THERMOGENIC EFFECT OF A HIGH ENERGY, PRE-EXERCISE SUPPLEMENT

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Abstract:

The thermogenic effect of a high energy supplement was examined in ten healthy and physically active female subjects that underwent two testing sessions administered in a randomized and double-blind fashion. The subjects reported to the Human Performance Laboratory after at least a 3-hour post-absorptive state and were provided either 120 ml of the supplement (SUP), or 120 ml of a placebo (PL). Following ingestion the subjects rested in a semi-recumbent position for 3 hours. The area under the curve analysis revealed no difference in oxygen consumption between SUP and PL for the 3 hours study period. No difference in energy expenditure was seen between SUP (.92±.16 kcal $\cdot$min^{-1}) and PL (.89±.17 kcal $\cdot$min^{-1}). A significant difference in the utilization of stored fat as an energy source was seen between the groups during the 3 hours study (.42±.18 kcal $\cdot$min^{-1} and .24±.10 kcal $\cdot$min^{-1} in SUP and PL, respectively). These differences were seen in the first (.35 ±.19 kcal $\cdot$min^{-1} and .20±.13 kcal $\cdot$min^{-1} in SUP and PL, respectively) and second hour (.46±.21 kcal $\cdot$min^{-1} and .24±.11 kcal $\cdot$min^{-1} in SUP and PL, respectively), but not in the third hour (.47±.25 kcal $\cdot$min^{-1} and .33±.20 kcal $\cdot$min^{-1} in SUP and PL, respectively). No differences in heart rate, blood pressure or mood were seen between the groups. The results indicate that although acute ingestion of this supplement does not increase energy expenditure, it does appear to stimulate a significant increase in fat utilization.

Key words: *females, energy expenditure, oxygen consumption, respiratory quotient, heart rate, blood pressure, mood state*

Introduction

Recent research has indicated that high energy drinks are the most popular supplement besides vitamins in the American adolescent and young adult population (Bell, Dorsch, McCreary, & Hovey, 2004; Dodge & Jaccard, 2006; Hoffman et al., 2008). The desire to reduce or control body fat appears to be the primary reason for the use of these supplements (Bell et al., 2004; Dodge & Jaccard, 2006; Hoffman et al., 2008). Thermogenic supplements can accomplish these goals by increasing both energy expenditure and the rate of fat oxidation. Often, caffeine is the primary ingredient in these supplements. However, despite research demonstrating that caffeine is effective in enhancing lipolysis and fat oxidation (Acheson, Zahorska-Markiewicz, Pittet, Anantharaman, & Jéquier, 1980; Dulloo, Geisler, Horton, Collins, & Miller, 1989), its effects are magnified when it is combined with other anorexic agents (Haller, Jacob, & Benowitz, 2004; Hoffman et al., 2006). Thus, caffeine is often combined with one or more of these agents to enhance the thermogenic effect.

Many thermogenic supplements contain amphetamine-like compounds such as ephedra or synephrine that increase energy metabolism by stimulating adrenergic receptors resulting in enhanced fat breakdown, appetite suppression and energy expenditure (Hoffman & Stout, 2008). However, the side effects associated with these stimulants such as elevations in blood pressure and heart rate may cause uneasiness on the part of some users, and potentially can result in untoward events in individuals with underlying cardiovascular disease. As a result, some nutritional companies have begun to market weight loss supplements with ingredients that have more mild stimulatory effects and also focus more on fat metabolism and appetite suppression.

Additional ingredients in these weight loss supplements may include herbal and botanical compounds whose primary role is to increase fat oxidation and possible mood enhancement. Some of these products may include yohimbine, evodiamine, and hordenine, all of which have been shown to play a role in enhancing lipolysis and increasing energy expenditure (Barwell, Basma, Lafi, & Leake, 1989; Galitzky et al., 1988; Kobayashi et al., 2001), while phenylethylamine, 5-hydroxytryptophan and St. Johns wort extract are compounds that are reported to enhance mood (Bell & Goodrick, 2002, Grimsby et al., 1997; Popplewell, Coffey, Montgomery, & Burton, 1983; Sabelli, Fink, Fawcett, & Tom, 1996; Singewald, Sinner, Hetzenauer, Sartori, & Murck, 2004). In consideration of the popularity in the use of these high energy supplements, research is warranted concerning their efficacy. Thus, the purpose of this study was to examine the acute effect of a multi-ingredient high energy supplement on resting oxygen uptake, respiratory quotient, caloric expenditure, heart rate, blood pressure, and mood.

Methods

Subjects

Ten female subjects (age 20.4±.8yrs; height 165.4±6.6 cm; body mass 58.3±7.7 kg; body fat 20.1±4.9 %) underwent two testing sessions administered in a randomized and double-blind fashion. Following an explanation of all procedures, risks, and benefits associated with the experimental protocol, each subject gave her written informed consent to participate in this study. The Institutional Review Board of the College of New Jersey approved the research protocol. Subjects who were pregnant, smokers or taking regular medication except birth control pills were excluded from the study. Subjects with any known metabolic or cardiovascular disease, or psychiatric disorder were also excluded. Subjects were also required to have been free of any nutritional supplements or ergogenic aids for the 6 weeks preceding the study, and were asked to refrain from taking any additional supplement during the duration of the study.

Study Design

The study followed a randomized double-blind, crossover design. The subjects reported to the Human Performance Laboratory on two separate days. Each testing session was separated by an average of 8 days (8.2±5.2 days). The subjects were instructed to refrain from consuming any caffeine products on the day of each testing session and from performing any strenuous physical activity for the previous 12 hours. In addition, the subjects were instructed to be at least 3 hours post-absorptive state prior to each trial. Following a 30-min resting period the subjects were randomly provided either the supplement (SUP) or the placebo (PL). On the subject's second visit to the laboratory they were provided with the opposite treatment.

Metabolic Measures

Immediately following supplement ingestion the subjects were fitted with a Medgraphics preVent™ pneumotach (Medical Graphics Corporation, St. Paul, MN) to measure oxygen consumption (VO_2) and respiratory quotient (RQ) through open-circuit spirometry using a metabolic measurement cart (CPX Ultima™ series, Medical Graphics Corporation, St. Paul, MN) using breath-by-breath analysis. Machine calibration was performed prior to each session. Measures were obtained one minute following supplement or placebo consumption, every 5 minutes for the first 30 minutes, and every 10 minutes thereafter until 180 minutes post consumption. Heart rate (HR) was also measured at these time points using a wireless HR monitor (Pacer, Polar CIC, Inc., Port Washington, NY), which updated HR display every 5 seconds. Blood pressure (BP) was measured using a sphygmomanometer and ausculatory method at 15 and 30 minutes post ingestion, and then every 30 minutes until the data collection concluded.

Questionnaires

The profile of mood states (POMS) was administered seven times during each testing session. The initial POMS administration was given as the subject reported to the Human Laboratory, and every half hour for the three hour period following supplement ingestion. All questionnaires were performed under controlled conditions (a quiet room solely with the investigator) and the same researcher performed all test administrations.

The POMS consisted of 65 words or phrases in a Likert format questionnaire which provides measures of specific mood states. It provides measures of tension, depression, anger, vigor, fatigue and confusion. A total mood score was computed by subtracting vigor from the sum of the five other negative measures and adding 100 to avoid a negative result. McNair, Lorr, and Droppleman (1971) have reported internal consistency of measures ranging between .85 to .95 and test-retest reliability estimates ranging between .65 and .74. These lower coefficients of stability are thought to be indicative of transient and fluctuating characteristics of mood states. During all test administrations the participants were asked to describe their feelings as to how they were feeling at that moment.

Supplement

On each visit the subjects consumed 120 ml of a ready-to-drink supplement (SUP) or placebo (PL). The supplement used is marketed as Redline Princess® (Vital Pharmaceuticals, Davie, FL) and contains caffeine, beta-alanine, vitamin C, and the following herbal and botanical compounds; Beta phenylethylene, hordenine HCL, Evodiamine, N-methyl tyramine, 5-hydroxytryptophan, potassium citrate, vinpocetine, yohimbine HCL, and St. Johns wort extract. The placebo was similar in appearance and taste to Redline Princess®, but contained only an inert substance.

Statistical Analyses

The area under the curve (AUC) for VO_2 was calculated by using a standard trapezoidal technique. RQ, HR, BP and POMS were averaged over each hour and the entire 180-minute period. Statistical analysis of the data was accomplished using a repeated measures analysis of variance. In the event of a significant F-ratio, LSD *post-hoc* tests were used for pair-wise comparisons. AUC analysis and 180-minute comparisons were analyzed using dependent t-tests. A criterion alpha level of $p \leq .05$ was used to determine statistical significance. All data are reported as mean±SD.

Results

The area under the curve analysis revealed no significant differences in VO_2 between SUP and PL for the three-hour study period (Figure 1). In addition, no significant difference in energy expenditure was seen between SUP (.92±.16 kcal·min^{-1}) and PL (.89±.17 kcal·min^{-1}) during the entire three-hour study (Figure 2). A significant difference was seen between the two groups in the average RQ for the three-hour study period (Figure 3). Although no change was seen in caloric expenditure during the three-hour study protocol, there was a significant difference observed in the utilization of fat as an energy source (Figure 4). Differences in the utiliza-tion of fat were seen in the first (.35±.19 kcal·min^{-1} and .20±.13 kcal·min^{-1} in SUP and PL, respectively) and second hour (.46±.21 kcal·min^{-1} and .24±.11 kcal·min^{-1} in SUP and PL, respectively), but not seen in the third hour (.47±.25 kcal·min^{-1} and .33±.20 kcal·min^{-1} in SUP and PL, respectively).

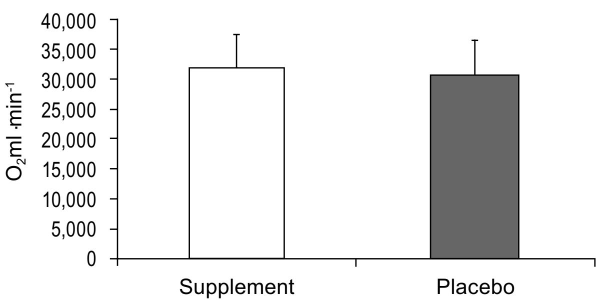

Figure 1. Under the curve analysis for 3-hour post-exercise oxygen consumption following supplement ingestion. Data are reported as mean±SD.

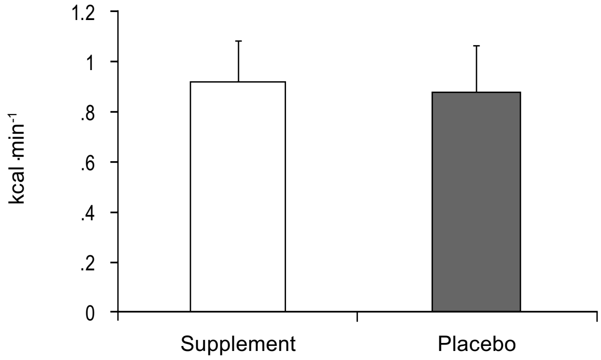

Figure 2. Average 3-hour energy expenditure. Data are reported as mean±SD.

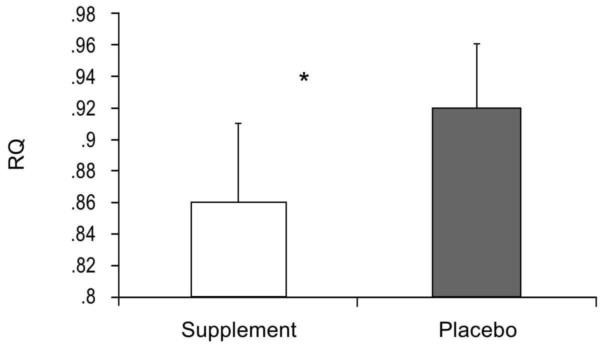

*Figure 3. Average 3-hour respiratory quotient (RQ). * = significant difference (p<.05) between the supplement and placebo. Data are reported as mean±SD.*

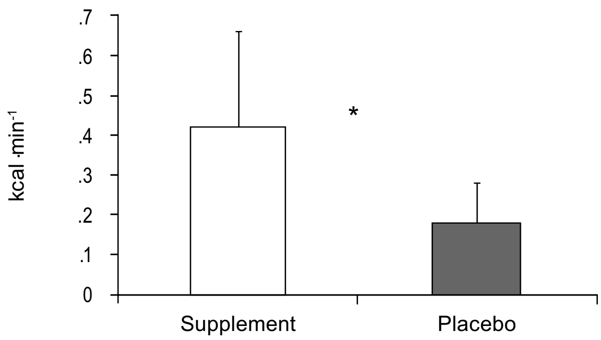

*Figure 4. Average 3-hour fat utilization. * = significant difference (p<.05) between the supplement and placebo. Data are reported as mean±SD.*

The average hourly cardiovascular response to the study protocol is seen in Table 1. No significant differences in the average hourly heart rate, or systolic and diastolic blood pressure between the groups were seen during the 3-hour study. Comparisons between groups in the average profile of mood states scores can be observed in Figure 5. Analysis of mood states showed no differences in tension, depression, anger, vigour, fatigue and confusion between the SUP and PL during the three-hour study.

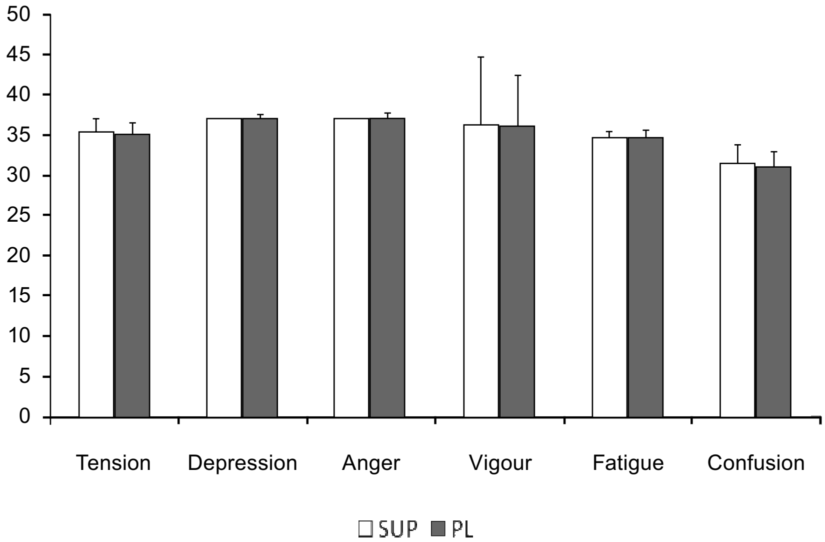

Figure 5. Average profile of mood states. Data are reported as mean±SD.

Table 1. Average hourly cardiovascular measures

Variable		Hour 1	Hour 2	Hour 3
Heart rate (b ·min^{-1})	Supplement	66.1±7.2	67.5±8.7	67.1±13.9
	Placebo	73.4±10.7	69.6±9.9	67.4±10.5
Systolic blood pressure (mmHg)	Supplement	102.6±3.9	103.0±4.6	102.6±3.7
	Placebo	104.0±7.1	103.6±5.9	103.9±7.1
Diastolic blood pressure (mmHg)	Supplement	73.9±5.5	72.4±5.3	73.1±5.7
	Placebo	73.4±5.0	73.8±4.1	72.0±5.3

Discussion

The results of this study indicate that a high energy supplement containing caffeine, beta-alanine, vitamin C, and the following herbal and botanical compounds; Beta phenylethylene, hordenine HCL, Evodiamine, N-methyl tyramine, 5-hydroxytryptophan, potassium citrate, vinpocetine, yohimbine HCL, and St. Johns wort extract is effective in significantly increasing fat utilization, but does not increase acute energy expenditure in young, healthy females. Ingestion of this supplement did not result in any change to heart rate or blood pressure indicating that this supplement may not pose a significant cardiovascular health risk in apparently healthy subjects. In addition, acute ingestion of this supplement did not alter mood in these subjects.

Caffeine has been shown to be effective in increasing lipolysis and fat oxidation (Acheson et al., 1980; Dulloo et al., 1989). However, its ability to increase energy expenditure may become more pronounced only when it is combined with compounds that stimulate adrenergic receptors such as ephedra or synephrine (Hoffman et al., 2006; Greenway, de Jonge, Blanchard, Frisard, & Smith, 2004; Roberts, de Jonge-Levitan, Parker, & Greenway, 2005; Vukovich, Schoorman, Heilman, Jacob III, & Benowitz, 2005). Considering that the supplement examined in this study contained compounds with only very mild stimulatory action, it is not surprising that energy expenditures during SUP was not significantly different compared to the placebo ingestion. Similarly, it also explains the lack of any change in heart rate and blood pressure response to the supplement.

The significant increase in the utilization of stored fat as the primary energy source during supplement administration in this study is likely related to the combination of yohimbine, evodiamine, and hordenine. Yohimbine is a selective α-adrenoceptor antagonist that has been reported to be effective in enhancing lipid metabolism (Galitzky et al., 1988; Lafontan, Berlan, Galitzky, & Montastruc, 1992). Evodiamine is a major alkaloidal from evodia fruits that has been shown to stimulate vanilloid receptor activities comparable to capsaicin (compound found in hot peppers) (Kobayashi et al., 2001). Limited research on evodiamine has shown that it can enhance lipolysis by raising core body temperature (Kobayashi, 2003). However, we can only speculate on that since core body temperature was not measured during this study. Hordenine is also an alkaloid that occurs naturally in grains, sprouting barley and certain grasses, but it is also found in small quantities in citrus aurantium (Slezak, Francis, Anastos, & Barnett, 2007). Citrus aurantium, a fruit commonly known as "bitter orange", is used in Asian herbal medicines to treat digestive problems (Fugh-Berman & Myers, 2004). It is also a mild stimulant that contributes to appetite suppression and enhances metabolic rate (Fugh-Berman & Myers, 2004). The combination of these three compounds in this supplement appears to be effective in enhancing fat oxidation for the three hour period following supplement ingestion, however the stimulatory effects from these compounds did not cause any increase in energy expenditure or change in cardiovascular measures.

The addition of phenylethylamine, 5-hydroxytryptophan and St. Johns wort extract as ingredients was intended to enhance the mood of subjects using this supplement. However, the results of this study indicate that acute ingestion of these ingredients failed to enhance mood significantly. Both phenylethylamine and 5-hydroxytryptophan are thought to enhance mood by stimulating dopamine release (Nakamura, Ishii, & Nakahara, 1998) and enhancing serotonin production (Rahman et al., 1982), respectively. St. Johns wort extract appears to act by reducing β-adrengergic receptor binding (Simbrey, Winterhoff, & Butterweck, 2003). However, an acute ingestion of these ingredients may not be sufficient to stimulate significant mood changes. Simbrey and colleagues (2003) reported that even after two weeks of St. Johns wort extract treatment no significant changes in β-adrengergic receptor binding was seen, but only after 8-weeks of treatment was significant changes realized. An acute effect on mood from phenylethylamine ingestion has been reported that is thought to be influenced by its modulating effect on catecholamine release (Popplewell et al., 1983). It is possible that the phenylethylamine concentration in this supplement (exact content not released by the manufacturer) was insufficient to cause any acute mood changes, and that a prolonged duration of supplement intake may be needed to stimulate mood changes related to 5-hydroxytryptophan and St. Johns wort extract treatment. Interestingly, phenylethylamine has also been shown to reduce appetite (Dourish & Boulton, 1981), and to stimulate lipolysis through its ability to stimulate catecholamine release and delay the reuptake of these neurotransmitters (Paterson, Juorio, & Boulton, 1990). Although this present study indicated that phenylethylamine did not affect mood, it may have contributed to the greater reliance on fat as an energy source.

The role that the additional ingredients in the supplement (e.g beta-alanine, tyramine, and vinpocetine) may have had is not clear. Beta-alanine is a non-proteogenic amino acid that can enhance the buffering capacity of muscle by increasing muscle carnosine concentrations (Dunnett & Harris, 1999). Its role as a high energy supplement though is questionable, considering that it has no known acute effect on metabolic rate or stimulation of adrenergic receptors (Hoffman & Stout, 2008). Tyramine is a monoamine compound that is derived from the amino acid tyrosine. It is an indirect sympathomimetic, meaning that it does not directly activate adrenergic receptors, but acts as a substrate for adrenergic uptake systems and monoamine oxidase prolonging the actions of adrenergic transmitters (Youdim & Weinstock, 2004). It has been used therapeutically to fight depression (Youdim & Weinstock, 2004). Its function in a high energy supplement may be to increase the sympathetic response. However, based upon the results of this study, its effectiveness in combination with the other ingredients used in this study was unable to be demonstrated. Vinpocetine is a derivative of vinacamine; a purified extract of *Vinca Minor L* (Periwinkle plant). It has been used as a cerebral vasodilator for enhancing mental alertness and memory (Kidd, 1999), and has also been shown to have antioxidant properties (Santos, Duarte, Moreira, & Oliveiera, 2000). This study though did not directly address the ability of vinpocetine to effect alertness or memory. Further research will need to determine whether the concentration of vinpocetine used in this high energy supplement is an effective agent in enhancing alertness and cognitive function.

In conclusion, the results of this study indicate that acute ingestion of Redline Princess® does not increase energy expenditure in young, healthy females. However, this high energy supplement does appear to enhance fat utilization without stimulating any increases in heart rate or blood pressure.

References

Acheson, K.J., Zahorska-Markiewicz, B., Pittet, P.H., Anantharaman, K, & Jéquier, E. (1980). Caffeine and coffee: their influence on metabolic rate and substrate utilization in normal and obese individuals. *American Journal of Clinical Nutrition, 33*, 989–997.

Barwell, C.J., Basma, A.N., Lafi, M.A., & Leake, L.D. (1989). Deamination of hordenine by monoamine oxidase and its action on vasa deferentia of the rat. *Journal of Pharmacy and Pharmacology, 41*, 421–423.

Bell, A., Dorsch, K.D., McCreary, D.R., & Hovey, R. (2004). A look at nutritional supplement use in adolescents. *Journal of Adolescent Health, 34*, 508–516.

Bell, S.J., & Goodrick, G.K. (2002). A functional food product for the management of weight. *Critical Reviews in Food Science and Nutrition, 42*, 163–178.

Dodge, T.L., & Jaccard, J.J. (2006). The effect of high school sports participation on the use of performance-enhancing substances in young adulthood. *Journal of Adolescent Health, 39*, 367–373.

Dourish, C.T., & Boulton, A.A. (1981). The effects of acute and chronic administration of beta-phenylethylamine on food intake and body weight in rats. *Progress in Neuro-psychopharmacology, 5*, 411–414.

Dulloo, A.G., Geisler, C.A., Horton, T., Collins, A., & Miller, D.S. (1989). Normal caffeine consumption: Influence on thermogenesis and daily energy expenditure in lean and postobese human volunteers. *American Journal of Clinical Nutrition, 49*, 44–50.

Dunnett, M., & Harris R.C. (1999). Influence of oral beta-alanine and L-histidine supplementation on the carnosine content of the gluteus medius. *Equine Veterinary Journal, 30*(Suppl.), 499–504.

Fugh-Berman, A, & Myers, A. (2004). Citrus aurantium, an ingredient of dietary supplements marketed for weight loss: Current status of clinical and basic research. *Experimental Biology and Medicine, 229*, 698–704.

Galitzky, J., Taouis, M., Berlan, M., Riviere, D., Garrigues, M., & Lafontan, M. (1988). Alpha 2-antagonist compounds and lipid mobilization: evidence for a lipid mobilizing effect of oral yohimbine in healthy male volunteers. *European Journal of Clinical Investigation, 18*, 587–594.

Greenway, F.L., de Jonge, L., Blanchard, D., Frisard, M., & Smith, S.R. (2004). Effect of a dietary herbal supplement containing caffeine and ephedra on weight, metabolic rate, and body composition. *Obesity Research, 12*, 1152–1157.

Grimsby, J., Toth, M., Chen, K., Kumazawa, T., Klaidman, L., Adams, J.D., Karoum, F., Gal, J., & Shih, J.C. (1997). Increased stress response and β-phenylethylamine in MAOB-deficient mice. *Nature Genetics, 17*, 206–210.

Haller, C.A., Jacob, P., & Benowitz, N.L. (2004). Enhanced stimulant and metabolic effects of ephedrine and caffeine. *Clinical Pharmacology & Therapeutics, 75*, 259–273.

Hoffman, J.R., Faigenbaum, A.D., Ratamess, N.A., Ross, R., Kang, J., & Tenenbaum, G. (2008). Nutritional supplementation and anabolic steroid use in adolescents. *Medicine and Science in Sports and Exercise, 40*, 15–24.

Hoffman, J.R., Kang, J., Ratamess, N.A., Jennings, P.F., Mangine, G., & Faigenbaum, A.D. (2006). Thermogenic effect from nutritionally enriched coffee consumption. J*ournal of the International Society of Sports Nutrition, 3*, 35–41.

Hoffman, J.R., & Stout, J.R. (2008). Performance-enhancing substances. In: R.W. Earle and T.R Baechle (Eds.), *Essentials of Strength and Conditioning* (pp. 179–200). 3rd edition. Champaign, IL: Human Kinetics.

Kidd, P.M. (1999). A review of nutrients and botanicals in the integrative management of cognitive dysfunction. *Alternative Medicine Review, 4*, 144–161.

Kobayashi, Y., Nakano, Y., Kizaki, M., Hoshikuma, K., Yokoo, Y., & Komiya, T. (2001). Capsaicin-like anti-obese activities of evodiamine from fruits of Evodia rutaecarpa, a vanilloid receptor agonist. *Planta Medica, 67*, 628–633.

Kobayashi, Y. (2003). The nociceptive and anti-nociceptive effects of evodiamine from fruits of Evodia rutaecarpa in mice. *Planta Medica, 69*, 425–428.

Lafontan, M., Berlan, M., Galitzky, J., & Montastruc, J.L. (1992). Alpha-2 adrenoceptors in lipolysis: alpha 2 antagonists and lipid-mobilizing strategies. *American Journal of Clinical Nutrition, 55*(Suppl), 219–227.

McNair, D.M., Lorr, M., & Droppleman, L.F. (1971). *Profile of mood states manual.* San Diego, CA: Educational and Industrial Testing Service.

Nakamura, M., Ishii, A., & Nakahara, D. (1998). Characterization of β-phenylethylamine-induced monamine release in rat nucleus accumbens: a microdialysis study. *European Journal of Pharmacology, 349*, 163–169.

Paterson, I.A., Juorio, A.V. & Boulton, A.A. (1990). 2-phenylethylamine: a modulator of catecholamine transmission in the mammalian central nervous system? *Journal of Neurochemistry, 55*, 1827–1837.

Popplewell, D.A., Coffey, P.J., Montgomery, A.M., & Burton, M.J. (1983). A behavioural and pharmacological examination of phenylethylamine-induced anorexia and hyperactivity − comparisons with amphetamine. *Pharmacology, Biochemistry and Behaviour, 25*, 711–716.

Rahman, M.K., Nagatsu, T., Sakurai, T., Hori, S., Abe, M., & Matsuda, M. (1982). Effect of pyridoxal phosphate deficiency on aromatic L-amino acid decarboxylase activity with L-DOPA and L-5-hydroxytryptophan as substrates in rats. *Japanese Journal of Pharmacology, 32*, 803–811.

Roberts, A.T., de Jonge-Levitan, L., Parker, C.C., & Greenway, F.L. (2005). The effect of a herbal supplement containing black tea and caffeine on metabolic parameters in humans. *Alternative Medicine Review, 10*, 321–325.

Sabelli, H., Fink, P., Fawcett, J., & Tom, C. (1996). Sustained antidepressant effect of PEA replacement. *Journal of Neuropsychiatry and Clinical Neurosciences, 8*, 168–171.

Santos, M.S., Duarte, A.I., Moreira, P.I., & Oliveiera, C.R. (2000). Synaptosomal response to oxidative stress: effect of vinpocetine. *Free Radical Research, 32*, 57–66.

Simbrey, K., Winterhoff, H., & Butterweck, V. (2003). Extracts of St. John's wort and various constituents affect beta-adrenergic binding in rat frontal cortex. *Life Sciences, 74*, 1027–1038.

Singewald, N., Sinner, C., Hetzenauer, A., Sartori, S.B., & Murck, H. (2004). Magnesium-deficient diet alters depression- and anxiety-related behavior in mice-influence of desipramine and Hypericum perforatum extract. *Neuropharmacology, 47*, 1189–1197.

Slezak, T., Francis, P.S., Anastos, N., & Barnett, N.W. (2007). Determination of synephrine in weight-loss products using high performance liquid chromatography with acidic potassium permanganate chemiluminescence detection. *Analytica Chimica Acta, 593*, 98–102.

Vukovich, M.D., Schoorman, R., Heilman, C., Jacob III, P., & Benowitz, N.L. (2005). Caffeine-herbal ephedra combination increases resting energy expenditure, heart rate and blood pressure. *Clinical and Experimental Pharmacology and Physiology, 32*, 47–53.

Youdim, M.B., & Weinstock, M. (2004). Therapeutic applications of selective and non-selective inhibitors of monoamine oxidase A and B that do not cause significant tyramine potentiation. *Neurotoxicology, 25*, 243–250.

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TERMOGENI UČINCI STIMULACIJSKOG NAPITKA, DODATKA PREHRANI PRIJE VJEŽBANJA

Sažetak

Uvod

Cilj ovog istraživanja bio je ispitati akutne efekte napitka za poticanje energetske potrošnje na primitak kisika u mirovanju (VO_2), respiracijski kvocijent (RQ), potrošnju kalorija (kcal), frekvenciju srca (HR) i krvni tlak (BP) kod zdravih i fizički aktivnih ispitanika ženskog spola.

Metode

Deset žena (u dobi od 20,4±,8 godina; visokih 165,4±6,6 cm; tjelesne mase 58,3±7,7 kg; s postotkom tjelesne masti od 20,1±4,9 %) testirano je dva puta metodom slučajnog i dvosmjerno anonimnog odabira. U oba mjerenja, provedena u Laboratory for Human Performance, ispitanice koje nisu ništa konzumirale prethodna 3 sata, uzimale su ili 120 ml suplementa (SUP) ili 120 ml placeba (PL). Ispitanice su nakon uzimanja supstancije 3 sata mirovale u poluležećem položaju. VO_2 i frekvencija srca bilježeni su svakih 5 minuta tijekom prvih pola sata te svakih 10 minuta tijekom sljedećih 150 minuta. Krvni tlak je mjeren svakih 15 minuta tijekom prvih pola sata te svakih 30 minuta kroz preostalo vrijeme testiranja. Profil raspoloženja utvrđivao se svakih 30 minuta. Analizom površine ispod krivulje (AUC) izračunat je VO_2, dok su se prosjek za tri sata i prosjek svakog pojedinačnog sata utvrđivali za respiracijski kvocijent (RQ), potrošnju ugljikohidrata u kcal, potrošnju masti u kcal, ukupnu potrošnju u kcal, frekvenciju srca i krvni tlak.

Rezultati i rasprava

Analiza površine ispod krivulje pokazala je da nema statistički značajnih razlika u primitku kisika (VO_2) između SUP i PL skupina ispitanica za vrijeme od tri sata u kojem je testiranje provedeno (slika 1). Isto tako nije pronađena statistički značajna razlika u potrošnji energije između grupa SUP (0,92±0,16 kcal/min) i PL (0,89±0,17 kcal/min) tijekom testiranja (slika 2). Značajna razlika zabilježena je između grupa u prosječnom RQ za vrijeme testiranja (slika 3). Iako nije zabilježena nikakva promjena u kalorijskoj potrošnji, značajne razlike zabilježene su u potrošnji masti kao izvoru energije (slika 4). Navedene razlike zabilježene su tijekom prvog (0,35±0,19 kcal/min u grupi SUP i 0,20±0,13 kcal/min u grupi PL) i drugog sata mjerenja (0,46±0,21 kcal/min u grupi SUP i 0,24±0,11 kcal/min u grupi PL), ali nisu zabilježene značajne razlike između grupa tijekom trećeg sata mjerenja (0,47±0,25 kcal/min u grupi SUP i 0,33±0,20 kcal/min u grupi PL). Tijekom trosatnog protokola mjerenja nisu zabilježene ni statistički značajne razlike u frekvenciji srca niti u sistoličkom ni dijastoličkom krvnom tlaku (tablica 1). Analiza stanja raspoloženja (slika 5) nije pokazala razlike između grupa u napetosti, depresiji, ljutnji, žestini, umoru i zbunjenosti tijekom trosatnog testiranja.

Rezultati ovog istraživanja pokazuju da uzimanje napitka Redline Princess® ne povećava potrošnju energije u mladih i zdravih žena, ali da značajno stimulira potrošnju masti. Nadalje, uzimanje ovog suplementa ne stimulira i ne povisuje frekvenciju srca kao ni krvni tlak.

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