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Research Note

Effects of a Sports Nutrition Bar on Endurance Running Performance

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ABSTRACT

The Access bar claims to contain adenosine antagonists and a precise mixture of macronutrients that are purported to improve aerobic performance by increasing fat metabolism and providing sustained exogenous energy. The purpose of this research was to examine the effect of the Access bar on endurance running performance. Twelve active, healthy runners completed 5 sessions: a $\dot{V}O_2$max test, a 30-minute familiarization session, and 3 experimental sessions. During each experimental session subjects ran a self-paced, simulated race on a treadmill (approximately 55 minutes) until they had completed a set energy expenditure target (0.8368 kJ × 60 minutes × body mass). Fifteen minutes before exercise subjects received either the Access bar and water, Uncle Tobys Peanut Butter Muesli Bar and water, or Crystal Light, using a randomized, double-blind design. Heart rate, oxygen consumption, respiratory exchange ratio, and running speed were measured every minute during testing. Blood lactate and rating of perceived exertion were assessed at selected intervals; time to finish was also recorded. Analysis of variance showed no significant difference between the 3 treatments in any of the measures. These results do not support the use of the Access Sports Nutrition Bar to enhance endurance running performance of approximately one hour.

Key Words: adenosine antagonists, exogenous energy, ergogenic aids, sports nutrition bar

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Introduction

The focus of this research was to examine the effects of the Access Sports Nutrition Bar on endurance running performance. The Access bar was developed by Dr. Lawrence Wang at the University of Alberta and is currently distributed by Melaleuca Incorporated. According to Melaleuca, over 10 million Access bars were sold in 1994 alone. In 1993, it received a U.S. patent for having ''functional usefulness in enhancing aerobic performance'' (8).

The research supporting the use of the Access bar examined the thermogenic responses of rats and humans in cold environments. It concluded that this was due to an increase in substrate metabolism, especially fat metabolism, and this would be beneficial to endurance performance (9). The developmental research on the Access bar did not include any exercise performance testing. The only previous research on the Access bar showed no significant difference in time to exhaustion between the Access bar (93.9 ± 21.4 minutes) and a water-only trial (104.6 ± 24.9 minutes) (6).

In a promotional publication, Wang (8) provided some of the scientific and physiological evidence underlying the purported benefits of the Access bar. He noted that as the body uses energy (ATP) it produces adenosine. Adenosine then acts as a negative feedback impulse, which reduces fuel support or substrate metabolism. From the patent information the adenosine antagonist present in the Access bar is believed to be 1 or more compounds within the methylxanthine group, which also includes caffeine. The product also claims to provide a precise combination of macronutrients for a continual supply of energy during sustained activity.

Although Wang did not test the effects of the Access bar on endurance running performance, the Access bar claims to (a) delay anaerobic threshold, (b) delay fatigue, (c) reduce lactate formation, (d) allow greater intensity of exercise, and (e) increase duration of endurance exercise (8). The focus of this research was to determine if the Access bar, when used as suggested by its creator, can enhance endurance running performance compared with a generic granola-type bar (Uncle Tobys) and a noncaloric control drink (Crystal Light).

Methods

This experiment was designed to be consistent with the recommended use of the Access bar as stated by its creator (to improve endurance performance of approximately 1 hour), and the way recreational and competitive athletes actually use it (i.e., to improve 10-

Table 1. Descriptive characteristics of subjects.

ID	Gender	Age (y)	Mass (kg)	Height (cm)	Level*	$\dot{V}O_2$max ($ml \cdot kg^{-1} \cdot min^{-1}$)	Body fat (%)
1	F	36	56.0	164.5	C	48.8	21.8
2	M	45	81.5	183.0	R	56.5	23.0
3	M	47	83.5	174.0	R	51.3	31.0
4	F	28	62.1	163.5	R	54.6	20.0
5	M	49	67.0	166.0	C	61.0	21.0
6	F	29	59.5	168.0	C	62.6	21.5
7	F	43	57.3	164.0	R	51.7	28.2
8	F	30	55.5	167.0	C	62.3	22.0
9	M	44	74.7	172.0	R	53.2	27.5
10	M	42	72.0	171.5	C	71.3	15.0
11	M	46	63.0	173.0	C	76.7	13.0
12	M	45	67.6	169.0	R	54.7	19.0
$\bar{x}$	F = 5, M = 7	40.3 ± 7.3	66.6 ± 9.4	169.6 ± 5.3	C = 6, R = 6	58.7 ± 8.2	21.9 ± 5.0

* C = competitive runner; R = recreational runner.

k run times). Consequently, in an effort to establish external validity, the physiological validity of the experimental protocol was compromised. For example, if a longer exercise protocol had been used, the effect of the exogenous calories and adenosine antagonist would be better assessed, but the utility to the fitness practitioner would be diminished.

This research received approval from the Institutional Ethics Review Board. Twelve healthy runners (running >40 km a week) volunteered as subjects. All subjects completed an informed consent form, a medical and health screening form, and a physical activity readiness questionnaire before the testing. Subjects were asked to rate themselves as either recreational (R) or competitive (C) runners. Subjects were grouped by running level to determine if there was a statistical effect across running level, as at least 1 methylxanthine, caffeine, has been shown to be less effective in well-trained endurance athletes (3). All subjects completed 5 sessions: a direct aerobic power ($\dot{V}O_2$max) test, a 30-minute familiarization session, and 3 experimental sessions. Their descriptive characteristics are shown in Table 1. Body fat percentage was calculated using the Durnin–Womersley table (2).

All testing was done on a Quinton 24-72 model treadmill. Subjects were required to wear a nose clip and mouthpiece connected to a T-shaped 2-way nonrebreathing valve during all testing. A calibrated metabolic cart was used to collect and analyze all expired gases. The Rayfield (modified REP-400 version) software program (Waitsfield, Vermont) was used to operate the metabolic cart. The software was modified to calculate and display a running total of energy expenditure during the exercise session. Measurements were collected every 30 seconds during the aerobic power test and every minute for the other sessions. Heart rate was assessed every 15 seconds during exercise using a Polar Vantage XL telemetric heart rate monitor. Time to completion and running speed were recorded during the experimental sessions.

The direct aerobic power test was a graded, modified Thoden (2) protocol that ended when the researcher or the subject determined that he could not continue running. To be considered valid, the results had to meet 3 of the following criteria: (a) volitional exhaustion, (b) rating of perceived exertion (RPE) score ≥19, (c) no increase in oxygen consumption (<150 ml/min) with an increase in work rate, (d) respiratory exchange ratio (RER) greater than 1.1 at conclusion of the test, and (e) reaching age-predicted maximal heart rate (220 − age).

The familiarization session was identical to the experimental sessions described below, except the distance was only half as long and the subject was not instructed to complete the session as quickly as possible.

Each subject completed their experimental sessions on the same day of the week (±1 day) and at the same clock time (±1 hour) to account for diurnal variations. The experimental sessions were randomized, double-blind, and balanced (except for 1 subject who redid a session where illness was a factor), with each subject serving as his own control.

Subjects were required to follow pretesting guidelines for all sessions. Subjects were not permitted to drink alcohol, smoke tobacco, or participate in vigorous exercise for 12 hours before the testing session. Subjects were not permitted to consume caffeine products for a minimum of 24 hours before each test. A list of caffeinated products to avoid was given to subjects. Subjects were advised not to eat a heavy meal for 3–4 hours before the aerobic power and familiarization sessions and fasted for the 6 hours preceding the experimental sessions. Subjects were asked to keep their di-

ets consistent before the experimental sessions and they recorded their food intake for the day of, and the day preceding, each experimental session for analysis. Dietary intake was analyzed with the Nutrient Analyst software program (University of Prince Edward Island, Charlottetown, PEI).

The body mass of each subject was recorded before each experimental session because body mass was used during each session to calculate the individualized energy expenditure goal. The 3 experimental sessions were the control, Uncle Tobys, and Access bar trials. Treatment administration was performed away from the testing area and subjects consumed the food and liquid associated with their treatment in as much time as necessary, and returned to the testing area. All testers were blind to the treatment. In all cases, 15 to 30 minutes elapsed between treatment administration and the start of the exercise test. This time frame was established to correspond with the Access bar instructions, which specify that it should be consumed 15 minutes before exercise on an empty stomach.

The control trial did not involve ingestion of any solid food. Subjects received 300 ml of chilled Crystal Light to consume. Crystal Light was chosen because it is noncaloric and nonnutritive. In the Access bar trial, subjects consumed the Access bar and 300 ml of water. In the Uncle Tobys trial, subjects consumed 300 ml of water and an Uncle Tobys Peanut Butter Muesli Bar that was the same mass (38 $\pm$1 g), and identical macronutrient and energy content as the Access bar. Because the 2 bars had the same macronutrient composition, and both were consumed with water, it was assumed that the gastric emptying rate would be similar between the 2 trials. After the treatment administration, subjects warmed up by running on the treadmill and were given the opportunity to stretch and use the washroom.

A formula was developed, entitled C-GOAL (caloric goal for athletes of all levels), that could be applied to each subject to determine the energy expenditure they were required to complete during the testing. The C-GOAL formula for the protocol was determined during the pilot work phase of this research. On the basis of the pilot work, the formula of 0.8368 kJ·min (0.2 kcal·min) of running per kilogram of body mass was adopted. This protocol was developed on the basis of research by Jeukendrup et al. (5) that showed that a protocol that involved completing a fixed quantity of work was more reliable than a test that continued until volitional exhaustion.

The desired length of the experimental session was 60 minutes. Applying the C-GOAL formula, each subject was given an energy expenditure target: 0.8368 kJ $\times$ body mass (kg) $\times$ 60 minutes. For a 75-kg person, this equaled 0.8368 $\times$ 75 $\times$ 60 = 3766 kJ. Using hand signals, subjects controlled the speed of the treadmill and were able to have it increased or decreased. The grade of the treadmill remained level at 0° grade throughout all the experimental sessions. Increasing the speed of the treadmill increased the rate of work being performed and decreased the time to finish and vice versa. Subjects were instructed to work hard, treat the energy expenditure goal as a finish line in a race, and attempt to complete the work as quickly as possible. Subjects were not informed of their speed or pace during the exercise; however, they were notified of their energy expenditure (kJ) at regular intervals. Time to completion was one of the most important performance variables. Therefore, subjects did not know the time during the test or the total time to completion. Subjects were not permitted to wear a watch during the experimental sessions and no clock was visible in the testing area.

Lactate was measured at 5 intervals during the experimental sessions. The first measurement was taken 3 minutes before the start of the treadmill. Lactate was measured again at 25, 50, 75, and 100% of the total work. A drop of capillary blood was taken from a fingerprick and analyzed using an Accusport portable lactate analyzer. All blood samples were collected according to standard safety practices (7). The Accusport portable lactate analyzer has been validated by this laboratory as well as others (4). As a result of difficulties encountered during the blood sampling, 16 of the 180 samples were lost (3 from the Access bar treatment, 6 from the Uncle Tobys treatment, and 7 from the Crystal Light treatment).

Subjects were asked for an RPE (1) at the same 4 intervals (except 1 minute later) as lactate measurement during the exercise: 25, 50, 75, and 100% of the total work.

Oxygen consumption ($\dot{V}O_2$), carbon dioxide production ($\dot{V}CO_2$), minute ventilation, RER, energy expenditure, heart rate (HR), time to completion, and running speed were recorded during each trial.

A repeated-measures analysis of variance (ANOVA) was performed to determine if there were statistical differences across treatments, order, running level, and gender. Analyses were performed on the following measures: subject's diet (kJ, carbohydrates, protein, and fat), subject's mass, energy expenditure goal, mean running speed, mean kJ·min, time to finish, mean HR, mean RER, mean $\dot{V}O_2$(ml·kg^{-1}·min^{-1}), mean $\dot{V}O_2/\dot{V}O_2$max, blood lactate, exercising blood lactate minus resting blood lactate, running speed, RPE, and RPE/running speed. For running speed, kJ·min^{-1}, HR, RER, $\dot{V}O_2$(ml·kg^{-1}·min^{-1}), and $\dot{V}O_2/\dot{V}O_2$max, the mean value for each experimental session was calculated before the analysis was performed. The data were analyzed using a repeated-measures ANOVA across treatment (3), order (3), running level (2), and gender (2).

Analyses were performed on the 2 factors that were measured at intervals: blood lactate and RPE. The data were analyzed using a repeated-measures ANOVA

Table 2. Running speed, kJ/min, time to finish, body mass, and energy expenditure goal across treatments.*

Treatment	Running speed (km/h)	kJ/min	Time to finish (min)	Body mass (kg)	Energy expenditure goal (kJ)
Access	12.7 ± 0.9	62.8 ± 2.6	54.3 ± 6.7	66.6 ± 9.7	3347 ± 485
Crystal Light	12.6 ± 0.9	61.5 ± 2.4	54.6 ± 6.2	66.4 ± 9.7	3334 ± 485
Uncle Tobys	12.9 ± 1.0	62.8 ± 2.8	54.2 ± 7.3	66.5 ± 9.6	3338 ± 485

* All values expressed as mean ± *SD*.

Table 3. Heart rate (HR), respiratory exchange ratio (RER), $\dot{V}O_2$ (ml·kg^{-1}·min^{-1}), $\dot{V}O_2/\dot{V}O_2$max, across treatments.*

Treatment	HR	RER	$\dot{V}O_2$	Mean $\dot{V}O_2/\dot{V}O_2$max
Access	155 ± 12	0.90 ± .03	45.7 ± 6.8	78.0 ± 6.6
Crystal Light	154 ± 14	0.88 ± .01	45.4 ± 5.8	77.7 ± 5.2
Uncle Tobys	156 ± 11	0.90 ± .01	45.8 ± 7.2	78.1 ± 6.2

* All values expressed as mean ± *SD*.

across treatment (3), order (3), running level (2), gender (2), and testing interval (5 for blood lactate, 4 for RPE).

For all data, statistical significance was set at $p < 0.05$. Data analysis was completed using the Minitab software package (Minitab Inc, State College, PA). All results are presented as means (±*SD*).

Results

Analyses of the pretesting dietary records showed no significant differences in dietary intake, protein percentage, fat percentage, or carbohydrate percentage across experimental sessions.

The body mass and energy expenditure goal results are shown in Table 2. ANOVA showed no significant difference between the mass and energy expenditure goal for subjects across experimental sessions. The protocol described previously allowed subjects to increase their own running speed, which would increase their energy expenditure per minute, and decrease the time to finish. These 3 variables, therefore, are closely related and are very important. ANOVA revealed no significant differences across the experimental trials for running speed, kJ·min^{-1}, or time to finish (Table 2).

Mean exercise HR and mean RER data are shown in Table 3. No significant differences were observed in HR or RER among trials. There was also no significant change in HR response across the order of the trials. ANOVA showed no significant differences across trials in mean $\dot{V}O_2$ (ml·kg^{-1}·min^{-1}) and mean $\dot{V}O_2/\dot{V}O_2$max (Table 3).

Blood lactate values, measured at 5 intervals, are shown in Table 4. There were no significant differences across the 3 trials in blood lactate levels. There was, however, a significant testing interval effect, with the last measurement being significantly different from all the others. The 50 and 75% values were also significantly higher than measures taken at rest. Similar to blood lactate, there was no treatment effect for RPE, but there was a testing interval effect.

When grouped by running level and gender, the competitive runners, and the male runners, had significantly higher $\dot{V}O_2$max values ($p < 0.01$). The competitive runners and male runners had significantly better ($p < 0.01$) performance indicators in running speed, mean energy expenditure, time to finish, and mean $\dot{V}O_2$. There was no significant testing order effect shown for any of the variables across the 3 experimental sessions.

Table 4. Blood lactate (BLa) and RPE, across treatment.*

Treatment	Rest	25	50	75	100
BLa (mM·L^{-1}) at testing interval (percentage of completion)					
Access	1.7 ± 0.6	2.8 ± 1.2	3.0 ± 1.4	3.0 ± 1.4	5.0 ± 2.6
Crystal Light	1.5 ± 0.4	2.2 ± 1.4	3.2 ± 1.4	3.5 ± 1.5	5.0 ± 2.3
Uncle Tobys	1.6 ± 0.3	2.9 ± 1.4	3.2 ± 1.7	3.8 ± 1.6	5.2 ± 2.5
RPE at testing interval (percentage of completion)					
Access		12.3 ± 2.2	14.3 ± 1.8	14.9 ± 1.8	16.9 ± 1.8
Crystal Light		12.2 ± 2.0	14.3 ± 1.7	15.2 ± 1.4	16.6 ± 1.7
Uncle Tobys		12.4 ± 2.3	14.3 ± 2.0	15.1 ± 1.8	17.3 ± 1.4

* All values expressed as mean ± *SD*. RPE = rating of perceived exertion.

Discussion

The pretesting data showed no significant differences across treatments, indicating that subjects were able to keep their diets and body mass consistent across experimental sessions. The performance results were also not significant across treatments. The mean $kJ \cdot min^{-1}$ values were very close, with only 1.3 $kJ \cdot min^{-1}$ difference between the 3 experimental treatments. The mean time to finish values were equally similar. Previous research on the Access bar by Kolkhorst et al. (6) used a protocol that continued until exhaustion. Although not statistically significant, they found that the Access trial caused subjects to reach exhaustion *more quickly* (93.9 ± 21.4 minutes) than a water-only control trial (104.6 ± 24.9 minutes). Kolkhorst et al. (6) could offer ''no logical explanation (p. 276)'' for the nonsignificant time difference.

The mean HR data was within 2 beats per minute ($b \cdot min^{-1}$) across the 3 treatments and was not significantly different. Mean RER was not significantly different between treatments, but the Uncle Tobys and Access treatments ($\bar{x} = 0.90$) were higher than Crystal Light ($\bar{x} = 0.88$). Other research examining the Access bar and exercise performance also failed to show a significant difference in RER between the Access bar and a placebo (6).

The results of mean $\dot{V}O_2$ ($ml \cdot kg^{-1} \cdot min^{-1}$) and mean $\dot{V}O_2/\dot{V}O_2max$ were very similar. The difference between the means of $\dot{V}O_2$ was 0.4 ml among the 3 treatment conditions. The mean $\dot{V}O_2/\dot{V}O_2max$ values were within 0.4% among the 3 treatments. A higher value in either of these measures would indicate that subjects were performing at a greater work rate.

The results for blood lactate showed no significant differences across treatments. The difference between the resting blood lactate value for the 3 treatments was $0.2\ mM \cdot L^{-1}$. In this protocol, individuals had varying running speeds and therefore blood lactate values were standardized by dividing by running speed. The blood lactate/running speed values were not significantly different across treatments. This conflicts with claims (8) that the Access bar would reduce lactate formation. Similar blood lactate results were reported by Kolkhorst et al. (6). There was no significant difference in RPE across the 3 treatments, which is similar to other research in this area (6).

The results of this study demonstrated that the Access bar was no more effective than Uncle Tobys Peanut Butter Muesli bar or Crystal Light, when used to enhance endurance running performance of approximately 1 hour. The results of this research are similar to the only other published study examining the effects of the Access bar on exercise performance (6).

Practical Applications

The results of this research on recreational and competitive runners of both genders does not support the use of the Access Sports Nutrition Bar to enhance endurance running performance of about 1 hour.

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