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Effect of prebiotic and probiotic supplementation on growth performance and body measurement in pre-ruminant Surti buffalo calves

Praveen Ratre, Rana Ranjeet Singh, Sandhya S Chaudhary, AK Chaturvedani, Vipul R Patel and Devkant Hanumant

Abstract
Present study was conducted among twenty four apparently healthy Surti buffalo calves were divided into four groups: Control (without any supplementation), Prebiotic (T_1: Mannan-oligosaccharides @ 10g/calf/day), Probiotic (T2: *Lactobacillus acidophilus* @ 3g/calf/day) and Prebiotic + Probiotic (T3: Mannan-oligosaccharides @ 10g/calf/day + *Lactobacillus acidophilus* @ 3g/calf/day). Twenty four apparently healthy Surti buffalo calves were divided into four groups: Control (without any supplementation), Prebiotic (T_1: Mannan-oligosaccharides @ 10g/calf/day), Probiotic (T2: *Lactobacillus acidophilus* @ 3g/calf/day) and Prebiotic + Probiotic (T3: Mannan-oligosaccharides @ 10g/calf/day + *Lactobacillus acidophilus* @ 3g/calf/day). Perusal of data revealed that there was statistically non-significant difference in the live body weight among all these four groups of animals. However, the live body weights of T_2 and T_3 group of animals were comparatively higher than control group of animals at all stages of the study. T_1 group of animals had comparatively lower body weights in comparison with T_2 and T_3 group of animals at almost all stages of the study. There was significant difference ($p<0.05$) in the average daily gain in body weights between control and T_2 at 13-20th, 34-41th, 48-55th day of age while it was significantly different between T_1 and T_2 group of animals during 55-62nd day of age. Overall daily average daily gain during entire study period was 388.88±27.39, 427.57±46.77, 468.25±22.51 and 463.29±27.42 gm/day for control, T_1, T_2 and T_3 group of Surti buffalo calves. A non-significant difference in the values of the heart girth, height at withers and body length among all four groups of calves at all stages was found.

Keywords: Snail, bovine, porcine, physicochemical properties, mucin, mucoadhesives

Introduction
Calves form the future dairy herd and raising of calves is the most difficult operation in a dairy farming enterprise, which requires a great deal of management skill, application and constant attention (Sastry and Thomas, 2005) [16]. Growth of calves during their first few weeks of life is of paramount importance affecting their performance during subsequent rearing, and it can be modified by disease, specifically gastrointestinal infections (Zabransky *et al.,* 2013) [22]. Healthy calves are fundamental for successful breeding which subsequently results in high milk and meat production. The calves are more sensitive to diseases and environmental challenges especially when weaned early. Thus, it becomes extremely important that they must be given proper care and nutrition as per their requirements.

Prebiotics and probiotics have the ability to modulate the balance and activities of the gastrointestinal (GI) microbiota, and are, thus, considered beneficial to the host animal and have been used as functional foods (Uyeno *et al*., 2015) [20]. Prebiotics, earlier defined as non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of colonic bacteria (Gibson and Roberfroid, 1995) [6] have now been defined as selectively fermented food ingredients that improve host health by targeting indigenous components thought to be positive (Walton *et al*., 2013) [21]. They can be used as potential alternatives to growth promoting antibiotics. Probiotics are defined as live microbial feed supplements that improve the health of livestock, or in other words, organisms or substances that contribute to intestinal microbial balance referred as probiotics (Parker, 1974) [15]. The main objectives of application of probiotics in the rearing of young animals are improved survival, inhibition of diarrhoea, superior growth and better feed conversion efficiency (Jin *et al.,* 1996) [9]. Dietary use of probiotics is thus preferred to that of antibiotics to enhance nutrient utilization, improve feed efficiency and maintain health status because of

their non-harmful effect on consumers (Onifade *et al.*, 1999) [14]. According to Timmerman *et al.* (2005) [19], probiotics have the ability of improving the immune system of the young animal as well as defending the animals against enteropathic disorders. In addition, probiotic supplementation to animals enhances feed effectiveness and weight gain (Lesmiester *et al.*, 2004) [10].

Material and Method
The investigation was carried out from September 2017 to January, 2018 in Surti buffalo calves maintained at Livestock Research Station, Navsari Agricultural University, Navsari, Gujarat. Navsari Agricultural University is situated geographically at an altitude of 11.89 M above mean sea level, at latitude of 20°57' 0" North and at longitude of 72° 54' 0" East. The climate of the area forms a part of tropical and coastal area. Generally, summer (March to June) is moderately hot and humid while monsoon (July to September) is warm and extremely humid and winter (November to February) remains fairly cold and dry.
Surti buffaloes at this farm are managed under loose housing and group management system. Housing structures are made up of concrete. The animals are fed green fodder, hay and compounded concentrate, as per the standard feeding schedule followed on the farm. Feed (dry and green roughage) is being provided in the continuous feeding manger while concentrate is offered at the time of milking twice a day. Additionally, sometimes they are let loose for grazing. Surti buffaloes are hand milked twice daily. Calf is reared in group housing system and they are allowed to suckle their dams both before and after milking up to 3-4 months of age and thereafter they are allowed to suckle their dams only before milking. Dipping of teats in anti-septic solution is practiced after milking. Periodic deworming is followed to control endoparasites and they are also vaccinated against FMD, HS and Brucellosis once in a year.
Twenty four apparently healthy Surti buffalo calves were divided into four groups: Control (without any supplementation), Prebiotic (T_1: Mannan-oligosaccharides @ 10g/calf/day), Probiotic (T2: *Lactobacillus acidophilus* @ 3g/calf/day) and Prebiotic + Probiotic (T3: Mannan-oligosaccharides @ 10g/calf/day + *Lactobacillus acidophilus* @ 3g/calf/day). Body weight of calves was recorded on the day 6 postpartum and thereafter at weekly intervals till 90th day of their age. Weighing of calves was done with the help of weighing balance before offering milk, feed and fodder. Average daily weight gain (gm/day) was calculated from the weights obtained at different intervals. Height at withers, body length and heart girth of calves were recorded on the day 6 after birth and thereafter at weekly intervals till 90th day of their age. These observations were recorded with the help of height measuring stick and measuring tape. Body measurements were taken when the calves were standing in a normal body posture. Statistical analysis of obtained data was carried out by one-way ANOVA using PROC GLM procedure using SAS 9.3 software for interpreting effect of different groups for the traits under study. Duncan multiple range test (DMRT) was used for mean

Result and Discussion
Growth Performance
The initial live body weight for control, T_1, T_2 and T_3 group of Surti buffalo calves were 24.83±0.54, 24.50±1.36, 24.67±0.76 and 24.83±0.48 kg while final live body weight for these group of animals were 55.92±2.33, 58.00±4.26, 62.42±2.39 and 62.50±2.44 kg, respectively. There was non-significant difference in the live body weight among all these four groups of animals. However, the live body weights of T_2 and T_3 group of animals were comparatively higher than control group of animals at all stages of the study except at the day 6 of the study. Meanwhile, T_1group of animals had slightly lower body weights than control group during early part of the experiment and at later stages this group had slightly higher body weight than control group of animals. Further, T_1 group of animals had comparatively lower body weights in comparison with T_2 and T_3 group of animals at almost all stages of the study. There was significant difference ($p<0.05$) in the average daily gain in body weights control and T_2 between 13-20th, 34-41th, 48-55th day of age while it was significantly different between T_1 and T_2 group of animals during 55-62nd day of age. Moreover, comparatively better average daily gain was observed at most of the stages of the study for T_2 followed by T_3, T_1 and control group of animals. Further, overall average daily gain during entire study period was 388.88±27.39, 427.57±46.77, 468.25±22.51 and 463.29±27.42 gm/day for control, T_1, T_2 and T_3 group of Surti buffalo calves.
Probiotics and prebiotics have found a wider role in calf prophylaxis. Mannan- oligosaccharides (MOS) are complex mannose sugars (Prebiotic) which have been considered as gut microbiota stabilizers as they aid in inhibiting pathogenic colonization and stimulating the growth of bacteria which are capable of health-promoting functions, such as bifidobacteria or lactobacilli (Gibson *et al.*, 2005, Baurhoo *et al.*, 2007) [7, 3]. Probiotics have been reported to enhance growth rate and metabolic activities by stimulating digestion and immunity and also to act as prophylactic and therapeutic medium. Lactobacilli are one of the major species of beneficial micro-organism in the gut of monogastric animals. Many workers have reported effect of pre and probiotics on body weight and growth rate in cattle as well as buffalo calves. Abe *et al.* (1995) [1], Malik and Sharma (1998) [11], Lesmeister *et al.* (2004) [10], Al-Saiady (2010) [2], Zabransky *et al.* (2013) [22], Nageshwer *et al.* (2016) [13], Gupta *et al.* (2015) [8], Dar *et al.* (2017) [4] and Sharma *et al.* (2018) [17] reported higher body weight or ADG in calves fed with prebiotic or probiotic or both in their study. However, Mudgal and Baghel (2010) [12] reported that feeding of probiotic to calves up to two months of age did not have significant effect on body weight gain of calves as compared to controlled groups.

Body Measurements
A non-significant difference in the values of the heart girth among all four groups of calves at all stages. Further, it was observed that the T_3 group of Surti buffalo calves had comparatively higher values of heart girth than other groups of animals in the later part of the study. There was non-significant difference in the height at withers among all four groups of calves at all stages of the study. There was non-significant difference in the body length among all four groups of calves at all stages of the study. Almost similar trend in the values of body length was observed as it was in the values of heart girth. These body measurements are indicator of growth of animals. As no any significant difference was found in the body weight at different stages and similar trends were also observed for these biometric traits. Similar findings were also reported by Lesmeister *et al.* (2004) [10], Frizzo *et al.* (2008) [5], Gupta *et al.* (2015) [8] and Nageshwar *et al.* (2016) [13].

Table 1: Least squares' means and standard error (LSM ± SE) of body weight (kg) of Surti buffalo calves at weekly interval

Group	Body weight (kg) on												
	6th day	13th day	20th day	27th day	34nd day	41th day	48th day	55th day	62th day	69th day	76th day	83th day	90th day
C	24.83±0.54 (6)	26.33±0.51 (6)	28.58±0.80 (6)	33.17±0.90 (6)	35.45±1.35 (6)	38.12±1.45 (6)	40.02±1.62 (6)	42.13±1.72 (6)	44.17±1.88 (6)	47.08±1.80 (6)	49.83±1.85 (6)	53.08±1.96 (6)	55.92±2.33 (6)
T₁	24.50±1.36 (6)	25.83±1.30 (6)	28.67±1.50 (6)	31.42±1.48 (6)	34.50±2.02 (6)	37.17±2.07 (6)	40.35±2.45 (6)	43.00±2.84 (6)	46.08±3.36 (6)	48.63±3.62 (6)	51.50±3.70 (6)	54.83±3.97 (6)	58.00±4.26 (6)
T₂	24.67±0.76 (6)	26.75±0.70 (6)	29.25±0.91 (6)	31.78±1.02 (6)	34.45±1.04 (6)	38.17±1.53 (6)	41.92±1.67 (6)	44.58±2.06 (6)	48.42±2.09 (6)	52.30±1.88 (6)	55.92±1.82 (6)	59.42±2.07 (6)	62.42±2.39 (6)
T₃	24.83±0.48 (6)	27.25±0.63 (6)	30.00±0.85 (6)	33.45±0.90 (6)	35.92±0.96 (6)	38.62±1.33 (6)	42.03±1.08 (6)	45.72±1.63 (6)	48.87±1.87 (6)	52.25±1.99 (6)	55.67±1.99 (6)	59.17±2.16 (6)	62.50±2.44 (6)
Overall	24.71±0.40 (24)	26.54±0.41 (24)	29.13±0.50 (24)	32.45±0.54 (24)	35.08±0.67 (24)	38.02±0.76 (24)	41.08±0.85 (24)	43.86±1.03 (24)	46.88±1.18 (24)	50.07±1.23 (24)	53.23±1.27 (24)	56.63±1.37 (24)	59.71±1.50 (24)
Figures in parentheses are the number of animals used to derive LSM.													

Table 2: Least squares' means and standard error (LSM ± SE) of average daily gain (gm) in body weight of Surti buffalo calves at fortnight interval

Group	Average daily gain(ADG) in gm between												
	6-13th day	13-20th day	20-27th day	27-34th day	34-41th day	41-48th day	48-55nd day	55-62nd day	62-69th day	69-76th day	76-83th day	83-90th day	6-90th Day
C	321.43±65.85	654.76ᵃ±81.27	326.19±82.92	380.95±27.52	271.43ᵇ±71.05	302.38±55.38	290.48ᵇ±66.67	416.67ᵃᵇ±38.76	392.86±30.58	464.29±40.20	404.76±57.34	440.48±46.72	388.88±27.39
T₁	404.76±85.85	392.86ᵃᵇ±114.81	440.48±91.13	380.95±30.12	454.76ᵃᵇ±74.27	378.57±70.83	440.48ᵃᵇ±87.32	364.29ᵇ±59.90	409.52±37.19	476.19±68.18	452.38±57.34	535.71±63.22	427.57±46.77
T₂	357.14±86.50	361.90ᵇ±76.19	380.95±43.90	530.95±111.30	535.71ᵃ±35.71	380.95±68.18	547.62ᵃ±54.29	554.76ᵃ±80.85	516.67±58.37	500.00±71.43	428.57±52.16	523.81±39.84	468.25±22.51
T₃	392.86±68.39	492.86ᵃᵇ±74.57	352.38±19.05	385.71±65.47	488.10ᵃ±86.06	526.19±85.43	450.00ᵃᵇ±76.02	483.33ᵃᵇ±36.96	488.10±62.32	500.00±61.17	476.19±54.29	523.81±51.07	463.29±27.42
Overall	369.05±36.65	475.60±47.54	375.00±32.06	419.64±34.30	437.50±38.49	397.02±37.07	432.14±38.70	454.76±30.47	451.79±25.29	485.12±28.84	440.48±26.39	505.95±25.04	437.00±16.50
LSM showing different superscripts in lower case letters in a column differ significantly at *P*<0.05.													
Figures in parentheses are the numbers of animals used to derive LSM.													

Table 3: Least squares' means and standard error (LSM ± SE) of heart girth (cm) of Surti buffalo calves at weekly interval

Group	Heart Girth (cm) on												
	6th day	13th day	20th day	27th day	34nd day	41th day	48th day	55th day	62th day	69th day	76th day	83th day	90th day
C	71±1.37 (6)	73±1.37 (6)	74.83±1.40 (6)	76.5±1.36 (6)	78.33±1.38 (6)	80.33±1.48 (6)	81.67±1.63 (6)	83±1.69 (6)	85±1.83 (6)	86.83±2.04 (6)	88.5±2.03 (6)	90.33±1.99 (6)	92.5±2.01 (6)
T₁	68.5±2.38 (6)	71.33±1.91 (6)	74±1.55 (6)	76.17±1.45 (6)	78.17±1.70 (6)	80.17±1.78 (6)	82±1.65 (6)	83.5±1.71 (6)	85.5±1.95 (6)	87.5±2.20 (6)	89±2.18 (6)	90.5±2.20 (6)	92.33±2.17 (6)
T₂	70.5±1.03 (6)	72.67±1.09 (6)	74.5±1.34 (6)	77.33±0.96 (6)	80±0.93 (6)	82±1.21 (6)	83.83±1.56 (6)	85.33±1.54 (6)	87.83±1.47 (6)	89.83±1.58 (6)	91.33±1.71 (6)	93.17±1.70 (6)	95.17±1.70 (6)
T₃	70.33±1.31 (6)	72.5±1.15 (6)	74.67±1.12 (6)	76.67±1.12 (6)	78.67±1.26 (6)	80.33±1.43 (6)	82.33±1.41 (6)	83.83±1.11 (6)	85.5±0.92 (6)	87.17±1.08 (6)	88.83±1.22 (6)	90.67±1.38 (6)	92.33±1.50 (6)
Overall	70.08±0.77 (24)	72.38±0.67 (24)	74.5±0.64 (24)	76.67±0.58 (24)	78.79±0.65 (24)	80.71±0.71 (24)	82.46±0.75 (24)	83.92±0.74 (24)	85.96±0.78 (24)	87.83±0.87 (24)	89.420.88 (24)	91.17±0.89 (24)	93.08±0.91 (24)
Figures in parentheses are the numbers of animals used to derive LSM.													

Table 4: Least squares' means and standard error (LSM ± SE) of height at withers (cm) of Surti buffalo calves at weekly interval

Group	Height at withers(cm) on												
	6th day	13th day	20th day	27th day	34nd day	41th day	48th day	55th day	62th day	69th day	76th day	83th day	90th day
C	65.50±1.26 (6)	68.67±1.15 (6)	70.83±1.11 (6)	72.17±1.11 (6)	74.17±1.28 (6)	75.83±1.54 (6)	77.17±1.38 (6)	78.17±1.42 (6)	78.831.40 (6)	80.00±1.39 (6)	81.33±1.48 (6)	82.50±1.48 (6)	83.50±1.48 (6)
T1	67.83±1.62 (6)	69.83±1.62 (6)	71.67±1.41 (6)	73.50±0.92 (6)	75.83±0.65 (6)	78.33±0.33 (6)	79.17±0.54 (6)	80.17±0.60 (6)	81.50±0.85 (6)	82.50±1.26 (6)	83.67±1.26 (6)	84.50±1.43 (6)	85.67±1.48 (6)
T2	64.67±0.42 (6)	67.33±0.42 (6)	70.00±0.52 (6)	73.00±1.03 (6)	75.50±1.03 (6)	77.67±1.23 (6)	78.83±0.95 (6)	79.83±0.65 (6)	81.00±0.52 (6)	81.67±0.62 (6)	82.67±0.62 (6)	83.33±0.62 (6)	84.50±0.62 (6)
T3	67.50±0.50 (6)	69.83±0.65 (6)	70.670.88 (6)	72.00±0.82 (6)	74.17±0.65 (6)	75.67±0.62 (6)	77.50±0.50 (6)	78.83±0.48 (6)	80.00±0.52 (6)	80.83±0.65 (6)	81.67±0.62 (6)	82.50±0.76 (6)	83.33±0.99 (6)
Overall	66.38±0.57 (24)	68.92±0.54 (24)	70.79±0.50 (24)	72.67±0.47 (24)	74.92±0.47 (24)	76.88±0.54 (24)	78.17±0.46 (24)	79.25±0.44 (24)	80.33±0.47 (24)	81.25±0.52 (24)	82.33±0.53 (24)	83.21±0.56 (24)	84.25±0.59 (24)
Figures in parentheses are the numbers of animals used to derive LSM.													

Table 5: Least squares' means and standard error (LSM ± SE) of body length (cm) of Surti buffalo at calves weekly interval

Group	Body length (cm) on												
	6th day	13th day	20th day	27th day	34nd day	41th day	48th day	55th day	62th day	69th day	76th day	83th day	90th day
C	57.67±1.91 (6)	60.50±1.77 (6)	63.67[ab] ±0.99 (6)	65.83±0.70 (6)	67.83±0.83 (6)	69.33±1.09 (6)	70.83±1.01 (6)	72.50±1.26 (6)	74.00±1.51 (6)	75.00±1.65 (6)	76.17±1.62 (6)	77.00±1.73 (6)	78.00±1.73 (6)
T1	57.00±1.37 (6)	59.67±1.52 (6)	63.17[b] ±1.14 (6)	65.50±1.26 (6)	67.83±1.52 (6)	69.50±1.52 (6)	70.67±1.54 (6)	72.00±1.61 (6)	73.83±1.96 (6)	75.67±2.33 (6)	77.17±2.50 (6)	78.67±2.65 (6)	80.67±2.65 (6)
T2	57.00±1.37 (6)	60.00±1.00 (6)	63.83[ab] ±0.54 (6)	66.67±0.80 (6)	69.17±0.98 (6)	71.17±1.01 (6)	72.67±0.99 (6)	74.33±0.96 (6)	75.33±0.88 (6)	76.50±0.76 (6)	77.83±0.65 (6)	79.17±0.79 (6)	80.33±0.76 (6)
T3	60.50±1.46 (6)	63.33±1.20 (6)	66.33[a] ±0.67 (6)	68.17±0.54 (6)	69.83±0.70 (6)	71.00±0.82 (6)	72.33±0.99 (6)	73.67±1.23 (6)	74.67±1.23 (6)	76.00±1.44 (6)	77.33±1.50 (6)	78.67±1.59 (6)	79.67±1.59 (6)
Overall	58.04±0.78 (24)	60.87±0.72 (24)	64.25±0.48 (24)	66.54±0.46 (24)	68.67±0.52 (24)	70.25±0.56 (24)	71.63±0.57 (24)	73.13±0.63 (24)	74.46±0.69 (24)	75.79±0.78 (24)	77.13±0.80 (24)	78.38±0.86 (24)	79.67±0.87 (24)
LSM showing different superscripts in lower case letters in a column differ significantly at *P*<0.05. Figures in parentheses are the numbers of animals used to derive LSM.													

Conclusions

There was non-significant difference in the body weight of control, T_1, T_2 and T_3 group of calves at all test days. However, the live body weights of T_2 and T_3 group of animals were comparatively higher than control group of animals at almost all stages of the study. There was significant difference ($p<0.05$) in the average daily gain in body weights control and T_2 between 13-20th, 34-41th, 48-55th day of age while it was significantly different between T_1 and T_2 group of animals during 55-62nd day of age. Overall daily average daily gain during entire study period was 388.88±27.39, 427.57±46.77, 468.25±22.51 and 463.29±27.42 gm/day for control, T_1, T_2 and T_3 group of Surti buffalo calves, respectively. There was non-significant difference in the heart girth, height at withers and body length among all four groups of calves at all stages of the study.

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