# The Protein Flip – An Environmental Analysis of Beef Substitution at Boston College


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## Introduction

Scientific consensus holds that beef production has a disproportionately negative environmental impact compared to the production of other foods. Despite genuine concern over environmental issues, many university students continue to consume beef regularly. Our hypothesis is that through the partial displacement of ground beef with mushrooms in popular dining hall options, university students will be able to enjoy their favorite offerings while consuming less total beef.

On March 1st 2017, Boston College, in collaboration with the Menus of Change University Research Collaborative (MCURC) and participating universities (Stanford, Rutgers, Harvard, and Lebanon Valley College) administered a taste test of four different mushroom and beef meatball blends in Boston College Dining Services' (BCDS) Corcoran Commons. The central goal was to study the potential for reducing beef consumption through the displacement of a portion of ground beef with mushrooms in menu items that contain ground beef (e.g. meatballs, burgers, chili, nachos, and ethnic cuisine).

The data collected provides food quality evaluation and consumer acceptance findings for universities seeking to create a more sustainable menu.

## Methods

Stanford University shipped to BCDS six hundred (600) precooked and frozen meatballs, one hundred fifty (150) of each of the following ratios of mushroom-to-beef: 60:40; 50:50; 40:60; and 0:100.

Undergraduate students participating in the study ate the four meatball blends and recorded on a standardized hedonic scale their rankings of various culinary qualities. Participants recorded their rankings on four iPads, which used Google Forms to directly transfer data into a Google Sheet. Participants were also asked to provide their age, gender, dining location habits, beef consumption habits, and when they participated in the study (i.e. before, during, or after their meal).

## Results

### Meatball Taste Test

**Corcoran Commons**

**March 1st 6pm**

Come join us for a mushroom:beef taste test!*

We're seeking taste testers who want to help us create new flavors in the dining hall.

Your input will provide us with valuable feedback.

*This taste test is not appropriate for (1) vegetarians, (2) pregnant women, and/or (3) individuals who have known food allergies.*

Meatball D was the top choice of ~44% of respondents, followed by Meatball B (~21%), Meatball C (~18%), and Meatball A (~17%).

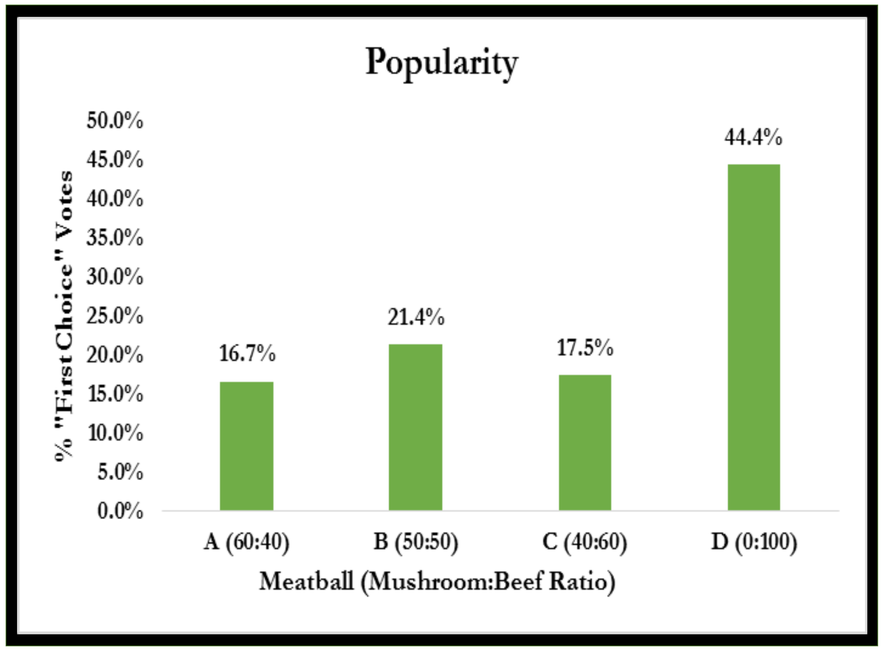


Figure 1. Popularity of four meatball blends as indicated by percentage of "top choice" votes.

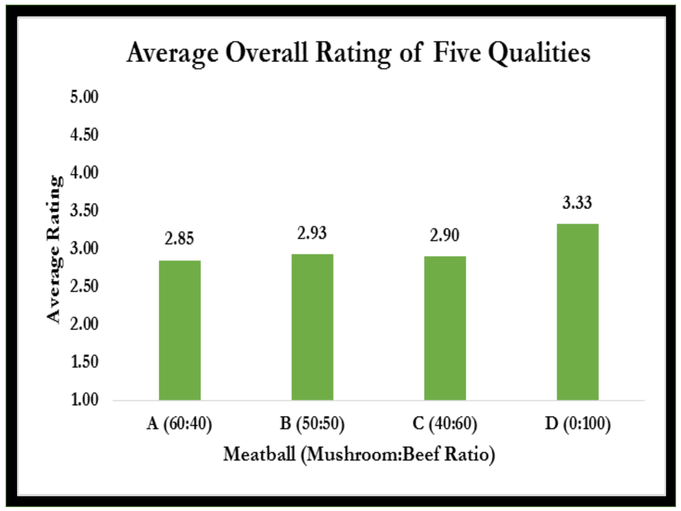


Figure 2. Average overall rating by meatball blend; calculated by averaging the mean ratings for each of the five qualities listed to the right.

**Qualities**

1. Flavor
2. Juiciness
3. Texture
4. Appearance
5. Likelihood to Eat

## Discussion

Although Meatball D (100% beef) was the most popular offering, our results indicate that Meatball B (50% beef, 50% mushroom) was comparable. While Meatball D received an overall rating of 3.33/5.0, Meatball B received an overall rating of 2.93/5.0, a difference of only 8%. Furthermore, the majority of participants (56%) selected a blended meatball as their top choice. Together, these findings support the conclusion that Boston College Dining Services should further pursue beef substitution offerings.

**The Importance of Reducing Beef Consumption:** Agriculture is responsible for more than a quarter of all global greenhouse gas (GHG) emissions, which in turn contribute to climate change.[1] Beef production requires 20 times more land and emits 20 times more GHG emissions per unit of edible protein than does the production of plant-based protein sources, such as beans, peas, and lentils.[2] Producing one pound of beef is associated with about 1,000 pounds of GHG emissions, whereas producing one pound of chicken is associated with only 8 pounds of GHG emissions.[3] Similarly, producing one pound of beef requires 2,500 gallons of freshwater.[4] Therefore, reducing beef consumption has the potential to reduce total GHG emissions and consumptive water use.

Because the standard American diet is heavily focused on beef, more than 30 million beef cattle are raised in the U.S. annually.[5] Shifting the American diet away from beef and toward plant alternatives can not only mitigate climate change, but can also improve public health. To wit, if consumers ate more plants and less beef, by 2050 GHG emissions could be cut by 66%, up to 8 million climate-vulnerable lives could be saved, and climate change-related damages totaling $1.5 trillion could be avoided.[1] These global-scale environmental findings corroborate medical research which has found strong correlations between beef consumption and many forms of cancer, type II diabetes, and heart disease.[6]

## Recommendations

In order to reduce beef consumption on campus, Boston College Dining Services should pursue a meat substitution strategy by further refining and retesting beef blends. Through these data and future student feedback, BCDS is positioned to develop blended recipes that are appealing as - or potentially even more appealing than - traditional options. By doing so, BCDS could become a leader in university dining service sustainability.


**References:**

**1** Springmann, Marco, H. Charles J. Godfray, Mike Rayner, and Peter Scarborough. "Analysis and Valuation of the Health and Climate Change Cobenefits of Dietary Change." Proceedings of the National Academy of Sciences. National Academy of Sciences, 12 Apr. 2016. Web.

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**6** Boada, Luis D., L. A. Henriquez-Hernandez, and O. P. Luzardo. "The Impact of Red and Processed Meat Consumption on Cancer and Other Health Outcomes: Epidemiological Evidences." Food and Chemical Toxicology 92 (2016): 236-44. Print



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