

Kinetic Analysis of Energy/Caloric Metabolism Activity of a Single Bout of Consuming Various Beverages and Dietary Supplements in Healthy Human Adults: Comparison of *Lycium barbarum*-containing Liquid Dietary Supplements to Caffeinated Beverages

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ABSTRACT

Lycium barbarum (*L. barbarum*) is known to increase metabolism, but little is known of its mechanism. The objective of this clinical study was to compare the impact of three different *L. barbarum*-containing liquid dietary supplements on energy/caloric metabolism activity compared to caffeine and various common caffeinated beverages (tea, coffee, and other commercially available products). The tested products were GoChi®= Product 1 (non-caffeinated *L. barbarum* juice); Chi3™= Product 2 (caffeinated *L. barbarum* juice with B vitamins, folic acid, taurine, L-phenylalanine, N-acetyl-L-tyrosine, glucuronolactone and green tea extract) and TAlsim™= Product 3 (caffeinated *L. barbarum* juice with soluble indigestible fiber, L-phenylalanine, N-acetyl-L-tyrosine and standardized tea polyphenols). Resting metabolic rate (RMR) was analyzed by breath oxygen volume using hand-held indirect calorimeter in healthy adults (average age=34.5 y). Subjects consumed single bout of one serving of test samples on different days after a 12 hour fast. RMR was measured immediately before (baseline), 1, 2 and 4 h after sample intake. Intake of caffeine and all beverages including Product 1-3 increased RMR by 100-300 kcal over baseline (1,823 kcal) within 1-2 hour post-intake. However, at 4 hours post-intake, RMR in subjects taking caffeine and all non-*L. barbarum*-containing caffeinated beverages had returned to baseline level. Conversely, in the groups of Product 1 (n=4), Product 2 (n=5) and Product 3 (n=7), RMR was increased by 153, 105 and 211 kcal over baseline, respectively, representing statistically higher levels than those observed for other beverages (P < 0.05). These results suggest that, compared to common caffeinated beverages, *L. barbarum*-containing products exhibit longer-lasting stimulating effects on energy/caloric metabolism in humans.

INTRODUCTION

Lycium barbarum is a Solanaceae defoliated shrubby and the fruit is a famous traditional medicine in Asian countries where it has been used for medicinal purposes and as a functional food for over 2,500 years. In support of traditional properties, modern studies indicate that *L. barbarum* possess a range of biological activities, including increased metabolism, glucose- and other symptoms-control in diabetics, and anti-oxidant efficacies. Along with a growing number of studies of *Lycium barbarum*, our recent randomized, double-blind, placebo-controlled clinical study showed that daily consumption of *Lycium barbarum*, provided in the form of a fruit juice, GoChi® (FreeLife International, Phoenix, Arizona), standardized for its LBP content, increased subjective feelings of general well-being, neurological/psychological assessment, gastrointestinal function, immunomodulation, endogenous anti-oxidant enhancements, waist-circumference reduction, maintained plasma catecholamine level, attenuated increased blood stress hormone and steroid level under exercise, and reduced inflammatory factors.

Caffeine is well-known to increase energy level and feeling, and is widely used in commercially available beverages. Tea and coffee have been reported to burn fat and increase metabolism.

This is the first clinical study comparing *L. barbarum*-containing dietary supplements (GoChi®, Chi3™, TAlsim™) on energy/caloric metabolism activity compared to various caffeinated beverages (green tea, coffee, 5-Hour Energy®). Resting metabolic rate (RMR) was analyzed by breath oxygen volume using hand-held indirect calorimeter in healthy adults.

MATERIALS AND METHODS

Test Products. FreeLife International LLC, in Phoenix, Arizona supplied commercially available *L. barbarum*-containing dietary supplements (GoChi®, Chi3™, TAlsim™). These contain LBP-standardized *Lycium barbarum* fruit juice, which was produced from fresh ripe *Lycium barbarum* fruit to contain a content of LBP equivalent to that found in at least 150 g of fresh fruit, the amount customarily consumed in Traditional Chinese Medicine. Chi3 contains *L. barbarum* juice, taurine, phenylalanine, N-acetyl-L-tyrosine, green tea extract containing 100 mg of caffeine, glucuronolactone, niacin, vitamin B₆, folic acid, and vitamin B₁₂. TAlsim contains *L. barbarum* juice, soluble indigestible fiber, phenylalanine, N-acetyl-L-tyrosine, and tea extract blend containing 100 mg of caffeine. Green tea and coffee were brewed from the commercially available dried leaves (Maeda-En USA) or roasted and grained powder (Van Houtte LP) immediately before intake and were cooled to ambient temperature. 5-Hour Energy® (Living Essentials) was purchased from local grocery store.

Study population. Subjects, 18 years old and older with body-mass-index (BMI) of 25-35 were recruited for the study and participants selected for the trial were judged to be healthy. Subjects were excluded from the study if they had known allergies to ingredients in the products, use of any fiber materials, medication or supplements for weight loss, weight control purpose, appetite suppression and/or energy drinks, had gastrointestinal disease or problems including chronic symptoms such as irritable bowel syndrome, diabetes, cardiac problems (previous myocardial infarction or cardiovascular diseases), were in a weight control diet program with unstable body weight (more than 2% loss/gain over the previous 3 months), were pregnant or breast feeding, or were under anticoagulant therapy with Coumadin® (warfarin). All subjects were fully informed of the purpose of the study, and signed the Human Subjects Informed Consent forms approved by the Internal Review Board under the Helsinki Declaration. No participants were pregnant during the study based upon standard urine pregnancy test.

Study design. Following enrollment and at least one month of wash-out period in this clinical trial, energy metabolism activity by VO₂ using indirect calorimeter (MedGem test kit) were assessed. All subjects were to discontinue use of any *Lycium barbarum*-containing foods, caffeinated drinks, weight-loss or weight-control products, or energy drinks. Also, background information regarding dietary habits, smoking, and disease history was recorded for each participant. All subjects took 1 serving of various products at different day with sufficient interval between the measurement. Urine and saliva test were performed using test kits supplied by NeuroScience.

Statistical Analysis. All data were analyzed by t-test for dependent groups. Descriptive statistics were calculated for pre-intervention and each measurement period for all dependent measures and summarized as means and standard errors. Differences were considered significant at P<0.05.

RESULTS

A single bolus consumption of GoChi in various dosages proportionally increased RMR in the subjects in a dose-dependent manner (Figure 1A). AUC from 0 to 4 hours after intake was also dose-dependent (Figure 1B). Increased RMR values over baseline level (average=1,746 kcal) was indicated in these Figures.

RMR in the subjects after a single bolus consumption of various products in conjunction was significantly increased by 186-413 kcal, which is about 11-24% of average basal level (1,745 kcal) at 1 hours after consumption, statistically higher than baseline level. Intake of all beverages including Product 1-3 increased RMR by 100-300 kcal over baseline within 1-2 hour post-intake. However, at 4 hours post-intake, RMR in subjects taking all non-*L. barbarum*-containing caffeinated beverages had returned to baseline level. Conversely, in the groups of Product 1 (n=4), Product 2 (n=5) and Product 3 (n=7), RMR was increased by 153, 105 and 211 kcal over baseline, respectively, representing statistically higher levels than those observed for caffeine and other beverages (P < 0.05). (Figure 2A)

Area under the curve (AUC, 0 through 4 hours after intake) was significantly higher in *L. barbarum*-containing products than control (nutritional beverage only). However, AUC in the non-*L. barbarum*-containing caffeinated beverages did not have significant changes from control level (Figure 2B).

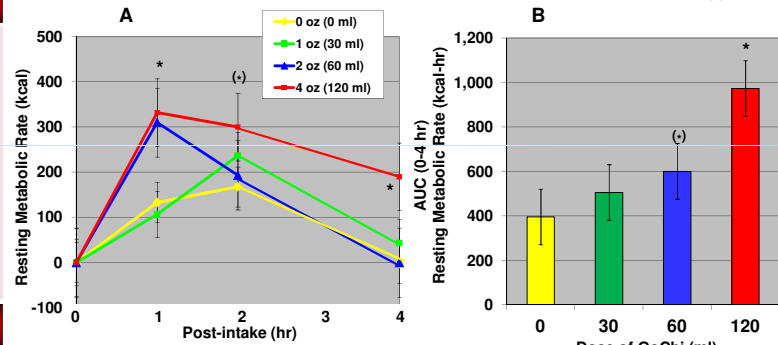


Figure 1. Time-course (A) and area under the curve (AUC) during 0-4 hr (B) of resting metabolic rate increase at various different dosages of GoChi in healthy human subjects. Each value indicates mean ± SEM.

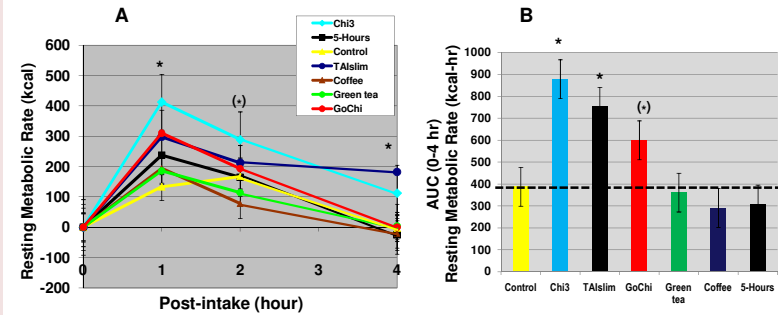


Figure 2. Time-course (A) and area under the curve (AUC) during 0-4 hr (B) of resting metabolic rate after a single bolus intake of various products in healthy human subjects. Each value indicates mean ± SEM.

Unlike caffeine, GoChi intake reduced the stress hormones, cortisol and dihydroepiandrosterone (DHEA) in saliva. Figure 3 shows impact of GoChi on salivary cortisol levels in different time in a day before and after GoChi intake in healthy human male subjects (n=4). Figure 4 indicates the impact of GoChi on DHEA level in saliva in healthy human male subjects (n=4). GoChi intake significantly reduced DHEA level in saliva.

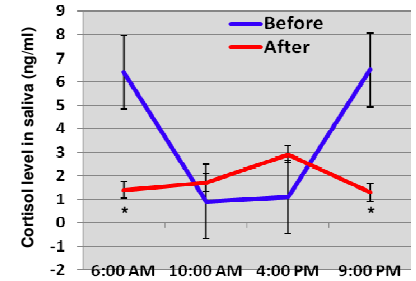


Figure 3. Impact of single bolus intake of GoChi (120 ml) on saliva cortisol level in a different time in a day in healthy human subjects (n=4). Each value indicates mean ± SEM.

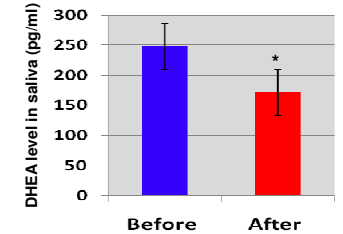


Figure 4. Impact of single bolus intake of GoChi (120 ml) on saliva DHEA level in healthy human subjects (n=4). Each value indicates mean ± SEM.

CONCLUSION

These results suggest that, compared to common caffeinated beverages, *L. barbarum*-containing products exhibit longer-lasting stimulating effects on energy/caloric metabolism in humans. As *L. barbarum*-containing products exhibit different impacts on adrenocortical hormones from caffeine, their mechanism of action may be unique. These may be related to various obesity and metabolism related hormonal levels, and further studies will clarify more details of action mechanisms.