Effects of dietary chromium-methionine supplementation on blood metabolites and insulin resistance index in fructose-fed diabetic rats model

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Introduction Insulin resistance (IR) is a problem in periparturient dairy cows (Hayirli, 2000). The transition period is a critical phase for dairy cows and can cause negative energy balance and physiological stresses that develops in to IR. Chromium has the potential for lowering plasma free fatty acids and cholesterol concentrations that potentiates predominantly the IR by causing secretion of inflammatory cytokines from insulin dependent adipose tissues. The role of chromium is probably associated with increasing the insulin internalization and amplifying insulin signalling through activation of cellular insulin receptors. The exact evaluation of chromium in ruminants, necessitates the use of modelling for simulation IR in laboratory animals (Jalal, 2007). The aim of this experiment was to evaluate the effects of organic chromium on blood metabolites and IR index in fructose-fed insulin resistant (diabetic) rats.

Material and methods Twenty six Wistar male rats (mean BW of 225± 25g), were provided by the Iranian Pastor Institute and housed individually in standard cages, in an air conditioned (22± 2°C) room with a 12h light and dark cycle. All rats were nourished with 15g standard rat chow. After 1 week adaptation, 10 rats were used as healthy control group and 16 rats received fructose (10% weight/volume) in drinking water for 5 weeks. The insulin resistant (fructose-fed) rats were divided into two groups. Eight rats were fed 50 ppm chromium-methionine (Cr-met) supplement in the diet and the others remained in the previous feeding state for 6 weeks. Animals were blood sampled prior to chromium administration in order to test for IR inducing as well as after the end of the experiment for determination of blood serum parameters including fasting glucose, triglyceride, cholesterol and insulin contents. Centrifuged and extracted serum samples were stored at -20°C and transported to Mashhad Medical University labs for analysis. IR index was calculated by HomA-IR (Homeostatic model assessment of IR) software (Oxford University). Data were analysed using general linear model of SAS (2000) as completely randomized design with analysis of covariance.

Results The effect of fructose on blood parameters are shown in Table 1. In the first period of the study, IR was induced significantly (P <0.05) in rats receiving fructose. Serum fasting glucose, insulin, IR index (HomA-IR) and triglyceride contents, were significantly increased (P <0.05) in the fructose-fed group in comparison with the control rats. These changes could be the result of the fructose metabolite effects on insulin signaling in adipose tissues. Gene expression of insulin signaling mediators under the indirect effect of increased triglyceride of blood serum is another possibility. According to the results obtained in the second period of this study, IR index significantly (P <0.05) decreased after Cr-met supplementation (Table2). The fasting insulin, glucose and triglycerides concentration in Cr-met treated group was lower (P<0.05) than the fructose-fed insulin resistant group.

Table 1 Blood serum content of the rats in first period of experiment

Variables	unit	Treatment	
		Control (n=10)	Fructose-fed (n=16)
Glucose	mmol/l	10.02 ± 0.12	10.48 ± 0.90[*]
Insulin	mU/l	3.89 ± 0.05	5.09 ± 0.04[*]
HomA-IR	-	1.81 ± 0.03	2.27 ± 0.03[**]
Triglyceride	mmol/l	1.459 ± 0.011	1.711 ± 0.003[*]

[*]p<0.05   [**]p<0.01

Table 2 Comparison of blood serum parameters after Cr-met administration

Variables	unit	Treatment		
		Control (n=10)	Fructose-fed (n=8)	Cr-met + fructose-fed (n=8)
Glucose	mmol/l	10.46 ± 0.16[a]	11.56 ± 0.16[b]	10.91 ± 0.16[a]
Insulin	mU/l	4.22 ± 0.35[a]	6.10 ± 0.27[b]	5.32 ± 0.21[a]
HomA-IR	-	1.68 ± 0.04[a]	3.38 ± 0.11[b]	2.78 ± 0.09[c]
Triglyceride	mmol/l	1.74 ± 0.11[a]	2.42 ± 0.09[b]	2.17 ± 0.07[c]

The significant differences between treatments are shown with small alphabetic characters (p<0.05).

Conclusions the result of this study indicated that chromium supplementation as Cr-met could be effective in lowering IR index, fasting insulin, glucose and triglyceride in insulin resistant rats. It is possible that the mode of action of chromium supplementation follows the similar model in ruminant animals, although more studies are required.

References
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