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Effect of Repeated Carbohydrate Mouth Rinsing on Female's Sprint Power Output

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Abstract

Rinsing of carbohydrate in the oral cavity has been shown to improve performance especially in endurance type activities. The exact mechanism responsible for this ergogenic effect remains unestablished but it is speculated that related to carbohydrate receptors in oral cavity which increase neural drive.

A randomised double-blind crossover counterbalanced study design was used to examine the effects of repeated carbohydrate mouth rinsing (%6.4 maltodextrine) on physically active female's 30-s sprint power output on a cycle ergometer. Fifteen physically active female (age 20.87 ± 2 years) completed the following 10-second mouth rinse trials; a-) %6.4 carbohydrate solution (Cho) b-) water as a placebo (PLA). Repeated mouth rinsing was carried out with 8x25 ml doses of the flavour matched solutions at 30-s intervals during 5 minutes warm up. Immediately after the last rinsing, participants cycled 30-second maximal sprint on a cycle ergometer. Peak Power and Mean Power output were obtained via cycle ergometer software, blood glucose (BG), blood lactate (BL), heart rate (HR) and rating of perceived exertion (RPE) at rest, immediately after test and several time points in active and passive recovery period were assessed. Compared with the PLA trials, Cho didn't significantly increase peak and mean power output (P>0,05). As for RPE, BG, BL and HR parameters, there wasn't statistical significance between trials though.

Keywords: Cycling performance, mouthwash, ergogenic aids, wingate

Introduction

Ingestion of carbohydrate (CHO) before and during prolonged endurance exercise has been demonstrated to improve self paced time trial performance via mechanisms related to maintenance of euglycemia that sparing muscle glycogen for later use and high rates of exogenous CHO oxidation (Coyle et all., 1986:165–72; Tsintzas et all., 1996:801–809). However, these mechanisms doesn't seem to be responsible for ergogenic effect of CHO feeding in endurance performance lasting 1 hour or less. Furthermore, considering these mechanism, it is suprising that the improved exercise performance with ingestion of CHO in intense aerobic events where CHO endogenous stores and hypoglycemia aren't limiting factors for endurance exercise performance (Jeukendrup et all., 2013:1-8). Researchers tested this phenomenon and suggesting that mechanisms for ergogenic effect of CHO ingestion in high intensity and short duration aerobic exercise may not be related to metabolism of CHO, may involve central effects (Jeukendrup et all., 2006:1134-1141). Supporting this mechanism, a study using the magnetic resonance imaging (MRI) technique suggested that rinsing of CHO without swallow in the mouth stimulates the brain regions believed to be involved in reward/motivation and increases corticomotor excitability (Chambers et all., 2009:1779-1794).

In support of these researches, CHO mouth rinsing has been demonstrated by most (Gant et all., 2010:151-158; Rollo et all., 2010:798-804; James et all., 2017:25-31) but not all studies (Kulaksız et all., 2016:269-283; Pottier et all., 2010:105-111; Beelen et all., 2009:400-409) to increase endurance performance. Further, though it has been supported by most studies that ergogenic effect of CHO mouth rinse in endurance performance, it is less known about effect on maximal sprint performance. In view of CHO mouth rinsing stimulate brain regions related to reward and motor activity that may increase anaerobic performance, a few studies tested this hypothesis. Beaven et al. showed rinsing of CHO solution in the mouth to improve peak power of first sprint in a 5 x 6-s sprint protocol with 24-s active recovery on a cycle ergometer and suggested that serial CHO mouth rinsing before each sprint may increase maximal exercise performance in the absence of fatigue with central mechanisms. Another study by Phillips et all. demonstrated that 8 x 5 second rinses with a 25 ml CHO (6% w/v matodextrin) solution before 30 second sprint on cycle ergometer significantly improve peak power output and suggested improvement confined to initial seconds of the sprint and this came at a greater cost for the remaider of the sprint (Philips et all., 2014:252-258; Whitham et all., 2007:1385-1392). Contrary to research papers had positive outcomes, it was showed that 5-s mouth rinse with isocaloric either maltodextrin or glucose didn't improved competitive male cyclist's 30-s maximal sprint performance by Chong et al. (Chong et all., 2011:162-167).

Furthermore, it was proposed that ergogenic effect of CHO mouth rinsing can be enhanced by increasing the duration of oral exposure time to a CHO solution, so culminate in more stimulation of receptors in the oral cavity which responsible for activate brain regions that increased central drive and motivation, likely to improving anaerobic exercise performance (Rollo et all., 2011:449-461; Chong et all., 2011:162-167).

The aim of this research is to evaluate the effects of repeated CHO mouth rinse protocol (8x10 second rising with CHO at 30-seconds intervals) on female's 30-s maximal sprint performance. To the author's knowledge, this study is the first to examine female's sprint power output with this CHO mouth rinse protocol. We tested the hypothesis that repeated CHO mouth rinsing would significantly improve anaerobic performance compared with PLA trials.

Materials and Methods

Fifteen physically active healthy female vounteered for the study (mean(±SD) age: 20,87 (2,00) years, height: 163,73 (5,81) m, body mass (BM): 55,91 (5,78) kg). Participants were physically active and regularly engaged in aerobic and recreational activites such as basketball, tennis, volleyball 5-7 hours in 3-4 days in a week. The study approved by the Institutional Human Research Ethics Committee. All participants were fully informed of the nature and possible risks of the study before giving written consent.

The participants attended 4 sessions within a 11-day period at a testing laboratory in a double-blind, randomized, counterbalanced and crossover research design. The first two session was familiarization sessions so the participants could become accustomed to the 30-seconds sprint power output test on a cycle ergometer (Monark 894E, Monark, Sweden). Water was used as a mouth rinse in these familiarisation sessions. Other 2 sessions were treatments during which participants rinsed 1-) 25 ml of 6.4% (w/v) carbohydrate solution (CHO; Natura, Germany) which was tasteless and colourless 2-) 25 ml of water (PLA; Pınar, Turkey) for 10 seconds in the mouth repeatedly during the 5 minutes warm up at 30 seconds interludes. To make solutions taste matched, both solutions contained same amount of orange flavour. Participants were asked to avoid caffeine ingestion and refrain from vigorous exercise for a minumum of 24 hours before the each trial. A 24 hour dietary recall was completed by participants during the first familiarization session and it was then photocopied and hand back to the participant for the same diet to be repeated for each trials. Participants provided verbal confirmation of compliance to these procedures prior to each trial.

The first two visit were familiarisation sessions during which antropometric data (body mass and heigth were measured using a stadiometer) were obtained. Except for two familiarization sessions to improve the reliability of testing (Hopkins et all., 2001:211-234), each participant attended the laboratory on 2 occasions separated by 2-4 days. Sessions began between 8-10 am. after 10 hour night-fasting. All sessions performed in the fasted state due to the previous studies showing benefits of carbohydrate mouth rinsing has been performed in this way (Chong et all., 2014:605-612). Upon arrival the laboratory, before beginning 30-s sprint cycling test, in the resting state, heart rate (Polar Team 2, Finland) was measured followed by blood lactate and glucose concentration were assessed through a 20 μL sample obtained from the finger using the Accutrend Plus anaylser (Roche Diagnostics, Basel, Switzerland). Following phsyiological measurements, participants began 5-minutes warm up at 50 Watt 50 rpm on cycle ergometer. İmmediately before and every 30 seconds intervals in 5 minutes warm up sessions, participants rinsed the solutions 10 seconds duration in the mouth and expectorating back into a plastic cup held by the investigator 8 times in total. Immediately after warm up, participants asked to cycle maximally till the end of sprint test and upon reaching 110 rpm, 0.075 g/kg BM resistance was automatically added to flywheel and 30-s sprint test began. Vigorous verbal encouragement was provided. Peak and mean power output were calculated with software (Monark Anaerobic Test Version 3.3.0.0). Upon completion the 30-s sprint test, participants cycled at 50 watt 50 rpm against to 1 kg resistance followed by sitting on bench for 5 minutes. Immediately after test, active and passive recovery periods heart rate, blood glucose and blood lactate and rating of perceived exertion (RPE) were measured. Rpe was obtained using the Ratings of Perceived Exertion Scale (Borg, 1982:377-381).

All data were analyzed using the IBM SPSS statistics for Windows, version 20.0 (IBM Corp., Armonk, NY, USA). To assess the distribution of all data Shapiro-Wilk test was used.

Peak and mean power output were analyzed by paired t-tests. Rpe, blood glucose and lactate and heart rate datas were anaylzed using two-way ANOVA for repeated measures. Learning effect between familiarisation and treatment sessions tested with one-way repeated measures ANOVA. Sphericity was anaylzed by Mauchly’s test of sphericity followed by the Greenhouse-Geisser adjustment where required. If any differences were identified, pairwise comparisons with Bonferroni correction were applied. Significance leves was set at $p < 0.05$.

Findings

There was no significant effect of carbohydrate mouth rinse on mean power (p=0,780) and peak power (p=0,532) indicating that rinsing of carbohydrate in the mouth did not improve in sprint power output through 30 seconds maximal sprint test (Figure 1).

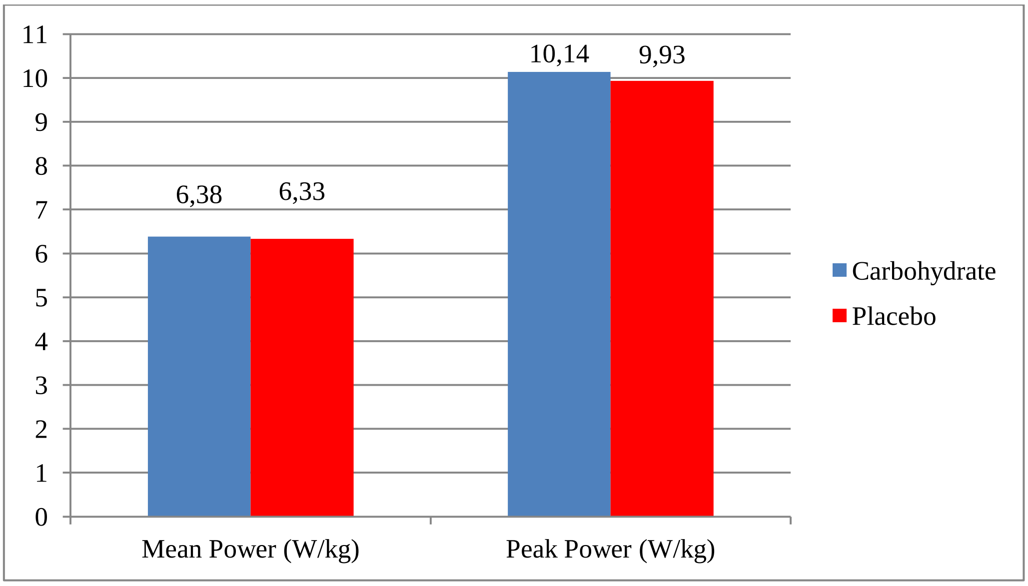


Figure 1. Mean and peak power for each experimental condition. No significant differences between groups were observed.

Heart rate presented a significant main effect for time during carbohydrate and placebo conditions (p=0,0001) indicating increased immediately after test and at recovery periods compared to resting values with no interactions between conditions (p=0,804) (Figure 2).

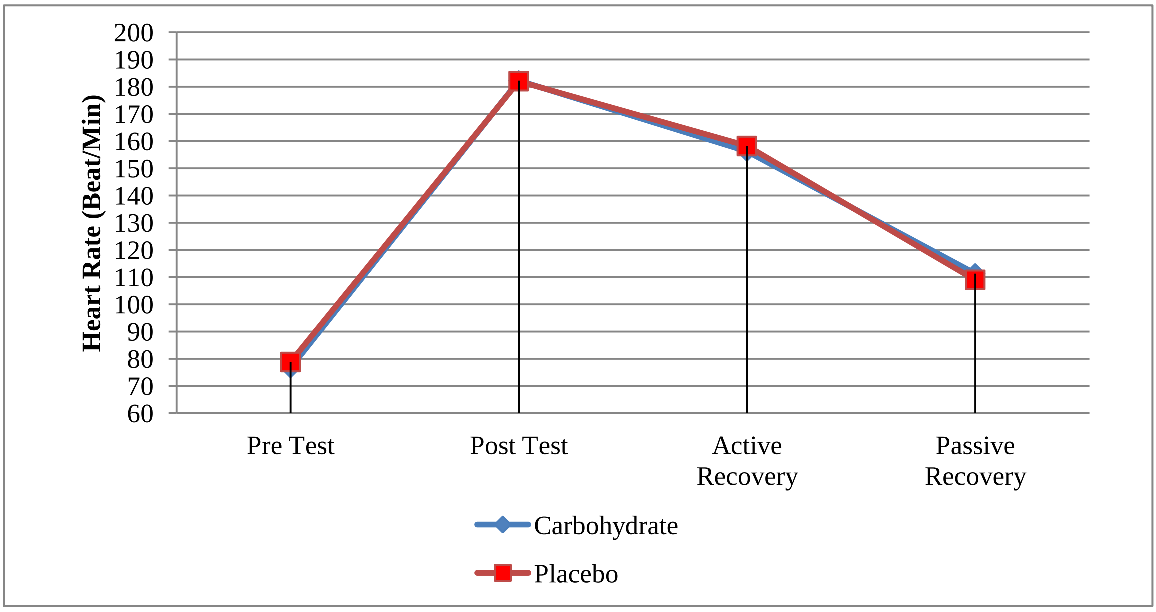


Figure 2. Heart rate values for each experimental conditions. No significant differences were observed.

Despite a significant main effect for time in RPE values (p=0,0001) no significant differences were observed between conditions (p=0,900) (Figure 3).

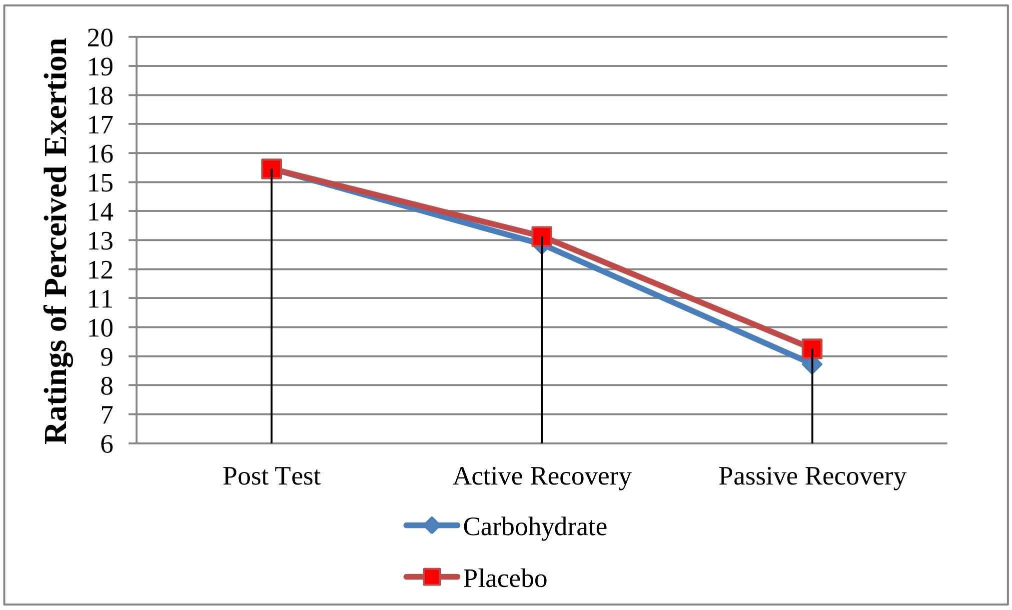


Figure 3. RPE values for each experimental conditions. No significant differences were observed.

Blood glucose concentration (Figure 4) increased over time through test protocol (p=0,0001), but there were no significant differences between conditions (p=0,311).

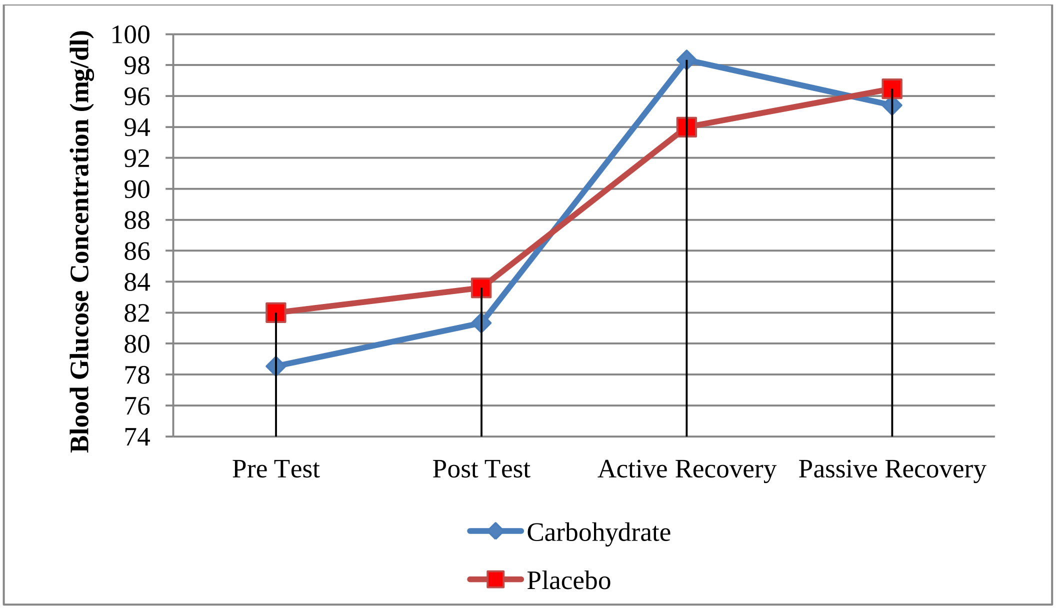
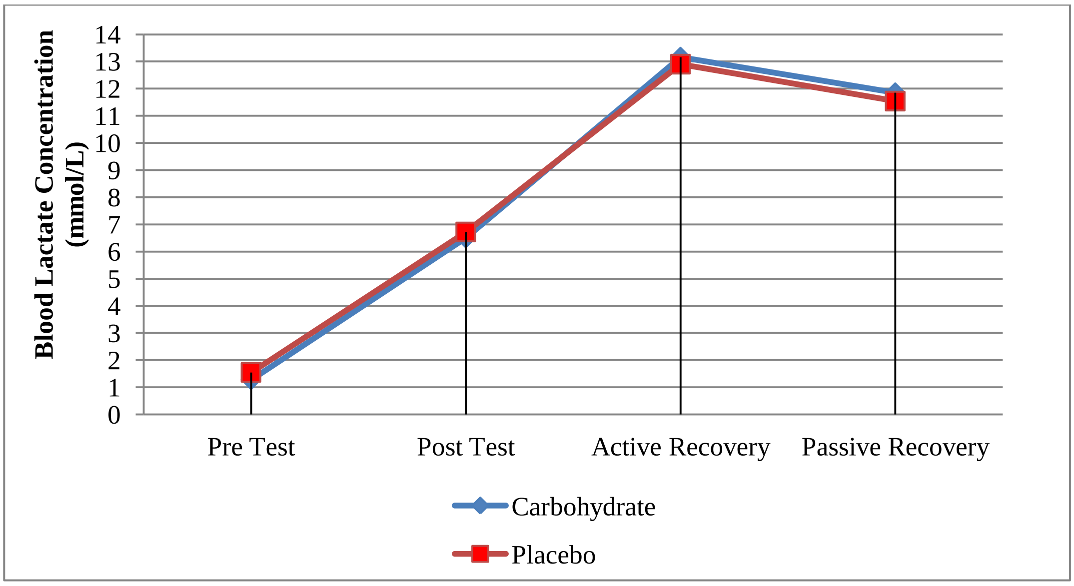


Figure 4. Blood glucose concentration for each experimental condition. No significant differences were observed.

Blood lactate (Figure 5) increased to by a large extent immediately after test and at recovery periods (p=0,0001), but there were no significant differences between conditions (p=0,921).



Discussion and Conclusion

The aim of the current research was to investigate the effects of CHO mouth rinsing on sprint power output. This was the first time to use repeated (8 mouth rinse in total seperated by 30 seconds intervals) mouth rinse protocol in females while testing sprint power output.

Contrary to our hypothesis, rinsing of the CHO repeatedly in the mouth didn't result in significant increase of sprint power output of physically active females. Further, there is no effect of CHO mouth rinse on RPE, blood lactate, blood glucose and heart rate at before and after test and recovery periods. The findings of this study is similar with previous studies into the effects of CHO mouth rinsing on sprint performance although applied on elite level athletes (Chong et all., 2011:162-167; Dorling et all., 2013:41-48; Bortolotti et all., 2013:639-645). Chong et all. stated use of 5 seconds rinsing of maltodextrin or glucose in oral cavity didn't result in increase of maximal sprint performance in trained male cyclists and speculated that artificial sweeteners used in study could interacted with CHO taste bud receptors and therefore result in a CHO-like ergogenic effect itself, in turn, may mask ergogenic effect of CHO solution. Purported ergogenic effect of artificial sweeteners is not the case for our study but orange flavour which was used in this research may cause feelings of nause, in turn, may negate the ergogenic effect of CHO mouth rinse. Further, it has been shown that maximal sprint activities duration in 30 seconds or more is generally related to feelings of nausea, vomiting and dizziness (Inbar et all., 1996:1-95; Özkan et all., 2010:207-224). Further research should replicate this research design (mouth rinsing of CHO at 30 seconds intervals in 5 minutes warmup session) without using of any flavour with elite level female athletes and measure psychological parameters as feeling of nausea, felt arousal, mood state which may impacted with activation of brain regions responsible for reward and motivation, leading to increase central drive by rinsing of CHO in the oral cavity (Dorling et all., 2013:41-49; Ali et all., 2017:14).

In contrast to our results, it has been shown that serial rinsing of a maltodextrin solution significantly increased peak power output in physically active males in which thorough familiarisation protocol were employed (Philips et all., 2014:252-258). Furthermore, in the aforementioned research, participants were familiar with cycle ergometer sprinting activities unlike participants not accustomed to cycle ergometer sprints in our study. However, with the applied of two familiarisation sessions in the study, learning or practice effect were not detected for peak and mean power performances in statistical analysis. It is also important to note that there hasn't been any difference with regard to learning effect in athletes and non-athletes (Hopkins et all., 2001:211-234).

Researches in sport nutrition topic has evolved to examine effect of rinsing of nutrients in the human mouth rather than ingesting over the past decade. In this regard, as an alternative to ingestion, one of this nutrients is carbohydrate which can be used by athletes that exprience gastrointestinal problem during training or competition and while training with low muscle glycogen state (Burke et all. 2015:29-40). Repeated CHO mouth rinsing protocol used (8x25 ml with 30 seconds intervals) during 5 minutes warming up session may implement in ‘‘ real world ’’ settings due to time efficient characteristic, however ergogenic effect of this protocol couldn't be confirmed in this study. Our research design wasn't without limitations. Although participants were asked to replicate their diet prior to each trial and adherence to diet was confirmed verbally at the beggining of each test sessions, they weren't analyzed with an nutrient analyze programme. Probable variation in daily total energy or macro/micro intake thought to influence effect of CHO trial. Moreover, participants' menstrual cycle weren't considered but recently it has been shown that anaerobic power wasn't influenced by follicular, ovulation and luteal phases of menstrual cycle (Aras et all. 2016:191-198).

Rinsing of CHO in the mouth is thought to improve sports performance especially in the fasted state. From an evolutionary perspective, when organism is under high physiological stress such as low glycogen level, ergegonic effect of CHO mouth rising would be more obvious (Beelen et all. 2009:400-409). Furthermore, Sinclair et all. suggested that 10 seconds mouth rinsing of CHO increase time-trial performance compared to placebo and 5 seconds CHO mouth rinsing. Therefore, it can be speculated that applied of longer duration or higher concentration of CHO mouth rinsing protocol would stimulate more receptor in the oral cavity and thus cause greater increase in performance. In this respect, tests were performed in fasted state and repeated CHO mouth rinsing protocol were applied to more activate brain regions to increase motor unite recruitment in explosive activites (Sinclair et all 2014:259-264). However, the results of this study didn't confirmed relevant hypothesis. It is also worth stating the relation of test protocol when expecting performance increase. Jensen et all. found that CHO mouth rinse counters fatigue related strength reduction and decrease the decline in neuromuscular output in fatigued state (Jensen et all 2015:252-261). Future research should employ repeated 30 seconds sprint tests (4x30 seconds sprint with 2-4 minutes active recovery intervals) to create central fatigue when examining effect of serial cho mouth rinsing.

In summary, repeated carbohydrate mouth rinsing dose not significantly improve sprint power output and recovery paramaters in physically active females. Further confirmatory study is required to investigate the effects of repeated CHO mouth rinse protocol in elite level female athletes.

Conflict of Interest

The authors have not declared any conflicts of interest.

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