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Growth Performance of F1 Friesian X Boran Crossbred Dairy Calves Supplemented with Effective Micro Organism (EM) Fermented Wheat Bran (Bokashi) in the Central Highlands of Ethiopia

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Keywords: calves, efficiency, effective microorganisms, weight gain.

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Aemiro Kehaliew [α], Getu kitaw [σ], Getnet Assefa [ρ], Dereje Fekadu [Ѡ] & Zewdie Wondatir [¥]

Abstract- This experiment was designed to investigate the biological and economical response of feeding effective microorganisms treated wheat bran provided at different level to young crossbred calves. Twenty crossbred Frisian*Boran calves weighing (100± 10.85) kg and 6 months of age were selected and divided randomly in to 4 similar treatment groups (5 animals each group) in 100 days feeding trial. All the calves in the different groups were fed similar basal diet of native pasture hay. The first group (T1, control) fed native hay as a basal diet and concentrate mixture as a supplement. Group 2, 3 and 4 (T2, T3 and T4) fed the same basal diet and concentrate mixture replaced by 33, 66 and 100 % EM treated wheat bran, respectively. Based on these treatments, the response of growing calves in terms of dry matter and nutrient intake, daily weight gain, feed conversion efficiency and economic feasibility were evaluated. The CP content of effective microorganisms (EM) treated wheat bran was lower than that of the concentrate mixture and wheat bran. However there was no significant difference in organic matter digestibility between the EM treated wheat bran and the concentrate mixture (65.26 Vs 65.61%), respectively. There was also no significant (P>0.05) difference in live weight change, dry matter and metabolizable energy intake among the different treatments. The highest daily body weight gain and better feed conversion efficiency was observed in T2. Among the different treatments the lowest feed cost per daily intake was encountered in T2. In general EM treated feed supplementation had positive effect on growth performance of calves.

Keywords: calves, efficiency, effective microorganisms, weight gain.

I. Introduction

Successful strategies for increasing the efficiency of utilization of low quality roughages include supplementation, chemical treatment, biological treatment and manipulation of the rumen ecosystem. Among the biological treatment methods, use of effective microorganism is one of the options for improving feed quality. Effective Microorganisms (EM) are a mixed culture of aerobic and anaerobic types of microbes living symbiotically with each other. These microorganisms are beneficial types, natural, free-living and safe. They can withstand a wide variation of environmental conditions making them consistent and stable. Modern animal production requires use of safe and effective additives to stimulate feed consumption and destroy harmful microorganisms of the diet in addition to be used as rumen manipulators to increase animal productivity.

According to Saili et al., 2010, fermentation of feeds with microorganisms had resulted in increased live weight gain. Probiotics are live microorganisms that often result in increased feed conversion efficiency and live weight gain (Sissons, 1989). They also introduce beneficial microorganisms into the gut which act to maintain optimal conditions within the gastrointestinal tract and inhibit the growth of pathogenic or other undesirable bacteria. Several functions of probiotics have been proposed, including the protection of young animals against enteropathic disorders such as diarrhea by inhibiting the colonization of the gut by coliform bacteria and an increase in feed conversion efficiency and live weight gain in growing animals (Fuller, 1990 and Saili et al., 2010).

Studies have shown that large mixtures of microorganisms can be used with superior results to single bacteria strain or simple mixtures of few types of bacteria (Mead and Impey, 1986; Stavric et al., 1991). The same authors also reported that the success of complex mixtures appears to be due to interactive effects of anaerobes and facultative anaerobes. As a mixed culture of beneficial and naturally occurring microorganisms, Effective Microorganisms (EM) contain selected species of microorganisms including predominant populations of lactic acid bacteria and yeasts and smaller numbers of photosynthetic bacteria, actinomycetes and other types of organisms. The use of EM in animal husbandry nowadays is very well identified in many parts of the world. In a study conducted in Belarus by Konoplya and Higa (2000), EM was successfully used in poultry and swine units as feed

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constituent and sanitation spray. In South Africa EM was used to increase productivity in integrated animal units and poultry farms (Hanekon et al., 2001). In a sudy conducted by Maqbool etal.,2001, the use of EM treated rice straw proved to be beneficial for the prevention of disease probably by virtue of its ability to check the growth of mycotoxin producing fungi. This agent not only controls the disease but also increases the growth rate, feed consumption and feed efficacy. Similar results were also recorded in broilers by Khan et al. (1992) and Haddadin et al. (1996).

Thus, the objectives of the present study was to evaluate the effect of the supplemental value of different levels of EM treated wheat bran on feed intake, growth performance and economic benefit of F1 crossbred Friesian* Boran calves .

II. Material and Methods

a) *Location and treatment description*

This study was carried out at Holetta Agricultural Research Center (9^{O}N latitude; 38^{O}E longitude). The experimental site lies at an altitude of 2400 meters above seas level. In this study, twenty Fresian* Boran crossbred calves with an average live weight of 100 ±10.85 kg and six month of age were used. The experimental calves were divided randomly in to four treatment groups (five animals in each group). Calves of the first group (TI, control) fed native hay as a basal diet and concentrate mixture of 43% noug seed cake (Guzotia abyssinica), 55% wheat bran and 2% salt. Calves of the 2nd, 3rd and 4th treatment group received the same basal diet with 33, 66 and 100% of the concentrate mixture replaced by effective microorganism (EM) treated wheat bran, respectively.

b) *Experimental treatments*

1. *Treatment 1:* native hay adlibtium + concentrate mixture(control)
2. *Treatment 2:* native hay adlibtium + 33% of the Concentrate mixture replaced by EM treated wheat bran
3. *Treatment 3:* native hay adlibtium + 66% of the Concentrate mixture replaced by EM treated wheat bran
4. *Treatment 4:* native hay adlibtium + 100% of the Concentrate mixture replaced by EM treated wheat bran

c) *Activated solution and EM treatment preparation procedures*

Bokashi (40% moisture) is an EM treated wheat bran that was prepared from; 1 lt EM1(stock solution) + lt molasses + 50 g table sugar + 18 lt chlorine free water + 50 kg wheat bran. The mix was allowed to ferment for about three weeks in a large plastic barrel of capacity 150kg before it was being fed to the animal. The EM stock solution was provided by Woljejji private limited company. Bokashi (EM treated wheat bran) was self prepared based on the procedures as follows:

1. One liter of molasses and 50 gm of sugar was added in to 18 liters of water and it was stirred very well.
2. One liter of EM-1(stock solution) was added in to the mixture
3. Stirring continue until a homogeneous solution was attained
4. The container was covered with the plastic sheet and it was very well tied to prevent the entry of air.
5. It was stored in shaded place with ambient temperature for 20 days.
6. After 20 days the resulting mixture known as EM Activated Solution (EMAS) was ready for use.
7. EMAS was viable for 15 to 20 days after fermentation. Always keep in anaerobic condition.

d) *Treatment of wheat bran with Activated solution*

- Molasses was dissolved in the 20 liter of water.
- EMAS was added into the above prepared molasses solution.
- The diluted EM solution was poured into 50kg of wheat bran and mixed well. EM diluted solution was added gradually and mixed well while checking the moisture content. The moisture content should be about 30-40%.
- The mixture was put into a plastic container that did not permit air entry to maintain an anaerobic condition
- The plastic container was stored in a place away from direct sunlight
- It was allowed to ferment for 21 days.
- The Bokashi was ready for use when it gives a sweet fermented smell. If it produces a rotten smell, it is a failure.
- The Bokashi should be used soon after preparation. If storage is required, spread it on a concrete floor, dry well in the shade and then put into vinyl bag.

e) *Feeding management*

Twenty calves were assigned in to four experimental treatments in RCBD design. Each calf was kept in a separate pen in a well ventilated barn. Native hay and water was provided ad libitum. Concentrate mixture including the EM treated wheat bran was provided twice a day early in the morning and late in the afternoon. The concentrate mixture (43% noug seed cake, 55% wheat bran and 2% salt) was formulated to meet the daily nutrient requirement of calves according to Kearl, (1982). The feed offered and refusal was recorded daily. Data on live weight change was recorded fortnightly.

f) Analysis of feed chemical composition and digestibility

Samples of native hay, wheat bran, noug seed cake, EM treated wheat bran and concentrate mixture were analyzed for dry matter (DM), crude protein (CP) and total ash using procedures described by AOAC, (1990). The neutral detergent fiber (NDF) and acid detergent fiber (ADF) concentrations in feed samples were determined according to the procedure of Van Soest and Robertson (1985). In-vitro organic matter digestibility (IVOMD) was determined according to the procedure of Tilley and Terry, (1963)

g) Data analysis

The calves were randomly assigned to the different dietary treatments in Randomized Complete Block (RCBD) design. The data was analyzed using SAS statistical software (SAS, 2002) as per the following model.

$Y_{ij} = \mu + B_i + T_j + e_{ijk}$ .Where, Y_{ij} = Response variables, μ = Overall mean, Bi = The effect of i^{th} block, T_j = The effect of j^{th} treatment and e_{ijk} = Random error.

III. Results and Discussion

a) Chemical composition of experimental feeds

The chemical compositions of experimental feeds are shown in Table 1. Dry matter content of experimental feeds was in the range of 89.39 to 91.69%. Among the experimental feeds, Bokashi (EM treated wheat bran) had lower dry matter content. The CP content of EM treated wheat bran was lower than that of the concentrate mixture and wheat bran. In a similar study by Bruchem, (1998) CP and ME content of EM treated silage was slightly lower than that of untreated silage. This might be due to the fact that part of the nutrients is utilized by the microbes for their growth and multiplication. However there was no difference in organic matter digestibility between the EM treated wheat bran and the concentrate mixture (65.26 Vs 65.61%), respectively. EM treated wheat bran had higher NDF content than un treated wheat bran and concentrate mixture. The current result is also in agreement with the report of Bruchem, (1998). On the other hand higher ADF content encountered in concentrate mixture than EM treated and un treated wheat bran.

Table 1 : Chemical compositions of experimental feed ingredients

Feed ingredient	Chemical compositions (% DM)						
	DM	Ash	CP	NDF	ADF	Lignin	DOMD
Noug seed cake	91.69	8.93	37.23	38.63	25.52	4.71	56.19
Wheat bran	88.97	4.77	16.27	43.48	12.66	3.35	70.89
Bokashi	88.39	6.75	15.39	46.65	13.66	3.53	65.26
Concentrate	89.26	8.26	24.79	36.09	21.93	4.30	65.61
Natural pasture hay	90.65	8.58	6.10	74.40	43.83	7.24	46.02

b) Dry matter and nutrient intake

As shown in Table 2, total dry matter (DM) intakes of calves were in the range of 3.68 to 4.43 kg/day. In a similar study by Khin et al., (2008), the DM intake was in the range of 3.75 to 3.92 kg/day. The highest and the lowest DM intake was observed in treatment 1and 4, respectively. There was no significant (P>0.05) difference in dry matter intake among the different treatments. Among the EM treated feed supplemented groups 100% replacement had lower DM intake than the other groups.

There was significant (P<0.05) difference in crude protein intake (CPI) among the different supplements. The highest CP intake was obtained in concentrate mixture supplemented group. Among the EM treated feed supplemented groups 100% supplemented ones had the lowest CPI. The difference in CPI was due to replacement of the protein sources of the concentrate mixture at different level by EM treated wheat bran. Metabolizable energy intake (MEI) was not significantly (P>0.05) varied among the different treatments.

Table 2 : Voluntary feed dry matter and nutrient intake Feed DM Intake

Feed DM Intake	Treatment				Mean	SE
	1	2	3	4		
Concentrate (kg/d)	2.08	1.27	0.596	0	1.32	
Bokashi (kg/d)	0	0.717	1.30	1.88	1.30	
Hay (kg/d)	2.34^{a}	2.07^{a}	2.05^{a}	1.80^{a}	2.07	0.217
TDMI (kg/d)	4.43	4.06	3.95	3.68	4.03	0.449
Hay intake, %BWt.	1.58	1.52	1.63	1.46	1.55	
TDMI, %BWt.	2.99	2.98	3.15	2.99	3.03	
CPI (gm/d)	657^{a}	550^{ab}	471^{ab}	396^{b}	519	0.06
CPI(gm/kg MBW)	15.47	13.79	12.75	10.72	13.25	
MEI (MJ/d)	38.39	35.65	34.73	32.82	35.40	4.01
MEI(MJ/kg MBW)	0.90	0.89	0.93	0.89	0.90	

$^{a-b}$,means in the same row with different superscripts are significantly different each other ($P<0.05$), kg/d: kilogram per day, BWt: body weight, TDMI: total dry matter intake, CPI: crude protein intake, MEI: Metabolizable energy intake, MJ/d: mega joule per day, gm/d: gram per day, SE: Standard error, gm/kgMBW: gram per kilo gram metabolic body weight, MJ/Kg MBW: maga joule per kilo gram metabolic body weight

c) Live weight change

There was no significant ($P>0.05$) difference in live weigh change among the different treatments (Table 3). Daily live weight gain was in the range of 696.7 to 823.3 gm/day. The highest daily body weight gain was obtained in T2, where 33% of the concentrate supplement was replaced by EM treated wheat bran (Bokashi). A similar work reported by Maqbool et al., (2001) indicated that 39.2 percent of body weight increase (600 gm/day) in live weigh gain was encountered in calves fed EM treated straw compared to other forms of feeding. Previous finding by Bruchem (1998) also indicated that higher growth rate was obtained from EM treated feed. The finding of this study indicated that in spite of replacing the protein source in the concentrate mixture by 100% EM treated wheat bran, daily weight gain was not affected markedly compared to concentrate mix supplemented groups. This implies that EM treatment improved the quality of the treated feed particularly CP content of the ration as was also recorded by Maqbool et al., (1997). In another study, Khin et al., (2008) obtained a weight gain of 300 gm/calf/day with the supplementation of 6 cc probiotics. These findings showed that supplementation of probiotics had positive effect on growth performance of young calves. EM treatment in addition to increasing growth rate, feed consumption and feed efficacy, it also helps to control disease (Maqbool et al..,(2001). Similar results were also reported in broilers by Khan et al., (1992) and Haddadin et al., (1996). According to Saili et al., (2010) treatment of cocoa-pods with micro organisms (A. niger) also result in increased live weight gain.

Feed conversion efficiency (FCE) was not significantly ($P>0.05$) different among the different treatments as shown in Table 3. Relatively higher FCE was observed in T2 (5.70 g feed/g gain) and T4 (5.73 g feed/g gain) where 33 and 100% of the concentrate mixture replaced by EM treated wheat bran, respectively. A similar study by Khin, et al., (2008) showed a feed conversion efficiency of 13.08 kg feed /kg gain which was lower than the present study.

The use of EM in animal production have demonstrated beneficial effects not only on health and production but also on environmental pollution. According to Li et. al., 1994 the naturally occurring microorganisms contained in EM after they enter into the body create more effective intestinal microflora with a greater synthetic capability i.e. one that can synthesize vitamins, hormones and enzyme systems that improve digestion, enhance growth, provide disease resistance, suppress malodor, inhibit pathogen and improves product quality. In all cases the improvement were associated to a greater flow of microbial protein and aminoacid to the duodenum, increased number of rumem cellulytic bacteria which improves fiber degradation, changes in the volatile fatty acids contents, greater glucose availability and reduced mobilization of fatty acids based on glucose, insulin, non-esterified fatty acids and ketones concentration in the blood.

Table 3 : Live weight changes

Growth paramete	Treatment 1	2	3	4	Mean	SE
Initial weight (kg)	112.40	101.7	91.1	95.9	100.28	10.85
Final weight (kg)	185.6	175.8	161.8	158.6	170.45	19.30
1	2	3	4			64.33
112.40	101.7	91.1	95.9	100.28	10.85	0.72
185.6	175.8	161.8	158.6	170.45	19.30	
813.33	823.33	785.56	696.67	779.72	64.33	

DWG = daily weight gain, FCE = feed conversion efficiency, SE = Standard error

d) Daily feed cost of experimental calves

The price in feed cost among the different treatment groups was varied from 6.31 to 7.42 birr/day (Table 4). The lowest feed cost was encountered in treatment 4 where 100% of the concentrate mixture was replaced by EM treated wheat bran. On the other hand the cost of feed was higher in concentrate mixture supplemented group (T1). In all cases, the cost of EM activated solution treated wheat bran was lower than that of concentrate mixture supplementation. This finding also indicated that in areas where the cost of protein sources is expensive the use of EM treatment is the best option.

Table 4 : Daily feed cost of experimental calves

Feed ingredient	T1 DMI (kg)	T1 Cost (birr)	T2 DMI (kg)	T2 Cost (birr)	T3 DMI (kg)	T3 Cost (birr)	T4 DMI (kg)	T4 Cost (birr)
Hay	2.34	3.11	2.07	2.75	2.05	2.73	1.80	2.39
Wheat bran	1.144	2.20	0.6985	1.34	0.3278	0.63	0	0
Noug cake	0.8944	1.99	0.5461	1.22	0.2563	0.57	0	0
Bokashi	0	0	0.717	1.44*/1.59**	1.30	2.63*/2.89**	1.88	3.80*/4.17**
Salt	0.0416	0.12	0.0254	0.08	0.0119	0.04	0.0416	0.12
Total		7.42		6.83*/6.98**		6.60*/6.86**		6.31*/6.68**

* The cost for 1kg Bokashi prepared from stock solution activated to 20lt EM-2= 2.02 Eth. birr,

**The cost for 1kg Bokashi prepared from purchased EM-2 solution = 2.22 Eth. birr

Note that water and labor cost were not considered in calculating the daily feed cost

*During the study period the average exchange rate was 17.0 Ethiopian birr = 1 USD

IV. Conclusion

The highest daily body weight gain was obtained in T2 (823 gm/calf/day) where 33% of the concentrate supplement was replaced by EM treated wheat bran. Among the different treatments the lowest feed cost per daily intake was encountered in 100% of the EM treated wheat bran supplemented group. EM treated feed supplementation at different level had positive effect on growth performance of calves. Further study on improvement of poor quality feed resource particularly crop residue with EM treatment is required.

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