66^{a} ±1.55	86.66^{a} ±1.62	87.45^{a} ±1.96	88.58^{a} ±1.74	89.63^{a} ±1.75	90.48^{a} ±1.77	91.25^{a} ±1.82	92.81 ±2.13	93.53 ±2.16	94.43 ±2.27	95.25 ±2.34	96.45 ±2.64	91.04 ±1.87
	T_1	86.15^{ab} ±0.2	87.70^{ab} ±0.84	88.43^{ab} ±0.82	88.38^{ab} ±1.66	89.80^{ab} ±1.67	91.33^{ab} ±1.62	92.10^{ab} ±1.63	93.38^{a} ±1.72	94.45 ±1.69	96.10 ±1.76	97.13 ±1.68	98.78 ±1.70	99.91 ±1.64	93.18 ±1.47
	T_2	84.76^{a} ±2.40	85.95^{ab} ±2.52	87.10^{ab} ±2.52	87.96^{ab} ±2.58	89.33^{a} ±2.54	90.50^{a} ±2.52	91.71^{ab} ±2.57	92.88^{ab} ±2.52	93.96 ±2.60	95.03 ±2.65	96.15 ±2.68	97.08 ±2.75	98.13 ±2.77	92.15 ±2.59
	T_3	92.05^{b} ±2.41	93.25^{b} ±2.49	94.38^{b} ±2.34	95.46 ±2.33	96.51^{b} ±2.37	97.81^{b} ±2.36	98.88^{b} ±2.43	99.98^{b} ±2.45	101.07 ±2.50	102.23 ±2.52	103.05 ±2.75	104.40 ±2.92	105.12 ±3.19	99.32 ±2.56

Table 4: Mean± SE for daily weight gain, body length, height at withers and chest girth of experimental Jaffarabadi buffalo calves during the post-natal phase (1st to 26th week of age)

Groups	Overall growth parameters							
	Average daily gain	Difference over control (g)	Body length	Difference over control (cm)	Height at withers	Difference over control (cm)	Chest girth	Difference over control (cm)
C	$355.86^{a}\pm6.28$	0.00	69.79±3.02	0.00	$76.65^{a}\pm2.35$	0.00	$84.24^{a}\pm1.35$	0.00
T_1	$391.40^{b}\pm5.12$	35.79	75.63±2.67	5.84	$82.55^{ab}\pm2.55$	5.9	$85.80^{ab}\pm1.16$	1.56
T_2	$385.83^{b}\pm4.72$	29.56	70.88±3.26	(8.36%)	$76.99^{a}\pm1.23$	0.34	$85.01^{ab}\pm2.43$	0.77
T_3	$402.71^{b}\pm7.04$	47.11	76.97±2.75	(1.56%)	$85.09^{b}\pm1.20$	8.44	$91.90^{b}\pm2.6$	7.66

Means with different superscripts (a,b) within a column differ significantly, p≤0.05); T1-Probiotic @ 5 g (*L. sporogenes* @ 5×10^7 cfu, *S. cerevisiae* 1.5×10^8 cfu), T2- Prebiotic @ 5 g (mannan-oligosaccharide),T3 Synbiotics (Probiotic @2.5 g+ Prebiotic @ 2.5 g)

The present study evaluated the effect of dietary supplementation on body length, height at withers and chest girth in Jaffarabadi buffalo calves. Body length showed no significant differences (p>0.05) across treatment and control groups, consistent with the findings of Sharma *et al.* (2023) and Ratre *et al.* (2019), who also reported no effect of probiotics or synbiotics on this parameter. This suggests that body length may not be highly responsive to supplementation or that the experimental conditions did not allow for measurable changes. In contrast, significant improvements in height at withers were observed in the treatment groups, particularly in T_2 and T_3, aligning with the findings of Dar *et al.* (2022), Chandra *et al.* (2009) and Kamal *et al.* (2015). These increases can likely be attributed to enhanced nutrient absorption, particularly of calcium and phosphorus, promoting better skeletal growth. However, studies by Sharma *et al.* (2023) and Ratre *et al.* (2019) found no such effects, suggesting that the influence of supplementation may depend on factors like breed, age, or dietary composition. Chest girth was significantly higher in the treatment groups, especially in T_3, which showed the greatest increase (29.07 cm, 37.59%). This aligned with previous studies (Chandra *et al.*, 2009; Agazzi *et al.*, 2014; Kamal *et al.*, 2015). Improved chest girth reflects better body development and feed efficiency due to microbial activity. However, some studies (Mandouh *et al.*, 2020; Wang *et al.*, 2021; Sharma *et al.*, 2023) did not report significant changes, suggesting variability in outcomes depending on experimental conditions.

Conclusion

The results revealed that supplementation with probiotics (T_1), prebiotics (T_2) and synbiotics (T_3) improved growth and body measurements in Jaffarabadi buffalo calves compared to the control group. In the early post-natal phase (2nd to 13th week), treated groups had significantly higher weight gains, with T_3 showing the greatest increase (10.92%). In the late post-natal phase (14th to 26th week), gains remained higher in all treatments, with synbiotics again leading (58.11%). Overall weight gain and average daily gain (ADG) were highest in synbiotics, with ADG differences being statistically significant. Body length, height at withers and chest girth also improved, with synbiotics showing the largest increase in chest girth (29.07 cm, 37.59%, p≤0.05) and wither height (p<0.01). Synbiotic supplementation (T_3) proved to be the most effective in enhancing growth and development throughout the study.

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