Toward a reduced meat diet: University North American students' acceptance of a blended meat-mushroom burger

Title: Toward a reduced meat diet: university students' acceptance of a blended meat-mushroom burger

Abstract

Reduction of meat intake and increase in vegetable consumption have attracted considerable attention from researchers and food businesses. We conducted a field experiment in a university canteen with the aim of investigating the main behavioral factors determining the consumption of a blended meat-mushroom burger. 296 students who consumed the blended burger completed a structured survey including hedonic and attitudinal questions. We then contacted the same sample after one month to measure their reported behavior. Our results show that providing information highlighting the sustainability attributes of mushrooms has the most significant and positive impact on acceptability in comparison to information related to nutrition and indulgence. In addition, the participants' beliefs about the health and sustainable benefits of mushrooms positively impact their attitude toward the blended burger. This then significantly influences their behavioral intention to purchase the product, which proves to be a good predictor of the consumption behavior. Our findings suggest marketing opportunities arising from blending plant-based ingredients with meat products.

Keywords: alternative meat, behavioral intention, sensory, hybrid meat, marketing, sustainability

1. Introduction

Meat is ubiquitous in almost all human diets. While its consumption offers vital nutrients (i.e., proteins and vitamins), excess meat production and (over)consumption can contribute to a broad range of environmental issues and diet-related chronic diseases (Arnaudova, Brunner, & Götze, 2022; Donati et al., 2016; Godfray et al., 2018). The increasing global consumer demand for meat products has negative consequences on the environment due to the inefficient conversion of plant proteins to meat proteins, which produces significant amount of greenhouse gas emissions, generates large land and water footprints, and requires large amount of energy resources (de Boer & Aiking, 2011, 2017; Donati et al., 2016; Tucker, 2014). Besides the burden on the environment, high intakes of meat-based products have a negative impact on human health. The World Health Organization suggests reducing meat intake as part of an overall healthy diet to prevent non-communicable diseases (NCD) such as obesity, type II diabetes, hypertension, and heart diseases (World Health Organization, 2017, 2018).

Consumers in North America are considered to have a meat-centric diet, which is associated with there being a deficit in plant-based foods and vegetables, and excess availability of animal protein (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). The reasons for the heavy consumption of animal-based foods include the appeal to the sensory properties preferred by many consumers, the food culture, and the tradition embedded in many Western countries (Heinz & Lee, 1998). Not surprisingly, in recent years, food scientists have increasingly addressed the growing demand for meat products with a range of creative solutions aimed at achieving more sustainable levels of meat consumption from the standpoints of human health and environmental protection (Alexander et al., 2017; Tucker, 2014). As a result, both the scientific community as well as the private sector have investigated the potential of moving toward meat alternatives, including cultured meat, algae, edible insects, and plant-based meat substitutes (Onwezen et al., 2021; Payne et al., 2019).

The transition from a primarily meat-based diet to one with lower meat content and an increased proportion of vegetarian ingredients has attracted considerable attention from researchers and food businesses alike (de Boer et al., 2017; Miller et al., 2014). As government and non-government organizations incentivize consumers to use more plant-based protein, it is important for the food industry to understand how and why consumers behave differently toward plant-based vs animal-based proteins. This will help the development of marketing and

communication strategies that can facilitate the leveraging of benefits arising from this emerging trend. However, many barriers exist to potentially encourage less meat-intensive diets among consumers, such as the strength of consumption habits (Arnaudova et al., 2022; Lentz et al., 2018). Another main challenge to increasing the consumer acceptance of novel protein-based foods, including alternatives to popular meat products (e.g., burgers), is the reduction of recurrent sensory objections (Tucker, 2014).

Consequently, the desirable sensory attributes of plant-forward products are crucial, particularly among heavy meat consumers (Ruby & Heine, 2012; Spencer & Guinard, 2018). To address this barrier, in 2014, the Culinary Institute of America collaborated with the National Mushroom Council to develop a meat-mushroom blended burger in which approximately 30% of the beef is replaced by mushrooms (Culinary Institute of America, 2016). Several studies suggest that the meat-mushroom blended burger can contribute to healthier diets (Summers et al., 2015; Wong, Corradini, Autio, & Kinchla, 2019) and to reduce negative environmental impacts (Robinson, Winans, Kendall, Dlott, & Dlott 2019; Perez-Montes et al. 2021) relative to a 100% beef burger.

While it has been several years since the transition to plant-forward products started and the meat-mushroom blended burger has come to be widely served in various dining venues, no rigorous research has been carried out to study consumer behavior, particularly consumer acceptance and consumption behavior, on such products. To fill this gap, we conducted a field experiment in a dining venue of a university campus to investigate the factors that discourage or encourage the consumption of a blended burger among university students. Guided by the Theory of Planned Behavior (TPB), this study investigates the following: (1) whether and how the information about the attributes of the blended burger (to be precise, sustainability, nutritional, and indulgent attributes) influences acceptance; (2) whether attitudes toward the blended burger is a good predictor of behavioral intention (i.e., willingness to try); and (3) whether the behavioral intention predicts the consumption behavior.

Having employed a structural equation model to analyze the data, we find that the information highlighting the sustainability attributes had the most significant and positive impact on the acceptability of the blended burger. In addition, the participants' attitudes toward this product significantly influences their behavioral intention, which is a good predictor of the actual consumption behavior.

These findings can help develop and guide future marketing communication strategies (e.g., messaging and promotion) by delivering product information that has the greatest impact on acceptance, which in turn could contribute toward the encouragement of healthier diets among younger generations.

2. Relevant Literature

In light of increasing environmental and health concerns regarding excessive meat consumption, especially among young adults, public and private authorities have been seeking ways to reduce the intake of meat in diets, including education on healthy diets and promotion of meat substitutes (de Boer et al., 2017; Onwezen et al., 2021; Schösler et al., 2012). For instance, Menus of Change Research Collaborative (MCURC), founded by the Standard University and the Culinary Institute of America, is seeking to replace animal proteins with vegetarian ingredients in their menus without compromising the sensory aspects. This is crucial considering that college students often consume excessive animal protein and lack the self-control or motivations necessary to maintain a healthy diet, especially because of the low sensory appeal of a plant-based diet (Spencer et al., 2018).

By changing the menus in college dining facilities, the Menus of Change initiative aims to provide students more nutritious and sustainable food choices, and to emphasize the impact of food production on the human health and environment (e.g., carbon emissions from animal production as a contributing factor in climate change). Instead of meat-reducing interventions like "meatless day" or replacing meat meals with meat-free options (Apostolidis & McLeay, 2016), the Menus of Change initiative aims to introduce meat hybrid substitutes across several campuses. Hybrid meats are products that combine meat and non-meat ingredients (Grasso, 2020). In general, the inclusion of plant-based ingredients in animal origin products has been highlighted because of their nutritional properties (e.g., no cholesterol, low fat ingredients) (Patinho et al., 2019). For example, in recent years, the use of mushrooms as a high nutritional value source of bioactive compound to partially replace ground beef in the production of healthier meat products has gained popularity (Pérez-Montes, Rangel-Vargas, Lorenzo, Romero, & Santos, 2021; Wong et al., 2017; Wong, Corradini, Autio, & Kinchla, 2019). Several nutritional benefits of including mushroom as a meat extender in beef patty formulation have been assessed, including the reduction of caloric content and improvement in terms of protein and carbohydrate content (Pérez-Montes et al., 2021; USDA National Nutrient Database for Standard Reference, 2021; Wong et al., 2019). One of the

studies (Summers et al., 2015) conducted a nutrient comparison between a blend burger and a beef burger. The study reported that the blend burger had lower total and saturated fat composition, caloric composition, and sodium content in comparison to the 100% beef burger. Moreover, mushrooms are rich in complex carbohydrates like dietary fiber, which is usually lacking in meat products (Mehta et al., 2015). In addition, mushrooms (e.g., fresh shiitake mushrooms) contain less sodium (9mg/100g) than ground beef meat (66mg/100g) and higher level of naturally occurring free glutamate (71mg/100g) that acts as natural sodium salt for flavor enhancement (Jo Feeney, Miller, & Roupas, 2014). As a result, past studies have shown how mushrooms can mitigate the sodium content of ground beef in meat-based products without a significant change in sensory appeal (Mattar et al., 2018; Guinard et al., 2016; Miller et al., 2014). For example, Wong et al., (2019) shows how a patty formulation with 20% mushroom extender and 80% ground beef has a lower salt content (1.1 % Weight) in comparison to an all-beef patty (1.5 % Weight), with a consumer hedonic sensory analysis showing similar saltiness liking scores. The flavor-enhancing properties of mushrooms are associated with umami taste, contributing to a more savory and meaty taste sensation (Jo Feeney et al., 2014; Zhang et al., 2013). In addition, mushrooms are a good replacement for ground beef because of the similarities in sensory properties like color and texture (Miller et al., 2014; Patinho et al., 2019 Spencer, Cienfuegos, et al., 2018). For instance, Patinho et al. (2021) has shown how a reformulation containing 15% mushrooms (*Agaricus bisporus*) as a fat replacement in beef burgers can be considered a promising strategy for commercial products to increase the nutritional profile without compromising the sensory appeal.

An emerging literature suggests that increasing mushroom in diets can contribute to environmental sustainability. For example, a few life cycle assessment (LCA) studies have examined the environmental impact of mushrooms production. Recently, Robinson, Winans, Kendall, Dlott, & Dlott (2019) conducted a LCA on mushroom production in the USA from cultivation to harvesting and preparation for bulk packaging. They concluded that, while most of the processes are fairly optimized for water and waste recycling, energy consumption is the most impactful process. In general, growing mushrooms can be considered as a sustainable cultivation as mushrooms require relatively little space and are considered to be "fast-growing organisms with a high yield" (Pérez-Montes et al., 2021).

As a result, several college foodservice settings (e.g., school canteens/cafeterias) across the US have started to introduce a blended meat-mushroom burger as a healthy and sustainable option

in their menus in recent years (Jacewicz, 2016, Sogari et al., 2021). Besides college dining halls, marketplaces have also come to offer increasing number of hybrid meat alternatives (Grasso & Jaworska, 2020). The development of hybrid vegetable-meat products is indeed a novel area and could be considered as an effective strategy to encourage meat reduction among those who are resistant to fully shift to vegetarian or vegan diets. These new products (e.g., burger, sausages) allow consumers to continue eating familiar foods with a reduced meat content without compromising on the desirable sensory attributes (Sogari et al., 2021). The inclusion of a non-meat ingredient (such as mushrooms) can lead to a transition to a more plant-based diet (Grasso, 2020). However, little is known about the consumers' acceptance of and their behaviors toward blended vegetable-meat products. Previous research on mixed or hybrid vegetable-meat products has focused mainly on identifying the sensory properties of such products, including texture, flavor, and appearance (Miller et al., 2014; Spencer, Cienfuegos, et al., 2018; Spencer & Guinard, 2018). Only a few studies have investigated the consumer preferences of dishes in which beef had been partially substituted by mushrooms (e.g., burgers). Lang (2020) investigated U.S. consumers' acceptance and consumption of the mushroom and meat combination and found the most preferred form of blended food products to be burgers. Prusaczyk, Earle, & Hodson (2021) examined the effectiveness of information (i.e., an education intervention and nudge) to encourage the consumption of a beef-mushroom burger among a group of US consumers. Sogari et al. (2021) found that, with the motivation to process sustainability and nutrition information, and with a positive attitude toward food innovation, college students are more likely to purchase a meat-mushroom blended burger.

While these past authors made substantial contributions to the literature, all these studies were based on surveys without the actual tasting experience of the products. Therefore, a call is needed for extending this field of research exploring how consumers perceive mushrooms as a meat replacement in a burger (Patinho et al., 2019). This study contributes to the understanding of how the actual consumption of a blended meat-mushroom burger affects the attitude, the intention, and the reported purchasing behavior in the near future. In addition, we investigated consumers' expectations and hunger level before tasting, and their acceptance (overall liking) during consumption. We then further investigate how these factors could influence the following repeat purchase, measured as the actual purchase of the product after one month. The investigation of the overall liking and preferences is crucial to trigger the first trial and the following repeat purchase

(Hung & Verbeke, 2018).

Using models that integrate both consumers' hedonic-based expectations (driven by information given before tasting) and the role of consumers' actual liking/disliking of food has led to a better understanding of consumer experience (Deliza, 2018). These types of studies that combine both research and development and marketing of a product are crucial in a situation where the private sector is developing and launching new food products. Without a better understanding of consumer behavior toward the blended burger, marketing strategies and policy intervention initiatives to encourage its consumption may be ineffective. Our work fills this gap in the literature by developing a conceptual behavioral framework and empirically testing the factors influencing the acceptance of and intention to consume the meat-mushroom blended burger.

3. Conceptual Framework and Hypotheses

The conceptual framework of this study is presented in Figure 1. The starting point is to measure the links between 1) the perceived level of hunger, and 2) the past experience of having eaten the product on the 'desire to eat and the expected liking' (Mela, 2006). We expect a positive relationship between the level of hunger and the desire to eat as hunger is the intrinsic motivation to eat. We also expect a positive relationship that between the level of hunger and the expected liking of the meat-mushroom burger due to the anticipation of pleasure. Past experience with the blended burger is expected to increase the desire to consume and the expected liking of the product. Expected liking tends to have a positive influence on food choices and is considered as a strong determinant of the actual enjoyment and acceptance of a food product (Cardello & Wright, 2010; Robinson et al., 2013). Therefore, we hypothesize that an increase in expected liking results in higher overall perceived liking and acceptance of the meat-mushroom blended burger.

[Insert Figure 1**]**

Figure 1. Structural model of the behavior toward consuming a meat-mushroom burger

Many studies have brought out the effectiveness of information (e.g., informative posters or nudges) at the point-of-purchase to alter the eating behavior of students with the aim to encourage a healthy diet (Peterson et al., 2010; Prusaczyk et al., 2021; Sogari et al., 2019). We hypothesize that the consumer acceptance of the blended meat-mushroom burger is influenced by the information provided (Caporale et al., 2006). Three different types of information were

provided: nutrition, sustainability, and indulgence. Cognitively-oriented information, such as nutrition and sustainability, is supposed to increase consumers' knowledge. This is crucial because, in order to encourage a more pro-environmental behavior, including a diet with substantial reductions in meat, consumers should be educated about the potential environmental and health benefits (Lee et al., 2014; Willett et al., 2019). The indulgent information is an affectively-oriented message that seeks to influence how consumers feel about the hedonic consequences of eating the product (Cadario & Chandon, 2018).

To assess consumer behavior toward the blended burger, our conceptual model follows the Theory of Planned Behavior (TPB) (Ajzen, 1991; Ajzen & Madden, 1986) and includes two constructs of the Theory: attitude and behavioral intention. The TPB is widely used in the literature to explain the adoption of healthy and sustainable behaviors (Biasini et al., 2021). Considering our aim is to investigate the motivational factors related to the inclusion of a healthier meat product in the diet of the students, we believe this decision-making model is appropriate in our study.

We hypothesize that the behavior under investigation (consumption of a blended burger) is determined by intention and attitude (i.e., people's overall evaluation of a behavior). We assume that, the more positive one's attitude is toward eating this blended mushroom-meat burger, the higher the intention to consume the product in the coming month. The reason to include a timeframe when measuring intention is suggested by Fishbein and Ajzen (2011).

In social psychology, attitudinal change can also be altered by expectations (Hovland et al., 1957). Therefore, we assume attitude and intention to be influenced by expected liking before tasting and level of acceptance after tasting. In addition, the TPB postulates that the behavioral beliefs are the antecedents of the attitude toward the behavior. Consumers' beliefs about the attribute of a product can link the behavior to a specific outcome. Based on this assumption and considering the high percentage of mushrooms in this burger, we assume that the belief of eating mushrooms is healthy and sustainable could also be a predictor of the positive attitude toward and acceptance of this product. The TPB further postulates behavioral intention to be the most important determinant to explain the performance of the respective behavior. Therefore, we hypothesize that the intention of eating the meat-mushroom burger at Time 1 (i.e., the likelihood that a person is going to consume this burger in the future) is a good predictor of the (reported) behavior at a later time (Time 2).

4. Materials and Methods

4.1 Participants

In this study, a between-subject experiment using a college student sample was conducted. Data was collected (n = 296) from the dining foodservice setting of a US university in New York State during lunch and dinner meals in the fall semester of 2018. The demographics of the students were as follows: mixed representation on the basis of gender, with 51.01% being females; majority of the students were from North America (i.e., USA and Canada); and the students' ages ranged from 18 to 35 years (M = 19.21, SD = 1.95) (Table 1).

[Insert Table 1**]**

We approached only the diners who had chosen the meat-mushroom blended burger, a new item on the menu, and then asked for their consent to participate in a short survey about eating habits. The participants received $5 in "meal bucks" in exchange for their participation in the study. They were asked to sign an informed consent. This study was deemed exempt by the Institutional Review Board (IRB) of the Office of Research Integrity and Assurance of Cornell University (Protocol ID#: 1808008184).

4.2 Design with information treatment

In the study design, before starting the questionnaire, subjects were randomly assigned to one of the following four treatments: nutrition information, sustainability information, indulgence information, or a control group with no messaging.

Respondents who received an information treatment were asked to read a short text which reported some of the positive characteristics of consuming the product (e.g., nutrition, sustainability, or indulgence attributes). The message about nutrition provided some nutritional information about the consumption of mushrooms for a healthy diet (e.g., rich in proteins and nutrients). Another message focused on the environmental sustainability of growing mushrooms (e.g., lower carbon footprint and less water usage). Then, the indulgence message considered the sensory appeal of mushrooms related to its flavor-enhancing properties (e.g., umami taste, juicier, and flavorful).

It is essential that any type of information provided to encourage consumption is appropriately presented at the point of purchase/selection, otherwise, it will not be salient to the consumers (Balcombe et al., 2016). Therefore, the information was provided on a single sheet

using a colored image, incorporating the message in a format that is similar to the communication campaigns that have run in the past in the dining venues. The content of the information treatment was agreed upon and supported by the representatives of The National Mushroom Council (https://www.mushroomcouncil.com/)[1].

4.3 Questionnaire and measures

In this study, three questionnaires, comprising psychographic and product-oriented questions, were used at three different times: (1) pre-eating at the dining venue, (2) post-eating at the dining venue, and (3) a follow-up survey four weeks later, administered online.

First, the students who decided to participate in this study were asked to complete a short preliminary questionnaire (Table A.1 in the Appendix) before consuming the burger. This questionnaire included a rating of the participants' state of hunger (Bacon & Krpan, 2018), their desire to eat (Liem et al., 2012) and their rating of hedonic attributes (i.e., past and expected overall liking) via the use of a 7-point hedonic scale (Peryam & Pilgrim, 1957; Vad Andersen & Hyldig, 2015).

After the participants ate the burger, the primary survey (Table A.2 in the Appendix) was distributed in the dining hall (Time 1 in Figure 1). It included two items investigating the participants' beliefs about the sustainability and nutritional implications of consuming mushrooms and two items investigating the perceived overall liking and desire to eat the blended burger again. In our analysis, we grouped the overall liking and desire to eat in one latent construct, namely "Food Acceptance" to represent the liking/disliking ratings of the foods that have actually been tasted/eaten (Cardello et al., 2000). The plating and presentation of the burger was identical every day; this way, we controlled the visual aspects of the food that can influence expectations. Finally, measures based on the TPB model were adopted to understand participants' attitude and behavioral intention to consume the product in the near future. These measures were focused on the attitudinal variables of introducing this product to college students, rather than the sensory profile and pleasantness of the product in comparison to a traditional burger. The last part of the questionnaire elicited demographic information such as age, gender, and country of origin.

Approximately one month after completing the primary survey, the respondents received an online follow-up questionnaire. They were asked about their meat-mushroom burger consumption frequency in the past month (from "never" to "almost always"). Inclusion of the question about past consumption (i.e., reported behavior) was relevant to measure if the intention

to eat a meat-mushroom blended burger would translate into there being an actual eating behavior in the future (Time 2 in Figure 1).

4.4 Data analysis

A Structural Equation Model (SEM) technique was employed to test the hypotheses posited in Figure 1. This statistical method has been used in the previous literature via the use of TPB to examine the behavioral decision making toward a healthy and sustainable diet (Biasini et al., 2021; Menozzi, Sogari, & Mora, 2017; Ricci et al., 2018). First, a confirmatory factor analysis (CFA) of all the measured variables tested the relationship with the latent factors. Second, this model tested the hypothesized relationship of the latent constructs obtained in the first step. The Full Information Maximum Likelihood method was specified to estimate the parameters of our dataset.

5. Results

The analysis was conducted using the statistical software STATA, version 15. The factor analysis results are present in Table 2. The SEM results identified in Figure 1 are presented in Table 3.

The measurement model fit was assessed through the CFA to assess the validity of the following constructs: expected liking and desire, food acceptance, beliefs regarding the health and sustainability with respect to mushroom consumption, as well as the attitude, and behavioral intention to try the blended burger. Convergent and discriminant validation, and the overall fit with data were examined to ensure model validity and reliability. To test the internal consistency of the indicators of each construct, the commonly used method to calculate the coefficient alpha of a given construct was adopted (Kang et al., 2013; Menozzi et al., 2017). Table 2 presents the Cronbach's α coefficients for each construct. Their values exceed the recommended minimum value of 0.7 (Nunnally & Bernstein, 1994), suggesting that all the constructs were internally consistent and reliable.

[Insert Table 2**]**

Table 3 presents the results of the structural model and the standardized path effects among the constructs in the structural model in Figure 1. Different goodness of fit indices are used to test whether the measurement model has a good fit with the data. The obtained values of the root mean square error of approximation (RMSEA) and the lower bound for the 90% confidence interval are 0.063 and 0.040, respectively, which meet the maximum criteria values of 0.08 and 0.05 (Hooper

et al., 2008). The chi-square is 54.676 with 25 degrees of freedom (df), and the ratio of the chi-square value to the df is 2.187, which is within the recommended intervals, between 2 and 5 (Hooper et al., 2008; Marsh & Hocevar, 1985). The comparative fit index is 0.932, above the recommended value of 0.900, suggesting that the measurement model has a good fit with the data.

[Insert Table 3]

The results show that both past experience and hunger have a statistically positive significant effect on the expected liking and desire to eat the blended burger, which support our hypotheses H1 and H2 ($coefficient_{past\ experience}$ = 0.559, p = 0.000; $coefficient_{hunger}$= 0.116, p = 0.001). These expectations and the beliefs that eating mushrooms is healthy and sustainable positively influence the acceptance of the blended burger, supporting our hypotheses H3 and H4 ($coefficient_{expected\ liking}$ = 0.418, p = 0.000; $coefficient_{beliefs}$ = 0.118, $p < 0.05$). The results also indicate that the sustainability message treatment significantly increased the participants' food acceptance rating relative to the control treatment ($coefficient_{sustainable}$ = 0.262, $p < 0.05$), while neither the indulgence nor the nutrition information were found to be significant. This result suggests that the product information highlighting the sustainability attributes of the burger influences the acceptance (answering the research question identified in Figure 1). The participants' characteristics such as gender, age, and country of origin were not found to be statistically significant.

In terms of estimating the consumer attitudes toward the meat-mushroom burger, the results indicate that the acceptance and beliefs about the health and sustainability benefits of mushrooms have significant and positive impacts on their attitudes toward the blended burger, supporting our hypotheses H5 and H6 ($coefficient_{acceptance}$= 0.521, p = 0.000; $coefficient_{beliefs}$ = 0.236, p = 0.000). Participants' attitudes further positively influenced the behavioral intention to consume in the future, supporting H7 ($coefficient_{attitudes}$= 0.479, p = 0.000; $coefficient_{acceptance}$ = 0.341, p = 0.000).

We tested the direct effects for the model identified in Figure 1. No significant direct effects were found between "Expected Liking and Desire" and both "Attitude" ($p > 0.05$) and "Behavioral Intention" ($p > 0.05$). In addition, no significant direct effects were found between communication messages and both "Attitude" ($p > 0.05$) and "Behavioral Intention" ($p > 0.05$). However, we found "Health and Sustainable Related Beliefs of Mushrooms" to have a significant direct effect on "Behavioral Intention" ($coefficient$ = 0.185, $p < 0.01$). As discussed in

the above results, the beliefs pertaining to mushrooms also have a direct impact on "Attitude," suggesting that beliefs pertaining to mushrooms influence "Behavioral Intention" directly, and also indirectly via "Attitude."

The last part of Table 3 presents the SEM results of the follow-up questionnaire in the structural model, which are used to test hypothesis H8 ("Time 2" in Figure 1). The obtained values of RMSEA and the lower bound are 0.045 and 0.000, respectively, which are lower to the criteria values of 0.07 and 0.05 (Hooper et al., 2008). In addition, the comparative fit index is 0.996, above the recommended value of 0.900. The results show the behavioral intention in the first period to be positively associated with the reported behavior measured in the follow-up question (*coefficient* = 0.500, p = 0.000), indicating that consumer behavioral intention toward the blended burger appears to be a good predictor of actual future consumption behavior.

6. Discussion

Many practitioners, policy makers, and academics have participated in the ongoing debate on how to reduce meat consumption in order to address the potential impact related to health, society, and environment (Apostolidis & McLeay, 2016). As a consequence, consumers are increasingly interested in shifting to diets with occasional inclusion of animal products (flexitarian). Reducing the consumption of meat is an easier practice to adopt than the complete exclusion of meat, i.e., a complete shift to strict vegetarianism or veganism (Sogari et al., 2021). Therefore, past studies (Arnaudova et al., 2022; Grasso & Jaworska, 2020) have suggested that, in order to create an effective dietary change, the new eating habits should be familiar to consumers, especially the consumers who are very attached to meat. Research on how marketers and food service operators can encourage consumers to include blended meat and plant-based ingredients in their traditional meat products are lacking. Our results show that the introduction of a meat-mushroom burger among university students represents a robust applicable strategy to simultaneously increase vegetable consumption and reduce red meat consumption and sodium intake. Moreover, this strategy does not include compromising the original taste of the burger and does not limit the number of food choices available at the school cafeteria.

As suggested by Balcombe et al. (2016), provision of nutritional information did not sway the target population, while an appropriately targeted environmental message may be more effective in reducing meat consumption. Thus, a foodservice operation's commitment to include more meat and plant-based options in its menu will be enhanced by investing in education related

392 to the sustainability and environmental impacts of food (Lee et al., 2014; Willett et al., 2019).

393 Although previous studies have identified how evocative and indulgent names and
394 descriptions of foods can result in higher hedonic valuation (Turnwald et al., 2017; Yeomans et
395 al., 2001), our findings did not find any significant relationships. This can be explained by the
396 content of the message based on the umami properties that may not be commonly known and
397 understood. This perhaps suggests that marketing strategies should focus more on the sensory
398 appeal of the overall product (Bublitz & Peracchio, 2015), i.e., the taste of the burger, rather than
399 the singular flavor ingredient of mushrooms.

400 High level of expectations and desire to eat the product have a positive association with
401 the acceptance of food, whereas a lack of correspondence between the expected and actual liking
402 may lead to a negative relationship between the perception of a product's quality and the appeal
403 and desire to eat. For instance, Spencer, Cienfuegos, & Guinard (2018) reported that the
404 acceptability of a dish using legumes as a meat replacement decreases if the expectations are not
405 being met. Our results confirm that the overall liking of this new vegetable-meat recipe was rated
406 higher when the eating experience matched the expectations. This implies that these new products
407 still need to meet sensory quality expectations to be accepted because positive messaging alone
408 will not compensate for low level of satisfaction. Nevertheless, in order to reduce the risk of
409 product failure in the marketplace, the providers of meat-mushroom blended burgers need to
410 communicate the attributes of the product (e.g., sustainability benefits of mushroom production)
411 to increase burger acceptance, which would in turn positively increase the overall eating
412 experience.

413 It is common in food research to investigate consumer acceptability to predict the
414 consumption or purchasing of food products in future occasions (Cardello et al., 2000). Our
415 findings emphasize the role of combined perceived and expected overall liking experiences to
416 explain most of the attitude and behavioral intention to try this new product in the future.
417 Consistent with previous studies (Menozzi et al., 2017; Ricci et al., 2018), the results confirm the
418 importance of attitude in predicting the intention to consume. Finally, in line with the TPB model,
419 our findings confirm that the ability of intention to predict behavior is higher when the behavior
420 in question is more accessible and context-specific to perform (i.e., availability of the product at
421 the dining hall) (De Cannière et al., 2009).

422 While previous research shows that openness to trying novel foods can be explained by

social influence and pressure (Mancini et al., 2019; Ruby & Heine, 2012), our results suggest food acceptance to also be a determinant in increasing the positive attitude toward this new blended burger. Since consumers are drawn to make choices based on the familiarity, the habits, and the taste of foods (Arnaudova et al., 2022; Bublitz & Peracchio, 2015), it is desirable to guarantee a positive reaction to the sensory appeal of these mixed meat and plant-based products. In fact, one of the main obstacles to the acceptance of these new novel products is the limited expected sensory appeal perceived by many consumers, which can create skepticism about the final quality. Therefore, new product development of meat alternatives (Arnaudova et al., 2022) and culinary strategies in the food service (Sogari et al., 2021) should consider the desired and expected sensory characteristics. The success of these products could encourage consumers to shift their traditional eating habits toward more sustainable options like "plant forward" menus (Culinary Institute of America, 2016; Spencer & Guinard, 2018). In particular, for heavy meat eaters, familiarity with the product is crucial to increase their intention to try reduced-meat alternatives.

Despite our encouraging findings, several limitations occur. First, generalizing our results to the general public might be problematic considering that our sample consists primarily of college students. University-educated individuals may be more receptive to information and in general be more open to switch to a diet with less meat intake than non-university students (Arnaudova et al., 2022). Future research should consider a broader and diversified sample, i.e., older consumer groups and other nationalities.

While our study provides valuable insights on the consumer acceptability of the meat-mushroom burger, this work does not consider the other critical aspects that may influence the success of this type of product in other market contexts. Future research should explore the costs, the consumer willingness to pay, and the preferences across different types of meat alternatives, including 100% plant-based versus hybrid meat products. New directions for research in this area should focus on the consumer behavior in other eating contexts and purchasing situations such as restaurants and grocery stores. Moreover, further studies should include sensory analysis measures to investigate the profile of products under blind and informed conditions to evaluate the role of information.

7. Conclusions

This research has looked at the possible pathways to reshape the current tradition of heavy meat consumption with a more environmentally sustainable and healthier "plant-forward" diet. In

order to examine this pathway, we investigated whether students were ready to replace traditional burgers with a hybrid meat-mushroom burger in college dining venues. This is grounded in the principle that it may be more plausible to reduce the intake of meat in our daily diet routines than to completely eliminate meat consumption.

Our findings suggest that higher familiarity with hybrid meat and plant-based products, i.e., consumer tasting experience, increase the likelihood of a repeated purchase in the near future. Moreover, information on the sustainability benefits (e.g., lower carbon and water footprint impact) influences the acceptability of the blended burger. Thus, it is necessary to develop effective campaigns to communicate the benefits of these new foods to create market acceptance.

The strategy used for the blended burger can be replicated with other traditional US food items to partially replace meat with plant-based ingredients. We believe that our contribution to the current literature and body of knowledge on meat reduction strategies and eating behavior of hybrid meat products among students could lead to further discussion and insights, which may in turn inspire new initiatives and studies to investigate healthier and more sustainable diets.

Footnote

[1]For the sake of transparency, the National Mushroom Council was involved in this study just as an external expertise. It did not take part in data collection or analysis, and neither did it finance the study.

Declaration of competing interest: None.

Acknowledgement of financial support of research

This study is part of a wider project called "CONSUMEHealth. Using consumer science to improve healthy eating habits" and has received funding from the European Union's Horizon 2020 research and Innovation programme under the Marie Sklodowska-Curie grant agreement No 749514.Acknowledgments

The authors express thanks to all the staff of the Cornell Dining venues for their collaboration and help in carrying out this study. Additionally, the authors thank The National Mushroom Council for providing vital support to carry out this investigation.

Ethical Statement

All study procedures were deemed exempt by the Institutional Review Board (IRB) of the Office of Research Integrity and Assurance of Cornell University (Protocol ID#: 1808008184). All participants in the study gave informed consent before taking part in the study.

Author Contributions

Giovanni Sogari: Conceptualization, Methodology, Data curation, Formal analysis, Project administration, Supervision, Writing - original draft. **Jie Li**: Data curation, Formal analysis, Writing - original draft. **Qian Wang**: Data curation, Formal analysis. **Michele Lefebvre**: Methodology, Writing - review & editing. **Shihua Huang**: Data curation. **Cristina Mora**: Writing - review & editing, Project administration. **Miguel I. Gómez**: Writing - review & editing, Project administration, Supervision. All authors have approved the final article.

Appendix

Insert here Table A1. Preliminary questionnaire items, before eating the burger

Insert here Table A2. Primary questionnaire, after eating the burger

References

Arnaudova, M., Brunner, T. A., & Götze, F. (2022). Examination of students' willingness to change behaviour regarding meat consumption. *Meat Science*, 184, 108695. https://doi.org/https://doi.org/10.1016/j.meatsci.2021.108695

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I., & Madden, T. J. (1986). Prediction of goal-directed behavior: Attitudes, intentions, and perceived behavioral control. *Journal of Experimental Social Psychology*, *22*(5), 453–474. https://doi.org/10.1016/0022-1031(86)90045-4

Alexander, P., Brown, C., Arneth, A., Dias, C., Finnigan, J., Moran, D., & Rounsevell, M. D. A. A. (2017). Could consumption of insects, cultured meat or imitation meat reduce global

agricultural land use? *Global Food Security-Agriculture Policy Economics And Environment*, *15*, 22–32. https://doi.org/10.1016/j.gfs.2017.04.001

Apostolidis, C., & McLeay, F. (2016). Should we stop meating like this? Reducing meat consumption through substitution. *Food Policy*, *65*, 74–89. https://doi.org/https://doi.org/10.1016/j.foodpol.2016.11.002

Bacon, L., & Krpan, D. (2018). (Not) Eating for the environment: The impact of restaurant menu design on vegetarian food choice. *Appetite*, *125*, 190–200. https://doi.org/10.1016/j.appet.2018.02.006

Balcombe, K., Fraser, I., Lowe, B., & Souza Monteiro, D. (2016). Information Customization and Food Choice. *American Journal of Agricultural Economics*, *98*(1), 54–73. https://doi.org/10.1093/ajae/aav033

Biasini, B., Rosi, A., Giopp, F., Turgut, R., Scazzina, F., & Menozzi, D. (2021). Understanding, promoting and predicting sustainable diets: A systematic review. *Trends in Food Science & Technology*, *111*, 191–207. https://doi.org/https://doi.org/10.1016/j.tifs.2021.02.062

Bublitz, M. G., & Peracchio, L. A. (2015). Applying industry practices to promote healthy foods: An exploration of positive marketing outcomes. *Journal of Business Research*, *68*(12), 2484–2493. https://doi.org/10.1016/j.jbusres.2015.06.035

Cadario, R., & Chandon, P. (2018). Which Healthy Eating Nudges Work Best? A Meta-Analysis of Field Experiments. *Marketing Science*, *July*. https://doi.org//dx.doi.org/10.2139/ssrn.3090829

Caporale, G., Policastro, S., Carlucci, A., & Monteleone, E. (2006). Consumer expectations for sensory properties in virgin olive oils. *Food Quality and Preference*, *17*(1–2), 116–125. https://doi.org/10.1016/J.FOODQUAL.2005.07.011

Cardello, A., Schutz, H., Snow, C., & Lesher, L. (2000). Predictors of food acceptance, consumption and satisfaction in specific eating situations. *Food Quality and Preference*, *11*(3), 201–216. https://doi.org/10.1016/S0950-3293(99)00055-5

Cardello, A. V., & Wright, A. O. (2010). Issues and methods in consumer-led development of foods processed by innovative technologies. In J. Ahmed, H. S. Ramaswamy, S. Kasapis, & J. I. Boye (Eds.), *Novel Food Processing: Effects on Rheology and Functional Properties. Boca Raton*. CRC Press.

Culinary Institute of America. (2016). *The Protein Flip: A Delicious Strategy for Change*.

http://www.menusofchange.org/images/uploads/pdf/CIA-MenusOfChange_ProteinFlip_(May_2016).pdf

de Boer, J., & Aiking, H. (2011). On the merits of plant-based proteins for global food security: Marrying macro and micro perspectives. *Ecological Economics*, *70*(7), 1259–1265. https://doi.org/10.1016/J.ECOLECON.2011.03.001

de Boer, J., & Aiking, H. (2017). Pursuing a Low Meat Diet to Improve Both Health and Sustainability: How Can We Use the Frames that Shape Our Meals? *Ecological Economics*, *142*, 238–248. https://doi.org/10.1016/j.ecolecon.2017.06.037

de Boer, J., Schösler, H., & Aiking, H. (2017). Towards a reduced meat diet: Mindset and motivation of young vegetarians, low, medium and high meat-eaters. *Appetite*, *113*, 387–397. https://doi.org/10.1016/j.appet.2017.03.007

De Cannière, M. H., De Pelsmacker, P., & Geuens, M. (2009). Relationship Quality and the Theory of Planned Behavior models of behavioral intentions and purchase behavior. *Journal of Business Research*, *62*(1), 82–92. https://doi.org/10.1016/j.jbusres.2008.01.001

Deliza, R. (2018). Chapter 18 - Expectations: Blind/Informed Testing. In G. Ares & P. B. T.-M. in C. R. Varela Volume 1 (Eds.), *Woodhead Publishing Series in Food Science, Technology and Nutrition* (Vol. 1, pp. 451–483). Woodhead Publishing. https://doi.org/https://doi.org/10.1016/B978-0-08-102089-0.00018-2

Donati, M., Menozzi, D., Zighetti, C., Rosi, A., Zinetti, A., & Scazzina, F. (2016). Towards a sustainable diet combining economic, environmental and nutritional objectives. *Appetite*, *106*, 48–57. https://doi.org/10.1016/j.appet.2016.02.151

Fishbein, M., & Ajzen, I. (2011). Predicting and changing behavior: The reasoned action approach. In Predicting and Changing Behavior: The Reasoned Action Approach. https://doi.org/10.4324/9780203838020

Godfray, H. C. J., Aveyard, P., Garnett, T., Hall, J. W., Key, T. J., Lorimer, J., Pierrehumbert, R. T., Scarborough, P., Springmann, M., & Jebb, S. A. (2018). Meat consumption, health, and the environment. *Science*, *361*(6399), eaam5324. https://doi.org/10.1126/science.aam5324

Grasso, S. (2020). Hybrid meat. *Food Science and Technology*, *34*(3), 48–51. https://doi.org/https://doi.org/10.1002/fsat.3403_12.x

Grasso, S., & Jaworska, S. (2020). Part Meat and Part Plant: Are Hybrid Meat Products Fad or Future? In *Foods* (Vol. 9, Issue 12). https://doi.org/10.3390/foods9121888

Guinard, J. X., Miller, A.M., Mills, K., Wong, T., Lee, S. M., Sirimuangmoon, C., Schaefer, S. E., & Drescher, G. (2016). Consumer acceptance of dishes in which beef has been partially substituted with mushrooms and sodium has been reduced. *Appetite*, *105*, 449–459. https://doi.org/10.1016/j.appet.2016.06.018

Heinz, B., & Lee, R. (1998). Getting down to the meat: The symbolic construction of meat consumption. *Communication Studies*, *49*(1), 86–99. https://doi.org/10.1080/10510979809368520

Hoffman, S. R., Stallings, S. F., Bessinger, R. C., & Brooks, G. T. (2013). Differences between health and ethical vegetarians. Strength of conviction, nutrition knowledge, dietary restriction, and duration of adherence. *Appetite*, *65*, 139–144. https://doi.org/10.1016/J.APPET.2013.02.009

Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural Equation Modeling: Guidelines for Determining Model Fit. *Electronic Journal of Business Research Methods*, *6*(1), 53–60. https://doi.org/10.21427/D7CF7R

Hovland, C. I., Harvey, O. J., & Sherif, M. (1957). Assimilation and contrast effects in reactions to communication and attitude change. *The Journal of Abnormal and Social Psychology*, *55*(2), 244–252. https://doi.org/10.1037/h0048480

Jacewicz, N. (2016). A Twist on the Mushroom Burger. *Scientific American*, *314*(4), 16–16. https://doi.org/10.1038/scientificamerican0416-16

Jo Feeney, M., Miller, A. M., & Roupas, P. (2014). Mushrooms-Biologically Distinct and Nutritionally Unique: Exploring a "Third Food Kingdom". *Nutrition Today*, 49(6), 301–307. https://doi.org/10.1097/NT.0000000000000063

Kang, J., Liu, C., & Kim, S.-H. (2013). Environmentally sustainable textile and apparel consumption: the role of consumer knowledge, perceived consumer effectiveness and perceived personal relevance. *International Journal of Consumer Studies*, *37*(4), 442–452. https://doi.org/10.1111/ijcs.12013

Lang, M. (2020). Consumer acceptance of blending plant-based ingredients into traditional meat-based foods: Evidence from the meat-mushroom blend. *Food Quality and Preference*, *79*, 103758. https://doi.org/https://doi.org/10.1016/j.foodqual.2019.103758

Lee, Y. ki, Kim, S., Kim, M. seong, & Choi, J. gu. (2014). Antecedents and interrelationships of three types of pro-environmental behavior. *Journal of Business Research*, *67*(10), 2097–

606 2105. https://doi.org/10.1016/j.jbusres.2014.04.018
607 Lentz, G., Connelly, S., Mirosa, M., & Jowett, T. (2018). Gauging attitudes and behaviours:
608 Meat consumption and potential reduction. *Appetite*, *127*, 230–241.
609 https://doi.org/10.1016/J.APPET.2018.04.015
610 Liem, D. G., Toraman Aydin, N., & Zandstra, E. H. (2012). Effects of health labels on expected
611 and actual taste perception of soup. *Food Quality and Preference*, *25*(2), 192–197.
612 https://doi.org/10.1016/J.FOODQUAL.2012.02.015
613 Mancini, S., Sogari, G., Menozzi, D., Nuvoloni, R., Torracca, B., Moruzzo, R., & Paci, G.
614 (2019). Factors Predicting the Intention of Eating an Insect-Based Product. *Foods*, *8*(7),
615 270. https://doi.org/10.3390/foods8070270
616 Marsh, H. W., & Hocevar, D. (1985). Application of confirmatory factor analysis to the study of
617 self-concept: First- and higher order factor models and their invariance across groups.
618 *Psychological Bulletin*, *97*(3), 562–582. https://doi.org/10.1037/0033-2909.97.3.562
619 Mattar, T. V., Goncalves, C. S., Pereira, R. C., Faria, M. A., de Souza, V. R., & Souza Carneiro,
620 J. de D. (2018). A shiitake mushroom extract as a viable alternative to NaCl for a reduction
621 in sodium in beef burgers: A sensory perspective. *British Food Journal*, 120(6), 1366–1380.
622 https://doi.org/10.1108/BFJ-05-2017-0265
623 Mehta, N., Ahlawat, S. S., Sharma, D. P., & Dabur, R. S. (2015). Novel trends in development of
624 dietary fiber rich meat products---a critical review. *Journal of Food Science and*
625 *Technology*, *52*(2), 633–647. https://doi.org/10.1007/s13197-013-1010-2
626 Mela, D. J. (2006). Eating for pleasure or just wanting to eat? Reconsidering sensory hedonic
627 responses as a driver of obesity. *Appetite*, *47*(1), 10–17.
628 https://doi.org/https://doi.org/10.1016/j.appet.2006.02.006
629 Menozzi, D., Sogari, G., & Mora, C. (2017). Understanding and modelling vegetables
630 consumption among young adults. *LWT - Food Science and Technology*, *85*, 1–7.
631 https://doi.org/10.1016/j.lwt.2017.02.002
632 Mushrooms: Coming soon to a burger near you. (2018, March 29). *Nature*, Vol. 555, p. 560.
633 https://doi.org/10.1038/d41586-018-03855-5
634 Miller, A.M., Mills, K., Wong, T., Drescher, G., Lee, S. M., Sirimuangmoon, C., Schaefer, S.,
635 Langstaff, S., Minor, B., & Guinard, J. X. (2014). Flavor-Enhancing Properties of
636 Mushrooms in Meat-Based Dishes in Which Sodium Has Been Reduced and Meat Has

Been Partially Substituted with Mushrooms. *Journal of Food Science*, *79*(9), S1795–S1804. https://doi.org/10.1111/1750-3841.12549

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory*. McGraw-Hill.

Onwezen, M. C., Bouwman, E. P., Reinders, M. J., & Dagevos, H. (2021). A systematic review on consumer acceptance of alternative proteins: Pulses, algae, insects, plant-based meat alternatives, and cultured meat. *Appetite*, *159*, 105058. https://doi.org/https://doi.org/10.1016/j.appet.2020.105058

Patinho, I., Saldaña, E., Selani, M. M., de Camargo, A. C., Merlo, T. C., Menegali, B. S., … Contreras-Castillo, C. J. (2019). Use of Agaricus bisporus mushroom in beef burgers: antioxidant, flavor enhancer and fat replacing potential. *Food Production, Processing and Nutrition*, 1(1), 7. https://doi.org/10.1186/s43014-019-0006-3

Patinho, I., Saldaña, E., Selani, M. M., Teixeira, A. C. B., Menegali, B. S., Merlo, T. C., … Contreras-Castillo, C. J. (2021). Original burger (traditional) or burger with mushroom addition? A social representation approach to novel foods. *Food Research International*, 147, 110551. https://doi.org/https://doi.org/10.1016/j.foodres.2021.110551

Patinho, I., Selani, M. M., Saldaña, E., Bortoluzzi, A. C. T., Rios-Mera, J. D., da Silva, C. M., … Contreras-Castillo, C. J. (2021). Agaricus bisporus mushroom as partial fat replacer improves the sensory quality maintaining the instrumental characteristics of beef burger. *Meat Science*, 172, 108307. https://doi.org/https://doi.org/10.1016/j.meatsci.2020.108307

Payne, C., Caparros Megido, R., Dobermann, D., Frédéric, F., Shockley, M., & Sogari, G. (2019). Insects as Food in the Global North – The Evolution of the Entomophagy Movement. In Edible Insects in the Food Sector (pp. 11–26). https://doi.org/10.1007/978-3-030-22522-3_2

Pérez-Montes, A., Rangel-Vargas, E., Lorenzo, J. M., Romero, L., & Santos, E. M. (2021). Edible mushrooms as a novel trend in the development of healthier meat products. *Current Opinion in Food Science*, 37, 118–124. https://doi.org/https://doi.org/10.1016/j.cofs.2020.10.004

Peryam, D. R., & Pilgrim, F. J. (1957). Hedonic scale method of measuring food preferences. *Food Technology*, *11*, *Suppl.*, 9–14.

Peterson, S., Duncan, D. P., Null, D. B., Roth, S. L., & Gill, L. (2010). Positive changes in perceptions and selections of healthful foods by college students after a short-term point-of-

selection intervention at a dining hall. *Journal of American College Health*, *58*(5), 425–431. https://doi.org/10.1080/07448480903540457

Prusaczyk, E., Earle, M., & Hodson, G. (2021). A brief nudge or education intervention delivered online can increase willingness to order a beef-mushroom burger. *Food Quality and Preference*, *87*, 104045. https://doi.org/https://doi.org/10.1016/j.foodqual.2020.104045

Ricci, E. C., Banterle, A., & Stranieri, S. (2018). Trust to Go Green: An Exploration of Consumer Intentions for Eco-friendly Convenience Food. *Ecological Economics*, *148*, 54–65. https://doi.org/10.1016/J.ECOLECON.2018.02.010

Robinson, B., Winans, K., Kendall, A., Dlott, J., & Dlott, F. (2019). A life cycle assessment of Agaricus bisporus mushroom production in the USA. *The International Journal of Life Cycle Assessment*, 24(3), 456–467. https://doi.org/10.1007/s11367-018-1456-6

Robinson, E., Blissett, J., & Higgs, S. (2013). The influence of recent tasting experience on expected liking for foods. *Food Quality and Preference*, *27*(1), 101–106. https://doi.org/10.1016/J.FOODQUAL.2012.07.001

Ruby, M. B., & Heine, S. J. (2012). Too close to home. Factors predicting meat avoidance. *Appetite*, *59*(1), 47–52. https://doi.org/10.1016/J.APPET.2012.03.020

Schösler, H., Boer, J. De, & Boersema, J. J. (2012). Can we cut out the meat of the dish? Constructing consumer-oriented pathways towards meat substitution. *Appetite*, *58*(1), 39–47. https://doi.org/10.1016/j.appet.2011.09.009

Sogari, G., Li, J., Lefebvre, M., Menozzi, D., Pellegrini, N., Cirelli, M., Gómez, M. I., & Mora, C. (2019). The influence of health messages in nudging consumption of whole grain pasta. *Nutrients*, *11*(12), 1–14. https://doi.org/10.3390/nu11122993

Sogari, G., Li, J., Wang, Q., Lefebvre, M., Gómez, M. I., & Mora, C. (2021). Factors influencing the intention to purchase meat-mushroom blended burgers among college students. *Food Quality and Preference*, *90*, 104169. https://doi.org/10.1016/j.foodqual.2020.104169

Spencer, M., Cienfuegos, C., & Guinard, J.-X. (2018). The Flexitarian Flip^{TM} in university dining venues: Student and adult consumer acceptance of mixed dishes in which animal protein has been partially replaced with plant protein. *Food Quality and Preference*, *68*, 50–63. https://doi.org/10.1016/J.FOODQUAL.2018.02.003

Spencer, M., & Guinard, J. X. (2018). The Flexitarian Flip^{TM}: Testing the Modalities of Flavor as Sensory Strategies to Accomplish the Shift from Meat-Centered to Vegetable-Forward

Mixed Dishes. *Journal of Food Science*, *83*(1), 175–187. https://doi.org/10.1111/1750-3841.13991

Spencer, M., Kurzer, A., Cienfuegos, C., & Guinard, J.-X. (2018). Student consumer acceptance of plant-forward burrito bowls in which two-thirds of the meat has been replaced with legumes and vegetables: The Flexitarian Flip™ in university dining venues. *Appetite*, *131*, 14–27. https://doi.org/10.1016/J.APPET.2018.08.030

Summers, A. C., Smith, P., Ezike, A., Frutchey, R., Fahle, J., DeVries, E., … Cheskin, L. J. (2015). A Pilot Study to Compare a Mushroom-Soy-Beef Burger to an All-Beef Burger in School Meals. *Journal of Child Nutrition & Management*, 39(2)

Tucker, C. A. (2014). The significance of sensory appeal for reduced meat consumption. *Appetite*, *81*, 168–179. https://doi.org/10.1016/j.appet.2014.06.022

Turnwald, B. P., Jurafsky, D., Conner, A., & Crum, A. J. (2017). Reading between the menu lines: Are restaurants' descriptions of "healthy" foods unappealing? In *Health Psychology* (Vol. 36, Issue 11, pp. 1034–1037). American Psychological Association. https://doi.org/10.1037/hea0000501

U.S. Department of Health and Human Services and U.S. Department of Agriculture. (2015). *2015–2020 Dietary Guidelines for Americans*. https://health.gov/dietaryguidelines/2015/resources/2015-2020_Dietary_Guidelines.pdf

Vad Andersen, B., & Hyldig, G. (2015). Food satisfaction: Integrating feelings before, during and after food intake. *Food Quality and Preference*, *43*, 126–134. https://doi.org/10.1016/J.FOODQUAL.2015.03.004

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L. J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J. A., De Vries, W., Majele Sibanda, L., … Murray, C. J. L. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, *393*(10170), 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4

Wong, K. M., Decker, E. A., Autio, W. R., Toong, K., DiStefano, G., & Kinchla, A. J. (2017). Utilizing Mushrooms to Reduce Overall Sodium in Taco Filling Using Physical and Sensory Evaluation. *Journal of Food Science*, *82*(10), 2379–2386. https://doi.org/10.1111/1750-3841.13838

Wong, K. M., Corradini, M. G., Autio, W., & Kinchla, A. J. (2019). Sodium reduction strategies through use of meat extenders (white button mushrooms vs. textured soy) in beef patties. *Food Science & Nutrition*, 7(2), 506–518. https://doi.org/10.1002/fsn3.824World Health Organization. (2017). Noncommunicable diseases: the slow motion disaster. In *World Health Organization*. http://www.who.int/publications/10-year-review/chapter-ncd.pdf?ua=1

World Health Organization. (2018). *Obesity and overweight*. https://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight

Yeomans, M. R., Lartamo, S., Procter, E. L., Lee, M. D., & Gray, R. W. (2001). The actual, but not labelled, fat content of a soup preload alters short-term appetite in healthy men. *Physiology & Behavior*, *73*(4), 533–540. https://doi.org/10.1016/S0031-9384(01)00502-9

Zhang, Y., Venkitasamy, C., Pan, Z., & Wang, W. (2013). Recent developments on umami ingredients of edible mushrooms – A review. *Trends in Food Science & Technology*, *33*(2), 78–92. https://doi.org/10.1016/J.TIFS.2013.08.002