Indian Journal of Animal Sciences **92** (11): 1364–1367, November 2022/Short communication
https://doi.org/10.56093/ijans.v92i11.125037

Effect of probiotic supplementation on growth performance of Osmanabadi kids

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Received: 22 June 2022; Accepted: 20 September 2022

Keywords: ADG, Growth performance, Osmanabadi goat, Probiotics

Goat is the most important ruminant species for small and marginal farmers, as well as landless labourers, as it helps in socio-economic upliftment of the farmers. Feed is one of the critical aspect in livestock rearing as it accounts up to 60-70% in terms of cost (Makkar 2018). Supplementation of concentrates with probiotics is proven for better feed utilization resulting in enhanced growth and productivity in different livestock. Many researchers have found that supplementing ruminants with probiotics improves nutritional intake, weight gain, and feed conversion ratio (FCR) (Chiofalo *et al.* 2004, Antunovic *et al.* 2006, Whitley *et al.* 2009). The research on use of probiotics in Osmanabadi goat is scanty, hence the present investigation was carried out to study the effect of supplementation of probiotics with concentrate on growth rate and feed conversion efficiency in Osmanabadi goat kids to exploit the growth potential under commercial feeding situations.

The experiment was carried out at Osmanabadi goat unit of Red Kandhari Research and Instructional Farm, College of Veterinary and Animal Sciences, Maharashtra Animal and Fishery Sciences University (MAFSU), Parbhani, for a period of 90 days. Osmanabadi kids (18) of 3-6 months age, were randomly selected and divided into three treatments with 6 animals in each group on equal body weight basis. The various treatment groups were T_0 (control) fed with basal ration without probiotics, T_1 fed with basal ration plus probiotics (*Aspergillus oryzae* and *Lactobacillus*), T_2 group fed with basal ration plus probiotics (*Saccharomyces cerevisiae* and *Lactobacillus*). Commercially available probiotics were used.

The probiotics (*Lactobacillus* = 2×10^{10}/kg CFU per g; *Saccharomyces cerevisiae* = 2×10^{10}/kg CFU per g and *Aspergillus oryzae* = 2×10^{10}/kg CFU per g) were incorporated @ 1 g per kg of concentrate feed. The experimental animals under all groups were fed with equal amount of concentrate and *ad lib.* green fodder, i.e, hybrid napier, mulberry, jowar and grasses were provided as per the body weight of animal with sufficient quantity of water. Feed and water kept overnight for feeding goats were weighed on next morning for left overs to calculate the actual consumption of concentrate and green fodder by the kids. The daily and weekly body weight gains were determined using the body weight recorded on a weekly interval. FCR were calculated on the basis of the total feed consumed to total live weight gain upon consumption. The treatment-wise data were statistically analysed by one-way ANOVA using IBM SPSS software version 24 (IBM Corp. Released, 2016).

The data pertaining to means for weekly body weight, weekly body weight gain and average daily gain, FCR and weekly and daily feed intake (kg) of Osmanabadi kids for various treatments is presented in Table 1.

Weekly body weight (kg): At the end of 13th week, among the three treatments, treatment T_2 (14.94±0.34) showed highly significant ($P<0.01$) differences as compared to T_1 (13.78±0.48) and T_0 (12.69±0.27) kg, however, there was no significant difference observed between T_1 and T_0 group. The study revealed that during initial period of experiment, the body weight of animals decreased and at the later stage of experiments, the body weight increased significantly. Similar findings were reported by Srivastava *et al.* (2017) depicting lower body weight in the initial phase of the experiment supplemented with probiotics whereas the growth rate was faster during the later stages (10-15 weeks) in crossbred kids. The present results are in line with those reported by Khan *et al.* (2003) showing higher body weight in probiotic supplemented group than control group with non-significant difference. The observed effect may be due to *p*H stabilization (Wiryawan and Brooker 1995) in the developing rumen by favouring establishment of non-cellulytic microflora (Mathiev *et al.* 1996). The present results are also in agreement with the findings of Jayabal *et al.* (2008) in kids revealing that the probiotic supplemented group had higher body weight than the control group. The effect of probiotic supplementation was more pronounced in later stages of growth in kids. Soren *et al.* (2012) reported the growth rate in probiotic supplemented group was at par to that of control group in Malpura lambs, contrasting to the present findings, however the supplementation of *Saccharomyces cerevisiae* and combination of *Saccharomyces cerevisiae* and

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Table 1. Comparison of means of different treatment groups for weekly body weight (BW), weekly body weight gain (WBWG), average daily gain (ADG), FCR, weekly feed intake (WFI) and daily feed intake (DFI)

Trait studied	Trt	Initial (0 day)	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
WBW (kg)	T0	8.87±0.31	9.08±0.31	9.30±0.30	9.54±0.30	9.79±0.30	10.08±0.29	10.36±0.28	10.68±0.28	11.01±0.27	11.35^{a}±0.27	11.67^{a}±0.27	12.00^{a}±0.27	12.34^{a}±0.27	12.69^{a}±0.27
	T1	8.87±0.47	9.15±0.48	9.45±0.47	9.77±0.47	10.11±0.48	10.45±0.47	10.78±0.47	11.14±0.47	11.53±0.47	11.94^{ab}±0.48	12.38^{ab}±0.48	12.82^{ab}±0.49	13.29^{ab}±0.48	13.78^{a}±0.48
	T2	9.18±0.31	9.49±0.31	9.83±0.31	10.19±0.31	10.57±0.31	10.95±0.30	11.35±0.31	11.78±0.31	12.24±0.32	12.73^{b}±0.32	13.25^{b}±0.33	13.80^{b}±0.34	14.36^{b}±0.34	14.94^{b}±0.34
F value		0.241^{NS}	0.341^{NS}	0.533^{NS}	0.795^{NS}	1.113^{NS}	1.415^{NS}	1.856^{NS}	2.266^{NS}	2.887^{NS}	3.630*	4.559*	5.725**	7.233**	9.010**
WBWG	T0		0.21^{a}±0.01	0.22^{a}±0.00	0.23^{a}±0.01	0.26^{a}±0.01	0.29^{a}±0.01	0.28^{a}±0.01	0.32^{a}±0.01	0.33^{a}±0.01	0.34^{a}±0.01	0.32^{a}±0.01	0.33^{a}±0.01	0.34^{a}±0.01	0.35^{a}±0.01
(kg)	T1		0.28^{b}±0.01	0.31^{b}±0.01	0.32^{b}±0.01	0.33^{b}±0.01	0.34^{b}±0.01	0.34^{b}±0.01	0.36^{b}±0.01	0.39^{b}±0.02	0.42^{b}±0.01	0.43^{b}±0.01	0.44^{b}±0.01	0.47^{b}±0.01	0.50^{b}±0.01
	T2		0.30^{b}±0.01	0.34^{c}±0.01	0.36^{c}±0.02	0.39^{c}±0.01	0.37^{b}±0.01	0.41^{c}±0.01	0.42^{c} ± 0.01	0.47^{c}±0.02	0.49^{c}±0.01	0.51^{c}±0.02	0.55^{c}±0.01	0.56^{c}±0.01	0.58^{c}±0.01
F value			29.96**	37.66**	33.17**	49.44**	11.65**	44.24**	62.19**	15.55**	46.08**	50.62**	109.02**	120.64**	151.79**
ADG (g)	T0		30.33^{a}±1.41	31.83^{a}±0.70	33.17^{a}±1.01	36.83^{a}±1.62	41.67^{a}±2.01	40.00^{a}±1.59	45.17^{a}±0.95	46.83^{a}±1.96	48.17^{a}±1.96	46.17^{a}±1.14	46.67^{a}±1.23	48.83^{a}±1.85	50.33^{a}±1.45
	T1		40^{b}±1.21	43.5^{b}±1.69	46.00^{b}±1.00	47.33^{b}±1.09	48.83^{b}±1.35	47.83^{b}±1.08	51.67^{b}±0.80	55.00^{b}±2.37	59.33^{b}±1.05	61.67^{b}±1.50	63.33^{b}±1.71	67.17^{b}±1.08	70.83^{b}±0.70
	T2		43.17^{b}±1.01	48.33^{c}±1.50	51.67^{c}±2.46	55.00^{c}±1.18	53.33^{c}±1.80	58.33^{c}±1.36	60.50^{c}±1.09	66.67^{c}±3.25	70.00^{c}±1.59	73.33^{c}±2.80	78.33^{c}±1.50	80.00^{c}±1.21	83.33^{c}±1.65
F value			29.98**	38.62**	33.39**	47.93**	11.39**	45.83**	65.28**	14.90**	47.86**	48.95**	112.92**	121.56**	156.63**
FCR	T0		9.29^{a}±0.12	9.04^{a}±0.03	9.88^{a}±0.18	9.10^{a}±0.04	8.73^{a}±0.16	9.08^{a}±0.16	8.44^{a}±0.03	8.64^{a}±0.17	8.76^{a}±0.05	9.62^{a}±0.15	9.87^{a}±0.04	9.55^{a}±0.11	9.20^{a}±0.28
	T1		7.37^{b}±0.02	6.76^{b}±0.02	7.15^{b}±0.16	7.04^{b}±0.06	7.29^{b}±0.15	7.87^{b}±0.04	7.70^{b}±0.16	7.62^{b}±0.02	7.29^{b}±0.08	7.44^{b}±0.03	7.32^{b}±0.09	7.44^{b}±0.05	7.14^{b}±0.04
	T2		6.61^{c}±0.07	6.09^{c}±0.02	6.38^{c}±0.06	6.07^{c}±0.03	6.91^{c}±0.07	6.42^{c}±0.03	6.62^{c}±0.15	6.26^{c}±0.02	6.27^{c}±0.12	6.26^{c}±0.02	6.02^{c}±0.09	6.22^{c}±0.05	6.14^{c} ± 0.01
F value			267.89**	3993.2**	168.36**	1028.7**	53.84**	178.94**	48.96**	138.63**	205.32**	381.44**	645.27**	525.35**	90.64**
WFI (kg)	T0		38.15^{a}±0.75	39.33^{a}±0.21	45.77±0.93	47.00±0.30	51.43±1.00	50.80±1.32	53.40±0.23	57.27±1.62	59.93^{a}±0.35	63.35^{a}±1.35	66.12±0.41	65.88^{a}±1.06	65.32^{a}±0.09
	T1		40.72^{b}±0.20	40.63^{b}±0.18	45.97±1.20	47.04±0.31	49.88±1.11	53.45±0.37	56.64±1.34	60.22±0.23	62.11^{ab}±0.61	66.27^{b}±0.42	66.72±0.79	72.68^{b}±0.62	73.84^{b}±0.09
	T2		39.10^{ab}±0.62	40.65^{b}±0.16	46.16±0.72	46.74±0.38	52.36±0.50	53.03±0.39	57.23±1.52	59.84±0.25	63.33^{b}±1.30	66.28^{b}±0.34	68.45±1.21	72.26^{b}±0.73	75.04^{b}±0.09
F value			5.097**	16.339**	0.040^{NS}	0.247^{NS}	1.883^{NS}	2.977^{NS}	3.068^{NS}	2.818^{NS}	4.083**	4.063**	1.947^{NS}	21.429**	10.143**
DFI (kg)	T0		5.59^{a}±0.09	5.8^{a}±0.02	6.59±0.10	6.68±0.05	7.48±0.07	7.58±0.06	8.18±0.22	8.55±0.04	9.05^{a}±0.19	9.47^{a}±0.05	9.78±0.17	10.32^{a}±0.10	9.33^{a}±0.09
	T1		5.82^{b}±0.03	5.80^{b}±0.03	6.57±0.17	6.72±0.04	7.13±0.16	7.64±0.05	8.09±0.19	8.60±0.03	8.87^{ab}±0.09	9.47±0.06^{b}	9.53±0.11	10.38^{b}±0.09	10.55^{b}±0.09
	T2		5.59^{ab}±0.09	5.81^{b}±0.02	6.59±0.10	6.68±0.05	7.48±0.07	7.58±0.06	8.18±0.22	8.55±0.04	9.05^{b}±0.19	9.47^{b}±0.05	9.78±0.17	10.32^{b}±0.10	10.72^{b}±0.03
F value			5.10**	16.34**	0.04^{NS}	0.25^{NS}	1.88^{NS}	2.98^{NS}	3.07^{NS}	2.82^{NS}	4.08*	4.06*	1.95^{NS}	21.43**	10.14**

Note: Mean bearing different superscripts (a, b, c) in a row differ significantly; **, Highly significant at P<0.01; *, Significant at P<0.05; NS, Non-significant.

Lactobacillus improved the protein digestibility by 18.3 and 14.4%, respectively. Contrary findings to the present work were also reported by Ozsoy (2013) in goats and Direkvandi *et al.* (2020) in Arabian lambs.

Weekly body weight gain (kg): At the end of experiment, T_2 group (0.58±0.01) showed highly significant (P<0.01) difference as compared to T_1 (0.50±0.01) and T_0 (0.35±0.01). The increase in weekly body weight gain in probiotic supplemented group as compared to control group in the present study may be due to improved digestion of animal by probiotic feeding and also by increasing protein availability, increasing rate of degradation in rumen, resulting in final increase in body weight gain as reported by Jinturkar *et al* (2009) in Osmanabadi kids, Anandan *et al.* (1999) in crossbreed Chegu kids, Khandebharad *et al.* (2009) in Osmanabadi kids. Whereas, contrary finding was reported by Kellems *et al.* (1990) in cows, and Aysigi *et al.* (2005) in Sannen kids.

Average daily gain (g): Average daily gain (g) of Osmanabadi kids reared under different probiotic feeding groups is presented in Table 1. At the end of experiment, treatment T_2 (83.33±1.65) showed highly significant (P<0.01) differences as compared to T_1 (70.83±0.70) and T_0 (50.33±1.45) group. The daily gain observed in the present study was higher than reported by Jayabal *et al.* (2008) for T_1 and T_2 treatments (T_1=55.69 ±4.55 g and T_2=62.78±5.05 g), whereas Kerketta *et al.* (2017) reported higher daily gain (91 g) for *Lactobacillus acidophilus* + *Saccharomyces cerevisiae* group. Jinturkar *et al*. (2009) also reported higher ADG (88 g) for *Lactobacillus acidophilus* + *Saccharomyces cerevisiae* group. The present study revealed that the average daily gain increased significantly in probiotic supplemented group as compared to control group which is in line to that reported by Anandan *et al*. (1999) in crossbreed Chegu kids.

Feed conversion ratio (FCR): At the end of experiment, the weekly feed conversion ratio showed highly significant (P<0.01) difference amongst treatment groups. The feed conversion ratio was better in T_2 group followed by T_1 as compared to T_0 group. The reason for better feed conversion ratio may be due to probiotic culture which increases cellulose digestion and microbial growth in the rumen which enhances the microbial protein synthesis resulting in improved feed efficiency of animals. This is in accordance to that reported by Jinturkar *et al.* (2009) in kids, Singh *et al.* (2016) in Barbari kids, Bhoi *et al.* (1992) and Srivastava *et al.* (2017) in kids. Whereas, contrary finding were reported by Lubis *et al.* (2002) in sheep and Ozsoy *et al.* (2013) in kids. Similarly, the overall feed conversion ratio in the present study was better in *Saccharomyces cerevisiae* + *Lactobacillus* supplemented group (T_2) followed by *Aspergillus oryzae* + *Lactobacillus* group (T_1) as compared to control group.

Weekly and daily feed intake (kg): At 13th week of experiment, the weekly feed intake of Osmanabadi kids showed significant difference amongst T_2 (75.04±0.09 kg) and T_1 (73.84±0.09 kg) group as compared to control group T_0 (65.32±0.09 kg) whereas for daily feed intake, T_2 (10.72±0.09 kg) and T_1 (10.55±0.09 kg) group showed highly significant (P<0.01) differences as compared to control group T_0 (9.33±0.09 kg), respectively. In present experimental study, increased feed intake at the end of experimental period may be due to positive effect of probiotics supplementation on feed intake and also due to increasing cellulolytic bacteria in rumen which improved the ruminal *p*H resulting in enhanced feed intake of kids. The present study result is in line to that reported by Ghani *et al.* (2004) in Zaraibi goats, Khandebharad *et al.* (2009) in Osmanabadi kids. Probiotics have been previously reported to improve feed intake by Chiofalo *et al.* (2004).

It can be concluded from the results that the combination of *Saccharomyces cerevisiae* and *Lactobacillus* supplemented group (T_2) exhibited better performance in terms of growth, FCR and feed intake as compared to *Aspergillus oryzae* and *Lactobacillus* supplemented group (T_1) and control (T_0).

SUMMARY

The present experiment was conducted for 90 days to assess the effect of probiotic supplementation on performance of Osmanabadi kids at Osmanabadi goat unit of Red Kandhari Research and Instructional Farm, College of Veterinary and Animal Sciences, MAFSU, Parbhani, Maharashtra. Eighteen male or female kids of 3-6 months age were selected and randomly divided on equal weight basis into three treatment groups viz. T_0 (control) with basal ration, T_1 group with basal ration plus probiotics (*Aspergillus oryzae* and *Lactobacillus*), T_2 group with basal ration plus probiotics (*Saccharomyces cerevisiae* and *Lactobacillus*). The averages for weekly body weight (kg) of kids in different treatment groups (T_0, T_1 and T_2) at the end of experiment were 12.69±0.27, 13.78±0.48, 14.94±0.34 kg, respectively. The weekly body weight gain was 0.35±0.01, 0.50±0.01, 0.58±0.01 kg, respectively while the average daily gain was 50.33±1.45, 70.83±0.70, 83.33±1.65 g, respectively, for T_0, T_1 and T_2 groups. At the end of 13th week, FCR for T_2 group was significantly lower (6.14±0.01) as compared to T_1 (7.14±0.04) and T_0 (9.20±0.28) groups. Highly significant differences were observed for weekly body weight, weekly body weight gain, average daily gain, weekly and daily feed intake. It can be concluded that *Saccharomyces cerevisiae* and *Lactobacillus* supplemented group (T_2) exhibited better performance in terms of growth and FCR as compared to *Aspergillus oryzae* and *Lactobacillus* supplemented group (T_1) and control (T_0).

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