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OFFICIAL STATEMENT

The Research Group leading by Dr. Fernando Naclerio, Department of Life and Sports Science, Faculty of Engineering and Science has completed an intervention study aimed to investigate the effects of a multi-ingredient supplement (Recovery), commercialised by Crown Sport Nutrition, Spain, to attenuate loss of performance perception of effort and muscle soreness in resistance training athletes.

The study was conducted from January to September of 2017 at the University of Greenwich Medway University Campus Kent (United Kingdom). All experimental procedures were conducted in accordance with the Declaration of Helsinki and approved by the University Research Ethics Committee. After being informed of all potential risk, discomforts, and benefits of the proposed investigation, participants signed a written informed consent. An application for this study has been agreed by the University Research Ethics Committee.

Dissemination plan

Results from the present study have been used for writing 2 final MSc dissertations at the MSc Strength and Conditioning University of Greenwich (October 2017).

Further actions:

- Presentation via poster or oral communications at the European Congress of Sports Science to be held in Dublin Ireland 4th to 7th July 2018 http://ecss-congress.eu/2018/18/index.php
- Preparation of one scientific manuscript for being submitted to an international journal of sports science sector by April 2018.

PROJECT METHODS AND DESIGNS

Participants

Twelve resistance trained college males participants (>18 to 35 years old) with a minimum of 1 year performing high-intensity resistance exercise 2–3 times per week prior to inclusion volunteered to take part in the present study. Exclusion criteria comprised: (1) participating in competition lifting sports, e.g., weightlifting, powerlifting, and bodybuilding or >3 resistance exercise training sessions per week within 6 months prior to inclusion in the study (to avoid elite or sub elite strength athletes); (2) a history of musculoskeletal pain or injuries; neurological or metabolic disorders and (3) use of dietary supplements or prescription medicine that would potentially affect muscle recovery or function (i.e., protein supplements, antioxidant supplements, NSAIDs, and angiotensin converting enzyme inhibitors).

Design

Randomised controlled trial, within participant comparison dressing with two

conditioning and 4 times-assessment points. After being considered eligible for the study and signed the inform concern, the participants completed three familiarisation sessions aimed explain the training protocol, control the proper exercise techniques and getting familiarised with the OMNI-RES 0-10 scale. Following inclusion and familiarization, the participants were randomly allocated to receive either a multi-ingredient (REC) or maltodextrin (CHO) in the first, 5-days training period, thereafter the participants switched to the other supplement type in the second training period.

The assessments were initiated with a pre-test (T0) week, followed by 1 week for recovery purpose (week 2) that was followed by the first 5-day intense resistance-training and testing period, including intake of either REC or CHO. Next, the participants had a second recovery period (2 weeks), during which the participants were instructed to maintain their habitual activity levels. After the second recovery period, a second 5-day intense resistance training and testing period was completed (week 6), including intake of the REC or CHO (opposite to the type of supplement ingested in the first 5-day training and testing period). Following the final resistance exercise bout in each period, three performance tests (T1, T2 and T3, described below) were completed to assess recovery 1, 24, and 48 h following the last training session (Figure 1).

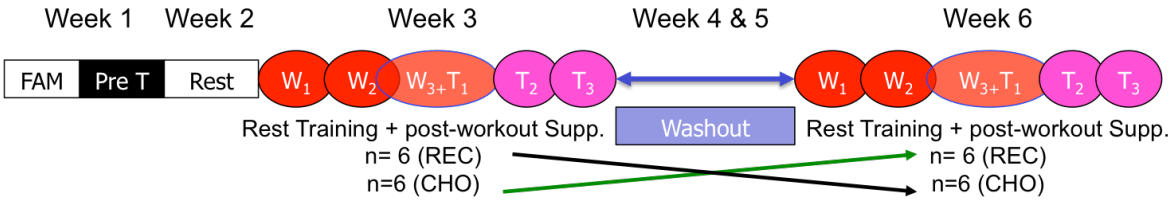

Figure 1. Schematic overview of the study design. The overall study period consisted of six consecutive weeks. Familiarization and Pre-tests were made in week 1, week 2 was a recovery week, and week 3 and 6 were the two intense training and testing periods consisting of three identical training sessions (W1–W3) and three post-test sessions (T1,T2 and T3). In weeks 4–5, a 2-week recovery/washout period was completed.

Exercise protocol

During each workout session, the participants performed a supervised full-body resistance-training protocol. Workout sessions were carried out late in the afternoon or early evening. After a warm-up the participants performed a total of 3 circuits involving 1 set of the following exercises: 1) alternate box set ups 2) hang clean; 3) bench press; 4) parallel squat using free weights; 5) upright row; 6) alternate lunges; 7) deadlift; 8) squat on an isoinertial fly-wheel concentric eccentric machine. Every set involved 16 maximal repetitions (MR) using the heaviest possible load. Experienced strength and conditioning coaches monitored all training sessions to ensure participants compliance to the training protocol. When participants were able to perform more than 16 repetitions per set, the load was slightly increased (between 2.5 to 5 kg). If less than 16 repetitions were completed, a minimum rest period of 15 sec was introduced until the participants were able to complete 16 repetitions per set. A ~30 sec rest period was permitted between exercises. Recovery between circuits was 3 minutes. All participants completed all lifts for each exercise. The average time to complete the workouts was 45 min. All workout sessions (W1–W3) were identical (i.e., identical total number of repetitions per exercise and inter-set recovery periods).

Control of Dietary habits and supplementation protocol

A research nutritionist collected dietary habits and explained the proper procedures for recording dietary intake. Each participant completed a 3-day food diary report (two

weekdays, and one weekend day). The food diary report was then analysed using Dietplan 6 (Forestfield Software, UK) to determine energy and macronutrient content. Participants were instructed to maintain their normal diet throughout the both intervention weeks as well as during the wash out (2 weeks) period. Additionally the macronutrient composition of the meal consumed during the post workout period and before sleep was also analysed.

All participants consumed a post-workout supplement containing either 56 g of a multi-ingredient (carbohydrate 37g, whey isolate 8.6 g, beef Hydrolysate 7.4g, fat 0.8g and glutamine 2 g) providing 222 kcal (Recovery, from Crown Sport Nutrition, Spain) or maltodextrin (contrast non-protein, isoenergetic group) mixed 250 ml of water within 10 min after completing every workout or testing session during week 3 and 6. No supplementation was consumed on non-exercising days (weekend and weeks 4 and 5).

Measurements (test 0 to 4)

In the pre-test period (T0), all participants underwent 2 days of assessments to determine body weight and height, strength, power and anaerobic performance variables. All participants were instructed to refrain from strenuous physical activity for 48 h before the first baseline tests and before the first 5-day training and testing intervention.

On day 4 (T0, first test session) after the three days of familiarization, the participants reported to the laboratory in the postprandial state (i.e., approximately 2 h since last meal) and were assessed for body mass and height. Thereafter the vertical jump test and a battery of isokinetic dynamic strength test involving knee extension and flexion movements were performed.

On day 5 (T0, second test session), the participants underwent assessments of upper body performance and the Wingate 30 s all-out cycling anaerobic test.

Post work out assessment (Test 1, Test 2, and Test 3)

All performance tests were repeated at 1 (T1), 24 (T2), and 48 h (T3) after the final (third) exercise bout in each of the training weeks (Fig. 1).

Performance Assessments

Vertical Jump test: Countermovement Jump was performed on a Kistler force platform (9287B, 3 component force platform; Kistler, Hook, United Kingdom; dimensions: 900 x 600 x 100 mm) with a sampling rate of 2000 Hz. From standing erect position, participants descended to a self-selected depth and immediately jumped upward as high as possible. To exclude the influence of arm swing, subjects were instructed to keep their hands on hips. Participants performed 3 consecutive jumps. Based on the height, the best of the 3 was chosen for the analysis.

Lower Body Isokinetic Strength: Peak torque of knee extensor and flexors of both eccentric and concentric muscle actions at 60 degree/sec were evaluated on an isokinetic dynamometer (Cybex-Humac norm testing and rehabilitation system; model 770). The dominant leg was used in a seated position where they were securely strapped in around the torso, hips, and thighs. Participants were required to hold the chair handles during the test as they performed 3 consecutive repetitions for each of the 4 muscle actions. A minute rest was given between tests.

Upper Body Strength Test: The 1RM value for Bench Press using free weights was determined.

Upper body power Test: The maximal upper body power value was measured for the Bench Press exercise using 50% of the previously determined 1RM value. Participants were

required to perform 5 repetitions with correct form and with the maximal possible movement velocity. Muscular power was determined from the repetition that produced the maximal average mechanical power (calculated from the accelerative portion of the concentric phase, during which the acceleration of the barbell was $\geq$ -9.81 $m.s^{-2}$). A portable single optoelectronic infrared camera system with a fixed sampling frequency of 500 Hz was used to track a retroreflective strip placed at the centre of the bar during the five Bench Press repetitions.

Wingate test: After a 5-min warm-up at a low intensity at 100 rpm, participants accelerated up to 120 rpm and after a 10-s countdown, the 30-s all-out sprint test was initiated. The participants were verbally encouraged to exercise as forcefully as possible throughout the test. Both the peak power and mean power from the test were recorded.

Rate of Perceived Exertion (RPE) post workout

Session RPE value, from the OMNI-RES (0-10), scale (Figure 2) was measured 15 min after completing each exercise bout (workout 1, 2 and 3). The obtained values were used to compare the global level of effort perceived by the participants under the two different conditions.

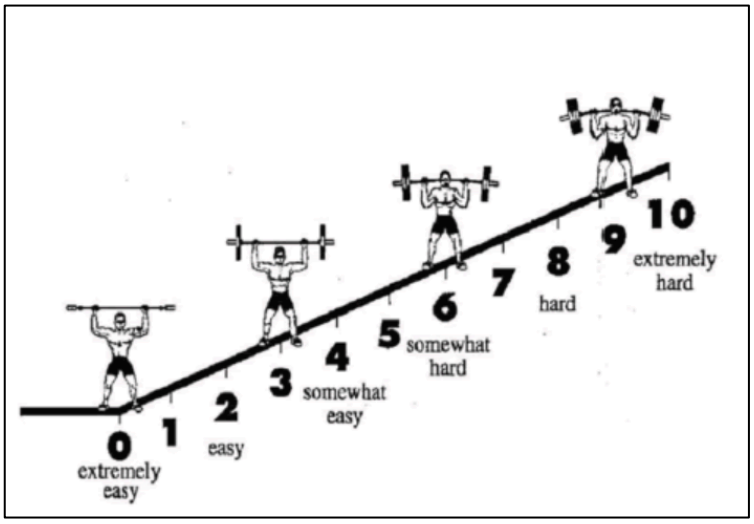

Figure 2. OMNI-RES scale used for estimation the global level of effort 15 min post workout

Muscle soreness

Muscle soreness in the lower extremity was evaluated at 24 and 48 h, before commencing Test 2 and Test 3. Participants were asked to perform the standardized warm-up movements using during T0 (slow squat movement without external overload walk and slight jogging). The participants then evaluated lower extremity muscle soreness on a visual analog scale (VAS) of 100 mm going from no pain at all (0 mm) to worst possible pain (100 mm), Figure 3.

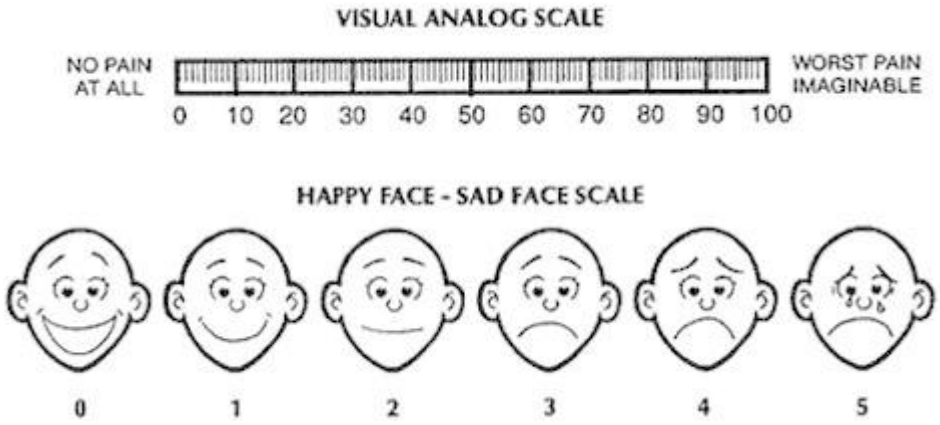

Figure 3. Visual Analog Scale (VAS) used to evaluate the degree of muscle soreness.

RESULTS

Due to non-intervention related reasons, two participants dropped out from the study. Consequently, ten participants successfully completed the study.

Diet Analysis

Table 1 shows the daily consumption of carbohydrate, protein, fat (grams) and energy (kcal) without including and including the two post-workout supplements.

Table 1. Descriptive analysis of the participant's diet composition, including and not including post –workout supplementation

Macronutrients	No supplementation	With REC	With CHO
Proteins			
$g \cdot d^{-1}$	123.50 (11.12)	139.60 (11.12)* $^{\delta}$	123.50 (11.12)
$g \cdot kg^{-1} \cdot d^{-1}$	1.68 (0.25)	1.90 (0.27)* $^{\delta}$	1.68 (0.25)
% of total energy	22.85 (3.76)	23.31 (1.95) $^{\delta}$	20.60 (1.84)
Carbohydrate			
$g \cdot d^{-1}$	261.36 (40.40)	299.09 (40.40)*	317.36 (40.40)*
$g \cdot kg^{-1} \cdot d^{-1}$	3.51 (0.38)	4.02 (0.38)*	4.27 (0.39)*
% of total energy	47.70 (5.63)	49.68 (4.27)	52.71 (4.23)*
Fats			
$g \cdot d^{-1}$	70.81 (12.13)	71.59 (12.13)	70.81 (12.13)
$g \cdot kg^{-1} \cdot d^{-1}$	0.97 (0.23)	0.98 (0.23)	0.97 (0.23)
% of total energy	29.45 (5.01)	27.00 (3.93)*	26.69 (3.93)
Energy			
Total daily energy	2236.43 (204.46)	2464.39 (204.46)*	2466.0.3 (204.46)*
$Kcal \cdot kg^{-1} \cdot d^{-1}$	30.29 (3.42)	33.39 (3.66)*	33.41 (3.67)*

Notes: values are presented as mean (standard deviation)
*$p<0.01$ respect to diet without post workout supplementation
$^{\delta}$ $p<0.01$ from diet with REC to diet with CHO supplementation

The ingestion of the multi-ingredient supplement (REC) determined a significant increase in total daily protein and carbohydrate intake. Meanwhile, the ingestion of 56g of maltodextrin caused significant increased of the total daily carbohydrate respect to the recorded habitual diet.

Analysis of the dependent variables:

Performance

Vertical Jump Height: VJ decreased in CHO but not in REC condition after test 1 (post 1h), test 2 (24h) and test 3 (48 h).

REC showed a significant higher VJ performance respect to CHO after test 1 (p=0.003) and a non-significant trend (p=0.062) after test 2. No differences were observed after test 3.

Isokinetic Strength:

Summary: The ingestion of a multi-ingredient (Recovery) would attenuate power performance loss 1 h after performing intense resistance training sessions compared to the ingestion of only carbohydrates in male recreationally trained males.

Lower Body Isokinetic strength:

Concentric and eccentric knee extension at 60 degrees/sec decreased in both conditions at test 1 (post 1h, P<0.05) and recovers similar values compared to the pre-test (T0) at 24h (T2) and 48h (T3). No differences were observed between groups. No differences were in time or between groups were observed for concentric and eccentric knee flexion at 60 degrees/sec.

Summary: The ingestion of a multi-ingredient (Recovery) seems not to produce any advantage compared to the ingestion of maltodextrin on the changes in isokinetic strength observed between 1 h to 48 h after performing three daily consecutive intense resistance-training sessions.

Upper Body strength: Both groups decreased 1RM values at test 1 (1h post, p<0.05) but only the REC condition recovered similar values to baseline at test 2 (24 h). Strength performance remained significantly lower in the CHO at test 2 (post 24 h, p=0.001), meanwhile, the two conditions recovered similar values to baseline at test 3 (post 48h). Furthermore, under REC condition, participants produced non-significant (p=0.097) and significant (p =0.003) higher 1RM values at test 1 (post 1h) and test 2 (24 h post) respectively compared to the CHO condition (Figure 4).

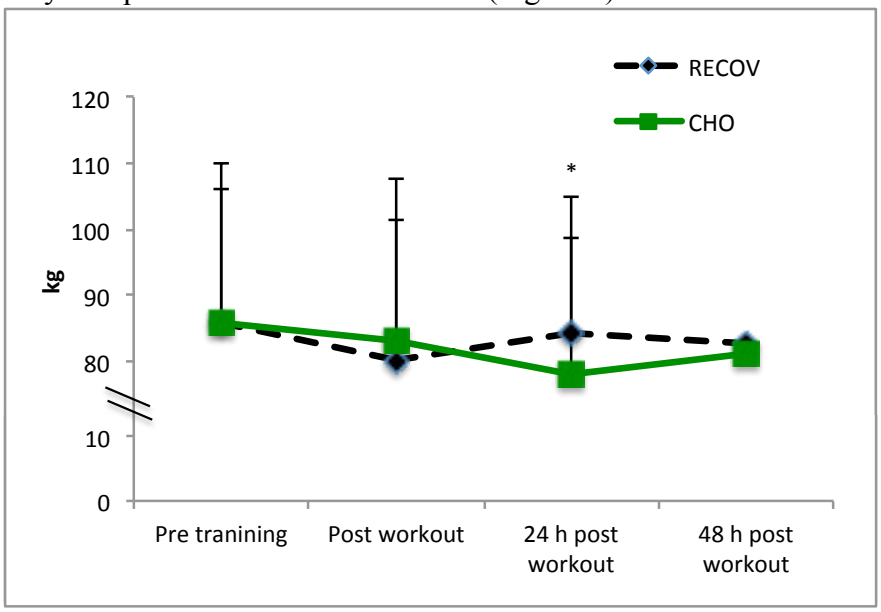

Figure 4. 1RM bench press measured at baseline and 1h, 24 h and 48 h after performing 3 daily consecutive intense resistance-training sessions. * p=0.003 between groups.

Summary: The ingestion of a multi-ingredient (Recovery) was effective to attenuate strength loss 1 h and 24 h after performing intense resistance training sessions compared to the ingestion of only carbohydrates in male recreationally trained males.

Upper Body power: No significant differences were observed by time or between conditions for the bench press power using 50% of the 1RM.

Summary: The ingestion of a multi-ingredient (Recovery) does not to produce any advantage compared to the ingestion of maltodextrin on upper body power measured during the bench press exercise using 50% of the 1RM.

Anaerobic Performance (Wingate test): Both conditions showed lower ($P<0.05$) anaerobic capacity and power at test 1 (1 h post) compared to test 0 (pre) and test 2 (24 h post). No other differences have been observed.

Summary: The ingestion of a multi-ingredient (Recovery) does not to produce any advantage compared to the ingestion of maltodextrin on anaerobic power and capacity measured during the Wingate cycling test.

Post Workout Global Perceived Exertion

Both conditions showed similar RPE values after workout 1 that was significantly higher ($p<0.05$) compared that measured after workout 3. Additionally, under the REC condition, the participants expressed significant lower RPE values compared to workout 1 ($p<0.04$). No differences between conditions were observed after workout 1. REC showed lower RPE values after workout 2 ($p=0.022$) and a non-significant trend ($p=0.081$) to produce lower RPE after workout 3 compared to the CHO condition (Figure 5).

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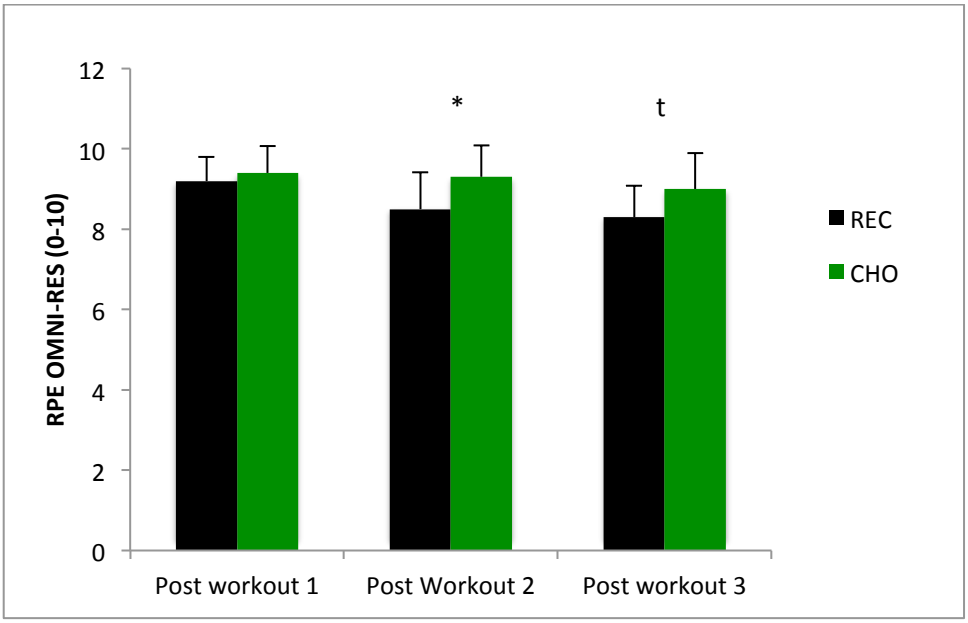

Figure 5. Global OMNI-RES scale values measured after the three workouts for the two conditions.
*$p<0.05$ between REC and CHO
t $p+0.081$ between REC and CHO

Summary: The ingestion of a multi-ingredient (Recovery) is associated with lower perceptions of effort expressed 15 min after completing intense resistance training workouts.

Delayed muscle soreness (DOMS)

Both conditions showed significant increases in the delayed muscle soreness at both 24h and 48h after completing the last training session (W3). Nonetheless, the level of DOMS manifested under the CHO conditioning was significantly higher compared to the REC condition at 24 h (p=0.04).

Summary: Compared to maltodextrin, the ingestion of a multi-ingredient (Recovery) attenuates lower body muscle soreness measured 24h after completing three daily consecutive sessions of intense resistance training workouts.

CONCLUSIONS

The present investigation suggests that the ingestion of a post-workout multi-ingredient beverage (Crown Sports Nutrition, Recovery) may help to attenuate loss in vertical jump performance and upper body strength, but not in upper body power after intense resistance training session in recreationally trained males. In addition, compared to the ingestion of maltodextrin, a multi-ingredient (Recovery) seems to reduce muscle soreness and promotes better perceptions of the global effort experienced 15 min after workout. On the other hand, the post-workout multi-ingredient administration did not produce any difference compared to carbohydrate when assessments involved exercises not included in the workout (non-specific movements), such as cycling or isokinetic single joint movements.

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