

The Efficacy of SPORT™ as a Dietary Supplement on Performance and Recovery in Trained Athletes

Brian W. Timmons, Ian J. Newhouse, Robert E. Thayer, Jim E. McAuliffe, and Steve McIllwaine

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Abstract/Résumé

This study investigated the efficacy of SPORT™ (a popular dietary supplement) in improving performance and assisting recovery in 9 trained athletes. In a double-blind, crossover experiment, subjects ran at workloads of 60 and 80% of peak oxygen uptake (PeakVO₂) for 5 min each with 5 min recovery after each bout and at 100% PeakVO₂ until exhaustion. Two capsules of either SPORT™ or a gelatin placebo were administered 1 hr prior to exercise and immediately after each workload. Heart rate (HR) and blood lactate (BLa) were measured at 1 hr prior to exercise, immediately after the 100% exercise bout and at 5, 10, 20, and 45 min during recovery. No significant differences between treatments on HR and BLa measures at any of the 6 time periods, or on subjects' time to exhaustion were found. Under the conditions of this experimental design, SPORT™ had no beneficial effects on performance or recovery in trained athletes.

Le marché des suppléments nutritionnels dans le domaine du sport est énorme. En 1990, les ventes au détail se sont chiffrées à 3,3 milliards de dollars et ont sans cesse augmenté par la suite. Cette étude analyse les effets d'un supplément nutritionnel populaire, le SPORT™,

The authors are with the School of Kinesiology at Lakehead University, Thunder Bay, Ontario P7B 5E1.

sur la performance et la récupération de neuf athlètes. Sept coureurs de demi-fond et deux skieurs de fond participèrent à une étude à double insu au devis contrebalancé. Les exercices de course demandés aux sujets furent : cinq minutes à 60 % et à 80 % du $\dot{V}O_2$ de crête, avec cinq minutes de repos entre chaque effort, puis à 100 % du $\dot{V}O_2$ de crête jusqu'à épuisement. Une heure avant les exercices et après chacun des efforts, les sujets avalèrent deux capsules d'une substance placebo à base de gélatine ou le SPORT™. Les valeurs de fréquence cardiaque et de lactate sanguin ont été enregistrées une heure avant les exercices, immédiatement après l'effort à 100 % et à la 5^e, 10^e, 20^e et 45^e minute de la récupération. D'après le test des signes de Wilcoxon pour observations appariées, il n'y eut aucune différence significative entre les temps d'épuisement et entre les valeurs des variables d'intérêt à chacun des six moments de la mesure. En conclusion, le supplément nutritionnel n'améliore ni la performance ni la récupération dans le contexte expérimental de cette étude.

Introduction

The popular dietary supplement SPORT™, from the nutritional product company Mannatech, is purported to decrease recovery time after strenuous exercise. A definition of strenuous exercise is not provided in any of Mannatech's literature, and SPORT™ is marketed as both a training and competition aid in events ranging from sprints to long distance. For the purposes of this study, recovery time is defined as that time when physiological processes altered during exercise return to baseline levels (Virus, 1985). In addition, any Mannatech literature available to the author gave no recommendation for a specific or appropriate amount of SPORT™ to be taken by the consumer. Taking into consideration the apparent lack of scientific experimentation with SPORT™, this study attempted to investigate its true effectiveness. By noting time to exhaustion and by using standard measures of the recovery process, heart rate (HR) and blood lactate (BLa), in a controlled experimental design, an improved insight into the legitimacy of SPORT™ was revealed.

A broader significance of this study is that the bold marketing and lack of scientific scrutiny afforded to SPORT™ is not unique to this particular product. With a greater emphasis on winning in sport, many athletes quickly adopt products that propose to improve performance (Burke and Heeley, 1994; Massad et al., 1995). Therefore, dietary supplementation has become common among athletes of all levels to gain the competitive "edge" in their respected athletic events. In 1994, the American government altered legislation concerning the classification of vitamins, minerals, amino acids, and herbal remedies as "foods"; this legislation was entitled "The Dietary Supplement Health and Education Act" (DSHEA). The act, as cited from the American Dietetic Association (1999), allows claims describing "the role of a nutrient or dietary ingredient intended to affect the structure or function in humans, [and] characterizes the documented mechanism by which a nutrient or dietary ingredient acts to maintain such structure or function" (p. 7). According to Wardlaw (1999) and the American Dietetic Association (1999), this act requires the Food and Drug Administration (FDA) to prove a nutritional product unsafe rather than demand the manufacturer prove its safety. As a consequence, companies are selling products without scientific scrutiny and are not subject to FDA approval. Burke and Heeley (1994) and Dykman and Dykman (1998) stress the fact that there is clearly a major need for well controlled research attempting to support the claims of industry. In Canada, the Canadian Centre for Ethics in Sport (CCES)

acknowledges the difficulty in verifying the accuracy of labeling of the nutritional supplements produced in the United States (1998). The CCES also warns that the ergogenic effects claimed by many products are unsubstantiated, and relevant information about the product pertaining to actual ingredients, side effects, and manufacturing practices is often scarce or nonexistent.

Macfarlane and Macfarlane (1998) have assembled a number of articles concerning SPORT™, which are compilations of Mannatech's own publications. SPORT™ is used primarily as a postexercise supplement combining several different bionutrients and phytochemicals. It also contains additional supplements thought to encourage the body's natural processes and was developed with the metabolic pathways of recovery in mind. It is suggested in Macfarlane and Macfarlane (1998) that the added herbs and glandulars in SPORT™ assist in the rebuilding phase of exercise recovery and enhance the associated anabolic processes. An overview of these ingredients is presented in Table 1.

The basic component of SPORT™ is dioscorea (wild yam), which is thought to provide the body with a large selection of plant sterols. One of dioscorea's functional components is diosgenin. This substance, when added to one's diet, "could help induce changes in muscle mass and/or performance" (Macfarlane and Macfarlane, 1998, p. 6). The ingredient "smilax" is also thought to act on the body with the same physiological consequences as dioscorea. "Orchic glandular extract" is the result of ground up bovine testicles thought to provide the body with testosterone. Although there is no specific mechanism explained as to how glandulars enhance anabolism, Mannatech suggests they are effective in this function. Friedl and Moore (1992), Colgan (1993), and Grunewald and Bailey (1993) refute the role of these three ingredients in SPORT™ as agents of anabolism. Their contentions are based on two theories. First, the human body does not have the appropriate enzymes to convert dioscorea or smilax into a useful substance in the body, and second, glandulars, in very high dosages, may provide testosterone, but the liver will remove this excess from the circulation. Maltodextrin is believed to play a significant role in gastric emptying during exercise (Colgan, 1993; Foster et al., 1980; MacLaren et al., 1994) due to its lower osmotic pressure as compared to glucose. Mannatech gives no physiological rationale or explanation as to the role of maltodextrin in SPORT™. Burke and Read (1993) suggest it assists in the postexercise period and glycogen synthesis. The ingredients, magnesium stearate and silicon dioxide have very little literature associated with them. Their role in the body, according to Wardlaw (1999), is to prevent caking and lumping that would otherwise make powder products difficult to use. Mannatech gives no rationale for the inclusion of these two substances in SPORT™. Mannatech's patented ambrotose™ is a carbohydrate complex designed to support cellular communication and provide optimally functioning glycoproteins (Mannatech Incorporated, 1998). There is no published research available specifically investigating ambrotose™ and exercise. The compound sodium carboxymethylcellulose is not absorbed into the circulatory system. It is used as a suspension medium in products such as eye drops and as a viscosity-increasing agent (Anderson et al., 1975). Mannatech gives no justification for the inclusion of this compound in SPORT™.

An abundance of testimonial, anecdotal results are readily donated in the defense of the product's ability to satisfy its objectives. By analyzing the recovery period, monitored by HR and BLA, and the time to exhaustion at a maximal workload

Table 1 Ingredients of SPORT™

Ingredient	Suggested physiological role in the body	Role accepted by	Role rejected by
Ambrotose™	Improved cell to cell communication	Mannatech Incorporated (1998)	N/P
Dioscorea (plant sterol)	Support of the endocrine system	Fioretti in Macfarlane and Macfarlane (1998)	Friedl and Moore (1992); Phillips (1997); Wheeler as cited in Cowart (1992)
Diosgenin	Precursor in the synthesis of prohormones	Tone in Macfarlane & Macfarlane (1998)	Colgan (1993); Friedl and Moore (1992)
Magnesium Stearate	Prevents caking of powdered food products	Wardlaw (1999)	N/P
Maltodextrin	Assists in gastric emptying and provides carbohydrates to the body	Burke and Read (1993); Foster et al. (1980); MacLaren et al. (1994)	N/P
Orchic Extract	Enhances body's anabolic state	Fioretti as cited in Macfarlane and Macfarlane (1998)	Colgan (1993); Cowart (1992); Friedl and Moore (1992)
Silicon Dioxide	Same as Magnesium Stearate	Wardlaw (1999)	N/P
Smilax	Same as Orchic Extract	Fioretti as cited in Macfarlane and Macfarlane (1998)	Colgan (1993); Friedl and Moore (1992); Grunewald and Bailey (1993); Phillips (1997)
Sodium Carboxymethyl-cellulose	Viscosity-increasing agent; suspending agent	Anderson et al. (1975)	N/P

Note: N/P = No published evidence.

of trained adult athletes supplemented with SPORT™, true scientific results can be obtained and interpreted. Therefore, the purpose of the present study was to determine the efficacy of SPORT™ in terms of performance, as measured by the time to exhaustion of trained adult athletes at a workload equal to 100% of their peak oxygen consumption (Peak $\dot{V}O_2$), and in terms of the recovery process, as measured by HR and BLA.

Methods

SUBJECTS

Seven middle distance runners (5 male and 2 female) and two male cross-country skiers from Lakehead University volunteered for this study. The mean \pm *SD* and ranges for their age, weight, height, and number of years trained were 24.5 ± 6.8 years (19–42), 72 ± 9.5 kg (57.5–86), 177 ± 6.1 cm (165–186), and 8.6 ± 5.5 years (2–22), respectively. Mean \pm *SD* and range for Peak $\dot{V}O_2$ of subjects was 64.3 ± 6.7 ml/kg/min (53.5–71.0). Experimental procedures were approved by the Lakehead University Ethics Advisory Committee, and all subjects gave written informed consent before their participation in the study.

MATERIALS

Heart rate throughout the testing session was monitored using a Polar heart rate monitor (Polar CIC Inc., New York), fastened across the chest, inferior to the pectoralis major muscle. Blood lactate levels were determined with a YSI Model 1500 Sport lactate analyzer (Yellow Springs Instrument Co. Inc., Ohio). Reagents used in the preparation of BLA samples were provided in the YSI Model 1504 Starter Kit. The lancet method was used in the acquisition of capillary blood samples from the right hand. To decrease discomfort of the subjects (bruising and soreness), samples were taken from each of the four digits of the right hand. Blood samples were contained in 25 μ L capillary tubes, and their analysis was performed immediately. During the exercising period, subjects ran on a Quinton motor driven treadmill (Quinton Instruments, Seattle), and during their recovery periods, they walked on a SensorMedics Horizon™ motor driven treadmill (SensorMedics Corporation, California). A stopwatch was used to record all necessary timing.

PROCEDURE

Determination of Peak $\dot{V}O_2$ preceded testing sessions by 1–2 weeks. Peak oxygen consumption of each subject was measured using a modified incremental graded treadmill run as described in Newhouse et al. (1989) with expired gases analyzed (Vmax system, SensorMedics Corporation, California). Initial treadmill speed was 2.22 m/s (5 mph) and was increased by 0.22 m/s (0.5 mph) every minute. The treadmill remained horizontal (0% elevation) until the subject had completed 2 workloads past the workload at which the subject's respiratory exchange ratio (RER) passed a value of 1.0. At that time, speed no longer increased, but grade increased by 2% each minute until exhaustion occurred. All subjects were experienced and comfortable with running on a treadmill.

Forty-eight hours prior to the actual testing sessions, subjects abstained from strenuous physical activity. In accordance with screening procedures of the Canadian Physical Activity, Fitness and Lifestyle Appraisal (CPAFLA) manual (Canadian Society for Exercise Physiology, 1997), subjects did not consume caffeine, eat food, or smoke cigarettes 2 hr prior, nor consume alcohol 6 hr prior to the testing time. The athletes did proceed, however, with their normal, routine diets during the week between tests. Diets of the athletes were recorded 24 hr prior to the exercise testing to determine the contributing percentage of carbohydrate, fat, and protein to energy intake. Analysis of dietary data was performed using NutriQuest© software (WCB McGraw-Hill Company).

On the day of testing, subjects arrived 1 hr prior to the start of exercise. After sitting quietly for 5 min, resting HR and BLA, height, weight, age, and number of years trained were recorded. When baseline measurements had been collected, two capsules of either the 500 mg supplement or 500 mg gelatin placebo (depending on the testing session) were ingested by the subjects at 1 hr prior to the start of testing and immediately after each workload of 60, 80, and 100% Peak $\dot{V}O_2$. Subjects consumed a total of 4 g supplement or 4 g placebo. An unbiased third party presented subjects with the appropriate capsules, and they were ingested with a desired amount of water. After 1 hr, including warming up and stretching in accordance with the subject's normal routine and preference, testing commenced.

Running intensities of 60, 80, and 100% Peak $\dot{V}O_2$ were indicated by speed and elevation of the treadmill. The 60 and 80% workloads were performed for 5 min each, with active recovery of 5 min after each. Active recovery consisted of walking on a second treadmill at a preset speed of 2.5 mph and an elevation of 0%. Sufficient water was provided at all times to meet the needs of the subjects. The final workload of 100% Peak $\dot{V}O_2$ was performed until exhaustion. This exercise protocol was felt to be reflective of a race effort for middle distance track athletes. Subjects were encouraged verbally to maintain their performance throughout each workload. Immediately following the 100% workload, HR and BLA were recorded after ingestion of the final 2 capsules. Heart rate and BLA were again recorded at 5, 10, 20, and 45 min of recovery. Ten minutes of the final recovery period was completed on the second treadmill, walking at 2.5 mph and 0% elevation. After 10 min, subjects passively recovered (35 min) by sitting quietly in the laboratory. Upon attainment of the final HR and BLA values, the subjects were allowed to leave the lab. The procedure was repeated, using the other treatment 1 week later, with the exception of recording the subjects' height, age, and number of years trained. Warm-ups during the 1 hr prior to exercise were maintained consistently within individuals for both sessions; however, each individual warmed up differently.

EXPERIMENTAL DESIGN

Subjects served as their own controls in a double-blind repeated measures design with the order of treatment randomly assigned. Testing sessions were one week apart (T1 and T2) and occurred at the same time of day on each trial. Heart rate (beats per minute), BLA (millimoles per litre of blood), and time to exhaustion (seconds) were measured as dependent variables.

STATISTICAL ANALYSES

The “statistical package for the social sciences” (SPSS) software was used to calculate Wilcoxon Matched-Pairs Signed-Ranks tests, independent *t*-tests and *t*-tests for paired samples. Paired sample *t*-tests were used to analyze percentages of carbohydrate, fat, and protein from the dietary data before each testing session. In order to test for a treatment order effect influence time to exhaustion, an independent *t*-test was performed on the change scores of subjects from T1 to T2 (Armitage and Hills, 1982). As a treatment order effect was disclaimed (see Results section), time to exhaustion data was pooled. Due to the nature of the sample size, the Wilcoxon Matched-Pairs Signed-Ranks test was used to determine any significant differences in rank scores between placebo and supplement for HR, Bla, and time to exhaustion. The level of significance was set at $p < .05$ for all statistical tests.

Results

Results of *t*-tests for paired samples performed on the group's diet 24 hr prior to each exercising session showed no significant differences between percentages of ingested carbohydrate ($t(8) = -.32, p > .05$), fat ($t(8) = -.28, p > .05$) and protein ($t(8) = 0.77, p > .05$).

The independent *t*-test on change scores discounted a treatment order effect for time to exhaustion ($p = 0.88$). When data were pooled, the Wilcoxon Ranks test showed no significant differences in HR or BLA at any time interval of recovery or in performance (time to exhaustion). Heart rate, Bla, and time to exhaustion data are summarized in Tables 2, 3 and 4, respectively, with the appropriate Wilcoxon Z-scores, *p* values, and degrees of freedom.

Discussion

The investigation of dietary supplements by scientific scrutiny is justified by the sometimes unfounded and often misleading claims made by the manufacturers of so-called “nutritional products.” Specifically, the dietary supplement SPORT™ proposes to reduce the recovery time from strenuous exercise. The significance in studying this product is its use and endorsement by USA Track and Field and Athletics Canada—the two major sports bodies in the US and Canada, respectively, responsible for track and field. According to a sales associate for Mannatech, consumption of SPORT™ by these athletes is variable and individualized. This is probably due to Mannatech's lack of recommendation and guidance as to the appropriate dosages of the supplement to achieve maximal effect. This study was delimited to two capsules of SPORT™ 1 hr prior to exercise and immediately after each of 3 workloads, for a total of 8 capsules. Therefore, the 8 capsules were consumed over at least 80 min (depending on time to exhaustion of subjects) before recovery indices were recorded. The assumption was made that this length of time would be sufficient for absorption to occur. In light of our results, SPORT™, under this particular regimen of consumption, seems ineffective. The protocol for exercise used in this study was to represent the conditions of “physical exertion”

Table 2 Heart Rate Values at 6 Time Intervals in Minutes for Both Treatments

Treatment	Heart rate (bpm)					
	Pre-exercise 60	0	5	10	20	45
SPORT™	67.22 ± 11.40	182.89 ± 6.33	112.56 ± 11.37	110.67 ± 11.71	91.11 ± 12.99	81.22 ± 9.05
Placebo	64.89 ± 10.30	184.22 ± 10.37	113.33 ± 8.79	108.11 ± 8.09	91.33 ± 8.89	80.33 ± 6.76
Wilcoxon values	Z = -.95 p = 0.34	Z = -.84 p = 0.40	Z = -.70 p = 0.94	Z = -.91 p = 0.36	Z = -.77 p = 0.44	Z = -.47 p = 0.64

Note. Values of SPORT™ and Placebo represent mean ± SD for N = 9. Degrees of freedom = 8 for Wilcoxon values.

Table 3 Blood Lactate Values at 6 Time Intervals in Minutes for Both Treatments

Treatment	Blood lactate (mmol/L)					
	Pre-exercise 60	0	5	10	20	45
SPORT™	1.44 ± 0.40	8.73 ± 3.13	8.65 ± 2.58	7.22 ± 1.87	5.78 ± 1.22	2.19 ± .69
Placebo	1.76 ± 0.75	8.04 ± 3.16	9.83 ± 2.06	8.14 ± 1.30	5.33 ± 1.51	2.70 ± .64
Wilcoxon values	Z = -1.13 p = 0.26	Z = -.53 p = 0.59	Z = -1.01 p = 0.31	Z = -.77 p = 0.44	Z = -.65 p = 0.51	Z = -1.48 p = 0.14

Note. Values of SPORT™ and Placebo represent mean ± SD for N = 9. Degrees of freedom = 8 for Wilcoxon values.

Table 4 The Effects of SPORT™ on Time to Exhaustion

Treatment	Time to exhaustion (sec)
SPORT™	103.22 ± 49.75
Placebo	105.44 ± 44.33
Wilcoxon values	Z = 0.41 p = 0.68

Note. Values of SPORT™ and Placebo represent mean ± SD for $N = 9$. Degrees of freedom = 8 for Wilcoxon values.

and "workout" as described by Mannatech in their marketing of this product. Training of runners and cross-country skiers often include interval-type exercise at differing intensities. Using this rationale, athletes exercising under similar conditions to the intensities and time duration controlled in this study, who are using SPORT™ in similar dosages, may consider these findings of interest.

There was no significant difference between the diets of subjects 24 hr prior to each testing session. Extreme variations in the fat and carbohydrate content of diets have been thought to reflect alterations in the metabolism of these substrates during submaximal exercise (Jansson, 1982). These alterations may produce subsequent changes in lactate production during exercise and presumably in recovery. Also, a high carbohydrate diet has been shown to increase time to exhaustion during intense workloads as well as elicit higher BLA concentrations (Galbo et al., 1979). Because the diets of the subjects in the present study were similar in composition, no alteration in metabolism would be expected, and diet may then be disregarded as a confounding factor on time to exhaustion and BLA.

It was acknowledged that the recovery parameters of HR and BLA would be affected by the time to exhaustion (Gollnick et al., 1986). For this reason, analysis of HR and BLA took into consideration any difference in time to exhaustion. The independent *t*-test for change scores of time to exhaustion from T1 to T2 showed no significance, thereby disclaiming a treatment order effect and permitting pooling of groups regardless of treatment order. The Wilcoxon Ranks test on pooled data showed no significant differences for time to exhaustion. These results suggest that time to exhaustion was not a confounding variable for interpreting HR and BLA results. Heart rate and BLA then may be discussed in reference to the effects of treatment and not how time to exhaustion may have altered the values on T1 and T2.

Many researchers have confirmed the utility and validity of HR and BLA as physiological indices of recovery in athletes. Authorities in the field of exercise physiology (Astrand and Rodahl, 1977; Shephard, 1972; Wilmore and Costill, 1994) have identified HR as a measurable indicator of recovery. Wilmore and Costill (1994) suggest trained individuals are able to have their HRs return to baseline (or resting levels) much more quickly than the untrained. Jacobs (1986) acknowledges that HR has traditionally been used to determine the appropriate recovery

time during interval exercise. Allerheiligen (1994) agrees with the use of HR to assess recovery during interval work of athletes, thereby allowing more effective training. Following the termination of maximal exercise, levels of BLA continue to rise (Baker & King, 1991; Gupta et al., 1996; Stone & Conely, 1994). Peak values of BLA commonly have been recorded to occur at approximately 5 min postexercise (Baker & King, 1991; Gollnick et al., 1986; Lai & Lien, 1983). The return to near resting levels of BLA occurs within 30 to 60 min after the termination of exercise and is dependent on the intensity and duration of the exercise (Gollnick et al., 1986). Stone and Conely (1994) describe a person's ability to recover as reflected in the clearance of BLA from the blood. Considering the number and time span of these studies, recovery HR and BLA are widely accepted and valid indicators of the body's natural recovery process.

Results of the present study showed no significant differences between treatments for recovery HR or BLA, thereby questioning the efficacy of SPORT™. No scientific, peer-reviewed research exists on the formulation of this product showing an enhanced recovery after exercise. Although this study did not investigate the ingredients of SPORT™ individually, other researchers have questioned their theoretical role in aiding the human body during recovery. The finding that SPORT™ had no effect on HR or BLA in this study is consistent with views suggesting there is no physiological advantage to the athlete by using dioscorea (Coward, 1992; Friedl and Moore, 1992; Phillips, 1997) or smilax (Colgan, 1993; Friedl and Moore, 1992; Grunewald and Bailey, 1993). The role of orchic glandular extract and ambrotose™ is also questioned. Results of the present study found both orchic extract and ambrotose™ unlikely to affect time to exhaustion or HR and BLA during the recovery period of trained adult athletes. These four ingredients, therefore, appeared to contribute little to SPORT™ as a whole and did not improve recovery.

The failure of HR and BLA values to significantly differ between treatments at each time interval in recovery may be a reflection of the amount and timing of the supplement ingested. This study was delimited to trained adult athletes, and, therefore, the initial fitness of the subjects may also have played a role in finding no differences between treatments. The HRs of trained athletes will return much more quickly to resting level as compared to sedentary, nontrained persons (Wilmore & Costill, 1994). Had the subjects not been involved with prior training, the effects of SPORT™ may have been more noticeable.

Obtained values for BLA in the present study are comparable to those reported by Gupta et al. (1996) but lower than in other studies. This may be a result of an insufficient intensity and/or duration of the exercise workloads to elicit maximal BLA concentrations in these trained subjects. In the present study, however, SPORT™ did not seem to affect the time course of BLA recovery after exhaustive aerobic exercise in trained adult athletes.

Further research involving dosage and duration of consumption of the supplement is necessary to provide athletes with improved guidelines for use. Also, research dealing with the analysis of blood hormones, male and female steroid hormones, and adrenal corticoid hormones is required to test the hypotheses of Mannatech scientists concerning this product. SPORT™ is speculated to provide support and biochemical building blocks for the synthesis of precursors to these

hormones (Macfarlane and Macfarlane, 1998). Scientific scrutiny should also be applied to the many other ergogenic aids and supplements being marketed today.

Conclusion

Under the conditions of this study, the dietary supplement SPORT™ had no beneficial effect on the recovery process as measured by HR and BLA. Also, ingestion of this product did not significantly increase time to exhaustion at a workload of 100% Peak $\dot{V}O_2$. Therefore, this study questions the efficacy of SPORT™ and its role in performance and in the recovery process of trained adult athletes after strenuous exercise.

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