# THE IMPACT of CLEAN LABEL PACKAGING for PEA-BASED PROTEINS

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# Abstract

There are several definitions of a clean label ranging from broad clean label claims identifying the type of ingredient (i.e., organic, non-GMO, unfamiliar/unrecognizable ingredients) to strict clean label claims identifying the number of ingredients (i.e., shortening of ingredients lists), both of which can appear as Front of Package (FOP) labeling. Therefore, the following research examines what Canadian consumers value in a clean label, how Canadian consumer attitudes toward clean labels could impact the demand for pea-based proteins, and assesses how pea-based burgers compete against hybrid and beef burgers.

The study relied on nationally collected data through an online survey to explore the objectives. The survey was composed of five sections featuring screener questions, discrete choice experiment (DCE), general food purchases, protein choices, and demographics, and analyzed using Multinomial Logit, Mixed Multinomial Logit, and Latent Class models.

The analysis revealed Canadian consumers ranked beef burger patties (60%) as the preferred choice, hybrid burger patties (22%) as the second most preferred choice, pea-based burger patties (18%) as the least preferred burger choice, with the rest selecting no purchase (1%). When exploring burger patty heterogeneity for clean label claims, individuals choosing pea-based burgers exhibited notably different taste preferences for the ingredient list length, exhibiting similar WTP between the organic attribute and shortened ingredient lists. Lastly, the respondents who were less likely to choose pea-based proteins, about 85% of individuals, valued stricter clean labels more than broad clean labels, perceiving that a reduced ingredients list signaled increased product naturalness, nutrition, and did not decrease taste. Concluding reduced ingredients list was the most significant clean label definition within the study.

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# Chapter 1. Introduction & Background

## 1.1 Introduction

Food marketers are increasingly emphasizing "clean labels" when marketing their products. There are several definitions of clean labeling; however, two important dimensions of clean labels are broad clean labels, i.e., front-of-the-package claims such as “organic” and strict clean labels, i.e., the length of ingredient lists. In this thesis, I examine how salient front-of-the-package labels are compared to the length of ingredient lists.

In this thesis, I examine consumer demand for clean labels in the context of plant-based proteins. Clean labels may be particularly salient in this product category, as many commentators have noted that plant-based proteins require more ingredients and more secondary processing than similar livestock products (Askew, 2020). However, it is unclear the extent to which consumers actually value the length of ingredient lists.

I use a discrete choice survey to estimate consumer willingness-to-pay for shorter ingredient lists versus two front-of-the package claims (organic and "excellent source of protein"). In the survey, 1000 English-speaking Canadian individuals were recruited to answer questions based on the following five sections: screener questions, discrete choice experiment (DCE), general food purchases, protein choices, and demographics. Within the survey, respondents were requested to ensure the questions were answered as honestly and accurately as possible and imagine themselves as if they were in a grocery store. The results would help understand consumer motivation behind purchasing particular foods.

The main results of the research revealed Canadian consumers ranked beef burger patties as the preferred burger option, followed by hybrid and pea-based burger patties. Exploring the different values for clean label claims led to 4 stratified consumer groups: *Burger Lovers, Price conscious carnivores, Vegivores, and Short Ingredient Lovers.* Between the consumer groups, *Vegivores* exhibited similar Willingness-To-Pay (WTP) between the organic attribute and shortened ingredient lists, differing from the other three listed classes. Whereas *Burger Lovers, Price conscious carnivores, and Short Ingredient Lovers* placed greater value on reduced ingredient list length, perceiving that a reduced ingredient list signaled increased product naturalness, nutrition, and did not decrease taste. The results implied that most of the sample believed the reduced ingredients list was the study's most impactful type of clean label.

## 1.2 Background

### *1.2.1 Clean Label*

Clean labels are a broad category, variously encompassing product qualities like organic, natural, free from artificial ingredients, non-GMO, allergen free, transparent packaging, minimally processed; and short ingredients lists/types of ingredients (Gelski, 2016). In a broad sense, clean labels refer to simple, identifiable Front-of-Package (FOP) information that identifies credence attributes such as health (nutritional enhancement), sustainability (organic, non-GMO, environmentally friendly, animal husbandry), or natural (reduced processing) attributes, or the absence of something (free-from, or reduced allergens and additives). Clean labels also encompass Back of the Package (BOP) aspects like the nutrition information panel or ingredient lists. In this context, clean labels refer to fewer, simpler, or more naturally sounding ingredients rather than chemically sounding or unfamiliar ingredients. The shortening of the ingredient list helps to infer product naturalness due to ‘additivity dominance’ (Rozin, Fischler, and Shields-Argeles, 2012) which refers to occurrences of individual’s tendency to define naturalness by the absence of unknown or artificial additives, which can lead to consumers choosing not to purchase and leading to biases and non-purity notions. Thus, by shortening the list of ingredients, consumers focus on less ingredients in the product and the implies the product closer resembles the form of the preprocessed product. As well, clean labels are clearly growing in importance: by 2013, an estimated 27% of newly packaged products marketed some aspect of having a clean label (Asioli et al., 2017).

There is considerable work examining consumer preferences for FOP labels that fall under the definition of a clean label. Numerous studies find a positive willingness-to-pay for organic claims (Van Loo et al., 2015; Drugova, Curtis, and Akhundjanov (2020); Campbell et al., 2010), health claims (Menozzi et al., 2020), and GMO-free labels (Drugova, Curtis, and Akhundjanov, 2020), to name just three examples. A smaller number of studies have examined back-of-the package information, such as nutrition labels (Jurado and Azucena, 2017; Hong et al., 2021) and ingredient lists (Uddin and Gallardo, 2021).

This thesis fills a gap in the literature by examining whether FOP or BOP information is more salient to consumers. Alongside addressing the gap in literature, the results of this research will provide data to both industry and food manufacturers as evidence for which product traits imply greater value to Canadian consumers. Clarifying consumer responses to different types of clean labels informs the debate whether consumers value strict clean labels and are more likely to buy a product if they recognize all of the ingredients listed on the label (Smolokoff, 2020) or place emphasis on credence attributes such as Organic or Excellent Source of Protein claims.

*1.2.2 Plant-Based Proteins*

I study the importance of clean labels in the context of plant-based proteins. Plant-based proteins represent diet alternatives to conventional meat products, and include proteins like pea, quorn, potato, canola, and soy. Plant-based proteins carry the potential to be labeled in various ways, including as organic or 100 % organic, contingent on production within an organic supply, or as non-genetically modified (). Recent technology has also advanced a variety of peas grown within Canada through biofortification by increasing the protein concentration by 3% (23% to 26%) compared to original varieties (Warkentin, 2020) to include the excellent source of protein health label.

The labeling and alternative to conventional meat may partially explain the increase in global consumption of plant-based proteins. Between expanding population sizes and mitigating the risk of Noncommunicable diseases (NCDs) caused by the overconsumption of calories, fat, sodium, and sugar (Labonte et al., 2019), plant-based proteins supply an alternative protein that addresses the consumer search for healthier, more sustainable substitutes. Multiple figures illustrate global plant-based market growth, including the 8% annual average global sales growth since 2010 for plant-based alternatives (N.R.C. Canada, 2019) or the global plant-based meat market expanded by 20% in 2018 (Plant Based Foods Association, 2020). More specifically, Europe's plant-based market accounts for 40% of the global market, with predictions to grow in value from €1.5 billion ($1.814 US billion) in 2018 to an estimated €2.4 billion ($2.9 US billion) by 2025 (Southey, 2019) or the USA plant-based industry expected expansion from $5.6 billion in 2020 to $10.7 billion by 2027 (Research and Markets, 2021). All of which contribute to the plant-based protein market incurring a sustained annual growth of 6% since 2017 and correspond with market value projections eclipsing $59.49 billion by 2022 (Balandra´n-Quintana et al., 2019).

## 1.3 Objective

This study seeks to address the following three objectives. The first is to determine which clean label attributes are most important to Canadian consumers and identify heterogeneity in consumer responses to clean labels. For instance, there are several definitions of a clean label: a) type of ingredient, i.e., organic, non-GMO, unfamiliar/unrecognizable ingredients, b) the number of ingredients, i.e., shortening of ingredients lists, c) Front of Package (FOP) labeling, i.e., "natural," "local," "organic" and "non-GMO." By examining how consumers respond to labels such as “organic” and “excellent source of protein" in the context of varied (short/long) ingredients lists, the empirical evidence provides information regarding the relative importance of the various types of clean labels and the extent to which (if any) consumers prepare to trade off one type of a clean label for another.

Secondly, the research assesses how pea-based burgers compete against hybrid pea/beef and beef burgers and the extent to which consumers are willing to pay a premium for environmentally friendly, animal welfare, or health attributes in plant-based protein products.

Thirdly, the research explores heterogeneity in consumer preferences for clean label claims in the context of pea-based burgers. This includes evaluating responses to “organic," “excellent source of protein," or varied length of ingredients lists.

The study will rely on online survey data that features a discrete choice experiment to explore the objectives. The survey comprises five sections: screener questions, discrete choice experiment (DCE), general food purchases, protein choices, and demographics.

## 1.4 Outline

The thesis is organized as follows. The next chapter reviews the literature on clean labels and plant-based proteins. Chapter three provides the methodology used to design the survey and discrete choice experiment and describes the data collection methods and data analysis tools. Chapter four reports the results of the Canadian consumer survey and addresses aspects of Willingness-To-Pay (WTP), consumer burger preference shares, and class segmentation based on latent class modeling compared to Multinomial Logit (MNL) and Mixed Multinomial Logit (MXMNL) modeling. Chapter five discusses the results and policy implications.

# Chapter 2. Literature Review

## Section 1: Plant-Based Proteins

### 2.1 Introduction

The growth of plant-based proteins partly reflects evolving consumer desires for alternatives to conventional animal-based products. Having exhibited strong market growth in the food sector, these food alternatives experience demand by consumers for various reasons related to social, health, and sustainability motivations (Hoek et al., 2011; Sjezda, Urbanovich, and Wilks, 2020). The following literature review examines consumer demand for plant-based (pea) proteins in the context of 'clean labels.' Clean labels have many dimensions, including production-derived quality attributes related to health and sustainability (i.e., organic, GM-free, an excellent source of protein, no artificial additives) and the length and contents of ingredient lists.

### 2.2 Demand for Plant-Based Proteins

Consumer demand for plant-based proteins is increasing (Sloan and Hurt, 2019; Plant Based Foods Association, 2020), and this growth is expected to continue as potential demand of all protein types (943.5 million metric tons) doubles by 2054 (N.R.C. Canada, 2019). Since 1975, Canadian protein consumption has transitioned from being mainly focused on red meat (~77%:50% of daily Canadian protein was from beef and 27% from pork) (Alain, 1999) to 2015, where daily Canadian diets contain a greater protein assortment of proteins with less focus on red meat (beef and pork combined (63.4%), nuts/seeds (33.7%), and legumes (14.3%) (Government of Canada, 2018).

Lusk (2021) conducted a year-long simulated experiment using revealed preference techniques to test individuals' selection of plant-based options against seven conventional meat substitutes. Beef products were the preferred choice of 24% of respondents; in comparison, plant-based proteins were selected by 3% of individuals. Part of the reason for the lower selection of plant-based proteins may be price differences. In the experiment, beef prices averaged $4.49/lb, while the plant-based option averaged $11.49/lb.

Slade's hypothetical choice experiment (2018) found that beef burgers held the largest market shares (67%), followed by plant-based (21%) and cultured burgers (11%). De Boer and Aiking's (2011) results list red meat (39%), white meat (23%), and plant-based (9%) as selectable protein sources, revealing 62% meat market share. Similar to the two studies, Van Loo, Caputo, and Lusk (2020) also indicate a large beef selection (72% of respondents), with the ordering of selection behind beef being plant-based (16% of respondents), yeast animal-like protein burgers (7% of respondents), and lab-grown burgers (5% of respondents). Respondents likewise exhibited the highest WTP for a beef burger ($14.08) in Van Loo's study, followed by pea-based burgers WTP ($4.35), yeast animal-like protein burgers ($3.27), and lab-grown burgers ($0.45). In contrast, Escribano et al.'s (2021) experimental approach set beef WTP as zero, making consumers exhibit negative values towards alternative burger options. As such, plant-based incurred the smallest disvalue (-$5.43), and cultured burgers sustained the largest disvalue (-$9.29).

## 2.3 Motivations

Consumer purchase motivations are both extrinsic and intrinsic. Intrinsically and extrinsically sourced motivations work alongside simple heuristics to determine how consumers choose to align purchase decisions with personal goals. Intrinsic motivation refers to pro-self benefits, and the motivation goals are personally rewarding for the individual, such as health benefits. Extrinsic motivation refers to socially conscious and externally rewarding attributes such as benefits related to sustainability or animal welfare (Asioli et al., 2017).

Both types of motivation likely influence the growth in plant-based protein consumption. Three primary motivations influence demand for plant-based proteins: health, environmental, and ethical concerns (Hoek et al., 2011). Jacobsen (2018) indicates the interplay of these factors as the reason behind the enhanced market demand for plant-based proteins with perceived naturalness and health benefits.

### *2.3.1 Health Consciousness and Demand for Plant-Based Proteins*

A few papers in the literature have examined the process by which consumers form health perceptions of plant-based and livestock products. In Lazzarini's (2016) study, livestock products, like cheese and dairy products, were perceived as less healthy. The study reveals that consumers categorize products into health categories based on sensory attributes (appearance) and product categories (i.e., dairy is unhealthy and vegetarian options are healthy).

Similarly, Lusk's (2019) research on how consumers perceived product healthfulness considered the type of protein (animal vs. plant) and the level of processing. Other research infers those preferences for plant-based protein products are positively related to the health-consciousness of individuals (Lea, Crawford, & Wolsely, 2006).

Other experiments examine the importance of health, environment, and ethics. As discussed later under environmental results, Lacroix and Gifford's (2019) Canadian experiment divided individuals by plant-based consumption frequency into the following three groups: meat-reducers, moderate-hindrance meat-eaters, and strong-hindrance meat-eaters. Health was consistently the essential motivation for plant-based protein consumption among the three groups. For each group, health was imperative: meat-reducers (66%), moderate-hindrance meat-eaters (76%), and strong-hindrance meat-eaters (68%).

Several common themes arise in the literature. First, animal-sourced products are associated with perceived unhealthiness and less nutritional content; animal-sourced products are associated with reduced levels of nutrition and high degrees of fat, sodium calories, and sugar. Hoek et al.’s (2013) findings support this conclusion; individuals who consumed increased amounts of plant-based proteins were more aware of product health factors than individuals who consumed large amounts of meat. De Boer, Schosler, and Aiking (2017) report similar findings. Not only vegetarians, but individuals who choose to vary meals and incorporate additional plant-based products, often considered health the primary reason for altering dietary habits and consuming additional plant-based proteins. Second, nutritional information determined the perception of health within products. Third, healthy eating motivations stem from wanting more energy, emotional well-being, social well-being/physical well-being, achievement/outward appearance, and autonomy (Geeroms, Verbeke, and Kenhove, 2008).

*2.3.2 Environmental Motivations and Demand for Plant-Based Proteins*

Environmental motivations for consuming plant-based proteins often relate to reducing the carbon footprint or repurposing land dedicated to livestock production to less environmentally damaging crop production. Comparing reported environmental impacts between the Beyond Burger and a beef burger, 2/) argue that the Beyond Burger generated 90% less greenhouse gas (GHG) emissions, required 46% less energy, 93% less land impact, and 98% less impact on water scarcity.

Vegetarian and vegan diets are often adopted to reduce meat consumption based on health, environmental, and ethical preferences. Bryant (2019) examines perceptions of U.K. consumers surrounding vegetarian and vegan diets. Among the listed reasons, many respondents perceived the mitigating environmental impacts as important-vegan (69.3%) and vegetarian (74.1%)-but not as beneficial as the ethics of such diets.

Environmental concerns also play a role in meat reduction. Lacroix and Gifford's (2019) Canadian study segmented individuals by frequency of plant-based consumption into the following three groups: meat-reducers, moderate-hindrance meat-eaters, and strong-hindrance meat-eaters. All three groups were motivated by environmental concerns, with the environmental impacts of livestock consumption being the third most important motivator for meat-reducers (60%), the second most important for moderate-hindrance meat-eaters (32%) and fourth most important strong-hindrance meat-eaters (27%).

On the other hand, environmental benefits are not always the primary motivator. Findings from a Dutch study by DeBoer, Schosler, and Aiking (2017) show that while not consistently viewed as the primary reason, 32% of individuals perceived not eating meat as better for the environment. Comparatively, Mancini and Antonoli (2020) place meat reduction for environmental reasons as the second most important reason for reducing meat consumption among non-meat eaters and third among meat-eaters.

### *2.3.3 Animal Welfare Motivations and Demand for Plant-Based Proteins*

Concerns over animal welfare are the third primary reason individuals exhibit increased demand for plant-based proteins alongside health-conscious and environmental. Mancini and Antonoli (2020) find that for meat-eaters considering switching protein sources, animal welfare was the second most important reason for reducing meat intake. Lacroix and Gifford (2019) find that animal welfare is the second most important motivator for meat reducers (60%), fourth-most important for moderate-hindrance meat-eaters (32%), and third most important for strong hindrance meat-eaters. Bryant (2019) found a large percentage of respondents perceive the ethically benefiting impacts of non-meat diets as most important-vegan (72.7%) and vegetarian (77%).

## 2.4 Barriers to adoption of plant-based proteins

Factors inhibiting consumers from choosing plant-based proteins include product characteristics such as meat taste and texture, product familiarity, habitual consumption of animal proteins, perceptions that meat is healthier, lack of convenience, product cost, political concerns, and societal identity (De Boer, Schosler and Aiking, 2017; Bryant, 2019; Southey, 2019). This list also encompasses education levels that impact dietary preferences, highlighted by De Boer and Aiking’s (2011) Dutch experiment revealing more highly educated individuals were more likely to consume plant-based proteins, while lower education consumed significantly more animal-sourced protein, likely due to protein literacy levels and comprehension.

## Section 2: Clean Label

### 2.5 Introduction of the Clean Label

Understanding the clean label trend is imperative to growth and industry development in the plant-based proteins sector. However, several definitions of 'clean label' exist. The following lists the broad and strict applications of the clean label as defined by Asioli et al. (2017). In a broad sense, clean labels refer to simple, identifiable Front-of-Package (FOP) information that identifies credence attributes such as health (nutritional enhancement), sustainability (organic, non-GMO, environmentally friendly, animal husbandry), or natural (reduced processing) attributes, or the absence of something (free-from, or reduced allergens and additives). Clean labels also encompass Back of the Package (BOP) aspects like the nutrition information panel or ingredient lists. In this context, clean labels refer to fewer, simpler, or more naturally sounding ingredients rather than chemically sounding or unfamiliar ingredients.

### 2.6 Clean Label Claims

#### *2.6.1 Prior Consumer Research*

Two recent studies have examined consumer perceptions of clean labels. Cassiday (2017) finds that consumers have various perceptions of what 'clean label' means, including in order of importance, free from artificial ingredients (36%), natural/organic claims (34%), I do not know what the clean label means (34%), no pesticides/chemicals/toxins (31%), free from allergens (24%), no-GMOs (23%), minimally processed (16%), simple/short ingredient lists (11%), and transparent packaging (7%). IFT (2021) reports different findings. Surveyed respondents associated clean labels with recognizable ingredient lists (68%), followed by natural claims (64%), no artificial ingredients (62%), organic claims (51%), and non-GMO claims (50%). Both Cassiday and IFT find that naturalness is a critical dimension of the clean label, along with a strong dislike for artificial ingredients.

Although consumers, food industry, and food marketers may disagree on the definition of a clean label due to different priorities to which aspects of the clean label they value, the attributes of clean labels are important to consumers and are increasingly emphasized in food marketing. Jacobsen (2018) tasked survey respondents to rate the impact of different product factors on purchase choices. The top five factors are natural labels (62 %), followed by the clean label (47%)- defined as a "new" product attribute, healthy (47%), organic (43%), and convenience (28%). Furthermore, 27% of all new products released in 2013 within the European Union contain some form of clean label (on the front or back of the package) (Ingredion, 2014). Shoup (2019) find that 44% of individuals report the clean label is essential to them, and 76% of that group believe clean label products are healthier than traditional foods. Smolokoff (2020) reports on research completed by Ingredient Communications, finding roughly 50% of individuals have a greater likelihood of purchasing products if they recognize the full list of ingredients, whereas the front of the package claims registered brandishing claims such as "free from artificial ingredients" registered 78%-81% saliency levels among respondents.

From prior research, it is clear that a fair amount of consumer uncertainty exists regarding the clean label. Nevertheless, there is a definite need to determine whether the clean label's best positioning is the number of ingredients, i.e., reducing the number of ingredients, or the type of ingredient, i.e., whether the product can claim organic or natural qualities.

*2.6.2 Literature on specific clean label claims*

As indicated by the conclusion of the previous section, broad clean labels refer to the credence attributes of a product or ingredient. This thesis will examine two broad clean label claim types: organic and health claims.

*2.6.2.a Organic Clean Labels*

Organic labels typically require certification from a national body and serve to verify that the product is produced to organic standards. Consumers have many different motivations for purchasing organic products. The preferences for organic as a clean label attribute depends on several factors with the main reasons including individual socio-cultural factors (personal norms, values, skepticism, and education), as well as intrinsic (nutritional properties, health-promoting effects, and sensory attributes) and extrinsic product characteristics (sustainability, label and certification, health claims, and higher price) (Asioli et al., 2017).

Inherent within socio-cultural factors is the presence of personal norms, values, and education, each of which has been shown to increase the motivation for organic products. Personal norms have largely impacted organic purchasing due to the halo effect- signals the product as socially beneficial-or consumer "warm glow" feelings (Aschemann-Wtizel et al., 2020). Individuals impacted by the halo effect perceive direct benefits, believing that organic products are less processed, contain increased naturalness, and do not contain pesticides, preservatives, or genetic modification (Aschemann-Witzel, Varela, & Peschel, 2019, and Aschemann-Witzel, 2015). Additional findings identify personal or self-reported knowledge levels can increase or decrease either consumption quantities (Pieniak et al., 2010; Aertsens et al., 2011) or WTP for organic products (Graca Royo and de-Magistris, 2007).

Other motivations for purchasing organic products include intrinsic and extrinsic product characteristics. Intrinsic product factors include nutritional properties, health-promoting effects, and sensory attributes (Asioli et al., 2017). Multiple experiments identify health-promoting effects and perceived nutritional properties as the reasoning behind organic choice motivation, including Sirieix et al.'s (2013) research which found consumers view organic attributes as containing both sustainability or health benefit associations and Aarset et al.'s (2004) find that organic product selection resides on the belief organic qualities promote healthiness and food security. Walley et al.'s (2019) research further exemplify health motivation for organic selection as 48% of consumers selected organic products because they believed it was healthier for them, while only 16% selected organic based on the betterment of the environment. These experiments suggest that nutrition and health-oriented claims can be beneficial in marketing organic products (Aschemann-Witzel, Maroscheck, and Hamm, 2013) and vice versa.

Perceived environmental benefits represent extrinsic product characteristics, which differ as they represent motivations resulting from sustainability and social benefits which require personal verification (Asioli et al., 2017). Drugova, Curtis, and Akhundjanov's (2020) results highlight sustainability as the primary reason for selecting products, whereas health claims (nutrient content labels) had a minimal or negative impact. Findings from Van Loo et al. (2015) list organic verification as the primary reasoning behind sustainability motivations contrary to Van Loo et al.'s (2014) results which did find as the organic logo as the most sought-after sustainability logo compared to Rainforest Alliance and Carbon Footprint claims.

*2.6.2.b Health Clean Labels*

Health labeling comes in many forms i) appearing in a numeric form such as daily percentage value on the back of package nutrition facts panel, ii) color-coded front of package labels like the traffic light system used in the United Kingdom iii) warning labels that address when the nutritional content exceeds the healthy amount (Egnell et al., 2018), and iv) FOP health claims about high levels of beneficial claims such as protein content claims. Clean health labels imply a potential contradiction for plant-based proteins as broad clean labels highlight nutritional information such as functional benefits provided by additional ingredients (e.g., to enhance sensory appeal), leading individuals to select between products with additional functional qualities or products containing fewer ingredients.

Consumers' understanding of health labels and functional benefits varies depending on the type and form of the label. Helfer and Schulz (2014) found free from, and other broad clean health labels provided reduced value compared to the nutritional facts panel, as the respondents listed seeking the nutrition facts panel 56% of the time as the primary source of product health information (Helfer and Schulz, 2014). However, Bucher, Muller, & Siegrist's (2015) findings discuss consumers' inability to accurately assess a product's nutritional content even though it may be the preferred information source, as participants' assessment of the nutritional content was often inaccurate and overestimated. Bearth, Cousin, & Siegrist's (2014) experimental results indicate products with additional additives received a mixed response from individuals. First, associated claims with increased healthiness levels, improved taste, and lowered calorie content; second, other respondents believed additional additives indicated an increased protein rating, a safer food product for consumption, or added ingredients addressed nutritional deficiencies. Occurrences of when beneficial ingredients are advertised and identified to consumers were associated with increased health benefits, but again the additional ingredients infringed upon consumers' perception of health-consciousness (Liu et al., 2017).

Other issues underly how consumers respond to or focus on health labels. Lusk (2019) found that 40% of surveyed U.S. consumers increased product consumption increased due to nutrition labels, with 15% believing health labels allow for product overindulgence (Lusk, 2019). Government of Canada (2018) lists several reasons consumers do not use the nutritional information on food products, including do not care (45%), do not need to (20%), do not know how to interpret (6%), do not believe or trust (5%), nutritional information not available (2%), and other (11%). The range of health label usage by consumers varies with the lowest usage at 55% in Switzerland (Visschers, Hess, and Siegrist, 2010), 78% in the United States (Satia, Galenko, and Neuhouser, 2005), and the highest at 82% label use in New Zealand (Gorton et al., 2008). Other research finds that only 67% of New Zealanders can adequately understand and evaluate the Nutrition Information Panel (Gorton et al., 2008).

### *2.6.3 Strict Clean Labels*

#### *2.6.3.a Additivity Dominance in Ingredients Lists*

For plant-based proteins, lengthy intricate ingredient lists with artificial ingredients may put novel products at a competitive disadvantage against animal-sourced proteins. Consumers may be unfamiliar with plant-based proteins due to either longer lists or less familiar ingredients. Prior Canadian research finds that 37% of Canadians search for the ingredients list to find information on the content of products (StatsCanada, 2018). Comparatively, IFT (2021) reports that only 23% of American individuals feel the ingredient list is essential, behind FOP attributes (44%) and Nutrition Facts Panels (33%).

Among polled American consumers, IFT (2021) listed the following perceptions surrounding the ideal number of ingredients products should contain: five ingredients or less (41% of respondents), number of ingredients does not matter (38%), ten ingredients (18%), and 15 plus (3%). Shoup (2019) finds different results indicating roughly 65% of American consumers are looking to eliminate unrecognizable and unfamiliar items from ingredient lists; however, they also seek added functional benefits from supplemental product ingredients. Further importance for the ingredient list can be partially explained by Uddin and Gallardo's (2021) WTP results which revealed that the ingredient list length was nearly four times more important than organic attributes. Thus, the importance of length and type of ingredients can lead consumers to believe that plant-based burgers are not natural, harmless, or contain simple ingredients, which Hung, Kok, & Verbeke (2016) denote as natural skepticism and unfamiliarity with novel foods.

Hung, Kok, & Verbeke's research explored consumer attitudes toward highly-processed meats, which enhanced consumer awareness of the product ingredient list and highlighted the following two outcomes. First, adding ingredients to the ingredient list reduced natural and health perceptions, and second, consumers' awareness of additives limits the potential to add functional benefits. The level of consumer attentiveness is explained by additivity dominance (Rozin, Fischler, and Shield-Argeles, 2009, Rozin, Fischler, and Shields-Argeles, 2012) which refers to occurrences of consumer fixation on ingredient additions rather than ingredient or quality subtractions (Rozin, Fischler, and Shield-Argeles, 2009; Rozin, Fischler, and Shields-Argeles, 2012). This translates to consumers avoiding purchasing these products and leading to biases and non-purity notions. A U.S. study by Scott and Rozin (2017) confirmed similar consumer ambivalence for food additives and the avoidance of additional non-natural ingredients. By testing for additivity dominance, the experiment determined that consumer awareness for food additives influenced the evaluation of the naturalness and healthfulness of food products, leading to biases regarding perceptions of healthiness and naturalness and inhibited selection of products with long ingredient lists (i.e., plant-based proteins) in the marketplace.

## 2.7 Research Gap Addressed

There is no evidence of the relationship between clean label attributes and plant-based products to date. Nevertheless, from the evidence provided throughout the literature review, there is justification to compare the influence of the most critical label from each clean label category against each other. Sustainability has two dimensions that impact plant-based proteins, and each complements the other. The ethical dimension is crucial because choices are impacted by animal welfare or increased social objectives. On the other hand, environmental sustainability generally pertains to mitigating damage to the surrounding environment, such as pollution or certain types of farm production with increased pesticide use. Between the two forms, experiment observations applied to both aspects of sustainability (Van Loo et al., 2015) point to organic as the highest valued sustainability label. The experiment tests consumer valuation of the two clean label definitions comparing broad clean labels (organic, natural) against the strict clean labels (number of ingredients) to see which is the preferred form of the clean label.

The three objectives of this study are presented in greater depth in the next chapter. The first objective is to determine which broad or strict clean label attribute is the most important to Canadian consumers and to identify heterogeneity in consumer responses to clean labels. The second objective is to explore heterogeneity in consumer preferences for clean label claims in the context of pea-based burgers using food values and sociodemographics, as well as evaluating responses to "organic," "excellent source of protein," or varied length of ingredients lists. The third objective of the research assesses how pea-based burgers compete against hybrid pea/beef and beef burgers and the extent to which consumers are willing to pay a premium for environmentally friendly, animal welfare, or health attributes in plant-based protein products.

# Chapter 3. Methodology

## 3.1 Introduction

The following chapter outlines the methodology for estimating consumer preferences for clean labels and plant-based burgers using a survey and discrete choice experiment. In this chapter, I outline my survey instrument (section 3.2), discrete choice experiment (section 3.3), theoretical model (section 3.4), and empirical model (section 3.5). The methodology allows the evaluation of this study's research question and to provide empirical evidence for the objectives by analyzing: 1) Willingness-to-Pay (WTP) for different clean label attributes, 2) WTP for plant-based products versus meat products, and 3) whether clean labels differentially impact plant-based versus meat products.

## 3.2 Survey Structure

An online survey was used for a multitude of factors. First, Internet access and use among Canadians increased to 35.32 million users by 2020, which is about 94% of the population (Kemp, 2020). Secondly, the COVID-19 pandemic precluded the use of in-person experiments involving direct contact with respondents. Online surveys are relatively low cost, typically generate a medium to high response rate in a short timeframe and allow broad geographical coverage.

The survey was divided into five sections: screener questions, discrete choice experiment (DCE), general food purchases, protein choices, and demographics. A copy of the survey instrument is provided in Appendix A. The first section, screener questions, screened out respondents who were not the primary grocery shopper. The second section contained the DCE and follow-up questions, which I describe in the subsequent section. The third section asked participants about their food values (Lusk and Briggerman, 2009), food neophobia (Slade, 2018), frequency of consulting product information, and perceptions of ingredient lists. The fourth section assessed respondents' attitudes towards different forms of dietary protein. In one task, respondents were asked to indicate which three of 11 types of protein they believed to have the highest nutritional value. In the remainder of this section, respondents were asked about their frequency of consuming meals in which the primary protein is meat, plant-based protein, and dairy. The fifth section collected demographic information.

## 3.3 Discrete Choice Experiment

### *3.3.1 Discrete Choice Experiment Design*

A variety of stated preference elicitation methods exist, including contingent valuation, discrete choice experiments, and field experiments (Carson and Louviere, 2011). DCEs are generally recognized to provide a more robust method for eliciting WTP than contingent valuation due to contingent valuation focusing on consumer value for a public good versus a private good. DCEs were likewise preferred for this study than observational data due to revealed preference studies requiring real-time context, which could not be used in this study due to the COVID-19 pandemic. On the other hand, DCEs represent an elicitation technique where respondents must choose between two or more alternatives within constructed, randomized choice sets (Carson and Louviere, 2011). The selected answers measure marginal consumer utility, which is expressed by varying one or more attributes within the choice set. To mimic real-world choices, DCE choice sets often include opt-out options.

Challenges with surveys include errors of non-observation (coverage, sampling, nonresponse), observation (survey instrument, respondent, interviewer), and processing (coding, editing, adjustment). Further issues for hypothetical DCEs include the hypothetical nature of the experiment, the lack of incentive compatibility (Johnston et al., 2017), the potential for strategic behavior caused by respondent survey fatigue, and information presentation (Carson and Louviere, 2011; Vaske (2011). Steps such as consequentiality, cheap talk scripts, and shortened surveys reduce these problems. Such as in the context of this survey, a cheap talk script was included requesting that respondents ensure the questions are answered as honestly and accurately as possible as the results would help understand consumer motivation behind purchasing foods.

### *3.3.2 Product Characteristics Applied to Design*

The DCE generated 36 choice sets composed of six different blocks of six questions. To view each choice set composition, refer to Appendix B. In each choice task, respondents were asked to imagine that they were making this decision in the grocery store. In each choice task, respondents were asked to choose between three different types of burgers or could choose the "I would not purchase" option with each alternative consisting of the burger, and four attributes (length of ingredients list, organic labeling, excellent source of protein labeling, and price) of which four were dummy coded and one (price) continuously coded. Three dummy coded attributes were 2-level (length of ingredients list, organic labeling, and excellent source of protein labeling), and the other was a 3-level dummy coded attribute (burger type). Price was continuously coded (six-level attribute).

Additionally, respondents were randomly assigned to one of two treatments: visible back-of-package and hidden back-of-package. Each option contained three burgers, with every DCE alternative being one of either pea, hybrid (50% beef and 50% pea), or beef. Every choice was priced according to a six-level price range between \$5.00/lb and \$12.50/lb with \$1.50 increments. These prices were based on observed prices in Sobeys grocery stores throughout Canada. Each burger could also be labelled as "Organic" or as an "Excellent Source of Protein" on the front of the package. The back of the package contained the ingredient list for the burgers. The ingredient list could either be short or long (the ingredient lists are contained in Table 3.1). Each long ingredient list except for the hybrid ingredient list was taken from Sobey's burger packaging, with the shortened ingredient list designed by selecting five of the most naturally sounding ingredients from each respective list. The hybrid ingredient list was designed to be identical to the pea burger ingredient lists, with the difference being the inclusion of beef to the ingredient list.

The treatments differed by visibility and accessibility to the back of the package. In the "visible back-of-package" treatment, the back of the package was always visible to participants. In the "click/hidden back-of-package" treatment, respondents had to click the image to flip the package on the screen and observe the ingredient list. Sample choice tasks are provided in Figure 3.1 (visible back-of-package treatment) and Figures 3.2 and 3.3 (click back-of-package treatment).

**Table 0-1. Short and Long Ingredient Lists**

| | Short Ingredient List | Long Ingredient List |
|---|---|---|
| Beef | Lean Ground Beef, Egg, Worcestershire Sauce, Salt, Pepper | Ground Beef, Steak Seasoning (Maltodextrin, Salt, Yellow Mustard Seed, Artificial Beef Flavour (Hydrolyzed Soy, Wheat and Corn Protein, Corn Syrup |
| Hybrid | Lean Ground Beef, Pea Protein Isolate, Natural Flavours, Potato Starch, Apple Extract, Lemon Juice Concentrate | Lean Ground Beef, Water, Pea Protein*, Expeller-Pressed Canola Oil, Refined Coconut Oil, Rice Protein, Natural Flavors, Cocoa Butter, Mung Bean Protein, Methylcellulose, Potato Starch, Apple Extract, Pomegranate Extract, Salt, Potassium Chloride, Vinegar, Lemon Juice Concentrate, Sunflower Lecithin, Beet Juice Extract (for color). |
| Pea | Pea Protein Isolate, Natural Flavours, Potato Starch, Apple Extract, Lemon Juice Concentrate | Water, Pea Protein*, Expeller-Pressed Canola Oil, Refined Coconut Oil, Rice Protein, Natural Flavors, Cocoa Butter, Mung Bean Protein, Methylcellulose, Potato Starch, Apple Extract, Pomegranate Extract, Salt, Potassium Chloride, Vinegar, Lemon Juice Concentrate, Sunflower Lecithin, Beet Juice Extract (for color). |


**Figure 0-1. Visible back of package treatment**


**Figure 0-2. Click Treatment-Hidden back of package treatment**

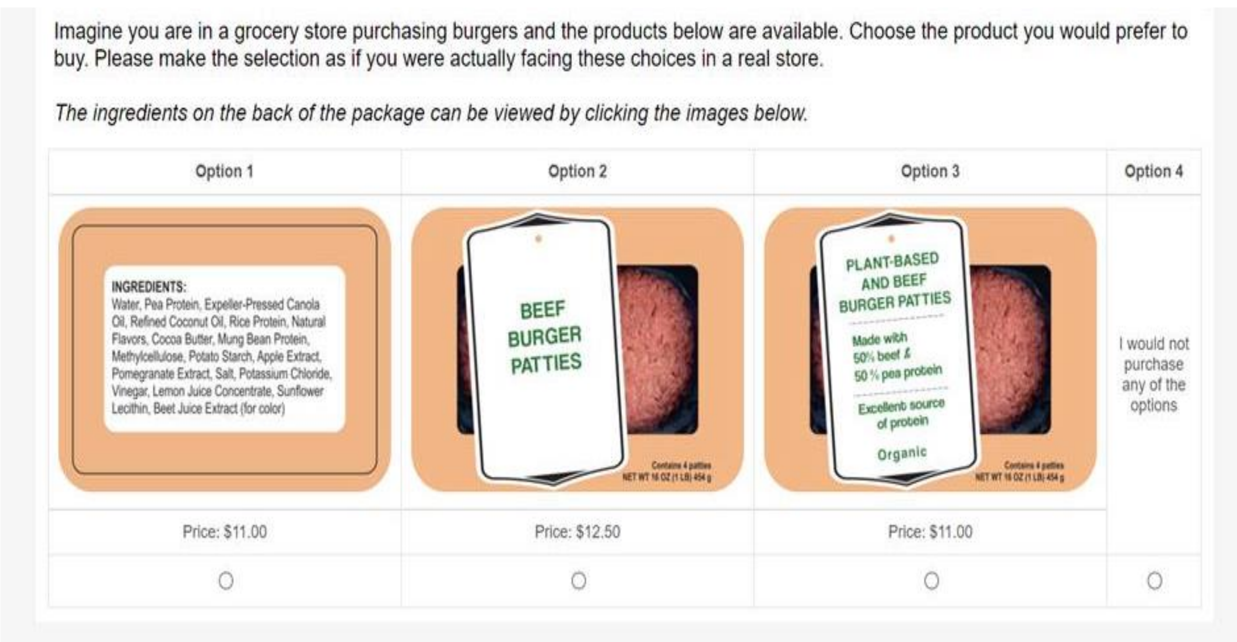



**Figure 0-3. Click Treatment-Hidden back of package treatment with option 1 flipped**

For the following DCE design, I used the idefix package in R. This package allowed for the specification of 36 total choices, blocked into six sections, resulting in six questions per individual. Idefix package design relies on previous attribute estimates to generate user specified number of choice sets with the most randomized dB-efficient design. Within the Idefix package, a coordinated exchange algorithm (CEA) was selected to measure changes based on an attribute-by-attribute basis for multinomial logit modeling.

This DCE was chosen to generate 36 choice sets. Therefore, I chose to use six different blocks of six questions, to which respondents were randomly assigned. The attributes within the blocks were chosen on the basis of d-efficiency, which elicits statistical efficiency of the variance-covariance matrix (Holmes, Adamowicz, and Carlsson, 2017), using the following equation from Holmes, Adamowicz, and Carlsson (2017)

$$D_0 - error = det\left(VC(Z,0)\right)^{\frac{1}{k}} \qquad (0.1\ )$$

Where Z represents the attributes of the DCE, 0 represents when β=β of prior studies of attributes listed below, and k represents the scaling factor for the number of parameters. Five of the six previous parameter estimates were from Slade (2018) and the other from Lusk and Briggerman (2009). Slade (2018) used a hypothetical choice experiment-similar to the framework of this study-to evaluate consumers' WTP and consumer response shares to purchasing beef, plant-based and cultured burgers with similar taste and nutrition profiles. On the other hand, Lusk and Briggerman (2009) used best-worst scaling alongside Random Parameter Logit (RPL) models to evaluate food values and preferences for organic, safety, nutrition, taste, and natural measures. From Slade, 2018, estimations (coefficients in brackets) for ingredients list (0.812), organic label (0.639), plant-based burger (-3.31), hybrid burger (-3.31), and price (-1.09) were used as the vector parameter estimates for the DCE experiment. The nutrition label (2.176) was used for estimation from Lusk and Briggeman (2009). Each of these estimates was used as an average, from which a matrix of ten par draws was used to calculate the Coordinated Exchange Algorithm (CEA), which drew from 12 different matrix designs, and used the best design with the lowest db-error to calculate the probability of selection based on attributes and the choice set generation. Each iteration of the design looped through each attribute and measured the change in error for each attribute level (Traets and Gil, 2020). The minimized d-efficiency of the design was 0.212576, indicating statistical efficiency of the variance-covariance matrix.

## 3.4 Theoretical (random utility) model

The consumer decision-making process is modelled based on random utility theory following Holmes, Adamowicz, and Carlsson (2017). Insights from behavioral economics, including Simon's (1955) concept of a rational consumer, Kahneman (2003) and Kahneman and Tversky's (1977 idea of prospect theory, Verbeke (2008), and Pandey, Rize, and Perez-Cueto's (2021) use of heuristics inform the approach to modelling the decision-making process. The model evaluates the impact on utility of different aspects of the clean label concept: health, sustainability, and ingredient list labels.

Following the workings of Holmes, Adamowicz, and Carlsson's (2017) random utility model, I assume the utility the *i*th individual receives from the *k*th product is,

$$U_{ki} = V_{ki} + \varepsilon_{ki}, \tag{0.2}$$

with $V_{ji}$ representing the systematic component and $\varepsilon_{ji}$ representing the random component of the choice alternatives. Thus, for individual *I*, alternative *k* is selected if and only if

$$V_{ki} + \varepsilon_{ki} > V_{ji}\ \varepsilon_{ji};\ \ \forall j \in C_{-i}, \tag{0.3}$$

where $C_{-I}$ represents all the non-i alternatives within the choice set. The probability of choosing the rth product is,

$$P(i\ chooses\ k) = P\left[V_{ki} + \varepsilon_{ki} > V + \varepsilon_{ji};\ \ \forall j \in C_{-i}\right] \tag{0.4}$$

In my base model, I assume that the systematic portion of the utility function is of the form,

$$V_{ik} = B_{price} * price_k + B_{beef} * D_{beef\ burger} + B_{hybrid\ burger} * D_{hybrid\ burger} + B_{pea\ burger} * D_{pea\ burger} + B_{protein} * D_{protein} + B_{organic} * D_{organic} + B_{long\ ingredient\ list\ (visible\ ingredient\ treatment)} * D_{long\ ingredient\ list} * D_{visibletreatment} + B_{click\ treatment} * D_{click\ treatment} + B_{long\ ingredient\ list\ (click\ treatment)} * D_{long\ ingredient\ list} *$$

$$D_{clicktreatment} * D_{flipping\ the\ product} + B_{click\ treatment\ and\ product\ flipped} * D_{click\ treatment} * D_{flipping\ the\ product} + Z\ variables_{(food\ values, demographics, consumption\ habits, frequency\ of\ consultation, .etc)} \quad (0.5)$$

For this study, utility is modeled by 11 parameters. The price coefficient measures the negative marginal utility of income, the three burger choices represent selection options throughout the DCE, protein and organic represent the two front of package attributes, while the last four parameters evaluate four ingredient list effects. The four ingredient list effects pertain to the earlier two ingredient list treatments. $B_{long\ ingredient\ list\ (visible\ ingredient\ treatment)}$ addresses options containing a long ingredient list relative to a short ingredient list when individuals did not have the option to turn over (flip) the package. The other three ingredient list effects pertained to occurrences when individuals had the option to turn over the package within the DCE. $B_{click\ treatment}$ measures relative utility from randomized assignment to Treatment 2 (click treatment). $B_{click\ treatment\ and\ product\ flipped}$ estimates relative utility for randomized placement in Treatment 2 and choosing to turn the package over. $B_{long\ ingredient\ list\ (click\ treatment)}$ assesses relative utility for options containing a long ingredient list relative to a short ingredient list when respondents did have the option to turn over the package. The final systematic utility component, Z, includes individual specific characteristics interacted with different attributes such as food values, demographics, protein consumption habits, and the stated frequency of reading food labels.

The two treatments represent the variation in coding required to capture consumer responses. The code differentiates how respondents "viewed' the ingredient. In the visible treatment, the back of the package was visible to respondents and the ingredient list could be consistently viewed. However, the click treatment required the clicking of each image to view the ingredient list on the back of the package, which the modeling must account for. Not coding the flipping into the analysis will suggest that the parameter for the long ingredient list does not fully represent the true impact of the long ingredient list and is similar to attribute non-attendance. Individuals who do not choose to “flip” and therefore do not see the ingredient list on the back of the package results in inaccurate coefficient estimates for the long ingredient list for individuals within the click treatment. Within the click treatment, only 23% of individuals chose to view the back of the package or “flip” for one of the alternatives on one or more occasions across the six choice sets, resulting in the long ingredient list impact being inaccurate due to not coding for the choice to turn over the package. For this reason, the code was constructed to reflect the occurrences for when individuals did choose to turn over the package within the choice sets at least once. To ensure accuracy of all variables, individual tendency to flip throughout the DCE was separated between the burger alternatives. The difference between accounting for the flip and not accounting for the flip is presented in the next chapter by the Mixed Multinomial Logit Model (MXMNL). Four model variations are run, representing either a pooled or treatment-specific impact of the above utility function.

The inclusion of socio-demographics to assess heterogeneity maintains strong justification through previous literature. The incorporation of food values, protein consumption habits, and the stated frequency of reading food labels, are other potential sources of heterogeneity. The food values scale is based on Lusk and Briggeman (2009), where the researchers identify 11 food values and measure their relative importance using Best-Worst scaling. An additional four food values are included (product familiarity, animal welfare, sustainability, and religion) that previous literature has found also impact consumer decision making. By using Lusk and Briggeman's (2009) 11 food values plus the additional four values, the models provide a basis of comparison with previous research and align with purchase motivations identified within the literature. This study will also explain how values, such as preferences for animal welfare, environmental benefits, nutrition, naturalness, and taste, have changed. Protein consumption habits and whether respondents report reading food labels are also included. The variable for protein consumption habits measures the frequency of consuming plant proteins or meat and indicates which form is the primary protein for a respondent. The frequency with which respondents report reading food labels is also measured.

For the different types of models-MNL, MXMNL, and LC- the heterogeneity variables listed above are incorporated differently or not at all in the case of the MXMNL, which was selected as the preliminary insights model. Following the workings of RUM, MNL models incorporate heterogeneity variables by interacting the final systematic component and other variables listed in equation 3.5. The MXMNL model allows that all individuals do not share the same coefficients, but instead assumes that preferences can be described by a particular distribution. The LC model incorporates heterogeneity through parameterizing the class probabilities into being dependent on individual data, such as sociodemographics, protein consumption habits, food values and stated frequency of reading food labels-hence the data is stratified into x number of classes, to be discussed later. From these models, parameter estimates allow the calculation of WTP and consumer burger preference shares, as described in the following section.

## 3.5 Consumer Utility and Estimation

### *3.5.1 Multinomial Logit Model*

The first model I use to estimate consumer utility is a MNL. There are three important properties of MNLs to discuss before outlying the following methodology including the Independence of Irrelevant Alternatives (IIA), Preferential Heterogeneity, and Panel Data. First, alternatives within the choice experiments (CEs) are assumed to be independent, leading to the error term's property and results being subjected to the IIA. Though a strong assumption, it is not always satisfied requiring further testing using the Hausman and McFadden method. The testing method requires proof that removing one alternative does not impact the choice probabilities; in the case of violation, a secondary model should be considered (Holmes, Adamowicz, and Carlsson, 2017). Second, there is limited ability to account for heterogeneity. Although observed heterogeneity can be modeled through interactions of attributes and demographic variables, it can be challenging to model with such a variety of interaction terms (including many demographic variables), this limits the model's effectiveness as unobserved heterogeneity is difficult to account for, requiring another form of modeling like latent class modeling (Holmes, Adamowicz, and Carlsson, 2017). Third, panel data, which is when correlations occur across choice sets in an experiment.

The MNL model assumes the error follows an extreme value type 1 distribution, which results in the following altered expression for equation 3.4 above.

$$P(i\ chooses\ k) = \frac{e^{V_{ki}}}{\sum_{k=1}^{J} e^{V_{ji}}} \qquad (0.6)$$

From the above equation, the probability of choosing alternative $k$ by respondent $i$ over alternative $j$ captures the heterogeneity in the difference between $V$. Not included is the simplified version of the ratio choice of probabilities $\mu$, the scale parameter, due to it being set to 1.

Estimation is done by maximum likelihood, which finds parameters producing the highest likelihood. The log-likelihood function is,

$$LL = \sum_{i=1}^{C} \sum_{k=1}^{K} log\ (y_{ij} P\ i\ chooses\ k)), \tag{0.7}$$

where $y_{ij}$ is dummy coded based: if the alternative is selected, $y_{ij}$=1; if the alternative is not selected, $y_{ij}$=0. The log of the likelihood was taken because results do not change between likelihood and log-likelihood, it is easier to calculate, and it is more stable.

As discussed previously, the first of two issues limiting multinomial logit model effectiveness relates to IIA. In the case of violation of the Hausman and Mcfadden test, a secondary model should be considered, such as a latent class or random parameter/mixed logit model (Holmes, Adamowicz, and Carlsson, 2017), as this violation overestimates joint probabilities, leading to incorrect data analysis (Johnson et al., 2017). Including either a MXMNL or LC model which resolves the lack of heterogeneity incorporation into the MNL. This is completed in the alternative models by considering additional heterogeneity effects (sociodemographic, food values, protein consumption levels, and consultation of food labels) as done in the LC model, which better serve to address observed and unobserved heterogeneity in a parsimonious setting relative to solely interaction terms, the form that is captured with MNL modeling. Or by randomizing the parameters and allowing for correlation across standard deviations as completed within the MXMNL model, providing more accuracy to the preliminary insights base model. While the design construct of MNL models is simple and easy to interpret, the issues of lacking heterogeneity and IIA assumption limit the viability of the MNL as the sole approach. Therefore, latent class modeling allows a more explicit consideration of heterogeneity through segmenting responses into classes based on probability and class membership parameters. By comparison, one MXMNL model strength is the ability to measure the degree of sampled heterogeneity. Compared to a MNL model, the MXMNL model provides an improved early interpretation model and is a logical post MNL next step, as the MXMNL allows for improved analysis due to the explicit capturing of heterogeneity. Thereby helping to reveal differences in utility across the visible versus click treatment versus an MNL pooled model.

### *3.5.2 Mixed Logit Model*

Mixed logit models, also known as random parameters logit, represent an alternative option to the MNL model (Hensher and Greene, 2003). The mixed logit model allows that all individuals do not share the same coefficients, but instead assumes that preferences can described by a particular distribution. These models relax the independence of irrelevant alternatives (IIA) assumption and allow for flexible substitution patterns across alternatives (Hensher and Greene, 2009 & Train, 2003).

For this study, the random parameters assumed either a log-normal or normal distribution. Economic theory suggests variables that the coefficient on price is negative, hence, the coefficient on price is assumed to be negative and distributed its absolute value distributed according to a log-normal distribution. The other variables (burger type, long ingredient list, and FOP attributes) are assumed to follow a multivariate normal distribution, which allows for an arbitrary correlation between these coefficients.

Adapted from Train (2003), the unconditional choice probability that individual *I*, chooses alternative *k*, is

$$P_{ik} = \int L_{ik}(\beta_{i)} f(\beta) d(\beta) - where - \ L_{ik}\beta_i = \frac{e(\beta' x_{ik})}{\sum_k e(\beta' x_{ik})} \tag{0.8}$$

where f $(\beta)$ represents the population density the coefficients vary over, and $\beta'$ is the mean and covariances of the population, and $x_{ik}$ are the observed choice variables that relate to each alternative. For this study, the error term is distributed according to an IID extreme value type 1 and the random parameters follow either normal or log-normal distribution according to the earlier listed assumptions.

However, the differentiation between the MNL and MXMNL models includes designing random parameters and using draws to simulate individual choice probability. With the specification for individual choice probability a result of each random parameter implying that the choice of burger and preference for product attributes is a mean and standard distribution that is either normally or log-normally distributed. Thus, for the model to follow parameter randomization, the model requires estimation via simulation, resulting in individual specific draws from choices made within the DCE. Therefore, the following equation adapted from Train (2003) simulates individual choice probabilities as a function of the random parameters and the parameters specified distribution,

$$P'_{ik} = (\frac{1}{R}) \sum_{r=1}^{R} L_{ik}(\beta^r) \tag{0.9}$$

where $R$ is the number of draws, $L_{ik}(\beta^r)$ is equation 3.8 discussed above, $\beta^r$ is the draw value of the parameters from f $(\beta|\theta)$ for individual *i*, and $SP_{ik}$ is the simulated probability based on the draws that individual *i* chooses alternative *k* based on the product's attributes. Hensher and Greene (2003) discuss the correct number of draws for model simulation to ensure accurate data explanation, reporting the ideal resides between 50-200 simulated draws.

Thus, the simulated probabilities for the above equations correspond with the following simulated log-likelihood (SLL) function where the maximum simulated log-likelihood estimation is the value that maximizes the SLL. Adapted from Train (2003),

$$SLL = \sum_{i=1}^{I} \sum_{k=1}^{K} d_{ik} lnP'_{ik} \tag{3.10}$$

where equation 3.10 denotes $d_{ik}$ = 1 if individual *i* chooses alternative *k* and 0 if otherwise.

To capture greater levels of unobserved heterogeneity among the listed attributes, the following subsection discusses the LC model, a model that stratifies the sample based on similar tastes and preferences using parameterized food values, demographics, and other experience variables.

### *3.5.3 Latent Class Model*

The latent class model differs from other estimation models as it segments individuals into different classes, each with distinct preferences. As Boxall and Adamowicz (2002) and Hensher, Rose, and Greene (2015) discussed, latent class models impose three assumptions. First, latent class models require parameter vectors to have a discrete distribution rather than a continuous distribution (which is typically estimated with a random parameter logit model). Second, the population consists of a finite number of individuals, as is generally the case with stated preference experiments. Third, there is no within group heterogeneity. The three assumptions enable latent class modeling to segment consumers based on probability into S different classes.

The probability of being placed in class S is based on class membership equation 3.11,

$$P(i\ is\ in\ class\ s) = \frac{e\ (\alpha_S Z_i)}{\sum_{s=1}^{S} e(\alpha_S Z_i)} \quad S = 1, \ldots s, \tag{0.11}$$

where $Z_k$ are individual characteristics and $\alpha_S$are membership parameters to be estimated. Within each class, the probability of selecting a particular product follows the same formula as equation 3.5, although now the $\alpha$ parameters are class specific.

Following Holmes, Adamowicz, and Carlsson (2017), and conditional on being in the Sth class, the probability of choosing the ith product is based on the following equation 3.12.

$$P(i\ chooses\ k) = \frac{e^{V_{ki}}}{\sum_{k=1}^{J} e^{V_{ji}}} \tag{0.12}$$

From the above equation, the probability of choosing alternative $k$ *by* respondent $i$ over alternative $j$ captures the heterogeneity in the difference between $V$, with the upper half representing individual utility over the conditional logit of choices for the individual.

The overall probability of choosing the kth product is the probability of being in the Sth class times the probability of choosing the kth product conditional on being in the Sth class,

$$P(i\ chooses\ k\ and\ i\ is\ in\ class\ s) = \sum_{s=1}^{S} P_{ik|s} P_{is} = \sum_{s=1}^{S} \frac{e^{(\alpha_s Z_i)}}{\sum_{j=1}^{N} e^{(\alpha_s Z_i)}} \frac{e^{V_{ki}}}{\sum_{k=1}^{J} e^{V_{ji}}} \qquad (0.13)$$

Maximization is again done by maximizing equation 3.13 above. The remaining question is how many classes exist in the data. I estimate the models with 2, 3, 4, 5, and 6 classes and evaluate these models based on the BIC (Bayesian Information Criterion) (Boxall and Adamowicz, 2002).

### *3.5.4 Willingness-to-Pay*

Willingness-to-pay measures the maximum the amount individuals are willing to spend per attribute and per burger. The following equation denotes attribute WTP for both MNL, MXMNL, and LC classes,

$$WTP = \frac{-b\ burger\ attribute_{\ class\ s}}{b\ price_{\ class\ s}} \qquad (0.14)$$

The following equation denotes burger WTP for both MNL, MXMNL, and LC classes and assumes the rest of the attributes are 0,

$$WTP = \frac{-b\ burger_{\ class\ s}}{b\ price_{\ class\ s}} \qquad (0.15)$$

For the MNL and MXMNL model, individuals are in the same class. For the LC model, the individuals exhibit different WTP per class as the sample is stratified based on membership parameters and taste preferences. Standard errors are calculated using the delta method in the Apollo package in R.

### *3.5.5 Predicted Burger Preference Shares*

The following outlines the methods used to measure predicted consumer burger preference shares for MNL and LC models. Forecasting predicted preference shares outlines the competitive nature of how each product fared within the research. The two presented equations account for the additional heterogeneity LC models incorporate.

Equation 3.16 is appropriate for the single-class nature of MNL models. Using Equation 3.5, the probability of choosing each burger patty was measured by the utility amount for each selection, following Train (2009). From Random Utility Modeling (RUM) theory, it is assumed selecting no purchase equalled 0 utility gained or loss; therefore, choosing no purchase (e^0) is listed as 1. It is also assumed all other attributes except for price are assumed 0, which can suggest lower opt-out percentages than in the context of this experiment. The utility for the price attribute is incorporated into each variable as the average MNL price multiplied by the MNL price utility, therefore each burger evaluation is from an equal price point.

$$Burger\ Probability = \frac{e^{\beta\ burger\ patty\ i}}{1+e^{\beta\ burger\ patty\ i}+e^{\beta\ burger\ patty\ j}+e^{\beta\ burger\ patty\ k}} \quad (0.16)$$

For LC modeling, equation 3.17 presents a similar approach also constructed using Train (2009). However, the LC sample is stratified, resulting in only using utility coefficients from each respective class, allowing for heterogeneous tastes to be separated. By having 4 different classes, this results in elaboration from equation 3.16. It is similarly assumed all other attributes except for price are assumed 0, and the utility for the price attribute is incorporated into each variable. The equations differ as equation 3.16 was for the entire model, whereas equation 3.17 represents each respective classes burger probability multiplied by the probability mean. For each class, the average price is multiplied by Class x's price utility (Appendix F), therefore each burger evaluation is from an equal price point.

$$Weighted\ Burger\ Probability$$

$$= Probability\ Mean\ x\ \frac{e^{\beta\ burger\ patty\ i}}{1+e^{\beta\ burger\ patty\ i}+e^{\beta\ burger\ patty\ j}+e^{\beta\ burger\ patty\ k}} \quad (0.17)$$

Similar to the MNL model, the probability of choosing each burger patty was measured by the utility amount for each selection; however, the difference relates to LC models stratification of the sample into classes. Due to each class expressing different utility for burger types compared to other classes, the burger probability of being selected was separated per class, resulting in pea, hybrid, and beef burgers having choice probabilities for classes 1,2,3 and 4. Each classes probability of choosing each burger patty was then weighted according to the percentage of respondents within that class. Total consumer response shares represent the cumulative figure of each class probability of being chosen. Again, following RUM, it was assumed for each class that selecting no purchase equalled 0 utility gained or lost; therefore, choosing no purchase (e^0) is listed as 1.

### *3.5.6 Probit Model Estimation*

I further implement a binary choice model to estimate the probability that individuals look at the back of the package in the hidden information treatment. As above, I assume that the utility individuals receive from flipping the package is

$$Vi = \ \alpha * Xi + \varepsilon_i, \quad (0.18)$$

where $\alpha$ contains the parameter vectors, and $Xi$ is the vector of relevant characteristics explaining why individuals choose to flip the package.  It is assumed the utility from not flipping is 0. Therefore,

$$P(i\ flips\ package) = Prob(\alpha * Xi + \varepsilon_i > 0). \quad (0.19)$$

The probit model assumes that $\varepsilon_i$ is a standard normal distribution, hence,

$$P(i\ flips\ package) = N(-\alpha * Xi), \tag{0.20}$$

$$P(i\ does\ not\ flip\ package) = 1 - N(-\alpha * Xi), \tag{0.21}$$

where N is the CDF of a normal distribution. The log-likelihood, adapted from Hensher, Rose, and Greene (2015), is, therefore,

$$LL = \sum_{yi=0} log[P(i\ does\ \ not\ flip\ package)] + \sum_{yi=1} log[P(i\ flips\ package)]. \tag{0.22}$$

This model incorporates several types of explanatory influences regarding whether individuals choose to flip the product or not. These variables include demographics (female, age, education, income, population size, and household size), food values (natural, nutrition, environmental impact, taste, appearance, product safety, and product familiarity), and stated preference actions (Read Ingredient List, Read Price, Meat Consumption, Plant Consumption, and Food Neophobia).

The food neophobia scale is adapted from Slade's (2018) survey examining milk substitutes Slade's scale was chosen over the Pliner and Hobden (1992) scale as it is more closely aligned with novel food products, referring to untried food as "weird" or "afraid" to consume, two common reasons for the non-consumption of plant-based products. Slade's version also asks for perceptions of foods from different countries contrary to Pliner and Hobden's (1992) asking a similar question regarding the food's ethnic or cultural origin. The scale provides insights into individual focus on the liking and sampling of new or different foods from other countries and individual levels of fear, trust, and weirdness perceptions concerning previously unknown or unconsumed food types. In the case of this study, the variable itself is used to measure whether individuals' reluctance to or fear of trying new foods inhibits or enhances the motivation to flip over the package to read the ingredient list in the choice experiment.

## 3.6 Summary

This chapter lays out the experimental design and model analysis for a Canadian internet survey to elicit consumer utility and WTP for clean label attributes and plant proteins. The framework for the empirical analysis was outlined using multinomial logit models, latent class models, and probit models, along with methods of calculating WTP and predicted consumer preference shares. The results are presented in the next chapter.

# Chapter 4. Results

## 4.1 Introduction

The following chapter reports the results of the discrete choice experiment and survey. The survey was administered in 2021 by the Canadian Hub for Applied and Social Research at the University of Saskatchewan. Asking Canadians, a survey company, recruited 1000 English-speaking individuals from their respondent pool to participate. Potential respondents were sent an email asking them if they were willing to participate in a 10–15-minute survey examining food purchases in grocery stores and were screened out of the survey if they did not have primary or shared grocery shopping responsibility.

The following chapter contains six sections. The chapter begins by assessing how well the sample represents the Canadian population several demographic variables. Descriptive statistics summarize respondents' consumption of plant proteins, burger type selection, and food values. Other beef, plant-based, and short ingredient list perceptions will describe consumer taste, actions alongside measuring the frequency of such actions. The discrete choice experiment is examined using three regression models: a probit regression model describing the probability to turn over the package, Multinomial Logit (MNL) model, and Latent Class (LC) model assessments of Willingness-to-Pay (WTP), consumer preference shares, and marginal effects.

## 4.2 Representativeness of the sample

Quotas were used to ensure that respondents reflected the English-speaking population in Canada (age, region, and gender). Figure 4.1 depicts the geographic distribution of the sample and the census population (Statistics Canada, 2016). The representativeness of the sample was ensured through quotas for each province.

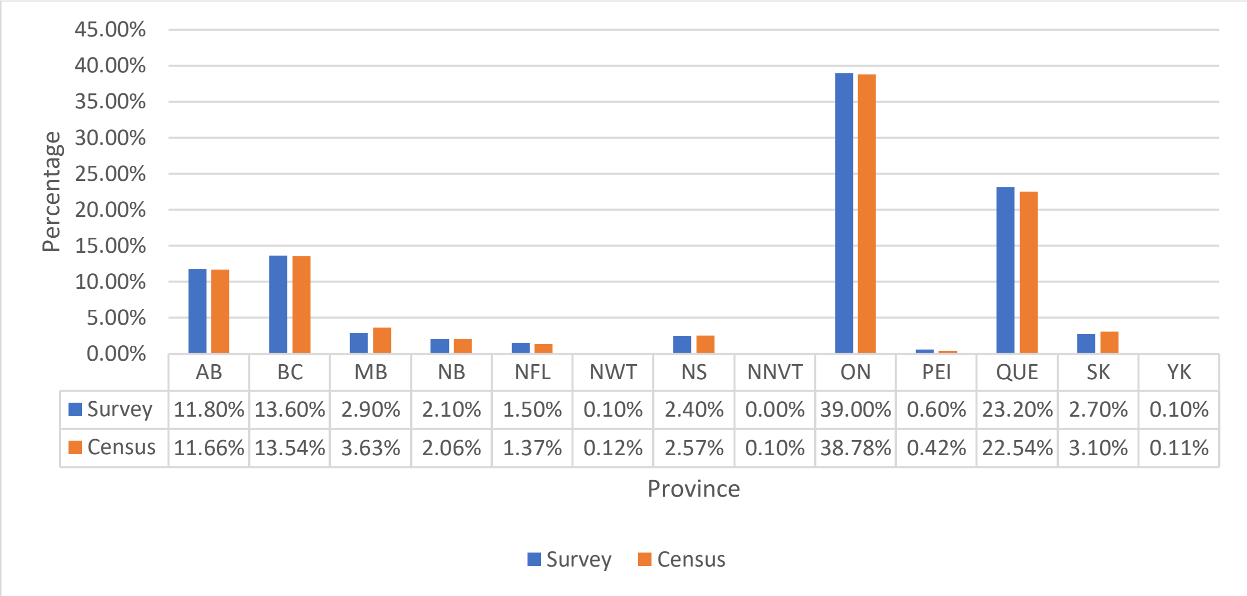



**Figure 0-1. Province Sample Accuracy and Canadian Population**

**Table 0-1. Survey Sample Accuracy and Canadian Adult Population**

| | Survey | Canadian Census (2016) |
|---|---|---|
| Average | | |
| Age | 52.8 | 49[1] |
| Income (in dollars) | 119,574 | 91,900 |
| Household Size | 2.4 | 2.4 |
| | | |
| Female | 50.20% | 50.49%[1] |
| | | |
| Household Living Situation | | |
| Lives alone | 24.50% | 28.20% |
| Lives with an individual under 18 years | 20.00% | 38.60% |
| | | |
| Education | | |
| Did not complete high school | 1.10% | 11.50% |
| Completed High School | 17.50% | 23.70% |
| Completed College | 22.50% | 36.30% |
| Completed Bachelor's Degree or Graduate School | 58.90% | 28.50% |
| | | |
| Population | | |
| Rural | 8.00%[2] | 18.52% |
| Urban | 92.00% | 81.48% |

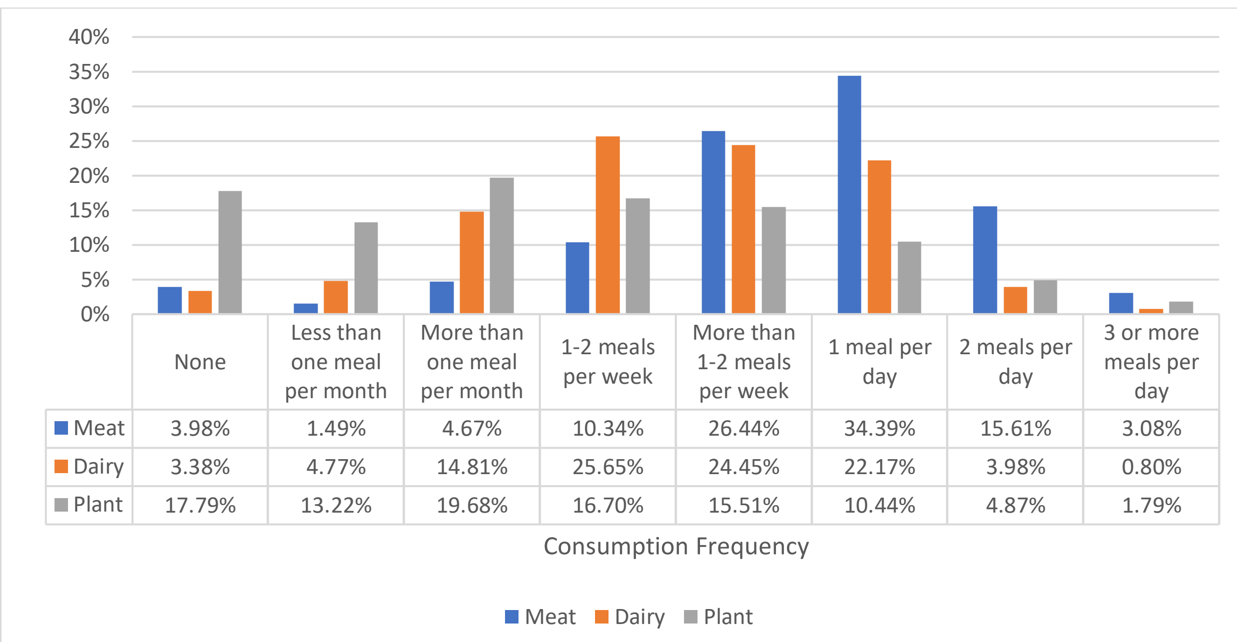
1-Averages are for Canadians between19-89 years old (the minimum and maximum age of the sample)
2-Denoted as individuals who live in a community with a population of less than 1,000.

Table 4.1 compares the sample and census population along with a number of demographic variables. The surveyed sample skews towards older respondents, higher-income respondents, and respondents with higher education levels (which may reflect individuals with greater education levels are better able to answer an internet-based survey). The sample and population are virtually identical in average household size and gender. Lastly, the sample population skews toward individuals residing in urban areas. It should be noted that the screening criteria on ‘primary/sole grocery shopper’ implied that the target sample population is grocery shoppers rather than the Canadian adult population per se.

## 4.3 Consumption Habits

### *4.3.1 Protein and Burger Consumption Habits*

This section describes consumption of proteins in general and burgers in specific. It also considers attitudes towards plant-based proteins.

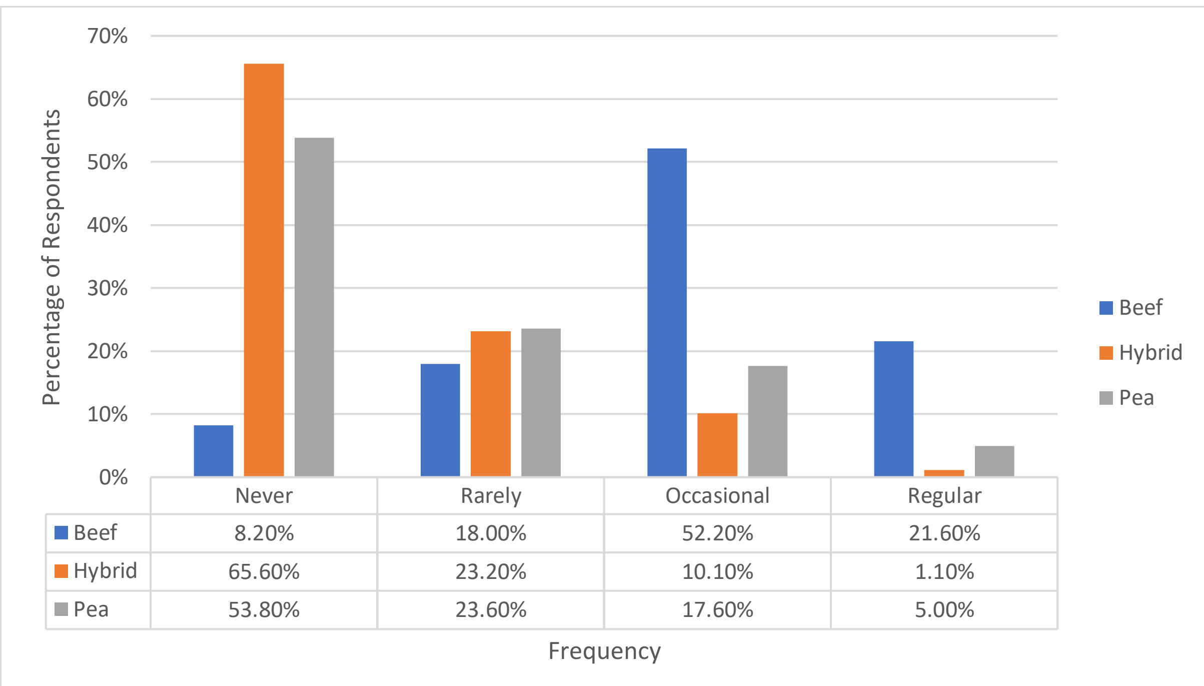



| | None | Less than one meal per month | More than one meal per month | 1-2 meals per week | More than 1-2 meals per week | 1 meal per day | 2 meals per day | 3 or more meals per day |
|---|---|---|---|---|---|---|---|---|
| Meat | 3.98% | 1.49% | 4.67% | 10.34% | 26.44% | 34.39% | 15.61% | 3.08% |
| Dairy | 3.38% | 4.77% | 14.81% | 25.65% | 24.45% | 22.17% | 3.98% | 0.80% |
| Plant | 17.79% | 13.22% | 19.68% | 16.70% | 15.51% | 10.44% | 4.87% | 1.79% |

**Figure 0-2. Protein Consumption Habits**

Figure 4.2 indicates responses to the following question posed toward three different protein types, "Thinking back on the meals you ate over the last month. In how many of these meals was **the type of protein** (e.g., animal/dairy/plant) the **primary** source of protein?" Individuals could select one of the following options: "None," "Less than one meal per month," "More than one meal per month, but not weekly," "1-2 meals per week", "More than 1-2 meals per week, but not daily", "1 meal per day", "2 meals per day", "3 or more meals per day".

Predictably, meat was the most frequently consumed protein source; the median animal consumption is between "More than 1-2 meals per week" and "1 meal per day". Dairy was the second most frequently consumed protein source, and plant-based proteins were the least frequently consumed protein type.




| | Never | Rarely | Occasional | Regular |
|---|---|---|---|---|
| Beef | 8.20% | 18.00% | 52.20% | 21.60% |
| Hybrid | 65.60% | 23.20% | 10.10% | 1.10% |
| Pea | 53.80% | 23.60% | 17.60% | 5.00% |

**Figure 0-3. Burger Consumption Type Frequency**

Figure 4.3 depicts the frequency with which respondents eat the types of burgers described in the DCE. Consistent with results from Figure 4.2, beef burgers were the most frequently consumed burger type, with 73.8% of sampled individuals consuming beef burgers regularly or occasionally. Comparatively, consumption of hybrid and pea burgers was less common, with

11.2% of sampled respondents reporting regular or occasional hybrid burger consumption compared to 22.6% of the sample reporting regular or occasional pea burger consumption.

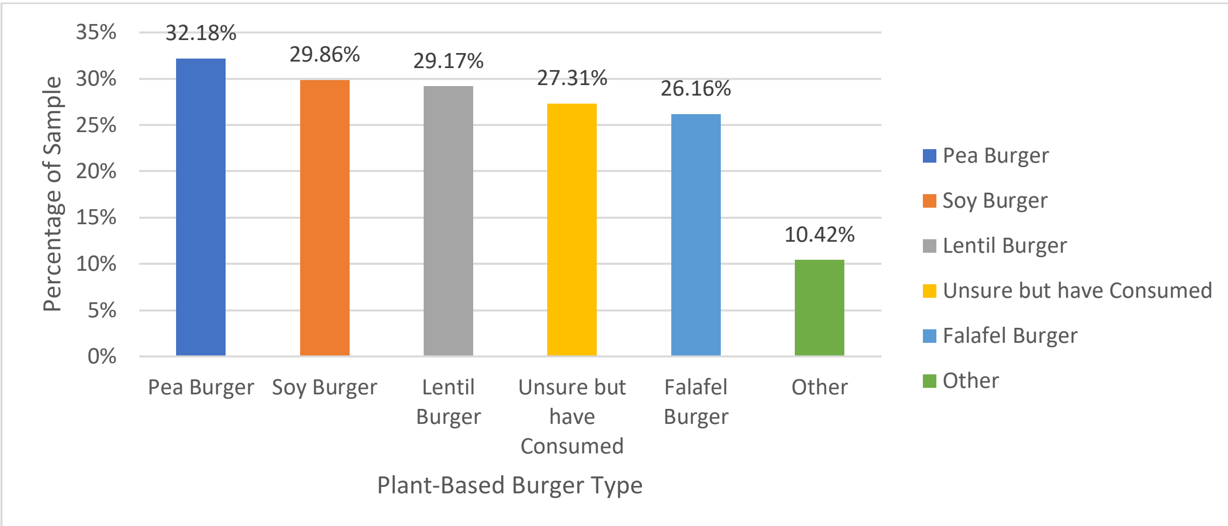
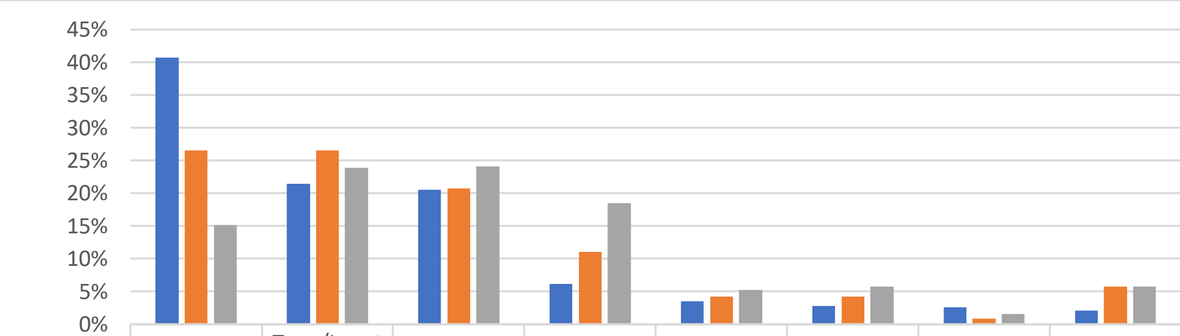



**Figure 0-4. Preferred Plant-Based Burger (n=432)**

Figure 4.4 portrays individuals' favourite type of plant-based burger for respondents who have eaten plant-based burgers. Burgers made with pea protein were the most commonly consumed (32% of responses), followed closely by soy and lentil burgers.




| | Taste/Texture | Type/Length of Ingredients | Price | Nutrition | No Access | Environmental Effects | Allergies | Ethical Value |
|---|---|---|---|---|---|---|---|---|
| Reason 1 | 40.77% | 21.44% | 20.56% | 6.15% | 3.51% | 2.81% | 2.64% | 2.11% |
| Reason 2 | 26.54% | 26.54% | 20.74% | 11.07% | 4.22% | 4.21% | 0.88% | 5.80% |
| Reason 3 | 15.11% | 23.90% | 24.08% | 18.45% | 5.27% | 5.80% | 1.58% | 5.80% |

**Figure 0-5. Reasons for Not Consuming Plant-Based Burgers (n=568)**

Individuals who did not consume plant-based burgers were asked: "Please select your top three reasons for not typically trying plant-based burgers." The results of this question are illustrated in Figure 4.5. The three main reasons were taste/texture, type/length of ingredients, and price. Prior research completed in the United States finds similar reasons for reluctance to consume plant-based burgers (He et al. (2020); International Food Information Council (2020)). Sensory attributes of meat, such as taste and texture, were believed superior to plant-based products (He et al., 2020). Likewise, International Food Information Council (2020) finds that 31% of respondents listed perceived taste as the main reason for not trying plant-based proteins. Contrary to the findings of this study, International Food Information Council (2020) found price and ingredient list length to be less important (fourth (14%) and fifth (13%)).

*4.3.2 Ingredient List Perceptions*

Respondents' perceptions of food products with simplified ingredient lists were probed with the question: "Products with fewer and simpler ingredients are…"(1 to 7, Strongly Disagree to Strongly Agree). The following figures summarize responses.

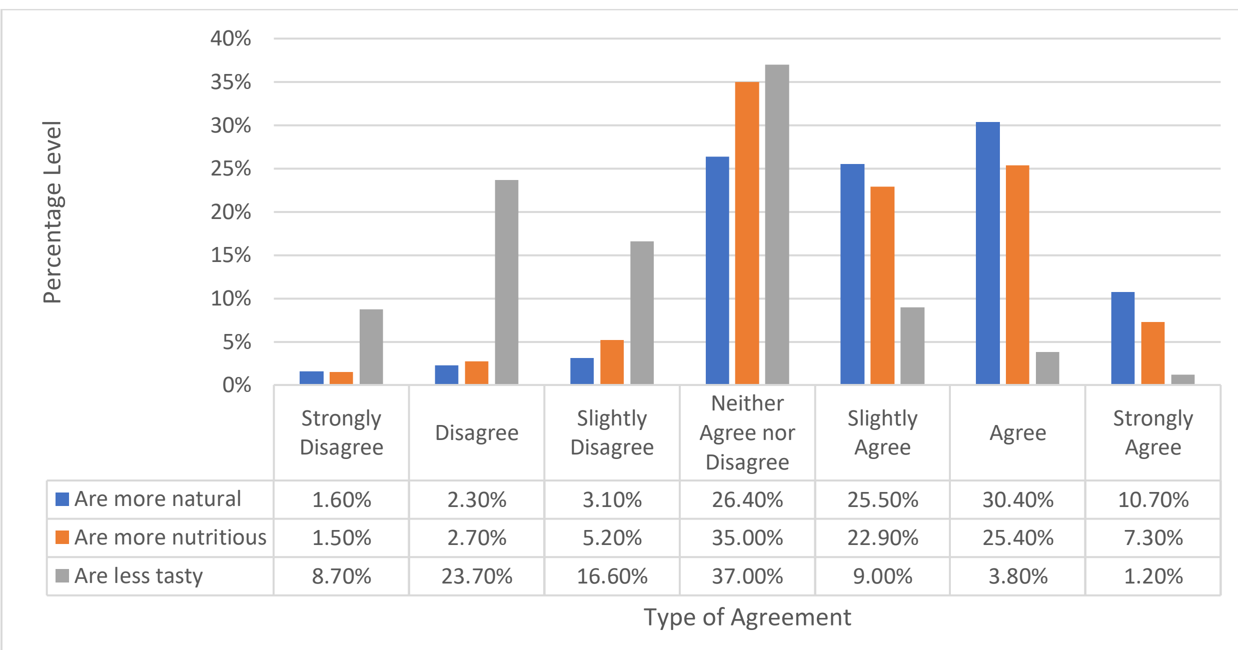



**Figure 0-6. Respondent Agreement Levels for Products with Fewer and Simpler Ingredients**

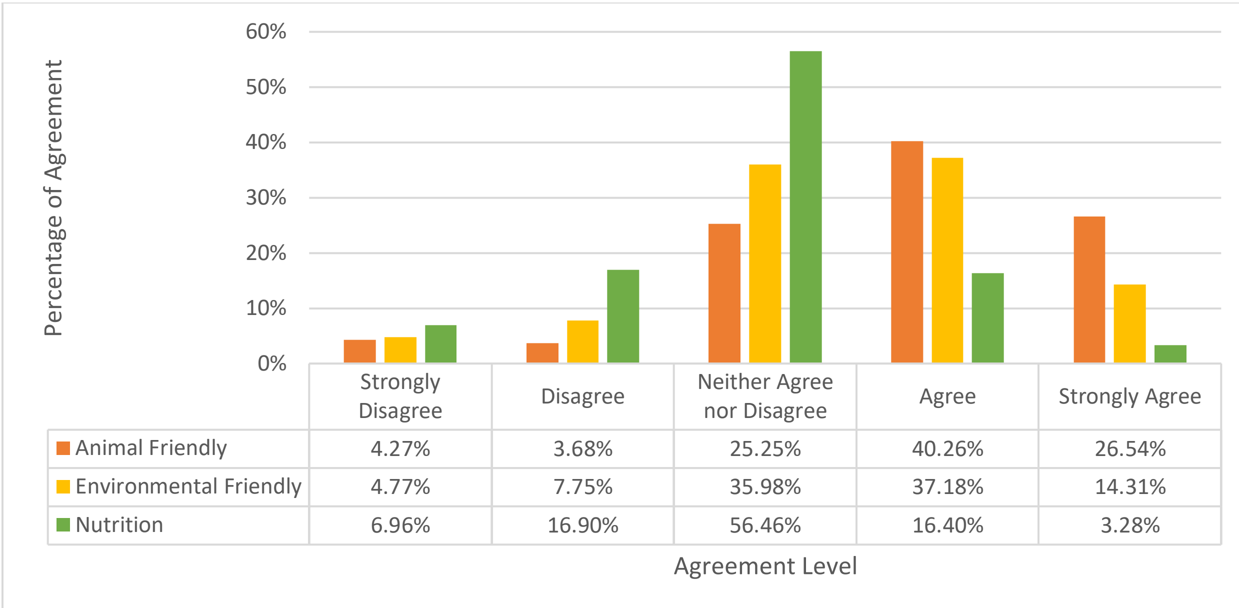
The study found high agreement levels regarding products with fewer and simpler ingredient lists are considered more natural. Per earlier disucssion of Rozin, Fischler, & Shields-Argeles (2009) and Rozin, Fischler, & Shields-Argeles (2012), this studies high agreement levels-this study shows 67% across three stages of agreement-could indicate individual reaction resulting from additivity dominance. Additivity dominance is the individual tendency to define naturalness by the absence of unknown or artificial additives—implying that reducing the ingredient list length implies greater naturalness due to product simplification and fewer product ingredient contents.

The study found large agreement levels regarding products with fewer and simpler ingredient lists deemed more nutritious. Across the three stages of agreement, slightly to strongly, 55% of respondents agreed that products containing reduced ingredient lists were more nutritious; however, just over a third of surveyed individuals neither agreed nor disagreed.

The study found that only a few respondents regarded products with fewer and simpler ingredient lists as being deemed less tasty. Contrary to natural and nutrition findings, the above figure reveals 15% of individuals believe limiting the number of ingredients reduces product taste, while slightly less than 50% of respondents do not agree that reduced ingredient lists impact product taste. A large segment (37%) remained neutral regarding the reduced ingredient lists' impact on taste.

### *4.3.3 Perceptions of Plant-Based Burgers vs. Beef Burgers*

The section summarizes attitudes brought forward in the literature review surrounding the top 3 drivers for plant-based protein consumption (increased healthiness, environmental concerns, and animal welfare) and towards plant versus beef burgers with responses to the question "To what extent do you agree or disagree with the following statements about plant-based burgers?" (1-5, Strongly Disagree" to "Strongly Agree.")




| | Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |
|---|---|---|---|---|---|
| Animal Friendly | 4.27% | 3.68% | 25.25% | 40.26% | 26.54% |
| Environmental Friendly | 4.77% | 7.75% | 35.98% | 37.18% | 14.31% |
| Nutrition | 6.96% | 16.90% | 56.46% | 16.40% | 3.28% |

**Figure 0-7. Respondent Agreement Levels for Perceptions of Plant-Based vs. Beef Burgers**

Figure 4.7 data highlights that about two-thirds of respondents agreed that plant-based burgers are more animal-friendly than beef. The results indicate that 67% of individuals perceive plant-based burgers as more animal friendly than beef burgers, while one-quarter of respondents neither agree nor disagree. Similarly, Bryant (2019) found United Kingdom consumers, including meat-eaters, supported similar outlooks regarding diet changes benefit animal welfare with 72.7% and 77% of individuals viewing vegan and vegetarian diets as animal benefiting, closely aligning to the 67% from this study.

The results indicate that slightly over half of surveyed individuals perceived plant-based burgers as more environmentally friendly than beef burgers, with 51% of respondents agreeing at varying levels, whereas 36% of individuals neither agreed nor disagreed. Compared against animal welfare agreement levels, responses indicated greater perception alignment away from environmental concerns, with more individuals suggesting animal welfare was of greater importance. Even though not ranked as high as in this study, environmental friendliness has been perceived as a primary driver through other studies- 47% of individuals listed environmental concerns as reasoning for transitioning to plant-based diets Ashcemann-Witzel, (2020). Findings from United Kingdom consumers imply much higher agreement levels among consumers for environmental benefits contrary to this study as respondents viewed vegan (69.3%) and vegetarian

(74.1%) diets as highly favorable; however, environmental benefits was viewed slightly less beneficial than diet impact on animal welfare (Bryant, 2019).

Contrary to the latter two figures discussed, respondent attitudes towards burger nutrition was not as agreed upon. Over half of individuals (57%) neither agreed or disagreed with the statement that plant-based burgers were more nutritious than beef burgers The results from this study align similarly to Bryant's (2019) experimental results, where nutrition also ranked behind environmental and ethical reasons in terms of positive outlook- less than half of individuals viewed plant-based diet types as nutritionally beneficial.

### *4.3.4 Frequency of Reading Ingredient Lists*

Figure 4.8 depicts the frequency with which respondents read a product's ingredients list. The median and modal response to this question was "Moderately Often"; however, almost half of the respondents (49%) consult the ingredient list "Always" or "Very Often. In contrast, IFT (2020) reports that 22% of individuals consult ingredient lists, while Government of Canada (2018) reports a figure of 37%. This response could be a result of the framing of the survey as this question appeared after the DCE, possibly focusing respondents' attention on ingredient lists.

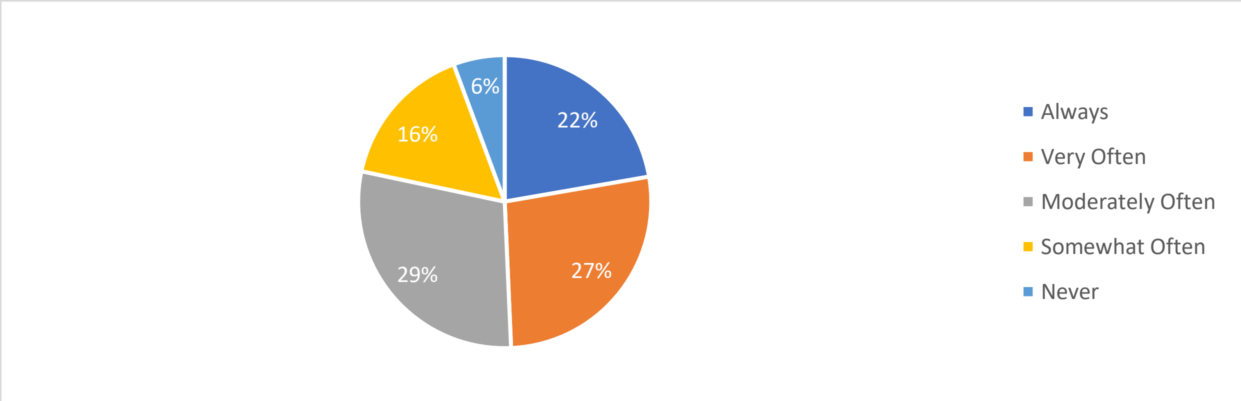



**Figure 0-8. "How often do you read the Ingredients List on a food label?"**

## 4.4 Choice Experiment Analysis

The following section reports the choice experiment results. This section consists of Mixed Multinomial Logit (MXMNL) and Latent Class (LC) model analysis, with the examination of the Multinomial Logit (MNL) contained in appendices C, D, E, F, G and H.

The MNL (found in appendices C, D, E, F, G and H) and the LC models capture additional unobserved heterogeneity by interaction and grouping similar tastes. To further explore heterogeneity, the MNL base model is interacted with DCE attributes, sociodemographic explanatory variables, and respondents' food values. Section 4.4.3 provides the Latent Class modeling results (4 classes) and compares the MNL and MXMNL model to the LC model. Results contain the membership stratification of sample respondents into four classes based on preferred burger choice, sociodemographic, food values, the rate of reading food labels, and protein consumption levels. Modeling outputs include detailing attribute mean Willingness-to-Pay (WTP), burger preference shares, and class membership marginal effects.

*4.4.1 Variable Explanation*

The following table outlines the definitions of each primary variable used in MNL, MXMNL and LC modeling and describes how each variable is measured.

**Table 0-2. Variable Explanation**

| Variable Name | Variable Defined | Variable Measurement |
|---|---|---|
| Price | A 6-level variable ranging from $5.00-$12.50 with $1.50 increments. | Measured as part of a continuous 6-Level Variable option, the price coefficient measures respondent's negative marginal utility of income. |
| Beef Patty Type | One of the three burger patty options to be presented within the DCE for respondents to choose. | Measured as part of the 3-level burger option. Measurement elicits the amount of utility incurred when this patty form is present. |
| Hybrid Patty Type | One of the three burger patty options to be presented within the DCE for respondents to choose. | Measured as part of the 3-level burger option. Measurement elicits the amount of utility incurred when this patty form is present. |
| Pea Patty Type | One of the three burger patty options to be presented within the DCE for respondents to choose. | Measured as part of the 3-level burger option. Measurement elicits the amount of utility incurred when this patty form is present. |
| Protein FOP Attribute | One of the two FOP attributes presented within the DCE with a content identifying label as to whether the product is an excellent source of protein. | Measured as DCE Binary Dummy Variable. Measurement elicits the amount of utility incurred when this FOP attribute is present. |
| Organic FOP Attribute | One of the two FOP attributes presented within the DCE as a content identifying label as to whether the product is organic. | Measured as DCE Binary Dummy Variable. Measurement elicits the amount of utility incurred when this FOP attribute is present. |
| Long Ingredient List (Visible Ingredient Treatment) | One of the two versions of ingredient lists presented within the DCE, identifies whether the product contains more than five ingredients (a long ingredient list), and the ingredient list is visible within the DCE (i.e., visible treatment) without the respondent having to take further action to view the back of the package (were presented with both the front and back of the package). | Measured as DCE Binary Variable. Measurement elicits the utility amount incurred when respondents are randomized into the visible ingredient treatment and view a long ingredient list. |
| Long Ingredient List (Click Treatment) | One of the two versions of ingredient lists presented within the DCE. This variable identifies whether the product contains more than five ingredients (a long ingredient list), the ingredient list is not visible within the DCE to the respondent (i.e., click treatment), and whether individuals chose to click to flip (product flipped) the image to view the back of the package. | Measured as DCE Binary Variable. Measurement elicits the utility amount incurred when respondents are randomized into the click ingredient treatment and view a long ingredient list-meaning they must click each image to view the patty type's ingredient list. |
| Click Treatment | One of two random treatments respondents are allocated to within the DCE. Describes the scenarios when respondents are only given access to information on the front of the package and are required to click on each image to view the package back. | Measured as DCE Binary Variable. Measurement elicits the utility amount incurred when respondents are randomized into the click ingredient treatment relative to the visible ingredient treatment. |
| Click Treatment and Product Flipped | Describes scenarios when respondents are given the front of the package (click treatment) relative to the fully visible information (visible treatment) package images (front and back) and consult the back of the package by choosing to click on an image (choosing to flip the package). | Measured as DCE Binary Variable. Measurement elicits the utility amount incurred when respondents are randomized into the click ingredient treatment and choose to turn over the package to consult the package back. |

*4.4.2 Mixed Multinomial Logit Model*

The MXMNL model in section 4.4.2 assesses the base model amid four different model variations: 1) a pooled model accounting for differences between the impacts of the different treatment on the ingredient list, 2) a model specified to study the impacts on individuals strictly within the visible treatment (access to the front and back of the package), 3) a model designed to analyze the choices of individuals within the click treatment (access to only the front of the package) disregarding the impact of whether the individuals chose to “flip” the package over, and 4) a model created to examine the “flipping”” effect on individuals within the click treatment (access to only the front of the package) assessing whether the individuals chose to “”flip”” the package over during the DCE.

**Table 0-3. Mixed Multinomial Logit Model**

| | Pooled Model | Visible Treatment | Click Treatment (No Flip) | Click Treatment (with Flip) |
|---|---|---|---|---|
| LL(final) | -5049.15 | -2477.28 | -2627.56 | -2525.89 |
| Rho-square (0) | 0.393 | 0.3782 | 0.3937 | 0.4171 |
| Adjusted Rho-square (0) | 0.3891 | 0.3709 | 0.387 | 0.4102 |
| AIC | 10162.3 | 5012.56 | 5313.13 | 5111.77 |
| BIC | 10376.69 | 5185.5 | 5488.5 | 5293.2 |
| Number of Individuals | 1000 | 480 | 520 | 520 |
| Number of Choice Observations | 6000 | 2880 | 3,120 | 3,120 |
| **Means** | Estimate (S.E) | Estimate (S.E.) | Estimate (S.E.) | Estimate (S.E.) |
| Price | -0.819*** (0.058) | -1.090*** (0.093) | -0.683*** (0.072) | -0.606*** (0.068) |
| Beef | 6.506 *** (0.299) | 6.258*** (0.396) | 6.798*** (0.390) | 7.192*** (0.473) |
| Pea | 3.162 *** (0.314) | 3.351*** (0.384) | 2.447*** (0.420) | 2.514*** (0.470) |
| Hybrid | 4.581 *** (0.294) | 4.192*** (0.410) | 4.621*** (0.362) | 4.796*** (0.437) |
| Organic | 0.191 *** (0.063) | 0.185** (0.094) | 0.231** (0.090) | 0.113 (0.089) |
| Protein | 0.042 (0.077) | -0.019 (0.113) | 0.193* (0.144) | 0.077 (0.108) |
| Long Ingredient List | -1.691*** (0.116) | -1.728*** (0.132) | -0.959*** (0.133) | |
| Long Ingredient List (Conditional on Flipping) | -2.154*** (0.176) | | | -2.552*** (0.234) |
| Flipping | 1.299 *** (0.200) | | | 1.420*** (0.274) |
| **Standard Deviation** | | | | |
| Price | 0.688 *** (0.058) | 0.785*** (0.050) | 0.792*** (0.054) | -0.500*** (0.032) |
| Beef | 1.908 *** (0.219) | 2.752*** (0.309) | 2.240*** (0.329) | 4.181*** (0.464) |
| Pea | 2.671*** (0.195) | 0.803*** (0.184) | 2.248*** (0.531) | 3.151*** (0.297) |
| Hybrid | 5.297 *** (0.306) | 3.498*** (0.305) | 3.461*** (0.279) | 4.608*** (0.288) |
| Organic | 0.668 *** (0.106) | 0.492*** (0.145) | 0.077 (0.177) | 0.314* (0.176) |
| Protein | 0.420*** (0.104) | 0.141 (0.178) | 0.070 (0.160) | 0.231 (0.163) |
| Long Ingredient List | 1.703 *** (0.164) | 0.259 (0.164) | -0.089 (0.203) | |
| Long Ingredient List (Conditional on Flipping) | 1.571 *** (0.226) | | | 0.698** (0.281) |
| Statistical Significance: 1% - ***, 5% - **, 10% - * | | | | |

The following section illustrates the preliminary impact of the MXMNL modeled variables. The table displays the differences between treatments and the resulting influence on burger selection and attribute preferences and assesses the difference between accounting for and not accounting for individual’’ ability to flip within the click treatment.

For the MXMNL table listed above, there are commonalities between the construction of each model. Estimating each model above was tested following only normal distribution or log normal distributions for random parameters, although the economic theory and model results evaluated based on Bayesian Information Criterion (BIC), Akaike Information Criterion (AIC), Log-Likelihood, and adjusted R-squared implied the above models best explained the data. Each model corresponded with following Hensher and Greene's (2020) specified 200 draws. Therefore, each estimated variable was assumed randomized except for the "flipping" variable.

The pooled model was also analyzed by separating the impact on each burger and FOP attribute through code construction. The code design specified a binary dummy variable set to each treatment to interact with each burger type and attribute, allowing for the differences for the burger and attributes to be examined across the click and visible treatment but within the same model. Code construction also specified the control of the long ingredient list by treatment. For the click treatment, the long ingredient list accounts for being randomized to the click treatment, choosing to flip one of the alternatives and viewing a long ingredient list relative to a short ingredient list. For the visible treatment, the design for the ingredient list measures the utility impact of being randomized to the visible treatment and viewing a long ingredient list relative to a short ingredient list.

The judgement to keep the pooled model controlled for only the ingredient list effects listed above rather than each burger and attribute diversified by code design discussed in the previous paragraph was due to three reasons. The first reason was due to simplifying the analysis of the model. The second reason for restricting the model to only control for click and visible treatment impacts on the long ingredient list is due to attribute non-attendance purposes, as not accounting for the "flip" for individuals in the click treatment would provide inaccurate ingredient list measurements. The third rationale for keeping the pooled model was although it was proved statistically different through F-testing and Likelihood Ratio testing, the differences between the models was not deemed economically significant, resulting in keeping the pooled model with only the ingredient list separated.

Similar results were exhibited across the four MXMNL logit models, whether the analyzed sample is pooled or within a specified treatment. On average, burger preferences consistently follow the same ranking across all models, as beef burgers are always favored, followed by hybrid and pea burgers. Also, regardless of being within either treatment or accounting for an individual's tendency to "flip" or not, the long ingredient list, on average, was always the most significant burger attribute relative to the organic or excellent source of protein labels.

However, the models do exhibit distinct taste characteristics and implications. In the pooled model, which accounted for differences between the different treatment impacts on the ingredient list but kept the remaining means and standard deviations grouped, not all FOP attributes are impactful across the pooled sample. For instance, only the organic attribute was significant between the FOP attributes, unlike the excellent source of protein label. This model represents the only example with both treatments impacting the long ingredient list, revealing that both ingredient list effects, on average, are more significant to consumer decision-making than either FOP attribute. However, both ingredient list effects reveal large standard deviations, implying large amounts of consumer heterogeneity toward the long ingredient lists. The standard deviations of the burger types reveal hybrid burgers had significant consumer taste variances, indicating individuals within the sample had very distinct differences for hybrid burgers across the pooled sample.

Unlike the pooled model, the visible treatment model examines the preferences of individuals strictly within the visible treatment (access to the front and back of the package). Individuals within the visible treatment, on average, valued price to a greater extent compared to individuals in the click treatment. Like the pooled model, only the organic attribute exhibited significance on average between the FOP attributes. However, the results reveal that when individuals had access to both the front and back of the package, the long ingredient list was more impactful to consumer choices than the FOP attributes.

Interestingly, the standard deviation of the FOP attributes and long ingredients exhibited different results from the pooled model. The organic attribute increased in preference heterogeneity compared to the pooled, whereas the long ingredient list’s standard deviation coefficient was substantially less than the pooled model. The standard deviation's estimates for long ingredient list in both the visible and pooled treatment reveal the distaste for the long ingredient was relatively shared between the models as both models simulate occurrences of when the individuals had easy access to the long ingredient list, suggesting the distaste occurs in both models when individuals are given ingredient list. Hybrid and beef burgers contained the largest standard deviation estimates, implying large degrees of preference heterogeneity within the sampled treatment. Although hybrid burger estimates were marginally less than the pooled model, the model suggests beef burgers elicited much higher heterogeneity in the visible treatment. The average value for pea burgers had a lower standard deviation, signaling reduced taste variations for pea burgers.

Unlike the visible model, the click treatment model not accounting for individuals' ability to "flip" over the package, was designed to analyze the choices of individuals with initial access to only the front of the package and disregarded the impact of whether the individuals chose to "flip" the package over. Without the "flip" effect, both FOP attributes are positively valued by the sample, although less than the long ingredient list as the model did not account for individual "flipping" occurred. Not including the "flipping" leads to several issues, including failing to account for attribute non-attendance and not revealing the true long ingredient list impact, as individuals who did and did not flip would be misrepresented by either overestimating or underestimating the effect of the long ingredient list—translating to incorrectly modeled assumptions as individuals who did not turn over the package would not view the ingredient list attribute.

Examining the standard deviations of the click no "flip" model indicates pea burgers registered the most extensive sample preference heterogeneity, greater than the implied taste heterogeneity of hybrid and beef burgers. Examining the ingredient list and FOP attributes, the estimates of the FOP attributes standard deviations imply the heterogeneity levels for organic and excellent source of protein labels were relatively similar. However, these estimates could be resulting from not accounting for the "flip", leading to over-estimation/under-estimation of these attributes. The ingredient list length had much taste variation even though flipping was not designed within the model construct.

The ability to "flip" or not "flip" is included in the last model. This model examines the "flipping" of individuals within the click treatment and rationalizes within the code that individuals who choose not to "flip" the product receive zero utility as they do not view the ingredient list. As indicated in the methodology chapter, the code was constructed to reflect the occurrences when individuals did choose to turn over the package within the choice sets at least once. To ensure accuracy of all the long ingredient variables, individual tendency to flip throughout the DCE was separated between the burger alternatives. Therefore, the long ingredient list variable captures utility only from those participants who have viewed this attribute, implying better design and possible explanation of consumer choices to the model than if not the "flip" is not included. One caveat of the coding pertains to the potential that, having flipped a product once and viewing either a short or long ingredient list, individuals may have assumed that subsequent products contained the same short or long ingredient list, whereas this may not have been the case, as the rate of the product being "flipped" throughout the choice sets decreased and may further result in the issue of attribute non-attendance.

When the "flip" variable is applied to the coding, the results reveal that only the organic label maintains value between FOP attribute for individuals within the click treatment. Nevertheless, on average, the ingredient list length is relatively more impactful. One contrast between the two treatments regards individuals randomized to the click treatment placed a lower value on price relative to the visible or pooled model. Between the two click treatment models- not accounting for the "flip" and accounting for the “flip”-the results of both click models suggest the standard deviation estimates of the long ingredient list contained the largest implied taste heterogeneity compared to the FOP attributes. Intriguingly, the pea burger within this model has the largest standard deviation, implying diverse and unobserved differences in tastes for the burger type relative to the other models.

**Table 0-4. Mixed Multinomial Logit WTP**

| | Pooled Model | Visible Treatment | Click Treatment (No Flip) | Click Treatment (with Flip) |
|---|---|---|---|---|
| Beef | $ 9.17*** | $ 6.48*** | $ 11.51*** | $ 9.45*** |
| Pea | $ 3.47*** | $ 3.59*** | $ 3.95*** | $ 2.38*** |
| Hybrid | $ 6.11*** | $ 4.29*** | $ 8.34*** | $ 6.33*** |
| Organic | $ 0.23*** | $ 0.28*** | $ 0.47*** | $ 0.32** |
| Protein | $ 0.00 | $ 0.05 | $ 0.37** | $ 0.27 |
| Long Ingredient List | $ -2.60*** | $ -1.95*** | $ -1.73*** | - |
| Long Ingredient List (Conditional on Flipping) | $ -3.33*** | - | - | $ -4.15*** |
| Statistical Significance: 1% - ***, 5% - **, 10% - * | | | | |

WTP exhibits an approximated value estimate for a more comprehensive understanding of the MXMNL model results. In each model, beef exhibits the greatest WTP, followed by hybrid and pea burgers, though WTP differences vary between models. In the pooled treatment, the WTP for beef burgers is roughly 1.5 times greater than hybrid burgers and 2.5 times larger than that of pea burgers. Differing by treatment, beef burger WTP is 1.5 times more, relative to hybrid burgers and 1.8 times greater than that of pea burgers in the visible treatment. When no flipping was accounted for in the click treatment model, individuals elicited almost 1.5 times the WTP for beef burgers compared to hybrid burgers and almost three times more than for pea burgers. When "flipping" was included, the WTP for beef burgers exceeded that of hybrid and pea burgers by roughly 1.5 and 4 times. Broad implications imply the WTP for beef burgers relative to hybrid burgers is generally about 1.5 times more; compared to pea burgers, beef burgers elicited WTP value range increases to become 2 to 4 times more.

Individuals greatest attribute desire was for a reduced ingredient list, expressed by the large, negative WTP for a long ingredient in each model. The negative estimate indicates respondents would require either compensation to select a product with long ingredient list, or more intuitively, the WTP for a reduced ingredient list. After the reduced ingredient list, the next largest attribute WTP was for the organic and excellent source of protein label, though the estimates vary between models. In the pooled treatment, the WTP for a reduced ingredients list or WTP compensation for a long ingredient list in either treatment is over ten times greater than the organic label. Individuals expressed no value for an excellent source of protein label as the estimate contained no statistical significance.

Differing by treatment, the WTP for a reduced ingredients list in the visible treatment is seven times greater than for the organic label, while the excellent source of protein label again was insignificant. In the click treatment model, when no flipping was accounted for, the WTP for a reduced ingredient list or the required compensation for products with long ingredient lists was roughly 3.5 times greater than the organic label and about 4.5 times greater than the excellent source of protein label. However, when flipping was included in the model, the WTP for a reduced ingredient list or the required compensation for products with long ingredient lists was estimated to be roughly 2.5 times greater impact than the non-flipping click treatment, implying the WTP for a reduced ingredient list or required compensation within the click treatment when flipping exceeded the organic label by 10 times the WTP, while the WTP for the excellent source of protein label was insignificant. Major takeaways indicate the long ingredient was substantially impactful to the organic and excellent source of protein label. Individuals exhibited relatively equal value for the organic label in the click and visible treatment and the excellent source of protein label was generally not significant across the two treatments. Lastly, respondents within the click treatment were more affected by the long ingredient list relative to respondents within the visible treatment as implied by the larger negative WTP. In summary, the WTP reveals individuals would rather view a shortened ingredient list or require a larger compensation for products with long ingredient lists on products rather an organic or excellent source of protein label.

### *4.4.3 Latent Class Analysis*

The following section analyzes the data using the Latent Class model. I estimated the models with 2-6 classes to decide how many classes to include. A 4-class model was selected for two reasons: the first pertains to the lowest BIC between classes (Bayesian Information Criterion) and the second to the Rho Square of the model. Both Innes (2009) and Louviere, Hensher, and Swait (2000) have discussed that the appropriate fit for choice models contains Rho Square values between 0.2 and 0.4. As can be viewed within Table 4.7, only the 3-Class and 4-Class are within that range. The BIC of the 4-Class model indicates the best fit due to containing the lowest BIC level, implying greater model likelihood and more significant data explanation. Thus, the 4-Class

Latent Model was the preferred selection; the following log-likelihood discussion will subsequently compare the MNL and LC models.

**Table 0-5. Summary of Class Measurements Results Evaluating Class Membership Indicators for Latent Class Modeling**

| Class | LL (Finish) | Rho Square | Adjusted Rho Square | AIC | BIC |
|---|---|---|---|---|---|
| 2-Class | -6197.662 | 0.2549 | 0.2504 | 12469.32 | 12757.85 |
| 3-Class | -5560.208 | 0.3315 | 0.3238 | 11248.42 | 11765.91 |
| 4-Class | -5092.006 | 0.3878 | 0.3769 | 10366.01 | 11122.13 |
| 5-Class | -4984.222 | 0.4008 | 0.3866 | 10204.44 | 11206.41 |
| 6-Class | -4878.939 | 0.4134 | 0.396 | 10047.88 | 11301.46 |

The following table describes multiple experimental outcomes. The first part describes per class Willingness-to-Pay for each DCE burger patty type and DCE attribute represented in MNL and LC models. By MNL and LC differentiation, burger preference WTP heterogeneity is captured within the model. The other part outlines two parts of MNL and LC probability. The first part reveals the probability of the DCE market shares from the MNL and the four LC model classes. The second part describes per class weighted probability of the DCE burger preference shares for each class of the LC model based on the number of respondents in each class, with the final row concluding the final patty market share.

**Table 0-6. Summary of Burger WTP, Predicted and Weighted Predicted Latent Class Burger Preference Shares**

| | | MNL | Class 1 – *Burger lovers* | Class 2 – *Price-conscious carnivores* | Class 3 – *Vegivores* | Class 4 – *Short-ingredient lovers* |
|---|---|---|---|---|---|---|
| Log-Likelihood | | -6593.925 | | -5092.006 | | |
| Rho-square (0) | | 0.1192 | | 0.3878 | | |
| Adjusted Rho-square (0) | | 0.1178 | | 0.3769 | | |
| AIC | | 13207.85 | | 10366.01 | | |
| BIC | | 13273.79 | | 11122.13 | | |
| Number of Individuals | | 1000 | | 1000 | | |
| Number of Choice Observations | | 6000 | | 6000 | | |
| Price Estimate (S.E.) | | -0.195***<br>(0.01025) | -0.320***<br>(0.024) | -0.447***<br>(0.05882) | -0.328***<br>(0.03526) | -0.299***<br>(0.03005) |
| Class Probability | | - | 0.3239 | 0.1684 | 0.14 | 0.3677 |
| WTP | Beef | $13.08*** | $16.55*** | $5.95*** | $4.28*** | $19.65*** |
| | Hybrid | $8.21*** | $18.68*** | NS | $5.72*** | $7.17*** |
| | Pea | 7.12*** | $14.18*** | NS | $14.52*** | $2.28** |
| | No Purchase | - | - | - | - | - |
| | Protein | NS | $0.45** | -$1.08** | NS | NS |
| | Organic | NS | $0.86*** | NS | $1.35*** | NS |
| | Long Ingredient List (Visible) | -$3.84*** | -$3.70*** | -$2.04*** | -$1.73*** | -$5.55*** |
| | Long Ingredient List (Click) | -$5.06*** | -$3.07*** | -$3.40*** | -$2.93** | -$8.13*** |
| Probability | Beef | 56.23% | 29.01% | 83.60% | 3.17% | 96.87% |
| | Hybrid | 21.75% | 57.27% | 8.42% | 5.08% | 2.32% |
| | Pea | 17.63% | 13.58% | 2.12% | 90.97% | 0.54% |
| | No Purchase | 4.39% | 0.15% | 5.86% | 0.78% | 0.27% |
| Weighted Probability | Beef | - | 9.40% | 14.08% | 0.44% | 35.62% |
| | Hybrid | - | 18.55% | 1.42% | 0.71% | 0.85% |
| | Pea | - | 4.40% | 0.36% | 12.74% | 0.20% |
| | No Purchase | - | 0.05% | 0.99% | 0.11% | 0.10% |

| | | Beef | Hybrid | Pea | No Purchase |
|---|---|---|---|---|---|
| Summary | Total LC Market Share | 59.54% | 21.53% | 17.70% | 1.25% |
| | Burger Weighted LC WTP | $14.19 | $9.62 | $7.08 | - |
| | | Protein | Organic | Long Ingredient List (Visible) | Long Ingredient List (Click) |
| | Attribute Weighted LC WTP | -$0.20 | $0.44 | -$3.82 | -$4.97 |

Statistical Significance: 1% - ***, 5% - **, 10% - *, NS-Not Statistically Significant, NP-No Purchase

The LC model proves to be a better data fit than the MNL model. Evidenced by both a lower log-likelihood, LC model (-5092), MNL model (-6395), and possessing a greater Rho-square (0.3878) and Adjusted Rho square (0.3769) than the MNL model (0.1192 and 0.1178). Lastly, the LC model contains smaller values for the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), concluding the LC model explains the data better than the MNL model as the additional estimated parameters in the LC model increase the model's explanatory power.

There is a 32.4% probability that individuals are in Class 1. Notably, individuals in Class 1 have high utility for all burger types, exhibited by the likelihood of making no purchase being under 1%. For class 1, hybrid burgers are preferred by a small amount, though all WTP for all burgers is quite high. *Burger lovers also* have a high WTP for burger attributes, including FOP attributes (organic and excellent source of protein) and for short ingredient lists. The importance of a short-ingredient list surpasses the importance of FOP attributes for this class.

Referring to Appendix K: MNL & LC Comparison Class Membership the *Burger lovers* class was associated with being younger, living in a larger population center, and having less income. Among the table explaining food value membership parameters, only environmental impact was statistically significant. Finally, *Burger lovers* displayed above-average plant protein consumption and reduced animal protein consumption levels, implying increased plant-based consumption increased the probability of hybrid burger patty purchase.

Class 2 (termed "*price-conscious carnivores")* account for 16.8% of the sample. *Price-conscious carnivores* are most likely to choose the no-purchase option. Individuals in class 2 placed more value on price than individuals in other classes and strongly prefer beef to hybrid or pea burgers. In fact, WTP for pea and hybrid burgers is not statistically different from zero. Individuals in this class have a significant WTP to avoid long ingredient lists ($2.04-$3.40). However, WTP for FOP claims are either not significant (organic) or negative (excellent source of protein).

Referring to Appendix K: MNL & LC Comparison Class Membership, the *Price-conscious carnivores* class membership was associated with greater beef and animal proteins consumption, with no other variables being significant.

Class 3 (termed "*Vegivores")* represents 14.0% of the sample. Individuals in this class prefer pea burgers to beef or hybrid burgers, by a substantial margin. *Vegivores* did not exhibit negative WTP for all attributes; however, similar to the other classes, both long ingredient lists displayed larger, negative WTP's, surpassing the positive organic attribute WTP. Individuals in this class 3 have the greatest WTP for the organic label, suggesting that preferences for plant-based products may be correlated with preferences for organic products.

*Vegivores* were more likely to be young and from larger population centres, which is consistent with past research (Charelobois, Sogomyogi, and Music, 2018; Hoek et al., 2004), and placed more value on animal welfare and the environment – which are two of the biggest motivators for plant-based protein consumption (Bonnet et al., 2020). *Vegivores* exhibited a higher likelihood of reading the ingredient list, which might be consistent with those who want to avoid certain ingredients (i.e., animal products). Predictably, class 3 individuals had greater plant protein consumption levels relative to class 4 and were far less likely to frequently consume animal meat.

Class 4 (termed "short-ingredient list lovers") represents 36.8% of the sampled population. WTP for beef burgers in this class was 2.75 times larger than the WTP for hybrid burgers, and 8.6 times larger than the WTP for pea burgers. Neither FOP attributes were statistically significant for *Short ingredient lovers*, confirming that the number of ingredients carried more importance than organic production or nutrition (protein attribute). The long ingredient lists in either treatment exhibited larger, negative WTP than found in the other classes.

**Table 0-7. Latent Class Marginal Effects**

| LC | Pea | Beef | Hybrid |
|---|---|---|---|
| Female | -1.11% | 2.25% | 1.27% |
| Age | -2.30%*** | 1.31% | -1.30%*** |
| Education | -0.11% | -1.03% | 0.27% |
| Income | -0.01% | 0.43% | -0.64%** |
| Population Size | 0.88%** | -0.54% | 0.35%* |
| Product Safety | -1.61% | 0.78% | 0.23% |
| Nutrition | 3.53%*** | -3.30% | -1.94% |
| Animal Welfare | 2.84%** | -0.57% | -0.72% |
| Environmental Impact | 2.13%*** | -3.54% | 2.31%*** |
| Taste | -0.13% | 2.58%** | -0.31% |
| Natural | -2.08%*** | 1.97% | -0.26% |
| Read Price | -2.23%** | 0.95% | 1.04% |
| Read Ingredient List | 2.03%** | -1.23% | -1.71% |
| Animal Protein | -3.40%*** | 4.02%*** | 0.24%*** |
| Plant Protein | 2.57%*** | -2.57% | 1.04%*** |
| Dairy Protein | -0.62% | -0.46%** | -0.84% |

The following table illustrates the marginal effects on LC modeled variables, displaying how much of an impact class membership indicators influenced burger selection to a certain percentage degree by assessing sociodemographic, food values, stated preference actions relating to the frequency of consulting the front or back of the package, and protein consumption levels.

The following indicators allowing for marginal effect analysis extend the model run in the MNL & LC Comparison Utility section. Therefore, the marginal effects of covariate variables in the context of pea-based burger patties provide an additional explanation by percentage rather than a suggestion of broad terms. Two sociodemographic variables explain the likelihood of pea-based burger patty selection: younger individuals (+2.30%) and individuals from a large population (+0.88%) were more likely to select pea-based burger patties relative to selecting no purchase in the experiment. Three food value variables indicating purchasing reasoning align with the three main plant-based motivations: environment, nutrition, and animal welfare increase selection by 2.13%, 3.53%, and 2.84%, respectively. However, the natural food value contradicts other studies, as naturalness seekers were 2.08% less likely to select pea-based burger patties. Individuals seeking additional plant protein (+2.57%) or individuals with a high propensity to consult the ingredient list (+2.03%) were more likely to choose pea burgers. On the other hand, individuals with significant animal consumption levels (-3.40%) and who frequently consulted the price (-2.23%) were less likely to choose a pea burger patty

LC covariate indicators allow heterogeneity to be explored in the context of beef-based burger patties to examine marginal effects further. Only three statistically significant class membership parameters explain beef preferences. Among the food value significant covariates, taste importance increased beef purchase by 2.58%. On the other hand, significant animal consumption increased beef purchase probability by 4.02%. Conversely, large dairy consumption reduced beef purchase probability by 0.46%.

In the context of hybrid-based burger patties, three significant sociodemographic covariates impact hybrid burger choice probability. Younger (1.30%), lower income (0.64%), and individuals from larger population centers (0.35) were more likely to select hybrid burgers. Individuals for whom environmental impact was an important food value had a 2.31% likelihood of selecting hybrid burgers. Because hybrid burger patties constitute two different protein types, high consumption levels from either animal (0.24%) or plant protein (1.04%) sources understandably improve hybrid burger selection probability.

**Table 0-8. Study Burger Results vs Previous Research**

| | | Beef burger | Plant/Pea | Hybrid/Animal Like/Yeast | Cultured |
|---|---|---|---|---|---|
| My LC results | WTP | $14.19 | $7.08 | $9.62 | - |
| | Burger Preference Shares | 59.54% | 17.70% | 21.53% | - |
| Slade (2018) | Market Shares | 67% | 21% | - | 11% |
| Van loo (2020) | WTP | $14.08 | $4.35 | $3.27 | $0.45 |
| | Market Shares | 72% | 16% | 7% | 5% |
| Escribano (2021) | WTP | $0 | -$5.43 | - | -$9.29 |

Multiple experiments provide context to this study's results. Compared to Slade's (2018) results, this study exhibits beef and plant burgers with lower burger preference shares, however, hybrid preference shares outperformed Slade's cultured burger. Van loo et al. (2020) provides both WTP and burger preference shares which provide comparisons to this study: both beef burgers WTP were roughly equivalent, however, the plant burger within my study exhibited nearly double the WTP and Hybrid's WTP nearly tripled Van Loo's third alternative. Burger preference share examination reveals consumers exhibited stronger preference for beef burgers in Van Loo et al's research (2020 than this study. Similar WTP results also occur between the hybrid and yeast alternatives, but both plant burger shares exhibit roughly equivalent consumer preference. Lastly, Escribano's (2021) WTP results imply the third alternative, cultured burgers, were substantially negatively valued compared to the beef burger, differentiating from my burger results study which indicate pea as the largest WTP difference from beef.

**Table 0-9. Study Attribute WTP Results vs Previous Research**

| Study | | Organic Claim | Health Claim | Short Ingredient List |
|---|---|---|---|---|
| My Results | WTP | $0.44 CDN | -$0.20 CDN | $3.82-$4.97CDN |
| Drugova, Curtis, and Akhundjanov (2020) | WTP | $ 0.54 U.S. | NS/-$0.74 U.S | - |
| Uddin and Gallardo (2021) | WTP | -$0.45 U.S | - | $2.22 U.S |
| Campbell et al (2010) | WTP | $0.10-$0.19 CDN | - | - |
| Van Loo et al (2015) | WTP | $1.16 U.S. | - | - |
| Hong et al (2021) | WTP | - | $7.05-$17.331 RMB | - |
| Menozzi et al (2020) | WTP | - | $0.51 € | - |
| Jurado and Azucena (2017) | WTP | - | $1.17-$1.20 € | - |

Other research provides comparative WTP results to this study. Consumers within my study incurred a positive value for the organic attribute compared to other listed research; however, the impact of the organic attribute in this study was less significant than other studies. Respondents within my study negatively valued the nutrient content claim, which is contrary to other research whose findings report a significantly more positive impact for nutritional food labels. Lastly, ingredient lists only had one experiment to be compared with, and as the table exhibits, respondents within this study were much more impacted by the ingredient list length. However, Uddin and Gallardo’s (2021) WTP results did reveal the length of the ingredient list carried nearly four times more importance than organic attributes, which while the ingredient list length is more impactful than organic in this study, it is not to that degree.

## 4.5 Probability of looking at ingredient list

The following section uses data from the “click treatment” in which individuals had to click to flip the package in order to observe the ingredient list.  The individual’s willingness to turn over the package is assessed through probit regression. The table below lists both the dependent and independent variables in the regression.

**Table 0-10. Probit Independent and Dependent Variables Defined**

| Variable Type | Variable Name | Defined Variable Explanation |
|---|---|---|
| Dependent Variable | Flipping the package within the DCE | Indicates individual influences on the probability of turning over the DCE Experiment package. |
| Independent Variables | Female | Variable indicating whether the individual identifies as female. |
| | Education | Indicates individuals' education level (Jr. High School-Ph.D. Degree). |
| | Age | Variable indicating individuals' age level (18-80+). |
| | Income | Variable indicating individuals' income level (>$24,999-$150,000+). |
| | Population Size | Variable indicating individuals' population region (Rural-100,000+). |
| | Household Size | Variable indicating individuals' house size (1-7+). |
| | Natural | Measures individual importance of eating food products made in its original state. |
| | Nutrition | Measures respondent value regarding the content value of calories, fat, proteins, etc. |
| | Environmental Impact | Measures individual value of food production effects on the surrounding environment. |
| | Taste | Measures respondent importance of taste of the product. |
| | Appearance | Measures individual value regarding the product's overall appearance. |
| | Product Safety | Measures the importance of eating food products that will not make you sick. |
| | Product Familiarity | Measures the importance of the product familiarity food value which is an individual's familiarity of having cooked with or has used the product in the past. |
| | Read Ingredient List | Indicates individuals' consultation frequency of the ingredient list. |
| | Read Price | Indicates individuals' consultation frequency of the price. |
| | Meat Consumption | Measures meal regularity regarding times meat was the primary protein source. |
| | Plant Consumption | Measures meal regularity regarding times plants was the primary protein source. |
| | Food Neophobia | Is a combined variable of five questions measuring an individual's general reluctance to eat or avoidance of new foods, In the context of this study, the variable includes liking food from other countries, consistent sampling of new foods, not trying food that appears weird to the individual, being afraid of foods an individual has never tried before, and not trusting new or different foods. For individuals, the higher the scaled value, the higher the neophobic. |

**Table 0-11. Probit Model Estimates to Turn Over the Package Within the Context of the DCE Experiment**

| Dependent Variable | Flipping over the Package | |
|---|---|---|
| | | |
| Number of Individuals | 520 | |
| Number of Observations | 3,120 | |
| Log-Likelihood | -2,027.610 | |
| Akaike Inf. Crit. | 4,095.220 | |
| | **Coefficient** | **Standard Error** |
| **Demographics** | | |
| Income | -0.017 | 0.012 |
| Population Size | -0.010 | 0.011 |
| Household Size | 0.038* | 0.021 |
| Education Level | 0.026 | 0.022 |
| Age | 0.068*** | 0.015 |
| Female | 0.211*** | 0.048 |
| **Food Values** | | |
| Price | -0.115*** | 0.029 |
| Taste | -0.025 | 0.041 |
| Product Safety | 0.195*** | 0.033 |
| Product Familiarity | 0.064** | 0.028 |
| Nutrition | -0.012 | 0.035 |
| Natural | -0.040 | 0.030 |
| Appearance | 0.067** | 0.029 |
| Environmental Impact | 0.037 | 0.026 |
| **Stated Preference Actions** | | |
| Read Price | -0.114*** | 0.034 |
| Read Ingredient List | 0.172*** | 0.033 |
| Meat Consumption | -0.001 | 0.018 |
| Plant Consumption | 0.036** | 0.014 |
| Food Neophobia | -0.045** | 0.023 |
| Constant | -1.227*** | 0.220 |
| Notes: *p<0.1; **p<0.05; ***p<0.01 | | |

The table assesses individual factors which influence individuals to turn over the package resulting in viewing the contents located on the back of the package. This assessment restricts to only individuals randomized into the click treatment per the context of the probit.

In terms of demographics, older individuals and females were more likely to flip the product to view the ingredient list. In terms of food values, those who valued price were less likely to flip the package, while individuals who valued product safety, familiarity, and appearance were more likely to flip the package as possible concerns caused by unfamiliarity, or curiousness motivated individuals to view the unknown product. Not surprisingly, those who were more likely to read the ingredient list were more likely to flip, while those who were more likely to read prices were less likely to flip as price was consistently available during the study, but to view the ingredient list, it required individual motivation and choice to turn over the package. Individuals who frequently consume plant-based diets exhibited greater tendencies to turn over the package.

Lastly, individuals who have a higher food neophobia level -those who are unsure of a product they have never seen before-may not have any interest in learning additional information, hence, being less likely to flip the package.

## 4.6 Conclusion

This chapter examined survey and choice experiment responses. Results imply four separate LCM classes based on attributes, burger types, and latent class covariates. Examining consumer burger preference shares and WTP, it was predictable for beef burger patties to be the dominant preference; however, it was somewhat surprising for novel hybrid burger patties to exceed pea-based burger patties in WTP and consumer burger preference shares. Results suggest the two clean label definitions from Asioli et al. (2017) – the broad clean (organic attribute) and the strict clean label (number of ingredients) – resonate differently in impact, highlighted by the number of ingredients carrying greater significance than the production type of ingredient for about 85% of respondents found in LCM classes preferring hybrid and beef burgers. Whereas the rest of the sampled population, the class who were more likely to prefer pea burgers, exhibited stronger favourability for the organic attribute than the rest of the classes. Generally, the findings suggest that in the context of pea-based burger patties, individuals focus on organic attributes and ingredient lists, motivated by environmental, animal welfare, and nutritional food values, whereas hybrid and beef burgers individual selection is based on ingredient lists and taste.

# Chapter 5. Summary and Implications

## 5.1 Introduction

In this chapter, I summarize my findings, discuss limitations and areas requiring further exploration, and highlight the conclusions of my research.

## 5.2 Summary-Research Gap Addressed

The past four chapters review past literature and apply experimental procedures to determine what consumers value in a clean label in the context of demand for pea-based proteins. The study set out three research objectives. First, determine which clean label attributes are most important to Canadian consumers, by evaluating responses to "organic," "excellent source of protein," or varied length of ingredient lists. Second, explore heterogeneity in consumer preferences for clean label claims in the context of pea-based and meat burgers. Third, assess how pea-based burgers compete against hybrid (50% pea and 50% beef) and beef burgers.

The first research task was determining which clean label attribute was most significant to Canadian consumers. As discussed in previous sections of the thesis, one of the experiment's central focuses assessed consumer response to the various clean label attributes. The results of the experiment showed that 85% of individuals valued shorter ingredient lists more than an "Organic" or "Excellent Source of Protein" claims.

From the survey results, I was able to determine what respondents valued from reduced ingredient lists. Respondents perceived that a reduced ingredients list signalled increased product naturalness (67% agreement), nutrition (55% agreement), and did not decrease taste (49% agreement). Marketing messages that promote the nutritional, natural, and taste qualities of products in conjunction with reduced ingredients lists could provide more favorable product reception.

The second research task was to explore heterogeneity for clean label claims in the context of pea-based and meat burger patties. Individuals who choose pea-based burgers exhibited different taste preferences than the other three classes within the latent class model. Notably, when ingredient lists were visible to respondents, plant-based consumers had similar WTP for the organic attribute as compared to a shortened ingredient list.

The third research task was to assess how pea-based burger patties competed against hybrid and beef burger patties. As the results chapter discussed, the predicted burger preference shares for the four burgers are: beef burger patties (59.54%), hybrid burger patties (21.53%), pea-based burger patties (17.70%), and no purchase (1.25%). The market share for pea burgers aligns with results from Van Loo, Caputo, and Lusk (2020). One reason for stronger demand for hybrid burgers over pea burger may be that hybrid burgers are more similar to beef, in taste and appearance.

The two sociodemographic variables that are most important in explaining pea-based burger patty selection: are age and urban location. The food values that are most important in explaining pea-based burger patty selection are environment, nutrition, and animal welfare. However, those who value naturalness were less likely to select pea-based burger patties.

The survey also provides interesting insights into consumer motivations for purchasing plant-based burgers. Of all respondents, 67% said that plant-based burgers were better for animal welfare, 51% said they had a lower environmental impact, and 19% said they were more nutritious (57% of individuals neither agreed nor disagreed that plant-based burgers were more nutritious than beef burgers).

## 5.3 Demand implications for the Plant-Based Proteins Industry

Plant-based proteins are a growing industry in Canada. Not only does Canada's new food guide emphasize increased plant-based protein consumption, but multiple reports confirm the growth in plant-based protein in Canada. Charlebois, Somogyi, and Music (2018) suggest that over 6.4 million Canadians are restricting meat consumption in favor of plant-based products.

The research within this thesis confirmed three noteworthy issues with future demand implications. First, slightly over half of the studied respondents consume meat daily, but the rest, ~ 46.92%, only consume meat 3 or 4 times per week or less. Second, among plant-based burgers, pea-burgers were listed as the most preferred alternative, positioned ahead of soy, lentil, falafel, mushroom, and black bean burgers. Third, taste, ingredient list length, and price were the top three (83%) reasons inhibiting consumption of plant-based proteins. Exploring ways to overcome barriers by improving the taste of plant-based proteins, reducing ingredient list length, and decreasing the price could substantially improve growth rates.

As discussed previously, younger individuals from larger geographical centers expressed a higher likelihood of selection pea-based burgers. Environmental, animal welfare, and nutritional food values also enhanced plant-based demand. Therefore, marketing messages that target younger individuals in larger centers advocating plant-based environmental, animal welfare, and nutritional benefits should enhance the purchase likelihood.

Other future demand implications deserving consideration include the value for the various clean label aspects. As has been described throughout the paper and as the results exhibit, longer ingredient lists pose an issue towards consumer acceptance of products. This is concerning for the plant-based industry as to improve comparable product features to meat, the product composition requires additional ingredients highlighting the contradictory nature of improving plant-based "meat-like" characteristics. Going forward, the results identify organic production labelling as potential resolutions to offset the lengthened ingredient lists, however, this may not fully counteract the negative perceived impact of additional ingredients. Instead, focus should be maintained on solutions to reduce ingredient lists with organic labelling providing added benefits to consumers.

## 5.4 Areas for further research

This thesis touched on several issues and questions that point to further research. One unexpected result relates to individuals who placed importance on the "natural" food value, suggesting respondents were less likely to choose pea-protein patties. This contradicts findings from Hoek et al. (2011), which found meat alternatives containing natural content are listed as one of three main motivational drivers for individuals choosing plant-based over conventional products. Current marketing trends list product naturalness as a large driver of plant-based protein consumption (Keoleian, 2018). Further research is needed to better understand how consumer perceive the naturalness of plant-based alternatives relative to meat products.

Another area requiring further research is the interactions between FOP attributes, nutritional value, and pea-based burgers. Within the study, an excellent source of protein, a nutritional quality claim, was not statistically significant for pea-based burger patties. However, individuals within the same latent class segment placed large importance on the nutritional food value of pea-based burgers and organic claims, leading to questions surrounding the interplay between the above-mentioned attributes and consumer behavior. Ascehmann-Witzel, Maroscheck, and Hamm (2013) propose health claims work beneficially in conjunction with organic claims, however nothing conclusive is provided regarding the relationship between the importance of individual's nutritional food values, excellent source of protein, and organic claims. Further research exploring these interactions in the context of plant-based burgers could provide insight regarding future marketing opportunities and packaging information.

Lastly, two other areas of research include repeating the study with other well-known FOP food labels versus ingredient list length, and to re-examine the study using pea, beef, and soy as the three burger types. Using labels such as non-GMO could provide additional context to the debate over whether it is the number of ingredients or type of ingredient (non-GMO vs conventional) that matters in the context of the clean label debate. With the addition of a second plant-based patty type, exploring consumer responses to a well-known plant-based product (soy) versus pea-based burgers will provide further insights into the broader market for plant-based proteins.

## 5.5 Study Limitations

The following paragraph outlines the limitations of the thesis. For the timing of the study, the covid-19 pandemic did not allow elicitation of revealed preference behavior within a laboratory setting. Instead, the survey was conducted online. This invited potential for strategic behavior or incentive compatibility issues. The inclusion of a cheap talk script attempted to counter the issue of incentive compatibility, reminding individuals to answer each question as honestly and accurately as possible. Strategic behavior, including biased responses, and speeding through the survey were similarly addressed by either cheap talk or robustness tests. Controlling for individuals taking a duration of fewer than 5 minutes to complete the questionnaire (running the models with and without these respondents) elicited no distinct change in regression coefficients. While the study did include individuals from across Canada, the questionnaire was restricted to English-speaking individuals. French-speakers may differ in their preferences and consumption habits. Lastly, the questionnaire was restricted to individuals with access to computer desktops, limiting responses from individuals who do not have access to the internet or access the internet from other devices.

## 5.6 Conclusion

This study has provided evidence regarding consumer behavior and motivational factors in the context of pea-based burgers and clean labels. The results indicate age and residing in urbanized centres work in conjunction with health and environment food value factors to influence preferences for pea-based burgers. Continued growth in consumer demand for pea proteins will be dependent on products utilizing organic claims and featuring shortened ingredient lists. Pea-based products need to overcome barriers by improving the taste, reducing ingredient list length, and decreasing the price.

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# Appendix

## Appendix A-Survey



CONDITION_BRAND_OR_CLICK

1 = Brand
2 = Click

CHOICE_BLOCK

C1_IMAGE_ORDER

C1_IMAGE1_FRONT

C1_IMAGE1_BACK

C1_IMAGE2_FRONT

C1_IMAGE2_BACK

C1_IMAGE3_FRONT

C1_IMAGE3_BACK

C1_IMAGE1_PRICE

C1_IMAGE2_PRICE

C1_IMAGE3_PRICE

C2_IMAGE_ORDER

C2_IMAGE1_FRONT

C2_IMAGE1_BACK

C2_IMAGE2_FRONT

C2_IMAGE2_BACK

C2_IMAGE3_FRONT

C2_IMAGE3_BACK

C2_IMAGE1_PRICE

C2_IMAGE2_PRICE

C2_IMAGE3_PRICE

C3_IMAGE_ORDER

C3_IMAGE1_FRONT

C3_IMAGE1_BACK

C3_IMAGE2_FRONT

C3_IMAGE2_BACK

C3_IMAGE3_FRONT

C3_IMAGE3_BACK

C3_IMAGE1_PRICE

C3_IMAGE2_PRICE

C3_IMAGE3_PRICE

C4_IMAGE_ORDER

C4_IMAGE1_FRONT

C4_IMAGE1_BACK

C4_IMAGE2_FRONT

C4_IMAGE2_BACK

C4_IMAGE3_FRONT

C4_IMAGE3_BACK

C4_IMAGE1_PRICE

C4_IMAGE2_PRICE

C4_IMAGE3_PRICE

C5_IMAGE_ORDER

C5_IMAGE1_FRONT

C5_IMAGE1_BACK

C5_IMAGE2_FRONT

C5_IMAGE2_BACK

C5_IMAGE3_FRONT

C5_IMAGE3_BACK

C5_IMAGE1_PRICE

C5_IMAGE2_PRICE

C5_IMAGE3_PRICE

C6_IMAGE_ORDER

C6_IMAGE1_FRONT

C6_IMAGE1_BACK

C6_IMAGE2_FRONT

C6_IMAGE2_BACK

C6_IMAGE3_FRONT

C6_IMAGE3_BACK

C6_IMAGE1_PRICE

C6_IMAGE2_PRICE

C6_IMAGE3_PRICE

CONSENTFORM

**Consent Form**

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This 10-15-minute survey examines food choices in grocery stores. The survey results will help us understand consumer motivations for purchasing particular foods. The survey is funded by the the Saskatchewan Ministry of Agriculture and is hosted by Voxco, a Canadian-owned and managed company whose data is securely stored in Canada. There are no known or minimal risks associated with completing the survey.

The data collected in this survey may be made publicly available in anonymous form. As the survey asks very general questions about purchase behaviors, values, and sociodemographic characteristics, participants will not be identifiable by their responses.

The results of the data analysis will be presented in anonymous form within a master's thesis and an academic publication.

This research project has been approved on ethical grounds by the University of Saskatchewan Research Ethics Board, and has indicated that there are no foreseeable risks.

Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office ethics.office@usask.ca; (306) 966-2975. Out of town participants may call toll free (888) 966-2975.

In order to complete this survey, you will be required to answer all questions; however, you may withdraw from the survey at any time by closing your internet browser. Participation is strictly voluntary.

By selecting next and completing this questionnaire, your free and informed consent is implied and indicates that you understand the above conditions to participate in this study.

**Please consider printing this page for your records.**

SCREENER

Are you the primary grocery shopper in your household?

- ○ Yes
- ○ I share responsibility for grocery shopping
- ○ No

S1Q1

Which of these statements best describes your grocery shopping habits?

- ○ I have a strict grocery shopping routine and usually purchase the same products.
- ○ I occasionally look to alter my diet with new products when grocery shopping.
- ○ I often purchase new products at the grocery store; variety seeking is a major factor when grocery shopping.

S1Q2

Please indicate how knowledgeable you are about the following topics:

| | Not knowledgeable at all | Slightly knowledgeable | Moderately knowledgeable | Very knowledgeable | Extremely knowledgeable |
|---|---|---|---|---|---|
| Of what composes a healthy lifestyle | ○ | ○ | ○ | ○ | ○ |
| Of a meal's nutritional value (vitamins, calories, daily fat, sodium, and sugar intake) | ○ | ○ | ○ | ○ | ○ |
| Environmental sustainability | ○ | ○ | ○ | ○ | ○ |
| Of different sources of proteins | ○ | ○ | ○ | ○ | ○ |
| Of different methods of food production | ○ | ○ | ○ | ○ | ○ |

DCE_INSTRUCTIONS_BRAND

**Please take the time to carefully read the directions below before proceeding forward.**

In this next section, we would like you to imagine you are in a grocery store and have a choice between different types of burgers. On the next few screens, you will be presented with a series of choices. In each case, please make the choice as if you were making this decision in the grocery store.

During the following simulated shopping experience, please ensure the questions are answered as honestly and accurately as possible.

IMPORTANT
Please choose one option per page
Options presented on each page are assumed to be the only options
Options presented on different pages are not comparable

**Example Choice Set**

Below is an example choice set.

*The ingredients on the back of the package can be viewed below.*

**Option 1**


Price: $8.00
○

**Option 2**


Price: $6.50
○

**Option 3**


Price: $6.50
○

**Option 4**

I would not purchase any of the options
○

DCE_INSTRUCTIONS_CLICK

**Please take the time to carefully read the directions below before proceeding forward.**

In this next section, we would like you to imagine you are in a grocery store and have a choice between different types of burgers. On the next few screens, you will be presented with a series of choices. In each case, please make the choice as if you were making this decision in the grocery store.

During the following simulated shopping experience, please ensure the questions are answered as honestly and accurately as possible.

IMPORTANT

Please choose one option per page
Options presented on each page are assumed to be the only options
Options presented on different pages are not comparable

**Example Choice Set**

Below is an example choice set.

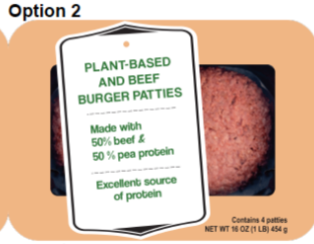
*The ingredients on the back of the package can be viewed by clicking the images below.*

**Option 1**


Price: $8.00

○

**Option 2**




Price: $6.50

○

**Option 3**


Price: $6.50

○

**Option 4**

I would not purchase any of the options

○

DCE_COMP

---

**Before you continue:**

Carefully reading and understanding the information on this screen is very important for the next part of this survey. Please take your time, and indicate below when you are ready to continue.

☐ I am ready to continue

DCE_INSTRUCTIONS_TIMER

---

BRAND_CHOICE_1

---

Imagine you are in a grocery store purchasing burgers and the products below are available. Choose the product you would prefer to buy. Please make the selection as if you were actually facing these choices in a real store.

*The ingredients on the back of the package can be viewed below.*

| Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|
| | | | I would not purchase any of the options |
| [C1_IMAGE1_PRICE] ○ | [C1_IMAGE2_PRICE] ○ | [C1_IMAGE3_PRICE] ○ | ○ |

BRAND_CHOICE_2

Imagine you are in a grocery store purchasing burgers and the products below are available. Choose the product you would prefer to buy. Please make the selection as if you were actually facing these choices in a real store.

*The ingredients on the back of the package can be viewed below.*

| Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|
| | | | I would not purchase any of the options |
| [C2_IMAGE1_PRICE] ○ | [C2_IMAGE2_PRICE] ○ | [C2_IMAGE3_PRICE] ○ | ○ |

BRAND_CHOICE_3

Imagine you are in a grocery store purchasing burgers and the products below are available. Choose the product you would prefer to buy. Please make the selection as if you were actually facing these choices in a real store.

*The ingredients on the back of the package can be viewed below.*

| Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|
| | | | I would not purchase any of the options |
| [C3_IMAGE1_PRICE] ○ | [C3_IMAGE2_PRICE] ○ | [C3_IMAGE3_PRICE] ○ | ○ |

BRAND_CHOICE_4

Imagine you are in a grocery store purchasing burgers and the products below are available. Choose the product you would prefer to buy. Please make the selection as if you were actually facing these choices in a real store.

*The ingredients on the back of the package can be viewed below.*

| Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|
| | | | I would not |

purchase any of the options

| | | | |
|---|---|---|---|
| [C4_IMAGE1_PRICE] ○ | [C4_IMAGE2_PRICE] ○ | [C4_IMAGE3_PRICE] ○ | ○ |

BRAND_CHOICE_5

Imagine you are in a grocery store purchasing burgers and the products below are available. Choose the product you would prefer to buy. Please make the selection as if you were actually facing these choices in a real store.

*The ingredients on the back of the package can be viewed below.*

| Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|
| | | | I would not purchase any of the options |
| [C5_IMAGE1_PRICE] ○ | [C5_IMAGE2_PRICE] ○ | [C5_IMAGE3_PRICE] ○ | ○ |

BRAND_CHOICE_6

Imagine you are in a grocery store purchasing burgers and the products below are available. Choose the product you would prefer to buy. Please make the selection as if you were actually facing these choices in a real store.

*The ingredients on the back of the package can be viewed below.*

| Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|
| | | | I would not purchase any of the options |

| | | | |
|---|---|---|---|
| [C6_IMAGE1_PRICE] | [C6_IMAGE2_PRICE] | [C6_IMAGE3_PRICE] | |

CLICK_CHOICE_1

Imagine you are in a grocery store purchasing burgers and the products below are available. Choose the product you would prefer to buy. Please make the selection as if you were actually facing these choices in a real store.

*The ingredients on the back of the package can be viewed by clicking the images below.*

| Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|
| [C1_IMAGE1_PRICE] | [C1_IMAGE2_PRICE] | [C1_IMAGE3_PRICE] | I would not purchase any of the options |

0 0 0

CLICK_CHOICE_2

Imagine you are in a grocery store purchasing burgers and the products below are available. Choose the product you would prefer to buy. Please make the selection as if you were actually facing these choices in a real store.

*The ingredients on the back of the package can be viewed by clicking the images below.*

| Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|
| [C2_IMAGE1_PRICE] | [C2_IMAGE2_PRICE] | [C2_IMAGE3_PRICE] | I would not purchase any of the options |

0 0 0

CLICK_CHOICE_3

Imagine you are in a grocery store purchasing burgers and the products below are available. Choose the product you would prefer to buy. Please make the selection as if you were actually facing these choices in a real store.

*The ingredients on the back of the package can be viewed by clicking the images below.*

| Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|
| [C3_IMAGE1_PRICE] ○ | [C3_IMAGE2_PRICE] ○ | [C3_IMAGE3_PRICE] ○ | I would not purchase any of the options ○ |

0 0 0

CLICK_CHOICE_4

Imagine you are in a grocery store purchasing burgers and the products below are available. Choose the product you would prefer to buy. Please make the selection as if you were actually facing these choices in a real store.

*The ingredients on the back of the package can be viewed by clicking the images below.*

| Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|
| [C4_IMAGE1_PRICE] ○ | [C4_IMAGE2_PRICE] ○ | [C4_IMAGE3_PRICE] ○ | I would not purchase any of the options ○ |

0 0 0

CLICK_CHOICE_5

Imagine you are in a grocery store purchasing burgers and the products below are available. Choose the product you would prefer to buy. Please make the selection as if you were actually facing these choices in a real store.

*The ingredients on the back of the package can be viewed by clicking the images below.*

| Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|
| [C5_IMAGE1_PRICE] ○ | [C5_IMAGE2_PRICE] ○ | [C5_IMAGE3_PRICE] ○ | I would not purchase any of the options ○ |

0 0 0

CLICK_CHOICE_6

Imagine you are in a grocery store purchasing burgers and the products below are available. Choose the product you would prefer to buy. Please make the selection as if you were actually facing these choices in a real store.

*The ingredients on the back of the package can be viewed by clicking the images below.*

| Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|
| [C6_IMAGE1_PRICE] ○ | [C6_IMAGE2_PRICE] ○ | [C6_IMAGE3_PRICE] ○ | I would not purchase any of the options ○ |

0 ⌄ 0 ⌄ 0 ⌄

POST_DCE_1

Between the three burger alternatives viewed on the last few screens, which one would you select the majority of the time?

- ○ Beef burger
- ○ Beef and plant-based burger made with 50% beef protein and 50% pea protein
- ○ Plant-based burger made with pea protein
- ○ None of the Above

POST_DCE_2

How often do you eat beef burgers?

- ○ I regularly eat beef burgers.
- ○ I occasionally eat beef burgers.
- ○ I rarely eat beef burgers
- ○ I never eat beef burgers.

POST_DCE_3

How often do you eat hybrid burgers made with some beef protein and some plant-based proteins?

- ○ I regularly eat hybrid burgers.
- ○ I occasionally eat hybrid burgers.
- ○ I rarely eat hybrid burgers.
- ○ I never eat hybrid burgers.

POST_DCE_4

How often do you eat plant-based burgers?

- ○ I regularly eat plant-based burgers.
- ○ I occasionally eat plant-based burgers.
- ○ I rarely eat plant-based burgers.
- ○ I never eat plant-based burgers.

POST_DCE_5

To what extent do you agree or disagree with the following statements about plant-based burgers?

| | Strongly Disagree | Disagree | Neither Agree nor | Agree | Strongly Agree |
|---|---|---|---|---|---|

| | | | Disagree | | |
|---|---|---|---|---|---|
| Plant-based burgers are more nutritious than beef burgers. | ○ | ○ | ○ | ○ | ○ |
| Plant-based burgers are more natural than beef burgers. | ○ | ○ | ○ | ○ | ○ |
| Plant-based burgers are more environmentally friendly than beef burgers. | ○ | ○ | ○ | ○ | ○ |
| Plant-based burgers are more animal-friendly than beef burgers. | ○ | ○ | ○ | ○ | ○ |
| Plant-based burgers are tastier than beef burgers. | ○ | ○ | ○ | ○ | ○ |
| Plant-based burgers have a better texture than beef burgers. | ○ | ○ | ○ | ○ | ○ |

POST_DCE_6

Which forms of plant-based burger(s) do you typically consume?

*Select all that apply.*

- ☐ Pea burger
- ☐ Lentil burger
- ☐ Soy burger
- ☐ Falafel burger
- ☐ Unsure
- ☐ None - I don't typically eat plant-based burgers
- ☐ Other (please specify):

POST_DCE_8

Please select your top three reasons for not typically trying plant-based burgers.

*To make your selections, please click and drag the three options into the box below. Please place the most important item at the top, followed by the second and the third most important reasons.*

**Reasons for not Trying**

- Taste and texture
- Price
- Nutrition
- The type of ingredients or the length of ingredients in plant-based burgers.
- The environmental effects of plant-based products are more harmful than meat-based products.
- The ethical value for raising farm life is more important than animal welfare.
- I am allergic to soy.
- I do not have access to plant-based products at my grocery store.

POST_DCE_9

Where did you purchase the majority of the burgers **(beef or plant-based)** (or ingredients to make beef or plant-based burgers) that you have eaten in the past?

○ Restaurants, fast food restaurants, food trucks and other food service outlets

○ Retail and wholesale grocery stores
○ Butcher shops
○ Farmer's markets
○ Other (please specify):

POST_DCE_10

Of the items listed below, please select the three types of plant-based protein sources that you eat most often.

*To make your selections, please click and drag the three options into the box below. Please place your most commonly eaten item at the top, followed by the second and the third most commonly eaten items.*

**Most Commonly Eaten**

- Yellow Peas
- Chickpeas
- Soy
- Mung Bean
- Peanuts/Almonds
- Beans (Kidney/Black/Pinto)
- Hemp Seeds
- Quinoa
- Seitan
- Lentils
- Oats
- None of the above

S3Q11

How often do you read the following forms of product information on a food label?

| | Never or almost never | Somewhat often | Moderately often | Very often | Always or almost always |
|---|---|---|---|---|---|
| Nutrition Information | ○ | ○ | ○ | ○ | ○ |
| Ingredients List | ○ | ○ | ○ | ○ | ○ |
| Price | ○ | ○ | ○ | ○ | ○ |

S3Q12

How important are the following attributes when you make a food purchase decision?

| | Not important at all | Slightly important | Moderately important | Very important | Extremely important |
|---|---|---|---|---|---|
| **Product Safety** (eating food products that will not make you sick) | ○ | ○ | ○ | ○ | ○ |
| **Nutrition** (content value of calories, fat, proteins, etc.) | ○ | ○ | ○ | ○ | ○ |
| **Sustainability** (choices protecting societal, economic, or | ○ | ○ | ○ | ○ | ○ |

| | | | | | |
|---|---|---|---|---|---|
| environmental well-being) | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Fairness** (workers such as farmers, retailers, processors equally benefit) | ○ | ○ | ○ | ○ | ○ |
| **Animal Welfare** (physical and psychological well-being of animals used in production) | ○ | ○ | ○ | ○ | ○ |
| **Environmental Impact** (the effects of the food production on the surrounding environment) | ○ | ○ | ○ | ○ | ○ |
| **Price** (the price of the product) | ○ | ○ | ○ | ○ | ○ |
| **Religion** (personal religious beliefs) | ○ | ○ | ○ | ○ | ○ |
| **Product Convenience** (easiness and cooking speed the food takes to prepare and eat) | ○ | ○ | ○ | ○ | ○ |
| **Tradition** (traditional consumption patterns) | ○ | ○ | ○ | ○ | ○ |
| **Product Familiarity** (has used or cooked with and has familiarity with the Product) | ○ | ○ | ○ | ○ | ○ |
| **Taste** (flavor of the product) | ○ | ○ | ○ | ○ | ○ |
| **Appearance** (whether the food looks appealing) | ○ | ○ | ○ | ○ | ○ |
| **Origin** (where the food comes from i.e., locally, regionally, nationally, or internationally) | ○ | ○ | ○ | ○ | ○ |
| **Naturalness** (made in its original state) | ○ | ○ | ○ | ○ | ○ |

S3Q13

To what extent do you agree or disagree with the following statements?

| | **Strongly Disagree** | **Disagree** | **Slightly Disagree** | **Neither Agree nor Disagree** | **Slightly Agree** | **Agree** | **Strongly Agree** |
|---|---|---|---|---|---|---|---|
| I like foods from different countries. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I am consistently sampling new foods. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| If food appears weird, I will not try it. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I am afraid to eat things I have never had before. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I do not trust new or different foods. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I am more likely to buy a product that has fewer and simpler ingredients. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

S3Q14

To what extent do you agree or disagree with the following statements?

*Products with fewer and simpler ingredients…*

| | **Strongly Disagree** | **Disagree** | **Slightly Disagree** | **Neither Agree nor Disagree** | **Slightly Agree** | **Agree** | **Strongly Agree** |
|---|---|---|---|---|---|---|---|
| Are more nutritious | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Are more natural | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Are less tasty | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Look more appealing | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Are more environmentally friendly | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Improve animal welfare | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Have a shorter shelf life | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Are more expensive | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

S4Q15

Please select and rank the top three products from the list below based on your understanding of their nutritional value.

*To make your selections, please click and drag the three options into the box below. Please place the most nutritious item at the top, followed by the second and the third most nutritious items.*

**Most Nutritious Products**

- Beef
- Lamb
- Chicken
- Pork
- Fish
- Soy (Tofu, Edamame, Whey)
- Peas (Green, Yellow, Chickpeas)
- Beans (Kidney, Black, Mung, and Pinto)
- Nuts (Peanuts, Almonds, Cashews)
- Lentils
- Dairy Products (Milk, Cheese, Eggs)
- Quinoa

S4Q16

Thinking back on the meals you ate over the last month. In how many of these meals was **meat** (e.g., beef, poultry, pork, fish, lamb) the **primary** source of protein?

○ None
○ Less than one meal per month
○ More than 1 meal per month, but not weekly
○ 1-2 meals per week
○ More than 1-2 meals per week, but not daily
○ 1 meal per day
○ 2 meals per day
○ 3 or more meals per day

S4Q17

Thinking back on the meals you ate over the last month, in how many of these meals was **plant-based proteins** (e.g., peas, soy, beans, nuts, lentils, quinoa) the **primary** source of protein?

○ None

○ Less than one meal per month
○ More than 1 meal per month, but not weekly
○ 1-2 meals per week
○ More than 1-2 meals per week, but not daily
○ 1 meal per day
○ 2 meals per day
○ 3 or more meals per day

S4Q18

Thinking back on the meals you ate over the last month, in how many of these meals was **dairy or eggs** the **primary** source of protein?

○ None
○ Less than one meal per month
○ More than 1 meal per month, but not weekly
○ 1-2 meals per week
○ More than 1-2 meals per week, but not daily
○ 1 meal per day
○ 2 meals per day
○ 3 or more meals per day

DEMOGRAPHICS_INTRO

Finally, please tell us a bit about yourself…

D19

What is your age range?

○ 18-29
○ 30-39
○ 40-49
○ 50-59
○ 60-69
○ 70-79
○ 80+

D20

Which gender do you prefer to identify as?

○ Male
○ Female
○ Other

D21

In which province/territory do you currently reside?

○ Alberta
○ British Columbia
○ Manitoba
○ New Brunswick

○ Newfoundland and Labrador

○ Northwest Territories
○ Nova Scotia
○ Nunavut
○ Ontario
○ Prince Edward Island
○ Quebec
○ Saskatchewan
○ Yukon

**D22**

---

In what geographical area do currently reside?

○ Rural
○ Town (population under 1000)
○ Town (population under 5000)
○ City (population under10,000)
○ City (population under 25,000)
○ City (population under 50, 000)
○ City (population 100,000 or more)

**D23**

---

Including yourself, how many people live in your household?

○ 1, Myself
○ 2
○ 3
○ 4
○ 5
○ 6 or more

**D24**

---

Do any individuals under the age of 18 reside within your household?

○ Yes
○ No

**D25**

---

What is the highest level of education that you have completed?

○ Less than Junior High School
○ Completed Junior High School
○ Completed High School
○ Completed College (i.e., diploma)
○ Completed University (i.e., degree)
○ Completed Master's Degree
○ Completed Ph.D. Degree

**D26**

---

What is your current household level of income before tax?

- ○ Less than $ 24,999
- ○ $25,000-$49,999
- ○ $50,000-$74,999
- ○ $75,000-$99,999
- ○ $100,000-$124,999
- ○ $125,000-$149,000
- ○ $150,000 plus

DESCRIPTION_2

*By pressing "Next," your responses will be submitted.*

DESCRIPTION

Thank you very much for completing the survey!

The main purpose of the completed survey was to determine how the choice of which burger to purchase is influenced by different product attributes such as the main ingredient (beef versus plant-based protein), product labels, and ingredient lists. Survey respondents were asked to choose between a selection of different burgers with different attributes. By observing the choices that respondents actually made the researchers can infer what types of attributes consumers prefer. Furthermore, the researchers can determine if these preferences are correlated with their past purchases, food values, and sociodemographic characteristics.

If you would like to receive a copy of the survey results, please contact one of the three researchers listed below to receive a summary of the results of the experiment.

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# Appendix B-Discrete Choice Experiment Design

| Block | Choice set | Alternative | Patty Type | Organic Claim | Excellent Source of Protein Claim | Ingredient list length | Price |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | hybrid | no | no | long | $9.50 |
| | | 2 | beef | yes | yes | long | $9.50 |
| | | 3 | pea | no | no | short | $9.50 |
| | 2 | 1 | beef | no | yes | short | $9.50 |
| | | 2 | hybrid | no | no | long | $11 |
| | | 3 | pea | yes | yes | long | $8 |
| | 3 | 1 | hybrid | yes | no | long | $5 |
| | | 2 | pea | no | no | long | $5 |
| | | 3 | beef | yes | yes | short | $5 |
| | 4 | 1 | beef | no | no | short | $11 |
| | | 2 | beef | yes | no | short | $8 |
| | | 3 | pea | yes | yes | long | $6.50 |
| | 5 | 1 | hybrid | no | no | short | $6.50 |
| | | 2 | pea | no | no | long | $8 |
| | | 3 | beef | yes | yes | long | $8 |
| | 6 | 1 | beef | no | yes | short | $12.50 |
| | | 2 | pea | yes | no | short | $9.50 |
| | | 3 | hybrid | yes | yes | long | $11 |
| | | | | | | | |
| 2 | 1 | 1 | pea | yes | no | long | $9.50 |
| | | 2 | beef | no | yes | short | $12.50 |
| | | 3 | hybrid | no | yes | short | $9.50 |
| | 2 | 1 | pea | yes | yes | short | $9.50 |
| | | 2 | beef | no | yes | long | $11 |
| | | 3 | hybrid | yes | no | short | $11 |
| | 3 | 1 | beef | yes | no | short | $12.50 |
| | | 2 | pea | yes | yes | short | $5 |
| | | 3 | beef | no | no | long | $9.50 |
| | 4 | 1 | hybrid | yes | yes | short | $11 |
| | | 2 | beef | no | yes | long | $12.50 |
| | | 3 | pea | yes | no | short | $11 |
| | 5 | 1 | pea | yes | no | long | $9.50 |
| | | 2 | hybrid | no | yes | short | $8 |
| | | 3 | hybrid | no | no | short | $12.50 |
| | 6 | 1 | beef | yes | yes | long | $6.50 |
| | | 2 | pea | no | no | short | $8 |
| | | 3 | hybrid | no | no | short | $6.50 |
| | | | | | | | |
| 3 | 1 | 1 | beef | yes | no | long | $12.50 |
| | | 2 | hybrid | no | yes | long | $8 |
| | | 3 | hybrid | yes | no | short | $9.50 |
| | 2 | 1 | hybrid | yes | no | long | $5 |
| | | 2 | pea | yes | yes | short | $12.50 |
| | | 3 | beef | no | yes | short | $6.50 |
| | 3 | 1 | pea | no | yes | long | $8 |
| | | 2 | hybrid | no | no | long | $11 |
| | | 3 | hybrid | yes | no | short | $9.50 |
| | 4 | 1 | beef | yes | yes | long | $5 |
| | | 2 | pea | yes | yes | short | 12.5 |
| | | 3 | pea | no | no | short | $5 |
| | 5 | 1 | hybrid | no | no | short | $5 |
| | | 2 | pea | no | no | long | $8 |
| | | 3 | beef | yes | yes | short | $6.50 |
| | 6 | 1 | pea | yes | no | short | $8 |
| | | 2 | beef | no | yes | short | $8 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 3 | hybrid | no | no | long | $8 |
| | | | | | | | |
| 4 | 1 | 1 | hybrid | yes | yes | short | $6.50 |
| | | 2 | beef | yes | yes | short | $8 |
| | | 3 | hybrid | no | no | long | $8 |
| | 2 | 1 | beef | no | no | short | $5 |
| | | 2 | hybrid | yes | no | long | $12.50 |
| | | 3 | beef | yes | yes | long | $5 |
| | 3 | 1 | pea | no | yes | short | $6.50 |
| | | 2 | beef | no | yes | short | $12.50 |
| | | 3 | hybrid | yes | no | long | $9.50 |
| | 4 | 1 | beef | yes | no | short | $12.50 |
| | | 2 | pea | no | no | short | $12.50 |
| | | 3 | pea | no | yes | long | $11 |
| | 5 | 1 | pea | yes | no | short | $5 |
| | | 2 | hybrid | no | yes | long | $5 |
| | | 3 | hybrid | no | yes | short | $12.50 |
| | 6 | 1 | pea | yes | no | long | $6.50 |
| | | 2 | hybrid | no | no | long | $8 |
| | | 3 | beef | no | yes | short | $8 |
| | | | | | | | |
| 5 | 1 | 1 | hybrid | no | no | short | $5 |
| | | 2 | beef | no | no | short | $9.50 |
| | | 3 | beef | yes | yes | long | $6.50 |
| | 2 | 1 | pea | no | no | short | $9.50 |
| | | 2 | hybrid | yes | yes | short | $6.50 |
| | | 3 | hybrid | yes | no | long | $9.50 |
| | 3 | 1 | hybrid | yes | no | long | $9.50 |
| | | 2 | beef | no | yes | long | $9.50 |
| | | 3 | pea | yes | no | short | $8 |
| | 4 | 1 | hybrid | yes | no | long | $5 |
| | | 2 | pea | no | no | long | $5 |
| | | 3 | beef | no | yes | short | $5 |
| | 5 | 1 | beef | no | yes | long | $11 |
| | | 2 | hybrid | yes | yes | short | $8 |
| | | 3 | pea | no | no | short | $11 |
| | 6 | 1 | pea | no | yes | long | $9.50 |
| | | 2 | hybrid | yes | yes | long | $9.50 |
| | | 3 | hybrid | yes | no | short | $9.50 |
| | | | | | | | |
| 6 | 1 | 1 | beef | no | no | long | $12.50 |
| | | 2 | beef | yes | yes | long | $8 |
| | | 3 | hybrid | no | yes | short | $5 |
| | 2 | 1 | pea | no | no | short | $5 |
| | | 2 | hybrid | yes | no | short | $5 |
| | | 3 | hybrid | yes | no | long | $5 |
| | 3 | 1 | hybrid | no | yes | long | $8 |
| | | 2 | beef | yes | no | short | $9.50 |
| | | 3 | pea | no | yes | long | $9.50 |
| | 4 | 1 | hybrid | yes | no | long | $11 |
| | | 2 | pea | yes | yes | short | $9.50 |
| | | 3 | pea | no | yes | short | $9.50 |
| | 5 | 1 | hybrid | no | no | long | $12.50 |
| | | 2 | hybrid | yes | yes | short | $11 |
| | | 3 | pea | no | yes | short | $12.50 |
| | 6 | 1 | hybrid | no | yes | short | $5 |
| | | 2 | pea | no | no | long | $9.50 |
| | | 3 | beef | yes | yes | long | $8 |

## Appendix C- Multinomial Logit Base Model

### Table Appendix-1. Multinomial Logit Base Model

| | | |
|---|---|---|
| Log-Likelihood | -6593.925 | |
| Rho-square (0) | 0.1192 | |
| Adjusted Rho-square (0) | 0.1178 | |
| AIC | 13207.85 | |
| BIC | 13273.79 | |
| Number of individuals | 1000 | |
| Number of Choice Observations | 6000 | |
| | **Estimate** | **Robust s.e.** |
| Price | -0.195*** | 0.01136 |
| | | |
| **Patty Types** | | |
| Beef | 2.55*** | 0.15164 |
| Hybrid | 1.60*** | 0.14232 |
| Pea | 1.39*** | 0.13991 |
| | | |
| **FOP Attributes** | | |
| Protein | 0.037 | 0.04506 |
| Organic | 0.063 | 0.03247 |
| | | |
| **Ingredient List Effects** | | |
| Long Ingredient List (Visible Ingredient Treatment) | -0.748*** | 0.06177 |
| Long Ingredient List (Click Treatment) | -0.986*** | 0.09761 |
| Click Treatment | -0.507*** | 0.12658 |
| Click Treatment and Product Flipped | 0.875*** | 0.16533 |
| Statistical Significance: 1% - ***, 5% - **, 10% - * | | |

Table 4.3 provides MNL choice experiment results. The price coefficient is negative and statistically significant. Each burger patty type and ingredient list effect is statistically significant ($p < 0.01$). In coefficient absolute value, beef burger patties provide the most utility relative to hybrid and pea burger patties. Regardless of the treatment, both long ingredient lists are negative and statistically significant ($p < 0.01$), confirming that viewing a long ingredient list within the base model yields disutility, even when only 23% of individuals choose to flip during the click treatment and viewed the long ingredient list.

## Appendix D- Multinomial Logit Model Interacted with DCE Attributes

**Table Appendix-2. Multinomial Logit Model Interacted with DCE Attributes**

| | | |
|---|---|---|
| Log-Likelihood | -7380.488 | |
| Rho-square (0) | 0.1127 | |
| Adjusted Rho-square (0) | 0.1105 | |
| AIC | 14796.98 | |
| BIC | 14917.57 | |
| Number of individuals | 1000 | |
| Number of Choice Observations | 6000 | |
| | **Estimate** | **Robust s.e.** |
| Price | -0.201 | 0.011 |
| | | |
| **Patty Types** | | |
| Beef | 2.765*** | 0.157 |
| Hybrid | 1.667*** | 0.145 |
| Pea | 1.233*** | 0.145 |

| Attribute/Patty Type | Beef | Hybrid | Pea |
|---|---|---|---|
| Long Ingredient List (Visible Treatment) (Could not flip) | -0.936*** | -0.961*** | -0.19** |
| Long Ingredient List (Click Treatment) (Could flip) | -1.03*** | -0.961*** | -0.912*** |
| Protein | -0.126* | 0.130* | NS |
| Organic | NS | NS | 0.185*** |

Statistical Significance: 1% - ***, 5% - **, 10% - *, NS=Not Statistically Significant

The above table outlines MNL interactions between patty types and the rest of the DCE attributes. For individuals with complete product information (aka visible information treatment), the appearance of a long ingredient list for beef or hybrid burger patties was more critical in impacting the purchase decision than the presence on a pea burger patty—indicated by the difference in coefficients. However, an almost equal impact occurred on each burger patty type when individuals could flip the package over. This result suggests that when individuals were given visibility to the ingredient list, these respondents were more likely to be adversely affected by the long ingredient interaction, especially for individuals selecting beef burgers and hybrid patties.

The presence of a protein quality claim increased utility for hybrid burgers, decreased utility for beef burgers, and had no statistically significant effect for pea burgers. Conversely, the organic claim increased utility for pea burgers and had no statistically significant effect for hybrid or beef burgers.

# Appendix E- Multinomial Logit Model Demographic Interactions

## Table Appendix-3. Multinomial Demographic Interactions

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Log-Likelihood | -7157.346 | | | | | | |
| Rho-square (0) | 0.1395 | | | | | | |
| Adjusted Rho-square (0) | 0.1324 | | | | | | |
| AIC | 14432.69 | | | | | | |
| BIC | 14827.96 | | | | | | |
| Number of individuals | 1000 | | | | | | |
| Number of Choice Observations | 6000 | | | | | | |
| | Pea | Hybrid | Beef | Protein | Organic | Long IL (Full Info) | Long IL (Click) |
| Female | NS | NS | NS | NS | NS | -0.255*** | NS |
| Education | 0.093**[a] | 0.0860**[b] | -0.120**[c] | NS | 0.054* | NS | NS |
| Age | -0.335***[a] | -0.146***[b] | NS | -0.044** | -0.039* | -0.067** | NS |
| Income | -0.047* | -0.060***[b] | NS | -0.044** | NS | NS | -0.071* |
| Population Size | 0.059**[a] | NS | NS | NS | NS | -0.046** | NS |
| Household Size | NS | NS | 0.140***[c] | NS | NS | NS | 0.176** |
| Household U18 | 0.159**[a] | NS | 0.116* | NS | NS | NS | 0.214* |

Statistical Significance: 1% - ***, 5% - **, 10% - *, NS = Not Statistically Significant, a=Significant differences between pea and beef (5% level), b= Significant differences between pea and hybrid (5% level), c=Significant differences between pea and beef (5% level)

## Appendix F-Modified Education Multinomial Sociodemographic Interaction Model

**Table Appendix-4. Modified Education Multinomial Sociodemographic Interaction Model**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Log-Likelihood | -7156.043 | | | | | | |
| Rho-square (0) | 0.1397 | | | | | | |
| Adjusted Rho-square (0) | 0.1326 | | | | | | |
| AIC | 14430.09 | | | | | | |
| BIC | 14825.36 | | | | | | |
| | Pea | Hybrid | Beef | Protein | Organic | Long IL (Full Info) | Long IL (Click) |
| Female | NS | NS | NS | NS | NS | -0.246** | NS |
| Post-Secondary Education & Above | 0.591***,[a] | 0.250**,[b] | NS | NS | 0.183** | NS | NS |
| Age | -0.334***,[a] | -0.147*** ,[b] | 0.057* | -0.044** | -0.040** | -0.065** | NS |
| Income | -0.044* | -0.054**,[b] | NS | -0.047** | NS | NS | -0.073* |
| Population Size | 0.081**,[a] | NS | NS | NS | NS | NS | NS |
| Household Size | NS | NS | 0.142***,[c] | NS | NS | NS | 0.171** |
| Household U18 | 0.164**,[a] | NS | 0.131* | NS | NS | NS | 0.222* |

Statistical Significance: 1% - ***, 5% - **, 10% - *, NS = Not Statistically Significant, a=Significant differences between pea and beef (5% level), b= Significant differences between pea and hybrid (5% level), c=Significant differences between pea and beef (5% level)

The above table A.3 outlines how utility for burgers, labels, and ingredient lists vary by demographics. Prior research finds plant-based are preferred by individuals who are young (Hwang et al., 2020), female, live in smaller households, have higher education, have higher income, and reside in larger urbanized centers (Hoek et al., 2004). Aligning with previous research, older individuals are less likely to choose pea or hybrid burgers. Similarly, higher educated individuals with less income from larger population centers and households with youth under 18 were more likely to select pea burger patties relative to choosing no purchase. Younger, more educated individuals with less income were more likely to select hybrid burger patties than no purchase for hybrid burgers. As shown in Appendix C, specifying education as a dummy variable (post-secondary education or higher) yields similar results: respondents with higher levels of education were more likely to select pea-based and hybrid burger patties and experienced greater utility from an organic attribute.

The lack of significance for ‘female’ throughout the interacted model was unexpected based on multiple research papers (Hoek et al., 2004; Pohjolainen, Vinnari, and Jokinen, 2015). The papers found females exhibited greater tendencies to select plant-based options, whereas males tended to select options that include meat and were usually telling indicators of influence on purchase selection, which this study does not contain. The papers also report individuals with lower income were more likely to select the plant-based option. Previous research finds that younger respondents, males, households with children, rural residents, and individuals with lower education levels generally prefer beef to non-meat alternatives (Pohjolainen, Vinnari, and Jokinen, 2015). This study finds similar beef preferences for lower educated individuals from larger household sizes and households containing youth. However, the rest of the sociodemographic variables were not significant.

Younger and lower-income individuals experienced increased disutility from the presence of an excellent source of protein claim. Higher educated individuals incurred positive utility from an organic label; however, younger individuals experienced disutility with organic claims. Female, younger, and respondents residing in rural areas encountered increased disutility from long-ingredient lists when presented with complete information. When given the option to turn over the package, individuals demonstrated different reactions to the long ingredient list. Lower-income individuals experienced increased disutility from the long ingredient list.

# Appendix G- Multinomial Logit Model with Food Value Interactions

## Table Appendix-5. Multinomial Logit Model with Food Value Interactions

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Log-Likelihood | -6817.797 | | | | | | |
| Rho-square (0) | 0.1803 | | | | | | |
| Adjusted Rho-square (0) | 0.1673 | | | | | | |
| AIC | 13851.59 | | | | | | |
| BIC | 14575.14 | | | | | | |
| Number of individuals | 1000 | | | | | | |
| Number of Choice Observations | 6000 | | | | | | |
| | Pea | Hybrid | Beef | Protein | Organic | Long IL (Full Info) | Long IL (Click) |
| **Environmental Values** | | | | | | | |
| Environmental Impact | 0.645*** | 0.273*** | -0.293*** | NS | 0.117** | NS | NS |
| Food Origin | -0.355*** | -0.104* | 0.170*** | NS | -0.106** | NS | -0.114* |
| | | | | | | | |
| Sensory Values | | | | | | | |
| Taste | NS | NS | 0.206** | NS | 0.133** | -0.454*** | NS |
| Appearance | -0.286*** | NS | 0.141** | NS | -0.099** | NS | -0.161** |
| | | | | | | | |
| **Product Quality Values** | | | | | | | |
| Food Safety | -0.218*** | NS | NS | NS | -0.100* | NS | NS |
| Convenience | 0.327*** | 0.308*** | 0.124** | NS | 0.088* | NS | NS |
| Product Familiarity | NS | NS | 0.178*** | -0.076* | NS | 0.277** | NS |
| | | | | | | | |
| **Ethical Values** | | | | | | | |
| Fairness | -0.479*** | NS | -0.150** | NS | NS | 0.190* | NS |
| Animal Welfare | 0.611*** | 0.109* | 0.147** | NS | -0.086* | NS | NS |
| | | | | | | | |
| **Traditional Values** | | | | | | | |
| Tradition | -0.207*** | -0.149*** | NS | NS | NS | NS | NS |
| Religion | 0.195*** | NS | NS | NS | NS | NS | 0.171*** |
| | | | | | | | |
| **Health Values** | | | | | | | |
| Nutrition | 0.271*** | NS | NS | NS | -0.179*** | NS | NS |
| Natural | -0.121* | NS | NS | 0.131*** | NS | NS | -0.140** |
| | | | | | | | |
| **Cost Value** | | | | | | | |
| Price | -0.250*** | NS | -0.394*** | NS | 0.169*** | NS | NS |

Statistical Significance: 1% - ***, 5% - **, 10% - *, NS = Not Statistically Significant

The above table outlines how utility for burgers, labels, and ingredient lists vary by respondents' food values. Based on previous literature it was assumed that preferences for plant-based foods would align positively with specific food values, including health, environmental, natural, and ethical values and negatively associate with other food values such as price, taste, and product convenience (Bryant, 2019; Graca, Oliveira, and Calheiros, 2015). As expected, consumers who valued environmental impact and animal welfare qualities were more likely to choose pea-based burgers in this study. However, it was interesting to find respondents who placed value on nutrition, religion, and product convenience qualities were also more likely to select pea-based burgers in this study, as product convenience is generally not associated with plant-based options. Environmental impact and animal welfare were expected to increase the likelihood of choosing pea-based burgers as the manufacturing of pea-based burgers is perceived as enhancing the aspects of environmentally friendliness and animal quality of life compared to beef burger production. However, the results suggest that individuals who emphasize food qualities of natural, traditional, fairness, product safety, or appearance were less likely to select pea-based burger patties.

Beef food values based on past literature imply individuals typically place a higher value on qualities of naturalness, taste, texture, appearance, health, preparation convenience, habitual/tradition, and affordability leading to more likely selection (Charlebois, Sogomyogi, and Music, (2018): Aschemann-Witzel et al., 2020). Aligned with findings from the literature, individuals who placed value upon product familiarity, taste, tradition, appearance, and food origin were more likely to select beef burger (Bryant, 2019; Graca, Oliveira, and Calheiros, 2015); however, food origin was unexpected as individuals preferring meat generally do not give concern for environmental implications Sensory attributes, tradition and product familiarity can be reasoned to increase beef burger choice for two reasons; first, beef burgers have been traditionally consumed throughout Canada for many decades compared to the other novel products within this study and second, the current marketing trends of beef burgers emphasize the sensory features of the product compared to the credence attribute marketing of novel food products. On the other hand, respondents who placed significant value on price were less likely to select beef burgers. With minimal literature addressing preferences for hybrid burgers, it was assumed attitudes would generally lie somewhere between attitudes toward pea and beef burgers. Within the study, respondents who valued environmental impact, animal welfare, or convenience qualities were generally more likely to choose hybrid burgers. However, respondents for whom tradition or food origin are important qualities were less likely to select hybrid burgers.

The two FOP attributes and ingredient list treatments differ by individual food values. An excellent source of protein claim resonated with individuals for whom natural is an important food value but decreased for valuation of product familiarity. Organic attribute presence increased selection likelihood for individuals who placed value on environmental impact, taste, product convenience, and price but incurred decreased choice probability for individuals who valued food origin, appearance, product safety, animal welfare, and nutrition. When individuals had the option to turn over the package, the presence of a long ingredient list increased purchase probability for individuals who placed high importance on religion but caused a decrease in choice likelihood for individuals who placed value on food origin, appearance, or natural qualities. It could be hypothesized individuals who chose to flip over the package in the click treatment are more motivated to pursue the information on the back of the package and therefore are dissuaded by the long ingredient list which would not seem appealing or natural due to the length of the list and presence of chemically sounding ingredients. By comparison, respondents in the visible ingredient treatment were more likely to make a choice when individuals valued product familiarity or fairness qualities, but product choice probability decreased for individuals who placed significant value on taste. Smolokoff (2020) finds that 36% of respondents were lee likely to buy a product with unfamiliar ingredients.

# Appendix H-Statistically Significant Difference between Burger Types

**Table Appendix-6. Statistically Significant Difference between Burger Types**

| | Pea | | | Hybrid | | | Beef | | |
|---|---|---|---|---|---|---|---|---|---|
| | Value | Robust s.e. | Rob t-ratio (0) | Value | Robust s.e. | Rob t-ratio (0) | Value | Robust s.e. | Rob t-ratio (0) |
| Female | -0.1776 | 0.2779 | -0.6393 | -0.1851 | 0.2752 | -0.6726 | 0 | 0 | NaN |
| Education | 0.02712 | 0.1347 | 0.2013 | 0.03388 | 0.1353 | 0.2504 | 0 | 0 | NaN |
| Age | 0.2894 | 0.0891 | 3.248 | 0.1005 | 0.08702 | 1.155 | 0 | 0 | NaN |
| Income | 0.03176 | 0.06871 | 0.4622 | 0.04456 | 0.06763 | 0.659 | 0 | 0 | NaN |
| Population Size | -0.05582 | 0.06822 | -0.8183 | -0.02533 | 0.06617 | -0.3828 | 0 | 0 | NaN |
| Household Size | -0.1471 | 0.1323 | -1.112 | -0.2001 | 0.129 | -1.551 | 0 | 0 | NaN |
| Household U18 | -0.2747 | 0.1838 | -1.495 | -0.2161 | 0.1803 | -1.199 | 0 | 0 | NaN |

## Appendix I-Defining of Independent Variables

The following table defines the independent variables used as class membership indicators for the LC models.

| Independent Variable | Independent Variable Defined |
|---|---|
| Female | Variable indicating whether the individual identifies as female. |
| Education | Variable indicating individuals' education level (Jr. High School-Ph.D. Degree). |
| Age | Variable indicating individuals' age level (18-80+). |
| Income | Variable indicating individuals' income level (>$24,999-$150,000+). |
| Population Size | Variable indicating individuals' population region (Rural-100,000+). |
| Natural | Measures individual importance of eating food products made in its original state. |
| Nutrition | Measures respondent value regarding the content value of calories, fat, proteins, etc. |
| Environmental Impact | Measures individual value of food production effects on the surrounding environment. |
| Taste | Measures respondent importance of taste of the product. |
| Animal Welfare | Measures individual value regarding physical and psychological well-being of animals. |
| Product Safety | Measures the importance of eating food products that will not make an individual sick. |
| Reading Ingredient List | Variable indicating individuals' consultation frequency of the ingredient list. |
| Reading Price | Variable indicating individuals' consultation frequency of the price. |
| Animal Protein | Measures meal regularity for how many times meat was the primary protein source. |
| Plant Protein | Measures meal regularity for how many times plants were the primary protein source. |
| Dairy Protein | Measures meal regularity for how many times dairy/eggs was the primary protein source. |

# Appendix J- Multinomial Logit and Latent Class Results

## Table Appendix-7. Multinomial Logit and Latent Class Results

| | MNL | Class 1 – *Burger lovers* | Class 2 – *Price-conscious carnivores* | Class 3 – *Vegivores* | Class 4 – *Short-ingredient lovers* |
|---|---|---|---|---|---|
| Log-Likelihood | -6593.925 | -5092.006 | -5092.006 | -5092.006 | -5092.006 |
| Rho-square (0) | 0.1192 | 0.3878 | 0.3878 | 0.3878 | 0.3878 |
| Adjusted Rho-square (0) | 0.1178 | 0.3769 | 0.3769 | 0.3769 | 0.3769 |
| AIC | 13207.85 | 10366.01 | 10366.01 | 10366.01 | 10366.01 |
| BIC | 13273.79 | 11122.13 | 11122.13 | 11122.13 | 11122.13 |
| | Estimate (S. E.) | Estimate (S. E.) | Estimate (S. E.) | Estimate (S. E.) | Estimate (S. E.) |
| Price | -0.195*** (0.01025) | -0.320*** (0.024) | -0.447*** (0.05882) | -0.328*** (0.03526) | -0.299*** (0.03005) |
| **Patty Types** | | | | | |
| Beef | 2.55*** (0.11734) | 5.296*** (0.362) | 2.658*** (0.567) | 1.405*** (0.38722) | 5.876*** (0.38541) |
| Hybrid | 1.60*** (0.10166) | 5.977*** (0.346) | 0.362 (0.52864) | 1.876*** (0.34787) | 2.143*** (0.31464) |
| Pea | 1.39*** (0.10118) | 4.537*** (0.341) | -1.016 (0.80633) | 4.761*** (0.35266) | 0.681** (0.3178) |
| **FOP Attributes** | | | | | |
| Protein | 0.037 (0.03757) | 0.145** (0.070) | -0.484** (0.24073) | -0.144 (0.14115) | -0.082 (0.1086) |
| Organic | 0.063 (0.03327) | 0.274*** (0.060) | 0.047 (0.2229) | 0.444*** (0.14386) | -0.035 (0.0955) |
| **Ingredient List Effects** | | | | | |
| Long Ingredient List (Visible Treatment) | -0.748*** (0.04975) | -1.185*** (0.107) | -0.911*** (0.32074) | -0.567*** (0.20304) | -1.66*** (0.18502) |
| Long Ingredient List (Click Treatment) | -0.986*** (0.0786) | -0.982*** (0.128) | -1.521*** (0.51872) | -0.959** (0.44674) | -2.431*** (0.23963) |
| Click Treatment and Product Flipped[1] | 0.875*** (0.08921) | 0.477* (0.267) | 1.640*** (0.24743) | 0.83451 (0.63573) | 2.107*** (0.26465) |
| Click Treatment[2] | -0.507*** (0.0679) | -1.084*** (0.34167) | -1.365*** (0.38464) | -0.615** (0.26936) | -1.166*** (0.22105) |
| Class Probability | | 0.3239 | 0.1684 | 0.14 | 0.3677 |

Statistical Significance: 1% - ***, 5% - **, 10% - *

1-Refers to DCE scenarios where respondents were randomized to the click treatment (could only view package front) and chose to click on the image to view the package back.

2-Click treatment refers to DCE scenarios where respondents could view only the front of the package.

# Appendix K- Multinomial Logit and Latent Class Membership Comparison

## Table Appendix-8. Multinomial Logit and Latent Class Membership Comparison

| | MNL | Class 1 | Class 2 | Class 3 | Class 4 |
|---|---|---|---|---|---|
| | Estimate (S. E.) | Estimate (S. E.) | Estimate (S. E.) | Estimate (S. E.) | Estimate (S. E.) |
| ASC | | 1.315 (0.82507) | -0.564 (0.96497) | 0.775 (1.09681) | |
| **Sociodemographic** | | | | | |
| Female | | -0.020 (0.19003) | -0.275 (0.21825) | -0.340 (0.28243) | |
| Education | | 0.095 (0.08717) | 0.143 (0.09902) | 0.036 (0.13045) | |
| Age | | -0.233*** (0.05752) | 0.087 (0.06727) | -0.466*** (0.08772) | |
| Income | | -0.094** (0.04462) | -0.029 (0.05007) | -0.013 (0.06478) | |
| Population Size | | 0.075* (0.04493) | -0.027 (0.04602) | 0.169** (0.07186) | |
| **Food Values** | | | | | |
| Natural | | -0.162 (0.11748) | -0.064 (0.13351) | -0.466*** (0.1795) | |
| Nutrition | | 0.028 (0.14388) | 0.228 (0.16698) | 0.689*** (0.22919) | |
| Environmental Impact | | 0.485*** (0.12805) | 0.212 (0.14306) | 0.522*** (0.1996) | |
| Taste | | -0.195 (0.15196) | -0.370** (0.1733) | -0.159 (0.21688) | |
| Animal Welfare | | -0.027 (0.11956) | -0.186 (0.13362) | 0.437** (0.17902) | |
| Product Safety | | -0.035 (0.12714) | 0.035 (0.14811) | -0.323 (0.19759) | |
| **Stated Action** | | | | | |
| Reading Ingredient List | | -0.093 (0.12831) | 0.062 (0.151) | 0.377** (0.19051) | |
| Reading Price | | 0.030 (0.13164) | 0.032 (0.15615) | -0.476** (0.20123) | |
| **Consumption Level** | | | | | |
| Animal Protein | | -0.244*** (0.08374) | -0.252*** (0.09421) | -0.864*** (0.10599) | |
| Plant Protein | | 0.290*** (0.05802) | 0.070 (0.06625) | 0.519*** (0.08489) | |
| Dairy Protein | | -0.060 (0.07027) | 0.164** (0.08306) | -0.059 (0.10376) | |
| Class Probability | | 0.3239 | 0.1684 | 0.14 | 0.3677 |

Statistical Significance: 1% - ***, 5% - **, 10% - *