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The Effect of Direct-Fed Microbials Plus Exogenous Feed Enzyme Supplements on the Growth, Feed Efficiency Ratio and Some Behavioural Traits of Brown Swiss x Eastern Anatolian Red F_1 Calves

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ABSTRACT

The purpose of this study was to determine effects of the combination of direct-fed microbials (DFM) with exogenous feed enzymes (EFE) on the growth performance, feed efficiency ratio as well as some behavioural traits of Brown Swiss x Eastern Anatolian Red F_1 calves reared in Eastern Region of Turkey. Twenty crossbred calves (10 males and 10 females) were assigned to treatment (DFM plus EFE additive) and control groups. Calves in DFM plus EFE group had 3.05 kg and 5.11 kg higher (P<0.05) weights at weaning and 3 months of ages than these in control group. Growth rate of the DFM plus EFE supplemented calves was significantly greater (P<0.05) than calves in control group in pre-weaning as well as between birth and 3 months of age. The feeding of DFM plus EFE additives to crossbred calves resulted in beneficial effect on the feed efficiency ratio in the pre-weaning period, and amount of dry matter of feed consumed per kg weight gain was significantly (P<0.05) decreased in the calves in the treatment group. Gains in front shank circumferences from body measurements was also significantly higher (P<0.05) in the calves fed DFM plus EFE supplement compared to these in the control group. Behavioural activities of the calves were not significantly affected by DFM plus EFE additives. In conclusion, feeding combination of DFM and EFE to the crossbred calves resulted in significant beneficial effect on the growth performance and feed efficiency ratio of the young animals.

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RK, RA and MY conceived and designed the study. MY wrote the article. AD, MA and SO executed the experimental work.

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Gains in body measurements.

INTRODUCTION

Recently, prolonged and widespread use of the antimicrobial feed additives brought about increasing worries about the development of resistant bacterial population which might have detrimental effects on the human health. As a result of the growing concern, the use of antimicrobial growth-promoting feed supplements, including antibiotics and ionophores in livestock production was banned by European Union and many other countries (Iqbal *et al.*, 2015). Consequently the feed manufacturers and consumers were prompted to look for alternative feed additives such as direct-fed microbials (DFM), and biological feed additives for example fibrolytic feed enzymes.

The DFM is defined as live naturally occurring microorganisms including yeast, bacteria and fungi, non-viable bacterial, fungal or yeast cultures, or end-products of bacterial, fungal or yeast fermentations (Calloway and Rickle, 2012). Beneficial effects of DFM in cattle are increased milk production, faster growth rate, more efficient feed utilization and improved general health. Influence of DFM on growth traits of dairy calves have not been adequately studied less and the findings reported in literature are inconsistent (Adams *et al.*, 2008; Elghandour *et al.*, 2015).

Although exogenous feed enzymes (EFE) are widely used in diets of non-ruminant animals, their commercial use in ruminant rations is relatively limited. On the other hand, increasing feed cost in several countries, as well as declining enzyme cost continues to increase research efforts to develop and evaluate enzyme supplements for ruminants (Beauchemin and Holtshausen, 2011). Krause *et al.* (1998) and Yang *et al.* (1999) have reported promising positive responses to EFE in mature ruminant animals. However, no data exists on potential use of EFE for young calves (Ghorbani *et al.*, 2007). Additionally, combined effect of the DFM and EFE needs to be investigated on the growth performance characteristics of the young calves since combination of EFE and DFM supplements are recently available in the livestock feed market. The present study was therefore, undertaken to assess synergistic effects of DFM plus EFE

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additives on the growth performance, feed efficiency ratio and some behavioural traits of Brown Swiss x Eastern Anatolian Red F_1 crossbred calves reared in Eastern Turkey.

MATERIALS AND METHODS

Brown Swiss x Eastern Anatolian Red F_1 calves (10 female and 10 male) reared in the Research Farm of Agricultural Collage at Ataturk University, Erzurum, Turkey were used in this study. After the calves were born, they were allowed to stay with their dams to receive colostrum for the first three days. Then, they were randomly assigned to treatment (DFM plus EFE) and control groups according to sex. The additives of DFM plus EFE had microorganisms such as *Lactobacillus acidophilus, Lactobacillus casei, Lactobacillus plantarum, Bacillus subtilis* and *Aspergillus oryzae* and enzymes such as pectinase, lipase, protease, amylase and cellulase. The daily amount of DFM plus EFE supplement was 10 g per animal. It was added into the milk and offered to the calves every morning in the pre-weaning period. The supplement of DFM plus EFE was supplied by a private feed company.

The calves were kept in the individual hutches furnished by water bucket, milk bottle and hay and calf starter feeders. Whole milk was fed to calves via milk bottles twice a day (8:00 am and 17:00 pm). Quantity of the milk given to calves was 10 % of their birth weight and the amount of milk remained constant during the milk feeding period. The calves were weaned at 8 weeks of age. The calves were fed during 3 months research period. The calf starter used in this study contained 88.9% dry matter, 20.1% crude protein; 5.2% ether extract, 5.3% crude ash and 7.6% crude cellulose. Dry hay had 90.5% dry matter, 7.2% crude protein, 3.2% ether extract, 9.8% crude ash and 27.7% crude cellulose. The quantities of starter and hay that remained in the feeders were weighed daily and amount of feeds consumed was recorded. *Ad libitum* feeding for starter and hay was practiced.

The weights and body measurements such as heart girth, body length, chest depth, front shank circumferences and height at withers were taken and recorded at birth, during weaning (8 weeks of age) and at 3 months of ages of the calves.

The data regarding behavioural activities of the calves were determined by using instantaneous sampling method as described by Martin and Bateson (1993). Calf's behaviour in this method was recorded once a week by walking through the calf barn, at a distance from the pen about 2.1 m, every 15 min. from 9.00 to 12.00 h. The calf's behaviour was recorded for each of the following activities as used by Kartal and Yanar (2011): lying (calf's body contacted bedding and ground), standing (calf is inactive in upright position), eating (calf's head in feed bucket) and drinking water (calf's head in water bucket). Percentage time spent for each activity was weekly calculated.

The data were statistically analysed by using 2x2 completely randomized factorial experimental design. In the preliminary statistical analysis of the all traits studied, birth weight of the calf was included-statistical model as a covariate. If the effect of the covariate was not significant, it was excluded from the model. The birth weight as a covariate was therefore, only used for statistical analysis of weights obtained at weaning and 3 months of ages. Other traits were analysed statistically without using birth weight as covariate. Interaction between DFM plus EFE and sex of calf was also excluded from statistical model because the interactions were found to be insignificant in the preliminary statistical analysis. Behavioural data were also subjected to analysis of variance, since they had normal statistical distribution. The ANOVA analysis was carried out by using SPSS (2013) statistics program.

RESULTS AND DISCUSSION

Weights of calves at birth, weaning and 3 months of ages are presented in Table I. Feeding of DFM plus EFE significantly ($P<0.05$) affected the weaning weight. The 6.1% improvement in weaning weight was observed in the present study when the calves were fed diet supplemented with DFM plus EFE. Similarly, Timmerman *et al.* (2005) also revealed that mean weight of calves in DFM treatment group at 8 weeks of age was significantly heavier than that of calves in control group. On the other hand, Aydin *et al.* (2008) reported insignificant effect of the DFM with EFE supplementation on the weaning weight of the Holstein Friesian calves.

The average weight of the calves at 3 months of age was also significantly ($P<0.05$) influenced by feeding of the diets supplemented with DFM plus EFE in the pre-weaning period. The 3 months weight of the calves in the DFM plus EFE group was 7.8 % higher compared to that of calves in the control group. The result is in accordance with finding of Adams *et al.* (2008) who reported significant live weight difference between DFM and control groups. Malik and Bandla (2010) also revealed significant beneficial influences of the DFM with EFE supplements on the live weights of the male buffalo calves at various parts of their growth. However, in some experiments, weights of the calves obtained at different stages of the growth were not significantly influenced by

inclusion of the DFM (Aydin *et al.,* 2008; Isık *et al.,* 2004) or EFE (Ghorbani *et al.,* 2007).

Average weaning weight of the male Brown Swiss x Eastern Anatolian Red F_1 calves was significantly (P<0.05) higher (4.35 kg) than that of females, but the difference between sexes disappeared at 3 months of age (Table I).

Table I.- Weights during ($\overline{X} \pm S_{\bar{x}}$) various stages of the growth of the calves[1]

	N	Birth weight	Weaning weight	3 Months weight
Overall mean	20	30.28±0.91	51.13±0.69	67.96±1.13
Feeding groups		*	*	*
Control	11	28.52±1.22	49.60±0.98	65.40±1.59
DFM plus EFE	9	32.03±1.35	52.65±1.09	70.51±1.78
Sex		NS	*	NS
Female	10	30.0±1.3	48.95±0.99	66.29±1.61
Male	10	30.6±1.3	53.30±0.99	69.62±1.61

* P<0.05; NS, Nonsignificant; $\overline{X} \pm S_{\bar{x}}$, least squares mean ± standard error.
[1] Means are adjusted for covariate (birth weight).

Total weight gains in pre- and post-weaning periods are given in Table II. Rates of weight gain in pre-weaning as well as between birth and 3 months of age were higher in favour of calves in DFM plus EFE groups. The crossbred calves in DFM plus EFE group had 3.1 and 4.89 kg higher total gain than those in control group. Similarly, improved weight gains of the dairy and buffalo calves fed DFM and EFE were already reported by Krehbiel *et al.* (2003), Dimova *et al.* (2013), Malik and Bandla (2010). Sex of the calves only had significant (P<0.01) effect on the total weight gain in the pre-weaning period, and male calves had 4.36 kg heavier total weight gain than female calves.

Amount of dry matter intake of milk, hay and calf starter per kg weight gain is presented in Table III. The amount of dry matter of the feed per kg weight gain of the calves received DFM plus EFE in the pre-weaning period was significantly (P<0.05) lower than that of calves in the control group. Although the feed efficiency value was also in favour of the calves in DFM plus EFE group, the difference between groups was not statistically different in the post-weaning period. Feed efficiency ratio calculated in the pre-weaning period corresponded with reported data on buffalo calves (Malik and Bandla 2010).

Gains in body measurements except for front shank circumferences were also not affected significantly by feeding DFM plus EFE supplement and gender (Table IV). While gain in the front shank circumferences as an indicator of the development of the calf's skeleton was positively (P<0.01) affected by DFM plus EFE additives, the rest of the gains in other body measurements were not significantly affected by the treatments. The result is in agreement with findings of Kocyigit *et al.* (2015) who also reported that gains in all body measurements were not influenced significantly by DFM plus EFE supplements in dairy calves. The effect of the sex of calves on the gains of the all body measurements was not significantly different between birth and 3 months. The result is in agreement with findings of Aydin *et al.* (2008).

Table II.- Total weight gains ($\overline{X} \pm S_{\bar{x}}$) obtained at different periods of the growth of the calves.

	N	Total weight gain (kg) between		
		Birth and weaning	Weaning and 3 months of age	Birth and 3 months of age
Overall mean	20	21.03±0.67	16.82±0.90	37.84±1.10
Feeding groups		*	NS	*
Control	11	19.48±0.90	15.91±1.21	35.40±1.47
DFM plus EFE	9	22.58±1.00	17.72±1.34	40.29±1.63
Sex		**	NS	NS
Female	10	18.85±0.96	17.35±1.28	36.20±1.56
Male	10	23.21±0.96	16.28±1.28	39.49±1.56

**P<0.01.
For statistical analysis detail see Table I.

Table III.- Feed efficiency ratio[1] of crossbreed calves. The values are in $\overline{X} \pm S_{\bar{x}}$.

	N	Total amount of dry matter consumed per kg weight gain between		
		Birth and weaning	Weaning and 3 months of age	Birth and 3 months of age
Overall mean	20	2.93±0.13	4.20±0.29	3.87±0.15
Feeding groups		*	NS	NS
Control	11	3.21±0.18	4.37±0.39	4.11±0.20
DFM plus EFE	9	2.66±0.19	4.03±0.44	3.64±0.22
Sex		NS	NS	NS
Female	10	3.16±0.18	4.03±0.42	4.03±0.21
Male	10	2.71±0.18	4.37±0.42	3.72±0.21

[1]Feed efficiency ratio: Consumed dry matter of feed (kg) / weight gain (kg).
For statistical analysis detail see Table I and II.

Table IV.- Gains in body measurements ($\overline{X} \pm S_{\bar{x}}$) of the calves between birth and 3 months of age.

	N	Height at withers	Body length	Chest depth	Heart girth	Front shank circumference
Overall mean	20	13.25±0.55	14.58±0.90	8.12±0.71	19.90±0.68	1.21±0.09
Feeding groups		NS	NS	NS	NS	**
Control	11	13.77±0.74	14.80±1.22	7.93±0.95	19.44±0.92	0.88±0.12
DFM plus EFE	9	12.72±0.82	14.35±1.34	8.31±1.05	20.36±1.01	1.54±0.14
Sex		NS	NS	NS	NS	NS
Female	10	13.25±0.77	15.40±1.28	8.30±1.00	18.70±0.97	1.35±0.13
Male	10	13.24±0.77	13.76±1.28	7.94±1.00	21.09±0.97	1.07±0.13

For statistical detail see Tables I and II.

Table V.- Percentage (%) of daily activities ($\overline{X} \pm S_{\bar{x}}$) of the calves.

	N	Lying	Standing	Feeding	Drinking water
Overall mean	20	39.59±1.63	31.94±0.95	27.61±1.57	0.88±0.27
Feeding groups		NS	NS	NS	NS
Control	11	38.75±2.20	31.85±1.28	28.63±2.11	0.81±0.36
DFM plus EFE	9	40.43±2.43	32.03±1.42	26.59±2.34	0.95±0.40
Sex		NS	NS	NS	NS
Female	10	39.78±2.30	32.69±1.34	26.85±2.21	0.72±0.37
Male	10	39.40±2.32	31.19±1.35	28.37±2.23	1.04±0.38

For statistical detail see Table I.

The percentage of time spent on different activities of calves are presented in Table V. Percentage of time spent for lying, standing, eating and drinking water behaviours were not significantly influenced by feeding of DFM plus EFE. In other words, supplementation of the diet of the calves in pre-weaning period with DFM plus EFE additives did not resulted in significant difference for behavioural traits of the young animals.

CONCLUSIONS

In conclusion, overall findings of this study suggested that feeding combination of DFM with EFE had considerably beneficial influence on growth performance and feed conversion ratio of the crossbred calves without causing adverse effects on the behavioural traits.

Statement of conflict of interest

Authors have declared no conflict of interest.

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