Motivations and barriers for flexitarianism of New Zealand consumers to eating plant-based products

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Abstract

Plant-based products (PBPs) are increasingly used by consumers to replace meat in their diet. Different motivators and barriers drive consumers to eat PBPs and ultimately determine whether consumers engage with these foods. Flexitarians, people actively trying to reduce their meat intake, are of particular study interest as they encompass an increasingly larger part of the population than vegetarians and vegans.

This study aimed to identify factors that motivate flexitarians in New Zealand to reduce meat intake, and to determine whether age, identified gender and meat consumption frequency play a role.

An online questionnaire (n=584) gathered data concerning drivers and barriers to eating meat and PBPs together with demographic information, which was used to further segments flexitarians. Drivers and barriers included demographics, consumption behaviour, ideal sensory characteristics of PBPs, food safety, industry and authority responsibilities, nutrition, health, social status, animal welfare and environment factors associated with consumption of meat and PBPs.

Flexitarians with higher meat consumption preferred meat-like properties in ideal PBPs. Generation X (born 1966-80) scored significantly higher than Millennials (born 1981-96) for food safety concerns for pesticides, antibiotics, genetically modified ingredients, and disease. Females scored significantly lower than males for wanting ideal PBPs to bleed-like-meat, be dry and bitter and significantly higher for umami. K-means clustering applied to the motivators and barriers responses identified four flexitarian clusters. Cluster 2 (n = 192) had most motivators for meat reduction whereas cluster 4 (n = 149) had most barriers. Cluster 1 (n = 90) had the lowest food neophobia. Cluster 1 was satisfied with appearance whereas cluster 2 was satisfied with the texture of currently available PBPs. The ideal PBP of clusters 1 and 3 (n = 153) was juicy, savoury, and flavourful. Cluster 2 preferred products to taste like

meat. Cluster 3 was similar to cluster 2 in terms of food safety concerns but had higher meat consumption and more barriers to PBP consumption.

Flexitarian segments differed in the drivers and barriers to eating meat and PBPs, suggesting they engage differently with PBPs. Future studies should investigate this difference including sensory evaluation of PBPs. These results can aid industry in developing and promoting products that meet clusters' needs.

Preface

Plant-based product consumption is on the rise amongst consumers (Bashi et al., 2019). This project forms part of a wider Ministry of Business, Innovation and Employment funded Future Foods Catalyst (FFC) Research Programme. The aim of this research was to understand flexitarian motivations and barriers that drive consumers towards accepting plant-based products, and to identify any subsequent segmentation in flexitarians. This thesis initially presents a review of the literature on motivations and barriers and clustering of flexitarians leading to research questions, objectives, and hypotheses. Clustering was done by grouping consumers that were similar in their behaviour, in this case based on their motivations and barriers to plant-based product consumption. The development of an online questionnaire used to evaluate motivations and barriers of New Zealand flexitarians is then described. Finally, the findings of this research, discussion, directions for future work and conclusions are presented.

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1. Literature Review

1.1 Introduction

Increasing concerns around health, the environment and sustainability, and animal welfare have created concerns regarding meat consumption (Bashi et al., 2019). Therefore, plant-based foods are increasingly used by consumers to replace meat in their diet (Bashi et al., 2019). Not all plant-based products are alternative proteins. Bashi et al. (2019) defined alternative protein as "protein-rich ingredients sourced from plants, insects, fungi, or through tissue culture to replace conventional animal-based sources". A consumer may turn to plant-based foods to replace protein, but more likely they will replace the whole food on the plate. A plant-based food might take the same form as conventional meat products, but not necessarily, and might be used to replace meat in a dish with or without intention to mimic the sensory attributes of meat. The scope of this review and subsequent study focused on plant-based meal components, including fungi and algae[1], and excluded snacks, beverages, dairy analogues (cheese, milk, and yoghurt) and insect products.

Plant-based products form part of meals that consumers eat where they try to reduce, substitute, or eliminate animal products used (Hoek et al., 2011). According to Wozniak et al. (2020) a vegan is a person who avoids animal products, a vegetarian one whose diet excludes fish and meat, but includes products derived from animals e.g. dairy and egg products. They also define pescatarian as a person who follows a vegetarian diet and includes seafood and fish products in their diet; flexitarian as person who occasionally eats meat; and omnivore as one who eats plant and animal products.

The first aim of this review was to investigate definitions of flexitarians. The second

[1] Fungi are eukaryotic organisms that cannot produce their own food and absorbs organic compounds through its cell wall (Dick, 1997). Algae are typically aquatic photosynthetic organisms (Vidyasagar, 2016). Although fungi and algae are not plants, consumers often perceive them that way.

aim was to investigate the motivations and barriers that affect different dietary groups' choices to consume and/or reduce meat, with specific attention to subgroups of flexitarians. The third aim was to investigate literature available on the sensory perceptions towards plant-based products.

1.1.1 Defining flexitarians

Many definitions for flexitarians incorporate frequency of eating meat varying from omitting meat once per week to eating meat occasionally (Table 1). This also points to the continuum that is viewed as flexitarianism, that varies not only in consumption frequency, but also in what drives flexitarians to reduce their meat intake. It is also important to note that a flexitarian can also be someone who reduces all animal products, not just meat (Noguerol et al., 2021). In this project a flexitarian is broadly defined as 'someone who is actively reducing, or has actively reduced, the amount of animal flesh they consume, but is not eliminating it completely from their diet'. This definition is based on the consumption of animal flesh, not frequency or amount of meat consumed. In this study 'meat' refers to red meat and poultry.

Table 1: Definitions of flexitarians

Reference	Definition
Verain et al. (2015)	"Every food consumer who abstains from eating meat at least one day a week may be called a flexitarian, regardless of the reason for abstention."
Vanhonacker et al. (2013)	"flexitarians (consumers with a mainly vegetarian diet, who consume meat from time to time) or flexivores (consumers with a varied diet, who alternate meat with fish, vegetarian meals and other alternatives)."
Campbell (2021)	"What exactly is a flexitarian? Well, this is where the rules get blurry. We have 21 meals a week, then a "beginner flexitarian" has seven meatless meals within that, an "advanced flexitarian" has 14 meatless meals and an "expert flexitarian" eats meat six or fewer times a week."
Dagevos and Voordouw (2013)	""meat-reducers" (or "flexitari-ans") consume meat only several days per week."
Kemper and White (2021)	"Flexitarian, also referred to as semi-vegetarian or meat reducers in the literature, is an individual that reduces their consumption of meat and can include those who avoid meat one or two days a week to those who only eat meat on occasion"

Cliceri et al. (2018)	"defined as those who consciously consume a limited quantity of either all types or specific types of meat"
Forestell et al. (2012)	"non-vegetarians who only occasionally eat red meat" "a flexitarian is someone who occasionally eats red meat, eats all white meat, seafood, eggs, dairy products, fruits, vegetables, and grains"
Kemper (2020)	"individuals identify as meat reducers"
Bryant and Sanctorum (2021)	"I eat meat and fish, but also regularly vegetarian"
Rosenfeld (2018)	"A flexitarian is an individual who limits his or her meat intake yet still includes meat in his or her diet. A combination of the words flexible and vegetarian, a flexitarian is essentially one who eats a mostly vegetarian, or a vegetarian-inclined, diet.
Rosenfeld et al. (2020)	"I limit my meat intake but I still include meat in my diet"
Lentz et al. (2018)	"'reducers' - defined as those who answered 'yes' to "Have you already or are you currently making any efforts to reduce your personal meat consumption?""
Janda and Trocchia (2001)	"'pseudo-vegetarians' - people who abstain from meat-based products, but occasionally eat some meat"
Corrin and Papadopoulos (2017)	"They are those who mainly eat a vegetarian diet, but will sometimes consume meat."
Dagevos (2021)	"The two R's of reducing and replacing are incorporated in flexitarianism, which may be defined as a food consumption pattern in which meat is eaten occasionally without avoiding it completely."
Faber et al. (2020)	"a flexitarian avoids meat and fish at least three days a week"
Hoek et al. (2004)	"Consumers of meat substitutes" "Consumers of meat substitutes were respondents who recorded the consumption of at least one meat substitute product and who did not indicate to be vegetarian"
Malek and Umberger (2021a)	"We define 'meat reducers' as individuals who are cutting back on meat but are not avoiding meat completely"
Mullee et al. (2017)	"almost vegetarian (eating meat or fish only on exceptional occasions), part-time vegetarian (eating meat or fish a few times a week)"
Neff et al. (2018)	"Meat reducers were defined as individuals reporting 'a lot less' or 'slightly less' consumption v. three years ago for one or more of the four meat types examined"
Piazza et al. (2015)	"restricted omnivore (limited meat intake, e.g., only fish or chicken, no red meat)"

Spencer et al. (2018)	"mostly plant-based, with meat in moderation" "This dietary shift can be accomplished within meals, as a partial replacement of meat with plant-based ingredients, or as an overall dietary shift in which fewer meat-centric meals are consumed and more vegetarian meals, or both."
Tucker (2014)	"restricted meat eaters (eats meat three days or less per week)"
Wozniak et al. (2020)	"flexitarians when they included eggs and dairy products in their daily diet and red meat or poultry at a frequency of ≥1/month but ≤1/week"

Different motivators and barriers drive consumers to eat plant-based foods and ultimately determine if consumers engage with plant-based foods or not. However, each consumer is unique in what drives them to consume food (Vabø & Hansen, 2014). These motivations and barriers have been identified as health (Cliceri et al., 2018; Dagevos & Voordouw, 2013; Forestell et al., 2012; Graça et al., 2015; Kemper, 2020; Kemper & White, 2021; Latvala et al., 2012; Verain et al., 2015), cost (Dagevos & Voordouw, 2013; Forestell et al., 2012; Kemper, 2020; Kemper & White, 2021; Latvala et al., 2012; Vanhonacker et al., 2013; Verain et al., 2015), social status and culture (Dagevos & Voordouw, 2013; Kemper, 2020; Kemper & White, 2021; Latvala et al., 2012; Verain et al., 2015), need for meat (Dagevos & Voordouw, 2013; Kemper, 2020; Kemper & White, 2021; Vanhonacker et al., 2013; Verain et al., 2015), food novelty or neophobia (Cliceri et al., 2018; Forestell et al., 2012; Verain et al., 2015), sensory characteristics (Cliceri et al., 2018; Latvala et al., 2012; Vanhonacker et al., 2013), animal welfare, environment and sustainability (Cliceri et al., 2018; Dagevos & Voordouw, 2013; Graça et al., 2015; Kemper, 2020; Kemper & White, 2021; Latvala et al., 2012; Vanhonacker et al., 2013; Verain et al., 2015), criteria for selecting meat alternatives (Kemper, 2020), emotions (Cliceri et al., 2018; Graça et al., 2015; Kemper & White, 2021), and trust and responsibility of industry and authorities (Graça et al., 2015; Kemper, 2020; Verain et al., 2015). These factors can be motivators or barriers depending on how they are perceived.

Flexitarians are growing in number and make up a larger part (37.1 %) of the New Zealand population than vegetarians and vegans (3 %) (Lentz et al., 2018).

Therefore, flexitarians drive the market demand for plant-based products (Boukid, 2021) and hence have become a recent segment of research interest in consumer sciences. The Netherlands and United States of America a have higher reported percentage of flexitarians or meat reducers compared to New Zealand at 42.9 % and 66 %, respectively (Neff et al., 2018; Verain et al., 2022). Canada (11 %), Denmark (27.6 %), Switzerland (16.9 %), Germany (20%) and Belgium (27.8 %) have lower percentages of flexitarians compared to New Zealand (De Backer & Hudders, 2015; Hielkema & Lund, 2021; Lacroix & Gifford, 2020; Michel et al., 2021; Wozniak et al., 2020). The proportion of flexitarians in Australia ranges depending on the study from 19 % (Estell et al., 2021) to 58.9 % (Marinova & Bogueva, 2019).

The first section of the literature review looks at motivations and barriers to meat reduction amongst flexitarians in which literature that pertains to flexitarians and clustering of flexitarians is summarised. The first section also considers variation of frequency and type of meat consumed. The review then discusses literature under identified motivations and barriers to plant-based products consumption for flexitarians in the second section.

1.2 Categorisation of flexitarians based on motivations and barrier for meat reduction

This section presents how, based on their motivations and barriers, flexitarians have been categorised in recent literature. Rather than having specific characteristics, flexitarians have been shown to choose plant-based food for varying factors and consume them at different frequencies. Understanding whether flexitarians can be grouped into more specific segments is important and could be important for identifying what different segments look for in a plant-based product. This would prove useful for product development and promotion of plant-based products.

1.2.1 Statistical approaches

Several studies in other countries have attempted to understand if flexitarians can be characterised as a discrete group or as a continuum of subgroups with different

factors affecting their food choice behaviours. Statistical techniques on the data collected, such as cluster analysis to form subgroups, was often used. Table 2 lists previous original studies reporting on data collected to categorise flexitarians using cluster analysis, and other studies together with the different motivations and barriers of food choices for flexitarians specifically. A simplified overview of clusters from these studies can be found in Table 3.

The first group of studies (Dagevos & Voordouw, 2013; Faber et al., 2021; Graça et al., 2015; Knaapila et al., 2022; Latvala et al., 2012; Niva & Vainio, 2021; Vanhonacker et al., 2013; Verain et al., 2015) grouped flexitarians based on different motivation and barrier criteria, and then assigned names to the resulting clusters. Verain et al. (2015) identified clusters of flexitarians based on opinions and motivations about meat consumption, whereas Vanhonacker et al. (2013), Latvala et al. (2012), Dagevos and Voordouw (2013), Knaapila et al. (2022), Niva and Vainio (2021) and Graça et al. (2015) based their clustering on level of meat consumption. Vanhonacker et al. (2013) mainly focussed on the ecological views of participants in their study and used ecological footprint together with meat consumption to form clusters. This meant that they studied the relationship between participants and their environment. Graça et al. (2015) included health, environment and animal welfare in their cluster analysis and were unique in that they included emotions to meat reduction in their analysis.

A limitation of some of these clustering studies is that although they provide valuable data, they are not recent and attitudes regarding barriers and motivations could have changed in the past 6 to 9 years. This could be because of change in awareness of environmental sustainability and animal welfare issues. Some important variables, such as sensory preferences and extent of processing of plant-based products, have been missed. Sensory preferences are important to include as it is a key driver for most food categories (Fiorentini et al., 2020). Another limitation was that Graça et al. (2015) and Vanhonacker et al. (2013) were biased towards females. A strength of many of the studies (Dagevos & Voordouw, 2013; Latvala et al., 2012; Verain et al., 2015)

Table 2: Comparison of motivation and barrier areas covered by original research studies investigating flexitarians

Factors	Meat Consumption			Health		Cost		Social Status / Culture			Meat-free Meals			Need for Meat	Food Neophobia	Sensory					Animal Welfare		Environment & Sustainability			Meat Substitute Criteria					Emotions	Industry & Authorities	
Subfactors	Frequency	Types of Meat	Strategies	Nutrition	Safety	Meat	Plant proteins	Social Status	Masculinity	Acceptance	Liking	Meat substitutes	Meat Alternative Types			Taste	Appearance	Smell	Texture	Flavour	Conditions	Meat Source	Eco-friendly	Footprint	Waste	Processing	Nutrition	(Non) Meat-like	Certification	Allergens		Responsibility	Methods
Verain et al. (2015)	✔	✔	✔	✔		✔		✔			✔			✔	✔						✔	✔	✔								✔	✔
Vanhonacker et al. (2013)	✔	✔	✔			✔	✔					✔	✔	✔		✔					✔		✔	✔								
Latvala et al. (2012)	✔	✔		✔	✔	✔		✔								?					✔		✔									
Dagevos and Voordouw (2013)	✔			✔		✔		✔						✔							✔		✔									
Graça et al. (2015)	✔	✔		✔	✔						✔		✔								✔		✔							✔		✔
Schösler et al. (2012)	✔	✔									✔		✔																			
Kemper and White (2021)		✔	✔	✔		✔				✔	✔		✔	✔							✔		✔		✔						✔		
Cliceri et al. (2018)	✔			✔							✔				✔	✔						✔									✔		
Forestell et al. (2012)	✔			✔		✔									✔																	
Kemper (2020)		✔	✔	✔		✔	✔		✔		✔	✔	✔	✔							✔		✔			✔					✔	✔
Knaapila et al. (2022)	✔			✔			✔	✔							✔	✔					✔		✔			✔						
Niva and	✔			✔		✔																	✔			✔						

Factors	Meat Consumption			Health		Cost		Social Status/ Culture			Meat-free Meals			Need for Meat	Food Neophobia	Sensory					Animal Welfare		Environment & Sustainability			Meat Substitute Criteria					Emotions	Industry & Authorities	
Subfactors	Frequency	Types of Meat	Strategies	Nutrition	Safety	Meat	Plant proteins	Social Status	Masculinity	Acceptance	Liking	Meat substitutes	Meat Alternative Types			Taste	Appearance	Smell	Texture	Flavour	Conditions	Meat Source	Eco-friendly	Footprint	Waste	Processing	Nutrition	(Non) Meat-like	Certification	Allergens		Responsibility	Methods
Vainio (2021)																?																
Faber et al. (2021)				✔		✔	✔									✔					✔		✔			✔			✔			

- "?" Latvala et al. (2012) measured taste preferences, however details were not specified
- Ticks (✔) indicates that the study covered the factor named in the corresponding column

Table 3: Breakdown of cluster characteristics from flexitarian studies

Study (location)	Clusters	Demographic information		Identifier
		Gender	Age (years)	
Verain et al. 2015 (Netherlands)	Meat lovers (22.2%)	57.2% male	Majority: 46-65 (46.4%)	- Consumes high amounts of meat - Does not much like meatless meals
	Unconscious flexitarians (38.8%)	52.5% male	Majority: 30-45 (33.1%)	- Derives status from meat consumption - Unhappy with meat having to come from animals
	Conscious flexitarians (19.6%)	31.7% male	Majority: 46-65 (44.3%)	- Lowest meat consumption, status derived from meat and need for meat - Animal and environmental friendliness very important, dislikes animals as meat source - Appreciates meatless meals
	Compulsive meat consumers (9.7%)	68.9% male	Majority: 46-65 (41.8%)	- Consumes high amounts of meat, high need for meat - Derives status from meat consumption - Does not like meatless meals
	Potential flexitarians (9.7%)	38.0% male	Majority: 46-65 (42.1%)	- Low need for meat - Appreciates meatless meals - Derives very little status from consuming meat

Study (location)	Clusters	Demographic information		Identifier
		Gender	Age (years)	
Latvala et al. 2012 (Finland)	No change in meat and vegetable consumption (48%)	Male dominant	NR	- No change to eating patterns of meat or vegetables in past and no aim to change eating patterns
	Past change: less beef and pork (12.9%)	Female dominant	NR	- Past change based on perceived healthiness and taste preferences - No intention to further change diet
	Ongoing change: more vegetables (17%)	No dominant gender	NR	- In past have increased amount of vegetables and chicken consumed and plans to further increase amount in future - No plans for reducing beef or pork consumption
	Ongoing change: less all meat, more vegetables (8.1%)	Female dominant	NR	- Pork and beef consumption decreased in the past and intends to further decrease consumption - Healthiness, environmental reasons, and animal welfare are important motivators
	Ongoing change: from pork to beef, more vegetables (7.1%)	No dominant gender	NR	- Increased beef consumption previously, and some participants plan on eating more meat in the future - Plan on decreasing pork intake and increasing vegetable intake - Environment least important to this cluster
	Ongoing change: less beef and pork, more chicken and vegetables (6.9%)	Female dominant	NR	- Past and intended future behaviour of decreasing pork and beef intake and increasing vegetable and chicken intake - Healthiness and weight management are important motivators
Vanhonacker et al. 2013 (Belgium)	Conscious (24.7%)	43% male	Average 36.3	- Ecological footprint of cluster is too high and their personal relevance regarding concept for ecological footprint is moderate
	Active (19.2%)	26% male	Average 44.4	- Personal relevance regarding the concept for ecological footprint is high and their ecological footprint is small
	Unwilling (16.4%)	44% male	Average 33.0	- Ecological footprint is high, and personal relevance is low
	Ignorant (17.8%)	31% male	Average 43.2	- Ecological footprint and personal relevance is low
	Uncertain (21.9%)	33% male	Average 48.1	- Ecological footprint and personal relevance is mid-point
Dagevos & Voordouw 2013 (Netherlands)	Conscious Flexitarians	30% males	NR	- Actively reducing meat intake based on health considerations, personal norms, and ethical concerns
	Unconscious flexitarians	50% males	NR	- Low motives about health effects and ethical considerations of eating meat - Not associate meat with a better social status and were open to vegetarian meals
	Extravert flexitarian	NR	Generally younger	- Believed social status is enhanced by meat consumption - Meat origins and health concerns were important

Study (location)	Clusters	Demographic information		Identifier
		Gender	Age (years)	
	Disengaged Meat-Eaters	NR	NR	- Moderate commitment to decreasing meat and low attachment to consuming it
	Meat-Lovers	62% male	NR	- No intention of reducing intake of meat
Graça et al. 2015 (Portugal)	Cluster 1 (14.1%) Renamed: Disgusted with meat	25.9% male	Majority: 25-40 (56.9%)	- Had moral internalisation and were disgusted with meat
	Cluster 2 (36.6%) Renamed: Not attached to meat	18% male	Majority: 25-40 (42.7%)	- Not attached to meat - Open to eating less meat and consuming a plant-based diet for the sake of animal welfare and health
	Cluster 3 (49.3%) Renamed: Affective towards meat	40.5% male	Majority: <25 (51.5%)	- Had affective connection with meat - Rationalised or denied the impacts of use of meat - Unwilling to change behaviour to consume a diet based on plants
Knaapila et al. (2022) (Finland)	MeatPos (14.3%)	57.7% male	20 – 39	- Positive association to meat and negative about meat alternatives - Taste is a barrier for plant-based product consumption
	MeatPref (20.0%)	51.4% male	20 – 39	- Preferred meat - "Like trying new foods" is a motivator for plant-based product consumption - Taste is a barrier for plant-based product consumption
	BothPos (23.6%)	42.6% male	20 – 39	- Positive associations to meat alternatives and meat - "Like trying new foods" is a motivator for plant-based product consumption
	NoPos (10.6%)	36.2% male	20 – 39	- Association to meat alternative or meat is neutral/marginally negative - Environment is a motivator for plant-based product consumption
	MaPref (13.9%)	34.2% male	20 – 39	- Preferred meat alternatives - Environment is a motivator for plant-based product consumption
	MaPos (17.6%)	21.9% male	20 – 39	- Positive association to meat alternatives and negative about meat - Environment is a motivator for plant-based product consumption - Animal welfare is a motivator for plant-based product consumption
Niva and Vainio (2021) (Finland)	Cluster 1 (37.0%)	Male dominant	Average 52.8	- "Established beef lovers" - Price is a motivator - Naturalness is a motivator
	Cluster 2 (25.5%)	Female dominant	Average 46.6	- "Alternative protein increasers" - The environment is a motivator - Naturalness is a motivator
	Cluster 3 (20.3%)	Male dominant	Average 53.3	- "Established 'light' flexitarians" - Price is a motivator - Naturalness is a motivator
	Cluster 4 (9.3%)	Female dominant	Average 38.6	- "Beef-avoiding plant-protein increasers" - The environment is a motivator

Study (location)	Clusters	Demographic information		Identifier
		Gender	Age (years)	
				- Naturalness is a motivator - Healthiness is a motivator
	Cluster 5 (8.0%)	Female dominant	Average 57.4	- "Beef reducers" - Price is a motivator - Naturalness is a motivator
Faber et al. (2021) (Denmark, Germany, Spain)	Segment 1 (10.3%)	46.7% male	Average 31	- No animal, high plant intake - Animal friendly, fairly traded and environmentally friendly are important attributes of products
	Segment 2 (20.8%)	33.7% male	Average 38	- Low animal, high plant intake - Affordable, minimally processed, organic, natural content, and produced with minimum CO_2 emissions are important attributes of products
	Segment 3 (34.4%)	54.0% male	Average 47	- Moderate animal and plant intake - Affordable is an important attribute of products
	Segment 4 (34.5%)	35.5% male	Average 46	- High animal, moderate plant intake - Affordable, minimally processed, healthy, and sensory appeal are important attributes of products

was very representative population samples with regards to age, gender, education level and sample size.

Further studies which, despite not attempting to subgroup flexitarians investigated motivations and barriers, either specifically for flexitarians (Kemper, 2020; Kemper & White, 2021), or also included other dietary groups (Cliceri et al., 2018; Forestell et al., 2012; Schösler et al., 2012). Schösler et al. (2012) investigated potential substitutions for meat and participant approval of those substitutes. Other studies (Kemper, 2020; Kemper & White, 2021) used focus groups and interviews to look at detailed qualitative data regarding motivations and barriers of flexitarians. These included health, cost, social status and culture, approval of meat-free meal, need for meat, animal welfare and the environment and sustainability. Kemper (2020) considered meat substitution criteria and the industry and authorities, whereas Kemper and White (2021) and Cliceri et al. (2018) investigated emotional responses of meat consumption. The study by Cliceri et al. (2018) explored relationships between personality and psychological traits, taste responsiveness, attitudes and beliefs of participants towards meat- and plant-based meals. Forestell et al. (2012) compared lifestyle and dietary behaviours of flexitarians, omnivores, vegans, and vegetarians.

The next sections will look at the key factors that have grouped flexitarians in the studies in the tables, which includes how meat consumption frequency and types of meat consumed varies amongst flexitarians, as well as the motivations and barriers to eating less meat and more plant-based foods.

1.2.2 Variations of flexitarians on frequency and types of meat consumed

Highest meat consumption frequency

The two clusters (Table 2) with the highest meat consumption frequency within the Verain et al. (2015) study were termed “meat lovers” and “compulsive meat consumers” and ate meat 5.2 and 5.9 days per week, respectively. This was similar to Dagevos and Voordouw (2013) whose two clusters “disengaged meat eaters” and “meat-lovers” had the highest meat consumption in their study of 5.5 and 6.0 days per week, respectively. The cluster “no change in meat and vegetable

consumption" (Latvala et al., 2012) ate beef and pork more than 3 times per week, whereas Vanhonacker et al. (2013)'s highest meat consuming clusters, the "conscious" and "unwilling", both ate beef, pork and chicken weekly and fish monthly. The "affective towards meat" cluster (Graça et al., 2015) had the highest frequency of meat consumption, with 59.2% and 70.3% of the cluster eating red meat and fish occasionally, respectively, and 56.4% eating white meat regularly. In most of these studies (Dagevos & Voordouw, 2013; Latvala et al., 2012; Verain et al., 2015) these high meat consuming clusters were male dominant, however the other studies (Graça et al., 2015; Vanhonacker et al., 2013) were biased to female respondents. Although results on age vary, clusters that ate the most meat tended to be male dominant.

Lowest meat consumption frequency

Verain et al. (2015)'s lowest meat consumption cluster ("conscious flexitarians") ate meat 3.5 days per week on average, whereas the lowest meat consumption cluster from Dagevos and Voordouw (2013) ("unconscious flexitarians"), ate meat 2.7 days per week. Interestingly Dagevos and Voordouw (2013)'s "conscious flexitarians", who were actively reducing meat intake based on personal norms, ethical concerns and health, had a higher meat intake (3.0 days per week) than their "unconscious flexitarians" who had low motives about the health effects and ethical considerations of eating meat. The "ongoing change: less all meat, more vegetables" cluster (Latvala et al., 2012) ate pork and chicken less than once a month and never ate beef. The two clusters that ate beef, pork, fish and poultry monthly (Vanhonacker et al., 2013) the least were called the "active" and "ignorant" clusters. "Disgusted with meat" cluster had the lowest meat consumption frequency (Graça et al., 2015), with 96.5%, 91.4% and 71.9% of respondents never eating red meat, white meat and fish, respectively. Kemper (2020) saw that retirees had a reduced enjoyment and appetite for meat. They often changed their consumption from red meat to chicken and fish. With the exception of the "unconscious flexitarians" (Dagevos & Voordouw, 2013), all low meat consuming clusters were female dominant and were mainly around the 40 years age group.

From these studies it is evident that frequency of meat consumption, as well as

type of meat consumed, varies considerably across flexitarians. Consumption ranged from 6 days a week at the high end to eating meat less than once per month. Therefore, no clear meat consumption level or type of meat consumed defines flexitarianism.

Meat and protein consumption around the world

The average person in New Zealand consumes 100.89 kg of meat per year (Ritchie & Roser, 2017), which is similar to the amount Spain (100.25 kg per year), Brazil (99.83 kg per year) and Israel (97.01 kg per year) consumes. Australia (121.6 kg per year), the United States of America (124.1 kg per year) and Argentina (109.38 kg per year) all consume more meat per annum than New Zealand. Most of Africa, except for South Africa (60.02 kg per year) consumes well below 60 kg of meat per person per year. India (3.78 kg per year) and neighbouring countries, and Indonesia (11.7 kg per year) consume minimal amounts of meat per person per year. Europe and Russia consume between 65.77 kg per person per year (Belgium) and 88.7 kg per person per year (Poland). Meat consumption per person for China is 60.59 kg per year. These figures show that New Zealand has a high intake of meat compared to other countries.

The average person in New Zealand has a daily protein intake of 39.03 g of from plant-based foods, which is similar to that of Spain (40.57 g), Australia (36.80 g), United States (39.86 g), and Argentina (37.01 g) (Roser & Ritchie, 2013). China and India have higher daily intake of protein from plant-based foods, 60.92 g and 50.62 g, respectively. Daily protein intake from plant-based foods in Europe and Russia ranges from 25.81 g (Slovakia) to 59.98 g (Bosnia and Herzegovina), while that of Africa ranges from 26.15 g (Central African Republic) to 72.25 (Egypt). From these figures it can be seen that New Zealand's intake of protein from plant-based products is similar to that of many nationalities.

1.3 Identified motivations and barriers to plant-based products consumption for flexitarians

Frequency and type of meat consumption has not clearly defined flexitarianism in

the previous studies. Exploring the motivators and barriers that flexitarians have for eating plant-based products may provide more insight into what drives flexitarians. These drivers could potentially define flexitarians in terms of their behaviour.

1.3.1 Health

Meat consumption has been associated with heart disease, type 2 diabetes, cancer, and hypertension (Battaglia Richi et al., 2015; Tso et al., 2020; Willett et al., 2019; Zhang & Zhang, 2018). Consumers may choose to reduce their meat consumption because they are concerned about this association. Further, consumers choose to limit their meat intake based on safety of meat products, in terms of carrying diseases e.g. Salmonella, E. coli, BSE/mad cow disease (Singer & Hofacre, 2006) and added substances e.g. antibiotics, hormones (Fiorentini et al., 2020; Hwang et al., 2020; Singer & Hofacre, 2006). In contrast, consumers may not want to reduce meat, or exclude meat completely in their diet, because of the nutritional benefits they associate with eating meat.

Health and nutrition have been identified as both motivators (Dagevos & Voordouw, 2013; Faber et al., 2021; Forestell et al., 2012; Graça et al., 2015; Kemper, 2020; Latvala et al., 2012; Niva & Vainio, 2021; Verain et al., 2015) and barriers (Dagevos & Voordouw, 2013; Kemper, 2020) to meat reduction. In most studies (Dagevos & Voordouw, 2013; Latvala et al., 2012; Niva & Vainio, 2021; Verain et al., 2015) the perceived health benefits of reducing meat in the diet was the driver for consumers to lower meat intake. Clusters made of mostly females had the strongest health reasons for reducing meat intake (Dagevos & Voordouw, 2013; Graça et al., 2015; Niva & Vainio, 2021; Verain et al., 2015). For segment 4 of Faber et al. (2021), it was an important attribute for a product to be healthy. Verain et al. (2015) investigated health effects of reduced meat consumption under four aspects; that addressed meat as unhealthy food, that meat is linked to cancer and heart disease, and that meat causes weigh gain. The other studies (Dagevos & Voordouw, 2013; Latvala et al., 2012) only mentioned “health reasons”, “health considerations” and “healthiness” as reasons why consumers lowered their meat intake, without defining what those health reasons were. Another reason indicated by consumers for reducing meat intake was weight

management (Forestell et al., 2012).

Graça et al. (2015) found that their "affective towards meat" participants believed that meat had no impact on health unless production was unregulated or consumed in excess. Some participants in the study by Kemper (2020) reduced meat due to their child having health or eczema allergies, whereas other participants still wanted to include meat in the diet due to its nutritional benefits of being a good source of protein and iron. Similarly, the "meat lovers" cluster (Dagevos & Voordouw, 2013) had low ratings for eating less meat due to health benefits. This cluster was mostly male (62%). The safety of meat was a motivator for meat reduction by the "disgusted by meat" and "not attached to meat" clusters (Graça et al., 2015) as they were concerned about diseases, unsafety of food and contamination. Kemper (2020) found that meat reducers were concerned about antibiotics being used in farming practices.

According to these studies, females tend to reduce their meat intake based on health motivations, however there is no trend with age. Therefore, females might be the main users of plant-based products. There is also a difference in perception of meat consumption on health between meat eaters and meat-reducers. From previous studies it can also be seen that there is a lack of detail concerning the nutrition and safety motivations and barriers of consumers for reducing meat intake.

1.3.2 Animal Welfare

Some consumers believe that animals feel pain and experience distress (Prunty & Apple, 2013). Consumers may otherwise be concerned about the conditions that animals face on factory farms where there is overcrowding of animals, possibly causing injury and disease because of lack of space and unhygienic conditions, (Anomaly, 2015). Others are concerned about overfishing, because numbers are dwindling faster than the fish can reproduce, and also because the methods used result in casualties of other marine life and destruction of coral reefs (Link & Watson, 2019). On the other hand, the literature that follows shows that animal welfare may not be a concern for some consumers.

Animal friendly production was important to the "conscious flexitarians", "meat

lovers", "unconscious flexitarians" and "potential flexitarians" clusters (Verain et al., 2015). Dagevos and Voordouw (2013) also found that it was important to the "conscious flexitarians" and "disengaged meat-eaters" that meat production was animal friendly. Segment 1 (Faber et al., 2021) considered it important for a product to be animal friendly. Similarly, animal welfare was a deciding factor for the "ongoing change: less all meat, more vegetables" cluster (Latvala et al., 2012) in changing their meat consumption, and the reason the MaPos cluster (Knaapila et al., 2022) ate plant-based products regularly.

Animal husbandry and slaughter

Kemper (2020) found that meat reducers did not talk about the slaughtering of animals and its ethical nature. Animal farming conditions were more of a concern to them. Participants in the "Disgusted with meat" cluster (Graça et al., 2015) associated the meat industry with keeping animals under poor rearing conditions and was the main reason they excluded meat.

Animals as a meat source

The "meat lovers" and "compulsive meat consumers" (Verain et al., 2015) were not opposed to animals being a meat source, whereas the "unconscious flexitarians" and "conscious flexitarians" did not like that animals were a meat source but still ate meat. The "disgusted with meat" cluster (Graça et al., 2015) associated eating meat with animal disrespect, suffering and abuse. However, the "affective towards meat" cluster argued that the purpose of livestock animals is for meat extraction and that there is only an impact when consumption or production is unregulated. Cliceri et al. (2018) found that omnivores justified their animal consumption based on an assumption that animals do not have human feelings or psychological characteristics, whereas vegetarians avoided meat based on their beliefs that animals have feelings and display psychological characteristics. Flexitarians were the median in this regard, having some form of empathy for animals reared for food and their reasonings for consuming meat.

From these studies it was evident that females, regardless of age, were more likely than males to cite animal welfare reasons for reducing meat intake. This would imply that animal welfare is a more important motivator for females than males.

1.3.3 Environment and Sustainability

Global warming and climate change are caused by greenhouse gasses (Praveen & Sharma, 2019), and in New Zealand 48.1% of greenhouse gasses are emitted by agricultural practices (Ministry for the Environment, 2019). Animals release methane gas that adds to the greenhouse gas load, and their rearing contributes to pollution of waterways, deforestation and overgrazing of land. The transport of these animal products adds to the greenhouse gasses released by the industry (Thornes, 2018). Some of these factors may motivate consumers to reduce their meat intake (Macdiarmid et al., 2016).

Eco-friendly

The environment has also been cited as a key driver to reduce meat intake (Dagevos & Voordouw, 2013; Graça et al., 2015; Kemper, 2020; Kemper & White, 2021; Knaapila et al., 2022; Latvala et al., 2012; Niva & Vainio, 2021; Vanhonacker et al., 2013; Verain et al., 2015). This was true for the "ongoing change: less all meat, more vegetables" cluster (Latvala et al., 2012) and young adults and families in the study by Kemper (2020). Similarly, Verain et al. (2015) found that environmental friendliness was important to all clusters in their study, with only "compulsive meat consumers" indicating it was of average importance. Similarly, Dagevos and Voordouw (2013)'s "conscious flexitarians" and "disengaged meat eaters" clusters scored the importance of environmentally friendly meat production highly, with the rest of the clusters, a combination of high and low meat consumers, scoring it of average importance. The NoPos, MaPref and MaPos clusters (Knaapila et al., 2022) were also motivated by the environment to eat plant-based products regularly. Sustainability was an important motivator for cluster 2 ("alternative protein increasers") and cluster 4 ("beef avoiding plant-protein increasers") of Niva and Vainio (2021)'s study. All segments in Faber et al. (2021) considered environmentally friendly to be an important attribute of products, but particularly segment 1 who had a high plant product intake. In the study by Vanhonacker et al. (2013), 'eating seasonal products' was a common approach adopted to be environmentally-friendly. "Conscious", "active" and "unwilling" clusters (Vanhonacker et al., 2013) were more aware of the environmental impact of animal production, however this

impact was still often underestimated by participants. The environmental impact of plant production was also underestimated by participants in their study, highlighting an issue that plant-based products have a greater impact on the environment than what consumers think. The “disgusted with meat” cluster (Graça et al., 2015) believed that the meat industry impacts the environment by depleting and polluting nature, whereas the “affective towards meat” cluster believed that it had no impact on nature. Young adults and retirees (Kemper, 2020) stressed the importance of consuming the whole animal from nose to tail to reduce waste. The environment was a concern for some participants knowledgeable of the impact of meat production on the environment (Kemper & White, 2021). Participants who enjoyed experimenting with new recipes would use up ingredients and avoid waste as it decreased greenhouse gas released from producing food and decomposing landfill waste (Ministry for the Environment, 2021).

Ecological Footprint

An ecological footprint is a measure of a person’s load on the environment by expending resources and producing waste weighed against how fast nature can regenerate resources and eliminate our waste (Global Footprint Network, 2021). Vanhonacker et al. (2013) clustered participants based on personal relevance, ecological footprint, and meat consumption variables. The “conscious” cluster were fully aware of their ecological footprint, the “ignorant” and “uncertain” clusters had a low awareness of their ecological footprint, and the “active” and “unwilling” clusters had above average awareness. Both the “conscious” and “active” clusters had a high concern for climate change, ecological footprint and CO_2 emissions and did not believe such factors are overstated. On the other hand, the “unwilling”, “ignorant” and “uncertain” believed somewhat that climate change, ecological footprint and CO_2 emissions are overstated and were only slightly concerned about these factors. There was no discernible trend in age or gender between these groups, apart from that education level was higher in the clusters that had a higher concern for the environment, and lower in those who had average concern. It should be noted that this study had a very small sample size that was biased towards females, 18–30-year-olds and higher education participants, and so does not give a reflection of the general population.

There was no noticeable trend in age and gender regarding environment and sustainability motivations, however from some studies (Graça et al., 2015; Latvala et al., 2012; Vanhonacker et al., 2013) it was clear that highly educated females are more likely to consider the environment and sustainability as a motivator for reducing meat intake. This might imply that the more educated consumers are, the more informed they are about environmental concerns, and that this influences their actions to lower their ecological footprint by reducing meat intake.

1.3.4 Cost

Cost of Meat

Findings concerning the impact of the price of meat as a motivator or barrier to meat consumption varied in terms of consumer perception of cost and willingness to pay. The “meat lovers”, “compulsive meat eaters” and “potential flexitarians” clusters (Verain et al., 2015) considered meat worth its cost and inexpensive, which was similar for the “conscious flexitarians”, “unconscious flexitarians” and “disengaged meat-eaters” clusters of Dagevos and Voordouw (2013). Families in Kemper (2020)’s study claimed that cost and convenience were barriers to reducing meat, as plant-based meals could take more time to prepare, and convenient plant-based products are often expensive. In these cases, the cost of meat did not drive consumers to look for less expensive, possibly plant-based alternatives, either because they consider meat worth its cost or because plant-based products were more expensive. These clusters tended to be either balanced in male to female ratio or female dominant and consist of older individuals (30 to 65+ years). Perhaps the reason for this is that older females tend to be the main shoppers in households and would therefore have a better understanding of meat prices.

The opposite was found with “conscious flexitarians” and “unconscious flexitarians” clusters (Verain et al., 2015), who claimed meat was expensive and that they wanted to pay less for it, whilst the “meat-lovers” and “extravert flexitarian” clusters (Dagevos & Voordouw, 2013) felt meat was expensive, but worth the price. There is no apparent trend between these and other clusters in terms of gender or age.

All the clusters in Vanhonacker et al. (2013)'s study were willing to pay a premium price for organic meat. The "unwilling", "ignorant" and "uncertain" clusters were against an 'unsustainable meat' tax.

Cost of Plant-based Products

Participants claimed that meat imitation and vegetable burger products were expensive (Kemper, 2020). Vanhonacker et al. (2013)'s "conscious" and "active" clusters were the only clusters willing to pay a premium price for plant-based alternatives to meat, implying that most people want to be paying prices at least comparable to that of meat, or ideally less, for plant-based products. Low price was an important motivator for clusters 1 ("established beef lovers"), 3 ("established 'light' flexitarians") and 5 ("beef reducers") in Niva and Vainio (2021)'s study. Similarly, affordability was an important attribute of a product for segments 2, 3 and 4 (Faber et al., 2021). The high cost of plant-based products could be a barrier to switch to plant-based products. All clusters in Vanhonacker et al. (2013)'s study were positive towards sustainable alternatives being subsidised by the government, which included organic meat and hybrid products together with plant-based products.

1.3.5 Social Status, Culture and Religion

The literature showed that consumers might be reluctant to reduce or increase, their meat intake, and include more plant-based products in their diet because of reasons relating to social status or culture aspects. The "unconscious flexitarians" and "compulsive meat eaters" (Verain et al., 2015) indicated that they obtained status from eating meat. Similarly, the "extravert flexitarian" cluster (Dagevos & Voordouw, 2013) believed that meat enhances status. These clusters were mostly male dominant and ages varied across the age spectrum and were in the minority. Despite popular belief that meat consumption is linked to affluence, studies (Chan & Zlatevska, 2019; Davison et al., 2021) have shown the opposite. Chan and Zlatevska (2019) found that meat preferences were affected by socioeconomic status and that those of low socioeconomic status have higher liking for meat than individuals of high socioeconomic status. This could be because of the perception of the low socioeconomic status that more affluent people eat more meat, and

that by eating more meat it gives the impression that they are affluent. Similarly, Davison et al. (2021) found that more affluent participants were inclined to consume less meat. Graça et al. (2019) observed that consumers who were concerned about their social image were inclined to consume fewer plant-based products per week. Social status can therefore be a possible barrier to reducing meat intake for these studies.

According to Kemper (2020), "meat and three veg" was part of most participants' upbringing, so having meat as the centre part of the meal was common and important growing up. But now their meals differ from the ones from growing up, indicating that upbringing does not necessarily influence meal and meat preferences as an adult. New Zealanders also have a strong link to farming and agriculture as part of their culture (Kemper, 2020). A strong connection between meat and masculinity meant it was a barrier for many families to go meat-free as it was not seen as a meal if there was no meat. Kemper and White (2021) found that when at social gatherings, many participants did not want to force their flexitarian diet onto others and be perceived as being difficult or judgemental. There was a greater level of comfort in discussing their flexitarian diet with friends, as opposed to family, because they believed friends accepted their diet. Culture, masculinity of meat, and social acceptance can thus be considered barriers to reducing meat intake, particularly in New Zealand.

Religious beliefs can dictate whether certain foods are allowed to be consumed or not (Asgar et al., 2010). Islamic faith does not allow for the consumption of pork, and beef needs to be slaughtered in a certain way in order to be considered halal (Asgar et al., 2010). Buddhism, Jainism and Hinduism is deeply rooted in vegetarianism because of ahimsa (no harming of living things)(Stoll-Kleemann & Schmidt, 2017), whereas Judaism and Christianity may have sporadic exclusion of meat (Lentz et al., 2018). De Boer et al. (2017) found the percentage of native Dutch consumers who reduced meat because of their religion was 4% for vegetarians, 13%, 10% and 5% for low, medium and high meat-eaters, respectively. Malek and Umberger (2021b) differed in percentages for Australian flexitarians, with 9.4%, 11.1% and 2% for 'Light meat reducers – indiscriminate meat eaters', 'Light meat reducers chicken, pork, and fish eaters' and 'Light meat

reducers - chicken and beef eaters', respectively. The moderate meat reducers who reduced meat because of religion were less (1.6%) than De Boer et al. (2017) found, and high meat reducers were 7.2%. Plant-based products would thus be an attractive option to these consumers who base their meat reduction on their religions. Religion would therefore be a motivator to consuming less meat and more plant-based products.

1.3.6 Food Neophobia and Familiarity

Food neophobia is when a person is reluctant to try a new food, or avoid novel foods, and is believed to serve a protective purpose when a food environment is possibly hostile (Pliner & Hobden, 1992). Some plant-based products are quite new in relation to foods that humans have eaten for generations, whereas others, for example falafels, would only be a new cultural experience for some. Food neophobia can therefore be a possible barrier to eating plant-based products. All clusters from Verain et al. (2015)'s study enjoyed ethnic food, implying that most of their participants were open to trying different cuisines. This is similar to what Kemper (2020) found, that a more recent shift in internationalization and culture resulted in mothers, retirees and young adults being exposed to new cooking methods, cuisines, and products. In the study by Knaapila et al. (2022), the MeatPref and BothPos clusters ate plant-based products regularly because they liked trying new foods. The "conscious flexitarians" and the "potential flexitarians" of Verain et al. (2015), which were female dominant and mostly of the age group 46-65 years, were the most open to trying new foods. On the other hand, the "unconscious flexitarians", which had the largest 30-45-year age group, had the highest distrust of new food. The results of Kemper (2020) is somewhat in contrast to those findings, in that their young adults were willing to try meat substitutes, however the families and retirees, i.e. the older participants, had reservations about consuming meat substitutes. Forestell et al. (2012) found that pesco-vegetarians and vegetarians were more variety seeking and had reduced food neophobia and were interested in new experiences compared to omnivores.

There was no discernible trend in gender or age relating to food neophobia in these studies. Food neophobia has not been indicated as a key barrier to plant-based products but to be of low concern when considering the literature. It is

possible that food neophobics are less likely to take part in food or online studies, and therefore are underrepresented in studies. Olabi et al. (2015) and Proserpio et al. (2018) found that recruiting high food neophobics was difficult, however Jaeger et al. (2021) found that doing an online study increased the number of participants that classify as neophobic. Food neophobia may be more relevant to non-plant-based meat alternatives such as insects and cultured meat (Dupont & Fiebelkorn, 2020; Onwezen et al., 2021).

Familiarity of food has to do with consumers choosing to consume foods that they know and recognise (Onwezen et al., 2021). If a product, such as seaweed, is unfamiliar to a consumer, it will be harder for them to accept that product (Birch et al., 2019). Increasing consumer experiences with those products could increase familiarity and acceptance. Birch et al. (2019) observed that familiarity in eating seaweed products made respondents 7.6 times more prone to eating it. Consumers that were more familiar with plant-based products were more likely to accept and purchase plant-based products (Bryant et al., 2019). Repeated exposure increased liking for plant-based products (Hoek et al., 2013), suggesting that familiarity improves liking of these products. Familiarity is therefore a motivator to consuming plant-based products.

1.3.7 Emotional response

Food choice is not merely determined by liking, but also by emotional response (Dalenberg et al., 2014). Emotional response is likely to play a determining role in choosing to reduce meat intake and eat more plant-based products. For the “disgusted with meat” cluster (Graça et al., 2015), meat was associated with suffering, disgust and death as opposed to consuming no meat being associated with feeling well and having a clear conscience. For the “not attached to meat” cluster no meat consumption was associated with indifference and feeling that they would adapt to not eating meat. The “affective towards meat” cluster was very emotional about meat, with no meat consumption associated with feeling weak, sad, bad, and missing something, and eating meat associated to pleasure and being satiated and being a symbol of food and eating. Kemper and White

(2021) found that increased awareness and knowledge about the environment resulted however in feelings of guilt towards eating meat but controlling or reducing meat resulted in positive feelings of pride and achievement towards themselves.

Although emotional response is acknowledged as being important when considering plant-based products and meat reduction, it was not studied in detail in this study as a coresearcher was specifically looking at this for the wider catalyst programme.

1.3.8 Meat Substitute Criteria

When consumers choose which plant-based products to buy, certain criteria need to be met, which criteria include processing level, taste, nutrition, or certification of the product (Dhawan & Choo, 2021; Kemper, 2020; Michel et al., 2021).

Processing

Kemper (2020) found that reducing meat consumption was based on knowledge of meat production as well as processed foods, which also led to decisions to consume wholefoods and homemade foods to avoid additives and chemicals. There was a concern about meat substitutes in terms of the extent to which they are processed and replacing animal products with more ethically sourced ones e.g., free-range, organic, home-kill was a more attractive option. Consumers in Norway and France were opposed to meat replacers because its highly processed nature (Varela et al., 2022). They were concerned of the additives and did not know what they were consuming. Similarly, 45% of respondents in a North American survey found plant-based products too processed (Clark & Bogdan, 2019), and lesser-processed plant-based products were preferred. In Finland, ‘naturalness’ was also a motivator for all clusters of Niva and Vainio (2021). For segments 2 and 4 (Faber et al., 2021), who were consumers in Denmark, Germany and Spain, it was important that products be minimally processed.

Sensory experience

Consumers want food to taste good (Szejda et al., 2020), regardless of it being of animal or plant origin. Consumers will not continue to buy a product that they do not find tasty (Szejda et al., 2020). Consumers might prefer their plant-based

product to taste meat-like or not. Michel et al. (2021) showed that the participants had a weak preference towards meat-like tasting meat alternatives. For the MeatPos and MeatPref clusters (Knaapila et al., 2022), taste was a barrier to eating plant-based products. Segment 4 of Faber et al. (2021) considered sensory appeal to be an important attribute of a product. Taste was the fourth and first most important deciding factor for vegetarian and non-vegetarian Gen Z's, respectively, when considering purchasing decision of plant-based products. This suggests that sensory experience was more important to non-vegetarian Gen Z's, and that dietary groups may have very different demands of a product.

Nutrition

Although many studies note nutrition as a reason for consumers to reduce their meat intake, literature on nutrition influencing consumer purchase of plant-based products is scarce. Dhawan and Choo (2021) found that nutrition was the 6th and 5th most important deciding factor for vegetarian and non-vegetarian Gen Z's, respectively, when choosing plant-based food. This suggests that nutrition is more important to non-vegetarians for choosing plant-based products. Participants perceived plant-based products like falafels, tempeh and tofu as healthier options compared to meat substitutes (Kerslake et al., 2022).

Availability

Availability of plant-based products refers to how easily they can be obtained to cook with, how accessible they are to the consumer (Ogot, 2021). Reipurth et al. (2019) found that respondents who had the lowest meat consumption had the most positive attitude regarding the availability of plant-based products. When eating out, consumers saw the lack of options for plant-based foods as a barrier to a plant-based diet (Lea et al., 2006). Sixty-five percent of consumers who were willing to try protein alternatives said that availability was important to them in deciding to purchase plant-based products (Clark & Bogdan, 2019). When products were unavailable at consumers' main shopping destination, it was seen as a barrier to purchasing plant-based products. Therefore, availability is a motivator and unavailability a barrier to consuming more plant-based products.

Cooking/preparation

The ease with which a food can be prepared will influence whether the consumer will eat that food on a continuous basis (Sajdakowska et al., 2018). Reipurth et al. (2019) found that three of their four clusters agreed that they found plant-based food difficult to cook, which equated to 52% of respondents. Clusters had a combined median age of 31 and were female dominant, however the sample was biased to females. They found that respondents that consumed more animal-based diets found it more difficult to cook plant-based foods. Participants from Lea et al. (2005) noted that legumes take too long to prepare because of soaking and long cooking times, and some participants did not know how to use legumes in meals. Cooking and preparation of plant-based product can therefore be a barrier to consuming them.

1.3.9 Industry and Authorities

The food industry and government authorities have direct and indirect control over which foods are available to consumers. This can be through regulations that govern foodstuffs or through products developed by the industry. Whether consumers engage with plant-based products and reduce their meat intake may therefore be influenced by industry and authorities.

Responsibility

In the Netherlands, the “meat lovers” and “compulsive meat consumers” cluster (Verain et al., 2015) believed that governments should not increase the tax on meat. The “unconscious flexitarians”, “conscious flexitarians” and “potential flexitarians” felt that it is the responsibility of consumers themselves to reduce meat consumption. “Conscious flexitarians” believed that the government should reduce meat consumption by raising taxes or by interventions, that supermarkets should increase meat alternatives, and that organisations should guide consumers. Likewise, the “potential flexitarians” also noted that it is the responsibility of organisations to guide consumers, and that government should use campaigns to reduce meat consumption.

Production Methods

“Not attached to meat” cluster from the study of Graça et al. (2015) associated

the industry with artificial methods and mass production of animals in Portugal. Participants of Kemper (2020) had a distrust of authorities and felt the need for transparency in the supply chain. They also argued that consumption of animal products was encouraged through government initiatives and industry, and that reducing meat was not being advocated in New Zealand.

These studies highlight that industry and authorities could be a barrier or motivator to consumers reducing meat intake and eating more plant-based products.

1.3.10 Sensory properties of plant-based products

Plant-based products are often seen as inferior in their taste, odour, texture, flavour and appearance from their meat-based counterparts (Tso et al., 2020). This can be because of difficulties to mimic the juiciness and flavour compounds found in meat, as well as the presence of plant lipoxygenases, isoflavones compounds and saponins that result in grassy, astringent, and bitter off-flavours. When plant proteins are cooked, the unsaturated fatty acids undergo oxidation and volatile compounds are released (Tso et al., 2020). Animal products also contain unsaturated fatty acids, however considerably less than plant-based products (Swing et al., 2021). The undesirable volatile compounds would therefore be less pronounced in cooked animal protein.

The appearance of plant-based burgers was significantly less brown in colour than meat-based burgers when evaluated by consumers (Schouteten et al., 2016). Plant-based burgers were rated as having a less meaty aroma than meat-based burgers. Consumers rated the flavour of plant-based burgers as less meaty, and more off and nuttier, compared to beef burgers. The texture of plant-based burgers was rated significantly drier and more granular and less juicy compared to meat-based burgers. Meat-based burgers had a significantly higher liking than plant-based burgers.

Neville et al. (2017) investigated the sensory attributes of commercial burgers by consumers using Check-all-that-apply (CATA) analysis. They found that both vegetarian burgers had a processed appearance. Vegetarian burger 1 had a smoky-grill flavour, however vegetarian burger 2 had an off and wheaty flavour.

Burger 1 had a juicy and soft texture, whilst burger 2 had a firm and dry texture, similar to the results found by Schouteten et al. (2016). Vegetarian burger 1 had a significantly lower acceptability score than the meat burger, and a significantly higher acceptability score to vegetarian burger 2.

Meat analogues had a higher homogenous colour compared to beef samples in the study by Gómez et al. (2019), and had a higher liking score. Meat analogues had less cooked meat odour than beef samples and had lower hedonic scores.

In the study by Vanhonacker et al. (2013), all clusters except the “active” found meat tasty, whereas the “active” cluster only found the taste of meat average. Latvala et al. (2012) on the other hand found that participant’s motivation for change to less meat was due to taste preferences, however they neglected to explain what those preferences were towards the taste that caused the change so there remains uncertainty on this. As mentioned previously, Kemper (2020) found that for their participants, enjoyment and taste were the main reasons not to eliminate meat, which resonates with the finding of Vanhonacker et al. (2013).

In an online questionnaire by Reipurth et al. (2019), the taste of plant-based products was found to be a barrier for participants who eat more animal products, and a motivator for participants who eat less animal products. Interestingly, Cliceri et al. (2018) found that an increased sensitivity response to 6-n-propylthiouracil (PROP), a bitter-tasting compound used in sensory science, lead to a more positive viewpoint of animal-based meal and negative viewpoint of plant-based meals. Thus, it is possible that bitter sensitivity affects people's ability to convert to a plant-based diet. No literature could be found that investigates the sensory properties of non-meat analogue plant-based products, such as tofu, falafels or tempeh.

1.4 Conclusion

Although various motivations and barriers have been investigated by previous researchers, there are gaps in the data and areas that have scarcely been investigated. These include values and attitudes concerning sensory appeal, meat substitute criteria for choosing plant-based products, food safety and trust in and responsibility of industry and authorities. No research has been done to the

author's knowledge on identification of flexitarian clusters, and associated drivers, in the New Zealand population. Flexitarians constitute the bulk of plant-based product consumers and hence investigation of their motivations and barriers is highly warranted. Different types of flexitarians might prefer different products and therefore it is necessary to understand needs of each flexitarian type. Previous studies indicate a lack of details concerning the nutrition and safety as motivations and barriers for plant-based product intake by consumers. Using plant-based products to replace meat for environmental reasons has not been examined in New Zealand. There is a gap in the research concerning the virtuous and ethical aspects of social status for consumers in plant-based research. There also seems to be a lack of information regarding the social status that eating plant-based products brings for consumers. This study also intended to include food neophobia of flexitarians in New Zealand as a potential barrier to engaging with plant-based products. Gaps in the literature were evident for meat substitute criteria. No literature was found concerning the desire for plant-based products to have non-meat-like attributes. Furthermore, no studies have investigated if individual nutrients influence food choice and purchase, or what nutrition criteria are important for Millennials and Generation X. Lastly, literature on whether certification for organic, free from genetically modified ingredients, or sustainably made, influences purchase of plant-based food by consumers is lacking. In terms of sensory appeal, a gap can be seen in literature relating to consumer sensory evaluation of commercially available plant-based products in New Zealand that explores sensory parameters instead of liking/acceptability, particularly of non-meat analogue products such as tofu, tempeh, and falafels. There is also a gap in the literature concerning the relative impact of sensory motivations and barriers in categorising different types of flexitarians.

This study aimed to address these gaps by studying New Zealand flexitarian consumers and identifying which barriers and motivators affect their decisions concerning plant-based products. This was addressed using an online survey to investigate which factors drive New Zealand flexitarian consumer decisions concerning plant-based product consumption and how New Zealand consumers can be categorised. The findings of this research aimed to provide valuable

information on satisfaction of and preferences for plant-based product sensory attributes, the criteria consumers look for when selecting plant-based products, whether social status is gained from consuming plant-based products, safety concerns over food and trust in the food industry and government authorities. Further whether males and females, Millennials and Generation X, and subgroups of flexitarians differ from each other in terms of drivers of engagement with plant-based foods. Identifying the motivations and barriers that are key in engagement with plant-based products is key to assist industry in their product development and marketing endeavours and guide industry on what type of products to target at certain demographic groups or subgroups of flexitarians.

1.5 Research questions

The key research questions were as follows:

1.1 Does age and identified gender influence motivations and barriers for engaging with plant-based products in New Zealand flexitarians?

1.2 What sensory properties do New Zealand flexitarians report drive their plant-based product preferences?

1.3 Can New Zealand flexitarians be segmented according to different motivations and barriers associated with plant-based products?

1.6 Objectives

- Determine whether health, nutrition, social status, food neophobia, sensory, animal welfare, the environment and the food industry are barriers and motivations for flexitarians adopting a plant-based diet
- Identify and define the flexitarian consumers in New Zealand, by grouping them into clusters based on their motivations and barriers towards plant-based products
- Investigate the effect of age on motivations and barriers for meat-reduction
- Investigate the effect of identified gender on motivations and barriers for meat-reduction
- Investigate the effect of meat consumption level on motivations and barriers for meat-reduction

- Determine whether taste, smell, texture, or appearance is important to flexitarians when deciding to consume plant-based products

1.7 Hypotheses

- Health, nutrition, food novelty, animal welfare and the environment will be motivators, and social status, sensory, safety, and the food industry will be barriers to adopting a plant-based diet
- Flexitarian clusters will be grouped according to motivations and barriers above
- Millennials (1981-96) will differ from Generation X (1966-80) in their motivations and barriers for meat reduction
- Female consumers will differ from males in their motivations and barriers for meat reduction
- Different meat consumers will differ from each other in their motivations and barriers for meat reduction
- Different flexitarian clusters will have different reported preferences for taste, smell, texture, appearance, and sensory attributes thereof

2. Materials and Methods

This study aimed to investigate the motivators and barriers of New Zealand flexitarians to consume commercially available plant-based products, in order to observe if there are any differences in age or identified gender, and to see if they could be segmented based on those motivators and barriers. An online questionnaire was used to collect data for this investigation.

The study was evaluated by peer review and judged to be low risk as per the Massey University Human Ethics Committee guidelines (Ethics Notification Number: 4000024924)

2.1 Participants

The final questionnaire was distributed through Dynata (Dynata™, New Zealand) to relevant participants (n=801) in New Zealand, of age 25 to 55 years, identified gender (male, female, another), meat consumption frequency (6 days per week

to less than monthly, 5 categories) and having tried plant-based products at least once. This was done in conjunction with Dynata to recruit across New Zealand to fill 30 quota groups. Millennials (25-40 years old) and Generation X (41-55 years old) were the focus of this study as they are the current and future consumers of plant-based products (Alae-Carew et al., 2022; Kamenidou et al., 2021; Knaapila et al., 2022). The study aimed for 38 counts in each male/female-age-meat consumption frequency combination, and 4 counts in each another gender-age-meat consumption frequency combination. The percentage of participants who identified with another gender (e.g. non-binary, bi-sexual, androgyne) will be quantified in the 2023 census (Stats New Zealand) and were included to 5% of participants.

2.2 Questionnaire development

Figure 1 shows the overall process of questionnaire development for the online survey.

2.2.1 Initial questionnaire

The questionnaire was presented in Qualtrics (Provo, UT). Categories of motivations and barriers to eating meat and plant-based products were identified from the literature: sensory drivers, meat substitute criteria, safety, industry and authorities, nutrition, health, social status, food novelty/neophobia, animal welfare, environment and sustainability. These were the category sections and were asked in the same order as mentioned by the motivators and barriers, which came after demographic and food consumption frequency questions were asked. Cost is known to be a primary determinant of food choice behaviour (Tso et al., 2020) and hence was excluded from this questionnaire to focus on other factors specific to plant-based foods. Questions were formulated under each category (see Appendix 1 for changes to questionnaire).

There was a need to ask for consumption levels of meat. The initial meat consumption frequencies put out for meat were identified as 7 days per week, 5-6 days per week, 3-4 days per week, 1-2 days per week, fortnightly, monthly, less than monthly, and never. Respondents that ate meat 7 days a week or never were

screened out of the questionnaire. It was also necessary to ask for satisfaction levels of currently available plant-based products. Satisfaction levels were included in the questionnaire to gauge consumers' satisfaction level of sensory aspects (appearance, smell, taste/flavour, texture/mouthfeel) of currently available plant-based products. This was measured on a 7-point Likert scale (1-always dissatisfied to 7-always satisfied).

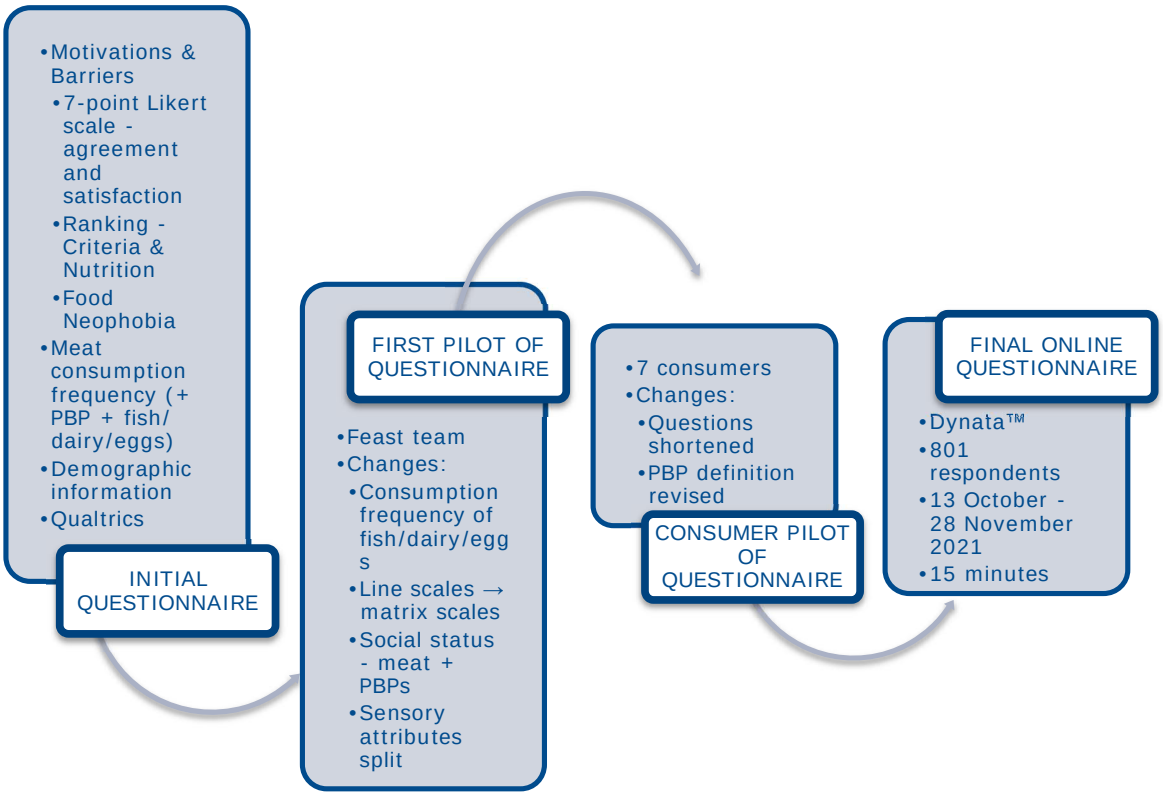

Figure 1: Diagram of questionnaire development stages

Statements were assigned to a 7-point Likert scale (1-strongly disagree to 7-strongly agree). This was assigned to questions about preference for sensory attributes; criteria for choosing plant-based products regarding nutrition, degree of processing, genetically modified ingredients, organic and environmentally friendly; safety of foods consumed; trust in the food industry/government authorities and responsibility of meat reduction; nutrition; health; social status associated with eating meat and plant-based products; animal welfare aspects;

and environmental sustainability and habits of consumers (Appendix 1).

Two sections of ranking questions were added that concerned criteria when selecting plant-based products, and nutrition. Statements were ranked from 1 'most important' to 6 'least important' for criteria for selecting plant-based products ('tastes like meat', 'made with wholefoods', 'no genetically modified ingredients', 'organic', and 'is environmentally friendly'). Similarly, criteria for nutrition, statements were ranked from 1 'most important' to 7 'least important' ('high in protein', 'low in fat', 'high in fibre', 'low in sugar', 'low in sodium', 'high in vitamins and minerals', and 'low in starchy carbohydrates'). Questions on the extent of food neophobia was added according to the method of Pliner and Hobden (1992).

Data on identified gender (male, female, another gender) and age (25-40 years, 41-55 years) of the respondents were gathered for analysis, whereas ethnicity, area of residence, and household income were gathered to characterise the participant sample. Those who did not wish to indicate identified gender, or who were less than 25 or more than 55 years old, were screened out from the questionnaire.

The questionnaire was then set up using line scales for the Likert scales. After it was set up on Qualtrics, plant-based products, fish, dairy, and eggs consumption frequency was added.

2.2.2 Initial pilot of questionnaire

Following an in-house pilot with peers in the Feast team, the questionnaire was revised (Appendix 1). The frequency of fish, dairy, and egg consumption was revised to reflect that of meat. Line scales were replaced by matrix scales. Statements were worded more appropriately. Social status was split into two questions, one relating to meat and one relating to plant-based products. 'Biological sex' was changed to 'identified gender'. "Family income' was changed to 'personal income'. The sensory attributes question was split into two questions as it was too long as one. Instructions were added to ranking questions on how to click and drag.

2.2.3 Consumer pilot of questionnaire

Next, a pilot was run with seven naïve individuals from the Feast consumer database identifying as flexitarian. Their comments were used to make the final improvements to the questionnaire. Questions were shortened where possible and plant-based products definition was amended. The final questionnaire can be found in Appendix 2.

2.2.4 Final online questionnaire

The questionnaire ran from 13 October to 28 November 2021. Dynata administered the survey to their panel. The questionnaire took approximately 15 minutes to complete, and consent was given by respondents to partake in the questionnaire.

2.3 Data analysis

Data was analysed using R software (v4.1.0) accessed via RStudio (v1.4.1106, © 2009-2021 RStudio, PBC). An alpha risk of ≤ 0.05 was used for all analyses. Means, standard deviations and percentages of results were reported using descriptive statistics. Respondents who identified as another gender were too few and were removed from subsequent analyses. Meat consumption frequencies were combined into three categories to make comparison of results easier: low (fortnightly, monthly, and less than monthly), medium (1-3 days) and high (4-6 days). Similarly, plant-based consumption frequencies were combined into four categories to make comparison of results easier: tried once, low (fortnightly, monthly), medium (1-3 days) and high (4-6 days, 7 days).

Analysis of variance (ANOVA) using a linear model for each motivation and barrier variable was carried out with age (Generation X/Millennials), identified gender (males/females), and different meat consumption frequencies, as factors. Benjamini-Hochberg post-hoc analysis (Ogle et al., 2021) was used to determine significant differences. A generalised linear model using Chi square analyses was used to identify how scores of variables were associated between questions.

Ranking of most important criteria when choosing plant-based products and

nutritional factors was analysed with a generalised linear model using Chi square analyses.

Food neophobia level was calculated as a score for each individual respondent (Pliner & Hobden, 1992). Questions 1, 4, 6, 9 and 10 were reverse scored as per the method of Pliner and Hobden (1992) because those questions had opposite orientation to neophobia. For example, if an individual had a food neophobia ratings on the 7-point Likert scale of 6+6+6+3+6+6+7+5+5+6, reverse scoring would be 2+6+6+5+6+2+7+5+3+2. The formula (Equation 1) for calculating neophobia score was:

$$-Q1 + Q2 + Q3 - Q4 + Q5 - Q6 + Q7 + Q8 - Q9 - Q10 \qquad \text{Equation 1}$$

where signs indicate if they are original or reverse scored. Values were summed to obtain a food neophobia score for each respondent. The mean and standard deviation of all scores was calculated. The thresholds for high (or low) neophobia were determined by adding (or subtracting) the standard deviation to/from the mean. Anyone below the threshold was classified as having low neophobia whist anyone above the upper threshold was classified as having high neophobia. Everyone whose neophobia score was within one standard deviation of the mean was classified as medium neophobic. Spearman's rank correlation and ANOVA was performed between food neophobia and identified gender, age, meat consumption and plant-based product consumption, respectively.

Clustering of flexitarians was carried out using K-means clustering (Forgy, 1965). Clusters were chosen based on personal judgement of the percentage obtained when dividing the between sum of squares by the total sum of square; this did not differ much between 3, 4, and 5 clusters. Variables of sensory, safety, industry/authorities, nutrition, health, social status, food neophobia, animal welfare and the environment were used for clustering. A linear model was fitted to look for associations between cluster membership and demographic variables. Linear model using ANOVA and Benjamini-Hochberg post-hoc analysis (Ogle et al., 2021) was used to determine significant differences between cluster means for each variable.

3. Results

3.1 Respondents

After analysis of data, 209 respondents were identified as 'no-effort'[2] respondents and were subsequently removed from further analyses. Demographic information relating to the respondents is displayed in Table 4. There were slightly more female and Millennial respondents than male and Generation X respondents, respectively. New Zealand Europeans made up most of the respondents (59.1%), followed by Māori (8.6%), Indian (13.7%) and Other (10.3%). Remaining ethnicities made up less than 10% of the respondents. Most respondents lived in urban settings (68.2%). Thirty-eight percent of respondents had a personal income between $50,000-$99,999, and a small percentage of respondents earned less than $20,000 (9.5%) or more than $200,000 (1.9%).

3.2 Opinions regarding motivations for and barriers to consuming plant-based products

3.2.1 Sensory experience

Satisfaction with sensory properties and preference for sensory attributes of plant-based products by flexitarians is shown in Table 5. Notably, for satisfaction with sensory aspects of plant-based products, low and medium meat consumption respondents were significantly more satisfied with the texture/mouthfeel of plant-based products than high meat consumption respondents. Medium meat consumption respondents scored satisfaction with taste/flavour of plant-based products significantly higher than high meat consumption respondents but not significantly different from low meat consumption respondents. However, although significant differences existed, satisfaction for taste/flavour and texture/mouthfeel, was scored neutral on average by all meat consumption levels.

[2] Respondents who simply answer the same to every question with the sole aim of claiming disturbance allowance

Table 4: Descriptive statistics of respondents who completed the online questionnaire

		Total	%
Age	25-40	332	56.1
	41-55	260	43.9
Identified gender	Male	275	46.5
	Female	309	52.2
	Another	8	1.4
Ethnicity	NZ European	350	59.1
	Māori	51	8.6
	Samoan	8	1.4
	Cook Islands Māori	1	0.2
	Tongan	2	0.3
	Niuean	1	0.2
	Chinese	37	6.3
	Indian	81	13.7
	Other	61	10.3
Area of residence	Rural	126	21.3
	Urban	404	68.2
	In-between	62	10.5
Personal income	Less than $20,000	56	9.5
	$20,000-$49,000	124	20.9
	$50,000-$99,999	226	38.2
	$100,000-$199,999	137	23.1
	$200,000 +	11	1.9
	Prefer not to say	38	6.4

Females agreed somewhat that their ideal plant-based products should be savoury/umami, whereas males were neutral. Both males and females disagreed somewhat that their ideal plant-based products should be sour or dry, with females scoring significantly lower than males. Females disagreed and males disagreed somewhat that their ideal plant-based product should be bitter or bleed-like-meat. Females disagreed somewhat that their ideal plant-based product should be sweet, chewy, grainy, pasty, tastes of legumes or have a meat-like smell, whereas males were neutral. Males scored significantly higher than females for meat-like appearance, taste/flavour, texture/mouthfeel, and salty taste,

however average scores for both identified genders were neutral.

Table 5: Means scores[‡] for motivation and barrier variables for sensory satisfaction and ideal preference in plant-based products (PBPs) by identified gender, age and meat consumption

Variables		Identified gender[††]		Age (years) [††]		Meat Consumption[††]		
		Female	Male	25-40	41-55	Low	Medium	High
Sensory satisfaction with PBPs	Appearance	4.51±1.44	4.41±1.55	4.55±1.47	4.36±1.51	4.22±1.72	4.67^{a}±1.39	4.51±1.33
	Smell	4.53±1.30	4.45±1.44	4.56±1.37	4.41±1.36	4.36±1.59	4.69±1.23	4.44±1.26
	Taste/flavour	4.55±1.43	4.52±1.60	4.59±1.50	4.47±1.53	4.54^{ab}±1.59	4.74^{a}±1.47	4.36^{b}±1.46
	Texture/mouthfeel	4.55±1.46	4.57±1.54	4.63±1.49	4.47±1.49	4.66^{a}±1.61	4.73^{a}±1.40	4.33^{b}±1.45
Sensory preference for PBPs	Meat-like appearance	4.07^{bD}±1.52	4.52^{aEF}±1.48	4.31^{G}±1.41	4.25^{GH}±1.64	4.09^{BCD}±1.53	4.31^{EF}±1.52	4.41^{G}±1.49
	Meat-like smell	3.70^{bC}±1.55	4.25^{aCDE}±1.51	4.01^{DE}±1.48	3.90^{EF}±1.65	3.87^{AB}±1.56	3.97^{CD}±1.59	4.03^{F}±1.53
	Meat-like taste/flavour	4.20^{bDE}±1.55	4.67^{aFG}±1.53	4.38^{G}±1.49	4.48^{H}±1.63	4.16^{bBCDE}±1.51	4.41^{abEF}±1.46	4.64^{aGH}±1.64
	Meat-like texture/mouthfeel	4.33^{bE}±1.40	4.65^{aFG}±1.48	4.50^{G}±1.35	4.45^{H}±1.56	4.22^{bBCDE}±1.43	4.50^{abF}±1.47	4.68^{aH}±1.41
	Bleed-like-meat	2.93^{bA}±1.60	3.65^{aA}±1.67	3.37^{A}±1.66	3.14^{A}±1.68	3.52^{aA}±1.77	3.38^{aA}±1.67	2.96^{bAB}±1.55
	Juicy/moist	$5.07^{\dagger F}$±1.22	$4.89^{\dagger G}$±1.31	4.92^{H}±1.25	5.07^{I}±1.28	4.60^{bFG}±1.34	5.09^{aG}±1.18	5.21^{aI}±1.19
	Savoury/umami	5.03^{aF}±1.17	4.73^{bFG}±1.31	4.83^{H}±1.25	4.96^{I}±1.23	4.60^{bFG}±1.34	5.04^{aG}±1.18	4.99^{aI}±1.18
	Spicy/flavourful	$5.03^{\dagger F}$±1.21	$4.85^{\dagger G}$±1.34	4.91^{H}±1.26	4.98^{I}±1.29	4.84^{G}±1.33	4.91^{G}±1.33	5.06^{I}±1.18
	Sweet	3.55^{bC}±1.34	4.12^{aCD}±1.32	3.94^{aDE}±1.38	3.66^{bCDE}±1.31	4.28^{aDEF}±1.30	3.80^{bC}±1.35	3.45^{cDE}±1.30
	Sour	3.07^{bAB}±1.37	3.80^{aAB}±1.48	$3.52^{\dagger AB}$±1.54	$3.28^{\dagger AB}$±1.35	4.00^{aBCD}±1.41	3.45^{bAB}±1.51	2.91^{cAB}±1.29
	Bitter	2.94^{bA}±1.38	3.68^{aA}±1.61	3.48^{aAB}±1.57	3.04^{bA}±1.44	3.90^{aBC}±1.57	3.36^{bA}±1.56	2.73^{cA}±1.26
	Salty	4.04^{bD}±1.25	4.31^{aDE}±1.28	4.29^{aFG}±1.28	4.00^{bFG}±1.24	4.46^{aEF}±1.29	4.12^{bDE}±1.31	3.97^{bF}±1.18
	Chewy	3.58^{bC}±1.39	4.32^{aDE}±1.35	4.07^{aEF}±1.41	3.74^{bDE}±1.41	4.26^{aDEF}±1.43	3.97^{aCD}±1.43	3.62^{bE}±1.35
	Grainy	3.53^{bC}±1.35	4.09^{aCD}±1.43	3.92^{aDE}±1.43	3.64^{bCDE}±1.38	4.30^{aDEF}±1.43	3.75^{bBC}±1.44	3.42^{cCDE}±1.24
	Pasty	3.29^{bB}±1.47	4.07^{aCD}±1.41	3.80^{aCD}±1.46	3.47^{bBC}±1.51	4.18^{aBCDE}±1.45	3.73^{bBC}±1.44	3.17^{cBC}±1.42
	Dry	3.08^{bAB}±1.44	3.77^{aAB}±1.52	3.60^{aBC}±1.54	3.15^{bA}±1.45	3.99^{aBCD}±1.53	3.47^{bAB}±1.49	2.86^{cA}±1.33
	Taste of legumes	3.59^{bC}±1.38	4.03^{aBC}±1.48	3.99^{aDE}±1.44	3.54^{bBCD}±1.40	4.25^{aCDE}±1.37	3.97^{aCD}±1.42	3.28^{bCD}±1.36

[abc] Means with different superscripts within a factor in a row differ significantly according to ANOVA ($p \leq 0.05$)

[ABC] Means with different superscripts within a factor in a column differ significantly according to ANOVA ($p \leq 0.05$)

[†] Means with different superscripts within a row have differences approaching significance ($p<0.1$)

[††] Identified gender: Females (n=309); Males (n=275). Age (years): 25-40 (n=332); 41-55 (n=260). Meat consumption: Low (n=181); Medium (n=181); High (n=222).

[‡] 7-point Likert scale (1-strongly disagree to 7-strongly agree)

Both Generation X and Millennials disagreed somewhat that their ideal plant-based product should be sweet, bitter, grainy, pasty, dry and taste of legumes, however Generation X scored significantly lower than Millennials. Millennials were neutral that their ideal plant-based product should be grainy, whereas Generation X disagreed somewhat to a significant extent. Both Generation X and Millennials were neutral concerning whether the ideal plant-based product should be salty, but with Millennials scoring significantly higher on average than Generation X.

Increasing meat consumption frequency increased scores for meat-like taste/flavour and texture/mouthfeel of the ideal plant-based product but was rated as neutral by all meat consumption frequencies. Low and medium meat consumption respondents disagreed somewhat that their ideal plant-based product should bleed-like-meat, and high meat-consumption respondents disagreed significantly more. Medium and high meat consumption frequency respondents agreed that their ideal plant-based product should be juicy/moist and savoury/umami, significantly more so than low meat consumption respondents who were neutral about those statements on average. As meat consumption frequency increased, there was a significant decrease in agreement that ideal plant-based products should be sweet, grainy, chewy, pasty and taste like legumes attributes. On average, low meat consumers were neutral and medium and high meat consumption disagreed somewhat to these attributes being ideal in plant-based products. Low meat consumers were neutral on that their ideal plant-based products should be sour, however medium and high meat consumption respondents disagreed somewhat and disagreed respectively. As meat consumption frequency decreased, there was a significant decrease in the scores that the ideal plant-based product should be bitter and dry, with low and medium meat consumption respondents disagreeing somewhat and high meat consumption respondents disagreeing on average. Low and medium meat consumption respondents were neutral that their ideal plant-based product should be salty, whilst high meat consumption respondents disagreed somewhat but not significantly less than medium meat consumption respondents.

For medium and high meat consumption frequencies their ideal plant-based product was juicy/moist and savoury/umami, significantly more than low meat

consumption respondents who were neutral. As meat consumption frequency increased, there was a significant decrease in sweet, grainy, chewy, pasty and taste like legumes attributes. Low meat consumption was neutral and medium and high meat consumption disagreed somewhat to these attributes as ideal in plant-based products. Low meat consumption was neutral on sour taste, however medium and high meat consumption respondents disagreed somewhat and disagreed, respectively. As meat consumption frequency decreased, there was a significant decrease in the scores for bitterness and dryness, with low and medium meat consumption respondents disagreeing somewhat and high meat consumption respondents disagreeing. Low and medium meat consumption respondents were neutral to the ideal plant-based product being salty, whilst high meat consumption respondents disagreed somewhat but not significantly less than medium meat consumption respondents.

All identified genders, age groups, and meat-consumption levels scored agreement that their ideal plant-based product should be savoury/umami, spicy/flavourful and juicy/moist attributes the highest. Males additionally scored meat-like flavour and texture highly as attributes for their ideal plant-based product. Females, males, Generation X, and medium and high meat consumption groups disagreed that their ideal plant-based product should be bitter, dry, sour, or bleed-like-meat. Millennials disagreed that their ideal plant-based product was bitter, sour and bleed-like-meat. Low meat consumption respondents scored the lowest for their ideal plant-based product to bleed-like-meat and to have a meat-like smell.

3.2.2 Criteria for selecting plant-based products

When selecting plant-based products, males had significantly lower agreement scores than females that high in vitamins and minerals, made with wholefoods and free of genetically modified ingredients were important to them (Table 6). For high in vitamins and minerals and made with wholefoods variables, both males and females rated that they somewhat agree that it is important when choosing plant-based products, whereas with free of genetically modified ingredients variable males were neutral whilst females somewhat agreed. Males scored significantly higher than females that tastes like meat was important, however

Table 6: Means scores[‡] for motivation and barrier variables to criteria for selecting plant-based products (PBPs), food safety concern and industry/authorities trust and responsibility by identified gender, age and meat consumption

Variables		Identified gender[††]		Age (years) [††]		Meat Consumption[††]		
		Female	Male	25-40	41-55	Low	Medium	High
Criteria for selecting PBPs	Low fat	$4.84^{B}\pm1.33$	$4.82^{AB}\pm1.33$	$4.77^{BC}\pm1.29$	$4.91^{BC}\pm1.38$	$4.75^{B}\pm1.30$	$4.90^{BC}\pm1.35$	$4.86^{AB}\pm1.34$
	Low sugar	$5.21^{\dagger CD}\pm1.23$	$5.02^{\dagger BC}\pm1.27$	$5.03^{bEF}\pm1.22$	$5.24^{aDE}\pm1.27$	$5.07^{CD}\pm1.20$	$5.08^{BCD}\pm1.31$	$5.20^{CD}\pm1.24$
	Low sodium	$4.86^{B}\pm2.29$	$4.81^{AB}\pm1.28$	$4.75^{\dagger B}\pm1.25$	$4.95^{\dagger BC}\pm1.21$	$4.78^{BC}\pm1.17$	$4.83^{B}\pm1.26$	$4.89^{AB}\pm1.26$
	High protein	$5.31^{\dagger DE}\pm1.04$	$5.12^{\dagger C}\pm1.26$	$5.18^{F}\pm1.17$	$5.27^{DE}\pm1.12$	$5.06^{bBCD}\pm1.20$	$5.23^{abCD}\pm1.20$	$5.35^{aD}\pm1.06$
	High fibre	$5.13^{CD}\pm1.17$	$5.01^{BC}\pm1.21$	$5.01^{DEF}\pm1.18$	$5.16^{CD}\pm1.20$	$5.09^{CD}\pm1.18$	$5.04^{BCD}\pm1.31$	$5.09^{BCD}\pm1.10$
	High vitamins and minerals	$5.31^{aDE}\pm1.18$	$5.04^{bBC}\pm1.20$	$5.10^{\dagger F}\pm1.18$	$5.29^{\dagger DE}\pm1.20$	$5.10^{CD}\pm1.23$	$5.19^{CD}\pm1.26$	$5.25^{CD}\pm1.11$
	Taste like meat	$4.29^{bA}\pm1.56$	$4.67^{aA}\pm1.51$	$4.49^{A}\pm1.46$	$4.45^{A}\pm1.65$	$4.33^{\dagger A}\pm1.53$	$4.41^{\dagger A}\pm1.53$	$4.64^{\dagger A}\pm1.57$
	Made with wholefoods	$5.44^{aE}\pm1.23$	$5.06^{bBC}\pm1.30$	$5.10^{bF}\pm1.26$	$5.47^{aE}\pm1.28$	$5.17^{D}\pm1.22$	$5.27^{D}\pm1.29$	$5.33^{D}\pm1.32$
	Free of genetically modified ingredients	$5.19^{aCD}\pm1.35$	$4.90^{bABC}\pm1.41$	$4.87^{bBCDE}\pm1.39$	$5.28^{aDE}\pm1.34$	$4.91^{BCD}\pm1.35$	$5.06^{BCD}\pm1.48$	$5.17^{CD}\pm1.32$
	Organic	$4.74^{B}\pm1.36$	$4.77^{AB}\pm1.29$	$4.80^{BCD}\pm1.30$	$4.70^{AB}\pm1.36$	$4.84^{BC}\pm1.12$	$4.80^{B}\pm1.43$	$4.65^{A}\pm1.40$
	Eco friendly	$5.09^{C}\pm1.26$	$4.94^{ABC}\pm1.32$	$4.99^{CDEF}\pm1.27$	$5.06^{CD}\pm1.31$	$4.99^{BCD}\pm1.26$	$5.04^{BCD}\pm1.37$	$5.02^{BC}\pm1.25$
Safety concern for	Pesticides/herbicides on plants	4.93 ± 1.56	4.84 ± 1.47	$4.70^{b}\pm1.50$	$5.12^{a}\pm1.52$	$4.64^{\dagger}\pm1.62$	$5.05^{\dagger}\pm1.48$	$4.96^{\dagger}\pm1.45$
	Antibiotics used in meat production	4.93 ± 1.59	4.82 ± 1.46	$4.69^{b}\pm1.52$	$5.12^{a}\pm1.51$	4.69 ± 1.69	4.99 ± 1.51	4.94 ± 1.40
	Genetically modified ingredients	$4.86^{\dagger}\pm1.57$	$4.64^{\dagger}\pm1.41$	$4.56^{b}\pm1.42$	$5.02^{a}\pm1.54$	4.59 ± 1.48	4.81 ± 1.54	4.85 ± 1.48
	Diseases from meat	4.84 ± 1.62	4.84 ± 1.41	$4.71^{b}\pm1.49$	$5.00^{a}\pm1.55$	4.63 ± 1.57	4.91 ± 1.54	4.95 ± 1.47
Industry/ Authorities	I trust the food industry	$4.07^{\dagger B}\pm1.42$	$4.27^{\dagger AB}\pm1.43$	$4.23^{A}\pm1.41$	$4.08^{B}\pm1.44$	$4.32^{aA}\pm1.53$	$4.27^{aAB}\pm1.40$	$3.95^{bB}\pm1.34$
	I trust the government authorities	$4.32^{bC}\pm1.43$	$4.59^{aC}\pm1.39$	$4.51^{B}\pm1.44$	$4.36^{C}\pm1.38$	$4.41^{A}\pm1.42$	$4.52^{B}\pm1.42$	$4.41^{C}\pm1.41$
	Meat reduction is the consumer's responsibility	$5.18^{D}\pm1.35$	$5.12^{D}\pm1.24$	$5.07^{\dagger C}\pm1.28$	$5.26^{\dagger D}\pm1.31$	$5.02^{B}\pm1.35$	$5.13^{C}\pm1.27$	$5.27^{D}\pm1.27$
	Meat reduction is the food industry's responsibility	$3.92^{bB}\pm1.56$	$4.32^{aB}\pm1.43$	$4.22^{\dagger A}\pm1.52$	$3.97^{\dagger B}\pm1.49$	$4.42^{aA}\pm1.49$	$4.25^{aAB}\pm1.41$	$3.73^{bB}\pm1.54$
	Meat reduction is the government's responsibility	$3.66^{bA}\pm1.55$	$4.06^{aA}\pm1.50$	$4.02^{aA}\pm1.52$	$3.64^{bA}\pm1.55$	$4.35^{aA}\pm1.45$	$4.04^{bA}\pm1.47$	$3.29^{cA}\pm1.50$

[abc] Means with different superscripts within a factor in a row differ significantly according to ANOVA ($p \leq 0.05$)

[ABC] Means with different superscripts within a factor in a column differ significantly according to ANOVA ($p \leq 0.05$)

[†] Means with different superscripts within a row have differences approaching significance ($p<0.1$)

[††] Identified gender: Females (n=309); Males (n=275). Age (years): 25-40 (n=332); 41-55 (n=260). Meat consumption: Low (n=181); Medium (n=181); High (n=222).

[‡] 7-point Likert scale (1-strongly disagree to 7-strongly agree)

both identified genders' scores were neutral. Low sugar, made with wholefoods and free of genetically modified ingredients were significantly more important to Generation X than Millennials. However, both age groups scored the first two variables as somewhat agree. Millennials were neutral on the free of genetically modified ingredients variable. As meat consumption increased, there was a significant increase in agreement that plant-based products should be high in protein, although all meat consumption levels scored it as somewhat important.

Taste-like-meat was scored the lowest as a criterion when selecting plant-based products by all respondents, at around neutral. Being high in protein was scored the highest as a criterion when selecting plant-based products by males, Millennials, and the high meat consumption group. Females, Generation X, and low and medium meat consumption groups scored highest for made from wholefoods as a criterion when selecting plant-based products. It should be noted that although these criteria were scored the lowest and highest, respectively, their means in most cases did not differ significantly from other criteria.

3.2.3 Safety concern for foods

Generation X scored significantly higher than Millennials, and agreed somewhat, that they were concerned about pesticides/herbicides on plants, antibiotics used in meat production, genetically modified ingredients, and diseases from meat. On average, Millennials were neutral.

3.2.4 Trust in the food industry / government authorities and responsibility for meat reduction

Females disagreed significantly more than males that facilitating meat reduction was the food industry and government's responsibilities. Males were neutral in outlook. Even though males had significantly more trust in the government than females, both identified genders scored neutral on average. Generation X disagreed somewhat that facilitating meat reduction was the government's responsibility, whereas Millennials were neutral. High meat consumption respondents disagreed somewhat that they trust the food industry and that facilitating meat reduction was the food industry and government's responsibilities, whilst low and medium meat consumption levels were neutral.

All respondents somewhat agreed that meat reduction was the consumer's responsibility. Females, Generation X, and high meat consumers disagreed that facilitating meat reduction was the government's responsibility.

3.2.5 Nutrition and health drivers of plant-based products

Females had a significantly higher agreement score for looking at plant-based product ingredient lists than males (Table 7). Males were neutral on this statement.

Females and high meat consumers scored significantly lower than males and low and medium meat consumers, respectively, regarding eating plant-based products to prevent diet-related diseases. However, they all scored neutral on average. Millennials scored significantly higher than Generation X for eating plant-based products to treat diet-related diseases, but on average were neutral with the statement. High meat consumers disagreed somewhat to eating plant-based products to treat diet-related diseases, whilst low and medium meat consumption respondents were neutral.

Females, Millennials and Generation X and low and medium meat consumption respondents somewhat agreed to looking at the ingredients list when purchasing plant-based products. All respondents agreed they ate plant-based products to be healthy, and scored eating plant-based products to treat diet-related diseases the lowest, although scores were neutral.

3.2.6 Social status gained from eating plant-based products and meat

Females disagreed somewhat that eating plant-based products made them feel masculine, accepted, affluent, or virtuous or was part of their culture. Males were neutral. Females, Generation X, and high meat consumption respondents scored significantly lower than males, Millennials, and low and medium meat consumption respondents, respectively, that eating plant-based products made them feel ethical. All of these respondents were neutral in their scoring. Generation X scored significantly lower than Millennials that eating plant-based products made them feel masculine, however both ages scored as somewhat disagree. Generation X

Table 7: Means scores[‡] for motivation and barrier variables for nutrition, health, and social status associated with eating plant-based products (PBPs) and meat by identified gender, age and meat consumption

Variables		Identified gender[††]		Age (years) [††]		Meat Consumption[††]		
		Female	Male	25-40	41-55	Low	Medium	High
Nutrition	I look at PBPs' ingredients list	5.24^{aB}±1.34	4.85^{b}±1.33	5.02±1.32	5.10^{B}±1.38	5.14±1.29	5.07±1.37	4.98^{B}±1.46
	I look at PBPs' nutritional information table	4.94^{A}±1.42	4.84±1.37	4.93±1.38	4.84^{AB}±1.41	4.92±1.42	5.01±1.26	4.77^{AB}±1.47
	I look at PBPs' protein content	4.79^{A}±1.47	4.79±1.33	4.80±1.41	4.78^{A}±1.40	4.90±1.46	4.85±1.39	4.66^{AB}±1.36
	I look at PBPs' health star rating	4.70^{A}±1.44	4.75±1.42	4.75±1.42	4.69^{A}±1.44	4.82±1.44	4.80±1.33	4.59^{A}±1.49
Health	I eat PBPs to prevent diet-related disease	4.54^{bB}±1.57	4.81^{aB}±1.48	4.64^{B}±1.54	4.69^{B}±1.52	4.88^{aB}±1.49	4.87^{aB}±1.37	4.31^{bB}±1.62
	I eat PBPs to treat diet-related disease	4.18^{A}±1.64	4.33^{A}±1.56	4.37^{aA}±1.60	4.09^{bA}±1.59	4.56^{aA}±1.60	4.47^{aA}±1.47	3.82^{bA}±1.61
	I eat PBPs to manage weight	4.48^{B}±1.59	4.62^{B}±1.45	4.48^{AB}±1.58	4.62^{B}±1.47	$4.56^{\dagger A}$±1.47	$4.72^{\dagger AB}$±1.40	$4.38^{\dagger B}$±1.66
	I eat PBPs to be healthy	5.15^{C}±1.40	5.09^{C}±1.30	5.06^{C}±1.39	5.21^{C}±1.30	$5.24^{\dagger C}$±1.33	$5.24^{\dagger C}$±1.72	$4.93^{\dagger C}$±1.48
Social status PBPs	Makes me feel masculine	3.10^{bA}±1.62	4.05^{aA}±1.54	3.83^{aABC}±1.65	3.20^{bA}±1.58	4.09^{aCDE}±1.60	3.69^{bAB}±1.56	3.00^{cA}±1.61
	Makes me feel accepted	3.60^{bCD}±1.57	4.14^{aAB}±1.58	4.14^{aDE}±1.54	3.49^{bABC}±1.59	4.28^{aDE}±1.48	3.99^{aBC}±1.56	3.40^{bBC}±1.61
	Is part of my culture	3.43^{bBCD}±1.67	4.16^{aAB}±1.60	4.00^{aBCD}±1.67	3.48^{bABC}±1.65	4.39^{aE}±1.58	3.89^{bABC}±1.53	3.18^{cAB}±1.68
	Makes me feel affluent	3.63^{bD}±1.53	4.16^{aAB}±1.58	4.15^{aDE}±1.55	3.54^{bBC}±1.55	4.25^{aDE}±1.54	4.08^{aCDE}±1.53	3.41^{bBC}±1.54
	Makes me feel virtuous	3.98^{bE}±1.45	4.37^{aBCD}±1.48	4.36^{aEF}±1.43	3.93^{bD}±1.50	4.40^{aE}±1.43	4.34^{aDEF}±1.38	3.84^{bDE}±1.54
	Makes me feel healthy	4.83^{G}±1.40	4.76^{E}±1.44	4.84^{H}±1.40	4.74^{G}±1.44	4.96^{F}±1.34	4.88^{G}±1.31	4.59^{F}±1.53
	Makes me feel ethical	4.34^{bF}±1.47	4.58^{aDE}±1.52	4.63^{aGH}±1.42	4.22^{bE}±1.56	4.76^{aF}±1.45	4.60^{aFG}±1.33	4.09^{bE}±1.59
Social status meat	Makes me feel masculine	3.07^{bA}±1.59	4.02^{aA}±1.58	3.50^{A}±1.59	3.42^{AB}±1.72	3.54^{A}±1.71	3.64^{A}±1.72	3.41^{BC}±1.55
	Makes me feel accepted	3.66^{bD}±1.50	4.20^{aABC}±1.39	4.03^{aCD}±1.46	3.77^{bCD}±1.48	3.75^{ABC}±1.63	4.04^{CDE}±1.44	3.94^{DE}±1.35
	Is part of my culture	4.35^{F}±1.57	4.48^{CDE}±1.56	$4.32^{\dagger EF}$±1.56	$4.53^{\dagger FG}$±1.56	3.95^{bBCD}±1.58	4.59^{aFG}±1.45	4.65^{aF}±1.56
	Makes me feel affluent	3.53^{bBCD}±1.48	4.07^{aA}±1.53	3.95^{aBCD}±1.51	3.57^{bBC}±1.52	3.72^{abAB}±1.66	4.03^{aBCD}±1.49	3.64^{bCD}±1.42
	Makes me feel virtuous	3.38^{bBC}±1.42	3.99^{aA}±1.53	3.76^{AB}±1.51	3.55^{BC}±1.49	3.64^{AB}±1.57	3.87^{ABC}±1.53	3.52^{C}±1.42
	Makes me feel healthy	4.24^{bF}±1.37	4.53^{aDE}±1.37	4.40^{FG}±1.29	4.34^{EF}±1.48	4.08^{bCDE}±1.45	4.38^{abEF}±1.36	4.61^{aF}±1.29
	Makes me feel ethical	3.31^{bAB}±1.46	3.98^{aA}±1.41	3.70^{A}±1.46	3.53^{BC}±1.49	3.60^{abA}±1.56	3.92^{aABC}±1.43	3.41^{bBC}±1.41

[abc] Means with different superscripts within a factor in a row differ significantly according to ANOVA ($p \leq 0.05$)

[ABC] Means with different superscripts within a factor in a column differ significantly according to ANOVA ($p \leq 0.05$)

[†] Means with different superscripts within a row have differences approaching significance ($p<0.1$)

[††] Identified gender: Females (n=309); Males (n=275). Age (years): 25-40 (n=332); 41-55 (n=260). Meat consumption: Low (n=181); Medium (n=181); High (n=222).

[‡] 7-point Likert scale (1-strongly disagree to 7-strongly agree)

disagreed somewhat that eating plant-based products made them feel accepted, affluent, or virtuous or part of their culture, whilst Millennials were neutral. The low meat consumption level was neutral on that eating plant-based products made them feel masculine or was part of their culture, however medium and high meat consumption levels scored significantly lower. Both levels somewhat disagreed to these statements. The high meat consumption level disagreed somewhat that eating plant-based products made them feel accepted, affluent, or virtuous, whereas low and medium meat consumption levels were neutral in agreement to these statements.

Males were neutral in agreement that eating meat made them feel masculine, accepted, affluent, virtuous, or ethical, whilst females disagreed somewhat on these statements. Males scored significantly higher than females the eating meat made them feel healthy, however both identified genders scored neutral to the statement. Generation X disagreed somewhat that eating meat made them feel accepted or affluent, whilst Millennials were neutral on average. High and medium meat consumption levels were neutral to meat being part of their culture, however the low meat consumption level disagreed somewhat to the statement. The medium meat consumption level was neutral that eating meat made them feel affluent. Low meat consumption level disagreed somewhat to this statement, however did not differ significantly from medium meat consumption level. High meat consumption level also disagreed somewhat to this statement, significantly different to medium but not low meat consumption levels. There was a significant increase in scores for meat making increasing meat consumption levels feel healthy, however all scores were around neutral. Similarly, meat consumption levels differed significantly in that eating meat made them feel ethical, however all scores were somewhat disagree on the scale.

Females, both age groups, and low and medium meat consumption groups significantly disagreed that eating meat made them feel masculine and scored highest for that plant-based products made them feel healthy, however the means were neutral. Males scored the lowest for feeling ethical and virtuous when eating meat. Other factors did not differ significantly from these, however were scored neutral. They also scored the highest for eating plant-based products making them

feel ethical and healthy, and eating meat being part of their culture and making them feel healthy, however these were also neutral. High meat consumption respondents scored plant-based products making them feel masculine and being part of their culture the lowest. Eating plant-based products and meat to feel healthy and meat being part of their culture was scored the highest, although being neutral on average.

3.2.7 Animal welfare

Millennials scored significantly higher than Generation X to eating less meat because of animal welfare concerns and liking meat but not liking that animals had to die for it (Table 8), however both ages' scores were neutral on average. An increase in meat consumption level resulted in a significant decrease in score for eating less meat because of animal welfare concerns. Low and medium meat consumption levels were neutral, whereas high meat consumption level disagreed somewhat to the statement.

Both ages and medium and high meat consumption groups scored highest for liking meat but not liking that animals had to die for it, although scores were neutral on average. They also scored the lowest for eating less meat because of animal welfare concerns, again the scores were neutral except for high meat consumption respondents who disagreed somewhat.

3.2.8 Environmentally sustainable habits

Females scored significantly higher than males for buying seasonal products and recycling, however both identified genders were in the somewhat agree score for the statements. Females disagreed somewhat to taking environmentally friendly transport and to avoiding products with imported ingredients, whilst males were neutral. Generation X scored significantly higher than Millennials for avoiding food waste and recycling. Both ages scored as somewhat agree on the scale. Millennials were neutral to taking environmentally friendly transport and avoiding products with imported ingredients, whereas Generation X somewhat disagreed to these statements. Millennials scored significantly higher than Generation X for eating less meat because of the environment, although both ages were neutral on average. Low and medium meat consumption levels were neutral to taking public

Table 8: Means scores[‡] for motivation and barrier variables for animal welfare and environment by identified gender, age and meat consumption

Variables		Identified gender[††]		Age (years) [††]		Meat Consumption[††]		
		Female	Male	25-40	41-55	Low	Medium	High
Animal welfare	I eat less meat because of animal welfare concerns	4.32^{A}±1.59	4.33±1.67	4.50^{aA}±1.56	4.10^{bA}±1.69	4.86^{a}±1.52	4.42^{bA}±1.52	3.81^{cA}±1.65
	I like meat but I don't like that animals have to die for it	4.74^{B}±1.66	4.55±1.53	4.78^{aB}±1.56	4.48^{bB}±1.65	4.69±1.58	4.83^{B}±1.49	4.46^{B}±1.70
Environment	I eat less meat because I believe it helps sustainability of the environment	4.36^{B}±1.62	4.42^{A}±1.54	4.58^{aC}±1.51	4.14^{bBC}±1.63	4.77^{aBC}±1.48	4.58^{aB}±1.42	3.92^{bAB}±1.66
	I eat plant-based products because I believe it is more sustainable for the environment	4.39^{B}±1.54	4.50^{A}±1.54	$4.55^{\dagger BC}$±1.48	$4.31^{\dagger C}$±1.61	4.73^{aABC}±1.50	4.67^{aB}±1.36	4.01^{bB}±1.62
	I actively avoid wasting food	5.58^{D}±1.23	5.42^{C}±1.25	5.41^{bEF}±1.26	5.63^{aEF}±1.21	5.42^{E}±1.33	5.41^{DE}±1.22	5.65^{D}±1.18
	I take public transport, carpool, cycle or walk to work	3.82^{bA}±1.94	4.32^{aA}±1.75	4.33^{aAB}±1.86	3.72^{bA}±1.84	4.47^{aAB}±1.72	4.12^{aA}±1.76	3.67^{bA}±2.00
	I often buy seasonal products	5.50^{aD}±1.14	5.11^{bB}±1.20	$5.22^{\dagger E}$±1.19	$5.43^{\dagger E}$±1.18	5.15^{bDE}±1.30	5.20^{bCD}±1.12	5.53^{aD}±1.10
	I often buy local products	5.09^{C}±1.30	4.93^{B}±1.18	4.96^{D}±1.24	5.10^{D}±1.26	5.02^{CD}±1.23	5.07^{C}±1.22	4.98^{C}±1.29
	I recycle glass, paper and/or plastic	5.84^{aE}±1.26	5.42^{bC}±1.26	5.53^{bF}±1.23	5.78^{aF}±1.32	5.35^{bDE}±1.43	5.56^{bE}±1.24	5.95^{aE}±1.10
	I avoid products with imported ingredients	3.93^{bA}±1.48	4.25^{aA}±1.45	4.21^{aA}±1.46	3.92^{bAB}±1.48	4.43^{aA}±1.43	4.21^{aA}±1.35	3.69^{bA}±1.52

[abc] Means with different superscripts within a factor in a row differ significantly according to ANOVA ($p \leq 0.05$)

[ABC] Means with different superscripts within a factor in a column differ significantly according to ANOVA ($p \leq 0.05$)

[†] Means with different superscripts within a row have differences approaching significance ($p<0.1$)

[††] Identified gender: Females (n=309); Males (n=275). Age (years): 25-40 (n=332); 41-55 (n=260). Meat consumption: Low (n=181); Medium (n=181); High (n=222).

[‡] 7-point Likert scale (1-strongly disagree to 7-strongly agree)

transport that was more environmentally friendly and avoiding products with imported ingredients, whereas high meat consumption level disagreed somewhat to these statements. High meat consumption level scored significantly higher than low and medium meat consumption levels for buying seasonal products and recycling, however all meat consumption levels scored somewhat agree on the scale. Recycling was rated highest by all respondents in their environmental sustainability efforts. The low meat consumption group rated avoiding food waste higher, however not significantly different from recycling. Females, Generation X, and high meat consumption respondents disagreed somewhat to taking public transport and avoiding products with imported ingredients. The other respondents scored these statements the lowest as well, however their means were neutral.

The large standard deviation indicates considerable variation in responses for identified gender, age, and meat consumption level, particularly around meat-like attributes of plant-based products. Although many means were neutral, the large standard deviation tells a different story about the motivators and barriers. It suggests segmentation of respondents in what drives them to eating plant-based products.

3.3 Ranking criteria for selecting plant-based products and nutrition factors of plant-based products

3.3.1 Ranked importance for criteria for selecting plant-based products

The average ranking and ranking counts for criteria when selecting plant-based products are shown in Table 9 and Figure 2, respectively. Not surprisingly, “Tastes good” was ranked as the most important criteria most often, with 245 respondents selecting it as their first option. For plant-based products to be made from wholefoods was also an important criterion, ranking in second place on average and having 129 and 141 respondents ranking it in second and third place, respectively. Taste-like-meat was ranked the least important criteria most often with 196 respondents ranking it in last place. However, there was a bimodal effect

Table 9: Average ranking of criteria when selecting plant-based products (1 - Most important, 6 - Least important)

Rank	Criteria	Average ranking (± SD)
1	Tastes good	2.50[a] ± 1.66
2	Wholefoods	3.47[b] ± 1.44
3	No GMI	3.55[bc] ± 1.62
4	Organic	3.73[bc] ± 1.71
5	Environmentally friendly	3.80[bc] ± 1.52
6	Taste like meat	3.95[c] ± 1.87

[abc] Means with different superscripts differ significantly according to ANOVA ($p \leq 0.05$)

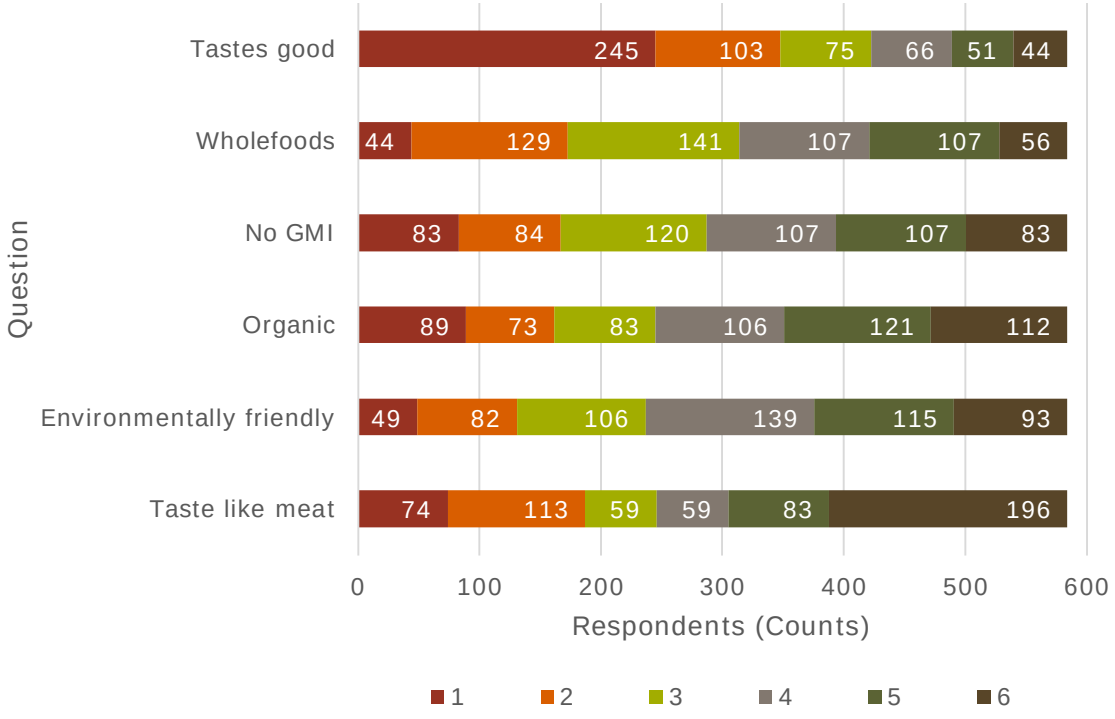

Figure 2: Frequency of rank position for criteria when selecting plant-based products (1 - Most important, 6 -Least important) [a]

[a] Frequencies > 97 counts are significant

to the ranking with 113 respondents ranking it as their second most important criterion when selecting plant-based products.

3.3.2 Ranked importance of nutritional factors of plant-based products

Table 10 and Figure 3 show the average ranking and ranking counts of nutrition factors of plant-based products. For plant-based products to be high in protein was ranked the most important nutritional factor by the largest number of respondents, with 175 respondents ranking it in first place. “High in vitamins and minerals” (122 counts) and “high in fibre” (145 counts) were ranked second and third most important nutritional factors of plant-based products, respectively. For plant-based products to be low in carbohydrates was ranked the least important nutritional factor for respondents, with 144 ranking it in last place.

Table 10: Average ranking for nutrition of plant-based products (1 - Most important, 7 - Least important)

Rank	Nutrition	Average ranking (± SD)
1	High Protein	3.11^{a} ± 2.02
2	High Vitamins & Minerals	3.41^{ab} ± 1.96
3	High Fibre	3.60^{b} ± 1.78
4	Low Sugar	4.08^{c} ± 1.94
5	Low Fat	4.39^{cd} ± 1.97
6	Low Sodium	4.59^{de} ± 1.82
7	Low Carbohydrates	4.83^{e} ± 1.87

^{abc} Means with different superscripts differ significantly according to ANOVA ($p \leq 0.05$)

The ranking results showed some trends in the drivers to eating more plant-based products, namely taste good and be high in protein. However, bimodality was seen on what was most important to the respondent regarding taste-like-meat. This suggests that there are some segments of consumers that differ in what they find

most important in a plant-based product.

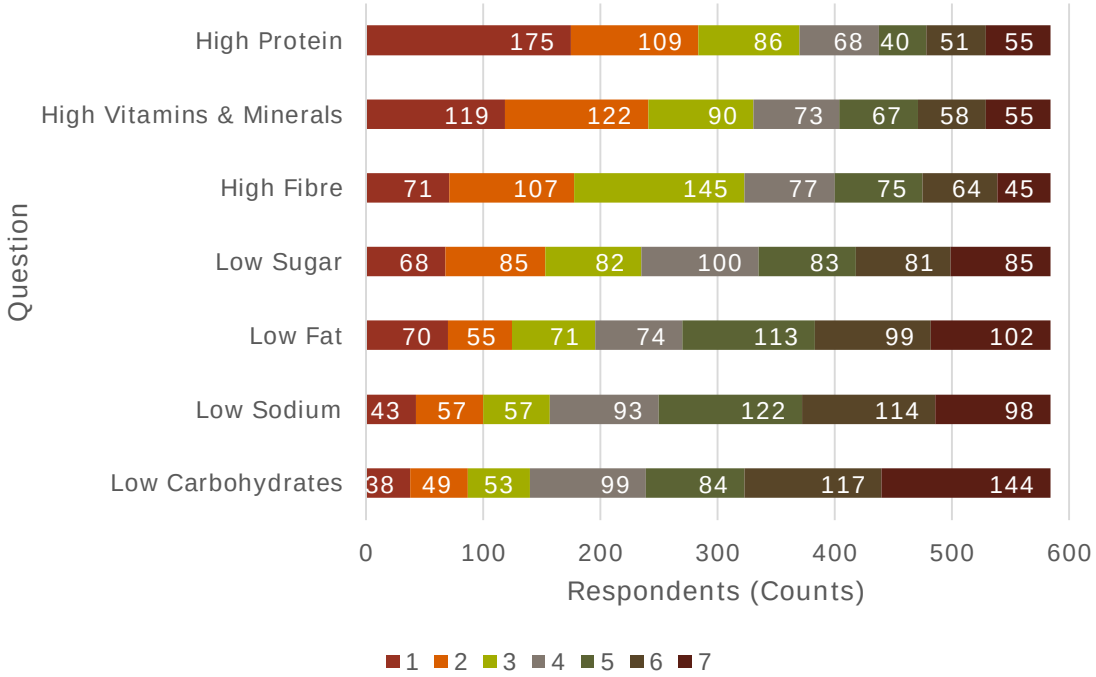

Figure 3: Frequency of rank position for nutrition factors of plant-based products (1 - Most important, 7 -Least important) [a]

[a] Frequencies > 83 counts are significant

3.4 Food neophobia distribution

Food neophobia scores for individuals ranged from 10 to 68, with an average of 35.07 and a standard deviation of 8.59. The low food neophobia category was ≤26.48 and had a total of 101 respondents. The high food neophobia category was ≥43.66 and had a total of 62 respondents. The medium food neophobia category consisted of 421 respondents. Food neophobia scores calculated and compared for identified gender, age, meat consumption and plant-based product consumption are shown in Table 11.

Males were significantly more neophobic than females, however the effect size was small (Table 11 and Figure 7). There was no significant difference on average between neophobia scores of Millennials and Generation X (Table 11 and Figure 6). Decreasing meat consumption was accompanied by a significant increase in

Table 11: Mean food neophobia scores (± standard deviation) by group and associated differences from post-hoc multiple comparison test

Variables		Food neophobia score
Identified gender	Female	34.39^{b}±9.22
	Male	35.84^{a}±7.78
Age (years)	25-40	35.40±8.45
	41-55	34.66±8.77
Meat consumption	Low	37.27^{a}±7.91
	Medium	35.55^{b}±7.96
	High	32.89^{c}±9.12
Plant-based product consumption	Tried once	33.74^{b}±9.01
	Low	34.03^{b}±9.20
	Medium	35.24^{b}±8.03
	High	37.96^{a}±7.05

^{abc} Means with different superscripts within a factor in a column differ significantly ($p \leq 0.05$)

food neophobia (Table 11 and Figure 5). High plant-based product consumption respondents were significantly more neophobic than the other consumption level respondents (Table 11 and Figure 4). There was a wide range of food neophobia scores for low meat consumption and high plant-based consumption. Although significant differences were observed, all observations fell within the medium food neophobia category.

Spearman's rank correlation between food neophobia and plant-based product consumption gave a negative coefficient which indicates that food neophobia decreased as plant-based product consumption level decreased (Table 12). The positive correlation for meat consumption and food neophobia suggests that food neophobia increased as meat consumption level decreased. Again, there was no significant difference between Millennials and Generation X. For the correlation

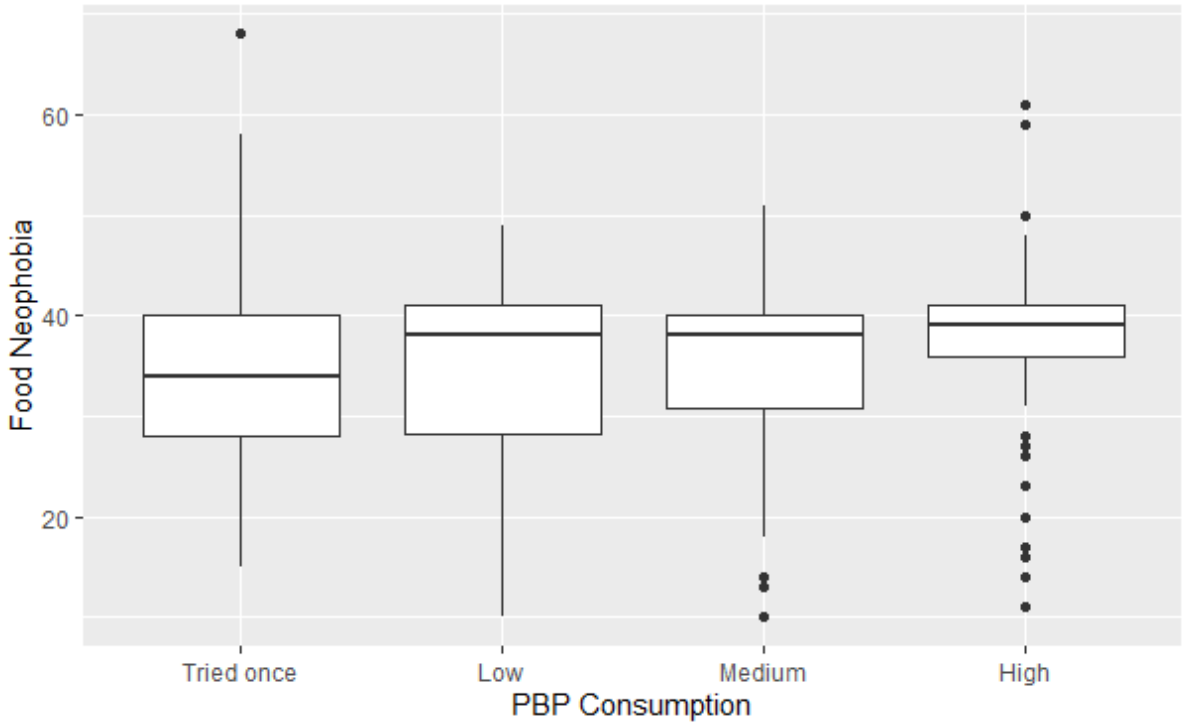

Figure 4: Food neophobia scores of plant-based product (PBP) consumption levels

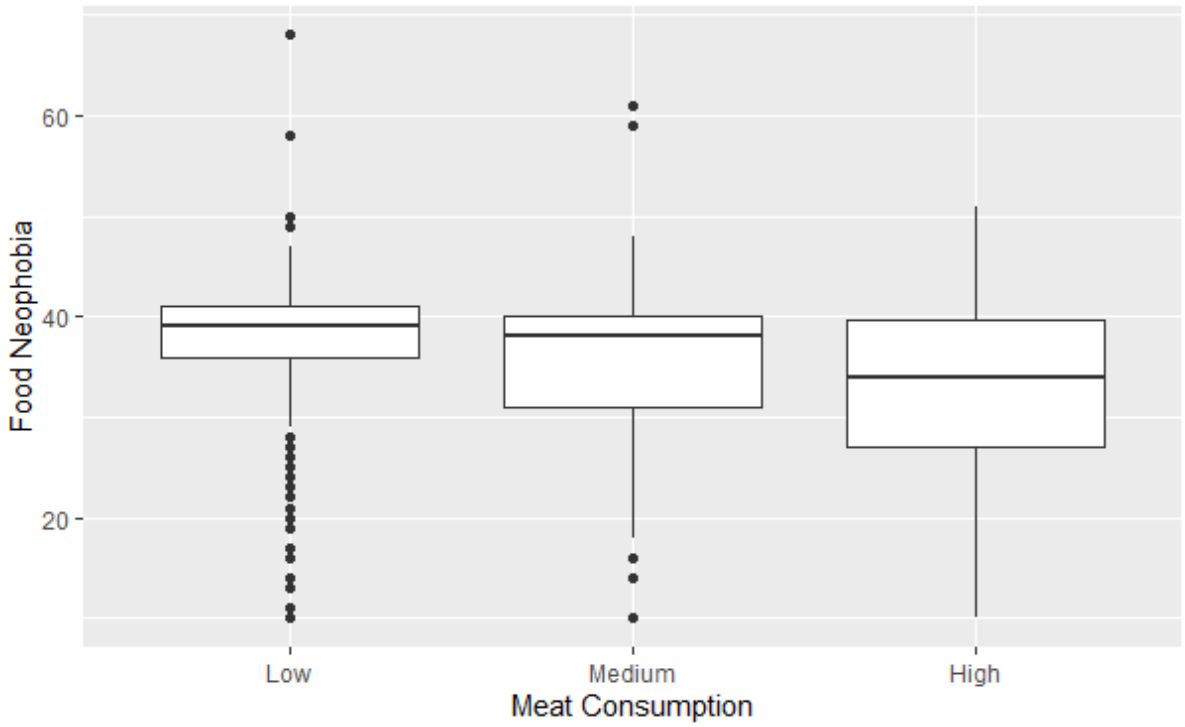

Figure 5: Food neophobia scores of meat consumption levels

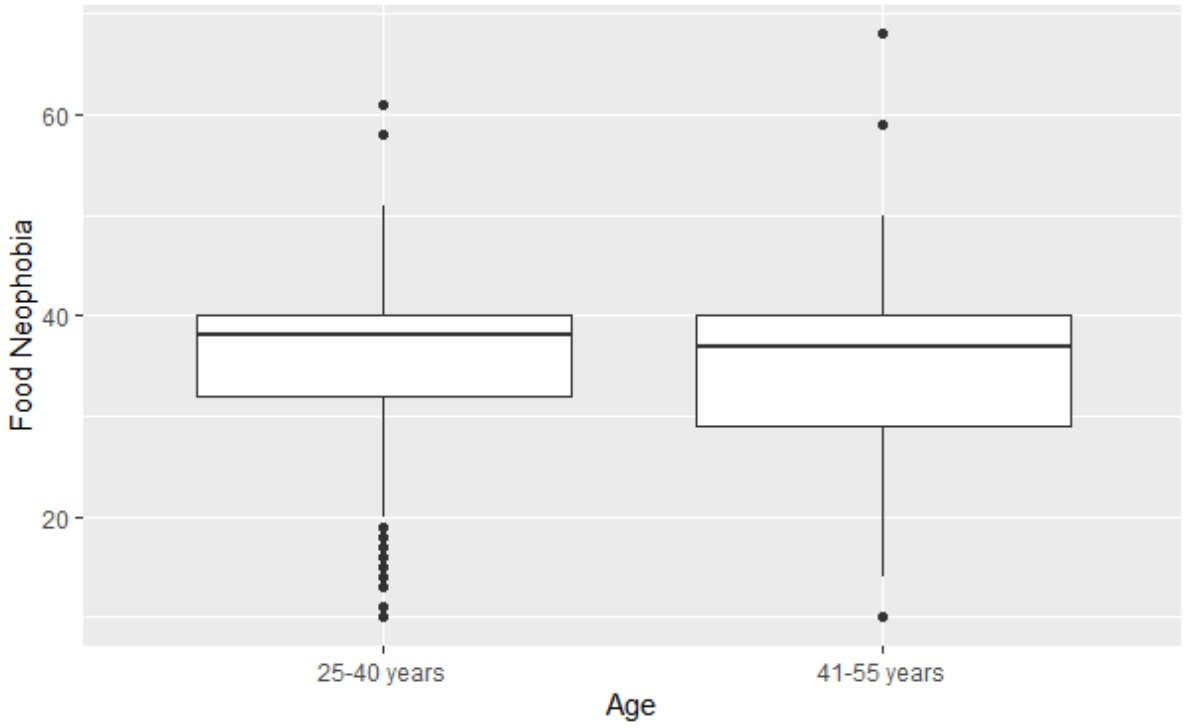

Figure 6: Food neophobia scores of Millennials and Generation X

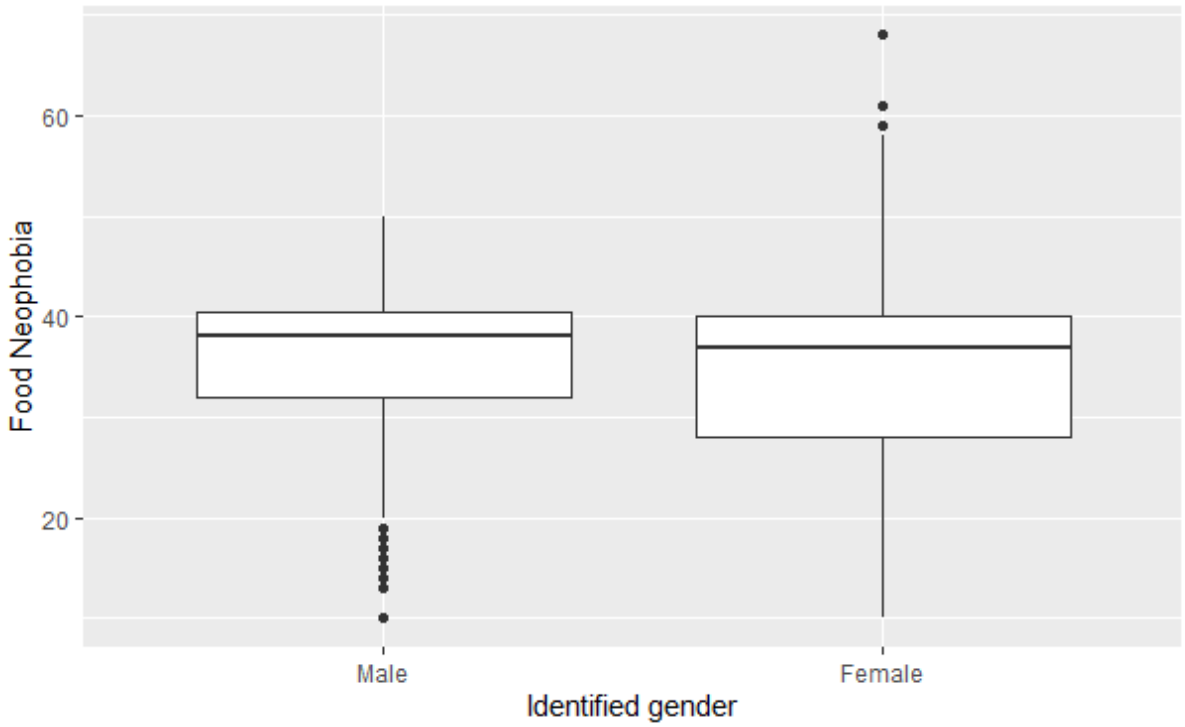

Figure 7: Food neophobia scores of males and females

Table 12: Spearman's rank correlation rho for food neophobia and plant-based product (PBP) consumption, meat consumption, age and identified gender

Correlation	p-value	rho
PBP consumption and food neophobia	0.00013	-0.16
Meat consumption and food neophobia	0.00024	0.15
Age and food neophobia	0.18	-0.055
Identified gender and food neophobia	0.013	0.13

between identified gender and food neophobia, whilst neophobia increased for both males and females, it increased more for males than for females. However, coefficients indicate that all significant correlations were very weak, and these trends were therefore small.

3.5 Clustering of flexitarians

Four clusters were identified following K-means clustering. Demographic information about each cluster is given in Table 13. Cluster 1 was female dominant with more respondents that had a high meat consumption level and a lower plant-based product intake. They were the smallest cluster in size and also had a low neophobia score. Cluster 2 was the biggest cluster and was male and Millennial dominant with more low meat consumption level respondents and more high plant-based product consumption. Cluster 3 like cluster 1 was female dominant and had more high meat consumption level but differed in that more had tried plant-based products once and were more neophobic. Clusters 3 and 4 were medium-sized clusters. Cluster 4 was dominated by those who were lower plant-based product consumers. They also had the highest food neophobia score.

However, all clusters consisted of both identified genders and age groups suggesting a minor role of demographics. Some meat and plant-based product consumption levels play a role, but again not exclusively.

Table 13: Demographic properties and consumption levels of clusters

Demographics	Cluster			
	1	2	3	4
Cluster size	90	192	153	149
Identified gender (Female – F, Male – M)	F: 60 M: 30	F: 73 M: 119	F: 96 M: 57	F: 80 M: 69
Age (years)	25-40: 48 41-55: 42	25-40: 120 41-55: 72	25-40: 72 41-55: 81	25-40: 86 41-55: 63
Meat consumption (Low – L, Medium – M, High – H)	L: 16 M: 25 H: 49	L: 89 M: 62 H: 41	L: 25 M: 43 H: 85	L: 51 M: 51 H: 47
PBPs consumption (Tried once – T, Low – L, Medium – M, High – H)	T: 26 L: 37 M: 21 H: 6	T: 19 L: 49 M: 52 H: 72	T: 57 L: 46 M: 32 H: 18	T: 38 L: 50 M: 35 H: 26

Further investigation looked at each cluster's questionnaire responses to determine how different barriers and motivators may have clustered people differently.

The results of the K-means clustering of NZ flexitarians based on identified barriers and motivators can be seen in Table 14. From these results it was seen that Cluster 1 were the most satisfied with the appearance of currently available plant-based products. Environmental sustainability and free of genetically modified ingredients were motivators for this cluster. They did not trust the food industry and they did not view eating plant-based products and meat as affecting their social status.

Cluster 2 was most satisfied with the texture of currently available plant-based products and agree that their ideal plant-based product is juicy/moist and spicy/flavourful. They were neutral on meat-like properties but did score the highest for these, and it was an important criterion for them that plant-based products taste-like-meat. They gained social status from eating plant-based products. Food safety concern for antibiotics in meat production and diseases from

Table 14: K-means clustering of flexitarians based on motivations and barriers of plant-based products (PBPs) and meat reduction

Variables		Cluster†			
		1	2	3	4
Sensory satisfaction with PBPs	Appearance	5.04^{a}	4.53^{b}	4.67^{b}	3.83^{c}
	Smell	4.77^{a}	4.71^{a}	4.64^{a}	3.90^{b}
	Taste/flavour	4.67^{a}	4.92^{a}	4.59^{a}	3.91^{b}
	Texture/mouthfeel	4.56^{b}	5.02^{a}	4.55^{b}	3.97^{c}
Sensory preference for PBPs	Meat-like appearance	3.85^{b}	4.95^{a}	4.08^{b}	3.89^{b}
	Meat-like smell	3.28^{b}	4.74^{a}	3.63^{b}	3.70^{b}
	Meat-like taste/flavour	4.04^{b}	4.95^{a}	4.22^{b}	4.17^{b}
	Meat-like texture/mouthfeel	4.30^{bc}	4.98^{a}	4.39^{b}	4.04^{c}
	Bleed-like-meat	2.27^{c}	4.35^{a}	2.50^{c}	3.26^{b}
	Juicy/moist	5.34^{a}	5.09^{a}	5.25^{a}	4.36^{b}
	Savoury/umami	5.38^{a}	4.99^{b}	5.14^{ab}	4.20^{c}
	Spicy/flavourful	5.46^{a}	5.04^{b}	5.24^{ab}	4.22^{c}
	Sweet	3.03^{c}	4.74^{a}	3.18^{c}	3.74^{b}
	Sour	2.62^{c}	4.40^{a}	2.64^{c}	3.43^{b}
	Bitter	2.31^{c}	4.38^{a}	2.39^{c}	3.39^{b}
	Salty	4.19^{b}	4.79^{a}	3.80^{c}	3.73^{c}
	Chewy	3.41^{b}	4.89^{a}	3.39^{b}	3.56^{b}
	Grainy	3.19^{b}	4.75^{a}	3.22^{b}	3.52^{b}
	Pasty	2.74^{c}	4.72^{a}	2.99^{c}	3.52^{b}
	Dry	2.73^{c}	4.53^{a}	2.69^{c}	3.31^{b}
	Taste of legumes	3.09^{b}	4.80^{a}	3.27^{b}	3.46^{b}
Criteria for selecting PBPs	Low fat	4.72^{b}	5.20^{a}	5.08^{a}	4.16^{c}
	Low sugar	5.36^{a}	5.41^{a}	5.43^{a}	4.30^{b}
	Low sodium	4.81^{b}	5.22^{a}	5.03^{ab}	4.17^{c}
	High protein	5.52^{a}	5.44^{a}	5.49^{a}	4.47^{b}
	High fibre	5.07^{b}	5.36^{a}	5.39^{a}	4.37^{c}
	High vitamins and minerals	5.23^{b}	5.45^{ab}	5.63^{a}	4.36^{c}
	Taste like meat	4.03^{bc}	5.08^{a}	4.39^{b}	4.04^{c}
	Made with wholefoods	5.40^{b}	5.42^{b}	5.81^{a}	4.40^{c}
	Free of genetically modified ingredients	5.04^{a}	5.39^{a}	5.44^{a}	4.22^{b}
	Organic	4.38^{c}	5.31^{a}	4.92^{b}	4.11^{c}
	Eco friendly	5.26^{a}	5.34^{a}	5.35^{a}	4.11^{b}
Safety concern for	Pesticides/herbicides on plants	4.79^{b}	5.14^{ab}	5.25^{a}	4.24^{c}
	Antibiotics used in meat production	4.77^{b}	5.09^{ab}	5.28^{a}	4.27^{c}
	Genetically modified ingredients	4.57^{b}	5.06^{a}	5.06^{a}	4.17^{c}
	Diseases from meat	4.76^{a}	5.07^{a}	5.09^{a}	4.32^{b}
Industry/ Authorities	I trust the food industry	3.42^{c}	5.05^{a}	3.84^{b}	3.79^{bc}
	I trust the government authorities	4.32^{b}	4.97^{a}	4.42^{b}	3.87^{c}
	Meat reduction is the consumer's responsibility	5.70^{a}	5.39^{b}	5.42^{ab}	4.24^{c}
	Meat reduction is the food industry's responsibility	3.54^{b}	5.14^{a}	3.58^{b}	3.66^{b}
	Meat reduction is the government's responsibility	3.08^{c}	4.90^{a}	3.24^{bc}	3.60^{b}

Variables		Cluster†			
		1	2	3	4
Nutrition	I look at PBPs' ingredients list	5.01[a]	5.45[a]	5.38[a]	4.25[b]
	I look at PBPs' nutritional information table	4.73[b]	5.46[a]	5.07[b]	4.07[c]
	I look at PBPs' protein content	4.61[b]	5.39[a]	4.82[b]	4.10[c]
	I look at PBPs' health star rating	4.37[c]	5.42[a]	4.86[b]	3.91[d]
Health	I eat PBPs to prevent diet-related disease	4.10[c]	5.42[a]	4.69[b]	4.01[c]
	I eat PBPs to treat diet-related disease	3.50[b]	5.16[a]	3.97[b]	3.82[b]
	I eat PBPs to manage weight	4.09[c]	5.16[a]	4.65[b]	3.91[c]
	I eat PBPs to be healthy	5.03[b]	5.61[a]	5.33[ab]	4.33[c]
Social status PBPs	Makes me feel masculine	2.40[c]	4.81[a]	2.80[c]	3.40[b]
	Makes me feel accepted	2.81[c]	5.02[a]	3.31[b]	3.54[b]
	Is part of my culture	2.59[c]	5.07[a]	3.14[b]	3.48[b]
	Makes me feel affluent	2.74[c]	5.02[a]	3.38[b]	3.62[b]
	Makes me feel virtuous	3.54[b]	5.03[a]	3.85[b]	3.76[b]
	Makes me feel healthy	4.91[b]	5.36[a]	4.78[b]	4.01[c]
	Makes me feel ethical	4.24[b]	5.31[a]	4.24[b]	3.70[c]
Social status meat	Makes me feel masculine	2.64[c]	4.33[a]	3.04[bc]	3.50[b]
	Makes me feel accepted	3.27[c]	4.54[a]	3.54[bc]	3.89[b]
	Is part of my culture	4.64[a]	4.70[a]	4.30[b]	4.01[c]
	Makes me feel affluent	3.10[c]	4.55[a]	3.21[c]	3.80[b]
	Makes me feel virtuous	2.73[d]	4.56[a]	3.20[c]	3.56[b]
	Makes me feel healthy	4.07[b]	4.76[a]	4.29[b]	4.16[b]
	Makes me feel ethical	2.56[d]	4.53[a]	3.15[c]	3.59[b]
Food neophobia	Score	19.71[d]	39.71[b]	31.71[c]	42.03[a]
Animal welfare	I eat less meat because of animal welfare concerns	4.12[b]	5.06[a]	4.16[b]	3.67[c]
	I like meat but I don't like that animals have to die for it	4.63[b]	5.18[a]	4.59[b]	4.03[c]
Environment	I eat less meat because I believe it helps sustainability of the environment	4.39[b]	5.18[a]	3.98[c]	3.79[c]
	I eat plant-based products because I believe it is more sustainable for the environment	4.24[a]	5.28[a]	4.16[a]	3.77[c]
	I actively avoid wasting food	5.94[a]	5.63[b]	5.92[a]	4.66[c]
	I take public transport, carpool, cycle or walk to work	3.77[b]	5.00[a]	3.52[b]	3.57[b]
	I often buy seasonal products	5.90[a]	5.38[b]	5.69[a]	4.48[c]
	I often buy local products	5.30[a]	5.41[a]	5.16[a]	4.20[b]
	I recycle glass, paper and/or plastic	6.32[a]	5.48[b]	6.17[a]	4.90[c]
	I avoid products with imported ingredients	3.16[c]	5.04[a]	3.77[b]	3.77[b]

[abc] Means with different superscripts in a row differ significantly ($p \leq 0.05$)

† Standard deviation range of means: 1.19-2.08

meat, free of genetically modified ingredients and organic were motivators for plant-based product use. Food safety concern for pesticides/herbicides on plants and genetically modified ingredients were barriers for this cluster. They had the most trust in the food industry and government. Animal welfare, the environment, nutrition, and health were also motivators to eating plant-based products.

Cluster 3 was similar to cluster 2 in terms of food safety concern as a motivator and barrier. They differ from cluster 2 in that they did not trust the food industry and eating plant-based products and meat did not affect their social status. Their ideal sensory attributes in plant-based products were juicy/moist, savoury/umami and spicy flavourful. Nutrition and the environment were motivators for this cluster. They differ from cluster 1 in that that nutrition and food safety concern are motivators and food safety concern was also a barrier.

Cluster 4 had no motivators for consuming plant-based products. They did not trust the food industry or government and eating plant-based products and meat did not affect their social status. Animal welfare, the environment and health did not drive them to eating plant-based products. This could be attributed to this cluster having a high food neophobia score and therefore were not open to trying new foods.

The hypothesis for clustering was that flexitarians will be grouped into clusters based on the motivators and barriers. Some clusters had similar motivators and barriers, such as social status and industry as barriers for clusters 1, 3 and 4, and the environment and free of genetically modified ingredients as motivators for clusters 1, 2 and 3. Sensory satisfaction and preference differed and distinguished clusters from each other. Cluster 2 had many motivators, whereas cluster 4 had many barriers. No two clusters were the same. Therefore, the hypothesis was successful in predicting flexitarians would be grouped based on different motivators and barriers into clusters.

4. Discussion

The objectives of this study were to determine the barriers and motivators for

flexitarians to adopt a plant-based diet; to identify and define the New Zealand flexitarian consumer by grouping them into clusters based on their motivators and barriers; to investigate the effect of age, identified gender and meat consumption level on motivators and barriers; and to determine whether taste, smell, texture, or appearance is important to flexitarians when deciding to consume plant-based products.

4.1 The importance of sensory attributes when deciding to consume plant-based products

High meat consumption respondents were significantly less satisfied with plant-based products than lower meat consumption levels, which is similar to the findings of Reipurth et al. (2019). Sensory attributes of plant-based properties, particularly bleeds-like-meat, sour, bitter, and dry were disagreed to be ideal properties of plant-based products for high meat consumption respondents and would therefore be a barrier to these respondents if they were present in products. Similar to Michel et al. (2021), high meat consumers and particularly cluster 2 had a weak preference for meat-like tasting alternatives. Additionally, taste-like-meat was a somewhat important criteria for cluster 2 when choosing plant-based products, and therefore meat-like properties would be a driver for cluster 2 to eating plant-based products. “Taste good” was ranked as the most important criteria when choosing plant-based products, which resonates with the findings of Michel et al. (2021) that taste was the most important for purchasing decision of plant-based products.

4.2 The effect of identified gender on motivators and barriers

For plant-based products to be made of wholefoods was an important criterion for all identified genders. This was seen in the Likert rating scores. This was in agreement with Clark and Bogdan (2019), Kemper (2020) and Varela et al. (2022) who found that their participants preferred minimally processed plant-based

foods. Wholefood, minimally processed plant-based products would therefore be a motivator for plant-based consumption. The “unconscious flexitarians”, “conscious flexitarians” and “potential flexitarians” (Verain et al., 2015) believed meat reduction was the consumers responsibility. Both males and females in this study similarly agreed that meat reduction was the consumer’s responsibility. In terms of health, both identified genders somewhat agreed that they ate plant-based products to be healthy. However, other health variables were scored neutral, indicating that health plays some role but may not be a big driver to eating plant-based products for males or females. In general, males were neutral and females somewhat disagreed that eating meat and plant-based products gave them social status. This was the opposite to what was found for the “unconscious flexitarians”, “compulsive meat eaters” (Verain et al., 2015) and “extravert flexitarian” clusters (Dagevos & Voordouw, 2013) who obtained status from eating meat. Males and females were neutral to the statement that meat consumption is part of their culture. Females also disagreed and males were neutral that eating meat made them feel masculine. These findings contradict the findings of Kemper (2020). However, the large standard deviation observed for these statements would mean that there were some individuals who agreed somewhat. On average, social status from eating plant-based products and meat did not affect males and was somewhat of a barrier for females.

Using seasonal products was a common approach to being environmentally-friendly (Vanhonacker et al., 2013) which was relevant to males and females, however females agreed significantly more than males. Both identified genders also actively avoided wasting food like the young adults and retirees in Kemper (2020)’s study. Females rated significantly higher than males for recycling. For a plant-based product to be eco-friendly was more important to females than to males. The environment could therefore be a somewhat greater motivator for females than for males to reducing meat intake.

4.3 The effect of age on motivators and barriers

The Likert rating scores showed that for plant-based products to be made of

wholefoods was an important criterion for all age groups. The findings of Clark and Bogdan (2019), Kemper (2020) and Varela et al. (2022) whose participants preferred minimally processed plant-based foods supports this study. For plant-based products to be minimally processed or made from wholefoods would therefore be a motivator to Millennials and Generation X. Generation X had a safety concern for antibiotics used in meat production and diseases from meat. This echoes Kemper (2020)'s study where respondents were concerned about antibiotic use in farming practices. The "disgusted by meat" and "not attached to meat" clusters from Graça et al. (2015) were also concerned by safety of meat, which motivated them to reduce meat intake. Similarly, food safety concern would be a motivator to reduce meat consumption for Generation X. Like the "unconscious flexitarians", "conscious flexitarians" and "potential flexitarians" (Verain et al., 2015), both Millennials and Generation X believed meat reduction was the consumers responsibility. All age groups somewhat agreed that they ate plant-based products to be healthy and that they looked at the ingredients list when purchasing plant-based products. All other nutrition and health statements were however rated neutral, thus indicating that nutrition and health were not motivators or barriers towards meat reduction.

Eating plant-based products was somewhat of a barrier towards the social status of Generation X, whereas it did not affect Millennials. Both age groups were neutral to that eating meat was part of their culture, and somewhat disagreed that eating meat made them feel masculine. This contradicts what was found by Kemper (2020) who's flexitarian respondents claimed meat to be part of their culture and that there was a strong link to masculinity. Social status gained by eating meat was therefore a slight barrier towards eating meat. When considering environmentally sustainable habits of Millennials and Generation X, there was not a great difference between them on average. Generation X scored significantly higher than Millennials for recycling and actively avoiding waste but also scored significantly lower for taking environmentally friendly transport and avoiding products with imported ingredients. The environment could be a slight motivator for both age groups, however this evidence was not supported by their neutral scores for the environment being the reason for reducing meat and increasing

plant-based product intake.

4.4 The effect of meat consumption level on motivators and barriers

An important criterion for all meat consumption levels was that plant-based products be made of wholefoods. Similarly, Clark and Bogdan (2019), Kemper (2020) and Varela et al. (2022) found that minimally processed plant-based foods were preferred by their participants. A motivator for plant-based consumption for all meat consumption levels would therefore be minimally processed and wholefood. All meat consumption levels somewhat agreed that meat reduction was the consumers responsibility, which was similar to the "unconscious flexitarians", "conscious flexitarians" and "potential flexitarians" (Verain et al., 2015). Low and medium meat consumers somewhat agreed to eating plant-based products to be healthy and to looking at the ingredients list of plant-based products, although not significantly more than high meat consumers. Despite this, other variables were scored neutral and therefore nutrition and health were not a motivator or barrier for meat consumption levels.

Whilst low meat consumers were neutral on social status gained from eating plant-based products, it was a barrier to high meat consumers. Opposite to the "unconscious flexitarians", "compulsive meat eaters" (Verain et al., 2015) and "extravert flexitarian" clusters (Dagevos & Voordouw, 2013) who obtained status from eating meat, no meat consumption level gained social status by eating meat. Instead, it was somewhat of a barrier to meat consumption levels, particularly low meat consumers. All meat consumption levels disagreed that eating meat made them feel masculine, which contradicts the findings of Kemper (2020)'s study who's respondents claimed it had a strong link to masculinity in New Zealand. Environmentally sustainable habits were somewhat relevant to all meat consumption levels, implying that the environment could be a motivator for them. However, this was not supported by the neutral scores for the environment being a reason for meat reduction and increased plant-based product intake.

Results from gender, age and meat consumption frequency could be

misrepresented when only looking at averages or just comparing identified gender, age, or meat consumption levels. The large standard variation observed with these results indicate there was a large variation in how respondents scored and that comparing identified gender, age and meat consumption levels was not the best perspective of looking at the data. There was thus a need to do clustering of the results to identify groups of respondents that scored the same. K-means clustering was used and four clusters were identified.

4.5 Identifying and defining New Zealand flexitarian clusters based on motivators and barriers

Cluster 4 was similar to the MeatPos and MeatPref clusters (Knaapila et al., 2022) for whom the taste of plant-based products was a barrier to their consumption. Clusters 1, 2, and 3 rated wholefoods as an important criterion for plant-based products, similar to what was found by Clark and Bogdan (2019), Faber et al. (2021), Kemper (2020), Niva and Vainio (2021) and Varela et al. (2022). Minimally processed plant-based products would thus be a motivator for plant-based consumption. Kemper (2020)'s study found respondents were concerned about antibiotic use in farming practices. Likewise, clusters 2 and 3 were concerned about the safety of antibiotics used in meat production and diseases from meat. Their study was conducted in New Zealand, therefore it seems that a large portion of New Zealanders are concerned about antibiotic use in animal rearing. The concern about meat safety motivated "disgusted by meat" and "not attached to meat" clusters (Graça et al., 2015) to reduce meat intake, which would equally be a motivator to reduce meat consumption for clusters 2 and 3. Like the "unconscious flexitarians", "conscious flexitarians" and "potential flexitarians" (Verain et al., 2015), all clusters in this study believed meat reduction was the consumers responsibility. The distrust of authorities by respondents was seen only in cluster 4, which is similar to the findings of Kemper (2020). Therefore, the findings show that some consumers find government authorities to be a barrier to meat reduction, however a larger portion of the respondents had a distrust in the food industry and were neutral in trust towards government authorities. Distrust

in the food industry was consequently a greater barrier for respondents in this study.

Clusters 1, 2, and 3 somewhat agreed to eating plant-based products to be healthy. This was however a broad term used, and this study was interested more in what specific health and nutrition reasons consumers had to reducing meat intake. In this regard cluster 2 were the only respondents that somewhat agreed to eating plant-based products to manage and treat diet-related diseases, which is similar to other studies (Dagevos & Voordouw, 2013; Latvala et al., 2012; Niva & Vainio, 2021; Verain et al., 2015) that found health was a driver to reducing meat and eating plant-based products. Cluster 2 also ate plant-based products to manage weight, which echoes what Forestell et al. (2012) found in their study. Unlike Dagevos and Voordouw (2013), Graça et al. (2015) and Verain et al. (2015) who's clusters that were driven by health were mostly older females, cluster 2 was male and Millennial dominant. It could be that there are more females and Generation X in New Zealand who would fall into cluster 2 and just was not part of this study, thereby shifting the balance to older females. Another reason for this conflict could be because Graça et al. (2015)'s study was biased towards females (69.9%) and Dagevos and Voordouw (2013)'s study only had 20% of respondents under 35 years of age. Or it could simply mean that young males in New Zealand are more concerned about their health and wellbeing than are the older females. The "meat lovers" cluster (Dagevos & Voordouw, 2013) had low ratings for eating less meat due to health benefits. This was similar to what was found in cluster 4, where their ratings for health variables were low and did not drive them towards eating plant-based products. Nutrition was a driver for clusters 2 and 3 because of nutrition variables as well as criteria that was important to them when selecting plant-based products.

Whereas "unconscious flexitarians", "compulsive meat eaters" (Verain et al., 2015) and "extravert flexitarian" clusters (Dagevos & Voordouw, 2013) obtained status from eating meat, this was not observed in the clusters of this study. In fact, the opposite was seen that most clusters disagreed or were neutral in their agreement that eating meat gives them social status. Eating meat just was not part of their culture, and did not give them feelings of affluence, healthiness,

acceptance, ethicalness, virtuosity, or masculinity. Perhaps meat does not hold the social standing that it would have 5, 10, or 50 years ago and times have changed, as have peoples eating patterns and cultures. Maybe, instead of food, some people's social status is more connected to other aspects of life. This study also found that cluster 2 gained social status from eating plant-based products and eating plant-based products did not affect the other clusters' social status. This is a novel finding that shows there is a segment of flexitarians who are driven by social status to consume plant-based products. Unlike New Zealand flexitarian respondents in Kemper (2020)'s study who claimed meat to be part of their culture and that there was a strong link to masculinity, this study did not support those findings. All clusters were neutral or disagreed to meat being part of their culture that it made them feel masculine. Therefore, despite the large standard deviation observed for these statements with identified gender, age and meat consumption, clustering did not identify a group of consumers who associate meat with masculinity or think it is part of their culture. It could be that because these respondents were already trying to change their meat intake, their mindset was different to that of people who eat meat every day and have no intention of reducing it. Therefore, they might perceive that meat is part of the diet culture of other New Zealanders and/or makes others feel masculine, they just do not identify with those feelings.

As in Latvala et al. (2012)'s "ongoing change: less all meat, more vegetables" cluster, cluster 2 ate less meat because of animal welfare concerns. Similarly, the MaPos cluster (Knaapila et al., 2022) ate plant-based products because of animal welfare reasons, and it was important to segment 1 (Faber et al., 2021) that products be animal friendly. Again, cluster 2 was similar to the "unconscious flexitarians" and "conscious flexitarians" (Verain et al., 2015) who liked meat but did not like that animals had to die for it. Therefore, animal welfare was a driver for cluster 2 to decreasing their meat intake and eating more plant-based products.

The environment was an important motivator for clusters 1, 2, and 3, particularly cluster 2. This was observed from their agreement to environmental sustainability statements in the questionnaire, as well as to "eco-friendly" being an important

criterion when selecting plant-based products. Similarly, the environment was a driver for the "ongoing change: less all meat, more vegetables" cluster (Latvala et al., 2012), young adults and families (Kemper, 2020), the NoPos, MaPref and MaPos clusters (Knaapila et al., 2022), clusters 2 ("alternative protein increasers") and 4 ("beef-avoiding plant-protein increasers") of Niva and Vainio (2021), all segments of Faber et al. (2021), and all clusters of Verain et al. (2015) except the "compulsive meat consumers" who indicated it as average importance. Using seasonal products was a common approach to being environmentally-friendly (Vanhonacker et al., 2013) which was relevant to clusters 1, 2, and 3. These clusters also actively avoided wasting food like the young adults and retirees in Kemper (2020)'s study. The environment was therefore a key motivator for clusters 1, 2, and 3.

Similar to the "conscious flexitarians" and "potential flexitarians" (Verain et al., 2015), cluster 1 had the lowest food neophobia score and was therefore most open to trying new foods. Food neophobia was therefore a motivator for cluster 1 whereas it was a barrier for cluster 4. A summary of clusters is shown in Figure 8.

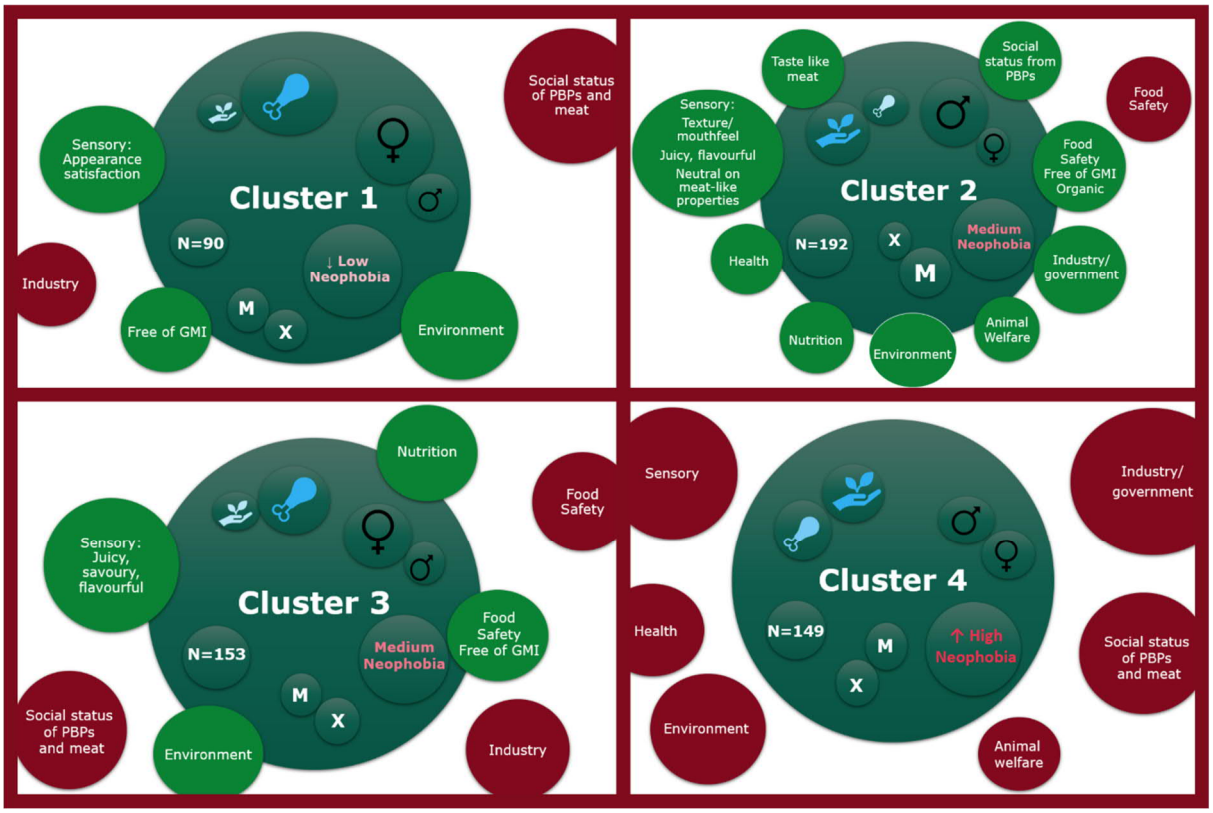

Figure 8: Illustration of main identifiers of each cluster

The size of meat vs plant-based, male vs female and Millennial vs Generation x bubbles indicate which was dominant. The number of respondents in the cluster is also shown, as is the level of food neophobia of the cluster. Green bubbles indicate motivators for plant-based consumption, whereas red indicate barriers or factors which did not influence consumption.

4.5.1 Implications of clustering on plant-based product need

From the identified gender, age and meat consumption level results some trends were seen. These were that respondents somewhat agreed that their ideal plant-based products were juicy/moist, savoury/umami, and spicy/flavourful, and in general somewhat disagreed that it bleeds-like-meat, was dry, pasty, bitter, sour, grainy and tastes of legumes. However, from the large standard deviation it was evident that there might be some segmentation in what consumers preferred for their ideal plant-based product, whether they were satisfied with current products' sensory qualities, as well as other motivations and barriers that might affect these products.

Clustering showed that a group of respondents, cluster 4, were unsatisfied with the appearance, smell, taste/flavour, and texture/mouthfeel of currently available plant-based products. These consumers would be the most difficult to please. However, they did score higher for meat-like taste/flavour and texture/mouthfeel, as well as juicy/moist, savoury/umami, and spicy/flavourful. Although these were scored neutral, it seems these attributes appealed more to this cluster, and therefore products could benefit from having these properties. Because this cluster also had the highest food neophobia, providing plant-based products that are versions of traditional dishes, like patties, "meatballs", and lasagne could be better options for their fear of trying new foods.

Cluster 2 was somewhat satisfied with currently available plant-based products' texture/mouthfeel. This might be the reason why they were neutral on the textural properties (chewy, grainy, pasty, dry) of their ideal plant-based products. They also rated higher than the other clusters for meat-like properties, although neutral, so they might prefer plant-based products that have meat-like attributes. All clusters scored high for their ideal plant-based products to be juicy/moist,

savoury/umami, and spicy/flavourful. These attributes therefore seem to be important in plant-based products. A product like falafels would most likely be flavourful and spicy, but in its nature also be dry. Perhaps pairing a product like this with a dipping or serving sauce would increase the appeal of that product. Clusters 1 and 3 scored very similar for properties that were not ideal for plant-based products. These properties were bleed-like-meat, meat-like smell, sweetness, sourness, bitterness, chewiness, graininess, pastiness, dryness, and taste of legumes. Products aimed at these clusters should avoid those properties. It should also be noted that although some basic tastes (sweet, sour, bitter, salty, umami) of ideal plan-based products were scored low, the taste of food is a complex composition of all or most of these basic tastes (Carpenter, 2013; Thomas-Danguin et al., 2019), and can even depend on the type of dish (e.g. sweet and sour sauce with rice and protein).

Nutrition was a driver for clusters 2 and 3. Products low in fat, sugar, and sodium, and high in protein, fibre and vitamins and minerals would thus appeal to them. For products to be made from wholefoods and environmental sustainability was important to clusters 1, 2, and 3. Products for these clusters should therefore aim to be minimally processed and be sustainably made with environmentally friendly packaging. Clusters 2 and 3 agreed that food safety was important, particularly for plants to be free of pesticides/herbicides and not be genetically modified. Products that are spray-free and free of genetically modified ingredients would be attractive options to these clusters.

Clearly no one ideal product exists that would satisfy the needs and ideals of all flexitarians. Clusters differed in what drove them and in their demographics and food neophobia level. Developing a range of products that cater to the different clusters and promoting these products based on their drivers would be the best approach to engage flexitarians in plant-based product consumption.

The definition of flexitarians for this study was 'someone who is actively reducing, or has actively reduced, the amount of animal flesh they consume, but is not eliminating it completely from their diet'. Based on this definition respondents who ate meat 7 days a week or never were screened out of the questionnaire. It is important to note that some individuals may naturally

fall into this definition because of their eating habits whist not actively trying to reduce their meat intake. An individual may also be reducing their meat intake, not of their own choice, but because they are dependent on a family member that purchases and/or prepares their meals. They would therefore classify as flexitarian, although it may not be their preference and should they have the option or chance could choose meat instead of plant-based foods. Individuals may also be reducing the amount of animal products that they use, but perhaps choose to still eat it every day. They would be excluded from this study based on the above definition, however may be regarded as flexitarians based on them actively reducing meat. With different studies defining and selecting flexitarians on varying factors, comparisons between studies are complicated.

4.6 Limitations and future work

This study had limitations. Firstly, the sample population was slightly biased towards females, Millennials, and those with a high meat consumption frequency. Secondly, the questionnaire failed to reach a significant number of respondents that identified with 'another gender', thereby prohibiting available responses to be used in the analysis. Thirdly, ethnic representation of respondents differed from that of the New Zealand population, which meant that the data collected was not fully representative of the New Zealand population although notably ethnic comparison was not in scope for this study. This can also be attributed to the sample size decreasing after 'no effort' respondents were removed from the dataset. Finally, self-selection bias from respondents could also have influenced the data collected. For example, if a respondent saw the topic of the questionnaire or read the information sheet and noticed it was intended for consumers who reduce meat intake, a respondent could have selected themselves to take part in the questionnaire based on the information provided. In future these limitations can be overcome by selecting respondents based on their demographic information from a database instead of respondents self-selecting to partake in the survey and monitoring the quality of data submitted. Specific test questions can also be implemented into the questionnaire to screen out respondents that click through simply for the disturbance allowance as opposed to reading the

questions.

Future work is needed to confirm the findings of this study by investigating sensory evaluation of commercially available plant-based products, as opposed to relying on respondent memory. By using a rate-all-that-apply (RATA) method sensory attributes could be measured and combined with acceptability ratings, to determine what sensory attributes are key in engagement and disengagement with plant-based products. By using a tool to identify in which cluster a sensory consumer would fall, the specific sensory drivers for each cluster could be determined and what which products appeal to each cluster. The specific objective for this would be to understand how flexitarians engage with plant-based products and which products they like. Investigating the interaction between sensory of plant-based products with other motivations and barriers would also be an interesting find. For this, the specific objective would be to compare the impact of sensory evaluation with extrinsic drivers by collecting information about motivators and barriers and performing sensory evaluation of plant-based products. The effect of taste sensitivity, in connection with genetics, on preferences for plant-based products could also be investigated. The specific objective would be to determine if taste sensitivity and genomics is connected to plant-based product preferences. Interviews or focus groups with participants that fall into cluster 4 would be useful in exploring their reasons for having many barriers and no motivators to eating plant-based foods, yet still consuming them. The specific objectives would be to identify what their sensory desires are for a plant-based product and investigate their reasons for plant-based product consumption. It could also be useful to gather information about flexitarians' meat reduction over a year or two span, and their intentions to further reduce meat in their diet. Another area of future research would be to investigate religions and cultures that naturally limit meat intake and their motivations and barriers for doing so. Future research could also investigate how income level influences consumer choices of plant-based products. If the questionnaire were to be repeated, there are some proposed changes. Firstly, asking the question about how masculine the respondent felt when eating meat or plant-based products could be rephrased to "eating meat/plant-based products make me feel more

masculine" or something similar. Otherwise, a baseline for how masculine a respondent feels in general, and even how feminine they feel, should be determined. Identifying and including more sensory properties of plant-based products would be beneficial. Secondly, in terms of ranking, having a combined ranking exercise that compares nutritional and other criteria that are important when choosing plant-based products. That way, it might come to light if high in protein or taste good is more important to respondents. Thirdly, including a validated questionnaire for environmental habits would help classify respondents on how concerned they are with environmental sustainability. And lastly, additional sections should be included to explore drivers of emotions, convenience, cooking and preparation, and religion.

5. Conclusion

This study set out to find out if New Zealand flexitarians could be segmented based on their drivers associated with plant-based products, to see if age and identified gender influence motivations and barriers for engaging with plant-based products, to identify what the motivators and barriers of flexitarians were, and what sensory properties respondents report drive their preference for plant-based products. An online questionnaire asked relevant New Zealand flexitarians questions about their motivators and barriers towards meat reduction and plant-based product consumption.

On average, consumers agreed that their ideal plant-based product was umami/savoury, juicy/moist and spicy/flavourful, and disagreed that it was dry, pasty, sour, bitter, or bleeds-like-meat. There was also a slight preference for more meat-like properties in the high meat consumption group. However, these ideal properties differed across respondents showing that there is no one ideal product for all. Taste and high in protein content were ranked as the most important by most respondents. Food safety concerns were a driver for Generation X but not for Millennials.

Demographics varied marginally across some clusters in this study. Cluster 1 had

few motivators to eating plant-based products, however were the most open to trying new foods. Cluster 2 was interesting to take note of because they had a high plant-based product consumption. They were driven by sensory, nutrition, health, the environment, animal welfare, food safety concern, organic, free of genetically modified ingredients, and gained social status from eating plant-based products. Food safety concern was a barrier to them as well. Cluster 3 was similar to cluster 2, but with more meat consumption, more barriers and fewer motivators to eating plant-based products. Cluster 4 was hard to please and had many barriers to eating plant-based products, most likely due to their high food neophobia. Segmentation shows that differences exist within flexitarians for drivers and barriers to eating plant-based products and therefore they engage differently with them. These findings are useful for future product development and marketing of plant-based products, however further investigation is needed to determine the sensory drivers of plant-based products as well as other factors that drive their consumption.

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7. Appendices

7.1 Appendix 1: Changes to questionnaire

Sensory

"Participants will be presented with images of current plant-based products (not including packaging) and asked

- What product they would choose
- What do they expect the smell/taste/texture of the product to be like
- How the product makes them feel
- If the other product that they did not choose had superior taste and texture, would they rather choose those
- To what extent do available plant-based products (e.g. patties, falafels, meat-less nuggets and sausages) meet your sensory needs, which sensory properties would you want improved
- To what extent do available plant-protein ingredients (e.g. soya, chickpeas, lentils, nuts, algae) meet your sensory needs
- How to you feel about hybrid products (products that combine plant and animal proteins)
- Do you want meat alternatives/substitutes to taste like meat or not
- Is it important that meat substitutes products taste savoury"

This section was changed to reflect satisfaction of current plant-based products and sensory attribute preferences for plant-based products.

- "Are you satisfied with the appearance of current commercially available plant-based products (e.g. patties, falafels, meat-less nuggets and sausages) (1 = 'Totally unsatisfied' to 7 = 'Totally satisfied')
- Are you satisfied with the smell of current commercially available plant-based products (e.g. patties, falafels, meat-less nuggets and sausages) (1 = 'Totally unsatisfied' to 7 = 'Totally satisfied')
- Are you satisfied with the taste/flavour of current commercially available plant-based products (e.g. patties, falafels, meat-less nuggets and sausages) (1 = 'Totally unsatisfied' to 7 = 'Totally satisfied')
- Are you satisfied with the texture/mouthfeel of current commercially available plant-based products (e.g. patties, falafels, meat-less nuggets and sausages) (1 = 'Totally unsatisfied' to 7 = 'Totally satisfied')
- Plant-based meat alternatives should (1 = 'Totally disagree' to 7 = 'Totally agree')

  - Have meat-like appearance
  - Have meat-like smell
  - Have meat-like taste/flavour
  - Have meat-like texture
  - Bleed-like-meat
  - Be juicy/moist
  - Be savoury/umami
  - Be spicy/flavourful
  - Be sweet
  - Be sour
  - Be bitter
  - Be salty
  - Be chewy
  - Be grainy
  - Be pasty
  - Be dry
  - Taste of legumes"

Meat Substitute Criteria

"Participants will be presented with ingredient lists and nutritional tables of current plant-based products and asked

- How much do they like/dislike
  - The ingredients used
  - Wholefoods, GMOs/non-GMOs, organic, free range, sugar-free, allergens
- How healthy they think the product is
- How important is it that the product is low in fat and sodium and taste like meat"

This section was changed to ask what criteria is important to the respondent when choosing plant-based products. Another question was added that asked the respondent to rank certain criteria from most to least important.

"When I choose plant-based products, it is important to me that:

- It is low in fat
- It is low in sugar
- It is low in sodium
- It is high in protein
- It is high in fibre
- It is high in vitamins and minerals
- It tastes like meat
- It is made with wholefoods and not highly processed ingredients
- It is free of genetically (GM) modified ingredients

- It is organic
- It is made sustainably and eco-friendly

Thinking about other characteristics of food, rank the following from 1 (top) most important to 6 (bottom) least important for you when selecting a plant-based product. Click and drag each option to its desired position.

- _____ Tastes like meat
- _____ Made with wholefoods
- _____ No genetically modified ingredients
- _____ Organic
- _____ Tastes good
- _____ Is environmentally friendly"

Safety

"How concerned are you with the safety of the following?

- Pesticides and herbicides on plants that are consumed by humans
- Antibiotics used in meat production
- Cultured meat/lab-grown meat
- GMOs
- Diseases from meat (e.g. Salmonella, E. coli, BSE/mad cow disease)"

This section did not change much, apart from "Cultured meat/lab-grown meat" being removed as it had its own section in the questionnaire.

Industry & Authorities

- "How important is transparency of food producers to you
- How much do you trust the food industry and authorities
- Do you think it is the consumer or the industry's responsibility to reduce meat consumption
- How important is it to you that your food is natural"

Statements were slightly altered to reflect trust in food producers and government authorities, and responsibility for meat reduction placed on the consumer, food industry and government authorities. The natural food statement was removed as it was covered by "wholefoods" in the criteria section.

"Thinking about the food industry, the government and reducing meat consumption,

how much do you agree with the following statements?

- I trust the food industry because they are open and transparent about their products
- I trust government authorities (food safety, food regulation) because they are open and transparent about their work and intentions
- Reducing meat consumption is the consumer's responsibility
- Reducing meat consumption is the food industry's responsibility
- Reducing meat consumption is the government's responsibility"

Nutrition

- "When choosing plant-based products, I look at the ingredients list (1 = 'Totally disagree' to 7 = 'Totally agree')
- When choosing plant-based products, I look at the nutritional information (1 = 'Totally disagree' to 7 = 'Totally agree')
- I consider the protein (and fat/fibre/sugar/sodium) content when purchasing plant-based products (1 = 'Totally disagree' to 7 = 'Totally agree')
- Protein (and fat/fibre/sugar/sodium) content of plant-based products meets my expectations (1 = 'Totally disagree' to 7 = 'Totally agree')
- I believe plant-based products meets my nutritional needs (1 = 'Totally disagree' to 7 = 'Totally agree')"

Some statements were removed ("meets my nutritional needs") and others were repurposed into a ranking question. After the consumer pilot of the questionnaire, the statement concerning "health star rating" was added.

"Thinking about the nutritional aspects of food, how much do you agree with the following statements?

When I choose plant-based products, I often consider the following:

- I look at the ingredients list
- I look at the nutritional information table
- I look at the protein content
- I look at the health star rating

Please rank the following from 1 (top) most important to 7 (bottom) least important when considering nutrition of plant-based products. Click and drag each option to its desired position.

_____ High in protein

_____ Low in fat

_____ High in fibre

_____ Low in sugar

_____ Low in sodium

_____ High in vitamins and minerals

_____ Low in starchy carbohydrates"

Health

- "I eat plant-based products to prevent/treat heart disease (1 = 'Totally disagree' to 7 = 'Totally agree')
- I eat plant-based products to manage weight (1 = 'Totally disagree' to 7 = 'Totally agree')
- I eat plant-based products to prevent/manage cancer (1 = 'Totally disagree' to 7 = 'Totally agree')"

This question was slightly revised to split eating of plant-based products for prevention and treatment of diet-related diseases into two statements. Another statement for "be healthy" was added.

"Thinking about health, how much do you agree with the following statements?

- I eat plant-based products because I want to:
- Prevent diet-related diseases
- Treat diet-related diseases
- Manage my weight
- Be healthy

Cost

- "Plant-based products are too expensive (1 = 'Totally disagree' to 7 = 'Totally agree')
- Meat is too expensive (1 = 'Totally disagree' to 7 = 'Totally agree')
- I am willing to pay a premium price for plant-based products (1 = 'Totally disagree' to 7 = 'Totally agree')
- I am willing to pay a premium price for sustainable meat products (e.g. organic, free range, wild caught) (1 = 'Totally disagree' to 7 = 'Totally agree')

- I am willing to pay a premium price for hybrid products (1 = 'Totally disagree' to 7 = 'Totally agree')"

This section was removed to allow for other questions regarding cultured meat.

Social Status

- "Eating meat makes me feel masculine (1 = 'Totally disagree' to 7 = 'Totally agree')
- Eating meat makes me feel accepted/not accepted (1 = 'Totally disagree' to 7 = 'Totally agree')
- Eating meat is part of my culture (1 = 'Totally disagree' to 7 = 'Totally agree')
- Eating meat makes me feel affluent (1 = 'Totally disagree' to 7 = 'Totally agree')"

Question was split into two sections with the same statements, one regarding meat and the other plant-based products. Statements on "virtuous", "healthy", and "ethical" were added.

"Thinking about how including plant-based products in your diet makes you feel, how much do you agree with the following statements?

- Eating plant-based products makes me feel masculine
- Eating plant-based products makes me feel accepted
- Eating plant-based products is part of my culture
- Eating plant-based products makes me feel affluent
- Eating plant-based products makes me feel virtuous
- Eating plant-based products makes me feel healthy
- Eating plant-based products makes me feel ethical

Thinking about how including meat products in your diet makes you feel, how much do you agree with the following statements?

- Eating meat makes me feel masculine
- Eating meat makes me feel accepted
- Eating meat is part of my culture
- Eating meat makes me feel affluent
- Eating meat makes me feel virtuous
- Eating meat makes me feel healthy
- Eating meat makes me feel ethical"

Food Novelty

- "I like trying new foods (1 = 'Totally disagree' to 7 = 'Totally agree')

- I like trying new foods in a restaurant (1 = 'Totally disagree' to 7 = 'Totally agree')
- I like ethnic foods (1 = 'Totally disagree' to 7 = 'Totally agree')
- I trust new foods (1 = 'Totally disagree' to 7 = 'Totally agree')"

This question was changed to reflect the food neophobia scale by Pliner and Hobden (1992).

"Thinking about how you interact with food in general, how much do you agree with the following statements?

- I am constantly sampling new and different foods
- I don't trust new foods
- If I don't know what is in a food, I won't try it
- I like foods from different countries
- Ethnic foods are too weird to eat
- At dinner parties, I will try a new food
- I am afraid to eat things I have never had before
- I am very particular about the foods I will eat
- I will eat almost anything
- I like to try new ethnic restaurants"

Animal Welfare

- "I eat less meat because of animal welfare (1 = 'Totally disagree' to 7 = 'Totally agree')
- I care that animals are a source of meat (1 = 'Totally disagree' to 7 = 'Totally agree')
- Animal conditions are important (1 = 'Totally disagree' to 7 = 'Totally agree')"

Statements about animal welfare were rephrased and condensed into two statements.

"Thinking about how animal welfare issues affect your food choice decisions, how much do you agree with the following statements:

- I eat less meat because of animal welfare concerns
- I like meat but I don't like that animals have to die for it"

Environment

- "I eat less meat because of the environment (1 = 'Totally disagree' to 7 = 'Totally agree')
- I avoid wasting food (1 = 'Totally disagree' to 7 = 'Totally agree')
- I take public transport or carpool (1 = 'Totally disagree' to 7 = 'Totally agree')
- I buy seasonal products (1 = 'Totally disagree' to 7 = 'Totally agree')
- I buy local products (1 = 'Totally disagree' to 7 = 'Totally agree')
- I recycle (1 = 'Totally disagree' to 7 = 'Totally agree')"

Additional statements were added and existing statements rephrased for better understanding.

"Thinking about your general habits, how much do you agree with the following statements?

- I eat less meat because I believe it helps sustainability of the environment
- I eat plant-based products because I believe it is more sustainable for the environment
- I actively avoid wasting food
- I take public transport, carpool, cycle or walk to work
- I often buy seasonal products
- I often buy local products
- I recycle glass, paper and/or plastic
- I avoid products with imported ingredients

7.2 Appendix 2: Online Flexitarian Questionnaire

Default Question Block

Thank you for your interest in our questionnaire. This study investigates consumer attitudes and food choice behaviour. Please answer questions truthfully. It should take about 15 minutes. Please read the Information sheet for further details about this study.

Do you consent to participate?

- O Yes
- O No

Please indicate your age:

- O 18-24 years
- O 25-40 years
- O 41-55 years
- O 56+ years

Please indicate which gender you identify with

- O Male
- O Female
- O Another gender (please specify) _____
- O Prefer not to say

Please indicate your ethnicity

- O New Zealand European
- O Māori
- O Samoan
- O Cook Islands Māori
- O Tongan
- O Niuean
- O Chinese
- O Indian
- O Other, eg. Dutch, Japanese, Tokelauan (please specify) _____

How would you most describe your area of residence?

- O Rural
- O Urban
- O In-between rural and urban

Please indicate your annual personal income

- O Less than $20,000
- O $20,000-$49,999
- O $50,000-$99,999
- O $100,000-$199,999
- O $200,000 +
- O Prefer not to say

How often do you consume meat, including poultry?

- O 7 days a week
- O 4-6 days a week
- O 1-3 days a week
- O Fortnightly
- O Monthly
- O Less than monthly
- O Never

How often do you eat the following

	Daily	4-6 days a week	1-3 days a week	Fortnightly	Monthly	Less than monthly	Never
Fish	O	O	O	O	O	O	O
Dairy (milk, yogurt, cheese)	O	O	O	O	O	O	O
Eggs	O	O	O	O	O	O	O

Here a **plant-based product** is defined as a commercial food that is made of plant ingredients, taking the same form (e.g. mince, balls, patties, sausages, steaks, nuggets) as conventional meat products, or provides the main protein source in the food. It may, or may not intend to mimic the sensory attributes of meat. Examples include tofu, Quorn, tempeh, meatless mince/meatballs/patties/sausages, and falafels. Plant-based products do not include cultured meat or insect-based products.

Based on this definition, which statement best describes how often you eat commercially available plant-based products?

- O 7 days a week
- O 4-6 days a week
- O 1-3 days a week
- O Fortnightly
- O Monthly
- O I have tried them once
- O Never

The sensory characteristics of food include its appearance (e.g. colour), smell, taste/flavour, and texture/mouthfeel. Thinking about the following sensory characteristics of plant-based products in general (e.g. patties, falafels, meat-less nuggets and sausages, tofu), are you:

	Always dissatisfied	Mostly dissatisfied	Sometimes dissatisfied	Neither satisfied nor dissatisfied	Sometimes satisfied	Mostly satisfied	Alw satis
Appearance	O	O	O	O	O	O	(
Smell	O	O	O	O	O	O	(
Taste/flavour	O	O	O	O	O	O	(
Texture/mouthfeel	O	O	O	O	O	O	(

How much do you agree with the following statements?

For me, an ideal plant-based product should:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Bleed like meat	O	O	O	O	O	O	O
Have a meat-like appearance	O	O	O	O	O	O	O
Have a meat-like smell	O	O	O	O	O	O	O
Be savoury/umami	O	O	O	O	O	O	O
Have a meat-like taste/flavour	O	O	O	O	O	O	O

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Have a meat-like texture/mouthfeel	○	○	○	○	○	○	○
Be juicy/moist	○	○	○	○	○	○	○
Be spicy/flavourful	○	○	○	○	○	○	○

How much do you agree with the following statements?

For me, an ideal plant-based product should:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Be pasty	○	○	○	○	○	○	○
Be grainy	○	○	○	○	○	○	○
Be chewy	○	○	○	○	○	○	○
Be bitter	○	○	○	○	○	○	○
Taste of legumes	○	○	○	○	○	○	○
Be dry	○	○	○	○	○	○	○
Be salty	○	○	○	○	○	○	○
Be sweet	○	○	○	○	○	○	○
Be sour	○	○	○	○	○	○	○

How much do you agree with the following statements?

When I choose plant-based products, it is important to me that:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
It is low in sodium	○	○	○	○	○	○	○
It is high in protein	○	○	○	○	○	○	○
It is high in fibre	○	○	○	○	○	○	○
It is organic	○	○	○	○	○	○	○

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
It is free of genetically (GM) modified ingredients	○	○	○	○	○	○	○
It is low in sugar	○	○	○	○	○	○	○
It is made with wholefoods and not highly processed ingredients	○	○	○	○	○	○	○
It is made sustainably and eco-friendly	○	○	○	○	○	○	○

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
It tastes like meat	○	○	○	○	○	○	○
It is low in fat	○	○	○	○	○	○	○
It is high in vitamins and minerals	○	○	○	○	○	○	○

Thinking about **other characteristics** of food, rank the following from 1 (top) most important to 6 (bottom) least important for you when selecting a plant-based product. Click and drag each option to its desired position.

Tastes good

Tastes like meat

No genetically modified ingredients

Organic

Made with wholefoods

Is environmentally friendly

Thinking about the safety of foods you consume, how much do you agree that you are concerned about:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Diseases from meat (e.g. Salmonella, E. coli, BSE/mad cow disease)	○	○	○	○	○	○	○
Genetically modified ingredients	○	○	○	○	○	○	○
Antibiotics used in meat production	○	○	○	○	○	○	○
Pesticides and herbicides on plants	○	○	○	○	○	○	○

Thinking about the food **industry, the government and reducing meat consumption**, how much do you agree with the following statements?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I trust the food industry because they are open and transparent about their products	○	○	○	○	○	○	○
Reducing meat consumption is the consumer's responsibility	○	○	○	○	○	○	○
I trust government authorities (food safety, food regulation) because they are open and transparent about their work and intentions	○	○	○	○	○	○	○

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Reducing meat consumption is the government's responsibility	○	○	○	○	○	○	○
Reducing meat consumption is the food industry's responsibility	○	○	○	○	○	○	○

Thinking about the **nutritional** aspects of food, how much do you agree with the following statements?

When I choose plant-based products, I often consider the following:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I look at the nutritional information table	○	○	○	○	○	○	○
I look at the ingredients list	○	○	○	○	○	○	○
I look at the health star rating	○	○	○	○	○	○	○
I look at the protein content	○	○	○	○	○	○	○

Please rank the following from 1 (top) most important to 7 (bottom) least important when considering **nutrition** of plant-based products. Click and drag each option to its desired position.

Low in fat

High in protein

Low in sugar

High in fibre

High in vitamins and minerals

Low in starchy carbohydrates

Low in sodium

Thinking about **health**, how much do you agree with the following statements?

I eat plant-based products because I want to:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Be healthy	○	○	○	○	○	○	○
Manage my weight	○	○	○	○	○	○	○
Treat diet-related diseases	○	○	○	○	○	○	○
Prevent diet-related diseases	○	○	○	○	○	○	○

Thinking about how including **plant-based products in your diet makes you feel**, how much do you agree with the following statements?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Eating plant-based products makes me feel virtuous	○	○	○	○	○	○	○
Eating plant-based products makes me feel healthy	○	○	○	○	○	○	○
Eating plant-based products makes me feel ethical	○	○	○	○	○	○	○
Eating plant-based products makes me feel affluent	○	○	○	○	○	○	○
Eating plant-based products makes me feel masculine	○	○	○	○	○	○	○

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Eating plant-based products makes me feel accepted	○	○	○	○	○	○	○
Eating plant-based products is part of my culture	○	○	○	○	○	○	○

Thinking about how including **meat products in your diet makes you feel**, how much do you agree with the following statements?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Eating meat makes me feel ethical	○	○	○	○	○	○	○
Eating meat makes me feel virtuous	○	○	○	○	○	○	○
Eating meat makes me feel healthy	○	○	○	○	○	○	○
Eating meat makes me feel affluent	○	○	○	○	○	○	○
Eating meat is part of my culture	○	○	○	○	○	○	○
Eating meat makes me feel accepted	○	○	○	○	○	○	○
Eating meat makes me feel masculine	○	○	○	○	○	○	○

Thinking about how you **interact with food in general**, how much do you agree with the following statements?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I like to try new ethnic restaurants	○	○	○	○	○	○	○
At dinner parties, I will try a new food	○	○	○	○	○	○	○
I like foods from different countries	○	○	○	○	○	○	○
I am very particular about the foods I will eat	○	○	○	○	○	○	○
I will eat almost anything	○	○	○	○	○	○	○
I am afraid to eat things I have never had before	○	○	○	○	○	○	○
If I don't know what is in a food, I won't try it	○	○	○	○	○	○	○
I don't trust new foods	○	○	○	○	○	○	○
I am constantly sampling new and different foods	○	○	○	○	○	○	○
Ethnic foods are too weird to eat	○	○	○	○	○	○	○

Thinking about how **animal welfare** issues affect your food choice decisions, how much do you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I eat less meat because of animal welfare concerns	○	○	○	○	○	○	○
I like meat but I don't like that animals have to die for it	○	○	○	○	○	○	○

Thinking about your **general habits**, how much do you agree with the following statements?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I recycle glass, paper and/or plastic	○	○	○	○	○	○	○
I often buy seasonal products	○	○	○	○	○	○	○
I avoid products with imported ingredients	○	○	○	○	○	○	○
I eat plant-based products because I believe it is more sustainable for the environment	○	○	○	○	○	○	○
I often buy local products	○	○	○	○	○	○	○
I eat less meat because I believe it helps sustainability of the environment	○	○	○	○	○	○	○
I take public transport, carpool, cycle or walk to work	○	○	○	○	○	○	○
I actively avoid wasting food	○	○	○	○	○	○	○