African Journal of Agricultural Research Vol. 4 (5), pp. 548-552, May 2009
Available online at http://www.academicjournals.org/AJAR
ISSN 1991-637X © 2009 Academic Journals

Full Length Research Paper

Effect of direct-fed microbials plus enzyme supplementation on the fattening performance of Holstein young bulls at two different initial body weights

Recep Aydin[1], Mete Yanar[1]*, Ridvan Kocyigit[1], Abdulkerim Diler[2] and Tugca Zeynep Ozkilicci[1]

[1]Department of Animal Science, College of Agriculture, Ataturk University, Erzurum-Turkey.
[2]Hinis Vocational School, Ataturk University, Hinis, Erzurum-Turkey.

Accepted 7 May, 2009

The study was designated to determine the effects of direct-fed microbials (DFM) plus enzyme supplement and initial body weights on the finishing performance, feed intake and feed efficiency ratio characteristics of Holstein Friesian young bulls. Eighteen male Holstein Friesian from two weight groups [light body weight (LBW) group = 178.3 kg and heavy body weight (HBW) group = 278.3 kg] were fed concentrate and roughages (dry hay and corn silage) for 182 days. DFM plus enzyme-treated animals were fed concentrate supplemented with 20 g of the combination of *Lactobacillus acidophilus, L. casei, L. plantarum, Bacillus subtilis, B. licheniformis, Aspergillus oryzae, Enterococcus faecium,* as well as enzymes (amylase, protease, cellulose, lipase, pectinase). Although average daily and total weight gains, final weight and DMI from all feeds of the bulls in the DFM plus enzyme group were numerically greater than these of cattle in control group, the differences were not statistically significant. However, supplementing diets with DFM plus enzyme significantly ($P<0.01$) improved feed efficiency ratio of the young bulls. While total and daily weight gains of the bulls in LBW group were significantly ($P<0.01$) higher than these of cattle in HBW, DMI from concentrate, roughage and all feeds ($P<0.05$) of HBW group was greater than these of LBW group. Improvement in the feed efficiency of the bulls in LBW was significant ($P<0.01$). There were significant ($P<0.01$) interactions of weight groups and DFM plus enzyme for weight gains and feed efficiency ratio.

Key words: Fattening performance, feed intake, direct-fed microbials, enzymes, cattle, Holstein, feed efficiency. ratio.

INTRODUCTION

In recent years, concern regarding the use of antibiotics and other traditional growth stimulants in finishing cattle diets has increased considerably. Most of the growth promoting substances has been banned in many countries. As a result of that, the use of direct-fed microbials (DFM) and other nontraditional additives has increased in response to demands for using more natural growth promoter substances.

Direct-fed microbials (DFM) products were defined as "single or mixed cultures of live, naturally occurring microorganisms", which, when fed to animals, beneficially affect the host (Peterson et al., 2005). The microorganisms used as DFM for ruminants include viable cultures of bacteria, yeasts and mold. There have been contradicting reports about efficiency of DFM in finishing cattle diets. Results of the some studies indicated that feeding of DFM to feedlot cattle generally results in increase in average daily weight gain and improvement in feed efficiency (Carraud, 1990; Krehbiel et al., 2003; Peterson et al., 2005). However, Brashears et al. (2003) and Greenquist et al. (2004) reported that supplementation of DFM resulted in no measurable impact on growth rate in finishing cattle.

Although successful application of dietary enzyme supplement technology was first achieve with poultry and swine, the microbial fermentation process in rumen has

*Corresponding author. E-mail: mtyanar@gmail.com. Tel: 90 442 2312569. Fax: 90 442 2360958

Table 1. Chemical compositions of concentrate, dry hay and corn silage.

Nutrients, %	Concentrate	Dry Hay	Corn Silage
Dry Matter	87.9	87.9	21.8
Crude Protein	14.0	7.0	2.1
Ether Extract	2.8	1.4	1.8
Crude Ash	7.0	8.5	1.7
Crude Cellulose	11.5	9.5	6.5
Nitrogen Free Extract	52.6	61.5	9.7

made adoption of dietary enzyme technology more challenging in ruminants (Tricarico et al., 2008). Fibrolytic enzymes which are the nontraditional growth stimulant may be effective in enhancing finishing performance and feed efficiency ratio by improving of digestion of forage. Feng et al. (1992) reported that adding the enzymes to grass hay before feeding, beef steers increased DM intake as well as DM, NDF and ADF digestibility. Tricarico et al. (2007) also concluded that dietary amylase supplementation of finishing beef diets could result in increased weight gain through increased DMI under certain dietary conditions.

Recently, combination of DFM and enzymes as feed supplement was also started to be used in diets of the finishing cattle. Reports of the DFM plus enzyme additives fed cattle are limited, and there is also no information about interaction between initial body weights (BW) and diets with or without DFM plus enzyme supplement. Therefore, the study was undertaken to investigate the effects of combination of DFM and enzyme supplement in diets of young Holstein Friesian bulls at two different initial BW on the finishing performance, feed intake and feed efficiency ratio characteristics.

MATERIALS AND METHODS

Eighteen male Holstein Friesian young bulls from cattle herd of the Research Farm of Agricultural College at Atatürk University, Erzurum, Turkey were used in this research. The young bulls at two different initial BW groups were randomly allocated to combination of DFM and enzymes (treatment group) and control groups. They were individually fed a diet consisting of concentrate, dry hay and corn silage. The corn silage was offered to the animals during the first 4 months of the finishing period. The animals were adapted to the diets over two weeks. Amounts of feed offered to the young bulls were determined according to the live weights obtained at 14-day intervals throughout the fattening (NRC, 1996). Amounts of feed offered and refusals for each individual were weighed daily in order to determine daily feed intake. The chemical compositions of the concentrate, dry hay and corn silage were tabulated in Table 1. DFM plus enzyme supplement used in this study was a combination of *Lactobacillus acidophilus, L. casei, L. plantarum, Bacillus subtilis, B. licheniformis, Aspergillus oryzae, Enterococcus faecium* as well as enzymes (amylase, protease, cellulose, lipase, pectinase). Total of 20 g of the supplement was added daily into the concentrate of the each animal as recommended by the manufacturer company.

The calves used in this trial were from two distinct weight groups. The first group was called as light BW (LBW) group because of low initial BW (average body weight at the beginning of the fattening = 178.3 kg). The second group was named as heavy BW (HBW) group whose average BW at the beginning of the trial was 278.3 kg. The young bulls were weighed after 12 h starvation on each of 2 consecutive days at the beginning and end of the fattening. The averages of these weights were recorded as the initial and final BW. The trial lasted for 182 days.

Data pertaining weights, total and daily gains, feed intake, feed efficiency ratio were statistically analyzed as 2x2 completely randomized factorial experimental design with the GLM procedure of SPSS Release 13.0 (SPSS, 2004). The statistical model used for analysis of variance was as follows:

$$Y_{ijk}=\mu + a_i + b_j + (ab)_{ij} + e_{ijk}$$

Where Y_{ijk}= live weights, total and daily gains, feed intake, feed efficiency ratio
μ = overall mean
a_i = effect of diets,
b_j = effect of initial BW,
$(ab)_{ij}$ = effect of interaction between diets and initial BW
e_{ijk} = random error.

RESULTS AND DISCUSSION

Overall finishing performance data are presented in Table 2. The 2.8 and 3.6% improvements in final weight and weight gains were observed in the present study when young Holstein Friesian bulls were supplemented with DFM plus enzyme. Similarly, Rust et al. (2000), Krehbiel et al. (2003) and Jukna et al. (2005) reported that average daily gain of DFM-treated steers was increased 6.2, 2.6 and 9.4% over control steers respectively. Although final weight, total and daily weight gains of the cattle in DFM plus enzyme group were numerically greater than these in control group, the differences were not statistically significant. Similar results were also reported by Gritzer and Leitgeb (1998) and Elam et al. (2003).

The effects of initial BW classification were significant ($P<0.01$) for both final BW and weight gains (Table 2). The average final weight of the bulls in HBW group was 29.5% heavier than these in LBW group. The result could be attributed to the greater amount of DMI of the HBW compared to LBW since DMI is a function of BW (NRC, 1996). Similar findings were also reported by Elam et al. (2003) who reported that the steers from HBW group was significantly heavier at the start and end of the trial than these from LBW group.

The interaction of initial BW group and DFM plus enzyme treatment was significant ($P<0.01$) for total and daily weight gains. In HBW group, total and daily weight gains of the DFM plus enzyme-treated cattle were 26.1 and 0.144 kg higher than these of control animals. However, in LBW group, the differences between control and DFM plus enzyme supplemented Holstein young bulls were 12.8 and 0.07 kg respectively. The results of the present study revealed that weight gains of the cattle with higher

Table 2. Least squares means with standard errors for finishing performance of Holstein young bulls.

	Final Weight	Total Weight Gain	Daily Weight Gain
Overall mean	386.0±9.0	189.4±3.5	1.041±0.019
Diets (D)	NS	NS	NS
DFM + Enzyme (DFM+E)	391.3±12.7	192.7±4.9	1.059±0.027
Control (C)	380.6±12.7	186.0±4.9	1.022±0.027
Initial Body Weight (IBW)	**	**	**
Light Body Weight (LBW)	336.2±12.0	221.3±4.7	1.216±0.026
High Body Weight (HBW)	435.7±13.4	157.4±5.2	0.865±0.029
D x IBW Interaction	NS	**	**
(DFM+E) x LBW	333.6±17.0	214.9±6.6	1.181±0.036
(DFM+E) x HBW	449.0±19.0	170.5±7.4	0.937±0.041
(C) x LBW	338.8±17.0	227.7±6.6	1.251±0.036
(C) x HBW	422.5±19.0	144.4±7.4	0.793±0.041

**:P<0.01, NS: Non-significant

Table 3. Least squares means with standard errors for feed intake of Holstein young bulls.

	Feed Intake (kg dry matter intake, DMI)		
	DMI from Concentrate	DMI from Hay and Corn Silage	DMI from of All Feeds
Overall mean	744.6±1.0	437.1±0.4	1181.6±0.9
Diets (D)	NS	NS	NS
DFM+Enzyme (DFM+E)	746.2±1.4	436.7±0.5	1182.8±1.3
Control (C)	743.0±1.4	437.4±0.5	1180.4±1.3
Initial Body Weight (IBW)	*	*	*
Light Body Weight (LBW)	696.1±1.3	388.9±0.5	1085.0±1.2
High Body Weight (HBW)	793.1±1.5	485.2±0.6	1278.2±1.4
D x IBW Interaction	NS	NS	NS
(DFM+E) x LBW	696.1±1.8	388.7±0.7	1084.8±1.8
(DFM+E) x HBW	796.3±2.1	484.7±0.8	1280.9±2.0
(C) x LBW	696.1±1.8	389.1±0.7	1085.3±1.7
(C) x HBW	789.9±2.1	485.7±0.8	1275.5±1.9

*:P<0.05, NS: Non-significant

initial BW might provide greater total and daily weight gains. Least squares means for total DMI from concentrate, dry hay and all feeds are measured during the trial, and presented in Table 3. DMI from concentrate, hay and all feeds did not differ significantly between young Holstein bulls fed either DFM supplemented diet or con-

Table 4. Least squares means with standard errors for amount of feed (kg) consumed per kg weight gain of Holstein young bulls.

	Amount of Feed (kg) Consumed per kg Weight Gain		
	Concentrate	Dry Hay and Corn Silage	Total Feed
Overall mean	4.126±0.069	2.441±0.043	6.568±0.112
Diets (D)	*	*	*
DFM+Enzyme (DFM+E)	3.969±0.098	2.334±0.061	6.303±0.158
Control (C)	4.284±0.098	2.548±0.061	6.833±0.158
Initial Body Weight (IBW)	**	**	**
Light Body Weight (LBW)	3.162±0.092	1.766±0.057	4.928±0.149
High Body Weight (HBW)	5.091±0.103	3.116±0.064	8.207±0.167
D x IBW Interaction	**	**	**
(DFM+E) x LBW	3.247±0.130	1.813±0.081	5.061±0.211
(DFM+E) x HBW	4.690±0.146	2.855±0.090	7.545±0.236
(C) x LBW	3.076±0.130	1.719±0.081	4.796±0.211
(C) x HBW	5.492±0.146	3.378±0.090	8.870±0.236

*:P<0.05, **:P<0.01

trol diet. The result is in accordance with findings of Gill et al. (1987) who reported no differences in DMI between control and DFM-supplemented stocker calves. In another study, Huck et al. (2000) supplemented finishing heifers with two microbial additives and reported no differences for DMI data. Rust et al. (2000) and Galyean et al. (2000) also noted that there were no significant differences for total DMI between steers in DFM and control groups.

DMI from roughage (dry hay and corn silage), concentrate and all feeds were also significantly (P<0.01) influenced by initial BW of the young bulls (Table 3). This was an expected result since the amount of feed offered to the bulls was determined according to the BW as recommended by NRC (NRC, 1996). Therefore, cattle in HBW group consumed greater amount of DM than these in LBW.

Least square means for feed efficiency ratio (amount of feed consumed per kg weight gain) are presented in Table 4. Supplementing diets on a daily basis with DFM plus enzyme significantly (P<0.01) improved feed efficiency ratio of the young Holstein bulls without signifycantly increasing average weight gain. The result is in agreement with finding of Swinney-Floyd et al. (1999). Amounts of concentrate, roughage (dry hay and corn silage) and total feed per kg weight gain of the young bulls treated with DFM plus enzyme were decreased 7.9, 9.1 and 8.4% over control animals respectively. On the other hand, Krehbiel et al. (2003) reported that feeding bacterial DFM to feedlot cattle results in approximately 2% improvement. Beauchemin et al. (1997) also indicated that fibrolytic enzymes can be used to improve feed conversion ratio of barley diets by 11% over the finishing period.

Improvement in the feed efficiency of the bulls in LBW was likely attributable to differences in the ages of the initial BW groups. Since the animals in the LBW group was about 3 months younger than these in HBW group, the lower feed consumption per kg weight gain for animals in LBW is expected.

The interaction of initial BW group and DFM plus enzyme treatment was significant (P<0.01) for feed efficiency ratio. In HBW group, amounts of concentrate, roughage and total feed (kg) consumed per kg weight gain for Holstein cattle supplemented with DFM plus enzyme were 0.802, 0.523 and 1.325 kg higher than these for animals in control group. However, in LBW group, the differences between control and DFM plus enzyme supplemented young bulls were 0.171, 0.094 and 0.265 kg respectively. The results of the present study revealed that finishing cattle in HBW group had greater an improvement in feed efficiency ratio compared with animals in LBW group.

REFERENCES

Beauchemin KA, Jones SDM, Rode LM, Sewalt VJH (1997). Effects of fibrolitic enzymes in corn or barley diets on performance and carcass

characteristics of feedlot cattle. Can. J. Animal Sci. 77:645-653.
Brashears MM, Galyean ML, Loneragan GH, Mann JE, Killinger-Mann K (2003). Prevalance of Escherichia coli 0157:H7 and performance by beef feedlot cattle given Lactobacillus direct-fed microbials. J. Food Protect. 66:748-754.
Carraud A (1990). Probiotics in beef cattle. CAB Abstracts, Accession Number:19921445618.
Elam NA, Gleghorn JF, Rivera JD, Galyean ML, Defoor PJ, Brashears MM, Younts-Dahl (2003). Effects of live cultures of Lactobacillus acidophilus and Propionibacterium freudenreichii on performance, carcass, and intestinal characteristics and Escherichia coli strain 0157 shedding of finishing beef steers. J. Anim. Sci. 81:2686-2698.
Feng P, Hunt CW, Julien WE, Dickinson K, Moen T (1992). Effect of enzyme addition *in situ* and *in vitro* degredation of mature cool-season grass forage. J. Anim. Sci. 70(Suppl. 1): 309 (Abstract).
Galyean ML, Nunnery GA, Defoor PJ, Salyer GB, Parsons CH (2000). Effects of live cultures of Lactobacillus acidophilus (strains 45 and 51) and Propionibacterium freudenreichii PF-24 on performance and carcass characteristics of finishing beef steers. Burnett Center Progress Report No:8.
Gill DR, Smith RA, Ball RL (1987). The effect of probiotic feeding on health and performance of newly-arrived stocker calves. Okla. Agric. Exp. St. MP-119:202-204.
Gritzer K, Leitgeb R (1998). Evaluation of the effectiveness of antibiotic and probiotic growth promoters on the performance of fattening bulls. Bodenkultur 49:51-59.
Greenquist MA, Droillard JS, Dicke B, Erickson GE, Klopfenstein TJ (2004). Effects of Lactobacillus acidophilus and Propionibacterium freudenreichii on growth performance and carcass characteristics of finishing beef cattle. Kansas State University Cattlemen's Day 2004, Report of Progress 923, KSU Agric. Exp. St. and Coop. Ext. Service. pp. 71-74.
Huck GL, Kreikemeier KK, Ducharme GA (2000). Effects of feeding two microbial additives in sequence on growth performance and carcass characteristics of finishing heifers. Kansas State University Cattlemen's Day 2000, Report of Progress, KSU Agric. Exp. St., and Coop. Ext. Service. pp. 32-34.
Jukna C, Jukna V, Simkus A (2005). The influence of probiotics and phytobiotics on meat characteristics and quality of fattening bulls. Veterinarjia ir Zootechnika 29:76-79.
Krehbiel CR, Rust SR, Zhang G, Gilliland SE (2003). Bacterial direct-fed microbials in ruminant diets: Performance response and mode of action. J. Anim. Sci. 81(E.Suppl.2):E120-E132.
NRC (1996). Nutrient requirements beef cattle 7th ed. National Academy Press, Washington, DC.
Peterson RE, Klopfenstein TJ, Smith DR, Folmer JD, Erickson GE, Hinkley S, Moxley RA (2005). Direct-fed microbial product for Escherichia coli 0157:H/ in market ready feedlot cattle. 2005 Nebreska Beef Report, Anim. Sci. Dept., University of Nebraska. pp. 64-65.
Rust SR, Metz K, Ware DR (2000). Effects of Bovamine rumen culture on the performance and carcass characteristics of feedlot steers. Mich. Agric. Exp. Sta. Beef Cattle, Sheep and Forage Sys. Res. Dem. Rep. 569: 22-26.
SPSS (2004). SPSS for windows Release 13.0. SPSS Inc., Chicago, IL.
Swinney-Floyd D, Gardner BA, Owens FN, Rehberger T, Parrot T (1999). Effect of inoculation with either strain P-63 alone or in combination with lactobacillus acidophilus LA53545 on performance of feedlot cattle. J. Anim. Sci. 77(Suppl. 1):77.
Tricarico JM, Abney MD, Galyean ML, Rivera JD, Hanson KC, McLeod KR, Harmon, DL (2007). Effects of a dietary Aspergillus oryzae extract containing alpha-amylase activity on performance and carcass characteristics of finishing beef cattle. J. Anim. Sci. 85: 802–811.
Tricarico JM, Johnston JD, Dawson KA (2008). Dietary supplementation of ruminant diets with an *Aspergillus oryzae* alpha-amylase. Anim. Feed Sci. Tech. 145:136-150