The Acute Effects of Late Evening Whey and Casein Protein Ingestion on Fasting Blood Glucose, Lipid Profile, Resting Metabolic Rate, and Hunger in Overweight and Obese Individuals

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Purpose

To evaluate the acute effects of evening (before sleep) consumption of whey and casein proteins in improving blood glucose, blood lipids, and resting metabolic rate in overweight and obese individuals.

BACKGROND

Consumption of food before sleep is thought to increase the likelihood of weight gain, which can lead to obesity (2). Furthermore, obesity has adverse effects on cardiovascular health in terms of blood glucose, blood lipids, and metabolism (5). It is recommended to limit caloric intake in the late evening hours because metabolic rate naturally decreases during sleep, leading to increased fat accumulation (3). It has been shown that increases in thermic effect of food and fat oxidation are greatest following ingestion of whey, followed by casein, and then carbohydrate, which could offset fat accumulation (1). Additionally, protein supplementation immediately prior to nocturnal sleep was recently shown to improve muscle protein synthesis (4). In addition, dietary protein appears to play a role in body weight control because of its impact on decreasing hunger, increasing satiety, and improving resting metabolic rate (6).

Theoretically, protein ingestion before sleep should affect obesity rates and promote cardiovascular health by increasing nocturnal metabolism and decreasing morning hunger. However, there is little research linking nighttime protein ingestion and morning cardiovascular health, metabolism, and satiety.

Methods

Participants: Twenty-nine (4 men; 25 women) overweight or obese individuals (Age, 27.6 ± 7.2 years; Height, 164.8 ± 9.1 cm; Weight, 98.3 ± 21.7 kg; Body Mass Index (BMI), 36.0 ± 6.0 kg/m^2; % body fat, 46.0 ± 6.5) participated in this double blind, placebo-controlled study.

Study Design: Following baseline measures (see below), individuals were matched for BMI, sex, and % body fat and randomly assigned to 1 of 3 groups (Table 2). After ingestion of the supplement at night, participants returned to the lab the next morning to repeat baseline measures. Participants visited the lab (between 6 and 8 am) following an 8-10 hour fast. Measurements included:

Resting Metabolic Rate (RMR)- RMR was then measured using indirect calorimetry (Parvometrics, Sandy, UT). This non-invasive test involves lying down on a padded table for 30-minutes while breathing into a ventilated tube.

Blood Measures- Twenty milliliters of blood was drawn from a forearm vein and analyzed for glucose (GLU), total cholesterol (TC), triglycerides (TRG), TC:HDL ratio, high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), and non-high-density lipoprotein (Non-HDL) utilizing the Cholestech LDX blood analysis system (Hayward, CA).

Supplement Intake- All supplements were consumed as the last food or caloric beverage at night at least 2 hours after dinner no more than 30 minutes before bed. Participants were asked to eat the same foods prior to each testing day, with the exception of the evening supplement to minimize a nutritional influence on the results other than the supplement consumed.

Statistics: Data was analyzed using a 3 x 2 (group x time) RMANOVA (JMP Pro 9, Cary, NC). A Tukey post-hoc analysis was used where appropriate to examine differences.

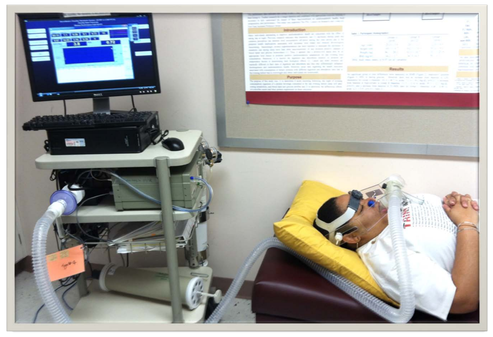


Figure 1: Indirect Calorimetry

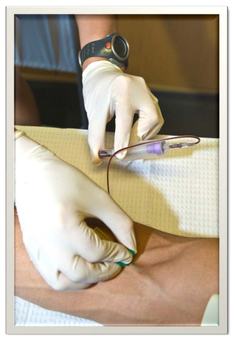


Figure 2: Blood Draw

Results

Table 1.

Whey protein	Casein protein	Placebo
30g whey protein	30g casein protein	0g protein
3g carbohydrate	3g carbohydrate	33g carbohydrate
2g fat	1g fat	2g fat
150 kcals	140 kcals	150 kcals
Small amounts sodium, potassium, and calcium (consistency and flavoring)		

Table 2.

Category	Whey (n=12: 1 Male)	Casein (n=9: 2 Males)	Placebo (n=8: 1 Males)
Age (year)	26.1 ± 5.5	33.2 ± 8.8	33.2 ± 8.8
Height (cm)	162.5 ± 10.0	167.3 ± 9.8	167.3 ± 9.8
Weight (kg)	91.9 ± 16.7	110.3 ± 25.9	110.3 ± 25.9
BMI (kg/m^2)	34.8 ± 4.8	39.2 ± 7.1	39.2 ± 7.1
% Body Fat	45.7 ± 7.0	45.9 ± 7.3	45.9 ± 7.3
Values are Mean ± SD	p>0.05 for all variables (no significant differences)		

Table 3.

No significant group by time differences were measured for glucose (GLU), total cholesterol (TC), triglycerides (TRG), TC/HDL, high-density lipoproteins (HDL), low-density lipoproteins (LDL), or non-high density lipoproteins (Non-HDL; TC-HDL). Post-hoc analysis indicated baseline differences for GLU and HDL.

Blood Variables	Whey		Casein		Placebo	
	Baseline	*Acute*	*Baseline*	*Acute*	*Baseline*	*Acute*
GLU	85.6 ± 5.2 ^{C}	83.1 ± 5.6 ^{C}	96.7 ± 11.7 ^{A}	93.8 ± 12.4 ^{B}	86.6 ± 8.8 ^{BC}	87.6 ± 9.5 ^{BC}
TC	168.8 ± 25.0	165.3 ± 33.7	161.7 ± 31.8	155.1 ± 27.6	169.8 ± 37.8	170.8 ± 33.9
TRG	109.7 ± 55.6	95.0 ± 53.0	105.9 ± 51.4	112.3 ± 40.8	107.1 ± 55.1	82.9 ± 22.1
TC/HDL	4.5 ± 1.6	7.8 ± 13.0	4.5 ± 1.0	4.2 ± 1.0	3.7 ± 1.5	3.8 ± 1.3
HDL	40.3 ± 10.6 ^{AB}	38.8 ± 14.6 ^{AB}	36.6 ± 3.8 ^{B}	38.6 ± 5.0 ^{AB}	49.6 ±15.0 ^{A}	48.9 ± 14.7 ^{A}
LDL	107.5 ± 28.9	109.2 ± 35.2	105.7 ± 29.5	97.8 ± 20.4	101.9 ± 40.7	111.4 ± 36.2
Non-HDL	122.3 ± 31.3	122.8 ± 34.8	126.0 ± 32.9	120.3 ± 27.5	119.9 ± 45.0	121.9 ± 38.0

Values not connected by the same letter are significantly different.

Table 3.

No significant group or group by time differences were measured for resting metabolic rate (RMR) or respiratory quotient (RQ).

Metabolic Variables	Whey		Casein		Placebo	
	Baseline	*Acute*	*Baseline*	*Acute*	*Baseline*	*Acute*
RMR (kcal/d)	1751.9 ± 466	1856.0 ± 305	2062.3 ± 460	2099.0 ± 370	2024.5 ± 290	1977.9 ± 300
RQ	0.84 ± 0.044	0.84 ± 0.028	0.83 ± 0.046	0.84 ± 0.045	0.85 ± 0.053	0.83 ± 0.064

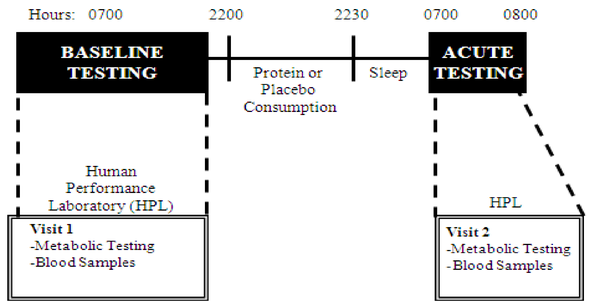
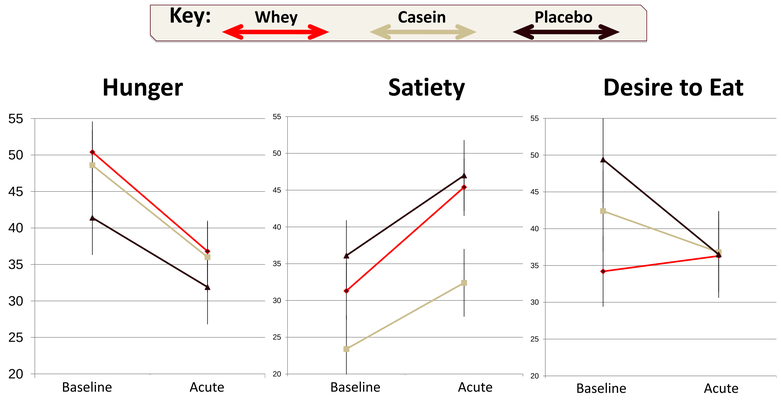


Figure 3: Overall Study Design

Hunger and Satiety:
No significant group or group by time differences were measured for the Visual Analogue Scale (VAS), however, there was a time difference from baseline to acute.



Units = millimeters (mm)

Conclusions

No significant differences were seen among our dependent variables. However, there was a greater magnitude of improvement for RMR and LDL for the protein groups compared to the placebo. Furthermore, regardless of macronutrient choice, eating before bed appears to improve hunger and satiety. Thus, we conclude that protein before bed may provide a health benefit, although more data is required. It is likely that a longer duration study with more participants and exercise training would reveal significant differences between these groups.

We aim to continue this line of research with different durations, populations, and designs to understand more about the impact of nutrient timing and exercise on body composition and human performance.

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