

Acute Effects on Satiety from White Button and Shiitake Mushroom Powder Supplementation in a High Fat Meal

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Abstract

Background: The current trend of rising obesity leads to an increase in cardiovascular disease and dyslipidemia. One of the factors involved with this trend are diets high in fat. Supplementing high-fat meals with bioactive compounds may be an effective way to limit the negative consequences of such a diet. Mushrooms contain high levels of fungosterols and β-glucans which are thought to be involved in the primary mechanism for improved postprandial lipemia. Mushroom supplementation may have effects on acute satiety which could dictate eating habits.

Purpose: To examine the acute effects on satiety by adding shiitake and white button mushroom powder to a high-fat meal.

Methods: Three high-fat meals were administered to 13 healthy subjects (6 males and 7 females, 24 ± 2yr, 20±6 % body fat, 57.1±11.5 kg fat free mass) in a double blinded, randomized design. Each meal (Control, White Button (WB), Shiitake (SH)) consisted of an 8oz cooked beef patty and a bun (819 kcal, 47g fat) with no mushroom powder or 14g of WB or 14 g of SH dried mushroom powder. Dietary intake on the day before testing was similar among subjects (2079 ± 791 kcal). Subjects were fasted and avoided vigorous exercise on the day prior to testing. Satiety was measured using a Likert visual analog scale every 2 hours for 6 hours following each meal. Blood from an indwelling catheter was also taken every 2 hours to measure plasma glucose and lipids. The effects of each meal were determined by measuring differences between meals.

Results: A more gradual decline in satiation from hour 2 to 6 was observed for treatments with mushrooms as compared to the control treatment. With the control burger there was a significant decline in satiety between hour 4 and 6 (P = 0.01) that was not seen with either mushroom powder. Plasma glucose was negatively correlated with satiety values in all groups (P = 0.02). However, there was no relationship between plasma triglycerides and satiety.

Conclusion: Adding mushroom supplements to a high-fat meal does not appear to change subjective satiety from 0 to 4 hours after consumption. However, between hours 4 and 6 after consumption, subjects were likely to have a longer feeling of fullness with mushrooms than without mushrooms. Plasma triglycerides levels did not predict satiety levels while plasma glucose was shown to be a better predictor of satiety. Using mushroom supplementation may limit the rise in felt hunger following a meal and could lead to less food consumption overall.

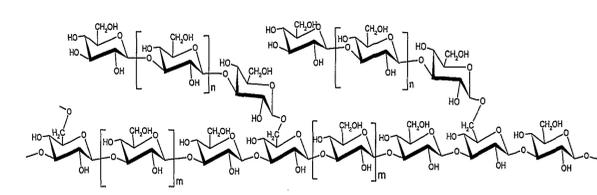
Background

The current trend of rising obesity levels and poor dietary choices have led to an increase in the incidence of chronic diseases in the United States, including cardiovascular disease (CVD). Few studies have been conducted in which the varying impacts of different types of mushrooms on postprandial lipemia, glycemia, and satiety have been explored.

Mushrooms contain high levels of bioactive compounds, which are thought to be a significant mechanism for reducing cholesterol absorption and for increasing satiety. Important bioactive compounds currently being extracted from these mushrooms, which are thought to have lipid lowering properties are beta glucans (Lentinan, an antitumor adjuvant), Eritadenine (possible hypocholesteremic agent) and Ergosterols. Ergothioneine, an antioxidant in mushrooms, may have a role in the reduction of postprandial triglyceride levels.

White button mushrooms (WB) have 0.21 mg/g dry weight, compared to Shiitake mushrooms (SH) with 1.98 mg/g dry weight.

Dietary fiber (beta glucans) may reduce the rate of nutrient absorption, which could increase satiety. As satiety increases, people tend to limit their caloric intake increasingly, which will most likely lead to reduced consumption of high fat meals. Previous studies have shown that beta glucan fiber may correlate in depression of the glycemic index of certain foods.



Lentinan, a Beta Glucan dietary fiber

Objectives

1. Determine if consumption of Shiitake (SH) and White Button (WB) Mushrooms with a high fat meal alters feelings of satiety.
2. Determine if consumption of Shiitake (SH) and White Button (WB) Mushrooms with a high fat meal affects postprandial glucose blood levels.
3. Correlate blood nutrient levels with satiety after three different high fat meals.

Methods

All subjects received a meal with only meat to serve as a control to test for a 'normal' metabolic response. 13 participants subjects (6 males and 7 females, 24 ± 2 y, 20 ± 6% body fat, 57.1 ± 11.5 kg fat free mass) were randomized into groups receiving either WB then SH (Group 1) or SH then WB (Group 2) treatments for their second and third lab visits. Subjects maintained normal dietary habits (no caffeine or alcohol) the day before. 12 hours prior, participants could not eat or participate in vigorous activity.



Whole Shiitake Mushrooms (*Lentinula edodes*)



Uncooked burgers being prepared. Precooked 13oz yields only 8oz cooked weight.

At each visit, a participant consumed a high-fat meal (8 oz cooked 80/20 cooked ground beef patty and a bun – 883kcal, 47g fat, 37.5g carbohydrate, 73.2g protein) with a bun high in carbohydrates within 10 minutes. This is considered time zero. An indwelling venous catheter was placed and a blood sample was taken every 2 hours including hour zero until hour 6 (when the visit concluded). A lipid panel and plasma glucose levels for each blood sample were recorded. Subjective satiety was recorded at each blood draw including time zero using an linear analog scale.

Two way ANOVA with repeated measures and the post-hoc Holm-Sidak test were used to determine statistical significance (Sigmaplot 13) (P<0.05). Values with a common letter within a time are not significantly different.

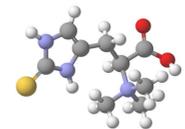
Group 1

1. Mushroom Absent
2. White Button
3. Shiitake

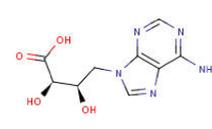
Group 2

1. Mushroom Absent
2. Shiitake
3. White Button

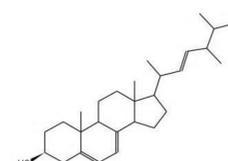
Each participant was randomly assigned to one of these two groups.



Ergothioneine
Powerful Antioxidant



Eritadenine
Hypocholesteremic Agent



Ergosterol
Hypocholesteremic Agent and Vitamin D precursor

Results

Figure 1. Effect of Mushroom Powder on Hunger

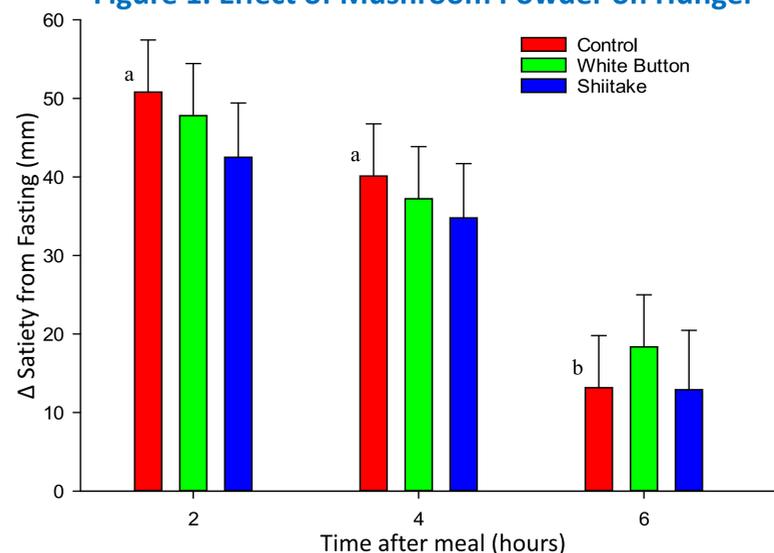


Figure 1. Change in Satiety from premeal values. Mean ± SEM subjective satiety (n=13).

a,b within Control, different letters indicate statistical difference (p<0.01).

Figure 2. Effect of Mushroom Powder on Postprandial Glycemia

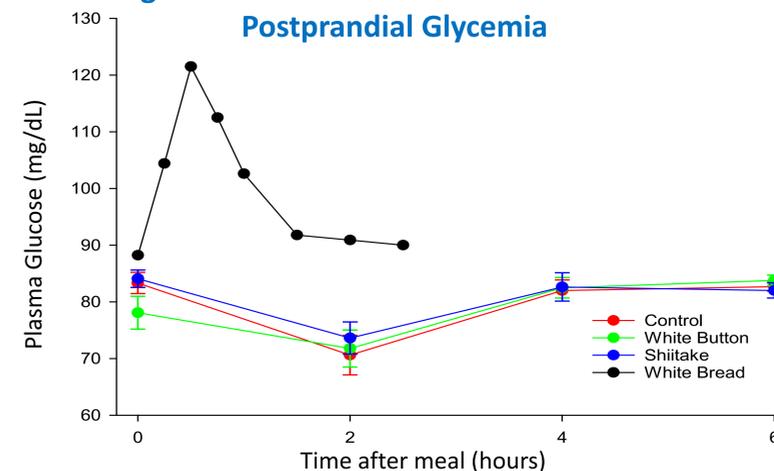


Figure 2. Mean SD plasma glucose . Black line represents white bread glycemic values added for reference (KA Hätonen 2006).

Figure 3. Relationship between Plasma Glucose and Hunger

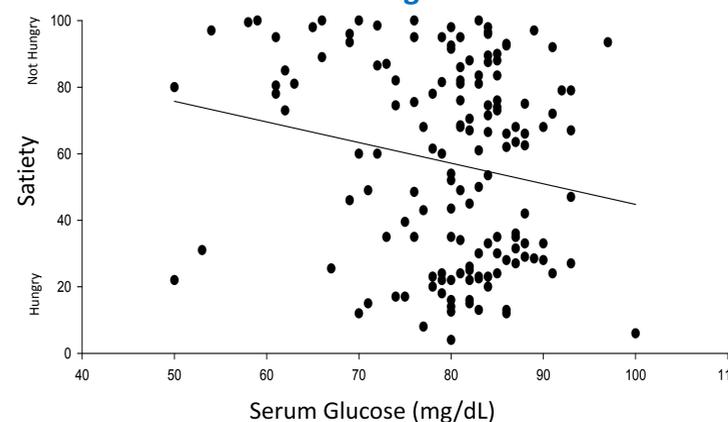


Figure 3. Satiety (mm) = 106 - (0.62 * GLUC, mg/dL), R² 0.04, P = 0.02

Discussion

The present study demonstrates that the incorporation of certain mushroom powders in a high fat meal did have an impact on postprandial satiety. The significant drop in satiety from hour 4 to hour 6 by the control group suggests that the consumption of mushrooms has a longer lasting impact on satiety than consuming a high fat meal without mushroom powder. This is a logical conclusion considering the fiber content and beta-glucans, contained in the mushrooms, and their ability to increase the water content of the mushroom-fortified burgers.

Though not a primary aim of the study, an unexpected negative correlation between satiety and serum glucose was also observed. The glycemic index of the foods in the meal was high but glycemic load of each meal was low and did not result in a significant postprandial glycemic response. Therefore, high plasma glucose levels were never reached in the postprandial phase which would limit the extent that glucose could modify satiety/hunger.

Blood glucose levels appeared to be unaffected by mushroom supplementation at the 2-hour time interval of blood testing. However, a normal physiologic glucose level rise may have occurred within the first 2 hours and therefore would not show in our experiment. Further study may be required to better understand and differences among mushroom supplements and their effects on blood glucose levels.

This study contained some limitations. Some atypical postprandial glycemic and lipemic responses were observed which led to those subjects being removed from the data set. Additionally, since blood was drawn only every 2 hours, it is possible that postprandial glycemia occurred after the fasting blood draw at hour zero and resumed fasting levels by the next blood draw at hour 2. Therefore, any differences between mushrooms could not be detected.

This study has left numerous questions and future considerations for continuing research. Other directions include investigating long term use of mushroom powders incorporated into other high fat foods, and their effect on glycemia and cholesterol synthesis, based on frequent exposure. One could re-conduct the study with one mushroom group at varying quantities to establish a dose dependent relationship. Additionally, the study could be re-conducted with a more uniform group of subjects. Also, further study is needed to understand the mechanisms underlying the differences between these mushrooms. Attempting to further understand how the dietary fibers such as beta glucans in the mushroom powder interact with and affect the uptake of other components of the meal may be areas to focus on.

Funding

CURCA CENTER FOR UNDERGRADUATE RESEARCH AND CREATIVE ACTIVITIES



Oakshire Mushroom Farm, Inc.

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