



International Journal of Biology Sciences

ISSN Print: 2664-9926
 ISSN Online: 2664-9934
 NAAS Rating (2025): 4.82
 IJBS 2025; 7(10): 102-106
www.biologyjournal.net
 Received: 11-07-2025
 Accepted: 15-08-2025

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Cost of feeding and body weight gain of Jaffarabadi buffalo calves as varied by feeding of probiotic, prebiotic and Synbiotic

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DOI: <https://www.doi.org/10.33545/26649926.2025.v7.i10b.503>

Abstract

An investigation was taken up to compare the influence of probiotic, prebiotic and synbiotic supplementation on the cost of feeding and body weight gain of newborn Jaffarabadi buffalo calves (early post-natal stage: 2nd to 13th week and late stage: 14th to 26th week of age). Twenty-four 8-day-old calves were chosen and divided into four groups of six at random: probiotic (T1), prebiotic (T2), synbiotic (T3) and control (C). All calves received restricted suckling plus a basal diet and pelleted concentrate as per ICAR (2013) standards. T1 calves were fed probiotics (*L. sporogenes* and *S. cerevisiae*, 5 g/day), T2 received prebiotics (mannan-oligosaccharides, 5 g/day) and T3 were given a synbiotic mix (2.5 g each of probiotic and prebiotic per day). During early post-natal phase, the feeding cost per kg BW gain was ₹36.37±1.23 (control), ₹35.28±0.59 (T1), ₹37.17±0.92 (T2) and ₹34.82±0.89 (T3), with no significant difference ($p>0.05$). The benefit over the control group in terms of reduction in feeding cost /kg b.wt. gain was maximum with synbiotic (4.26%), followed by that with probiotic (2.99%). During early post-natal phase, the feeding cost per kg of BW gain was lowest in T2 (₹97.78 ± 2.76), while control had the highest cost (₹103.21 ± 3.50). The benefits over control in terms of reduced cost per kg body weight gain was maximum with prebiotic (8.73%), followed by synbiotic (7.15%) in least in magnitude with probiotic feeding (5.99%). However, the difference in feeding cost per kg body weight gain was non-significant ($P>0.05$) during the experiment. For the entire period i.e., up to 6 months of age, overall feeding cost per kg BW gain was ₹68.78 for control, ₹65.68 for T1, ₹65.41 for T2 and ₹65.19 for T3, with no significant difference ($p>0.05$). The benefit over the control group in terms of reduced feeding cost per kg BW gain was for all supplemented groups: 4.50% for T1, 4.89% for T2 and 5.21% for T3. Thus, while the addition of probiotics, prebiotics or synbiotic did numerically alter the cost per kg of BW gain, there was a slight decrease in feeding cost per calf across all treatment groups as compared to the control, maximum (5.21%) being with synbiotic feeding, followed by almost same, 4.5 to 4.9% with prebiotic or probiotic alone feeding.

Keywords: Jaffarabadi, Buffalo, Calves, Feeding cost, Body weight gain

Introduction

Among livestock, buffalo holds a unique position in India's dairy sector, often regarded as the "Black Gold" and "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) [1]. While antibiotics have traditionally been used to manage infections, growing concerns over antibiotic resistance and treatment failure (Jin *et al.*, 1996) [8] 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) [13], while prebiotics selectively promote beneficial gut bacteria and suppress pathogens (Deng *et al.*, 2007; Fleige *et al.*, 2009) [4, 6]. Synbiotics, combining both, further improve nutrient utilization, growth performance and immune competence (Dar *et al.*, 2017) [3]. 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 cost of feeding and body weight gain of Jaffarabadi buffalo calves.

Materials and Methods

A study was undertaken to evaluate the impact of dietary supplementation with probiotic, prebiotic and their combination (synbiotic) on the feed intake and feed conversion ratio of Jaffarabadi buffalo calves. The trial involved 24 calves (Average body weight and age in days), divided into four equal groups (n=6 per group) and was conducted at the Cattle Breeding Farm, Kamdhenu University, Junagadh, following approval from the Institutional Animal Ethics Committee. The experimental period spanned from 8 to 182 days of age. Calves were allocated to groups based on birth weight, dam parity, previous and current average milk yield of the dam and calf sex, ensuring equal distribution (3 males and 3 females per group). Pelleted concentrate was offered to meet protein

requirements as per ICAR (2013) feeding standards and mineral mixture @10-15 g/h (Table 1).

Daily intake of feed was recorded for individual animals. Weighed quantities of feed was offered to animals as per the protocol and left over was collected next day in the morning and weighted. All the experimental calves were individually offered green and dry fodder and concentrate feed in a plastic bowl. The feed and fodder leftover was collected and average daily feed intake of each animal was calculated by measuring feed offered and residues left.

Data were worked out of the early post-natal phase i.e., 2nd to 13 weeks of age, late post-natal phase i.e., 14th to 26th weeks of age and pooled over both phases (early and late post-natal phases) of experimental Jaffarabadi buffalo calves during the study.

Table 1: Schedule for probiotic, prebiotic and synbiotic inclusion in feed

Treatment Groups	No. of animals	Dietary treatment details
Control (C)	6	Restricted suckling milk of their dam + basal diet
Probiotic (T-1)	6	Restricted suckling milk of their dam + basal diet +supplementation of probiotic (<i>Lactobacillus sporogenes</i> 5x10 ⁷ c.f.u./g, <i>Saccharomyces cerevisiae</i> 1.5x10 ⁸ c.f.u./g (in 1:1) @ 5 g/day/calf.
Prebiotic (T-2)	6	Restricted suckling milk of their dam + basal diet +supplementation of prebiotic (mannan-oligosaccharides) @ 5 g/day/calf
Synbiotic (T-3)	6	Restricted suckling milk of their dam + basal diet+ supplementation of synbiotic (<i>Lactobacillus sporogenes</i> 5x10 ⁷ c.f.u./g, <i>Saccharomyces cerevisiae</i> 1.5x10 ⁸ c.f.u./g (in 1:1) @ 2.5g/day/calf + mannan-oligosaccharides @ 2.5g/day/calf)

Feeding cost per day per calf and daily cost of feeding per kg b.w. gain of Jaffarabadi buffalo calves under different experimental groups was calculated in the present investigation with and without inclusion of probiotic, prebiotic and synbiotic on the basis of the expenditure incurred of feeds of early post-natal phase, late post-natal phase and pooled over both phases (early and late post-natal phase). For calculation of economics of feeding in present study, institutional and purchase prices of various feeds (pelleted compound concentrate- Rs. 25/kg), fodder (green fodder-Rs. 3.00/kg; dry fodder Rs. 5.00/kg) and probiotic-Rs. 162.0/kg, T2- prebiotic- Rs. 180.00/kg) and synbiotic - Rs. 171.00/kg were taken for the purpose of the calculation. Amount of milk suckled by the calf was not considered in working out cost of feeding since the calves of all the experimental groups had similar, non-significant difference in body weight and parity and milk yield of dams in previous and current lactation were almost same. Statistical analysis was performed using ANOVA, following the method of Snedecor & Cochran (1994) [12]. Group differences were assessed using Duncan's Multiple Range Test (Duncan, 1955) [5] with SPSS software version 16.0. Results have been expressed as mean $\pm$ standard error, with statistical significance considered at $p < 0.05$ and $p < 0.01$ levels.

Results and Discussion

1. Cost of feeding during early post-natal phase up to 12 weeks of experiment, i.e., 2nd to 13th week of age of the calves

The study evaluated the intake of feeds, fodder and concentrate (kg/day) during the early post-natal phase for first 12 week of experiment (2nd to 13th weeks of age) in Jaffarabadi buffalo calves under four different treatments: Control, T1 (probiotic), T2 (prebiotic) and T3 (synbiotic). The average daily intake of green fodder was 1.039 $\pm$ 0.02, 1.066 $\pm$ 0.01, 1.087 $\pm$ 0.02 and 1.060 $\pm$ 0.01 kg/d in the control, T1, T2 and T3 group of buffalo calves, respectively. Dry fodder average intake averaged 0.346 $\pm$ 0.02, 0.388 $\pm$ 0.02,

0.373 $\pm$ 0.02 and 0.373 $\pm$ 0.02 kg/day in the control, T1, T2 and T3 group of buffalo calves, respectively and the compound concentrate mixture intake was 0.294 $\pm$ 0.03, 0.308 $\pm$ 0.02, 0.326 $\pm$ 0.02 and 0.314 $\pm$ 0.02 kg/d in the control, T1, T2 and T3 group of buffalo calves, respectively. Additives feeding was fixed for each treatment: T1 had probiotic at 0.005 kg/d, T2 had prebiotic at 0.005 kg/d and T3 had synbiotic at 0.005 kg/d.

As detailed in Table-2, the cost of feeding was calculated for each treatment group, the total feeding cost per calf during the experimental period was ₹1024.55 for the control, ₹1078.39 for T1, ₹1115.18 for T2 and ₹1083.18 for T3. The average feeding cost per calf per day was ₹12.20 $\pm$ 0.49, for the control, ₹12.84 $\pm$ 0.23 for T1, ₹13.28 $\pm$ 0.36 for T2 and ₹12.90 $\pm$ 0.37 for T3 group.

Despite the slightly higher costs, there was no significant difference ($P > 0.05$) in the average cost of feeding ₹ per calf per day during experiment, with the control group showing a BW gain of 335.34 $\pm$ 4.44 gm/d, T1 having 363.91 $\pm$ 3.99 gm/d, T2 with 357.14 $\pm$ 3.34 gm/d and T3 showing 370.33 $\pm$ 6.99 gm/d. The feeding cost per kg BW gain was ₹36.37 $\pm$ 1.23 (control), ₹35.28 $\pm$ 0.59 (T1), ₹37.17 $\pm$ 0.92 (T2) and ₹34.82 $\pm$ 0.89 (T3), with no significant difference ($p > 0.05$). The benefit over the control group in terms of reduction in feeding cost /kg b.wt. gain was maximum with synbiotic (4.26%) followed by that with probiotic (2.99%).

2. Cost of feeding during late post-natal phase (from 13th to 25th week of experiment, i.e., 14th to 26th weeks of age of the calves)

The study also separately assessed the intake of feeds, fodder and supplements (kg/day) during the late post-natal phase 13 week onwards till end of the experiment (14th to 26th weeks of age) in Jaffarabadi buffalo calves under four different treatments: Control, T1 (Probiotic), T2 (Prebiotic) and T3 (Synbiotic).

The Table-3 presented the feed, fodder, supplement intake and cost of feeding of Jaffarabadi buffalo calves during the late post-natal phase (14th to 26th weeks of age) for different

treatment groups: Control, T1 (Probiotic), T2 (Prebiotic) and T3 (Synbiotic).

Average daily green fodder intake averaged 2.610 ± 0.07 , 2.565 ± 0.03 , 2.573 ± 0.05 and 2.712 ± 0.08 kg/day in the control, T1, T2 and T3 group of buffalo calves, respectively. Dry fodder intake was 1.481 ± 0.07 , 1.594 ± 0.05 , 1.681 ± 0.12 , 1.664 ± 0.09 kg/day in the control, T1, T2 and T3 group of buffalo calves, respectively (Table-3). The compound concentrate mixture intake averaged 0.823 ± 0.10 , 0.877 ± 0.04 , 0.801 ± 0.08 and 0.855 ± 0.06 in the control, T1, T2 and T3 group of buffalo calves, respectively. Calves of T1 received probiotic (0.005 kg/day), T2 received prebiotic (0.005 kg/day) and T3 received synbiotic (0.005 kg/day).

The cost of feeding was highest in T3 (₹3510.87), followed by T1 (₹3420.69), T2 (₹3289.56) and control (₹3258.71). The average daily feeding cost per calf was highest in T3 (₹41.80) and lowest in control (₹38.79). In terms of body weight gain, T3 showed the highest gain (435.10 ± 9.10 g/day), followed by T1 (418.90 ± 8.61 g/day), T2 (413.19 ± 4.18 g/day), and control (375.87 ± 10.8 gm/day). A highly significant ($p \leq 0.01$) difference was found in weight gain between control and treatment groups. The feeding cost per kg of body weight gain was lowest in T2 (₹97.78 $\pm$ 2.76), while control had the highest cost (₹103.21 $\pm$ 3.50). The benefits over control in terms of reduced cost per kg body weight gain was maximum with prebiotic (8.73%), followed by symbiotic (7.15%) in least in magnitude with probiotic feeding (5.99%). However, the difference in feeding cost per kg body weight gain was non-significant ($P > 0.05$) during the experiment (Table-3).

Present findings confirm with the results of Chandra *et al.* (2009) [2], who revealed that in probiotic supplemented group (₹69.04) reduced feed cost /kg body wt. gain as compared to control (₹73.72). Similarly, Kumar *et al.* (2011) [9] observed that inclusion of yeast culture (*Saccharomyces cerevisiae*) reduced the cost of feed per unit live weight (₹32.01 vs. 33.10 in control group) of Murrah buffalo bull calves. Similarly, Singh *et al.* (2014) found effect of probiotic on Murrah buffalo calves and revealed that rearing cost can be reduced to 40.55% and 36.66% in supplemented group as compared to control group. Dar *et al.* (2017) [3] conducted a study in crossbred calves and found that cost incurred per kg body weight was decreased in probiotic supplemented group (₹5.20) and synbiotic group (₹6.68) than control.

3. Overall cost of feeding during entire experimental period, i.e., entire 25 weeks of experiment (2nd to 26th weeks of age of the calves)

The daily intake of green fodder averaged 1.86 ± 0.04 , 1.85 ± 0.01 , 1.86 ± 0.03 and 1.92 ± 0.05 kg/d avg. in the

control, T1, T2 and T3 group of buffalo calves, respectively. Average daily dry fodder intake was 0.94 ± 0.04 , 1.02 ± 0.04 , 1.05 ± 0.04 and 1.04 ± 0.06 kg/d in the control, T1, T2 and T3 group of buffalo calves, respectively. The compound concentrate mixture intake was 0.57 ± 0.07 , 0.60 ± 0.03 , 0.57 ± 0.05 and 0.61 ± 0.03 kg/d in the control, T1, T2 and T3 group of buffalo calves, respectively. Additives intake was specific to each treatment: T1 had probiotic at 0.005 kg/d, T2 had prebiotic at 0.005 kg/d and T3 had synbiotic at 0.005 kg/d.

Data of Table-4 revealed that the total feeding cost per calf for the experimental period was ₹4283.26 for the Control, ₹4499.08 for T1, ₹4404.74 for T2 and ₹4594.05 for T3. The average cost per calf per day was ₹24.48 for the control, ₹25.71 for T1, ₹24.17 for T2 and ₹26.25 for T3. Despite the differences in feeding costs, there was no significant difference ($P > 0.05$) in body weight (BW) gain across treatments. The BW gain was 355.86 ± 6.28 gm/d for the control, 391.40 ± 5.12 g/d for T1, 385.16 ± 2.69 g/d for T2 and 402.71 ± 7.04 g/d for T3.

The feeding cost per kg BW gain was ₹68.78 for control, ₹65.68 for T1, ₹65.41 for T2 and ₹ 65.19 for T3, with no significant difference ($p > 0.05$). The benefit over the control group in terms of reduced feeding cost per kg b.wt. gain was for all supplemented groups: 4.50% for T1, 4.89% for T2 and 5.21% for T3. Thus, while the addition of probiotics, prebiotics or synbiotics did numerically alter the cost per kg of BW gain, there was a slight decrease in feeding cost per calf across all treatment groups as compared to the control, maximum (5.21%) being with synbiotic feeding followed by almost same 4.5 to 4.9 % with prebiotic or probiotic alone feeding (Table 4).

Present findings confirm with the results of Patel *et al.* (2020) [10] studied the effect of probiotic and prebiotic on Murrah buffalo calves. They found that feed cost was total expenditure (₹/calf) on, feed, fodder and feed additives were almost same 12,750 to 13,003 the in control, probiotic and prebiotic groups.

Overall results of the study tended to indicate that synbiotic feeding to calves up to 2 to 13 days (during first 3 months) of age yielded best results from significantly higher body weight gain (BWG) and feeding cost per kg BWG. During 13 to 26 days (3 to 6 months) of age, synbiotic feeding resulted in maximum daily BWG, however, prebiotic feeding was more economical from feeding cost per kg BWG point of view. Considering both phases together, overall results revealed best results from significantly higher (BWG) and feeding cost per kg (BWG) by synbiotic feeding upto 2 to 26 weeks (upto 60 months of age)

Table 2: Cost of feeding probiotic, prebiotic, synbiotic and the concentrate mixture to the Jaffarabadi buffalo calves during the early post-natal phase (2nd to 13th weeks of age)

Mean $\pm$ SE of feeds, fodder and supplements intake (kg/day) during early post-natal phase (2 nd to 13 th weeks of age)				
Particulars	Control	T1	T2	T3
Green fodder (kg/d)	1.039 $\pm$ 0.02	1.066 $\pm$ 0.01	1.087 $\pm$ 0.02	1.060 $\pm$ 0.01
Dry fodder (kg/d)	0.346 $\pm$ 0.02	0.388 $\pm$ 0.02	0.373 $\pm$ 0.02	0.373 $\pm$ 0.02
Compound concentrate mixture (kg/d)	0.294 $\pm$ 0.03	0.308 $\pm$ 0.02	0.326 $\pm$ 0.02	0.314 $\pm$ 0.02
T1- Probiotic (kg/d)	0	0.005	0	0
T2- Prebiotic(kg/d)	0	0	0.005	0
T3-Synbiotic Probiotic + Prebiotic) (kg/d)	0	0	0	0.005
Cost of feeding experimental Jaffarabadi buffalo calves (₹/calf) in the experimental period				
Particulars	Control	T1	T2	T3
Green fodder (@₹3.00/kg)	261.83	268.63	273.92	267.12
Dry fodder (@₹5.00/kg)	145.32	162.96	156.66	156.66
Comp. conc. mixture (@₹25/kg)	617.40	646.80	684.60	659.40

T1-Probiotic (@ ₹ 162.0/kg)	0	73.71	0	0
T2- Prebiotic (@ ₹ 180.0/kg)	0	0	81.9	-----
T3- Synbiotic (kg/day) (@ ₹171.0/kg)	0	0	0	77.81
BW gain (gm/d)	335.34 ^a ±4.44	363.92 ^b ±3.99	357.14 ^b ±3.34	370.33 ^b ±6.99
P-value	0.0004			
Total feeding cost , excluding milk, ₹	1024.55±41.80	1078.39±20.00	1115.18±30.90	1083.18±31.60
Average cost of feeding /d/calf	12.20±0.49	12.84±0.23	13.28±0.36	12.90±0.37
F.C, ₹ per kg BW gain	36.37±1.23	35.28±0.59	37.17±0.92	34.82±0.89
Rs. Benefit over control	-----	1.09	-0.80	1.55
% Reduction on F.C.	-----	2.99	-2.19	4.26

Means with different superscripts (a,b) within a row differ significantly ($p \leq 0.01$); T1-Probiotic @5 g (*L. sporogenes* @ 5×10^7 cfu, *S. cerevisiae* 1.5×10^8 cfu), T2-Prebiotic @5gm (Mannan-oligosaccharides), T3- Synbiotic (Probiotic-2.5gm, Prebiotic-2.5 g)

Table 3: Cost of feeding probiotic, prebiotic, synbiotic and the concentrate mixture to the Jaffarabadi buffalo calves during the late post-natal phase (14th to 26th weeks of age)

Mean ± SE of feeds, fodder and supplements intake (kg/day) during late post-natal phase (14 th to 26 th weeks of age)				
Particulars	Control	T1	T2	T3
Green fodder (kg/d)	2.610±0.07	2.565± 0.03	2.573± 0.05	2.712± 0.08
Dry fodder (kg/d)	1.481±0.07	1.594±0.05	1.681± 0.12	1.664± 0.09
Comp. con. mixture(kg/d)	0.823±0.10	0.877± 0.04	0.801±0.08	0.885± 0.06
T1- Probiotic (kg/d)	0	0.005	0	0
T2- Prebiotic(kg/d)	0	0	0.005	0
T3-Synbiotic (Probiotic + Prebiotic) (kg/d)	0	0	0	0.005
Cost of feeding experimental Jaffarabadi buffalo calves (₹/calf) in the experimental period				
Particulars	Control	T1	T2	T3
Green fodder (@₹3.00/kg)	712.53	700.245	702.429	740.376
Dry fodder (@₹5.00/kg)	673.86	725.27	764.86	757.12
Comp. con.mix.(kg/d) (@₹ 25/kg)	1872.33	1995.18	1822.28	2013.38
T1-Probiotic (@ ₹162.0/kg)	0	73.71	0	0
T2- Prebiotic (@ ₹ 180.0/kg)	0	0	81.90	0
T3- Synbiotic (kg/day) (@ ₹ 171.0/kg)	0	0	0	77.81
BW gain (g/d)	375.87 ^a ±10.61	418.86 ^b ±8.62	413.19 ^b ±4.18	435.10 ^b ±9.10
P-value	0.0007			
Total feeding cost, excluding milk, ₹	3258.71±117.80	3420.69±139.10	3289.56±126.70	3510.87±109.00
Average cost of feeding /d/calf	38.79±1.27	40.72±0.53	39.16±1.36	41.80±1.17
F.C., ₹ per kg BW gain	103.21±3.50	97.22±0.95	94.78±3.92	96.06±2.76
Rs. Benefit over control	-----	5.99	8.43	7.15
% Reduction on F.C.	-----	5.80	8.17	6.93

Means with different superscripts (a,b) within a row differ significantly ($p \leq 0.01$); T1-Probiotic @5 g (*L. sporogenes* @ 5×10^7 cfu, *S. cerevisiae* 1.5×10^8 cfu), T2-Prebiotic @5gm (Mannan-oligosaccharides), T3- Synbiotic (Probiotic-2.5gm, Prebiotic-2.5 g)

Table 4: Cost of feeding probiotic, prebiotic, synbiotic and the concentrate mixture to the Jaffarabadi buffalo calves during the entire experimental period (2nd to 26th week of age)

Mean ± SE of feeds, fodder and supplements intake (kg/day) during experimental period (2 nd to 26 th weeks)				
Particulars	Control	T1	T2	T3
Green fodder (kg/d)	1.86±0.04	1.85±0.01	1.86±0.03	1.92±0.05
Dry fodder (kg/d)	0.94±0.04	1.02±0.04	1.05±0.04	1.04±0.06
Compound concentrate mixture(kg/d)	0.57±0.07	0.60±0.03	0.57±0.05	0.61±0.03
T1- Probiotic (kg/d)	0	0.005	0	0
T2- Prebiotic (kg/d)	0	0	0.005	0
T3-Synbiotic (Probiotic +Prebiotic) (kg/d)	0	0	0	0.005
Cost of feeding experimental Jaffarabadi buffalo calves (₹/calf)				
Particulars	Control	T1	T2	T3
Green fodder (@₹3.00/kg)	974.358	968.877	976.353	1007.496
Dry fodder (@₹5.00/kg)	819.18	888.23	921.52	913.78
Compound concentrate mixture (@₹ 25/kg)	2489.73	2641.98	2506.88	2672.78
T1-Probiotic(@ ₹ 162.0/kg)	0	147.42	0	0
T2-Prebiotic (@ ₹ 180.0/kg)	0	0	163.80	0
T3-Synbiotic (kg/day) (@ ₹ 171.0/kg)	0	0	0	155.61
BW gain (g/d)	355.86 ^a ±6.28	391.40 ^b ±5.12	385.16 ^b ±2.69	402.71 ^b ±7.04
P-value	0.0001			
Total feeding cost, Excluding milk, ₹	4283.26 ±154.84	4499.086 ±58.48	4404.74 ±155.23	4594.05 ±123.38
Avg. feeding cost ₹/d/calf	24.48 ±0.83	25.71 ±0.31	25.17 ±0.84	26.25 ±0.66
F.C. ₹ per kg BW gain	68.78 ±2.31	65.68 ±0.64	65.41 ±2.38	65.19 ±1.48
Rs. Benefit over control	-----	3.10	3.37	3.59
% Reduction in cost	-----	4.50%	4.89%	5.21%

Means with different superscripts (a,b) within a row differ significantly ($p \leq 0.01$);

T1-Probiotic @5 g (*L. sporogenes* @ 5×10^7 cfu, *S. cerevisiae* 1.5×10^8 cfu), T2-Prebiotic @5gm (Mannan-oligosaccharides), T3- Synbiotic (Probiotic-2.5gm, Prebiotic-2.5 g)

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