EFFECT OF CLINOPTILOLITE ZEOLITE ON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS IN HOLSTEIN STEERS

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ABSTRACT

In this experiment, 27 crossbred steers (average body weight 250 kg) were fed a diet with clinoptilolite (CLN), a natural zeolite, substituted at 0 be regarded as control, 2.5% as (T1) and 5% as (T2) of the diet dry matter. The objective of this study was to evaluate effects of natural zeolite on daily gain and carcass characteristics in Holstein steers. The experiment lasted for 210 days. Average daily gain of steers in T3 diets were highest (P<0.05) compare to control groups and T2 diets. Daily dry-matter intake for all the treatments diets was not significantly different. Hot carcass weight and dressing percentage in T3 was significant among others but lean cuts percentage and quality grade for all the treatments were not significant among each other.

Key words: Zeolites, Crossbred, Growth, Beef steers.

Zeolite clay is a naturally occurring hydrated aluminosilicate mined from volcanic ash deposits associated with alkaline lakes. The clay has a high cation exchange capability and permeability rate which makes it effective in adsorbing ammonia (Sherwood et al., 2006).

Zeolites and bentonites are somewhat similar products, being aluminosilicates of other cations such as sodium, potassium, or calcium (Mumpton and Fishman, 1977), and have been evaluated extensively. Because of their physical and chemical structures, these products can bind certain toxins in both nonruminants (Schell et al., 1993) and ruminants (McKenzie, 1991). Consequently, zeolites and bentonites offer other potential uses such as reducing bloat (Carruthers, 1985), binding ammonia in the rumen to help ruminants more efficiently utilize nonprotein nitrogen, and runoff (Mumpton and Fishman, 1977). Responses of ruminant animals to supplemental zeolites varies both with source and diet (Murray et al., 1990; Coffey et al., 2000).

Blednov (1995) reported improvements in daily live-weight gain and food efficiency when 30 g/kg of zeolite was added to the diet of finishing beef, but further increases were not evident when zeolite was increased to 50 g/kg of dietary DM.

The objectives of this study were to determine the influence of CLN on feedlot performance and carcass characteristics in steers consuming different levels of supplemental zeolite diet.

Animals, experimental design and feeding: A 210-day feedlot trial was conducted at the Toskestan Livestock Dairy Farm, Gorgan vicinity. This experiment was approved by directorate of research, Gorgan University of Agricultural Sciences and Natural Resources, Iran.

Twenty seven crossbred Holstein steers were blocked by weight and assigned in a randomized complete block design with 3 pens of 9 steers/pen. Treatments were compared by ANOVA. The average body weight of animals was 250 kg (s.d. 12.50) body weights. The treatments combined no supplemental zeolite, as control group, 2.50 % as treatment 1 (T1) and 5 % in treatment 2 (T2) of diet dry matter (Table1), respectively.

In the following studies, clinoptilolite was mixed with the diets prior to feeding. The material had a minimum purity of 88%, a particle size less...
than 300 μm and average ammonia exchange capacity of 1.8 meq/g. The commercially procured zeolites were supplied. Clinoptilolite (Anzymite®; Product Code: A713726) was supplied by Afrandtoska Co., Tehran, Iran) from Semnan zeolite mines located central of Iran. Chemical composition based on X-ray diffraction (Rahmani et al., 2004) was (per kg): 695.3 g SiO₂, 36.7 g CaO, 27.7 g K₂O, 77.5 g Al₂O₃, 6.3 g Na₂O, 14.1 g Fe₂O₃, 1.9 g TiO₂ and 129.4 g LOI (loss on ignition).

All diets met or exceeded the minimum requirements for CP, Ca, and P as described for medium-framed yearling steers. The diets were formulated, on a DM basis, to be isoenergetic (2.72 Mcal/kg) and isonitrogenous (18.8 % of CP) (Table 1) (NRC, 1996).

**Feedlot performance**: Starting and ending weights were the average of 2 consecutive early-morning weights. Steers were weighed at 0700 and fed upon (9 animals/treatment) at weighing on d 0, 30, 60, 90, 120, 150, 180 and 210 of the trial.

**Carcass characteristics**: At the end of trial steers were slaughtered and carcass weight, dressing percentage, lean cuts percentage and quality grade were determined. Carcass data were adjusted to the mean hot carcass weight by use of this weight as a covariate. Performance and carcass characteristics were analyzed by least-squares regression analysis (Snedecor and Cochran, 1994).

**Feedlot performance**: Performance data for the feedlot experiment are presented in Table 2. Steers consuming CLN tended to gain faster than control group, but differences were not significant among treatments for daily intake (DM and OM) and feed efficiency. Average daily gain of steers given T2 diet was higher (P<0.05) (1.315kg/day) than steers given control (0.980 kg/day) or T1 (1.200 kg/day) diets (Table 2). No significant differences (P>0.05) in dry matter intake was observed among different treatments, respectively. Further more control diet animals grew less than other treatment and finally T2 grew efficiently than steers on control and T1 diets (P<0.05).

**Carcass characteristics**: In order to determine the effect of diet on carcass composition at an equal weight, all steers within a treatment were slaughtered at an approximately same weight. Carcass traits were further adjusted to the mean hot carcass weight within each treatment (Table 2). Hot carcass weight for the T2 were heavier than other treatments (P<0.05). Although lean cuts percentage and quality grade of all the treatments were been near each other and were not significant, but dressing percentage of control group were more than the other treatments (P<0.05).

Average daily gain for steer gains, intake, or gain/ feed ratios (feed efficiency) were affected by zeolite addition during the experiment (Table 2 ). It might be said that the level was predicted by NRC (1996) for the beef steers on the T2 diet (1.358 kg/day).

In overall performance, adding zeolite improved feed utilization compared with the no-zeolite diet (Table 2). These results were consistent with past research by McCollum and Galyean (1983) who reported that inclusion of 25 g zeolite per kg in high concentrate diets increased ADG of steers by proportionately 0.05. However dry matter intake in this experiment was not significant among different diets. Mumpton and Fishman, 1977 and Sweeney et al., 1980 reported that increased DM intake has been observed in beef and dairy cattle consuming zeolite but for growth response has not been consistent.Because wheat-based diets were used, a buffering effect from zeolite might have been the

<table>
<thead>
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<th>Table 1. Composition of diets fed to beef steers.</th>
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<td><strong>Ingredients</strong></td>
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<tr>
<td>Natural zeolite</td>
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<tr>
<td>Alfalfa hay</td>
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<tr>
<td>Barley</td>
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<tr>
<td>Wheat straw</td>
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<td>Wheat bran</td>
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<td>Sugar beat pulp</td>
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<td>Canola seed meal</td>
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<td>CaCO₃</td>
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<td>Vit. premix</td>
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cause of the improved performance of the non zeolite diet.

Better gain and feed utilization when feeding zeolite have been related to its increased energy density. Zeolite increased DMI in this study. The critical factor of the intake effect in this study was the type of grain fed (i.e., wheat). However, steam-flaking compared with dry-rolling often results in better performance when feeding wheat (Brandt, et al. 1987) by altering ruminal fermentability, specifically by decreasing the rate of starch digestion (Kreikemeier et al. 1990).

Carcass characteristics: Tenderness is one of the most important meat palatability attributes (tenderness, juiciness, and flavor) and is influenced by a many factors, including carcass maturity or animal age (Li, et al., 2007). Many studies have shown that meat tenderness decreases with animal age (Shorthose and Harris; 1990; Moon et al., 2006). But different scientists ascribed this increase to different reasons. Shorthose and Harris (1990) reported decreased tenderness of all muscles as animal age increased from 10 to 60 months.

In the present experiment, energy level had little effect on marbling score or quality grade. Increasing energy level did, however, result in increased fat thickness and lower ribeye area and percentage retail product.

Protein gain, both within individual tissues and across the whole animal, is the difference between the opposing mechanisms of protein synthesis and degradation (Lobley et al., 2000). Husbandry strategies based on lower resource inputs but with a higher plane of nutrition prior to slaughter, may yield meat of similar eating quality to that obtained from animals maintained on higher intakes and faster rate of live-weight gain throughout the rearing period. The effectiveness and timing of such strategies may differ between large-and small-framed animals and those considered ‘early’ as opposed to ‘late’ maturing (McCarthy, et al., 1983).

Conclusion: Based on findings, clinoptilolite zeolite has the potential to increase ADG, carcass weight and dressing percentage of steers. But CLN has no beneficial effect on DMI, lean cuts percentage and quality grade.

**REFERENCES**


