



The Flexitarian Flip™ in university dining venues: Student and adult consumer acceptance of mixed dishes in which animal protein has been partially replaced with plant protein

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ABSTRACT

There is a growing interest in the shift from meat-centric diets towards plant-based diets due to the negative impacts of meat production and consumption on public health and the environment. This research tested the Flexitarian Flip™ in a university dining venue context, by partially replacing meat with legumes in current Dining Services recipes. A two-part Central Location Test was conducted with a college student population sample ($n = 118$) in a University of California, Davis campus dining venue. This study was repeated at a later date with $n = 110$ adults ages 18–88 years. Acceptability measures were collected for two recipes (an Indian dish and a Latin American dish), two meat levels (high meat/low legume (HM) and low meat/high legume (LM)), and two spiciness levels (Regular and Spicy). The student and adult consumer populations had similar results, and preference segments were found for both. Overall, in the Latin American recipe, the HM samples had higher acceptability than the LM samples, and in the Indian recipe, the HM and LM had similar acceptability. The LM Spicy sample had the same acceptability as both the Regular and Spicy HM samples or higher, depending on the preference segment. Additionally, the higher level of trigeminal heat increased perceived flavor complexity. To achieve the highest consumer acceptability of plant-forward mixed dishes, a mixture of legumes and vegetables, rather than vegetables or legumes alone, is recommended as a partial replacement for meat, along with a trigeminal boost in the recipe to maintain perceived flavor complexity.

1. Introduction

There is a growing global need and interest in the shift from meat-centric diets towards plant-based diets. Current levels of meat production and consumption in the United States have been linked to negative impacts on public health and the environment (de Boer & Aiking, 2011, 2017; de Boer, de Witt, & Aiking, 2016; Macdiarmid, Douglas, & Campbell, 2016; Neacsu, McBey, & Johnstone, 2017). Diets high in animal proteins (from meat and dairy) contain high amounts of saturated fat and have been linked to higher blood cholesterol, especially low density lipoprotein (LDL), the undesirable type of blood cholesterol (Hodson, Skeaff, & Chisholm, 2001; Sacks & Katan, 2002). This can lead to coronary heart disease and other non-communicable diseases such as obesity, type II diabetes, and hypertension (Dietary Guidelines, n.d.; Sacks & Katan, 2002; Willett, 2012). Plant-based diets low in saturated fats are linked to decreased blood cholesterol, which reduces the risk of coronary heart disease and other health consequences (Dietary Guidelines, n.d.; Ferdowsian & Barnard, 2009). It is difficult to fully commit to the shift from a typical meat-centric American diet to strict

vegetarianism or veganism, due to barriers such as positive beliefs and attachments formed to meat and meat-centric societal constructs (de Boer & Aiking, 2017; Derbyshire, 2017; Graça, Calheiros, & Oliveira, 2015; Hayley, Zinkiewicz, & Hardiman, 2015; Macdiarmid et al., 2016; Raphaely & Marinova, 2014; Ver Schage, 2016). However, switching to a semi-vegetarian diet (mostly plant-based, with meat in moderation) is less strict but still has a positive impact. We have termed this dietary shift the Flexitarian Flip™. In fact, in theory, a large population practicing this dietary shift, the Flexitarian Flip™, would have a much greater positive impact on public health and the environment than a small population practicing strict vegetarianism or veganism. This dietary shift can be accomplished within meals, as a partial replacement of meat with plant-based ingredients, or as an overall dietary shift in which fewer meat-centric meals are consumed and more vegetarian meals, or both. The present study explores the partial meat replacement concept in a mixed dish, a strategy supported by the U.S. Dietary Guidelines to increase protein source variety and consumption of plant-based foods (Dietary Guidelines, n.d.). The challenge is to find sensory and culinary strategies to apply to plant-forward meals that are both

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appealing and familiar to heavy consumers of meat, thus creating pull or attraction factors drawing these consumers to plant-forward dishes. It is recommended that pull frames like these sensory and culinary strategies offer a bit of novelty but build on familiar culinary notions such as variety and balance, allowing consumers to make positive sensory associations and impressions of plant-forward dishes (de Boer & Aiking, 2017). A mixed dish is the perfect blend of novelty and familiarity.

This research is part of the Healthy Flavors Research Initiative (HFRI) and Menus of Change Research Collaborative (MCURC). HFRI is an initiative by the Culinary Institute of America and the Foods for Health Institute at the University of California, Davis with the objective of accomplishing healthy dietary shifts without the loss of sensory appeal. MCURC is a large research collaborative between American universities that has academic researchers and dining services operators conducting joint research, and is led by the Culinary Institute of America (CIA) and Stanford University. One of the main goals of Menus of Change (MOC) is to apply the Protein Flip to menus; that is, reducing meat consumption and increasing consumption of plant-based protein and other plant-based foods (Protein Flip, n.d.). MOC operates on twenty-four principles, focused around creating healthy, sustainable, and delicious food for university menus across the United States, with the potential of expanding to restaurant menus. Some of the principles include encouragement of choosing healthier plant-based oils with more unsaturated fat and less saturated fat, moving legumes and nuts to the center of the plate, serving less red meat, reducing salt and added sugar intake, serving minimally processed foods, and prioritizing fresh, seasonal, and local ingredients (Protein Flip, n.d.). The involvement of academics and university dining services allows for a unique collaboration in which research can inform, guide, and inspire change in menus across the United States, thus potentially affecting the diets of many Americans.

In our proof-of-concept study for the Healthy Flavors Research Initiative, we found that ground beef could be partially replaced with mushrooms without reducing consumer acceptance or overall flavor of the dish (Guinard et al., 2016; Myrdal Miller et al., 2014). This beef-mushroom mix was termed The Blend™ and has already been successfully introduced in burger form. This substitution, served over 10,000 times, represents a beef reduction that amounts to almost 2 million gallons of water saved, not to mention the decrease in other negative environmental and health consequences. In another study that introduced the Flexitarian Flip™ concept, we found that meat could be partially replaced with vegetables in three different mixed dish recipes, and in fact, in most of the samples, the high-vegetable dishes had higher consumer acceptance than the high-meat dishes (Spencer & Guinard, 2018). In the same study, spiciness (or trigeminal heat) was found to be a promising flavor strategy for the Flexitarian Flip™.

However, in both the beef-mushroom study and the meat-vegetable swap study, the shift followed the principles of the Flexitarian Flip™, but it was not a true Protein Flip, as termed in the MOC objectives. In both cases, the meat was partially replaced by vegetables, which do not contain much protein, but do have inherent flavor, color, and texture properties that can be appealing from a sensory perspective (Guinard et al., 2016; Myrdal Miller et al., 2014; Spencer & Guinard, 2018). A truer protein flip would be to replace the meat with a plant protein source, such as legumes. However, although some vegetables do impart more of a bitter taste and fibrous texture compared to other food groups, typically, legumes are not as inherently appealing as most vegetables with respect to sensory properties – the texture is mushier, the color is duller, and the flavor is milder (König & Renner, 2018; Lease, Hendrie, Poelman, Delahunty, & Cox, 2016; Poelman, Delahunty, & de Graaf, 2017; Spencer & Guinard, 2018). Although a meat-legume flip would not be a true match for protein quantity and quality, this is justifiable because Americans consume too much animal protein in the first place. An increase in plant protein consumption was recommended by the U.S. Dietary Guidelines, and the mixed dishes in this study

contain grains, which have amino acid profiles that complement those of the legumes (Dietary Guidelines, n.d.).

Additionally, the previous research on this topic was conducted in a controlled laboratory setting. To determine if these menu changes could be applied in a dining hall or restaurant, it has been recommended that consumer testing be conducted in a realistic context (Hathaway & Simons, 2017; Jaeger & Porcherot, 2017; Kim, Lee, & Kim, 2016; Spencer & Guinard, 2018). Since this research was conducted in collaboration with University of California Davis Dining Services as part of the MOC research collaborative, the study took place in university dining venues, first with university students and then with adult consumers.

The objective of this research was to test the concept of the Flexitarian Flip™ in a dining venue context, by partially replacing meat with legumes in current UC Davis Dining Services recipes. It was hypothesized that the consumers would have lower acceptance of the low-meat/high-legume dishes than the corresponding high-meat/low-legume dishes and that adding trigeminal heat (spiciness) could boost the appeal of the low-meat/high-legume dishes.

2. Materials and methods

2.1. Consumer testing with university students

A two-part Central Location Test (CLT) was conducted with a student population sample ($n = 118$) in the Segundo Dining Commons on the University of California, Davis campus. On each testing day, the study took place between the lunch rush and dinner rush in the dining venue, between 2:30 pm and 5:30 pm. The study subjects were students at UC Davis who held a meal plan on campus, did not dislike any of the ingredients in the recipes (per screening survey), were not vegetarians or vegans, and were 33% male and 67% female, a representative mix of ethnicities on campus, and ranging in age from 18 to 24 years, with the exception of one 25-year-old. Two different recipes from two different cuisines were tested, one on each of two testing days: chicken tikka masala (termed Tikka in this paper), an Indian recipe, and pork carnitas arepas (termed Arepas in this paper), a Latin American recipe. The recipe selection was a collaborative effort between the chefs and scientists: two recipes were chosen from a larger selection of current dining venue recipes offered by the university dining services chefs with the criteria being that they 1) were mixed dishes containing meat, vegetables, grains, and legumes, and 2) were from different geographical regions (cuisines). Samples were served with blinded codes in small white porcelain bowls with utensils and drinking cups used by the UC Davis dining halls. The subjects were not given any information about the names, recipes, or ingredients of the samples, so the only biases would be from expectations based on visual cues. Participants tasted four samples in total, two samples of each recipe, a high-meat/low-legume (HM) sample designed to be the control, and a low-meat/high-legume (LM) sample designed to be the prototype. In the LM samples, 50% of the meat was replaced with legumes, holding grains and vegetables constant. The two Tikka samples were evaluated on the first day, in counterbalanced two-sample serial monadic sequences, and the two Arepas samples were evaluated on the second day of testing, also in counterbalanced sequences. The seasoning in all samples was the current dining hall recipe seasoning, effectively the trimodal combination seasoning (containing a mixture of taste, aroma, and trigeminal components) found to be the most appealing in our 2017 meat-vegetable swap study (Spencer & Guinard, 2018). The proportions of the samples were determined by volume rather than weight, based on the assumption that consumers rely on visual cues when eating and that volume is more visibly apparent than weight (Delwiche, 2012; Elzerman, Hoek, van Boekel, & Luning, 2015; Scheibehenne, Todd, & Wansink, 2010; Shankar, Levitan, & Spence, 2010; Van Ittersum & Wansink, 2012; Wansink, Painter, & North, 2005). The proportions of the main components of the samples and nutritional information are

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