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Effects of pre-weaning probiotic treatments on growth performance and biochemical blood parameters of Holstein calves

İsmail Ülger

Animal Science Department,
Agricultural Faculty, Erciyes University, Kayseri-38039, Turkey.
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ABSTRACT

The present study was conducted to assess the effects of pre-weaning probiotic treatments on growth performance of male Holstein calves. For experimental treatments, 20 male calves were divided into 2 groups as of control and treatment group. Control group calves were supplied with fresh milk daily in two meals without any growth promoting supplement. Together with fresh milk supply, treatment group calves were supplied with additional 2 g probiotics to their morning meal. Throughout 56-day milk-feeding period, live weights (LW) and feed consumptions (FC) of the calves were determined. As compared to the control group, probiotic-supplemented calves had 5.25% higher weaning live weight and 11.4% higher daily live weight gain ($P<0.05$). Probiotic-supplemented calves consumed 2% more feed than the control calves ($P>0.05$) and had 9.52% better feed conversion ratio than the control group calves ($P<0.05$). Probiotic supplementation did not affect blood biochemical parameters significantly ($P<0.05$), except ALT, triglyceride and iron levels ($P<0.05$). It was concluded that probiotic supplementation during milk-feeding period improved growth performance of experimental Holstein calves.

Key words: Calf, Feed additive, Growth performance, Holstein, Probiotic.

INTRODUCTION

Permanence of herd in dairy facilities can only be possible through the replacement of discharged cows from the herd for various reasons with higher-yield ones. To create a well-herd composition, the heifers to be included into the herd should be available for high-yield and they should be well-developed to present their potential, in other words, they should reflect these characteristics on phenotypes. Such a case can only be possible with well-nutrition and care of calves from the first day of their birth on (Kumar *et al.*, 2017; Zhang *et al.*, 2017).

Pre-weaning calf mortalities result in significant economic losses even in developed countries. New-born calves are quite prone to infections. Therefore, initial couple of weeks are the most critical periods for their future performance (Kahraman, 1993). To overcome such problems, today various growth-promoting compounds are used. Such compounds are commonly called as feed supplements or additives. Although some natural ones are not harmful, some synthetic ones are composed of various chemicals and thus may exert serious health risks both on animals and humans consuming animal products (Özen, 2007). Thus, researchers have long searched for new and safe feed supplements or additives. In this sense, probiotics are undoubtedly the first thing that comes to mind. A well-probiotic should accelerate animal growth and improve the resistance to diseases. Besides, it should not be pathogenic and toxic, should also sustain vitality and efficiency in digestive tracks (Khanna *et al.*, 2016).

Probiotics are used as a significant alternative to antibiotics and similar feed additives with serious health risks on animal and public health. They are commonly used as a growth promoting substance. Different results were reported in previous researches about the effects of probiotics supplemented in pre-weaning period on calf performance (Avila *et al.*, 1995; Abu-Tarboush *et al.*, 1996; Morril *et al.*, 1995; Strzetelski *et al.*, 1996; Feist *et al.*, 1997; Kocyigit *et al.*, 2015). Therefore in this study, effects of pre-weaning probiotic treatments on growth performance of calves were investigated.

MATERIALS AND METHODS

This study was carried out in a private cattle breeding facility located in Kayseri in early summer months (May-June) of 2016. For experimental treatments, 20 male Holstein calves with close birth weights, similar colostrum ($P>0.05$) and fresh milk consumptions (Table 1) and close live weights were selected (Table 3). Calves were then divided into 2 groups (control and treatment/probiotic) with 10 calves in each. Throughout the experiments, control (unsupplemented) group calves consumed plain milk daily in 2 meals. Treatment (probiotic) group calves were fed with probiotic-supplemented milk in one of (morning) daily 2 meals for 56 days until weaning age. As the probiotic source, mixture of alive microorganisms composed of *Lactobacillus*

*Corresponding author's e-mail: ismailulger@erciyes.edu.tr

Table 1: Birth weights and colostrum consumptions of calf groups.

Parameters	Control	Probiotic	SEm±	SL
Birth weight (kg)	40.85	41.50	0.293	NS
Consumed colostrum (lt)	16.3	16.8	0.137	NS

SEm- Standard error of the means; SL- Significance level; NS- Non Significant at P>0.05

acidophilus, *Lactobacillus casei*, *Enterococcus faecium* and *Bifidobacterium bifidum* (including at least 1.0x109 CFU in each gram) were used. Ready probiotics were supplied from a commercial dealer (PrimaLac®).

Calves were housed in individual calf pens with wheat straw bedding replaced twice in a week. From the beginning of experiments (7th day) till weaning (56th day), clean drinking water, alfalfa dry hay and calf starter feed were provided *ad libitum* to calves. Nutritional composition of dry alfalfa hay and calf starter feed were determined in accordance with the methods specified in AOAC (1990) in the laboratory of Animal Science Department of Erciyes University (Kayseri, Turkey) and results are provided in Table 2.

At the end of experiments, blood samples were taken from the calves into vacuumed sample tubes and samples were centrifuged at 3500 rpm for 10 minutes to separate the serums. Resultant serums were then transferred to Eppendorf tubes and preserved at -20 °C until the time of analysis. Serum samples were subjected to glucose, triglyceride, total cholesterol, phosphorus, aspartate amino transaminase (AST), alanine amino transferase (ALT), total protein, calcium, iron, high density lipoproteins (HDL), low density lipoproteins (LDL) and albumin analyses in a biochemistry auto-analyser (Vegasys, AMS Alliance, Rome, Italia) with proper test kits (AMS Diagnostics, Rome, Italia) in the laboratory of Animal Science Department of Erciyes University (Kayseri, Turkey).

Descriptive statistics for resultant data were expressed in means and standard errors. Independent samples t-test was used to test the differences between the groups at 5% level. SPSS (SPSS, 2012) software was used in statistical analyses.

RESULTS AND DISCUSSION

Effects of probiotic supplements at pre-weaning age on performance of Holstein calves are provided in Table 3.

Table 2: Nutritional composition of alfalfa hay and calf starter.

Nutrients	Calf Starter Feed	Dry Alfalfa Hay
Dry matter (%)	88.34	90.97
Crude protein (% of DM)	18.71	12.64
Ether extract (% of DM)	3.14	3.47
Crude cellulose (% of DM)	9.35	25.40
Crude ash (% of DM)	7.69	7.14

DM- Dry Matter

The differences in initial live weights of the calves (7th day) were not found to be significant (P>0.05) (Table 3). Considering the birth weights provided in Table 1, it was observed that daily weight gain (DWG) in 0-7 day period was 385 g/day. The differences in final live weights (FLW) of the calves (56th day) at the end of experiments were found to be significant (P<0.05). Final weight at 56th day was measured as 70.35 kg in control (C) group and 74.25 kg in probiotic group (P). The probiotic group had 5.25% more live weight at weaning than the control group. Görgülü *et al*. (2003) carried out a probiotic study for 60 days and reported that probiotic group had 3.15% higher weaning weight than the control group. Bakhshi *et al*. (2006) carried out 56-day milk-feeding study and reported 3.33% higher weaning weight for probiotic-treated calves than for the control calves. Present findings comply with but higher than those earlier ones. On the other hand, Jatkauskas and Vrotniakiene (2010) carried out 62-day milk-feeding study and reported 8.56% higher weaning weight for probiotic-treated calves than for the control calves. Such a value complies with, but higher than the present value. Although both the previous studies and the present study indicated positive effects of probiotic treatments on weaning weight of the calves, the differences in findings mostly come from the differences in genotype and race of the calves, experimental start up and weaning ages, milk composition, type of probiotics, roughage and concentrate feeds.

The differences in daily weight gains (DWG) of the groups were found to be significant (P<0.05). The value

Table 3: Effects of pre-weaning probiotic treatments on performance of calf groups

Parameters	Control	Probiotic	SEm±	S.L.
Initial live weight (kg)	43.65	44.10	0.429	NS
Final live weight (kg)	70.35	74.25	0.762	*
Daily weight gain (kg)	0.545	0.615	0.057	*
Daily roughage consumption (g)	165.3	157.8	2.491	NS
Daily concentrate feed consumption (g)	751.4	778.1	8.814	NS
Daily total feed consumption (g)	916.7	935.9	9.935	NS
Feed conversion ratio, FC/DWG	1.68	1.52	0.086	*

SEm- Standard error of the means; SL- Significance level; *- Significant at P<0.05; NS- Non Significant at P>0.05; FC- Feed consumption; DWG- Daily weight gain

was calculated as 615 g/day in probiotic (P) group and as 545 g/day in control (C) group. About 11.4% higher value was observed in probiotic group than the control group. Bakshi *et al.* (2006) reported daily weight gains in probiotic and control groups respectively as 441.5 and 422.8 g/day with 4.24% difference in favour of probiotic group. Görgülü *et al.* (2003) also reported daily weight gain of probiotic and control calves respectively as 366.26 and 349.29 g/day with 4.63% difference again in favour of probiotic group. Present findings comply with, but higher than those earlier ones. The differences in DWG values were mostly because of differences again in above specified parameters.

The differences in daily roughage, concentrate and total feed consumptions of the groups were not found to be significant (P>0.05), but the differences in feed conversion ratios (FCR) were found to be significant (P<0.05). The ratio in control and probiotic group was calculated respectively as 1.68 and 1.52 with 9.52% difference in favour of probiotic group (Table 3). FCR values are calculated as the ratio of daily feed consumption to daily weight gain and lower FCR values indicate more efficient feed conversions. As can be seen in Table 3, probiotic group consumed almost the similar quantity of feed with the control group (the difference was 2%, but not significant), but the difference in live weights at the end of 56-day milk-feeding period was 5.25%. Such values indicated that probiotic supplements improved feed conversions in this period. Jatkauskas and Vrotniakiene (2010) reported feed conversion ratios of control and probiotic groups respectively as 1.71 and 1.49; Bakshi *et al.* (2006) reported these values respectively as 1.5 and 1.3. Present findings on feed conversion ratios in favour of probiotic groups comply with those earlier findings.

Blood serum biochemical parameters of calf groups are provided in Table 4.

Probiotic group had higher serum glucose, cholesterol, AST, HDL and LDL values than the control group, but the differences between the groups were not found to be significant (P>0.05).

High blood glucose levels may be attributed to conversion of propionic acid synthesized in rumen into glucose in liver through gluconeogenesis (Ensminger *et al*., 1990). Although serum calcium, phosphorus, albumin and total protein values were higher in control group, the changes in these parameters were not found to be significant. Previous studies also reported increased total protein levels with probiotic supplementation (Denev *et al.*, 2007; Hossain *et al.*, 2012). However, total protein levels of probiotic group of the present study were lower than the control group. Serum triglyceride levels were higher in probiotic group than in control group and the differences between the groups were found to be significant (P<0.05). Probiotics may be autolyzed in rumen and form ethanol, then propionic acid and acetic acid concentrations in rumen and liver increase and such increases may then raise triglyceride levels (Bruning and Yokoyama, 1988; Nursoy and Baytok, 2003).

Probiotic supplementation significantly reduced blood serum ALT levels (P<0.001). Loguercio *et al.* (2002) also reported decreasing ALT levels with probiotic treatments. Effects of probiotic supplementation on serum iron levels were also found to be significant (P<0.001).

Different results were obtained from previous probiotic studies on calves; while some researchers (Avila *et al.*, 1995; Abu-Tarboush *et al.*, 1996; Morril *et al.*, 1995) indicated that probiotics did not have significant effects on performance of calves, some others (Roth *et al.*, 1992; Feist *et al.*, 1997; Strzetelski *et al.*, 1996) indicated that probiotics improved calf growth performance. It was observed that the effects of probiotics on growth performance largely depended on growing conditions and calves in themselves. Such improvements are related to stimulant effects of probiotics on special immunologic defence mechanisms and thus response against antigen and pathogens (Görgülü *et al.*, 2003).

Table 4: Effects of pre-weaning probiotic treatments on blood biochemical parameters of calf groups.

Parameters	Control	Probiotics	SEm±	S.L.
Glucose (mg/dL)	74,33	82,94	5,750	NS
Triglyceride (mg/dL)	17,45	20,50	0,710	*
Cholesterol (mg/dL)	51,30	60,00	2,419	NS
Phosphorus (mg/dL)	7,98	7,37	0,286	NS
AST (u/L)	67,80	74,92	6,692	NS
ALT (u/L)	27,10	20,92	0,903	**
Total Protein (g/dL)	7,19	6,86	0,219	NS
Calcium (mg/dL)	12,65	11,88	0,495	NS
Iron (mg/dL)	9,79	15,18	0,876	**
HDL (mg/dL)	84,00	84,80	3,604	NS
LDL (mg/dL)	22,62	24,20	1,433	NS
Albumin (g/dL)	3,31	3,25	0,192	NS

AST- Aspartate amino transaminase; ALT- Alanine amino transferase; HDL- High density lipoproteins; LDL- Low density lipoproteins; SEm- Standard error of the means; SL- Significance level; *- Significant at P≤0.05; **- Significant at P≤0.001; NS- Non Significant at P>0.05

CONCLUSION

It was concluded based on present findings that pre-weaning probiotic supplements improved growth performance of experimental Holstein calves. Hereby, probiotics can be recommended to be used during the pre-weaning period to improve calf growth performance.

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