Omega 3 Chia Seed Loading as a Means of Carbohydrate Loading

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Abstract

Illian, TG, Casey, JC, and Bishop, PA. Omega 3 chia seed loading as a means of carbohydrate loading. *J Strength Cond Res* 25(1): 61–65, 2011—The purpose of this study was to determine if Omega 3 Chia seed loading is a viable option for enhancing sports performance in events lasting >90 minutes and allow athletes to decrease their dietary intake of sugar while increasing their intake of Omega 3 fatty acids. It has been well documented that a high dietary carbohydrate (CHO) intake for several days before competition is known to increase muscle glycogen stores resulting in performance improvements in events lasting >90 minutes. This study compared performance testing results between 2 different CHO-loading treatments. The traditional CHO-loading treatment served as the control (100% cals from Gatorade). The Omega 3 Chia drink (50% of calories from Greens Plus Omega 3 Chia seeds, 50% Gatorade) served as the Omega 3 Chia loading drink. Both CHO-loading treatments were based on the subject's body weight and were thus isocaloric. Six highly trained male subjects ($\dot{V}O_2max$ 47.8–84.2 $ml\cdot kg^{-1}$; mean (*SD*) of $\dot{V}O_2max$ 70.3 $ml\cdot kg^{-1}$ (13.3) performed a 1-hour run at ~65% of their $\dot{V}O_2max$ on a treadmill, followed by a 10k time trial on a track. There were 2 trials in a crossover counterbalanced repeated-measures design with a 2-week washout between testing sessions to allow the participants to recover from the intense exercise and any effects of the treatment. There was no statistical difference ($p = 0.83$) between Omega 3 Chia loading (mean 10k time = 37 minutes 49 seconds) and CHO loading (mean = 37 minutes 43 seconds). Under our conditions, Omega 3 Chia loading appears a viable option for enhancing performance for endurance events lasting >90 minutes and allows athletes to decrease their dietary intake of sugar while increasing their intake of Omega 3 fatty acids but offered no performance advantages.

Key Words fatty acids, macronutrients, running, performance, muscle glycogen, high fat diet

Introduction

This study aimed to evaluate Omega 3 Chia seed loading as a means of enhancing sports performance of distance runners. Omega 3 Chia seeds are a rich and unprocessed whole food source of Omega 3 fatty acids. They contain all the essential amino acids and are high in antioxidants. They are also rich in fiber and absorb up to 10 times their weight in water allowing the slow absorption of sugar into the body. Omega 3 Chia seeds were prized by ancient Aztec warriors as an endurance promoting food, eaten with bread just before battle, and drunk with water before running long distances on foot (14).

Carbohydrate (CHO) loading has been used for approximately 40 years to enhance the performance of athletes in events lasting >90 minutes. There are many forms of CHO loading, but recent research has shown that 8 $g\cdot kg^{-1}\cdot d^{-1}$ should be consumed to enhance performance (1,17,18). All other things being equal, endurance athletes who can store more muscle glycogen will have some advantage over an athlete who cannot and who exhausts muscle glycogen stores earlier.

Research has supported the benefits of a high-fat diet over a high-CHO diet for enhancing an endurance athlete's performance because a high-fat diet can increase fat utilization and glycogen sparing, but research has also noted that the rating of perceived exertion is higher with a high-fat diet than with very low-CHO diet (17). Sherman et al. (16) reported that a 20.9-km run by trained endurance athletes with a high-CHO diet (70% CHO) used significantly more glycogen compared to a moderate CHO diet (50% CHO) but made no difference in performance run times or postperformance glycogen levels. They also reported that "muscle glycogen can be elevated to high levels with a moderate exercise–diet regimen (50% CHO)". Studies done to compare high-fat diets to high-CHO diets have shown that with a high-fat diet there is a significant increase in fat oxidation during exercise and thus a reduced CHO usage (3–5,8,10,13).

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By using Omega 3 Chia seeds as a CHO-loading method, athletes may be able to increase their fat oxidation while sparing muscle glycogen compared to traditional CHO loading. Because "muscle glycogen can be elevated to high levels with a moderate exercise–diet regimen (50% CHO)" and Omega 3 fatty acids may increase fat oxidation, it seems logical that a drink of Omega 3 Chia seeds (50% cals) and CHOs (50% cals) may prove to be a more beneficial source of fuel for endurance performance lasting >90 minutes (16). It was hypothesized that Omega 3 Chia loading would be more beneficial than traditional CHO loading because its high fat and moderate CHO might improve endurance fuel usage.

Methods

Experimental Approach to the Problem

To examine the hypothesis that Omega 3 Chia loading may be more beneficial than traditional CHO loading, 6 highly trained endurance athletes were recruited to participate in this investigation. Only men were employed in this study because there is recent evidence that CHO loading does not occur in the same manner for men and women, thus affecting performance and possibly confounding testing results (18). The study was based upon the CHO loading strategy that has shown that a combination of a short-term bout of high-intensity exercise followed by a high-CHO intake enables athletes to attain supranormal muscle glycogen levels (6). Subjects were asked to perform a high-intensity workout 2 days before testing and were then required to drink either an Omega 3 Chia loading drink (Greens Plus, Vero Beach, FL, USA) or a CHO-loading drink (100% Gatorade) for 2 days before an endurance performance trial. The CHO-loading drink was used as the control drink because there is a large amount of scientific evidence that shows CHO loading to be superior to water before endurance events lasting >90 minutes. Carbohydrate loading should exceed 8 $g \cdot kg^{-1} \cdot d^{-1}$ to increase muscle glycogen stores, which has been shown to lead to performance benefits often seen in events lasting >90 minutes in duration (1,15,16). Because each subject was encouraged to eat like they normally do, the investigators calculated the drinks so that they were isocaloric and consisted of 6 $g \cdot kg^{-1} \cdot d^{-1}$ per athlete. This assumed that each subject obtained 2 $g \cdot kg^{-1} \cdot d^{-1}$ of CHOs from his daily food. Food logs were taken to insure that each subject met the minimum intake of CHO of 8 $g \cdot kg^{-1} \cdot d^{-1}$.

Two weeks before performance trials, testing was done to assess each participant's $\dot{V}O_2$max. All subjects performed a maximal bout of running on a treadmill. Each subject wore a heart rate (HR) monitor (Model FS3 Polar, Kempele, Finland). There was a 3-minute warm-up with a gradual increase in speed. During the rest of the test, speed was increased every 2 minutes until the subject reached 8 mph. At this point, elevation was increased by 1% every 2 minutes until a 3% incline was reached. After 3% incline was attained, the speed was increased by 0.5 mph every 2 minutes until the subject reached maximal oxygen uptake. Rate of perceived exertion was recorded every 2 minutes. During this protocol, HRs were recorded every minute. This data allowed us to replicate a corresponding HR of ~65% $\dot{V}O_2$ max during our performance testing. This protocol was continued until each subject reached his maximal oxygen uptake or until the subject could not perform any longer. To ensure that the subjects reached maximal oxygen, they were required to meet 2 of the following criteria: (a) attaining their predicted maximum HR, (b) a respiratory exchange ratio (RER) >1.17, (c) or the subject reached a plateau of oxygen consumption while exercise intensity increased (12). Each subject was verbally encouraged to work to his maximal capacity.

On the day of performance testing, the subjects ran 1 hour at ~65% of their $\dot{V}O_2$max (as assessed by HR) on a treadmill followed by a 10k time trial on a track. This was done to create a controlled competitive endurance event that lasted >90 minutes. There were 2 trials in a crossover counter-balanced repeated measures design with a 2-week washout between testing sessions to allow the participants to recover from any effects of the intense exercise and the treatment. The experimental design is displayed in Table 1.

Subjects

Six subjects (6 men) with $\dot{V}O_2$max values that varied from 47.8 to 84.2 $ml \cdot kg^{-1}$, and a mean (*SD*) $\dot{V}O_2$max of 70.3 $ml \cdot kg^{-1}$ (13.3). The subjects varied in age from 20 to 34 years. Mean (*SD*) subject physical characteristics were as follows: age 23.67 (5.2) years, height 196.7 (8.7) cm, weight 68.2 (8.5) kg, mean personal best for 10k was 35 minutes 55 seconds.

The Chia seeds used for this study were Omega 3 Chia seeds (Greens Plus, Vero Beach, FL, USA) and were certified kosher and pesticide-, herbicide-, gluten-, and genetically modified-free.

This study was approved by the local Institutional Review Board for the Protection of Human subjects, and written consent was obtained from all subjects before the collection of any data.

Procedures

Three days before testing, participants were given a food intake log and were reminded of the training protocol and asked if they needed any clarification on procedures.

Two days before testing, the participants were required to complete an intense run on their own between 5 and 9 AM. They were instructed to do intervals runs alternating periods of high intensity with low intensity, and the workout could not last >60 minutes. Immediately after their run, they were given a drink mix that they could drink ad libitum throughout the day. The amount of drink that each participant was given was based on his body weight and was isocaloric, regardless of the treatment. For example, a participant weighing 68 kg (170 lbs) would drink 1 of the 2 drinks below (1 each trial): (a) CHO drink (Gatorade Original Powder, Barrington, IL, USA) = 1,636 cals from simple CHO; (b) Omega 3 Chia loading drink = 820 cals from Greens Plus Omega 3 Chia seeds plus 820 cals from CHO drink (Gatorade).

TABLE 1. Experimental design.

Wednesday	Thursday	Friday	Saturday
Fill out food log	Intense run (morning) Carb or Chia drink (all day) Food log	Easy run (<30 min) Carb or Chia drink (all day) Food log	6:17 AM start 1-h Run at 65% $\dot{V}O_2$max, then timed 10k

Each drink for this participant would be 1,636 cals, and he would be required to drink that throughout the day. The Chia drink (50% Greens Plus Omega 3 Chia seeds, 50% Gatorade) and the control drink (100% Gatorade) were isocaloric.

One day before the test, the subjects were instructed to do only light exercise before 9 AM or to rest completely. They were also required to pick up a drink mix (identical to the one they received the day before). Each participant was asked to have the drink mix finished by 9 PM the night before the test. This encouraged frequent feedings and reduced possible digestion problems associated with a change in diet.

On the day of the test, all subjects reported to the testing site at 6 AM. They were given a prerun questionnaire. Each subject was only allowed to drink water during the test performance. The test consisted of a 1-hour run at ~65% of their $\dot{V}O_2$max on a treadmill, followed by a 10k time trial on a track. To assess ~65% of their $\dot{V}O_2$max on the treadmill, the investigators matched HRs with each subject's HR during $\dot{V}O_2$ max testing. Each subject wore an HR monitor (Model FS3 Polar, Kempele, Finland). Subject were required to keep his HR within 5 beats ± of the HR that was assigned to them associated with 65% of their $\dot{V}O_2$max. After the 1-hour run at ~65% of their $\dot{V}O_2$max on a treadmill, the subjects did a 10k time trial on the track. All 10k times were recorded. After the test, each participant filled a postrun questionnaire.

After completing the first round of treatments, all subjects had 2 weeks off before beginning the second round of treatments. The second round of treatments was identical to the first round, other than each subject receiving the other form of CHO-loading drink. During the second round of treatments, each subject was encouraged to eat similarly to their recorded food logs from the first treatment.

Both tests were completed in late November and early December of 2009. During the first testing procedure, the temperature outside was 44°F with 85% humidity, and the wind speed was 0 mph. During the second testing procedure, the temperature was 52°F with 74% humidity, and wind speed was 4 mph. Treatments were counterbalanced, and the 10k was on a competitive track.

Statistical Analyses

The statistical analyses were performed using SPSS 19 (SPSS, Inc., Chicago, IL, USA). A paired *t*-test was used to compare

TABLE 2. Results comparing 10k personal records, $\dot{V}O_2$max, first and second treatments, and performance times ($n = 6$).*

	10k PR	$\dot{V}O_2$max ($ml \cdot kg^{-1} \cdot min^{-1}$)	Treatment: First	Treatment: Second	Time comparing both treatments
1	N/A	68.4	41 min 35 s w/GAT	42 min 09 s w/CHIA	:34 s faster W/GAT
2	33 min 50 s	78.5	35 min 09 s w/CHIA	36 min 40 s w/GAT	1:31 faster W/CHIA
3	33 min 0 s	79	33 min 00 s w/CHIA	31 min 46 s w/GAT	1:15 faster W/GAT
4	45 min 40 s	47.8	46 min 04 s w/GAT	45 min 42 s w/CHIA	:22 s faster W/CHIA
5	N/A	64	38 min 45 s w/GAT	39 min 02 s w/CHIA	:19 s faster W/GAT
6	31 min 10 s	84.2	31 min 50 s w/CHIA	31 min 30 s w/GAT	:20 s faster W/GAT
		GAT	CHIA		
	Avg (min)	37.72	37.81		
	SD	5.67	5.45		
	t-Test	0.83			

*N/A = not applicable; PR = personal record; GAT = Gatorade.

Table 3. Applying Omega 3 Chia loading to a personal training scheme before an endurance event lasting >90 minutes.

2 Days before RACE	1 Day before the RACE	RACE day
Interval run in the AM (run hard for 1 min, easy for 2 min, repeat for a minimum of 30 min)	Easy 20-min jog if desired	Run your best!
Calculate caloric needs Bodyweight in lbs/2.2 = X X multiplied by 24 = calories Calories/2 = number of calories needed from chia seeds and a carbohydrate mixture	Make exact same mixture as yesterday that contains 50% greens plus Omega 3 chia seeds, and 50% simple carbohydrates	
Mix a drink in a gallon container that is 50% greens plus Omega 3 chia seeds, and 50% simple carbohydrates	Start drinking immediately after easy morning jog or upon waking	
Start drinking immediately after the morning run and drink ad lib during the rest of the day	Consume meals as normally as possible	
Consume meals as normally as possible		

10k times in seconds. An alpha of 0.05 was used for significance testing.

Results

Group and individual results are shown in Table 2. There was obviously no statistical difference ($t(5) = 0.232$, $p = 0.83$) between Omega 3 Chia loading (mean 10k time = 37 minutes 49 seconds) and CHO loading (mean = 37 minutes 43 seconds).

Participants' reported intakes in food logs were compared between the 2 protocols, and no large (>500 cals) differences were noted. The prerun and postrun questionnaires suggested that 3 of the most highly trained endurance athletes ($\dot{V}O_2max$ 78.5–84.2 $ml \cdot kg^{-1} \cdot min^{-1}$) reported subjective differences between the 2 treatments. One of the half-marathon runners ($\dot{V}O_2max = 84.2\ ml \cdot kg^{-1} \cdot min^{-1}$) noted that during the 1-hour run at 65% of their $\dot{V}O_2max$, they had to run faster (ca. 15 $s \cdot mile^{-1}$) to keep their HR at 65% of their $\dot{V}O_2$ max while on Omega 3 Chia loading treatment. A 1,500-m runner ($\dot{V}O_2max = 79\ ml \cdot kg^{-1} \cdot min^{-1}$) stated in the postrun questionnaire that during the Gatorade loading that "he felt worse on the treadmill" and that during the Omega 3 Chia Loading that his "heart rate was lower on the treadmill" in relation to his speed. A half-marathon runner ($\dot{V}O_2max = 78.5\ ml \cdot kg^{-1} \cdot min^{-1}$) stated on his postrun questionnaire that "Chia seeds helped me. Felt more energized when I took it. Ran a lot slower on Gatorade (more than I expected). Also, (Gatorade) had too much sugar in it, so it started getting difficult to drink in the afternoon/evening, especially when keeping a regular eating schedule."

Although 2 of the 3 runners ran slightly faster for their timed 10k with the Gatorade treatment, both of those runners had to run at a faster pace during the first hour of their run to stay within $\pm$ 5 $b \cdot min^{-1}$of their prescribed HR. Keeping HR at 65% of their $\dot{V}O_2max$ was the constant, so speed was a variable that was adjusted to keep their HR within their zone. A half-marathon runner ($\dot{V}O_2max = 78.5\ ml \cdot kg^{-1} \cdot min^{-1}$), ran faster with the Omega 3 Chia seed loading by 1 minutes 31 seconds, the largest difference between treatments. The only marathon runner of the group ($\dot{V}O_2max = 47.8\ ml \cdot kg^{-1} \cdot min^{-1}$) almost broke his 10k personal record (2 seconds slower) with the Omega 3 Chia loading treatment.

All participants reported that both treatments were a lot of calories to drink in a day. One participant noted digestion issues or a little cramping for both treatments. Two subjects reported that they were hungrier while drinking the Omega 3 Chia seed drink.

Discussion

There was no statistical difference between Greens Plus Omega 3 Chia loading (mean = 37 minutes 49 seconds) and CHO loading (mean = 37 minutes 43 seconds) in timed 10k performance after an hour run at ~65% of their $\dot{V}O_2max$. This study is the first study to show that a CHO-loading scheme can be manipulated to add in Omega 3 Chia seeds and lead to performances that are statistically similar to CHO loading alone.

The literature has shown that with a high-fat diet, there is a significant increase in fat oxidation during exercise and thus a reduced CHO usage (3–5,8,10,13). The adaptation to a high-fat diet leads to measurable changes in the capacity to store (in muscle), recruit, transport, and use fat for oxidation (7,9,11). There are also literature data to show that there are many techniques of CHO loading and that 8 $g \cdot kg^{-1} \cdot d^{-1}$ should be consumed to enhance performance (1,15,16). There are no scientific studies that combine a CHO and fat loading strategy.

Sherman et al. (16) reported that "muscle glycogen can be elevated to high levels with a moderate exercise-diet regimen (50% CHO)." It was speculated that 50% CHO could elevate muscle glycogen with a balanced approach to CHO loading that included Omega 3 fats and proper amino acids would prove to be a better performance enhancer than a traditional CHO-loading model that is frequently used by endurance athletes today. However, no advantage was seen from the Omega 3 Chia seed-CHO approach.

Practical Applications

Omega 3 Chia loading with additional CHO appears to be an option for CHO loading for endurance events lasting >90 minutes. This approach would allow athletes to decrease their dietary intake of sugar while increasing their intake of healthy Omega 3 fatty acids. A simple scheme that can be used to apply this to a race can be found in Table 3. This dietary approach yielded results similar to traditional all-CHO loading.

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