The Effects of ENDUROX™ on the Physiological Responses to Stair-Stepping Exercise

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Many athletes and fitness enthusiasts look to ergogenic aids to accelerate or enhance physiological and performance adaptations to training or to make training feel easier and produce less homeostatic disruption so they can train harder. ENDUROX™, whose active ingredient is listed as the herb ciwujia (Radix Acanthopanax senticosus), is advertised as such an ergogenic aid.

Literature published by Pacific Health Laboratories (Kaman, 1996), which manufactures and distributes ENDUROX™, touts increased swim time to exhaustion in laboratory animals ranging from 72 to 318% over control trials, from 47 to 111% over caffeine trials, from 47 to 190% over ginseng-cordyceps-wolfberry and ginseng-cordyceps trials, respectively, and 43% over a ginseng trial alone. Three clinical trials with humans purport confirmation of these results. Study 1 claimed to show a 43.2% increase in fat utilization and a 31–33% decrease in lactate accumulation during incremental cycle ergometer exercise to maximum in response to 2 weeks of 800-mg·d⁻¹ supplementation. Study 2 reported a 22% increase in fat utilization during a 10-min treadmill walk after 2 weeks of 1,200-mg·d⁻¹ supplementation. Finally, Study 3 described a 30% increase in fat utilization and a 7% decrease in heart rate while exercising on a cycle ergometer at 100 W for 60 min after 10 days of 800-mg supplementation.

Each of these studies has serious methodological flaws. None appears to have followed a randomized crossover single or double blind design. None mention placebos. The studies do not describe participants, and in Study 2 training level variations between the control and experimental groups could account for the results, if such a difference existed. The studies make no mention of a pretest meal, and what food is eaten can impact fuel utilization. They do not report statistical analyses other than percentage changes. None of the studies have been published in peer-reviewed sources to date. Therefore, the purpose of this study was to evaluate the claims that ENDUROX™ will spare carbohydrates and increase fat metabolism, delay lactic acid accumulation, decrease heart rate, and decrease feelings of fatigue during exercise.

Methods

Participants

Ten recreationally active individuals (5 men and 5 women; M age = 23.9 years, SD = 1.79; M height = 174.5 cm, SD = 7.92; M weight = 75.6 kg, SD = 14.58) served as participants in this study after signing informed consent forms approved by the university’s Institutional Review Board.
Board. The study followed a double blind, placebo-controlled crossover design, with balanced randomization.

**Testing Schedule and Controls**

For the first 10 days participants either ingested 800 mg of ENDUROX™ in two capsules with water or two identically sized capsules filled with granulated brown sugar that appeared similar to the ENDUROX™ capsules. On the 10th day, participants completed the first exercise test (T₁). Days 11–15 were a washout period in which no one took any capsules. From Day 16 to 26, each participant ingested the opposite type of capsule from what they had initially been given. On Day 26 participants completed the second exercise test (T₂). During the supplementation period, participants were instructed to continue their normal training and dietary habits. Each participant was tested at the same time of day on the same day of the week for both trials. All were requested to replicate both their 24-hr activity and food intake from T₁ to T₂, but neither activity nor food records were kept to verify this. Each participant ingested a standard meal that consisted of one bagel with jelly, one piece of fruit, water, and the last two capsules 2–3 hr prior to both exercise tests. All participants signed a control sheet prior to testing indicating compliance with the pretesting "loading" protocol.

**Exercise Tests**

Exercise testing was done on a StairMaster™ 4000PT (StairMaster Sports/Medical Products, Inc., Kirkland, WA). All participants were familiarized with this equipment prior to testing and self-selected the load at which they wished to exercise in a practice session. Each self-selected workload was recorded during T₁ and replicated during T₂. The workloads ranged from 97 to 191 W and averaged 137.7 W (± 3.49) and 68.9 steps·min⁻¹ (± 16.7). Five minutes of gradual warm-up preceded 25 min of exercise at the self-selected workload. During the exercise tests, oxygen consumption (VO₂), respiratory exchange ratio (RER), heart rate, and rating of perceived exertion (RPE) were recorded each minute. Blood lactate accumulation ([La⁺]) was recorded at rest and at Minutes 10, 20, and 30 during exercise.

**Equipment**

An Applied Electrochemistry Oxygen analyzer (model S-3A) and Carbon Dioxide analyzer (model CD-3A; AEI Technologies, Pittsburgh, PA), with Rayfield software (Rayfield, 1982) and an Apple IIe computer (Apple Computer, Inc., Cupertino, CA). Hans Rudolph two-way nonrebreathing valve (model 2700; Hans Rudolph, Inc., Kansas City, MO), Pneumoscan spirometer (model S-301; Vacumetrics, Ventura, CA), and headgear support were used for gas analysis and ventilation measurement. Calibration was completed prior to each test using gases of known concentration and a 3-L volume syringe. Heart rate was monitored and recorded by a Polar Vantage XL heart rate monitor (Polar Electro, Inc., Port Washington, WA). These data were downloaded via a Polar computer interface. The 6–20 Borg Rating of Perceived Exertion scale (1982) was used, and all participants were familiarized with this scale prior to testing. Blood samples were obtained by finger prick into a 25-microliter capillary tube for injection into a Yellow Springs lactate analyzer (YSI model 1500 Sport; YSI, Inc., Yellow Springs, OH) calibrated prior to each test according to the manufacturer’s specifications and standards. Centers for Disease Control and Prevention (CDC) guidelines were followed for collecting all blood samples and disposing of wastes.

**Statistical Analyses**

Dependent t tests were used to determine if a significant difference occurred in each of the dependent variables between the control and experimental trials using SPSS software, version 6.1.3. The alpha level was set at .03 to control for overall Type I error rate because of the multiple t tests.

**Results**

The experimental results are presented in Table 1. The statistical analyses for oxygen consumption, t(9) = 0.52, p = .618; RER, t(9) = 0.51, p = .885; heart rate, t(9) = 0.38, p = .714; RPE, t(9) = 0.50, p = .632; and lactate concentration, t(9) = 0.77, p = .461, revealed no statisti-
cally significant difference between the means of the control and the ENDUROX™ tests results. The resting lactate concentration values show that these values were within the normal expected range. No statistical analysis was done between resting and exercise lactate values.

**Discussion**

The results of the current study do not support the claims for ENDUROX™. What percentage of differences did occur in the current study favored the control (C) and not the experimental (E) trial. Oxygen consumption was 3% less in the C than in the E trial, RPE was 5.88% less, and the concentration of lactate was 13.8% less. These changes are opposite all those reported by Kaman (1996) but did not achieve statistical significance.

The reasons for the lack of positive changes in the current study may be revealed in the stringency of the design. Training status was controlled by the crossover of participants who maintained their normal patterns of activity. The blinding of participants was accomplished only as one believed he or she knew when he or she was taking the real supplement. The impact of diet on fuel utilization was minimized by the 24-hr replication and ingestion of a standardized pretrial meal. This meal represented the content and amount an exerciser realistically might eat a couple of hours before working out. All the previous participants were men, but there is no reason to believe that data obtained from the women in the current participant pool contributed to the lack of significant differences. The modality or intensity-duration should also not be responsible for the insignificant results. This workout was also specifically structured to mimic what a fitness exerciser in a health club might do.

Comparing the current results with others in the literature is problematic. Only three other studies on ENDUROX™ have been found, and each is available only in abstract form. However, they share a common theme, that is, no significant difference in physiological responses to submaximal exercise (Cheuvront, Moffatt, Biggerstaff, Bearden, & McDonough, 1998; Smeltzer & Gretebeck, 1998) and critical power or anaerobic work capacity (Stout, Eckerson, & Yee, 1998) as a result of ENDUROX™ supplementation at the level suggested by Pacific Health Laboratories.

Comparison with compounds of similar chemical composition is also problematic. The active ingredient in ENDUROX™ is listed as the Chinese herb ciwujia (Radix Acanthopanex senticosus). Acanthopanax senticosus is also known as eleutherococcus senticosus, or, more commonly, Siberian ginseng (Farnsworth, Kinghorn, Soejarto, & Waller, 1985). The term Siberian ginseng is a misnomer; for it is not a true ginseng. Three medicinal species of ginseng (Panax ginseng C.A. Meyer—Chinese or Korean ginseng; Panax japonicus C.A. Meyer—Japanese ginseng; and Panax quinquefolius—American ginseng) are currently recognized. The active constituent in each of these is saponins (compounds of sugar and another chemical ingredient). The saponins in true ginsengs are called ginsenosides or panaxosides. The saponins in Siberian ginseng are known as cisjáanosides or eleutherosides and are completely different in chemical structure from the saponins of the panax ginsengs (Bahrke & Morgan, 1994; Shao, Kasai, & Tanaka, 1989; Farnsworth et al., 1985). Despite the nomenclature used, Pacific Health Laboratories neither claims nor denies that ENDUROX™ is Siberian ginseng (Schwartz, 1997). This is particularly confusing, because, in the swimming endurance trials mentioned in this paper's introduction, ENDUROX™-supplemented animals were said to have exceeded the performance of animals supplemented with ginseng alone or in combination with other herbs. The species of ginseng used in these comparisons is not given.

Both the panax and Siberian ginsengs are touted as being adaptogens, that is, substances that do no harm while normalizing physiological responses and increasing resistance to physical, chemical, or biological stressors (Farnsworth et al., 1985). The panax ginsengs are generally considered to be more potent than Siberian ginseng (Bahrke & Morgan, 1994). However, studies using either form have failed to consistently support ginseng as an ergogenic aid. Much of the literature has been reported only in Russian (Farnsworth et al., 1985).

In their 1994 review, Bahrke and Morgan concluded that "...the efficacy of ginseng as an ergogenic aid, in terms of human performance, remains to be demonstrated" (p. 245). They emphasized that this may reflect the absence of an ergogenic effect of ginseng or the inadequacy of the research designs. The latter seems generous, because the poorly designed and controlled studies were generally those that showed performance and physiological benefits, whereas the more stringent designs did not.

In contrast to this generalization, one study (Asano et al., 1986) not included in Bahrke and Morgan's 1994 review, in which eleutherococcus senticosus was used, employed both a control and placebo trial. Total work on a cycle ergometer and time to exhaustion were significantly higher in the eleutherococcus trial than either of the other two trials. In support of this generalization, two recently published studies (Engels & Wirth, 1997; Morris et al., 1996) using double blind, randomized, placebo-controlled designs showed no performance, cardiorespiratory, substrate utilization, oxygen consumption, or perceptual effects of panax ginseng.

The ENDUROX™ capsules taken in this study were not chemically analyzed for ciwujia content. The study was intended to determine the efficacy of the claims for the product as it was commercially available to the exer-
Cising public. In light of the confusion as to what EN-
DUROX™ really is, it should perhaps be analyzed as an
unknown chemical to determine whether saponins are
the active ingredients, and, if so, which ones. Until that
is done the current results cannot be placed firmly
within the body of literature on "ginseng." As is, the current
results cast serious doubts on the effectiveness and use-
fulness of ENDUROX™.

Conclusion

There were no significant differences or benefits be-
tween the ENDUROX™ and placebo trials in oxygen
consumption, fat metabolism, lactate accumulation,
heart rate, or subjective ratings of fatigue. The claims
for ENDUROX™ were not verified in participants per-
forming 25 min of stair-stepping exercise at a self-se-
lected intensity.

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