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Effects of chromium picolinate supplementation in type 2 diabetic patients

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ABSTRACT. The effects of chromium picolinate in Type 2 diabetic patients are investigated. Seventeen Type 2 diabetic patients were randomly divided into two groups. The experimental group received fiber-rich hypocaloric diet and chromium picolinate whereas the control group received fiber-rich hypocaloric diet and placebo. The chromium picolinate was offered twice a day at the dose of 100 µg. Anthropometric data such as blood pressure, fasting glycemia and glycated hemoglobin (HbA1c) were measured and these parameters were evaluated again after 90 days. No difference was reported in rates of body weight, waist, hip, body mass index, blood pressure and fasting glycemia (Control *vs.* Experimental groups) after treatment. However, a decrease ($p = 0.0405$) of HbA1c occurred in the experimental group when the pre- and post-treatment rates were compared. HbA1c data showed that chromium picolinate improved the glycemic control in Type 2 diabetes.

Keywords: *diabetes mellitus*, fasting glycemia, glycated hemoglobin A1c, fibers.

Efeitos da suplementação com picolinato de cromo em pacientes portadores de *Diabetes mellitus* tipo 2

RESUMO. Neste estudo investigamos os efeitos do picolinato de cromo em pacientes portadores de *Diabetes mellitus* tipo 2. Para alcançar este objetivo 17 pacientes foram aleatoriamente divididos em 2 grupos. O grupo Experimental recebeu dieta hipocalórica rica em fibras e picolinato de cromo enquanto o grupo Controle recebeu dieta hipocalórica rica em fibras e placebo. Picolinato de cromo foi oferecido na dose de 100 µg, 2 vezes ao dia. Avaliamos os dados antropométricos, pressão arterial, glicemia de jejum e hemoglobina glicada A1c (HbA1c), sendo estes parâmetros reavaliados após 90 dias. Os resultados de peso, cintura, quadril, índice de massa corpórea, pressão arterial e glicemia de jejum, antes e após o tratamento não foram diferentes (Controle *vs.* Experimental). Contudo, houve redução ($p = 0,0405$) da HbA1c no grupo Experimental, ao compararmos os valores antes e após o tratamento. Portanto, a partir dos dados de HbA1c foi possível evidenciar que o picolinato de cromo melhora o controle glicêmico no *Diabetes mellitus* tipo 2.

Palavras-chave: *diabetes mellitus*, glicemia de jejum, hemoglobina glicada A1c, fibras.

Introduction

Diabetes is a chronic metabolic disturbance characterized by hyperglycemia due to insulin deficiency and/or resistance. Insulin resistance is a condition in which the amount of insulin released is inadequate to produce a normal glucose response by adipose, muscle and liver. As part of the pathophysiology of the disease, in most cases it is related to an increased intra-abdominal adipose tissue even in the absence of diabetes (ANTON et al., 2008).

In general, insulin resistance precedes Type 2 diabetes and is accompanied by risk factors such as dyslipidemia, hypertension, obesity and pro-thrombotic status. Its prevalence and incidence are

on the increase, especially among the elderly (MARTINEZ et al., 2008). Diabetes results in hyperglycemia, which increases the glycation of blood and intracellular proteins. In excessive amounts, glycated proteins damage the tissues and contribute towards the micro and macro vascular complications that result in neuropathy, retinopathy and cardiovascular diseases (RODERJAN et al., 2007).

Since eating habits influence glycemia in diabetic patients, nutritional strategies for health promotion must be considered (TEIXEIRA NETO, 2003). In this context, chromium, a trace mineral found in oleaginous vegetables, asparagus, mushrooms,

plums, whole cereals, legumes, meat and viscera, with an active role in the metabolism of carbohydrates, could be evaluated.

The major role of chromium is the potentiating of insulin effects with the improvement of glucose tolerance. This is due to the fact that chromium may be characterized as an amplifying component of the insulin cell signaling.

Chromium effect is more specifically related to the stimulation of glucose uptake. This is not caused by isolated chromium; rather, it acts as a low-molecular-weight organic complex, formed by Cr^{3+} , its active form in food.

Cr^{3+} is not toxic when ingested at a low dose. On the other hand, chromium intoxication is linked to Cr^{6+} , which is frequently inhaled in industrial environments and may cause changes in the nasal septum, inflammation of the nasal mucosa, chronic bronchitis and emphysema (VINCENT, 2007).

Currently, the supplementation with chromium picolinate seems to have a beneficial effect on carbohydrate metabolism. Chromium picolinate, among other forms, presents the best absorption (GOMES et al., 2005).

Further, several studies suggest that the supplementation with chromium picolinate may decrease insulin resistance and improve glycemic control in Type 2 diabetic patients, while contributing towards the reduction of hypercholesterolemia and hypertriglyceridemia (FEINER et al., 2008; GOMES et al., 2005). The stimulus to insulin action depends on the content of chromium in intracellular chromodulin which favors insulin sensitivity by stimulating the tyrosine kinase activity of the insulin receptor (GOMES et al., 2005).

The daily and safe ingestion of chromium in adults is estimated between 50 and 200 $\mu\text{g day}^{-1}$. Albeit an essential element, no recommended dietary intake (RDI) for chromium is prescribed (GOMES et al., 2005).

Since chromium administration may be included within the therapeutic design for glycemia control (BROADHURST, DOMENICO, 2006; GEOHAS et al., 2007; KESZTHELYI et al., 2003; KLEEFSTRA et al., 2007; MITA et al., 2005; MUÑOZ et al., 2006; SINGER; GEOHAS, 2006), current research investigates the effects of chromium picolinate supplementation in Type 2 diabetic patients.

Material and methods

Type 2 diabetic patients from Brazilian Unified National Health System (SUS) attended to at the Laboratory of Teaching and Research in Clinical

Analysis (LEPAC) of the State University of Maringá were invited to participate in current investigation. The criteria for inclusion were: ≥ 30 years old, non-use of insulin therapy and absence of previous history of ischemic heart disease. All patients read and signed the consent form before taking part in the study. The experimental protocol was approved by the Committee of Ethics in Research involving Human Beings (statement 457/2009).

The sample was composed of 17 patients (2 men and 15 women), average age of 59 years, randomly divided into two groups. Before starting the treatment, patients received a questionnaire to determine their nutritional status and medication schedule. Anthropometric data (body mass index, waist and hip) and arterial blood pressure were then measured. A blood sample was collected during fasting to evaluate glycemia and glycated hemoglobin A1c (HbA1c). Data were recorded in individual files for further comparison at the end of the treatment.

Nine patients were assigned to the Experimental group that received capsules of chromium picolinate and 8 patients to the Control group that received capsules of placebo, i.e., kaolin, a neutral excipient used in some supplements and medications, which does not affect the patient's metabolism.

Chromium picolinate was provided in a flask with 62 capsules (dose of 100 μg), twice a day, 30 min. before lunch and dinner. The amount was enough for 31 days.

A fiber- and protein-rich hypocaloric diet suited to diabetics, adapted by the researchers, was prescribed to both groups, for the standardization of the study. Moreover, the balanced and well-partitioned diet was low in cholesterol and saturated fats.

The patients returned every 30 days to get a new flask of supplement. In addition, phone contacts were made every 15 days to report any eventual discomforts concerning the supplement or to clarify issues concerning the diet. The flask of the previous supplement was returned when a new flask was delivered so that control and adhesion to the treatment could be assured.

After 90 days of treatment, anthropometric data, blood pressure record, fasting glycemia concentration and HbA1c levels were evaluated again.

Before the conclusion of the study 3 patients from the Experimental group and 2 patients from the Control group had quitted, owing to adaptation difficulties to diet. Six patients remained in each group.

SAS statistic software was used for statistical analyses. The non-parametric, distribution-free,

Wilcoxon test at 5% significance level was used. The median of the data of the two groups was calculated.

Results and discussion

Rates of body weight, waist, hip and body mass index (BMI) before the start and after the finish of treatment (Experimental *vs.* Control group) were not statistically different (Table 1).

Table 1. Comparison of body weight (Kg), waist (cm), hip (cm) and BMI (kg m^{-2}) of the Experimental and Control groups, before and after the treatment with chromium picolinate. $n = 12$.

| Parameters | Group | Initial media | Final media | P-rate |
|-------------|--------------|---------------|-------------|--------|
| Body weight | Experimental | 69.7 | 70.2 | 0.3750 |
| | Control | 83.5 | 83.2 | 0.0625 |
| Waist | Experimental | 99 | 100 | 0.9688 |
| | Control | 103 | 101 | 0.1875 |
| Hip | Experimental | 95.5 | 97 | 0.9688 |
| | Control | 113.5 | 113.5 | 0.8125 |
| BMI | Experimental | 28.1 | 28.3 | 0.312 |
| | Control | 31.9 | 30.7 | 0.062 |

Further, as shown in Table 2, there was a slight reduction of fasting glycemia and a significant reduction ($p = 0.0405$) of HbA1c in the Experimental group (before start *vs.* after finish of treatment) occurred.

Table 2. Fasting glycemia (mg dL^{-1}) and HbA1c (%) of the Experimental and Control groups before (Initial) and after (Final) the treatment with chromium picolinate. $p < 0.05^*$ (Final *vs.* Initial). $n = 12$.

| Parameters | Group | Initial media | Final media | P-rate |
|------------|--------------|---------------|-------------|---------|
| Glycemia | Experimental | 150 | 148 | 0.9375 |
| | Control | 140 | 129 | 0.5625 |
| HbA1c | Experimental | 7.6 | 6.7 | 0.0405* |
| | Control | 7.7 | 5.8 | 0.1563 |

Furthermore, the comparison of initial (before starting the investigation) and final (after finishing the investigation) rates showed a slight decrease (not statistically significant) of systolic blood pressure (from 13 mmHg to 12.5 mmHg in the experimental group; and from 13 mmHg to 11.5 mmHg in the Control group) and diastolic blood pressure (from 8 mmHg to 7.5 mmHg in the Experimental group; and from 7.5 mmHg to 6.5 mmHg in the Control group).

The nutritional orientation and diet to establish metabolic control in patients with *Diabetes mellitus* and its association with changes in lifestyle – including physical activity – are considered fundamental (SANTOS; ARAÚJO, 2011).

The above nutritional treatment could be obtained with a balanced diet with fiber-rich whole cereals (MCLELLAN et al., 2007).

In this study, the rates of body weight, waist, hip, BMI, blood pressure and fasting glycemia in the

Experimental group before and after treatment were not different, i.e., the supplementation with chromium picolinate did not change these parameters. However, the Control group had a slight decrease in BMI and fasting glycemia, which indicated that the fiber-rich hypocaloric diet was an important tool to improve the results of the diabetic patient's treatment. In agreement with these results, Anton et al. (2008) evidenced in Type 2 diabetic patients that decrease in BMI, body weight, waist, hip and percentage of fat was related to a healthy diet and correlated positively with glycemia decrease.

No scientific evidence exists that chromium supplementation changes body composition. It merely acts as an adjuvant factor in the improvement of insulin resistance (GOMES et al., 2005; MOTA et al., 2009).

Furthermore, in the case of glycemia, Ibarra et al. (2009) evaluated the effect of *Tecoma stans* associated with chromium picolinate for 45 days and did not find glycemia changes. The above suggests that HbA1c is a more adequate parameter to evaluate the impact of chromium picolinate on glycemic control. In agreement with this suggestion, HbA1c decrease in patients treated with chromium picolinate has been reported. Moreover, HbA1c decreased not only in the group that received chromium picolinate but also in the placebo group. This fact suggests that the fiber-rich diet also contributed to reduce glycemia rate in Type 2 diabetic patients within a 90-day period.

Conclusion

These results suggest that the treatment with chromium picolinate may be an important tool to improve glycemia control in Type 2 diabetic patients.

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