

Use of a mixture of amino acids, caffeine and botanical extracts pre-workout in tennis athletes: a preliminary study

Abstract

Multi-ingredient pre-workout supplements (MIPS) are a category of nutraceutical products that aim to improve acute performance and, to favour physical and psychomotor adaptations to following training, with a sufficiently prolonged continuous intake^[1–3] but the data available are rather limited. The purpose of this pre-clinical crossover trial is to analyze the results of 14 training sessions where ten adult amateur tennis athletes (eight men, two women) alternated seven training sessions where they consumed a MIPS nutraceutical product before training (L-Arginine, L-Glycine, L-Alanine, Taurine, L-Carnitine, Glucuronolactone, *Eleutherococcus senticosus* Rupr. & Maxim. *Panax ginseng* C.A.Mey, caffeine and bromelain – marketed under the name of StartUp) with seven training sessions where they consumed a control product before training (based on carbohydrates and magnesium). This alternation was separated with a seven-day washout period. Evaluated athletes regularly practising tennis for at least three years. Each athlete had to train for a minimum of three to a maximum of four times per week, carrying out a 90-minute match in each session. For each training session, the perception of effort was assessed using the Borg CR-10 scale. In the control group, the mean perceived effort was 4.51(SD 1.05), while in the treated group, the mean was 4.16 (SD 0.99). We conclude that treatment with the formulation allows a variation of -8% in the perception of fatigue during training, with Levene test value ($p>0.05$) and Student's t value of 2.097 and a p -value of 0.039. No participant dropped out of the study. The data obtained demonstrate how the intake of StartUp over seven training sessions compared to a control product interspersed with a seven-day wash-out period, correlates with an 8% reduction in Borg CR-10 rated Ratings of Perceived Exertion (RPE), Further longer evaluations with a larger and more circumscribed sample, will be necessary to further clarify the application potential of this MIPS nutraceutical blend.

Alexander Bertuccioli^{1*},

Giordano Zonzini²

Simone Di Marco²

¹ Department of Biomolecular Sciences, University of Urbino Carlo Bo, 61029 Urbino, Italy

² AlFeM Ravenna, Italy

*Corresponding author:
Alexander Bertuccioli

alexander.bertuccioli@uniurb.it

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Introduction

New approaches to sports training, nutrition, recovery and food supplementation are continuously being developed with the goal of optimising sports performance. Within this research, the continuous development of pre-workout food supplements has birthed a new product category: multi-ingredient pre-workout supplements (MIPS)^[1].

While some single food supplements, such as caffeine^[2] are used as pre-workouts, MIPS typically contain a mixture of food supplements and nutraceutical substances created with the aim of improving acute performance and, according to some authors, to favour adaptations following training when used continuously over a prolonged period^[2-4]. Despite the promising results obtained with some formulations^[1], the data available are rather limited, especially considering the great heterogeneity of mixtures of different food supplements and nutraceuticals that are potentially useful in supporting acute performance. Several substances can prove useful in the composition of MIPS. A factor to consider may be the modification of the amino acid pattern due to training in subjects who report a feeling of heavy fatigue as examined by Kingsbury *et. al.* They identified, among other things, lower levels of glucogenic amino acids, including arginine^[5]. Taurine, a non-essential amino acid, is described in the literature as being able to exert metabolic, antioxidant and ergogenic effects. When consumed in chronic conditions it has been documented to improve time-to-exhaustion during endurance exercise and improve muscular endurance during resistance exercise^[2, 6]. Caffeine is a methylxanthine present in numerous varieties of plants, of which the best known are those belonging to the genus *Coffea* L.. Its action manifests itself as an adenosine receptor antagonist^[7] and has been shown to acutely improve cognition as

well as performance during endurance, power, and resistance exercise^[1, 8]. Glucuronolactone is a glucose metabolite associated with the intake of taurine and caffeine has been shown to have positive effects on endurance performance, (favouring an increase in effort without a concomitant increase in perceived effort), on mental performance and mood^[9, 10].

Carnitine is one of the main substances involved in the efficiency of muscle energy metabolism, particularly regarding the oxidation of lipids; its chronic intake together with that of carbohydrates is correlated in the long-term to the increase in muscle carnitine levels^[11].

Bromelain is a proteolytic enzyme derived from pineapple that elicits an anti-inflammatory response by reducing prostaglandin E2 (PGE-2) and cyclooxygenase-2 (COX-2) synthesis^[12]. *Panax ginseng* C.A.Mey. and *Eleutherococcus senticosus* (Rupr. & Maxim.) Maxim. are generally considered botanicals with an adaptogenic function, that is, capable of altering an organism's response to stress in a manner that improves adaptation to stress. It is proposed that ginseng can inhibit 11-beta hydroxysteroid dehydrogenase and *Eleutherococcus* can inhibit catechol-O-methyl transferase catalysing the degradation of stress hormones into inactive compounds^[13].

The purpose of this study is to evaluate the effects on performance deriving from pre-workout intake of a MIPS mixture of amino acids (and derivatives), botanicals and glucose metabolites.

Methods

Study overview

This was a pre-clinical crossover trial that analyzed the results of 14 training sessions where ten amateur tennis athletes alternated seven training sessions where they consumed, in addition to their normal diet

and supplementation programme, a MIPS nutraceutical product, with seven training sessions used as control where they consumed a product based on carbohydrates and magnesium. This alternation was separated with a seven-day washout period during which athletes only followed their basic nutritional programme. The MIPS nutraceutical product used contained a blend of 500 mg L-Arginine, 500 mg L-Glycine, 500 mg L-Alanine, 500 mg Taurine, 500 mg L-Carnitine, 200 mg Glucuronolactone, 150 mg *Eleutherococcus senticosus* (Rupr. & Maxim.) fluid extract (EPO Srl, Milan, Italy), 50 mg Panax ginseng C.A.Mey. dry extract titrated at 30% in Ginsenosides (Nutraceutica, Bologna, Italy), 50 mg caffeine and 50 mg bromelain 2500 GDU/g.

The control product used a blend of 370 mg magnesium and 3000 mg isomaltulose, formulated in such a way as to be indistinguishable in appearance, consistency and taste from the MIPS nutraceutical product. For each training session, the perception of effort was assessed using the Borg CR-10 scale^[14]. Studies and analysis were conducted in accordance with good clinical practice rules fixed by the Declaration of Helsinki and in accordance with the European Union Directive 2001/20/EC^[15].

Each patient signed a consent form and privacy policy documents and approved data analysis and publication.

Patients

Data from eight adult men with a mean age of 32 years and a mean BMI of 22.57, and two adult women with a mean age of 19 years and a mean BMI of 23.45, regularly practising tennis for at least three years continuously, were examined.

Each athlete trained for a minimum of three to a maximum of four times per week, following a programme that included 90 minutes of training aimed at simulating competitive activity.

Patient characteristics are reported in **Table 1**.

Inclusion and exclusion criteria

Ongoing pathologies; treatment with anticoagulants, anti-inflammatories and analgesics; the execution of physiotherapy treatments; recent injuries; changes to usual food consumption; behaviour and drug use (smoking, alcohol consumption) and additional physical activity in addition to that usually scheduled constituted exclusion criteria.

Evaluated products and evaluation scheme

The period of crossover evaluations provided for one group of five subjects to take MIPS and for a second group of five different subjects to take the control product for a total of seven training sessions. This was followed by a seven-day washout period where the athletes took no supplement in addition to that normally consumed. The evaluation concluded with an additional seven training sessions where the previous groups were reversed.

MIPS nutraceutical product, produced by Aquaviva srl (Acquaviva, San Marino Republic), and notified to the Italian Ministry of Health as a food supplement by complying with Law no. 169-2004 (notification number: 86529) and marketed under the name StartUp, contains 500 mg L-Arginine, 500 mg L-Glycine, 500 mg L-Alanine, 500 mg Taurine, 500 mg L-Carnitine, 200 mg Glucuronolactone, 150 mg *Eleutherococcus senticosus* (Rupr. & Maxim.) fluid extract (EPO srl, Milan, Italy), 50 mg Panax ginseng C.A.Mey. dry extract titrated at 30% in Ginsenosides (Nutraceutica, Bologna, Italy), 50 mg caffeine and 50 mg bromelain 2500 GDU/g packaged in the form of ready-to-use drinking vials. The control product, produced by Aquaviva srl (Acquaviva, San Marino Republic), and notified to the Italian Ministry of Health as a food supplement by complying with Law no. 169–2004 (notification number: 48800), marketed under the name Biomag contains 370 mg magnesium and 3000 mg isomaltulose. The scores relating

to the scales used in the assessment of training effort were independently collected by the subjects being evaluated, in the periods of taking the products and in the period of washout. Anthropometric data such as height and weight were obtained according to the standard methods.

Statistical analyses

Descriptive statistics are reported as mean and standard deviation for quantitative variables, or as percentage counts and frequencies for qualitative variables. RPE (Ratings of Perceived Exertion) was determined with the Borg CR-10 scale^[14], with a numerical rating format, using a procedure described in the literature. A standard definition of perceived exertion and instructional sets for the Borg CR-10 scale was read to the subjects immediately before the exercise test. To check whether taking the supplement may have decreased the perception of exertion, a paired t-test was used to verify whether the supplement intake could ever decrease the perception of fatigue.

The assumption of normality of the sample distribution was verified with the Levene test.

All data were analyzed using Excel 365 or SPSS version 20.0 (SPSS Inc., Chicago, Illinois); the significance threshold was fixed at 0.05.

Results

Ten subjects were included in the trial intervention. No participant discontinued intake (supplement or control) in the period of the supplementation nor dropped out of the study. Descriptive results were reported in **Table 1**.

	Mean (dev.st)
Weight (kg)	69.8 (9.5)
Height (m)	1.75 (0.07)
BMI (kg/m ²)	22.74 (2.40)
Age	26.5 (9.2)

Table 1: Descriptive results of subjects

In the control group, the mean perceived effort was 4.51, with standard deviation equal to 1.05, while in the treated group the mean was 4.16, with standard deviation equal to 0.99. Levene test ($p > 0.05$) showed a homoscedasticity of samples. Student's t test showed a t statistic corresponding to a value of 2.097 and a p -value of 0.039. In conclusion, it can be stated that treatment with the formulation allows a variation of -8% in the perception of fatigue during training, and this is significantly different from the null hypothesis. (see Fig. 1)

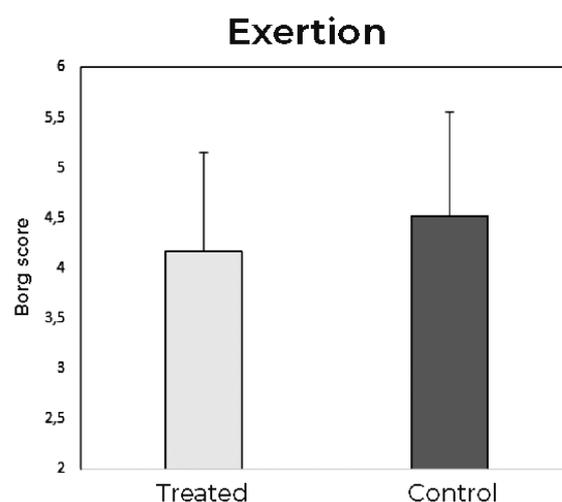


Fig. 1: Treated vs control; results were reported as mean and standard deviation.

Discussion

The results show that the intake of Start-Up is correlated to an 8% reduction of the RPE evaluated with the Borg CR-10 scale when compared to a control product. These results reflect what has already been analyzed in the main literature for StartUp components^[6-13], and could be related to a sum of adaptogenic, stimulating and nutritional effects. The potential presence of different functionally synergistic effects could be at the basis of the results found.

The variation in the RPE of 8% when compared to the control product may form the basis of a better performance capacity, especially considering that in interval sports, such as tennis, a lower perception of effort can confer advantages on both the physical and mental compo-

nents of the performance ^[16]. Particularly relevant is that none of the participants needed to stop taking 'StartUp' and its consumption was not related to any type of adverse event.

Limitations of the work are the reduced sample size combined with the heterogeneity of the sample under consideration. Future analysis on larger samples with more restricted recruitment dynamics will further clarify the real potential of this MIPS blend, it is possible to speculate that the results found on a sample with the characteristics of heterogeneity described could be even greater in a more uniform sample.

Conclusions

The data obtained from this preliminary evaluation demonstrate how the intake of Start-Up (500 mg L-Arginine, 500 mg L-Glycine, 500 mg L-Alanine, 500 mg Taurine, 500 mg L-Carnitine, 200 mg Glucuronolactone, 150 mg *Eleutherococcus senticosus* (Rupr. & Maxim.) fluid extract, 50 mg Panax ginseng C.A.Mey. dry extract titrated at 30% in Ginsenosides, 50 mg caffeine and 50 mg bromelain 2500 GDU/g) for seven training sessions compared to a control product (370 mg magnesium and 3000 mg isomaltulose), separated with a seven-day washout period, correlates with an 8% reduction in Borg CR-10 rated RPE, potentially contributing to a better performance capacity. Further evaluations with a larger sample, more circumscribed with more uniform criteria, protracted for longer times, will be necessary in the future to further clarify the application potential of this MIPS nutraceutical blend.

Conflict of Interest

Alexander Bertuccioli carries out consultancy in the sports field for the manufacturer of StartUp and Biomag.

Giordano Zonzini carries out consultancy in the health sector for the manufacturer of StartUp and Biomag.

Simone Di Marco declares no conflicts of interest regarding the publication of this paper.

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