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Research article

GROWTH EFFICIENCY AND CARCASS CHARACTERISTICS OF GROWING MALE COWS FED DIETS SUPPLEMENTED WITH ORGANIC CHROMIUM YEAST

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ABSTRACT: The present study was carried out to examine the effect of organic chromium yeast supplementation in feedlot diets of growing male cows on growth efficiency and carcass characteristics. The experiment was conducted in Ibadan (7.38^0 N and 3.93^0 E), in the South Western region of Nigeria. The study lasted six months (180 days). A total of seventy-five Ndama Ndama growing male cows with average weights ranging between 280 and 284kg were kept outdoors in feedlot pens of 15 cows per treatment. The different treatment groups received organic chromium yeast mix of 9%, 18%, 27% and 36%, representing 0.1, 0.2, 0.3 and 0.4 ppm organic chromium yeast respectively. Each cow was replicated 3 times with 5 cows per replicate. Parameters recorded during the experimental period include average daily gain, feed: gain ratio and feed consumption. Carcass characteristics studied at the end of the experiment include final yield grade, marbling scores, dressing percentage, quality grade and longissimus muscle area. Statistical analysis revealed significant ($P<0.05$) differences between the means. Cows fed diets supplemented with 0.3 ppm organic chromium yeast showed higher performance characteristics than cows fed the control diet and the other experimental diets. Treatment with 0.3 ppm organic chromium yeast in the diet of the cows significantly ($P<0.05$) increased carcass characteristics and these values were higher than the values obtained from cows fed the control diet and the other experimental diets.

Key words: Organic chromium yeast, average daily gain, feed: gain ratio, feed consumption, carcass characteristics.

INTRODUCTION

Chromium was first reported as an essential mineral in rats (Schwarz and Mertz, 1959) and was demonstrated as an essential nutrient for humans (Jeejebhoy *et al.*, 1977). The primary role of chromium in metabolism is in enhancing the glucose uptake by the cells (Davis and Vincent, 1997). Chromium activates certain enzymes and stabilizes proteins and nucleic acids (Anderson, 1994). Chromium supplementation reduces the negative effects of environmental stress (Sahin *et al*., 2001, Lien *et al*., 1999). The major sources of chromium include chromium propionate, chromium picolinate, chromium nicotinate and high chromium yeast. Organic source of chromium is over ten times more bio- available than inorganic sources (Lyons, 1994). Chromium propionate has been approved as an acceptable additive in swine feed by United States Food and Drug Administration (Anon, 2007). Numerous studies have clearly and effectively demonstrated the benefits in supplementing chromium in livestock diets. Rate of growth and feed conversion by feedlot cattle are highly influenced by feed intake and energetic efficiency (NRC, 1996). Chromium is an important trace element in the regulation of blood glucose and immune response in humans, where it is known to act as a structural component of a glucose tolerance factor, which potentiates the action of insulin and is an essential mineral for normal metabolism of carbohydrates and lipids (Mertz, 1993). Studies by Chen *et al* (2006) have revealed diminished plasma membrane cholesterol content in cells exposed to chromium and exogenous cholesterol replenishment was found to render the enhancement of insulin action by chromium ineffective. In broilers dietary chromium supplementation has been shown to positively affect egg production and performance in laying hens (Sahin *et al*., 2001; Sahin *et al*., 2002).

Increase in carcass yield and decrease in abdominal fat content in broilers was observed when supplemented with chromium picolinate (Sahin *et al*., 2003) or high chromium yeast (Debski *et al*., 2004). Studies by Sahin *et al* (2003) showed that decrease in weight gain and feed efficiency in broiler birds reared under heat stress conditions, was alleviated by dietary chromium supplementation. Chromium supplementation has been shown to improve feed conversion ratio by up to 6.2% (Zhang *et al*., 2002). Dairy cattle provided chromium as chromium propionate ate more feed and produced more milk than untreated cows (McNamara and Valdez, 2003). Increased milk production might be an indirect effect of increased glucose production (McNamara and Valdez, 2003). Studies by Dhiman *et al*, (2007), showed that supplementation with chromium propionate decreased plasma cholesterol concentration in 6 month old buffalo calves. Chromium supplementation increased total weight gain, average daily weight gain and decreased cholesterol in young goats (Mondal *et al*., 2007). The present study examines the effect of organic chromium yeast supplementation on the growth efficiency and carcass characteristics of growing male cows in the tropics. Organic chromium yeast is a food upgrade of spray dried whole yeast cells of the specie *Saccharomyces cerevisiae*, containing controlled high levels of chromium.

MATERIALS AND METHODS

The study was carried out over a period of six months at the Research and Teaching Farm, University of Ibadan, Ibadan (7.38^0 N and 3.93^0 E), Oyo State in the South-Western region of Nigeria. The organic chromium yeast used had the following product description:

Appearance ---------- powder

Active ingredient ---------- chromium

Particle size ---------- 80 mesh

Color ---------- tan

Taste ---------- characteristic

Odor ---------- characteristic

Moisture ---------- 7% max.

A total of seventy-five (75) Ndama Ndama growing male cows with average weights ranging from 280 to 284kg were kept outdoors in feedlot pens of 15 cows per treatment, the floors of the pens were made of slotted concrete and equipped with an automated feed and water delivery system. Each cow was replicated 3 times with 5 cows per replicate. Feed for each pen was initially weighed and delivered early in the mornings. Each day, prior to feeding, left over feed was weighed and used to estimate intake. Water was given ad lib. Individual cow weights were recorded at 15 days intervals for the first 90 days and then 10 days interval for the last 90 days of the experimental period. Average daily gain, feed: gain ratio and feed consumption were calculated for each period. At the end of the experimental period, the cows were slaughtered and the following parameters were measured: final yield grade, marbling scores, dressing percentage, quality grade and longissimus muscle area.

The composition of the experimental diet is given in Table 1 below.

The different treatment groups received organic chromium mix of 9% (diet 1), 18% (diet 2), 27% (diet 3) and 36% (diet 4) of the diet, representing 0.1, 0.2, 0.3 and 0.4 ppm chromium respectively. The chromium in each group replaced wheat offal in the basal diet. The diets were formulated to contain approximately 14% crude protein and 2340kcal/kg metabolizable energy and were typical feedlot diets containing grains.

Data collected were subjected to a one-way analysis of variance procedure in a completely randomized design using IRRISTAT for windows (Version 5.0) computer software. Significantly different means were separated using Duncan's Multiple Range Test procedure (Duncan, 1955).

Table 1: Composition of the experimental diets

Ingredient (%)	Control	Diet 1	Diet 2	Diet 3	Diet 4
Maize	80	80	80	80	80
Organic chromium	-	0.09	0.18	0.27	0.36
Fish meal	3.00	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Wheat offal	15.00	14.91	14.82	14.73	14.64
Oyster shell	0.8	0.8	0.8	0.8	0.8
Vit/mineral premix	0.2	0.2	0.2	0.2	0.2
Salt	0.4	0.4	0.4	0.4	0.4
Total	100.00	100.00	100.00	100.00	100.00

RESULTS and DISCUSSION

The effect of organic chromium supplementation on average daily gain, dry matter intake and feed: gain ratio of growing male cows for the first 90 days of the study is given in Table 2.

Table 2: Effect of organic chromium supplementation on performance of growing male cows (0-90 days)

Parameter	Control	Diet 1	Diet 2	Diet 3	Diet 4
Initial weight (kg)	282.28	280.90	283.45	284.00	281.95
Dry matter intake (kg/dm)	8.25^{a}	8.24^{a}	8.34^{a}	8.35^{a}	7.20^{c}
Average daily gain (kg/dm)	0.75^{a}	0.76^{a}	0.77^{a}	0.75^{a}	0.70^{b}
Feed: gain ratio	11.00^{a}	10.84^{a}	10.83^{a}	11.13^{a}	10.28^{b}

^{ab} Means with different superscripts within the same row are significantly ($P<0.05$) different

There were no significant differences in average daily gain, dry matter intake and feed: gain ratio between the control diet and diets 1, 2 and 3 (0.1, 0.2 and 0.3 ppm Cr respectively) during the first 90 days of the experiment. Results show that the performance characteristics measured were relatively highest in cows fed diets supplemented with 0.3 ppm organic chromium. Significant ($P<0.05$) differences were observed in average daily gain, dry matter intake and feed: gain ratio between cows fed diet 4 (0.4ppm Cr) and cows fed the control diet and the other test diets. Feed intake by cows fed diet 4 reduced over the 90 day experimental period. Results would suggest that supplementation with organic chromium above 30% inclusion in the diet would not be beneficial to the animal. Feed: gain ratio of cows fed diets supplemented with organic chromium is lowest in cows fed with 0.4 ppm chromium; this suggests that feed conversion during the first 90 days of the study was more efficient with cows fed diets supplemented with 0.4 ppm chromium. Table 3 shows the effect of organic chromium supplementation on average daily gain, dry matter intake and feed: gain ratio on the performance of the experimental animals during the final 90 days of the study.

Table 3: Effect of organic chromium supplementation on performance of growing male cows (91-180 days)

Parameter	Control	Diet 1	Diet 2	Diet 3	Diet 4
Initial weight (kg)	349.00^{a}	349.30^{a}	352.75^{a}	351.50^{a}	344.95^{b}
Dry matter intake (kg/dm)	8.87^{b}	8.86^{b}	9.00^{b}	9.42^{a}	8.08^{c}
Average daily gain (kg/dm)	1.21^{c}	1.29^{b}	1.32^{b}	1.40^{a}	0.94^{d}
Feed: gain ratio	7.33^{b}	6.87^{c}	6.81^{c}	6.70^{d}	8.50^{a}

^{abc} Means with different superscripts within rows are significantly ($P<0.05$) different

Results show significant (P<0.05) differences in dry matter intake, weight gain and feed: gain ratio between the experimental animals fed the different diets during the last 90 days of the experiment. Animals fed diet 3 showed higher dry matter intake, average daily gain and lower feed: gain ratio. During the first 90 days feed: gain ratio was lower for cows fed diets supplemented with 0.4ppm chromium. However as the study progressed feed: gain ratio which is a measure of the animal's ability to convert feed to flesh, increased which might suggest a reduction in the conversion of feed to flesh with time. Table 4 shows the effect of organic chromium supplementation on the overall average daily gain, dry matter intake and feed: gain ratio on the performance of the experimental animals during the study period.

Table 4: Effect of organic chromium supplementation on overall performance of growing male cows (180 days).

Parameter	Control	Diet 1	Diet 2	Diet 3	Diet 4
Initial weight (kg)	282.28	280.98	283.45	284.00	281.95
Final weight (kg)	458.68^{c}	465.40	471.55^{a}	477.5^{a}	429.55^{d}
Dry matter intake (kg/dm)	8.80^{a}	8.79^{a}	8.99^{a}	9.12^{a}	8.06^{b}
Average daily gain (kg/dm)	0.88^{b}	1.03^{a}	1.05^{a}	1.08^{a}	0.82^{c}
Feed: gain ratio	10.00^{d}	8.53^{b}	8.56^{b}	8.44^{a}	9.83^{c}

^{abc} Means with different superscripts within rows are significantly(P<0.05) different.

Overall, cows fed diets 2 and 3 showed significantly (P<0.05) higher performance characteristics than cows fed the other experimental diets. Lowest values were obtained from cows fed diet 4 (0.4 ppm organic chromium). Feed: gain ratio was lowest for cows fed diet 3, which indicates better conversion of feed to muscle for cows in this group. Results of the effect of organic chromium supplementation in the diet of the cows on carcass characteristics are given in Table 5. The Table shows significant (P<0.05) differences between the means with cows fed diet 3 (0.3ppm chromium) showing significantly (P<0.05) higher values than cows fed the other experimental diets. Treatment with 0.3ppm chromium in the diet of the cows significantly (P<0.05) increased hot carcass weight when compared to cows fed the control diet and the other experimental diets. Dressing percentage, marbling score and final yield grade were much lower with cows fed diet 4 when compared to cows fed the other experimental diets. Longissimus muscle area was also significantly (P<0.05) higher with cows fed diet 3.

Table 5: Effect of organic chromium supplementation on carcass characteristics

Parameter	Control	Diet 1	Diet 2	Diet 3	Diet 4
Hot carcass weight (kg)	273.30^{d}	280.02^{c}	286.17^{b}	292.12^{a}	244.17^{e}
Dressing percentage (%)	57.33^{c}	58.81^{b}	60.10^{a}	61.35^{a}	51.30^{d}
Longissimus muscle are (cm^{2})	68.33^{d}	70.01^{c}	71.54^{b}	73.03^{a}	61.04^{e}
Marbling scores[1]	409.95^{d}	420.03^{c}	429.30^{b}	438.18^{a}	366.30^{e}
Final yield grade	2.30^{b}	2.35^{b}	2.41^{a}	2.45^{a}	2.05^{c}

^{abc} Means with different superscripts within rows are significantly (P<0.05) different

[1] Marbling scores: 300 = trace, 400 = slight, 500 = small.

CONCLUSION

Results show that growing male cows fed diets supplemented with up to 0.3ppm organic chromium yeast had better growth performance indices than cows fed a controlled feedlot diet and diets supplemented with 0.1, 0.2 and 0.4ppm organic chromium yeast respectively. Hot carcass weight, dressing percentage and final yield grade were improved in cows fed diets supplemented with 0.3ppm organic chromium yeast when compared to cows fed the other experimental diets. Longissimus muscle area was significantly higher in cows fed diets supplemented with 0.3ppm organic chromium yeast. Although rated small, the marbling scores for cows fed diets supplemented with 0.3 ppm organic chromium yeast were much higher than that for cows fed the other experimental diets. The data from this study indicate that supplementation of feedlot cow diets with 0.3 ppm organic yeast chromium improves two economically important carcass traits which are hot carcass weight and longissimus muscle area.

REFERENCES

Anderson, R.A. (1994). Stress effects on chromium nutrition of humans and farm animals. In: Biotechnology in the feed industry (Lyons, T.P. & Jacques, K.A. eds.), University Press, Nottingham, UK. Pp.267-274.

Anon, (2007). Kemin industries receive clearance for its Kem Trace® Brand Chromium propionate.Kemin Press Release, January 24, 2007. www.kemin.com/about/news/news-release.

Chen, G., Liu, P., Patter, G.R., Tackett, L., Bhonagiri, P., Strawbridge, A.B and Elmendorf, J.S., (2006). Chromium activates glucose transporter 4 trafficking and enhances insulin-stimulated glucose transport in 3T3-L1 adipocytes via a cholesterol dependent mechanism. Molecular Endocrinology, 20 (4): 857-870.

Davis, C.M., Royer, A.C., and Vincent, J.B, (1997). Synthetic multinuclear chromium assembly activates insulin receptor kinase activity: functional model for low-molecular-weight chromium-binding substance. Inorganic Chemistry, 36: 4382-4385.

Debski, B., Zalewski, W., Gralak, M.A and Kosla, (2004). Chromium yeast supplementation of broilers in an industrial farming system. J. Trace Ele. Med. Biol., 18: 47-51.

Dhiman Ashok, Srikant Kulkami, Ralesh Jindal and S.P.S Sangha (2007). Proceedings: International Tropical Animal Nutrition Conference. Abstract MV 21: 314-315.

Jeejebhoy,K.N., Chu, R.C., Marliss, E.B., Greenberg, G.R and Bruce-Robertson, A, (1977). Chromium deficiency, glucose intolerance and neuropathy reversed by chromium supplementation in a patient receiving long-term total parenteral nutrition. Am. J. Clinical Nutrition, 30:531-538.

Lien, T.F., Horng, Y.M. and Yang, K.H, (1999). Performance, serum characteristics, carcass traits and lipid metabolism of broilers as affected by supplement of chromium picolinate. Br. Poult. Sci., 40: 357-363.

Lyons, T.P (1994). Biotechnology in the feed industry, 1994 and beyond In: Proceedings of Alltech's 10th Annual Symposium on Biotechnology in the Feed Industry, (Lyons, P., Jacques, K.A. eds),Nottingham University Press, UK, pp 1-50.

McNamara, J.P and F. Valdez, (2003). Adipose tissue metabolism and production responses to calcium propionate and chromium propionate. J. Dairy Sci., Vol. 88, No.7, 2005.

Mertz, W, (1993). Chromium in human nutrition: a review. Journal of Nutrition, 123:626.

Mondal, S., Samanta, S., Halder, S and Gosh, T.K, (2007). Proceedings: International Tropical Animal Nutrition Conference. Abstract MV 21:303.

National Research Council (1996). Nutrient requirements of beef cattle, 7th edition. Washington DC: National Academy of Sciences, National Academy Press.

Sahin, K., Kucuk, O and Sahin, N, (2001). Effects of dietary chromium picolinate supplementation on performance, insulin and corticosterone in laying hens under low ambient temperature. J. Anim. Physiol. Anim. Nutr. 85:142-147.

Sahin, k., Ozbey, O., Onderci, M., Cikim, G and Aysondu, M.H. (2002). Chromium supplementation can alleviate negative effects of heat stress on egg production, egg quality and some serum metabolites of laying Japanese quail. J.Nutr. 132: 1265-1268.

Sahin, K., Sahin, N and Kucuka, O, (2003). Effects of chromium and ascorbic acid dietary supplementation on growth, carcass traits, serum metabolites and antioxidant status of broiler chickens reared at a high ambient temperature. Nutr. Res., 23: 225-238.

Schwartz, K and Mertz, Z. (1959). Chromium (III) and glucose tolerance factor. Arch. Biochem. Biophysics, 85: 292-295.

Zhang, M.H., Wang, R. Du., Zhang, W.H., Zhou, S.Y and Xie, B.X, (2002). Effect of dietary chromium levels on performance and serum traits of broilers under heat stress. Acta. Zoonutrimenta Sinica, 14:54.

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