Yerba Mate Consumption Effect on the Total Concentration of Creatine Phosphokinase in Healthy Volunteers from the Age of 50

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Abstract—This preliminary study investigated for the first time the effect of roasted yerba mate (*Ilex paraguariensis* A. St. Hil.) tea on total creatine phosphokinase (CPK) in volunteers from the age of 50 years. Volunteers were randomly assigned to intervention (n = 3) and control (n = 3) groups. Treated subjects consumed mate tea for 28 days (500 mL/daily) and were submitted to five blood collection taken at intervals of seven days. It was observed a poor correlation between CPK level and yerba mate consumption. Results were also analyzed through cluster and principal component analyses. Treated and not treated subjects were not grouped into independent clusters which agreed with correlation analysis. Principal component analysis conferred partial discriminatory information about non-treated and treated groups. This study did not identify any influence of yerba mate consumption on total CPK concentration in physiological conditions. Larger sample studies should be addressed to detect significant small physiological variations in CPK values.

Index Terms— Roasted yerba mate; Serum creatine phosphokinase; Muscle physiology; Aging process.

I. INTRODUCTION

The consumption of yerba mate (*Ilex paraguariensis* A. St. Hil.) was associated with several beneficial effects to human health [1,2,3]. A recent study [4] demonstrated that for 14 days, yerba mate tea consumption decreased CPK serum concentrations in institutionalized patients (n = 4) with traumatic brain injury (TBI) when compared to control (n = 4). The CPK participates in the reversible phosphorylation reaction of creatine and seeks to maintain constant levels of ATP in cells that require high energy demand, such as muscle cells. The higher level of serum CPK is a trauma biomarker early after injury since the enzyme cannot cross the sarcoplasmic membrane barrier [5]. In patients with TBI, the values of CPK and other biochemical markers are monitored continuously in order to evaluate post-trauma events [4]. Despite the small sample in the study of Ribeiro et al. [4], the conjunction of principal component analysis with Person's correlation suggested, for the first time, positive correlation between yerba mate tea consumption and lower CPK levels in TBI patients.

Continuing the study of the effect of yerba mate

consumption on CPK levels, our interest was to investigate, for the first time, this effect in non-institutionalized volunteers from the age of 50 years. At that age, people already show a progressive and physiological decrease of the skeletal muscle mass, originating from the aging process. Aging is a gradual and multifactorial process that is related to the progressive loss of organic functions and adaptive responses [6]. One of the effects of aging is the physiological loss of muscle mass. Between 20 and 80 years, human beings are expected to lose 20 to 30% of their skeletal muscle mass [7]. From the age of 50 years, there is a progressive decrease in muscle mass at the rate of 1 to 2% per year [8]. Given the Yerba mate's therapeutic potential in patients with TBI, our group aimed to investigate whether the consumption of mate tea can modulate serum concentrations of CPK under physiological conditions.

II. MATERIALS AND METHODS

A. Materials and yerba mate tea preparation

Yerba mate leaves of *I. paraguariensis* A. St. Hil were harvested by the producers Claudio Kovaleski and Sílvia Kovalesky from "Ervateira Chiru" located to Chapecó, Santa Catarina State, Southern Brazil (27° 09' 05" S, 52° 38' 14" W), in November and December of 2014. Vouchers were examined by XXX to verify the identity of dried plants. A voucher specimen was deposited by the authors in the Herbarium Professor Jorge Pedro Pereira Carauta (Botanical Department, UNIRIO, Rio de Janeiro, Brazil) under the number HUNI 2344.

Yerba mate leaves were roasted at 200°C for 20 min in oven. To obtain infusions, boiling distilled water (250 mL) was poured over the plant material (7.0 g), mixed, capped and filtered under gravity after 15 min.

B. Participants and design study

The study consisted of a randomized clinical trial. The volunteers were randomly assigned to two groups of equal numbers: control group (non-treated subjects, n = 3) and intervention group (treated subjects, n = 3). Volunteers interested in the study completed a questionnaire containing personal information and data for assessing health conditions and life habits. The inclusion criteria were as follow: if

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hypolipidemic medicament was used, the volunteer should have reached the minimum time of 3 months of treatment; the diabetic volunteer should have their blood glucose controlled. The exclusion criteria were as follow: renal failure; muscle or articulation disease; any uncontrolled illness; use of new drug therapy during the study; if volunteer stop taking *yerba mate* tea more than once or for more than two consecutive days.

The volunteers consumed *yerba mate* tea infusion twice a day (7 g 250 mL⁻¹ each; a total of 500 mL/daily) for 28 days.

Before starting to consume *yerba mate* tea, the volunteers were submitted to the first blood collection. Soon after, the volunteers consumed the *yerba mate* tea, uninterruptedly. Five blood samples were taken at intervals of seven days between each collection, being a collection done before tea consumption and four collections during the 28 days of consumption. Throughout the study, volunteers were instructed to avoid drinking alcoholic beverages, teas, chocolate, and caffeinated beverages such as guarana, cola, and coffee. In addition, participants were instructed not to initiate any physical activity other than the usual routine. The non-treated volunteers followed a similar protocol of the treated ones, except for the consumption of *mate*. The staff of the clinical laboratory did the blood collection. The study was approved by the Official Ethics Committee of Human Research under the number CAAE: 44604215.0.0000.5285.

C. Statistical

Pearson's correlation was performed to verify the association between *yerba mate* tea consumption over the days with CPK serum concentration. Multivariate analysis was performed through Principal Component Analysis to observe the correlation between CPK variables and *mate* tea consumption and the Hierarchical Group Analysis (cluster analysis) to observe the grouping of analyzed data. For all inferences, $P < 0.05$ was considered statistically significant.

III. RESULTS

The CPK concentrations of the treated and non-treated groups were compared after 28 days of study as illustrated in Figures 1, 2 and 3. In general, there was a poor Pearson's correlation between CPK level and *mate* tea consumption (Fig. 1).

The results for total CPK were further analyzed by means principal component and cluster analyses to observe the correlation via multivariate analysis. The dendrogram showed in Fig. 2 exhibited a similar tendency to Pearson's correlations analysis (Fig. 1). It was not possible to group into independent clusters both treated and not treated subjects. Further, there was a dissimilarity between volunteers of the same group.

On the other hand, it was possible to identify a partial grouping by principal component analysis not only in non-treated subjects but also in treated subjects (Fig. 3).

The first two principal components (F1 and F2) accounted for 67.89% of the total data variance and conferred partial discriminatory information about non-treated and treated groups.

Fig. 1. Serum phosphocreatine kinase concentration of the non-treated (A) and treated (B) groups with *yerba mate* tea over 28 days of the study.

Fig. 2. Cluster analysis of the treated and non-treated groups with *yerba mate* tea, dashed line indicates sharp group partition.

IV. DISCUSSION

This preliminary study was not closed to that from Ribeiro et al. [4], which identified a significant ($P < 0.05$) decrease of CPK concentration in *yerba mate* treated patients with TBI. Under the conditions used in the present study, it was not possible to identify any influence of *yerba mate* tea consumption on total CPK concentration. It could be hypothesized that the effects of *yerba mate* may be more evident in pathological conditions, where there are abnormal concentrations of total CPK. In addition, it is possible that small physiological variations in CPK values, imperceptible

when in a small sample, are identified in a larger sample study. More wide clinical studies are needed to confirm this hypothesis.

Fig. 3. Principal Component Analysis of total serum creatine phosphokinase in the treated and non-treated groups with yerba mate tea.

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