DOI: 10.22055/ivj.2024.484522.2745

Evaluation of the effect of nano chromium and chromium on the blood level of glucose, BHBA and NEFA in high-producing dairy Holstein cattle

Ali Bahmani Ghayedi[1], Afshin Jafari-Dehkordi[2*], Abdonnaser Mohebbi[2] and Mohammad Reza Aslani[3]

[1] DVSc Student in Large Animal Internal Medicine, Faculty of Veterinary Medicine, Shahrekord University, Shahrekord, Iran

[2] Associate Professor, Department of Clinical Science, Faculty of Veterinary Medicine, Shahrekord University, Shahrekord, Iran

[3] Professor, Department of Pathobiological Science, Faculty of Veterinary Medicine, Shahrekord University, Shahrekord, Iran

Received: 20.10.2024 Accepted: 18.12.2024

Abstract

Chromium is an essential trace element that is vital in regulating glucose metabolism and improving animal performance, especially in dairy cattle. Negative energy balance and disturbance in glucose metabolism are major challenges in dairy cattle, which directly affect cow's health and milk production. This study aimed to investigate the effects of nano chromium and chromium in improving the metabolic status of dairy cattle and increasing production efficiency. A total of 36 high-producing Holstein dairy cows were selected**.** The cows were randomly divided into three groups: the control group, the nano chromium group, and the chromium group, which respectively received 0.1 mg/Kg MW (metabolic weight) nano chromium picolinate and 0.1 mg/Kg MW of chromium picolinate orally for 3 weeks. Blood samples were taken from the jugular vein on days 0 (before the start of the experiment), 7, 14, 21 and 28 to measure non-esterified fatty acids, beta-hydroxybutyric acid and glucose. The blood glucose level in both groups receiving chromium and nano chromium was significantly lower than the control group on days 21 and 28. The amount of NEFA in the nano chromium group showed a significant decrease on days 21 and 28 compared to the control group. A significant decrease in BHBA was observed in the chromium and nano chromium groups on days 14, 21 and 28 compared to the control group. Also, a significant difference in BHBA level was observed between chromium and nano chromium groups on days 21 and 28. The results of this research showed that the use of chromium supplements, especially chromium nanoparticles, can be used to improve the health and performance of livestock. By conducting more studies, these findings can be used to improve nutrition and increase performance in the cattle dairy farms.

Key words: Chromium, Nano chromium, Cow, Glucose, NEFA, BHBA

[*] **Corresponding Author**: Afshin Jafari-Dehkordi, Associate Professor, Department of Clinical Science, Faculty of Veterinary Medicine, Shahrekord University, Shahrekord, Iran
E-mail: jafari-a@sku.ac.ir

Refrences

Aguirre, V., Werner, E. D., Giraud, J., Lee, Y. H., Shoelson, S. E., & White, M. F. (2002). Phosphorylation of Ser307 in insulin receptor substrate-1 blocks interactions with the insulin receptor and inhibits insulin action. *Journal of Biological Chemistry, 277*(2), 1531-1537 **.**

Al-Haidary, A., Alsoghair, A., & Alshaikh, M. (2003). Influence of niacin supplementation on thermoregulatory responses and performance of Holstein cattle during the summer months. *Journal of the Saudi Society of Agricultural Sciences*, 15, 3-25 **.**

Alshaikh **,**M., Alsiadi, M., Zahran, S., Mogawer, H., & Aalshowime, T. (2002). Effect of feeding yeast culture from different sources on the performance of lactating Holstein cows in Saudi Arabia. *Asian-Australasian Journal of Animal sciences, 15*(3), 352-356 **.**

Amoikon, E., Fernandez, J., Southern, L., Thompson Jr, D., Ward, T., & Olcott, B. (1995). Effect of chromium tripicolinate on growth, glucose tolerance, insulin sensitivity, plasma metabolites, and growth hormone in pigs. *Journal of Animal Science, 73*(4), 1123**-**1130.

Armstrong, D., Steele, R., Altszuler, N., Dunn, A., Bishop, J. d., & De Bodo, R. (1961). Regulation of plasma free fatty acid turnover. *American Journal of Physiology-Legacy Content, 201*(1), 9-15.

Assis, J.R. (2021). Chromium in performance and metabolism of dairy cow. *Scientific Electronic Archives 14*(1):100-107.

Bakr, M. H., Abd Elazeim, M. G., Abd El Rahman, M., Olafadehan, O. A., & Kholif, A. E. (2023). Chocolate byproducts and protected fats enriched with chromium to replace corn in diets of early lactation Holstein cows: feed utilization, blood profile, and lactational performance. *Annals of Animal Science, 23*(4), 1119-1129 **.**

Borgs, P., & Mallard, B. (1998). Immune-endocrine interactions in agricultural species: chromium and its effect on health and performance. *Domestic Animal Endocrinology, 15*(5), 431-438 **.**

Davis, S., & Collier, R. (1985). Mammary blood flow and regulation of substrate supply for milk synthesis. *Journal of Dairy Science, 68*(4), 1041-1058 **.**

Drackley, J. K. (1999). Biology of dairy cows during the transition period **:**The final frontier? *Journal of Dairy Science, 82*(11), 2259-2273 **.**

Dunshea, F., Bell, A., & Trigg, T. (1990). Non-esterified fatty acid and glycerol kinetics and fatty acid re-esterification in goats during early lactation. *British Journal of Nutrition, 64*(1), 133-145.

Ghorbani, A., Sadri, H., Alizadeh, A., & Bruckmaier, R. (2012). Performance and metabolic responses of Holstein calves to supplemental chromium in colostrum and milk. *Journal of Dairy Science, 95*(10), 5760-5769 **.**

Hung, A.T., Leury, B.J., Sabi**,** M.A., Lien, T.F., & Dunshea, F.R. (2014). Dietary chromium picolinate of varying particle size improves carcass characteristics and insulin sensitivity in finishing pigs fed low-and high-fat diets. *Animal Production Science, 55*(4), 454-460 **..**

Hung, A.T., Leury, B. J., Sabin, M.A., Fahri, F., DiGiacomo, K., Lien, T.F., & Dunshea, F. R. (2020). Nano chromium picolinate improves gene expression associated with insulin signaling in porcine skeletal muscle and adipose tissue. *Animals, 10*(9), 1-14.

Kitchalong, L., Fernandez, J., Bunting, L., Southern, L., & Bidner, T. (1995). Influence of chromium tripicolinate on glucose metabolism and nutrient partitioning in growing lambs. *Journal of Animal Science, 73*(9), 2694-2705 **.**

Malik, M.I., Jonker, A., Raboisson, D., Song, B., Rashid, M.A., Sun, X. (2024). Effects of dietary chromium supplementation on blood biochemical parameters in dairy cows: A multilevel meta-analytical approach. *Journal of Dairy Science, 107*(1):288-303.

Mirzaei, M., Ghorbani, G., Khorvash, M., Rahmani, H., & Nikkhah, A. (2011). Chromium improves production and alters metabolism of early lactation cows in summer. *Journal of Animal Physiology and Animal Nutrition, 95*(1), 81-89 **.**

Mousavi, F., Karimi-Dehkordi, S., Kargar, S., & Ghaffari, M. (2019). Effect of chromium supplementation on growth performance, meal pattern, metabolic and antioxidant status and insulin sensitivity of summer-exposed weaned dairy calves. *Animal, 13*(5), 968-974 **.**

Panda, P ,.Verma, H. K., Lakkakula, S., Merchant, N., Kadir, F., Rahman, S., Rao, P. V. (2022). Biomarkers of oxidative stress tethered to cardiovascular diseases. *Oxidative Medicine and Cellular Longevity*, *2022*(1), 1-15.

Rhoads, R., La Noce, A., Wheelock, J., & Baumgard, L. (2011). Alterations in expression of gluconeogenic genes during heat stress and exogenous bovine somatotropin administration. *Journal of Dairy Science, 94*(4), 1917-1921.

Sano, H., Konno, S., & Shiga, A. (2000). Chromium supplementation does not influence glucose metabolism or insulin action in response to cold exposure in mature sheep. *Journal of Animal Science, 78*(11), 2950-2956 .

Stofkova, A. (2009). Leptin and adiponectin: from energy and metabolic dysbalance to inflammation and autoimmunity. *Endocrine Regulations, 43*(4), 157-168 .

Wheelock, J. B., Rhoads, R. P., VanBaale, M. J., Sanders, S. R., & Baumgard, L. H. (2010). Effects of heat stress on energetic metabolism in lactating Holstein cows. *Journal of Dairy Science, 93*(2), 644-655 .

Wu, Z.Z., Peng, W.C., Liu, J.X., Xu, G.Z., & Wang, D.M. (2021). Effect of chromium methionine supplementation on lactation performance, hepatic respiratory rate and anti-oxidative capacity in early-lactating dairy cows. *Animal, 15*(9), 1-7.

Zarifi, M., Buczinski, S., Rezakhani, A., Dezfouli, M. R. M., & Khonsha, A. (2012). Effect of lactation on functional and morphological echocardiographic variables in adult dairy cows. *Journal of Veterinary Cardiology, 14*(3), 415-421.