Replacing enzose by corn grains: Impact on nutrients utilization and weight gain in growing buffalo calves

M. Nisa,[1] M.Aasif Shahzad, and M.Sarwar

*Institute of Animal Nutrition and Feed Technology, University of Agriculture, Faisalabad 38040, Pakistan

ABSTRACT: The study was planned to investigate the potential of enzose as replacement of corn grains on growth performance of growing calves. Thirty five male buffalo calves of 1 year of age were randomly divided into five groups. Five isonitrogenous and isocaloric diets were formulated. Control diet contained no enzose (E0). The enzose replaced 20, 40, 60 and 80% corn grains on energy equivalent basis in E20, E40, E60 and E80 diets, respectively. Animals were fed twice a day at *ad libitum* and feed intake was recorded daily. Decreasing trend in dry matter (DM) intake by calves fed E0, E20 and E40 diets were noticed. Neutral detergent fiber and acid detergent fiber digestibilities differed significantly in calves fed diets with varying enzose concentration, however, DM and crude protein digestibilities remained unaltered across all diets. Cost of feed per Kg live weight produced was higher in calves fed E0, E20 and E40 diet than those fed E60 and E80 diets; however lower feed conversion ratio was noticed in calves fed E40 than those fed other diets. Ash, minerals, hematology, pre-slaughter weight, dressing percentage, half carcass separable primal cuts, in calves didn't change and the same was true for lean, fat and bone proportions of these respective cuts. The findings of the study indicate that enzose can be used as substitute of corn grain without any ill effects on growth performance.

Key words: growth, enzose, buffalo calves

INTRODUCTION

Escalating prices of feed ingredients coupled with their shortage (Sarwar *et al.,* 2004) is one of the main issues which impede ruminant animal productivity in Pakistan. There are many ways to minimize this shortage but adding newly emerging feed by products into feedstuff inventory of the country seems most promising. This can only be done after their proper nutritional evaluation which will not only help abridge the nutrient shortage gap but will also make ration formulation more versatile. Many new agro-industrial waste products are pouring into the market for usage as livestock feeds (Nisa *et al.,* 2004, Khan *et al.,* 2004).

Enzose, a by product of the corn industry, is a liquid derived from the enzymatic conversion of corn starch to dextrose and is a cheap energy source due to available fermentable sugars. Enzose is light amber color liquid derived from the enzymatic conversion of corn starch to dextrose. Unlike other fermentable sugars, enzose has high lactic acid content and is a cheaper source of dextrose. It enhances the nitrogen retention in urea treated corn cobs because of its lactic acid content (18%) low pH (4.4) and availability of reducing sugars (corn dextrose) for lactic acid production through anaerobic fermentation during ensiling process (Khan *et al.,* 2004). In order to use this corn industry by product as a suitable ruminant animal feed, it should be evaluated biologically as replacement of some economical energy fed ingredient. However, scientific information regarding the potential of enzose to replace corn grains in beef diets is limited. Therefore, the present project was planned to nutritionally evaluate enzose as potential substitute of corn grains in the diet of buffalo calves for economical beef production.

[1]Corresponding Author: linknisa@gmail.com

MATERIALS AND METHODS

Thirty five male buffalo calves of 1 year of age were randomly divided into five groups. Five isonitrogenous and isocaloric diets were formulated. Control diet had no enzose (E0) while enzose replaced 20, 40, 60 and 80% corn grains on energy equivalent basis in E20, E40, E60 and E80 diets, respectively (Table 1). Animals were fed twice a day at *ad libitum* and feed intake was recorded daily. The calves were weighed fortnightly. Faces and urine were collected by total collection methods as described by Nisa *et al*. (2004). Faces were dried at 55^0C, bulked and mixed by animal and were stored for further analysis. Urine was acidified with 50% H_2SO_4 and stored at -20 ºC for laboratory analysis. Feed and faecal samples were analyzed for NDF and ADF by methods described by Van Soest *et al.* (1991) and CP using method described by AOAC (1995). Blood samples were collected six hours post feeding. Blood sample (10 mL from each animal) was collected by puncturing jugular vein; 2mL was collected into the vaccutainers each containing 81µL of 15% EDTA (anticoagulant) solution, while 8mL was collected in test tube to harvest the serum for further analysis. Plasma samples were separated and frozen at -20°C.

At the end of the experiment, three animals from each group were slaughtered for evaluation of carcass characteristics. Weight of external parts (skin, head, and feet), thoracic organ (heart, lungs, and trachea) and viscera (digestive tract, liver and kidney) were recorded. Their weight was subtracted from body weight to obtain empty body weight. Warm carcass weight was recorded. Dressing percentage was calculated following the procedure described by Atti *et al.* (2004).

Carcass was divided longitudinally in two halves. The left half-carcass was cut according to Diaz *et al*. (2002) into primal cuts. Every cut was weighed and dissected in fat, muscles and bones. Other tissues such as tendons, lymph nodes, etc. were separated as waste. Pelvic fat was removed from the leg and kidney fat from the thoracic region. Samples of *longissimus dorsi* muscles were carefully dissected from the left side, weighed and stored at -20°C for chemical analysis. Samples of meat were dried at 50°C, ground (1-mm screen), and stored for subsequent analysis. Dry matter was determined by drying at 80°C for meat until constant weight. Ash was determined by placing samples at 600°C in furnace for 8 hours. Nitrogen in meat was determined by the methods described by AOAC (1990).

Blood samples were used for the determination of red blood cells (RBC) count, white blood cells (WBC) count, packed cell volume (PCV) and haemoglobin by using their respective procedures as described by Benjamin (1978).

The Na and K were determined according to the methods as adopted by Jackson (1973) using flame photometer 410 Cornning PYE Unicam PU 8650 philips (England) where as Ca and Mg were determined from the dry ashed (550C) meat sample using atomic absorption spectrophotometer (GBC, Atomic Absorption Spectrophotometer, Australia) according to the methods described by Ruig (1986).

Statistical Analysis

The data collected were analyzed using Randomized Complete Block Design and means were separated by Tukey's Test for treatment differences using software SPSS (1996).

RESULTS AND DISCUSSION

Nutrient Ingestion, Digestibilities and Nitrogen Balance

The DM, CP, NDF and ADF intake by calves differed significantly across all diets. Maximum DMI was recorded in calves fed E0 diet where as minimum DMI was noticed in calves fed E80 diet (Table 2). Dry matter and CP digestibility remained unaltered across all treatments by varying enzose levels. The NDF and ADF digestibility increased ($p<0.05$) with gradual replacement of corn grains by enzose (Table 2).

Higher NDF and ADF digestibilities by calves fed E40 diet might be attributed to better rumen fermentation due to gradual replacement of corn grains by enzose which night have ensued sufficient availability of keto acids (i.e. carbon skeleton), a vital requisite for microbial multiplication. Improved rumen fermentation and increased rumen microbial enzyme production have been reported to enhance nutrient digestion (Nisa *et al.,* 2004; Sarwar *et al.,* 2004).

Growth Performance

Weight gain in calves fed E0, E20, E40, E60 and E80 diets remained unaltered (Table 3). Cost of feed per Kg live weight gain was higher in calves fed E0, E20 and E40 diets than those fed E60and E80 diets. Better feed conversion ratio in calves fed E40 diet might be attributed to either better volatile fatty acid production by rumen microbes or post rumen supply of amino acids or both due to efficient microbial proliferation and feed utilization (Nisa *et al.*, 2004; Sarwar *et al.,* 2004).

Carcass Quality

Pre-slaughter weight and dressing percentage remained unchanged across all diets (Table 4). Likewise, skin, heart, liver, kidney and heart weight did not differ across all diets (Table 4). Half carcass separable primal cuts in calves also remained unaltered in all diets and the same was true for lean, fat and bone proportions of these respective cuts (Table 5 and 6). Non-significant effects of carcass quality reflect the suitability and potential of enzose as a suitable ingredient to replace corn grains. Furthermore, encouraging effects of enzose also indicate the absence of any undesirable constituent of this energy source.

Mineral Profile and Hematology

Ash and mineral profile (Na, K, Ca, and Mg) of the meat is given in table 7. All minerals and ash values remained unchanged across all diets. The results are concordant with those reported by Ono *et al*. (1984) and Hoke *et al*. (1999). Comerford *et al*. (1992) and Petit and Flipot (1992) also reported that meat composition wasn't affected in steers raised on protein supplemented diets. In the present study, ash content of the carcasses remained unaltered as noticed by Szabo *et al*. (2001).

Table 1. Ingredients and chemical composition of experimental diets representing use of different concentrations of enzose as a substitute of corn grains for fattening calves

	Experimental Diets[1]				
Ingredients, %	E0	E20	E40	E60	E80
Wheat Straw	20.0	20.0	20.0	20.0	20.0
Corn Grains	24.0	18.0	12.0	6.0	0.0
Urea	2.0	2.0	2.0	2.0	2.0
Canola Meal	5.0	5.5	5.5	7.0	8.0
Corn Glutten 30%	12.0	13.0	15.0	15.0	15.5
Rice Polishing	18.0	18.0	15.0	16.0	14.0
Maize Bran	14.5	13.0	15.0	11.5	12.0
Enzose	0.0	6.0	12.0	18.0	24.0
Maize Oil	1.0	1.0	0.0	1.0	1.0
Sod Bicarbonate	0.5	0.5	0.5	0.5	0.5
Salt	1.0	1.0	1.0	1.0	1.0
Chemical Composition, %					
Dry Matter	90.0	89.5	89.1	88.6	88.0
Crude Protein	17.5	17.5	17.5	17.5	17.5
Total Digestible Nutrients	69.8	70.9	71.6	73.0	73.8
Neutral Detergent Fiber	31.0	30.2	31.3	29.4	29.6
Acid Detergent Fiber	17.8	17.5	17.7	17.3	17.3
Non Structural Carbohydrates	33.5	21.0	21.0	21.0	21.0

[1]E0, E20, E40, E60 and E80 diets contained enzose as replacement of corn grains at the rate of 0, 20, 40, 60 and 80% on the basis of energy supply by corn grains, respectively.

Table 2. Effect of varying levels of Enzose when replaced with corn grains on nutrient intake and their digestibilities in fattening calves

	Diets[1]					
Parameters	E0	E20	E40	E60	E80	SE
Nutrient intake, g/day						
Dry matter	7650[a]	7607.5[b]	7395.3[d]	7531[c]	7392[d]	28.32
Crude protein	1338.75[a]	1331.31[ab]	1294.18[c]	1317.93[b]	1293.6[c]	5.43
Neutral detergent fiber	2371.5[a]	2297.47[b]	2314.73[b]	2214.11[c]	2188.03[d]	18.12
Acid detergent fiber	1361.7[a]	1331.31[b]	1308.97[c]	1302.86[c]	1278.82[d]	7.8
Nutrient digestibilities, %						
Dry matter	68.2	70	69.8	70.4	69.7	2.1
Crude protein	75.4	75.2	76.2	76.9	78.2	2.6
Neutral detergent fiber	59[b]	61[a]	61.8[a]	60.9[a]	60.9[a]	2.1
Acid detergent fiber	45[b]	57.2[a]	56.7[a]	55.9[a]	55.1[a]	1.8

[abcd] : Means within row bearing different superscripts ($p<0.05$)
40, 60 and 80% on the basis of energy supply by corn grains, respectively.
[1]E0, E20, E40, E60 and E80 diets contained enzose as replacement of corn grains at the rate of 0, 20,

Table 3. Effect of varying levels of Enzose when replaced with corn grains on growth performance in fattening calves

	Diets[1]					
Parameters	E0	E20	E40	E60	E80	SE
Wt. gain, g/day	801	800	798	798	800	19.19
Cost (Rs) of feed to produce one kg live weight	109.32[a]	105.11[a]	103.22[a]	99.23[b]	100.32[b]	3.7
Feed Conversion Ration	5.93[d]	6.93[b]	5.94[a]	5.86[b]	5.85[b]	0.18

Means within row bearing different superscripts ($p<0.05$)
[1]E0, E20, E40, E60 and E80 diets contained enzose as replacement of corn grains at the rate of 0, 20, 40, 60 and 80% on the basis of energy supply by corn grains, respectively.

Table 4. Effect of varying levels of Enzose when replaced with corn grains on carcass characteristics in fattening calves

	Diets[1]					
Parameters, kg	E0	E20	E40	E60	E80	SE
Pre-Slaughter wt	189.6	185.5	185.0	183.4	188.6	2.27
Warm Carcass wt	91.0[ab]	90.9[ab]	88.8[b]	90.8[ab]	91.8[a]	0.35
Dressing Percentage,%	48	49	48	49.5	48.7	0.32
Skin wt	15.7	15.7	15.6	15.6	15.6	0.06
Feet wt	5.7	5.7	5.8	5.8	5.8	0.04
Heart wt	0.84	0.84	0.85	0.85	0.86	0.02
Liver wt	2.45	2.5	2.5	2.45	2.45	0.04
Kidney wt	0.6	0.6	0.59	0.58	0.6	0.01
Lung wt	2.51	2.52	2.52	2.5	2.5	0.03

[a,b,c,d] : Means within row bearing different superscripts differ significantly ($p<0.05$).
[1]E0, E20, E40, E60 and E80 diets contained enzose as replacement of corn grains at the rate of 0, 20, 40, 60 and 80% on the basis of energy supply by corn grains, respectively.

The results of this study revealed that there had been a linear increase in the mineral profile of the meat from calves fed varying levels of enzose but difference is statistically non-significant. These findings showed that there was nothing wrong with enzose as an ingredient and it could be incorporated in the fattening diets without any adverse effects on meat quality and mineral profile.

Hemaotological characteristics remained unchanged across all diets (Table 8). Similar results were reported earlier by Bednarek *et al.* (1996), who observed that the erythrocytes count, haemoglobin and PCV values in calves were similar to that of control group.

Table 5. Effect of varying levels of Enzose when replaced with corn grains on half carcass separable primal cuts in fattening calves

	Diets[1]					
Item, kg	E0	E20	E40	E60	E80	SE
Neck	6.8	6.75	6.8	6.8	6.9	0.32
Shoulder	7.8	7.9	7.6	7.7	7.9	0.04
Breast	10.6	10.6	10.55	10.5	10.5	0.04
Loin	3.5	3.2	3.1	3.3	3.45	0.05
Leg	16.9	16.8	16.7	17.0	17.15	0.05

[1]E0, E20, E40, E60 and E80 diets contained enzose as replacement of corn grains at the rate of 0, 20, 40, 60 and 80% on the basis of energy supply by corn grains, respectively.

Table 6. Effect of varying levels of Enzose when replaced with corn grains on primal cuts with respective proportion of lean meat, fat and bone (as %age of primal cut) in fattening calves

Items (Lean, fat and bone proportions expressed as %age of respective primal cut)		Diets[1]					
		E0	E20	E40	E60	E80	SE
Neck	Lean	63	62.5	62.8	63.1	62.9	1.46
	Fat	7	7.1	6.9	7	6.95	0.31
	Bone	30	30.4	30.3	29.9	30.15	1.39
Shoulder	Lean	63.55	63.15	63.6	63.65	64.1	1.83
	Fat	6.90	7	6.95	6.8	7.05	1.19
	Bone	29.55	29.85	29.45	29.55	28.85	1.02
Breast	Lean	56.25	56.15	56.3	56.1	56	0.82
	Fat	14.1	14	14.25	14.05	14.5	0.91
	Bone	29.65	29.85	29.45	29.85	29.5	0.83
Loin	Lean	62	62.3	63	63.4	62.9	0.66
	Fat	10.5	10	9.9	10.9	10.65	0.91
	Bone	27.5	27.7	27.1	25.7	26.45	0.86
Leg	Lean	67.1	67	66.5	67.5	67.8	1.08
	Fat	11.50	11	12.1	11.35	11.9	1.62
	Bone	21.4	22	21.4	21.15	20.3	0.89

Means within row bearing different superscripts ($p<0.05$)
[1]E0, E20, E40, E60 and E80 diets contained enzose as replacement of corn grains at the rate of 0, 20, 40, 60 and 80% on the basis of energy supply by corn grains, respectively.

Table 7. Effect of varying levels of Enzose when replaced with corn grains on mineral profile of meat in fattening calves

Minerals %	Diets[1]					
	E0	E20	E40	E60	E80	SE
Ash	1.1	1.2	1.15	1.05	1.2	0.03
Na	0.4	0.4	0.45	0.45	0.5	0.02
K	0. 93	0.95	0.97	0.97	0.98	0.03
Ca	0.25	0.25	0.3	0.3	0.3	0.02
Mg	0.34	0.35	0.35	0.35	0.35	0.03

[1]E0, E20, E40, E60 and E80 diets contained enzose as replacement of corn grains at the rate of 0, 20, 40, 60 and 80% on the basis of energy supply by corn grains, respectively.

Table 8. Effect of varying levels of Enzose when replaced with corn grains on hematological characteristics in fattening calves

Blood Parameter	Diets1					
	E0	E20	E40	E60	E80	SE
RBC	9.03×10^6	9×10^6	9.21×10^6	9.9×10^6	9.5×10^6	0.2
WBC	9.7×10^3	9.8×10^3	9.9×10^3	9.7×10^3	9.9×10^3	0.1
PCV	30	29	30	30	30	0.38
Hb	11	11	11	11	12	0.28

[1]E0, E20, E40, E60 and E80 diets contained enzose as replacement of corn grains at the rate of 0, 20, 40, 60 and 80% on the basis of energy supply by corn grains, respectively.

CONCLUSION

The findings of the study indicate that enzose can be used as a suitable alternate of corn grain without any ill effects on haematological and growth aspects in growing buffalo calves.

LITERATURE CITED

AOAC. 1990. Official Methods of Analysis, 15 Edition, Vol. 1. Association of Official Analytical Chemists, Virginia, USA.

AOAC, 1995. Official methods of analysis (16th ed.). Association of Official Analysis Chemists International. Arlington, Virginia, USA.

Atti, N., H. Rouissi, and M. Mahouachi. 2004. The effect of dietary protein level on growth, carcass and meat composition of male goat kids in Tunisia. Small Rumin. Res. 54:89-97.

Bednarek D., M. Kondracki and S. Cakla, 1996. Investigation into the infl uence of selenium and vitamin E on red and white blood pictures, on concentration of several minerals and microelements in blood serum, and on immunological parameters in calves. Deut. Tierarztl. Wochenschr. 103, 457-459.

Benjamin, M. M. 1978. Outline of Veterinary Clinical Pathology. 3rd ed. The Iowa State University Press, Ames, 351p.

Comerford, J.W., R.B. House, H.W. Harpster, W.R. Henning and J.B. Cooper, 1992. Effects of forage and protein source on feedlot performance and carcass traits of Holstein and crossbred beef steers. J. Anim. Sci. 70: 1022-1031.

Diaz, M. T., S. Velasco, V. Caneque, S. Lauzurica, F. Ruiz de Huidobr, C. Perez, J. Gonzalez and C.Manzanares. 2002. Use of concentrate or pasture for fattening lambs and its effect on carcass and meat quality. 43:257-268.

Hoke, I. M., Buege, D. R., Ellefson, W., and Maly, E. 1999. Nutrient and related food composition of exported Australian lamb cut. Journal of Food Composition and analysis, 12:97-109.

Jackson, M. L. C. 1973. Soil chemical analysis, prenticeitall of India, Private Limited, New Delhi.

Khan, M. A., M. Sarwar, M. Nisa and M. S. Khan. 2004. Feeding value of urea treated corncobs ensiled with or without enzose (corn dextrose) for lactating crossbred cows. Asian-Aust. J. Anim. Sci. 7:70.

Nisa, M., M. Sarwar, and M. A. Khan. 2004. Influence of ad libitum feeding of urea treated wheat straw with or without corn steep liquor on intake, in situ digestion kinetics, nitrogen metabolism and nutrient digestion in Nili-Ravi buffalo bulls. Aust. J. Agric. Res. 55: 235-239.

Ono, K., Berry, B. W., Johnson, H. K., Russek, E., Parker, C. F., Cahill, V. R., and Althouse, P. G. 1984. Nutrient composition of lamb two age groups. Jouranal of Food Science, 49:1233-1239, 1257.

Petit, H.V. and P.M. Flipot, 1992. Sources and feeding levels of nitrogen on growth and carcass characteristics of beef steers fed grass and hay silage. J. Anim. Sci. 70: 867-875.

Ruig, W.G. DE. 1986. Atomic absorption spectrophotometeric determination of calcium, copper, iron, manganese, potassium, sodium, and zinc in animal feeding stuffs inter laboratory collaborative studies. Journal of the Association of official analytical chemists. 69(60): 175-187.

Sarwar, M., M. A. Khan and M. Nisa. 2004. Effect of urea treated wheat straw ensiled with organic acids or fermentable carbohydrates on ruminal parameters, digestion kinetics,digestibility, and nitrogen metabolism in Nili-Ravi buffalo bulls fed restricted diets. Austr. J. Agric. Research 1:87.

SPSS, 1996. Statistical Packages for Social Sciences, Ver. 7.5, SPSS Inc. Illinois (USA)

Szabo, C., A.J. Jansman, L. Babinszky, E. Kanis and M.W. Verstegen, 2001. Effect of dietary protein source and lysine: DE ratio on growth performance, meat quality, and body composition of growing-finishing pigs. J. Anim. Sci. 79:2857-2865.

Van Soest, P. J., J. B. Robertson, and B. A. Lewis. 1991. Method for dietary fiber, neutraldetergent fiber, and nonstarch polysaccharides in relation to animal nutrition. J. Dairy Sci. 74:3583-3597.