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Poster presentation

The effect of a proprietary maca powder (Maca-N21) on endurance capacity in exercised rats

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Abstract

Background: *Lepidium meyenii*, commonly known as maca, is a Peruvian plant that has been used for centuries to enhance mood, libido, and energy. Maca-N21 is a propriety blend of maca that has been shown to enhance cellular energy production and the activity of signaling proteins involved in muscle energy metabolism. The purpose of this preclinical study was to assess the effect of Maca-N21 on endurance capacity in exercised rats.

Materials & Methods: Twenty-eight Sprague-Dawley rats (age: 8 weeks, weight: 180 ± 20 g) were randomly divided into four groups (n=7 per group): 1) Control (vehicle), 2) Maca-N21 powder (40 mg/kg body weight), 3) Exercise control (vehicle), 4) Exercise + Maca-N21 powder (40 mg/kg body weight). Groups received treatment via oral gavage once per day for 21 consecutive days. All rats completed a swimming acclimation schedule. On the 14^{th} day of the experiment, 30 minutes after administration of study product, a weight-loaded forced swim test (5% body weight) was employed and rats were timed to exhaustion. On the 21^{st} day of the experiment, after administration of study product and a non-loaded swim test, rats were sacrificed. Serum and tissue samples were collected to measure levels of lactate and oxidative markers such as superoxide dismutase (SOD), glutathione peroxidase (GSH-Px), and malondialdehyde (MDA).

Results: Swimming time to exhaustion in the Exercise + Maca-N21 group was 44% higher than the Exercise group ($p < 0.05$) (Figure 1). Following exercise, serum lactate levels were 42% lower in the Exercise + Maca-N21 group (12.74 mg/dL) compared to the Exercise group (21.89 mg/dL) ($p < 0.05$). Both exercised and non-exercised rats supplemented with Maca-N21 had lower levels of oxidative stress marker MDA in the serum, liver, and muscle compared to corresponding control groups ($p < 0.05$). Comparing exercise groups, muscle MDA levels were 19% lower in the Maca-N21 group ($p < 0.05$). Moreover, levels of muscle GSH-Px, an enzyme known to protect against oxidative damage, were higher in the Maca-N21 groups compared to corresponding control groups ($p < 0.05$). Comparing exercise groups, muscle GSH-Px levels were 44% higher in the Maca-N21 group ($p < 0.05$).

Conclusions: The results of this preclinical study showed that Maca-N21 significantly improved swimming time to exhaustion in rats, as well as serum lactate and oxidative stress marker levels after exercise. These results support the use of Maca-N21 as an anti-fatigue and endurance enhancing ingredient for sports nutrition.

Background

Lepidium meyenii, commonly known as maca, is a Peruvian cruciferous plant that is grown at high altitudes in the Andes mountains. Due to its high phytonutrient content, maca has been used for centuries as both a food and medicinal source. Research has shown that maca can be used to enhance sexual drive and fertility, improve mood, and increase energy levels and endurance [1].

Maca-N21 is a propriety blend of maca that has been shown to enhance cellular energy production, although the mechanism is not yet known. Results from a preclinical study showed that Maca-N21 improves energy production by enhancing factors that stimulate mitochondrial biogenesis [2], defined as the process by which mitochondrial function and content increases in order to generate more energy [3]. An additional mechanism of action may be the inhibition of exercise-induced oxidative stress and lactate build up that can impede exercise capacity and increase resistance to fatigue. The following preclinical study was carried out to examine the effect of Maca-N21 on endurance capacity and to explore other molecular mechanisms behind Maca-N21's energy enhancing effects.

Methods & Materials

8-week old male Sprague-Dawley rats (n = 7/group) were randomly divided into 4 groups: 1) Control group (vehicle), 2) Maca-N21 powder (40 mg/kg body weight), 3) Exercise, 4) Exercise + Maca-N21 powder (40 mg/kg body weight). Maca groups received 40 mg/kg body weight maca powder (Maca-N21) intragastrically once per day for 21 days (control group was treated with a similar volume of vehicle). To acclimate the rats to exercise, rats swam without loading for 10 minutes, twice a week. After 14 days, a weight-loaded swim test was carried out as follows: 30 minutes after oral administration of product, rats were placed in an acrylic plastic pool containing fresh water (27 ± 1°C and approximately 35 cm deep). Rats tails were loaded with a lead block (5% body weight). Rats were then timed until exhaustion, defined as the inability to keep their nose out of the water within a ten second period. After the weight-loaded swim test, rats were orally administered product for 7 more days.

Rats were sacrificed on the 21st day of the study, 30 minutes post dosing and following a 90 minute non-loaded swim test. Serum was collected to measure lactate levels and muscle samples were collected to measure levels of oxidative markers such as malondialdehyde (MDA) and glutathione peroxidase (GSH-Px).

Results

Exercise Capacity

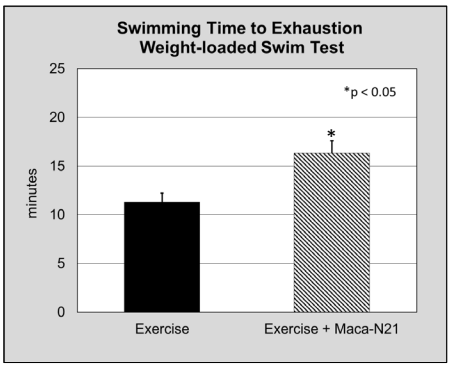

Figure 1. Swimming time to exhaustion during the weight-loaded swim test. The Exercise + Maca-N21 group time to exhaustion was significantly higher (16.3 minutes) compared to the Exercise group (11.3 minutes). Time to exhaustion was 44% higher in the Exercise + Maca-N21 group compared to the Exercise group.

Lactate Levels

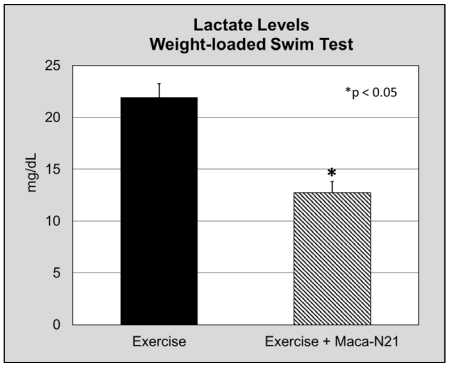

Figure 2. Serum lactate levels following the weight-loaded swim test. Lactate levels were significantly lower in the Exercise + Maca-N21 group (12.74 mg/dL) compared to the Exercise group (21.89 mg/dL). Lactate levels were 42% lower in the Exercise + Maca group compared to the Exercise group.

Muscle MDA Levels

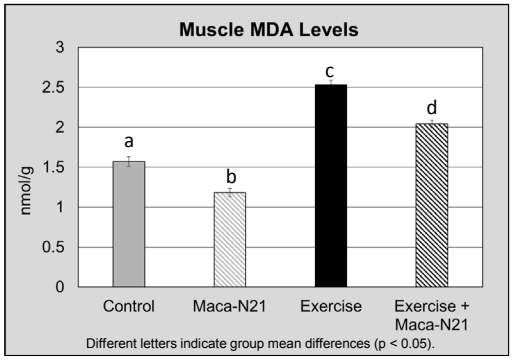

Figure 3. Muscle MDA levels (a marker of oxidative stress) following the non-loaded swim test. MDA levels were significantly lower in both Maca-N21 groups (with and without exercise) compared to corresponding control groups.

Muscle GSH-Px Levels

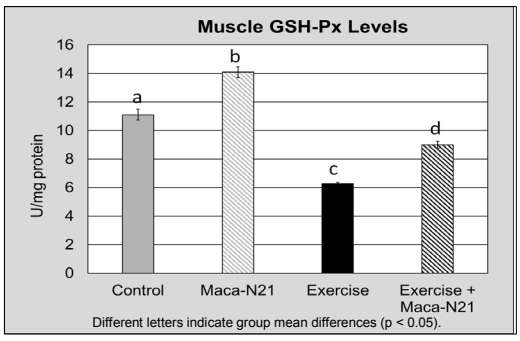

Figure 4. Muscle GSH-Px levels (an antioxidant enzyme) following the non-loaded swim test. GSH-Px levels were significantly higher in both Maca-N21 groups (with and without exercise) compared to corresponding control groups.

Discussion and Conclusions

Maca-N21 is a proprietary maca blend that has been previously shown to enhance cellular energy production and the activity of factors involved in the mitochondrial biogenesis signaling cascade. In the present preclinical study, Maca-N21 was shown to increase swimming time to exhaustion and decrease post-exercise lactate levels significantly compared to exercise controls. With and without exercise, Maca-N21 significantly decreased levels of oxidative stress markers and increased levels of antioxidant markers compared to corresponding control groups. These results suggest that Maca-N21 enhances exercise capacity by reducing the buildup of lactate and oxidative stress that occurs from strenuous exercise. The results of this study provide evidence to support the use of Maca-N21 as a nutritional ingredient to reduce common causes of muscle fatigue, and in turn, give individuals greater stamina and endurance during athletic events.

References

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