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Evaluation of the Efficacy of Lactigo™ Topical Gel as an Ergogenic Aid

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ABSTRACT

Sharpe TM, Macias CJ. Evaluation of the Efficacy of Lactigo™ Topical Gel as an Ergogenic Aid. **JEPonline** 2016;19(3):15-23. The purpose of this study was to investigate whether a novel topical carnosine preparation could affect anaerobic and potentially aerobic exercise performance. Eleven elite male soccer players (age, 22.47 ± 2.14 yrs; body weight, 84.2 ± 7.82 kg; height, 183.79 ± 4.5 cm; BF 6.90 ± 1.8%) with no previous use of LactiGo™ participated in this study. First, the subjects completed a Level 1 Yo-Yo intermittent recovery test designed to test maximal aerobic capacity. Second, they performed a series of all-out 3 x 1000 m runs requiring a robust anaerobic contribution. A 3-day washout was used between each exercise (Yo-Yo, 3 x 1000 m) and between each 3 x 1000 m series. After the initial application of LactiGo™ topical gel, a clinically significant improvement in distance traveled during the Yo-Yo intermittent recovery test (5.41% ± 4.80%, P=0.069) was observed along with a statistically significant reduction in time to complete the all-out 3 x 1000 m runs (4.13% ± 0.68%, P=0.036). The observed improvements in both tests after the initial application of LactiGo™ indicate a loading phase, commonly seen in buffering agents, is not required. The increase in aerobic and anaerobic work capacity evidenced after the use of LactiGo™ topical gel suggests that it could serve as an ergogenic aid.

Key Words: Carnosine, Beta Alanine, Ergogenic Aid, pH Buffer

INTRODUCTION

Carnosine (beta-alanyl-L-histidine) is a naturally occurring cytoplasmic neuropeptide with many roles in the human body. Intracellular pH buffering and improvement in Ca^{2+} sensitivity are the mechanisms by which carnosine has been suggested to improve exercise performance (5,21). During moderate to intense exercise, there is a generation of lactic acid. The ensuing dissociation into lactate and H^+ can alter cellular pH levels (19). Costill et al. (7) demonstrated that pH values can decline from a resting value of ~ 7.1 to ~ 6.5 following high-intensity exercise. There are several ways to keep the skeletal muscle pH within physiological ranges, including extracellular buffers, intracellular buffers, and the dynamic buffering systems (17). As early as 1938, carnosine was documented as a pH buffer (22). It is especially effective as an intracellular buffer because its pKa value is close to that of the cellular pH. The imidazole ring on the histidine moiety has a pKa of 6.83 and can utilize its nitrogen to accept a proton, thus making carnosine an obligatory physicochemical buffer (1,6).

Existing literature suggests that higher muscle carnosine concentrations can help attenuate the decrease in Ca^{2+} sensitivity as well as the accumulation of H^+ during high-intensity exercise. Dutka and Lamb (10) demonstrated that carnosine did not affect Ca^{2+} release from the sarcoplasmic reticulum, but Ca^{2+} sensitivity of the myofilaments was increased. This mechanism would be most beneficial during the onset of fatigue when Ca^{2+} release begins to decrease. Hydrogen ion may compete with Ca^{2+} for the binding site on troponin (9,14) of which the increase in Ca^{2+} sensitivity at that time could help in maintaining normal force production.

Considering the physiological importance of carnosine as a buffer during exercise, it would appear promising that there does not seem to be an upper limit to the carnosine concentration in skeletal muscle (8). However, elevating muscle carnosine as well as understanding the translational benefit from the increased muscle concentrations has proven to be challenging. Both oral carnosine and beta-alanine (β -ALA) supplementation have been explored to raise muscle carnosine levels. Regarding β -ALA, there are several potential issues with its supplementation; the first of which is its poor conversion rate to carnosine. By dividing the molar increase in muscle carnosine by the total molar amount of β -ALA, Stegen et al. (23) were able to calculate β -ALA supplementation efficiency. They reported that only 2.80% of ingested β -ALA was incorporated into muscle carnosine, with 95%-96% being metabolized by non-carnosine directed pathways. Also, β -ALA requires a loading phase of up to 10 wks (3,16), and that users commonly report up to 1 hr of paresthesia shortly after ingestion (20).

Similar to β -ALA, carnosine supplementation has several challenges. Due to individual differences in plasma carnosinase levels, there is significant variability in response to carnosine ingestion. Both Asatoor et al. (2) and Gardner et al. (15) were unable to detect any notable carnosine in plasma after administration of a high dose of carnosine, $\sim 60 \text{ mg}\cdot\text{kg}^{-1}$ body weight and 4 g, respectively. Gardner and colleagues (15) further noted that large quantities (e.g., up to 14% of the dose) of ingested carnosine was lost in urine. Everaert et al. (13) observed a considerable non-responder rate to oral carnosine supplementation, noting that in non-responders the plasma carnosinase protein content was ~ 2 fold higher, and the protein content had ~ 1.5 fold higher activity compared with the responders. Oral carnosine

supplementation fails to substantially elevate plasma carnosine levels, and despite a high absorption rate in the gastrointestinal tract, ingested carnosine is susceptible to hydrolysis via plasma carnosinase, thus making it inefficient at increasing muscle carnosine levels. A topical carnosine formulation could bypass the hydrolysis of carnosine and serve as a pH buffer. The purpose of this study was to investigate the potential of LactiGo™ brand topical carnosine gel as an ergogenic aid in elite male athletes.

METHODS

Subjects

Eleven healthy elite male soccer players gave written informed consent to participate in this study. An elite player was defined as one who had played international level soccer for 3+ yrs. The subjects were recruited from teams in the Italian Serie League with assistance from (C. Giacobbe) at the Castel Covati Sports Center in Brescia, Italy. The research was conducted according to the principles of the Declaration of Helsinki and approved by Segreteria Scientifica del Comitato Etico, Milan, Italy. An anthropometric assessment was completed on all subjects (age, 22.47 ± 2.14 yrs; body weight, 84.2 ± 7.82 kg; height, 183.79 ± 4.5 cm; BF $6.90 \pm 1.8\%$). Each subject was advised not to take any dietary supplements or start any other type of training for the duration of the study. The subjects were familiarized with the testing protocols and with how to apply both the warm-up cream and the LactiGo™ gel before testing.

Experimental Protocol

LactiGo™ is a topical gel that consists of water, glycerin, magnesium sulphate, and a proprietary Carnosine-Complex. It is distributed by Outplay Inc., Las Vegas, NV, USA. Testing was completed June through August, which represented the off-season months of the athletes. Two tests were employed: A Level 1 Yo-Yo Intermittent Recovery Test, and a series of All-Out 3 x 1000 m Runs.

Level 1 Yo-Yo Intermittent Recovery Test

This is a standardized test of the athletes' maximal aerobic capacity (4) in the sport of soccer. It is comprised of 2 x 20 m shuttle runs at increasing speeds, interspersed with a 10-sec period of active recovery. The test ends when the subject is no longer able to maintain speed. The final result is determined by the distance covered during the test.

All-Out 3 x 1000 m Run Series

The "run series" was comprised of three all-out 1000 m distance runs for time. Each run was separated by a 1-min and 30-sec rest period. This test requires a robust anaerobic contribution. The total time taken to complete the distance is recorded in minutes and seconds.

A warm-up cream was used to optimize muscle preparation before the tests. During a pre-study stage, the differences between athletes' performances with "no cream" (NC) and "with cream" (WC) were evaluated to verify that the warm-up cream did not affect performance (Table 1). In the study stage, application of the warm-up cream was followed by LactiGo™ topical gel (WC+LG) (Figures 1 and 2). The dose of LactiGo™ gel used was the manufacturer recommended 10 ml (10 pumps), which was applied only once to arms, legs, and torso 45 min before the commencement of each respective test (Yo-Yo, 3 x 1000 m).

The athletes did not use LactiGo™ gel or other supplements in the weeks before participating in this study. For each type of exercise, there was a 3 d washout between the NC, WC, and WC+LG groups.

Table 1. Performance Improvement (%) of WC and WC+LG Compared to NC for the Yo-Yo and 1000 m Tests.

Athlete	WC		WC+LG	
	Average Yo-Yo	Average 1000 m	Average Yo-Yo	Average 1000 m
A.F.	0.12%	0.26%	1.20%	4.12%
F.F.	-0.06%	-0.40%	2.29%	4.63%
S.A.	0.20%	0.26%	7.58%	3.95%
C.S.	-0.19%	0.00%	8.19%	2.23%
B.G.	0.00%	0.37%	14.79%	2.80%
T.A.	0.00%	0.00%	11.36%	4.69%
B.S.	-0.21%	0.00%	2.57%	10.15%
S.S.	-0.07%	-1.56%	7.27%	2.02%
A.A.	0.06%	-1.42%	1.87%	0.66%
S.P.	0.00%	-0.27%	2.81%	2.63%
D.S.	-0.12%	0.00%	-0.71%	4.80%
Average	-0.02% ± 0.001%	-0.25% ± 0.66%	5.38% ± 4.81%	3.88% ± 2.46%
Δ			5.41% ± 4.80%	4.13% ± 0.68%

NC = No cream; WC = Warm-up cream; WC+LG = Warm-up cream + LactiGo™ gel; Results are shown as mean ± SD

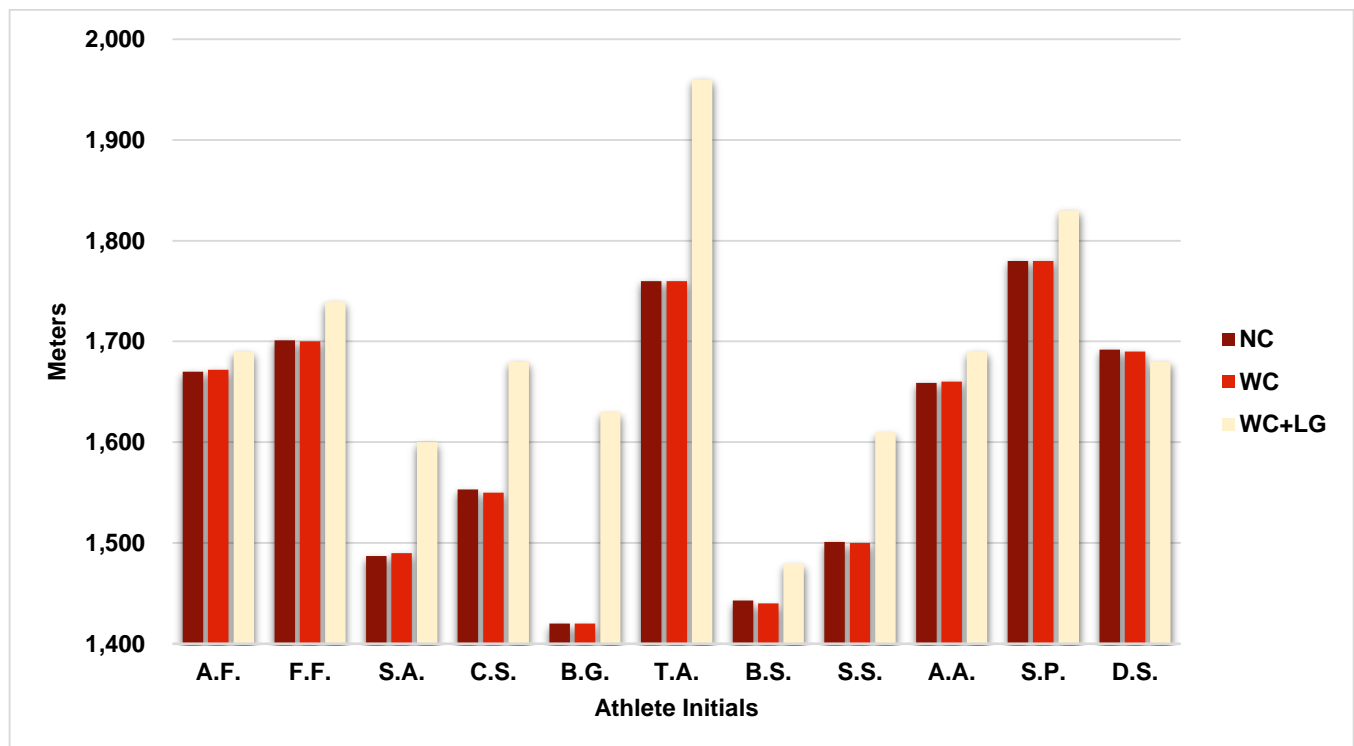


Figure 1. Total Distance Traveled for 40 m Yo-Yo Test. (NC = No cream; WC = Warm-up cream; WC+LG = Warm-up cream + LactiGo™ gel)

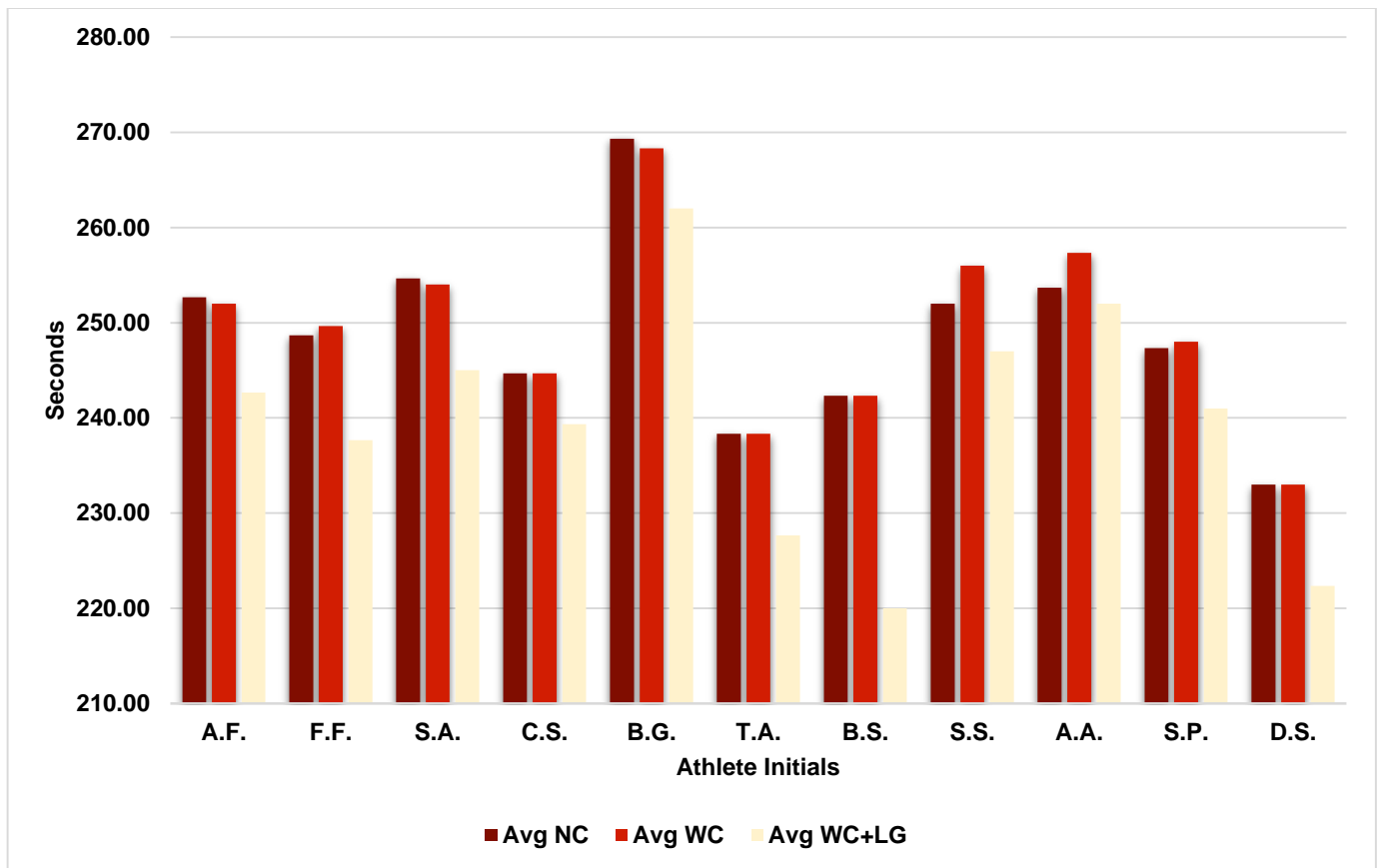


Figure 2. Average Time in Seconds of Each Group in the 3 x 1000 m Test. (NC = No cream; WC = Warm-up cream; WC+LG = Warm-up cream + LactiGo™ gel)

Statistical Analyses

The results for the Yo-Yo and all-out 1000 m running tests are presented as mean \pm standard deviation (Table 2). The performance improvements between the applications for each test are shown in % improvement \pm standard deviation (Table 1). Normality was tested for all variables using the ShapiroWilk test with all variables presenting a normal distribution in this test. Differences in maximal running distance during the Yo-Yo tests and in the time to complete the all-out 1000 m tests were analyzed respectively using an ANOVA analysis. The data were analyzed with the statistical package Minitab v 17 (Minitab Inc).

Table 2. Comparison of Mean Values of NC and WC+LG Groups in Both the Yo-Yo and 1000 m Run Tests.

Variable	NC	WC+LG	Δ (%)	P-Value
Yo-Yo (m)	1606.00 \pm 129.00	1690.00 \pm 125.00	+ 0.94	P=0.069
1000 m (sec)	248.80 \pm 9.62	239.71 \pm 12.58	-4.00	P=0.036

NC = No cream; WC+LG = Warm-up cream + LactiGo™ gel; Results are shown as mean \pm SD

RESULTS

The results of each subject's performance during the different tests performed, NC, WC, and WC+LG are summarized in Tables 1 and 2 and Figures 1 and 2. To eliminate any variability of performance that the warm-up cream may have caused, the mean differences between the NC and WC were analyzed. No statistical difference in the mean times of the NC and WC groups (time of NC vs. time of WC, $P < 0.05$) were found. Clinically significant results were seen in the Yo-Yo test (NC time vs. WC+LG time $P = 0.069$), and statistically significant differences were found between the NC and the WC+LG groups for the all-out 1000 m run test (time of NC vs. time of WC+LG, $P = 0.036$) (Table 2). No side effects were reported after the WC+LG treatments.

DISCUSSION

The purpose of this study was to determine the efficacy of LactiGo™ topical gel on the aerobic and anaerobic performance of elite male soccer players. It was hypothesized that significant improvements would occur from the addition of an intracellular buffer in the all-out 1000 m run test; whereas, a minimal improvement in the maximal aerobic capacity Yo-Yo test would be observed. Intra-cellular H^+ accumulation is considered a key rate limiting factor in anaerobic but not aerobic metabolism.

There were several novel findings in this study. First, the WC+LG group demonstrated a $5.41\% \pm 4.80\%$ improvement in the Yo-Yo test as compared to the NC group ($P = 0.069$). While clinically significant, the study was underpowered to reach statistical significance and provide clear insight into the performance improvements during the Yo-Yo test. It is possible that, as described by Dutka et al. (11) carnosine's impact on Ca^{2+} sensitivity may have been responsible for this result. However, outcome-based studies regarding the role of improved Ca^{2+} sensitivity during the onset of fatigue are required before it can be identified as a likely mechanism. Further investigation with more subjects should help clarify the potential of LactiGo™ topical gel to improve aerobic work capacity.

In contrast, the time to complete the all-out 1000 m running tests improved by $4.13\% \pm 0.68\%$ for WC+LG compared to NC group ($P = 0.036$) (refer to Table I). These findings suggest that the application of LactiGo™ topical carnosine gel is an effective ergogenic aid able to significantly increase the performance of elite soccer players.

Limitations of the Study

This study is not without limitations. First, the subject population of elite male athletes limited the total sample size. Second, extrapolation of potential performance improvements in non-elite athletes, untrained individuals, and in females of any training status is not possible. Lastly, quantification of changes to intramuscular and plasma carnosine content is necessary to provide insight into both the localized and systemic effects of LactiGo™ topical gel.

CONCLUSIONS

The data obtained from this investigation indicate that the elite male soccer players who applied LactiGo™ topical gel experienced significant improvements in tests of maximal aerobic capacity and anaerobic work capacity. The documented improvements in both tests were observed after the first application of LactiGo™ topical gel. An intervention that rapidly increases buffering capacity could have major implications for sports performance, particularly since existing interventions such as beta-alanine, creatine, and NaHCO₃ all require loading phases (12,18,24). Overall, these findings provide evidence for the efficacy of LactiGo™ topical gel as an ergogenic aid.

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