

Teacrine Does Not Enhance Physical Performance or Training Status Over 8 Weeks

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Abstract

Background: Fatigue is a condition that may affect physical performance during training sessions. Consequently, this will impact training performance, moreover in the performance of the individual in long-term. Caffeine is broadly utilized to this purpose, however contains several side effects. Thus, teacrine emerges as an alternative to the use of caffeine, providing the same benefits without the side effects. Thus, the current work had as an objective to investigate the effects of 8 weeks of supplementation with teacrine on physical performance and the training status of young amateur athletes.

Methods: 22 subjects were divided into two groups – Teacrine Group (T) and Placebo Group (P) – and evaluated before and after the intervention period. Evaluations included physical tests and hormonal doses of IGF-I and IGFBP-3, utilized as markers of training status.

Results: Results demonstrated that teacrine was not capable of promoting benefits in relation to physical performance of the subjects. Neither produced effects on serum secretion of IGF-I and its binding protein, IGFBP-3.

Conclusion: Therefore, the findings of the present study do not support the use of teacrine for the purpose of increasing physical performance.

Introduction

Mental fatigue is a condition that may affect the performance in training sessions and, consequently, impact in the efficiency in a chronic way and also in training status of the individual [1,2].

Among the stimulating dietary supplements, in which the function is to decrease fatigue, the most known and utilized is the caffeine [3,4]. Although, it is not uncommon for caffeine to cause side effects in some individuals, such as insomnia, agitation, tremors, and increased heart rate [3].

Thus, teacrine, an alkaloid found mainly in *Camellia kucha* Hung T. Chang [5], has been gaining strength in the market and also attention from researchers. The structure of the teacrine is similar to caffeine, it is even speculated that it is synthesized in plants from caffeine, although this is not totally understood yet [5]. Despite the structural similarity, the literature points that teacrine does not present the side effects inherent to caffeine [6]. Despite being commercialized under the allegation of promoting positive effects in the physical performance, the literature is scarce about the theme. To our knowledge, we found only two studies that evaluated the effects of teacrine in physical performance, and performed only in an acute way [7,8]

Therefore, the main objective of this work was to evaluate the effects of supplementations with teacrine in the chronical physical performance. We also evaluated the effects of teacrine on secretion of serum of

IGF-I and its binding protein IGFBP-3 in order to monitor the training status of the athletes before and after the intervention.

Methods

This is an 8-week longitudinal double-blind clinical trial type study. The study was approved by the Research Ethics Committee of Hospital of Clínicas in Medical School of Ribeirão Preto – HCFMRP (Universidade de São Paulo – USP); technical opinion n.º 3.089.224).

Participants

22 flag football male players participated in this study with age between 19- 24 years old. The sample size was determined by convenience, according to the acceptance and availability of the athletes. As inclusion criteria were adopted: being between 18-25 years old and experience in the sport of, at least, one year. As exclusion criteria: the subjects have been taking any supplementation; took or have been taking any anabolic steroids. All participants received and signed an informed consent form in which they were informed of the structure of the study, and its possible risks and implications.

Design

The participants were randomized through a computer software and divided into two groups, being instructed to ingest a “supplement capsule” 60 minutes before trainings. The content of the provided capsule of each group was unknown for both researcher and athletes. One group received capsules containing 200mg of teacrine (named T) and the other group received placebo capsules containing maltodextrin (placebo). The capsules of the two groups were of the same weight and size. The person in charge for the receiving and distribution of the capsules to the subjects of this study was a responsible for the team, in which, kept the confidentiality of the content in order to preserve the authoritativeness of the research. Participants were evaluated in two distinct moments: the first evaluation was done before the supplementation period (pre); the second evaluation occurred after 8 weeks of supplementation and the training program (post). The evaluations included:

Physical tests

The tests utilized to evaluate the physical performance of the athletes were the following: sextuple jump [9], T test [10], 30m sprint [11], 40-second run test (Matsudo test) [12], and 12-minute run test (Cooper test) [13].

Anthropometric measurements

Height, body mass, fat mass, and lean mass were determined. For this, a stadiometer (AVA-312, Avanutri, Três Rios, Brazil) and a bioimpedance scale (BF 1000, Beurer, Ulm, Germany) were used. Anthropometric evaluations were performed one day before physical tests, since it was necessary the athletes to be in fasting.

Blood collection

Blood analyzes were performed to determine serum levels of IGF-1 and its binding protein IGFBP-3. Blood samples were collected right after lunch, respecting the interval of, at least, 2 hours after the last meal, by a qualified nurse professional. Venous blood sample was collected by puncture of blood vessel on the anterior forearm. 5 ml blood of each individual were collected in tubes without addition of anticoagulant. The samples were immediately stored at 0-4°C, then centrifuged between 0 and 4°C at 1200 rpm for 12 minutes and the blood serum stored at -80°C for hormonal dosages. There was not storage of biological material in a bank, and the samples were discarded right after the analysis.

Immunoassays

Serum levels of IGF-1, IGFBP-3 were determined by specific immunoassays using a commercial kit and expressed in ng/mL (Immulite 2000, Siemens, Los Angeles, CA, USA). All samples of the study were dosed in duplicate within same assay. The intra-assay coefficients of variation were 2.77% for IGF-I; and 2.60% for IGFBP-3. The assays were carried out in the Endocrinology Lab of Hospital of Clínicas in Medical School of Ribeirão Preto (Universidade de São Paulo).

Training Program

The training of the athletes during the research period was composed by physical preparation (2 weekly session constituted by force training and followed by aerobic work, totalizing about 90 minutes each) on Mondays and Thursdays; also, technical-tactical preparation (on Saturday afternoon and Sunday mornings, in which the athletes perform physical, technical, and tactical training specific of the modality).

Diet and total energy expenditure

The total energy expenditure (TEE), as well as the composition of the diet of the athletes were calculated by a nutritionist of the team. To estimate TEE, it was utilized the Dietary Reference Intakes (DRIs) 2005 [14]. The energetic intake and the division of micro and macronutrients followed the literature recommendations [15,16].

Statistical treatment

It was utilized a linear model of mixed effects, adopting a significance level of 0,05. The variables are expressed in median and interquartile range and standard deviation, or when indicated and appropriated in mean and standard deviation. After a well detailed description of the data, it was adjusted linear models of mixed effect to compare the means of the group and moments of interest. Multiple comparisons were performed by estimating orthogonal contrasts, obtaining the difference between means and their respective confidence interval of 95%. The data were analyzed by the software SAS (SAS Statistical Software version 9.3; SAS Institute, Inc. Cary, NC). It was utilized PROC MIXED of the software SAS 9.4 (SAS Institute Inc, Cary, NC).

Results

Results are shown in tables 1,2,3, 4m and in figure 1. In table 1 is found sample characterization, while in table 2 are displayed the alterations in body composition before and after 8-weeks intervention. Table 3 presents the results of the physical fitness test battery before and after the intervention. In table 4 and figure 1 are described the hormone levels of the subjects before and after the 8-weeks intervention.

Table 1 – Sample characterization

Variable	Mean ± SD (n=22)
Age (years)	20.05 ± 1.81
Height (cm)	178.27 ± 7.10
Body mass (kg)	78.57 ± 14.70
Lean mass (kg)	63.43 ± 9.96
Fat mass (%)	18.74 ± 3.88
Energy expenditure (kcal)	3233,82 ± 352.42
Cm = centimeters	
Kg = kilograms	
% = percentage value	

Table 2 - Anthropometrics measurements of the subjects before and after 8-weeks supplementation

Variable	Teacrine (n=11)			Placebo (n=11)		
	Pre	Post	Δ	Pre	Post	Δ
Body mass (kg)	76 ± 14.25	77.82 ± 14.67*	1.82	79,18 ± 16,37	81,17 ± 16,85*	1,99
Lean mass (kg)	61,98 ± 9,89	63,34 ± 10,15*	1,36	63,58 ± 10,88	65,14 ± 11,15*	1,56
Fat mass (kg)	14,02 ± 4,97	14,49 ± 5,12*	0,47	15,60 ± 5,83	16,04 ± 6,07*	0.44
Kg = kilograms						
* significant difference pre x post (p < 0,01)						

Both groups had increases in both lean and fat mass, besides the total body mass (p< 0,01). However, there were not significant differences between the two groups after this period: body mass (p= 0,62); lean

mass (p= 0,69); fat mass (p=0,52).

Table 3– Performance of physical tests before and after the intervention

Variable	Teacrine			Placebo		
	Pre	Post	Δ	Pre	Post	Δ
Sextuple jump (m)	12.96 (±0.89)	13.52* (±1.09)	0.56	12.18 (±1.31)	13.00* (±1.48)	0.82
T test (s)	9.96 (±0.86)	9.68* (±0.81)	-0.28	9.94 (±0.73)	9.65* (±0.78)	-0.29
30m sprint (s)	4.69 (±0.44)	4.55* (±0.40)	-0.14	4.69 (±0.36)	4.54* (±0.35)	-0.15
40 second run test (m)	212.73 (±34.95)	222.91* (±36.63)	10.18	225.45 (±22.07)	236.27* (±23.92)	10.82
Cooper test (m)	1745.45 (±391.21)	1831.50* (±404.10)	86.09	1734.55 (±221.47)	1822.82* (±239.48)	87.90
m = meters						
s = seconds						
* significant difference pre x post (p < 0,01)						

In table 3 is presented the performance of the subjects before and after the period of intervention. Based on the data analysis, both groups improved their performance in all tests, with significant difference intra-group when comparing pre and post moments. Sextuple jump: teacrine (12.96 ± 0.89 x 13.52 ±1.09, p < 0,01); placebo (12.18 ±1.31 x 13.00 ±1.48, p < 0,01); T test: teacrine (9.96 ±0.86 x 9.68 ±0.81, p < 0,01); placebo (9.94 ±0.73 x 9.65 ±0.78, p < 0,01); 30m sprint: teacrine (4.69 ±0.44 x 4.55 ±0.40, p < 0,01); placebo (4.69 ±0.36 x 4.54 ±0.35, p= < 0,01); 40 second run test: teacrine (212.73 ±34.95 x 222.91 ±36.63, p < 0,01); placebo (225.45 ±22.07 x 236.27 ±23.92, p < 0,01); Cooper test: teacrine (1745.45 ±391.21 x 1831.50 ±404.10, p < 0,01); placebo (1734.55 ±221.47 x 1822.82 ±239.48 p= < 0,01). However, there was not significant difference between the groups to any tests performed.

Table 4 – Hormonal concentrations before and after the intervention

Variable	Theacrine			Placebo		
	Pre	Post	Δ	Pre	Post	Δ
IGF-I (ng/ml)	268,82±52,38	255,59±49,54*	-13,23	260,91±63,07	248,67±59,83*	-12,24
IGFBP-3 (ug/ml)	4,19±0,40	4,01±0,39*	-0,18	4,07±0,41	3,90±0,39*	-0,17
ng/ml = nanograms per milliliter ug/ml = micrograms per milliliter * significant difference pre x post (p < 0,01)						

In table 4 and figure 1 are presented serum levels of IGF-I and IGFBP-3. There was a decrease of serum levels of IGF-I and IGFBP-3 in both groups (intra-group) when compared the pre and post moments. IGF-I (p= < 0,01), however, without difference when compared to the results between the groups (inter-groups).

Discussion

The main finding of this study was that the chronical use of teacrine was not capable of promoting improvements in physical tests of young athletes and neither impede the reduction of serum levels of IGF-I and IGFBP-3 after an 8-week supplementation. To our knowledge, this was the first study to evaluate the effects of the teacrine in a chronical way. The rationale of the use of teacrine would be to have the benefits of caffeine, but without the desired side effects, which was not demonstrated in our results. It is worth mentioning that only two studies were found in the literature that evaluated the acute effects of supplementation, on physical performance, and they did not demonstrate the efficiency of teacrine supplementation for this purpose either [7,8].

One of this study, Bello et al. (2019) [7], evaluated soccer players of both genders in 4 conditions: placebo, teacrine, caffeine, and teacrine + caffeine. It was performed a running test until exhaustion at 85% of vO_2max , in addition to cognitive tests. There was not significant difference in both parameters evaluated.

Another study conducted by Cesareo et al. (2019) [8] evaluated the effects of teacrine on maximum strength and strength resistance in trained subjects. The results demonstrated that teacrine did not promote benefits in any of the variables studied, in both exercises utilized – squat and bench press.

While it is well established that caffeine is efficient in increasing the performance in strength, resistance, speed and performance in sports in general [4], available data in the literature added to those presented in this study indicates that the same does not seem to occur with teacrine as in an acute form [7,8], as well in a chronical way, analyzed in this current study.

Besides the strength and resistance evaluated in the previous studies [7, 8], our study also evaluated the anaerobic power, agility and sprint ability. In these parameters, supplementation with teacrine did not show effective either. It is important to highlight that only field tests were utilized, which reflect better the specificity of the tasks performed by the subjects in their day-to-day training.

On the other hand, supplementation with teacrine is safe and does not provoke side effects commonly caused by caffeine, moreover some studies demonstrated improvement on focus and willingness to exercise with its use [5, 17, 18], however with regard to physical performance, our data do not provide evidences that support the use of teacrine. It is important to point that none of the subjects related any type of side effect due to the use of teacrine over the 8-week supplementation.

In the current study, teacrine did not provided long-term benefits in relation to training status of the subjects either, evaluated by analyzing serum levels of IGF-I and IGFBP-3.

These markers were used since the literature points to an association between IGF-IGFBPs system and the training status, mostly IGF-I and IGFBP-3 [19-21]. It may serve as an important tool to control the volume and intensity of training during the season.

According to the literature, when the individual is in a phase of more intense trainings and/or inadequate nutrition, serum levels of IGF-I and IGFBP-3 tend to decrease and if this condition is not monitored and the suppression persists, then the athlete may reach overtraining condition [20,22]. In this study, the use of teacrine did not altered the kinetic of the system IGF-I-IGFBPs when compared between the groups and, neither, impeded the reduction of serum levels in the second moment of evaluation in both groups.

Literature points the effects of teacrine in reducing fatigue [5]. Studies have been demonstrating association between the fatigue levels and IGF-1, both in athletes and in patients with chronic non-communicable disease [23, 24]. Our results did not show any difference either in the performance, or in the hormonal levels between the groups T and P. Thus, in the present study, teacrine did not demonstrate positive effects in the improvement of performance of the subjects, neither in the training status of them.

Conclusion

- The findings of the present study demonstrate that the chronical use of teacrine was not capable of provoking improvement in the physical performance of the athletes;
- Also did not impede the reduction of serum secretion of IGF-I and IGFBP-3 after 8 weeks of supplementation of a training program of the subjects, and neither in the body composition of them;
- Thus, our findings do not support the use of teacrine in order to improve physical performance, neither by the athletes non by exercise practitioners in general.

Declarations

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Authors' contributions

HC and CM conceived and designed the study. CM were responsible for coordination the study. HC and MC collected data. HC, CM, MC and HT analyzed data and reported results. HC and HT constructed the first manuscript. All authors edited the manuscript and approved the final version of manuscript.

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Availability of data and materials

Data and publication materials are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by the Ethics Committee in Research of the Hospital of the Ribeirão Preto Medical School, University of São Paulo - HCFMRP - USP, under number 3.089.224 .according to ethical standards in the research of the Brazilian National Health Council.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Trial registration

ReBEC, RBR-63rn74y. Registered 2 February 2021 - Retrospectively registered, <https://ensaiosclinicos.gov.br/rg/RBR-63rn74y>

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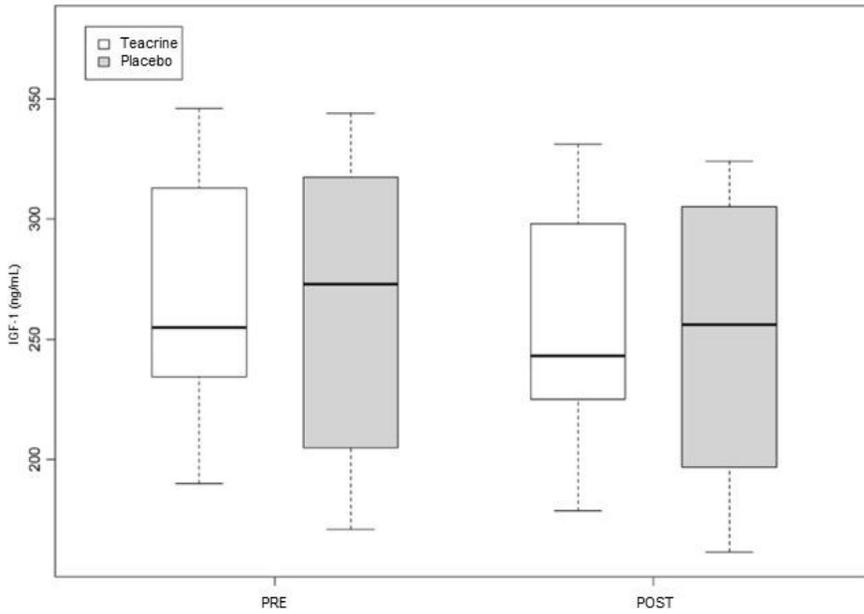
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Figures

A



B

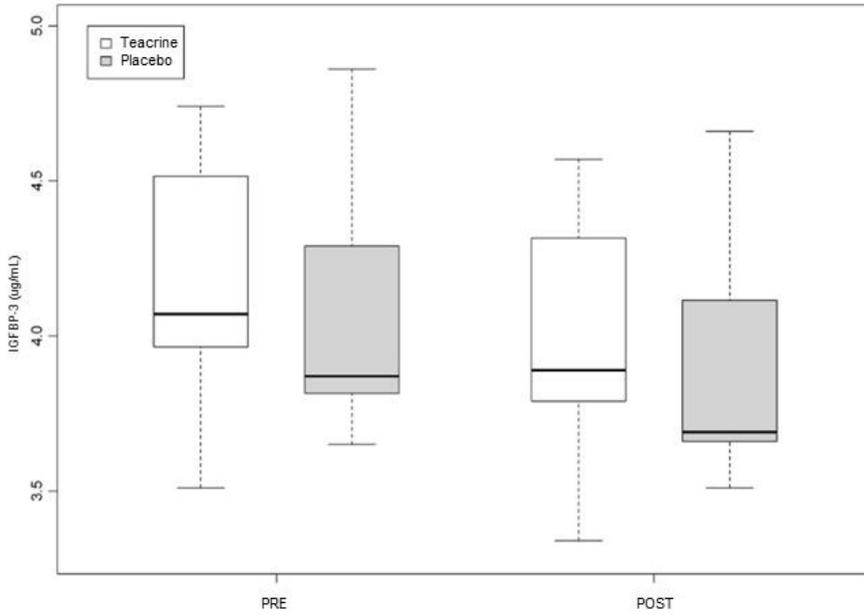


Figure 1

Changes in the hormonal concentrations after 8-week intervention. Values expressed as median – interquartile interval. 2A: IGF-I; 2B: IGFBP-3. ng/mL = nanograms per milliliter; ug/ml = micrograms per milliliter.