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Fruit- and vegetable-based condiments increased taste preference and stimulated postprandial energy expenditure more than meal replacement alone when combined with liquid dietary supplement TAI*slim*®, a combination of *Lycium barbarum* fruit (goji) juice, indigestible dietary fiber, phenylalanine, N-acetyl tyrosine and tea extract.

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ABSTRACT

Background: For subjects who use meal replacements daily for weight management, product flavor variety is a key factor in avoiding boredom and encouraging continuity of usage. We thus developed a mix-in type of condiment in 2 different flavors using dried fruits and vegetables (TAI*slim*® BOOSTERs), and tested flavor preference and postprandial energy expenditure (PPEE) to see if the condiments would provide additional effects when mixed with a meal replacement shake with or without TAI*slim* liquid supplement.

Methods: In a randomized, double-blind, placebo-controlled, repeated measures design, visual analogue scale was used to investigate taste preference, and the possible additive effect of TAI*slim* BOOSTERs on resting metabolic rate (RMR)/PPEE with meal replacement was investigated in human adult subjects (n=6) randomly consuming an adjusted in same calories of single bolus serving of 1 of 8 dietary samples. The tested products were: placebo, TAI*slim* BOOSTERs, meal replacement (Boost® Plus as control or TAI*slim* SHAKE). RMR/PPEE was measured by breath oxygen volume immediately before (baseline), 1, 2 and 4 h after sample intake. All samples were randomly tested by all subjects at weekly intervals following an overnight fast.

Results: Taste preference was significantly increased 27.1 ± 4.7(SE)% compared to the placebo control. Consumption of placebo materials did not statistically change PPEE from control levels. However, the addition of TAI*slim* BOOSTERs significantly increased RMR/PPEE by 20% compared to the control, which was about 7% over the baseline.

Conclusions: These results show that addition of TAI*slim* BOOSTERs to a meal replacement shake may improve efficacy in weight management by encouraging usage compliance and by increasing PPEE in humans.

INTRODUCTION

Our recent clinical trials have shown that consumption of *Lycium barbarum* (*L.barbarum*) fruit (goji) juice stimulated postprandial energy expenditure (PPEE) through adrenocortical hormone control. This rise in PPEE may in part explain the improvements in waist circumference observed in our previous clinical trials. To strengthen the effects of *L.barbarum* on central adiposity and further expand its effects for better body weight control, we have developed a liquid dietary supplement, TAI*slim* ®, by combining *L.barbarum* with soluble indigestible dietary fiber, appetite-suppressing amino acids, a blend of tea extracts standardized with polyphenols, including epigallocatechin gallate (EGCG), and caffeine. It is designed to provide appetite suppression, increased metabolism/thermogenesis, increased fat burning, decreased absorption of dietary fats and starches, improved insulin sensitivity, blood lipid reduction, blood glucose control, and remodeling of intestinal flora to reduce counts of those implicated in obesity.

We have shown in randomized double-blind, placebo-controlled human clinical studies that negative energy balance by the systematic procedure (TAI*slim* System) with increasing metabolic rate through physical activity and use of TAI*slim*, and decreasing caloric intake by consuming meal replacement shake (TAI*slim* SHAKE), was successful to lose weight in obese humans. We examined these products combined as TAI*slim* System on PPEE, appetite and anthropometrics during a weight loss program.

For subjects who use meal replacements daily for weight management, product flavor variety is a key factor in avoiding boredom and encouraging continuity of usage. We thus developed a mix-in type of condiment in 2 different flavors using dried fruits and vegetables (TAI*slim*® BOOSTERs), and tested flavor preference and postprandial energy expenditure (PPEE) to see if the condiments would provide additional effects when mixed with a meal replacement shake with or without TAI*slim* liquid supplement.

MATERIALS AND METHODS

Test Products. The tested products were: placebo, TAI*slim* BOOSTERs, meal replacement [Boost® Plus (Nestlé Nutrition, Florham Park, NJ) as control or TAI*slim* SHAKE]. FreeLife International Inc, in Phoenix, Arizona supplied commercially available TAI*slim* products. All product information is shown in Figure 1. Fiber content in TAI*slim*, meal replacement shake (TAI*slim* SHAKE) or TAI*slim* BOOSTER was 5, 5 or 2 g, respectively.

Study population. Healthy subjects, 18 y and older were recruited for the study. Subjects were excluded from the study if they had known allergies to ingredients in TAI*slim*, use of any fiber materials, medication or supplements for weight loss, weight control, and/or appetite suppression; had gastrointestinal disease such as irritable bowel syndrome, diabetes, cardiac problems (previous myocardial infarction or cardiovascular diseases); had engaged in a weight control diet program with unstable body weight; were pregnant or breast feeding; or were under anticoagulant therapy with warfarin (Coumadin®). All subjects were fully informed and signed the Human Subjects Informed Consent forms approved by the Internal Review Board under the Helsinki Declaration. All subjects were to discontinue use of any *L.barbarum*-containing foods, any weight-loss or weight-control products or energy drinks, and this was continued throughout the study. Also, background information regarding dietary habits, smoking, and disease history was recorded for each participant. Caffeinated drinks were not allowed during the study period.

Study design. Visual analogue scales (0-100) for flavor preference were assessed using 4 different kinds of questions after 12 h fast at baseline and during the 3 days. In all quesitons, 100 is the highest score and 0 is least preference. The scores were averaged for evaluation.

RMR/PPEE was measured by breath oxygen volume using hand-held indirect calorimeter immediately before (baseline), 1, 2 and 4 h after sample intake. All samples were randomly tested by all subjects at weekly intervals following an overnight fast in a randomized, placebo-controlled, double-blind manner.

Statistical Analysis. All clinical symptom questions were graded and the scores analyzed for changes between pre-intervention and each measurement with the nonparametric Wilcoxon matched pairs tests. Differences were considered significant at P<0.05.

Figure 1. Supplement and Nutrition Facts of the Products.

TAI*slim*

Supplement Facts
Serving Size: 2 fl. oz. (60 mL)
Servings Per Container: Approx. 67

	Amount Per Serving	% Daily Value
Calories	20	
Total Carbohydrates	7 g	2†
Dietary Fiber	5g	20†
Sugar	2 g	*
Sodium	20 mg	1%
Potassium	15 mg	<1%
Appitol Plus™ (appetite controlling complex) L-Phenylalanine N-Acetyl-L-tyrosine	700 mg	*
Lipitol Ultra™ (fat burning complex) Standardized extracts of green, black, oolong and white tea leaf providing 200 mg polyphenols (90 mg as EGCG) and 100 mg caffeine	330 mg	*
NuFlora™ (advanced soluble fiber complex) Modified dextrin with whole fruit goji fiber	5.7 g	*
GoChi® HIMALAYAN GOJI® Juice (reconstituted goji juice from fresh whole *Lycium barbarum* fruit utilizing our exclusive Spectral Signature LBP Process™**), white grape juice concentrate, red grape juice concentrate, pomegranate juice concentrate, and natural flavor)	0.5 fl. oz. (15 mL)	*

†Daily Values based on a 2000 calorie diet.
*Daily Value not established.

Other ingredients: Ultra-purified reverse osmosis water, natural flavors, potassium sorbate and sodium benzoate (to maintain freshness), malic acid (for tartness) and sucralose.

TAI*slim* SHAKE

Nutrition Facts
Serving Size: 1 scoop (40.5 g)
Servings Per Container: 15

	Amount Per Serving
Calories	156
Calories from Fat	40
	% Daily Value**
Total Fat 4 g*	6%
Saturated Fat (from MCT/EFA complex) 1 g*	5%
Trans Fat 0 g	
Cholesterol 29mg*	10%
Sodium 173 mg*	7%
Potassium 1000mg*	29%
Total Carbohydrate 19 g*	6%
Dietary Fiber 5 g*	20%
Sugars 14 g*	
Protein 10 g	20%
Vitamin A	35%
Vitamin C	35%
Calcium	30%
Iron	17%
Vitamin D	35%
Vitamin E	35%
Thiamin	35%
Riboflavin	35%
Niacin	35%
Vitamin B6	35%
Folate	35%
Vitamin B12	33%
Biotin	35%
Pantothenic acid	35%
Phosphorus	20%
Iodine	35%
Magnesium	35%
Zinc	33%
Selenium	25%
Copper	25%
Manganese	50%
Chromium	28%
Molybdenum	35%

*Amount in Mix. Skim milk provides additional nutrients.
**Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories	2,000
Total Fat	Less than	65 g
Saturated Fat	Less than	20 g
Cholesterol	Less than	300 mg
Sodium	Less than	2400 mg
Potassium		3500 mg
Total Carbohydrate		300 g
Dietary Fiber		25 g
Protein		50 g

Calories Per Gram:
Fat 9 , Carbohydrate 4, Protein 4

TAI*slim* BOOSTER

Supplement Facts
Serving Size: 5 g (1 scoop)
Servings Per Container: 30

	Amount Per Serving	% Daily Value
Calories	10	
Total Carbohydrates	3 g	1†
Dietary Fiber	2 g	8†
Sugar	0 g	*
Sodium	20 mg	1%
Potassium	15 mg	<1%
Proprietary Super Greens Blend	4,585 mg†	

(approximately 2,500 ORAC units per serving)
SYNBIOTIX PLUS™ [provides 2 billion probiotic *Bifidobacteria* (*B. breve*, *B. infantis* and *B. longum*) in a cellulose enzyme-activated prebiotic blend of glucose polymers, NuFlora™ dextrin fiber, guar gum, beet fiber, gum acacia, inulin, oat fiber, and xanthan gum]; **VEGETABLES (LOW-TEMPERATURE DRIED):** Spinach (source of lutein), onion (standardized to quercetin), asparagus (source of lutein and zeaxanthin), broccoli floret (source of indole-3-carbinol), Brussels sprout (source of sulphoraphane), cabbage (source of sinigrin), carrot (source of beta-carotene), cauliflower (source of indole glucosinolates), celery stalk (source of 3-N-butylphthalide), cucumber (source of polyphenols), garlic (source of alliin), ginger root (source of gingerols), green bell pepper (source of capsiate), green pea (source of carotenoids), kale (source of flavonoids), leek (source of allyl sulfides), lettuce (source of chicoric and chlorogenic acids), parsley leaf (source of apiol), radish (source of isothiocyanates), red beet root (source of betanine), tomato (source of lycopene), yellow pepper (source of carotenoids), sea vegetables (kombu, nori and wakame seaweeds); **GREEN FOODS:** Aloe vera leaf inner gel (source of acemannan), marine phytoplankton [spirulina blue-green algae (source of phycocyanins), chlorella green algae (source of chlorophyll)], gluten-free cereal grasses (wheat and barley), alfalfa leaf (source of octacosanol and saponins)

*Percent Daily Values are based on a 2,000 calorie diet.
†Daily value not established.

RESULTS

Taste preference was increased by adding BOOSTER mix-in supplement compared to the base SHAKE product alone that had not been mixed with BOOSTER (Figure 2). An average of preference was significantly increased by 27.1±4.7% than base SHAKE alone (P<0.05).

A combination of TAI*slim* SHAKE and BOOSTER was more preferable than other brands by 25.7±4.4%. Subjects expressed their likelihood to take this combination more often 20.0±4.5%. Finally, they stated that they would recommend this SHAKE combination to other people 35.7±5.1% (P<0.05). Gastrointestinal side effects were not detected except for noticeable abdominal rumbling noises in some of the subjects, but these were minor effects with no need to discontinue use of samples.

Kinetic behavior of TAI*slim* System on breath oxygen volume (VO_2) or postprandial energy expenditure (PPEE), and area under the curve (AUC) 0 through 4 h after the consumption measured by the indirect calorimeter were significantly increased by single bolus intake of TAI*slim* SHAKE + BOOSTER (indicated by TAI*slim* System). The baseline RMR level in average of all subjects before intake of samples was 1,655 kcal/d. TAI*slim* System was compared to this placebo baseline level. Placebo RMR at 1 h post-intake after over 12 h overnight fasting was significantly increased by 6.7±1.9% due to the nutritional beverage intake of 158 kcal, which was the placebo of the SHAKE (Figure 3A). PPEE was significantly increased by TAI*slim* System compared to the placebo baseline levels for more than 4 h post-intake. PPEE at 1 h post-intake was significantly increased by 16.3±2.6 % with TAI*slim* System, which was statistically significantly higher than placebo group (Figure 3A). RPPEE in the control returned to baseline within 2 h. Conversely, PPEE at 4 h post-intake with TAI*slim* System remained elevated by 8.6±2.1% over baseline, representing statistically higher levels than the control all times (P<0.05) (Figure 3A).

Area under the curve (AUC) during the 4 h study is shown in Figure 3B. AUC throughout 0-4 h post-consumption was increased by 5.6% in TAI*slim* System group, which is significantly higher than the control group (Figure 3B). Placebo control did not show any significant increases over the baseline.

Figure 2. Taste preference of TAI*slim* BOOSTER.

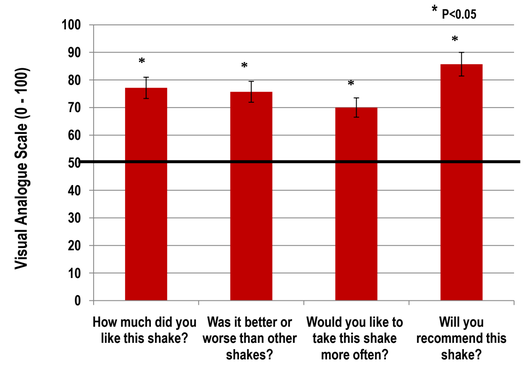
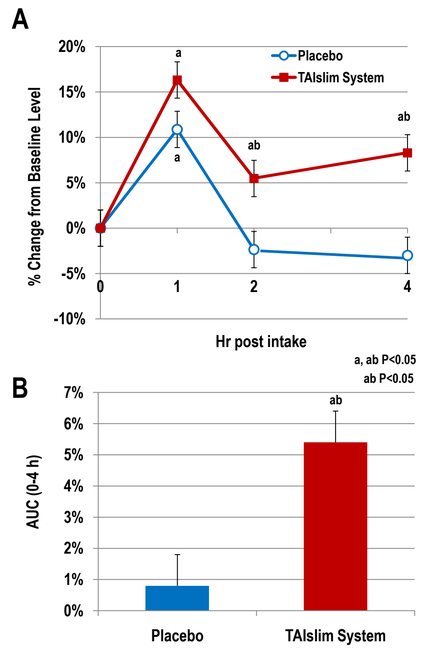


Figure 3. Kinetic analysis of postprandial energy expenditure (PPEE) of TAI*slim* BOOSTER +TAI*slim* + TAI*slim* SHAKE, or placebo control (A), and comparison of area under the curve (0-4 h) on the PPEE (B).



CONCLUSION

These results show that addition of TAI*slim* BOOSTERs to a meal replacement shake may improve efficacy in weight management by encouraging usage compliance and by increasing PPEE in humans. The present studies suggest that TAI*slim* System controls PPEE which may be caused by improving caloric metabolism and as a result, body weight, waist circumference and other morphometric parameters seem to be reduced significantly from the pre-intervention. It is suggested that combining these products may be useful as part of a weight loss program.