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Motivators and barriers to plant-based product consumption across Aotearoa New Zealand flexitarians

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ABSTRACT

Limited knowledge exists concerning Aotearoa New Zealand (A-NZ) flexitarians and their respective motivators and barriers towards consumption of novel plant-based products (PBPs) heralded as aids for dietary meat reduction. This study aimed to determine if A-NZ flexitarians, who have tried novel PBPs, can be segmented based on different motivators and barriers to meat reduction and PBP consumption, if the consumer profile of the different segments varies according to identified gender, generation group, neophobia and meat and PBP consumption frequency. It also aimed to identify sensory characteristics novel PBPs need to possess to be attractive to A-NZ flexitarians and if these vary across segments. PBP-consuming flexitarians (n = 584), stratified according to age (Millennial/Gen X), identified gender and meat consumption frequency, completed an online survey regarding a) their level of agreement regarding statements related to factors driving PBP consumption and flexitarianism in general, and b) their satisfaction with the sensory experience of consuming current PBPs. 'Tastes good' was the top-rated factor for selecting PBPs for all consumers, but most were dissatisfied with the sensory characteristics of current PBPs. K-means cluster analysis identified three flexitarian segments based on similarities and differences in key motivations and barriers to consume PBPs. Attitudes and behaviours related to nutrition/health, and social status attained from eating both PBPs and meat products, accounted for most variation across the respondents. Overall, higher food neophobia was associated with higher PBP consumption, suggesting that neophobia itself is not necessarily a barrier to PBP consumption in A-NZ flexitarians. Improving the sensory profiles of PBPs whilst delivering nutritional requirements presented as key considerations for future product development and research. This research highlights the importance of understanding the distinct values, attitudes and behaviours of different flexitarian groups as opposed to generalised research aimed at flexitarians per se.

1. Introduction

Flexitarians are generally identified as consumers who reduce meat intake without eliminating meat completely from their diet (Rosenfeld, 2018; Rosenfeld, et al., 2020). Flexitarian meat consumption is reported to vary in terms of the frequency (Campbell, 2021; Kemper & White, 2021; Verain et al., 2015), amount (Cliceri et al., 2018), and type of meat (Neff et al., 2018; Wozniak et al., 2020) that is consumed. Flexitarianism is not necessarily just limited to meat but can also relate to reduction in consumption of other animal products (Forestell et al., 2012; Vanhonacker, et al., 2013). Some researchers have categorised flexitarians as high or low meat eaters, based on cluster analysis of meat consumption frequency. High meat consumption frequency has often been defined as consuming meat 5–6 days per week (Dagevos & Voordouw, 2013; Verain et al., 2015) and low meat consumption defined as consuming meat less than 4 days a week (Verain et al., 2015). Further

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variations within high and low frequency groups are reported based on the type of meat consumed. For example, some flexitarians have been reported to eat less beef and pork weekly, but more chicken (Latvala et al., 2012), others as reducing meat but eating more fish (Vanhonacker et al., 2013) or as regularly eating white meat and occasionally eating red meat and fish (Graça et al., 2015). Regardless of age, male flexitarians generally eat meat more frequently than female flexitarians (Dagevos & Voordouw, 2013; Latvala et al., 2012; Verain et al., 2015).

Flexitarians often replace a portion of meat (animal protein source) in their diet with a plant-based alternative (Bashi et al., 2019; Hoek et al., 2011). Traditionally, plant protein sources (for example cereals and legumes), fungi (mushroom) and algal proteins (seaweeds) formed part of the diet across many cultures. However, recent interest has turned to novel plant-based alternatives (Tso et al., 2021), such as Impossible Foods, Beyond Meat and mock chicken, that are developed to resemble the sensory properties of conventional meat products, or other products such as vegetable patties not attempting to mimic their meat counterparts. The availability of novel plant-based products (PBPs), over more traditional meat alternative foods, is suggested to make the transition to a more flexitarian diet easier (Ma and Chang, 2022).

Primary consumer drivers affecting the adoption of a flexitarian diet recently identified from the literature (2012–2022) are summarised in Table 1. (adapted from Coetzee (2022)). These consumer drivers have been identified as either motivators, barriers, or both with respect to different flexitarian cohorts.

There have been many studies conducted on flexitarians across Europe, for example in the Netherlands (Dagevos & Voordouw, 2013; Verain et al., 2015), Finland (Knaapila et al., 2022; Latvala et al., 2012; Niva & Vainio, 2021), Belgium (Vanhonacker et al., 2013), Denmark (Faber et al., 2021), Germany (Michel et al, 2021), Switzerland (Hagmann et al., 2019), and Portugal (Graça et al., 2015). In Germany, with respect to the general dietary pattern, consumers (74% omnivores, 20% flexitarians, 6% pescatarians, vegetarians or vegans) still preferred to eat meat over meat alternatives and expected meat alternatives to closely represent the taste, texture, price and ease of preparation of meat (Michel et al., 2021). For Swiss vegetarians, vegans and pescatarians, ethics, animal welfare, environmental aspects and taste are reported to be strong drivers for avoiding meat (Hagmann et al., 2019). Additionally, weight regulation was a driver for Swiss females to eat less meat. Michel, Knaapila, et al., (2021) used an online survey to explore attitudes and expectations of meat eaters from Germany, France and the United Kingdom on beef burgers compared to pea and algae protein burgers. Overall, participants expected the beef burger to be superior in taste and the pea and algae burgers to be superior in health and 'environmentally friendly' attributes. However, participants with higher meat consumption, negative attitudes toward vegetarian/vegan diets and higher food neophobia had negative expectations regarding the taste, health and environmental aspects of pea and algae burgers. Negative attitudes towards vegetarian/vegan diets and negative taste expectations were identified as barriers towards adopting more plant-based diets (Michel, Knaapila, et al., 2021).

In contrast to research conducted elsewhere, limited knowledge exists concerning Aotearoa New Zealand (A-NZ) flexitarians and their respective motivators and barriers towards meat reduction and plant-based product (PBP) consumption. Amongst the few available studies, Kemper (2020) reported that health, environmental and cost aspects drive motivation for meat reduction among A-NZ young adults, families, and retirees. Conversely, cravings, sensory preferences and beliefs concerning nutrition propelled these consumer groups to continue to eat meat. A very recent online survey of 1061 general consumers in A-NZ focused on meat and meat alternative consumption indicated that health concern was a key motivating factor for reducing meat consumption (Realini et al., 2023). Generally, findings from A-NZ studies are inconclusive as to the extent to which sensory, nutritional, and processing aspects of meat, meat substitutes and plant-based foods are motivators or barriers for A-NZ flexitarians to consume PBPs.

Despite following a traditional meat-based diet (Realini et al, 2023), the A-NZ population has become increasingly diverse and flexitarianism is on the rise - as is the availability of novel plant-based meat alternatives on the New Zealand market (Anthony, 2021; Beef + LambNZ, 2021; Castle, 2018). At the time of this study, A-NZ studies regarding PBP consumption had been conducted using either small numbers in focus groups or larger studies solely among student populations. A need existed for wider research investigating the potential heterogeneity of A-NZ flexitarians and their current motivators and barriers regarding novel PBP consumption. Such knowledge will provide a basis for future research focus concerning plant-based foods and inform the A-NZ agri-food industry's PBP development activities.

Consequently, the key objectives of this study were to determine i) if A-NZ flexitarians, who have tried novel PBPs, can be segmented based on different motivators and barriers to meat reduction and PBP consumption; ii) if the consumer profile of the different segments varies according to identified gender, generation group, neophobia and meat and PBP consumption frequency and iii) preferred sensory characteristics that novel PBPs need to possess to be attractive to A-NZ flexitarians and if these vary across segments.

Table 1
Primary factors influencing adoption of a flexitarian diet.

Consumer drivers	Authors (year)
Cost	Forestell et al. (2012); Kemper and 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)
'Need' for meat	Dagevos and Voordouw (2013); Kemper (2020); Kemper and White (2021); Vanhonacker et al. (2013); Verain et al. (2015)
Food safety	Graça et al. (2015); Latvala et al. (2012)
Trust and responsibility of industry and authorities	Graça et al. (2015); Kemper (2020); Verain et al. (2015)
Health/nutrition	Cliceri et al. (2018); Forestell et al. (2012); Graça et al. (2015); Kemper (2020); Kemper and White (2021); Knaapila, et al. (2022); Latvala et al. (2012); Niva and Vainio (2021); Verain et al. (2015)
Social status and culture	Dagevos and Voordouw (2013); Kemper (2020); Kemper and White (2021); Vanhonacker et al. (2013); Verain et al. (2015)
Animal welfare/ethics	Cliceri et al. (2018); Faber et al. (2021); Kemper and White (2021); Knaapila et al. (2022); Verain et al. (2015)
Environment and sustainability	Dagevos and Voordouw (2013); Graça et al. (2015); Kemper (2020); Kemper and White (2021); Latvala et al. (2012); Niva and Vainio (2021); Vanhonacker et al. (2013); Verain et al. (2015)

2. Methodology

To investigate motivators and barriers to PBP consumption across A-NZ flexitarians, a stratified online survey approach was adopted.

2.1. Respondents

The study was considered and assessed as low risk following the Massey University Human Ethics Committee process (human ethics notification number: 4000024924). All respondents indicated informed consent by selecting a checkbox to that effect at commencement of the survey.

Respondents were recruited via an online recruitment company (Dynata, Auckland, New Zealand) comprising members of the Dynata database who volunteer to complete online surveys in return for compensation for their time (NZ$10).

Younger adults are more likely to adopt a flexitarian diet (Bayer,2019) and, as Millennials (25–40 years old) and Generation X (Gen X) (41–55 years old) are more likely to engage with meat mimics and other plant-based meat alternatives (Alae-Carew et al., 2022; Kamenidou et al., 2021; Knaapila et al., 2022), they were selected as the focus of this study. Respondents consumed a flexitarian diet defined here as eating meat less than seven days per week (Campbell, 2021; Kemper & White, 2021; Verain et al., 2015). To enable comparison across age, identified gender and meat consumption frequency, quotas aimed for 38 counts in each identified gender (male/female)-age (Millennial/Gen X)-meat consumption frequency (5 categories ranging from less than once a month to 4–6 days per week) combination (Appendix Ai, Part A). The survey terminated if respondents indicated that they ate meat every day, or never, as they were not considered to consume a flexitarian diet. Furthermore, the survey terminated if respondents indicated that they had never tried novel PBPs according to this study's definition: '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 falafel'. Plant-based products do not include cultured meat or insect-based products.*'

2.2. Survey design

The online survey questions focused on motivators and barriers to adopting a flexitarian diet and consuming novel PBPs previously identified in the literature (Table 1) (Coetzee, 2022), except for cost. Cost is already a well-established primary determinant of food choice behaviour including choices related to animal-based and plant-based foods (Tso et al., 2021), especially when deciding whether to purchase a novel product for the first time in preference to its conventional counterpart (Specht, 2019). A clear gap pertaining to knowledge concerning the preferred sensory characteristics of PBPs was identified in the literature and so a set of questions addressing that area was included here as a specific research objective.

To facilitate survey termination for those not conforming to inclusion criteria, and enable group quotas to be obtained, respondents first completed demographic questions (Appendix Ai) concerning gender, age range, and meat and PBP consumption frequency. Ethnicity (Stats-NZ, 2018), income (Stats-NZ, 2022), and residential location (rural, urban, or in between) (Stats-NZ, 2021) were also collected to characterise the sample but were not part of the stratification. Ethnicity data were summarised by combining the counts of New Zealand Europeans and other Europeans as 'European', and Chinese, Indian and other Asians as 'Asian'. Consumption frequencies of other animal products including fish, egg and dairy were also collected. Appendix A depicts the full set of survey questions and response scales. Part A of the Survey pertains to participant demographics; Part B comprises 55 statements (Appendix Ai) related to: Satisfaction with currently available PBPs; ingredient criteria for selecting PBPs; nutrition criteria for selecting PBPs; taste criteria for selecting PBPs; food safety concerns; trust in/responsibilities of industry and government; nutrition labelling; health factors; social status associated with eating PBPs, and with eating meat; animal welfare concerns; and environmental concerns. The social status section included statements regarding impact on feelings of masculinity given the close relationship between meat and masculinity (Rozin et al., 2012; Sobal, 2005; Stanely et al., 2023) and social status and masculinity (McIntyre et al., 2011).'Makes me feel healthy' was also included as a statement as eating certain foods or particular diets has been shown to be part of impression management in food choice behaviour (Martins & Pliner, 1998).

To determine the importance of the different drivers and motivators to the respondents, statements were rated on a 7-point scale ranging from always dissatisfied (score = 1) to always satisfied (score = 7), or strongly disagree (score = 1) to strongly agree (score = 7). One question referred to the 5 Health Star rating system which is a joint Australia and New Zealand government initiative. In addition, two questions asked respondents to rank general and nutritional characteristics of PBPs in order from most (score = 1) to least (score = 6 or 7) important for PBP selection (Appendix Aii). Given the gap identified in the literature concerning sensory preferences regarding PBPs, respondents also were asked to indicate their level of agreement to statements indicating what the ideal sensory characteristics of PBPs should be (Appendix Aiii). The sensory attributes in the list were selected from previous literature and included those identified as drivers of liking (including meat-like attributes) and dislike (for example, legume/beany flavours) for PBP.

As PBPs deliver a new experience for some consumers, and willingness to try new foods is known to impact food choice behaviour (Prescott et al., 2022), respondents were asked to complete the food neophobia scale (Pliner & Hobden, 1992) comprised of 10 questions rated on a 7-point Likert scale ranging from strongly disagree (score = 1) to strongly agree (score = 7).

The survey was initially piloted with colleagues from the Food Experience and Sensory Testing (Feast) laboratory (n = 4) and then general consumers (n = 7) to make further clarifications prior to data collection. The former led to consistency for food consumption frequencies across foods being applied and the initial continuous line scale swapped to the more user-friendly 7-point Likert scale for agreement statements. The social status statements were also separated into one section for meat and one for PBP. Following the consumer pilot clearer instructions on how to carry out the ranking questions were added.

The survey was hosted on the Qualtrics platform (Qualtrics, Provo, Utah, USA). Data were collected in October and November 2021.

2.3. Statistical analyses

All statistical analyses were performed in XLStat v2021.2.2, (Addinsoft, France). P-values <0.05 were considered statistically significant and mean ± standard error (SE) values are reported throughout the article.

To create fewer and more equal group sizes, meat frequency consumption groups were further categorised into high (4–6 days /week), medium (1–3 days /week) and low (fortnightly, monthly, or less than monthly) consumption categories. The same approach was applied to the fish, egg and dairy consumption data collected. PBP frequency consumption groups were further categorised into three groups: high (7 days/week, 4–6 days/week), medium (1–3 days/week), and low (<fortnightly).

To isolate non-genuine respondents, food neophobia data, which includes reverse-scored items (i.e. statements for which scoring runs in the opposite direction), was assessed. Respondents who contradicted themselves by repeatedly giving the same response to each statement were identified using k-means clustering of neophobia scores and removed from the dataset.

To calculate neophobia scores, reverse-scored items were recoded so that the direction of scoring was equal for all statements, and scores of all 10 questions were summed to a score out of 70.

Correlations between meat and PBP consumption frequencies and respondent demographics were determined using Kendall's tau (τ) (ordinal variables) to aid data interpretation.

A Factor analysis (with Principal components extraction and varimax rotation) was applied to the responses to the 55 statements to determine if they could be reduced to particular factors accounting for variation in participant response. Cronbach's alpha was extracted for each factor. K-means cluster analysis (Euclidean distance, Determinant (W)) was applied to the Factor scores but failed to give an interpretable solution based on the average and individual respondent negative Silhouette scores. Negative silhouettes scores indicate respondents not fitting the cluster solution (Bhardwaj, 2020). Consequently, the cluster analysis was applied to the original respondent scores. The optimal number of clusters was determined using the elbow method and Silhouette score

values were checked. One-way ANOVA and Tukey post hoc multiple comparison tests were applied to identify differences between clusters in their scores for motivators and drivers, sensory preferences and neophobia. Differences in demographic variables between each cluster and the total sample were investigated with the Chi-square goodness of fit tests.

To determine if significant differences existed in the rank importance of 'product characteristics' and 'nutritional criteria', rank scores per cluster were analysed using a Friedman's test followed by a Nemenyi's multiple pairwise comparison procedure.

3. Results

A total of 801 respondents completed the survey; however, 217 were classified as non-genuine, based on their inconsistent responses to the food neophobia statements, leaving 584 survey responses for analysis.

3.1. Factors identified in motivations and barriers factor analysis

Table 2 indicates the factor scores and general themes associated with the 10-factor solution that summarised a little over 65% of the data variability in response to the 55 motivation and barrier statements. Factor 1 related to statements pertaining to consideration of nutritional and ingredient composition criteria when selecting PBPs, whereas Factor 2 related to those concerning social status attained by eating PBP. Beliefs that meat-reduction is the responsibility of industry and government were also associated with this factor. Factor 3 was strongly associated with statements relating to social status obtained from eating meat, and meat taste as a criteria for PBP selection. Factor 4 aligned to respondents' level of satisfaction with their sensory experience of PBP's. Factor 5 was mixed relating to statements including animal welfare concerns, environmental sustainability reasons for meat reduction/increasing PBP consumption, alongside behaviours concerning buying local versus imported foods in general, indicating correlation between these attitudes and behaviours. Factors 6 and 7 were related to food safety concern and looking at PBP food labelling respectively. Participants trust in industry and government was allied with Factor 8. Factor 9 was linked to avoiding food waste, using seasonal products and general recycling alongside views on meat reduction being the consumer's responsibility. Finally, Factor 10 related to attitudes towards eating PBP to be healthy by preventing or treating disease, or to manage weight.

3.2. Segmentation by cluster analysis

An initial K-means cluster analysis on Factor Analysis respondent factor scores failed to deliver a robust solution, likely due to loss of information as only 65% variation was accounted for across the 10 factors. Via the elbow method, in a subsequent k-means cluster analysis on individual statement scores a three, evenly-sized, cluster solution was identified; with 203, 199 and 182 participants across Clusters 1, 2 and 3 respectively, no negative cluster Silhouette scores and only a few individual negative Silhouette scores.

The mean and SE for each statement, pooled and by cluster, are presented in Table 3 together with Tukey multiple comparison test outcomes. One-way ANOVAs revealed significant differences between clusters for all statements ($p < 0.05$), indicating that the PBP consuming flexitarians could be segmented according to different motivations and barriers.

Clusters 2 and 3 both agreed to a similar level that they considered nutritional and ingredients criteria when selecting PBPs (Factor 1) although, of note, Cluster 2 agreed significantly more that organic ingredients were an important consideration. Both were equally concerned about food safety (Factor 6) and not overly satisfied with their sensory experiences of PBP (Factor 4). However, Cluster 2 agreed significantly more that PBPs should taste like meat. Both agreed that meat reduction was the consumer's responsibility (element of Factor 9).

What differentiated the two clusters was that participants in Cluster 2 agreed significantly more that they look at nutrition related labelling on products and health star ratings (Factor 7) and eat PBPs for health reasons (Factor 10). Notably, Cluster 2 also agreed significantly more that they felt eating both PBP and meat increased elements of their social status, whereas Cluster 3 generally disagreed (Factors 2 and 3). Cluster 2 agreed that meat reduction was the responsibility of industry and authorities and had more trust in these organisations (Factor 8), whereas Cluster 3 did not. Although both clusters agreed to some extent that animal welfare and sustainability concerns impacted their food choice decisions, this was significantly more pronounced for Cluster 2 (Factor 5). Both agreed that they chose local products and avoided imported ones. Although both agreed to a similar level that they avoided food waste and recycled, Cluster 3 agreed significantly more on these Factor 9 elements.

Cluster 1 was significantly different from Cluster 2 on all Factors, and from Cluster 3 on the majority. Cluster 1 participants were generally ambivalent regarding the importance of nutrition and ingredient composition criteria in their choice of PBPs (Factor 1) or whether they ate them for health reasons (Factor 10), although their average score regarding eating them 'to be healthy' tended towards slightly agree. Aligned to this, they disagreed that they looked at nutritional information or health star ratings and were ambivalent with regards to studying ingredient lists (Factor 7). They also disagreed that they were concerned about food safety (Factor 6). Cluster 1 leaned towards slightly disagreeing that they gained social status from eating PBPs or meat (Factor 2 and 3) but generally not as much as Cluster 3. Average responses to environment related statements in Factors 9 and 5 also indicated significantly low agreement to avoiding imports or seeking local or seasonal products. Although they tended towards agreeing that they recycle and avoid food waste, this was significantly less than Clusters 2 and 3. Like Cluster 3, they disagreed that they trust industry and had the lowest score for trusting government (Factor 8). This cluster was not satisfied with the appearance, smell and flavour experience of PBP and ambivalent regarding texture (Factor 4), however, like Cluster 3, disagreed that that PBPs needed to taste like meat.

Results from the ranking questions (Tables 4 and 5) provided additional insights and supported differentiation between the Clusters. From a nutritional perspective (Table 4), protein content was important, together with vitamins and minerals, for all Clusters. Fibre content was equally as important for Clusters 1 and 2 but not as important as protein for Cluster 3. The remaining nutrients were then considered as equal for Clusters 1 and 2. Cluster 3, however, was more discerning with low sugar and low fat and low sodium next important (with some overlap) and low sodium and carbohydrate content least important.

Product characteristic criteria ranking emphasised that 'tastes good' was a top criterium for all clusters but singularly so for Clusters 1 and 3 (Table 5). Only Cluster 2 differentiated that tasting like meat was less important than the other criteria. Although Cluster 1 had only slightly agreed that PBP tasting like meat was an important criterion when selecting PBPs, they ranked 'tastes like meat' as more important than products being environmentally friendly. Cluster 3, however, indicated that the use of whole foods and no genetically modified ingredients were more important to them than the environment, organic ingredients and PBPs tasting like meat.

3.3. Cluster demographics, consumption frequencies and neophobia scores

3.3.1. Demographics

Demographic data, product consumption frequency and neophobia scores across pooled respondents and by cluster ($n = 584$) are summarised in Table 6. Perhaps not surprisingly there was a weak, but significant, negative correlation between meat consumption frequency and PBP consumption frequency ($\tau = -0.27$; $p < 0.001$) (Appendix B). Neophobia scores were positively correlated with PBP consumption

Table 2
Factor loadings (and related Cronbach's alpha) for each statement across 10 factor solution following Factor Analysis with varimax rotation.

Statement	Factor (% Variation explained)/Main Factor Theme									
	F1 (10.7) Composition	F2 (10.3) Social Status PBP	F3 (8.6) Social Status Meat	F4 (6.6) Sensory Satisfaction	F5 (5.2) Animal Welfare	F6 (6.4) Safety	F7 (5.0) Use labelling	F8 (3.4) Trust	F9 (4.2) Waste	F10 (5.2) Health
Cronbach's Alpha	**0.907**	**0.903**	**0.881**	**0.904**	**0.815**	**0.877**	**0.841**	**0.729**	**0.759**	**0.851**
CN_LowFat	**0.691**	0.212	−0.016	0.076	−0.109	0.118	0.097	0.063	0.050	0.144
CN_LowSugar	**0.652**	0.153	−0.092	0.102	−0.012	0.249	0.182	0.041	0.177	0.056
CN_LowSodium	**0.648**	0.146	0.042	0.220	0.055	0.128	0.080	0.100	0.022	0.145
CN_HighProtein	**0.608**	0.007	0.028	0.178	−0.078	0.146	0.278	0.125	0.223	−0.032
CN_HighFibre	**0.690**	0.063	−0.032	0.174	−0.032	0.143	0.159	0.150	0.111	0.154
CN_HighVits&Mins	**0.704**	0.014	−0.043	0.145	0.042	0.148	0.238	0.044	0.171	0.165
CI_Wholefoods	**0.691**	−0.094	−0.047	0.107	0.195	0.200	0.203	−0.022	0.149	0.080
CI_FreeGM	**0.667**	−0.093	0.072	0.080	0.224	0.261	0.119	−0.020	0.000	0.196
CI_Organic	**0.541**	0.117	0.093	0.091	0.320	0.229	0.079	0.088	−0.163	0.265
CI_Eco-friendly	**0.629**	0.045	0.001	0.184	0.338	0.168	0.088	0.062	0.161	0.092
I/G_Industry Responsibility	−0.028	**0.438**	0.101	0.076	0.396	0.043	0.190	0.344	−0.138	0.129
I/G_Government Responsibility	−0.047	**0.506**	0.080	0.008	0.356	−0.013	0.144	0.303	−0.251	0.086
SS_PBP_Masculine	−0.010	**0.734**	0.288	0.064	0.077	−0.035	0.006	0.181	−0.233	0.117
SS_PBP_Accepted	0.031	**0.759**	0.279	0.092	0.155	−0.035	0.071	0.084	−0.053	0.163
SS_PBP_Culture	−0.023	**0.724**	0.217	0.059	0.117	0.001	0.173	0.160	−0.092	0.154
SS_PBP_Affluent	0.048	**0.761**	0.257	0.093	0.067	0.039	0.099	0.093	−0.071	0.167
SS_PBP_Virtuous	0.082	**0.716**	0.250	0.111	0.113	0.073	0.048	−0.047	0.104	0.160
SS_PBP_Healthy	0.290	**0.492**	0.048	0.267	0.078	0.083	0.145	−0.091	0.285	0.282
SS_PBP_Ethical	0.187	**0.630**	0.179	0.219	0.322	0.130	0.066	−0.132	0.177	0.096
SS_Meat_Masculine	−0.073	0.244	**0.736**	0.013	−0.022	−0.034	−0.036	0.123	−0.118	0.130
SS_Meat_Accepted	−0.019	0.217	**0.796**	−0.049	0.020	−0.023	0.007	0.001	0.056	0.031
SS_Meat_Culture	0.089	−0.032	**0.680**	0.033	0.011	0.056	0.099	−0.121	0.301	−0.104
SS_Meat_Affluent	−0.023	0.212	**0.809**	−0.026	0.041	0.026	0.014	0.114	−0.050	0.063
SS_Meat_Virtuous	−0.001	0.301	**0.760**	−0.073	−0.003	−0.041	0.013	0.134	−0.093	0.069
SS_Meat_Healthy	0.032	−0.057	**0.727**	0.020	−0.002	−0.002	0.114	0.057	0.090	−0.002
SS_Meat_Ethical	−0.038	0.293	**0.762**	−0.059	0.007	0.004	0.052	0.115	−0.138	0.082
CT_MeatTaste	0.348	0.197	**0.369**	0.015	−0.193	0.049	−0.021	0.351	−0.006	−0.129
Sn_Appearance	0.219	0.038	−0.053	**0.825**	0.044	0.058	0.033	0.030	0.144	0.002
Sn_Smell	0.172	0.030	0.007	**0.861**	0.051	0.008	0.064	0.060	0.105	0.098
Sn_Taste/flavour	0.070	0.167	−0.058	**0.876**	0.054	0.085	0.092	0.056	−0.012	0.099
Sn_Texture/mouthfeel	0.067	0.145	−0.007	**0.832**	0.097	0.043	0.115	0.071	−0.074	0.080
AW_Concerns	0.118	0.396	−0.075	0.147	**0.647**	0.133	0.149	0.019	−0.019	0.061
AW_NoAnimalsDie	0.176	0.245	0.017	0.111	**0.642**	0.155	−0.001	0.004	0.046	−0.089
E_LessMeatSustainability	0.055	0.463	−0.029	0.151	**0.615**	0.047	0.084	0.077	0.197	0.144
E_MorePBPSustainability	0.135	0.472	0.026	0.134	**0.548**	0.077	0.086	0.023	0.251	0.147
E_LocalProducts	0.254	−0.007	0.098	0.054	**0.383**	0.136	0.328	0.104	0.319	0.153
E_AvoidImported	0.053	0.311	0.185	−0.054	**0.422**	0.139	0.217	0.152	−0.111	0.247
S_Pesticides&Herbicides	0.211	−0.018	−0.003	0.063	0.100	**0.836**	0.088	−0.001	0.079	0.095
S_Antibiotics	0.205	0.036	−0.032	0.016	0.107	**0.822**	0.054	−0.018	0.099	0.126
S_GMIngredients	0.193	−0.008	0.057	0.054	0.113	**0.802**	0.105	−0.030	0.014	0.171
S_Diseases	0.130	0.121	−0.040	0.082	−0.078	**0.792**	0.117	0.043	0.115	0.009
L_IngredientsList	0.363	0.032	−0.005	0.123	0.198	0.162	**0.668**	−0.033	0.112	0.172
L_NutritionalTable	0.264	0.192	0.075	0.132	0.072	0.159	**0.746**	0.015	0.097	0.173
L_ProteinContent	0.227	0.205	0.109	0.141	0.019	0.101	**0.740**	0.069	0.062	0.123
L_HealthStarRating	0.323	0.218	0.053	0.173	0.124	0.166	**0.497**	0.224	0.027	0.254
I/G_TrustIndustry	0.137	0.217	0.218	0.082	0.020	−0.025	0.082	**0.737**	0.019	0.110
I/G_TrustGovernment	0.143	0.091	0.184	0.207	0.101	−0.005	0.013	**0.739**	0.144	0.049
E_AvoidFoodWaste	0.265	−0.077	−0.029	0.057	0.078	0.205	0.097	0.144	**0.650**	0.202
E_SeasonalProducts	0.290	−0.081	0.000	0.108	0.174	0.204	0.287	0.043	**0.548**	−0.006
E_Recycle	0.346	−0.184	−0.083	0.146	0.105	0.225	0.090	0.015	**0.579**	−0.092
I/G_ConsumerResponsibility	0.316	−0.010	−0.075	0.158	−0.019	0.222	0.190	0.142	**0.442**	0.101
H_PreventDiseases	0.178	0.269	0.110	0.127	0.117	0.193	0.143	0.058	0.030	**0.743**
H_TreatDiseases	0.149	0.330	0.125	0.050	0.060	0.140	0.101	0.133	−0.221	**0.656**
H_ManageWeight	0.179	0.232	0.070	0.098	−0.036	0.129	0.161	0.058	0.105	**0.719**
H_BeHealthy	0.322	0.209	0.003	0.239	0.130	0.141	0.206	−0.030	0.227	**0.642**

CN – nutrition criteria, CI - Ingredient type criteria, I/G – Trust in industry/authorities, SS - Social Status, PBP - Plant-based product, CT - Taste criteria, Sn-satisfaction with sensory attributes, AW - Animal welfare, E- Environment, S - safety, L - Labelling, H - Health. *Values in **bold** correspond for each variable to the factor for which the squared cosine was the largest.*

frequencies ($\tau = 0.15$; $p < 0.001$).

Generally, Cluster 1 matched the demographic profile of the pooled sample but with significant differences including slightly more men (55% in Cluster 1 compared to 47% in the pooled sample) and slightly less urban respondents (61% compared to 68%).

Cluster 2 similarly consisted of slightly more men (58%) than the pooled sample, as well as proportionally more Millennials (66%). It contained significantly fewer Europeans and more 'other' ethnicities and, although still dominated by urban respondents, contained a slightly higher proportion of those living rurally.

Notably, Clusters 1 and 2 were significantly more neophobic than Cluster 3, although average scores for all cluster fell at a medium level of neophobia (Turorila, Lähteenmäki, Pohjallainen & Lotti, 2011).

Markedly, Cluster 3 had a higher proportion of females (70%), slightly higher proportion of Gen X than the pooled sample, and almost 70% were European. It included a higher than pooled average number of urban dwellers (75%) and people in lower personal income brackets.

3.3.2. Consumption patterns

Cluster 2 was comprised of a considerable proportion of meat reducers with significantly more 'low meat' (41%) and less 'high meat' (24%) consumers than the other clusters. Although PBP consumption was equally dispersed over the low, medium and high frequency categories, this cluster included significantly more medium (31%) to high (35%) PBP consumers than expected by chance. Cluster 3 was the reverse, with many respondents (52 %) who still consumed meat 4–6 days a week and fewer (18%) 'low meat' consumers; and almost 74% were low frequency PBP consumers.

There was some variation in consumption of other animal proteins across the clusters. Egg and Dairy consumption were generally medium to high across the clusters, but fish varied. Of note Cluster 2 had higher egg consumption, Cluster 1 relatively lower dairy consumption, and Cluster 3 consumed less fish than the overall average.

3.3.3. Sensory preferences

Pooled and Cluster mean scores (plus SE) for agreement level regarding the sensory characteristics that ideal PBP should have are presented in Table 7.

Preferences for PBP sensory characteristics varied across the Clusters. Cluster 2 and 3 agreed that PBPs should have a meat-like appearance, smell and flavour as well as juicy, savoury and spicy/flavourful characteristics. Cluster 1 were ambivalent and, in fact, slightly disagreed that PBPs should have a meat-like appearance. No cluster agreed PBPs should bleed like meat, but unlike the ambivalence of Cluster 2, Clusters 1 and 3 disagreed that this should be the case - Cluster 3 strongly so. Although Cluster 1 agreed that PBPs should also be moist, savoury and flavourful, agreement was significantly less than Cluster 2 and 3. Cluster 1 disagreed that PBPs should be beany, sweet, sour or bitter and Cluster 3 disagreed significantly more so. Cluster 2, however, scored close to neither agree nor disagree for sour and bitter and tended towards agree slightly for beany and sweet. Whether PBPs should be salty split the clusters with Cluster 2 slightly agreeing and Clusters 1 and 3 disagreeing. Opinions on texture were perhaps the most dissimilar with Cluster 2 slightly agreeing PBP should be chewy, grainy, pasty and tending towards agreement on dry, whereas Cluster 1 somewhat disagreed on these attributes and Cluster 3 disagreed significantly more so.

4. Discussion

This study investigated drivers of PBP consumption in A-NZ flexitarians, and their segmentation according to different motivations and barriers. Three flexitarian segments were discovered: an unmotivated/ambivalent Cluster 1; a health conscious/socially aware Cluster 2 containing more meat reducers; and a health conscious/environmentally responsible Cluster 3 with higher numbers of women and lower frequency PBP consumption; highlighting that A-NZ flexitarians are not a homogenous group. Although some differences were identified in gender, age, income, residence, and neophobia across clusters, these were not as prominent as differences in opinions towards different motivators and barriers to PBP consumption or meat and PBP consumption frequencies. Each segment also varied to some degree in what they believed the ideal sensory characteristics of PBPs should be; however, unsurprisingly all clusters agreed that PBPs should taste good.

4.1. Factors explaining variation across respondents

Factor analysis indicated that, for the most part, the answered statements grouped into expected underlying concepts, or themes, impacting flexitarian engagement with PBPs. Most variation across respondents was attributed to the importance of nutritional and ingredient criteria, and level of social status associated with eating PBP, closely followed by social status associated with meat consumption. Although eating meat has long been associated with social status (Stoll-Kleemann and Schmidt, 2017) this association to PBP has not previously been identified, other than in relation to virtue signaling concerning reducing climate change (Albrecht & Mauch, 2021; Gössling, 2019). Further factors highlighted variation in satisfaction with sensory aspects of PBPs, importance of animal welfare, food safety and health concerns and consultation of food labels. Finally, environmental behaviours and level of trust in industry and government explained less variation but were still relevant.

At first glance, statements grouped in three of the Factors seemed unconnected and warranted closer inspection. Attitude statements regarding industry and government responsibility for meat reduction grouped with social status statements associated with eating PBP (Factor 2). This can be explained by the fact that respondents in Cluster 1 and 3, who did not feel they gained social status from PBP consumption, also indicated they did not think meat reduction was the responsibility of industry or the government and hence these statements possessed largely similar data patterns. Secondly, in Factor 5, animal welfare concerns were grouped with statements concerning sustainable food choices but notably both are concerns about foods systems relating to ethical considerations (de Boer & Aiking, 2022). Finally, belief that meat reduction was the responsibility of the consumer was aligned in Factor 9 with environmental behaviours. Again, this can be explained by the fact that these are behaviours which the consumer would also take responsibility for (or not) regarding wider environmental concerns beyond only meat reduction.

4.2. Variation in key motivators and barriers to plant-based product consumption across segments

4.2.1. Taste

All clusters ranked 'tastes good' as the most important criteria (or one of the most in Cluster 2) for PBP selection. However, satisfaction with current PBP offerings varied whereby two clusters were unsatisfied and Cluster 2 was satisfied, but only marginally. Consistent with other studies that highlight the perceived inferior sensory quality of PBPs (Michel, Hartmann, et al., 2021; Michel, Knaapila, et al., 2021; Onwezen et al., 2021; Vainio et al., 2016) this indicates that sensory characteristics are also a major barrier for A-NZ flexitarians to adopt PBPs in their diet. Interestingly, Cluster 2 preferences for sensory attributes of PBP demonstrated they were more accepting of the attributes many find detrimental in PBP, such as beany/legume flavour or pasty texture and,

Table 3
Pooled and Cluster mean scores plus standard error for each motivation/barrier statement (rated on a 7 point Likert scale), grouped by Factor.

	Statement	Pooled Sample		Cluster 1		Cluster 2		Cluster 3	
Factor		Mean	SE	Mean	SE	Mean	SE	Mean	SE
1	CN_LowFat	4.83	0.06	4.03[a]	0.08	5.28[b]	0.08	5.24[b]	0.09
	CN_LowSugar	5.12	0.05	4.23[a]	0.08	5.53[b]	0.07	5.68[b]	0.08
	CN_LowSodium	4.84	0.05	4.09[a]	0.08	5.28[b]	0.07	5.19[b]	0.08
	CN_HighProtein	5.22	0.05	4.41[a]	0.08	5.59[b]	0.06	5.71[b]	0.07
	CN_HighFibre	5.07	0.05	4.34[a]	0.08	5.45[b]	0.07	5.47[b]	0.08
	CN_HighVits&Mins	5.18	0.05	4.29[a]	0.08	5.56[b]	0.07	5.77[b]	0.07
	CI_Wholefoods	5.26	0.05	4.32[a]	0.08	5.50[b]	0.08	6.04[c]	0.07
	CI_FreeGM	5.05	0.06	4.07[a]	0.08	5.48[b]	0.08	5.68[b]	0.09
	CI_Organic	4.76	0.05	3.93[a]	0.08	5.44[b]	0.07	4.93[c]	0.10
	CI_Eco-friendly	5.02	0.05	4.11[a]	0.09	5.48[b]	0.07	5.53[b]	0.08
2	I/G_Industry Responsibility	4.11	0.06	3.70[a]	0.09	5.15[b]	0.08	3.43[a]	0.11
	I/G_Government Responsibility	3.85	0.06	3.60[a]	0.09	4.91[b]	0.09	2.97[c]	0.11
	SS_PBP_Masculine	3.55	0.07	3.45[a]	0.10	4.83[b]	0.09	2.25[c]	0.09
	SS_PBP_Accepted	3.85	0.07	3.66[a]	0.10	5.11[b]	0.08	2.70[c]	0.10
	SS_PBP_Culture	3.77	0.07	3.46[a]	0.10	5.15[b]	0.08	2.62[c]	0.11
	SS_PBP_Affluent	3.88	0.07	3.63[a]	0.09	5.10[b]	0.07	2.83[c]	0.11
	SS_PBP_Virtuous	4.17	0.06	3.81[a]	0.09	5.19[b]	0.08	3.45[c]	0.11
	SS_PBP_Healthy	4.80	0.06	3.99[a]	0.10	5.53[b]	0.07	4.89[c]	0.10
	SS_PBP_Ethical	4.45	0.06	3.71[a]	0.10	5.47[b]	0.07	4.17[c]	0.11
3	SS_Meat_Masculine	3.52	0.07	3.68[a]	0.09	4.36[b]	0.11	2.42[c]	0.11
	SS_Meat_Accepted	3.91	0.06	3.85[a]	0.09	4.66[b]	0.09	3.18[c]	0.11
	SS_Meat_Culture	4.41	0.06	4.05[a]	0.10	4.81[b]	0.10	4.38[b]	0.13
	SS_Meat_Affluent	3.78	0.06	3.79[a]	0.09	4.56[b]	0.10	2.93[c]	0.11
	SS_Meat_Virtuous	3.67	0.06	3.67[a]	0.09	4.52[b]	0.10	2.74[c]	0.10
	SS_Meat_Healthy	4.38	0.06	4.21[a]	0.09	4.83[b]	0.09	4.06[a]	0.11
	SS_Meat_Ethical	3.63	0.06	3.65[a]	0.09	4.48[b]	0.10	2.66[c]	0.09
	CT_MeatTaste	4.47	0.06	4.15[a]	0.09	5.11[b]	0.09	4.14[a]	0.14
4	Sn_Appearance	4.7	0.06	3.86[a]	0.10	4.69[b]	0.11	4.90[b]	0.10
	Sn_Smell	4.49	0.06	3.98[a]	0.09	4.74[b]	0.10	4.80[b]	0.09
	Sn_Taste/flavour	4.53	0.06	3.99[a]	0.10	4.87[b]	0.11	4.77[b]	0.11
	Sn_Texture/mouthfeel	4.56	0.06	4.06[a]	0.11	4.89[b]	0.10	4.75[b]	0.10
5	AW_Concerns	4.32	0.07	3.56[a]	0.09	5.21[b]	0.09	4.21[c]	0.13
	AW_NoAnimalsDie	4.65	0.07	3.91[a]	0.10	5.37[b]	0.09	4.68[c]	0.13
	E_LessMeatSustainability	4.39	0.07	3.66[a]	0.09	5.36[b]	0.08	4.14[c]	0.13
	E_MorePBPSustainability	4.44	0.06	3.61[a]	0.09	5.41[b]	0.08	4.31[c]	0.12
	E_LocalProducts	5.02	0.05	4.15[a]	0.08	5.60[b]	0.06	5.36[b]	0.08
	E_AvoidImported	4.08	0.06	4.15[a]	0.08	5.60[b]	0.08	5.36[b]	0.11
6	S_Pesticides&Herbicides	4.89	0.06	3.91[a]	0.09	5.32[b]	0.09	5.50[b]	0.11
	S_Antibiotics	4.88	0.06	3.97[a]	0.09	5.32[b]	0.09	5.42[b]	0.12
	S_GMIngredients	4.76	0.06	3.87[a]	0.09	5.22[b]	0.09	5.25[b]	0.12
	S_Diseases	4.84	0.06	4.01[a]	0.09	5.24[b]	0.09	5.31[b]	0.12
7	L_IngredientsList	5.06	0.06	4.08[a]	0.09	5.56[b]	0.07	5.60[b]	0.09
	L_NutritionalTable	4.89	0.06	3.90[a]	0.08	5.65[b]	0.06	5.17[c]	0.11
	L_ProteinContent	4.79	0.06	3.92[a]	0.09	5.52[b]	0.07	4.96[c]	0.10
	L_HealthStarRating	4.73	0.06	3.74[a]	0.09	5.52[b]	0.07	4.96[c]	0.11
8	I/G_TrustIndustry	4.16	0.06	3.73[a]	0.08	5.09[b]	0.09	3.63[a]	0.10
	I/G_TrustGovernment	4.45	0.06	3.95[a]	0.09	5.11[b]	0.08	4.28[c]	0.11
9	E_AvoidFoodWaste	5.51	0.05	4.68[a]	0.09	5.78[b]	0.07	6.12[c]	0.07
	E_SeasonalProducts	5.31	0.05	4.52[a]	0.08	5.57[b]	0.07	5.91[c]	0.07
	E_Recycle	5.64	0.05	4.93[a]	0.09	5.65[b]	0.08	6.43[c]	0.07
	I/G_ConsumerResponsability	5.15	0.05	4.31[a]	0.09	5.48[b]	0.07	5.74[b]	0.08
10	H_PreventDiseases	4.66	0.06	3.91[a]	0.09	5.55[b]	0.07	4.54[c]	0.13
	H_TreatDiseases	4.25	0.07	3.72[a]	0.09	5.31[b]	0.08	3.68[a]	0.13
	H_ManageWeight	4.54	0.06	3.82[a]	0.10	5.21[b]	0.08	4.62[c]	0.13
	H_BeHealthy	5.12	0.06	4.24[a]	0.09	5.74[b]	0.07	5.43[c]	0.09

CN – nutrition criteria, CI - Ingredient type criteria, I/G – Trust in industry/authorities, SS - Social Status, PBP - Plant-based product, CT - Taste criteria, Sn-satisfaction with sensory attributes, AW - Animal welfare, E- Environment, S - safety, L - Labelling, H – Health.[abc] – mean scores with different letter codes are significantly different ($p < 0.05$) within a statement between clusters.

Table 4
Mean rank scores (±SE) by cluster for importance of nutrient criteria when selecting PBPs (1 = most important, 7 = least important).

Nutritional Criteria	Cluster 1	Cluster 2	Cluster 3
High in protein	$3.50^{a} \pm 0.15$	$3.13^{a} \pm 0.15$	$2.63^{a} \pm 0.13$
High in vitamins/minerals	$3.56^{a} \pm 0.13$	$3.44^{a} \pm 0.14$	$3.22^{ab} \pm 0.13$
High in fibre	$3.70^{a} \pm 0.13$	$3.54^{a} \pm 0.13$	$3.54^{bc} \pm 0.13$
Low sugar	$3.92^{ab} \pm 0.14$	$4.32^{b} \pm 0.13$	$3.97^{cd} \pm 0.14$
Low fat	$4.34^{b} \pm 0.14$	$4.33^{b} \pm 0.14$	$4.51^{de} \pm 0.14$
Low sodium	$4.45^{b} \pm 0.13$	$4.50^{b} \pm 0.13$	$4.84^{ef} \pm 0.13$
Low carbohydrate	$4.52^{b} \pm 0.13$	$4.73^{b} \pm 0.14$	$5.29^{f} \pm 0.13$

[a-f] different letters indicate significantly different rank scores within a column by Nemenyi's procedure.

Table 5
Mean rank scores (±SE) by cluster for ranking of importance of product characteristic criteria when selecting PBPs (1 = most important, 6 = least important).

Criteria	Cluster		
	1	2	3
Tastes good	$2.40^{a} \pm 0.12$	$3.07^{a} \pm 0.12$	$1.97^{a} \pm 0.10$
Organic	$3.88^{bc} \pm 0.12$	$3.22^{a} \pm 0.13$	$4.16^{c} \pm 0.11$
Wholefoods	$3.58^{bc} \pm 0.10$	$3.48^{a} \pm 0.12$	$3.32^{b} \pm 0.10$
No genetically modified ingredients	$3.84^{bc} \pm 0.11$	$3.59^{ab} \pm 0.12$	$3.18^{b} \pm 0.11$
Environmentally friendly	$3.93^{c} \pm 0.11$	$3.52^{a} \pm 0.11$	$3.95^{c} \pm 0.10$
Tastes like meat	$3.37^{b} \pm 0.13$	$4.11^{b} \pm 0.13$	$4.41^{c} \pm 0.13$

[a,b,c] different letters indicate significantly different rank scores by column by Nemenyi's procedure.

despite their view that PBPs should 'taste like meat', is consistent with their ranking that PBPs 'tasting like meat' was less important than the other criteria presented. As the Cluster with a higher consumption of PBPs, their increased familiarity with PBP products is likely to have increased acceptability (Hoek et al., 2013); in addition, as the cluster that most indicated animal welfare motivations for consuming PBPs, they may not prioritise meat-like characteristics in PBPs.

4.2.2. Nutrition and Health.

Onwezen et al.'s (2021) review recently reported health as an important driver for PBP consumption across Europe. In the current study, product composition from a nutritional and ingredient perspective accounted for the biggest variation across segments. Clusters 2 and 3 agreed that nutritional quality was a key consideration, although being made from wholefoods was more important to Cluster 3 and free from genetically modified ingredients was more important for Cluster 2. By contrast, Cluster 1 was ambivalent regarding the importance of these elements for PBP choice. This pattern was also evident in Factor 7 where Clusters 2 and 3 consulted food labelling (with Cluster 2 more likely to consult food labelling information than Cluster 3), and Cluster 1 did not look at label information. Furthermore, health motivations were evident for Clusters 2 and 3, although these varied. Whereas Cluster 2 participants were clearly motivated by health to eat PBPs, Cluster 3 was less motivated by disease prevention/treatment but more so by weight management and general health reasons. The higher proportion of female respondents in Cluster 3 may account for high nutrition and health motivations as females are known to consider these more in food choice than males (Wardle et al., 2004; Arganini, et al., (2012)). Cluster 1 responses indicated no specific health motivations for PBP consumption. Similarly, variation in health motivations has been found in previous studies. For example, Verain et al., (2022) identified health as a top three motivator for reducing meat intake but only in three of its five identified clusters in the Netherlands and, based on ratings, health was only scored as a credible motivator for its 'Conscious flexitarian' cluster, with other clusters rating health more modestly.

4.2.3. Social status

Prior research has indicated that most flexitarians think meat consumption elevates social status to some degree (Dagevos & Voordouw, 2013; Verain et al., 2015). However, the consumption of plant-based foods has also been associated with prestige (Dagevos & Voordouw, 2013) and virtue signaling (Levy, 2020) to build perception of moral character (Albrecht & Mauch, 2021). Social status Factors 2 and 3 segmented the responsdents in the study quite discretely. Cluster 2 gained a sense of social status from eating both meat and PBPs, but the others did not. Cluster 2 was also the highest consumer of PBPs and hence this contrasts with Graça et al. (2015), who found that individuals who were concerned with social image consumed fewer PBPs per week, although that study was conducted almost a decade ago. Whereas elements of social status may be motivation for PBP consumption for Cluster 2, it was not the case for most A-NZ respondents.

4.2.4. Food safety and animal welfare concerns

Food safety and disease related risks from animal products were linked to a surge in demand for PBPs in 2020 after the COVID-19 and African swine flu pandemics (Attwood & Hajat, 2020; Terazono & Meyer, 2020). Some consumers also avoid meat, and hence may consume PBPs, due to beliefs concerning the impact of farm conditions and practices on animals, or that animals have feelings (Cliceri et al., 2018). Although they accounted for a lower level of variation across this study cohort than other factors, attitudes concerning food safety and animal welfare did divide respondents. Cluster 2 and 3 agreed they were concerned about both issues and Cluster 2 was particularly concerned about animal welfare. Cluster 1 disagreed they had concerns with either issue. This differentiation aligns with previous studies indicating animal welfare (Verain et al., 2015; Dagevos and Voordouw, 2013, Faber et al., 2021; Knaapila et al., 2022) is only relevant for some flexitarian segments. Similarly, only some consumers are particularly concerned about food safety (Graça et al., 2015; Latvala et al., (2012)). Concordant with these reports, Clusters 2 and 3 were concerned about diseases from meat and food safety related to agrochemicals, genetically modified ingredients and antibiotics, revealing food safety concerns as a motivator for some A-NZ consumers to consume PBPs.

4.2.5. Environmental sustainability

Across Europe (Dagevos & Voordouw, 2013; Latvala et al., 2012; Niva & Vainio, 2021; van Dijk et al., 2023) and more recently in A-NZ (Kemper, 2020; Kemper & White, 2021), studies have identified environmental sustainability as a key motivator for meat reduction in flexitarians, often second to health. However, de Boer et al., (2016) discovered that only a small cohort of consumers recognised eating less meat as being an environmentally sustainable practice. In this current, larger A-NZ study, Clusters 2 and 3 agreed that eco friendliness was an important criterion (Factor1) when choosing PBP, but not Cluster 1. Cluster 3 presented as the most environmentally responsible followed by Cluster 2, but although Cluster 3 agreed environmentally friendly was an important criterion for selecting their PBP they were somewhat ambivalent as to whether meat reduction and eating PBMA per se contributes to environmental sustainability. Cluster 1 tended towards ambivalence suggesting that fewer consumers are motivated to consume PBP for environmental reasons. Interestingly, when asked to rank criteria for selecting PBP, 'environmentally friendly' was positioned behind good taste, for Clusters 1 and 3, but equal to good taste for Cluster 2. Consumers still tend to prioritise personal over planetary considerations with cost, convenience and the sensory experience being important (Blake, 1999). Consequently, although the perceived environmental credentials of PBPs may be a motivator towards PBP

Table 6
Pooled and cluster demographic and food consumption numbers (percentage†) and mean (plus standard error) neophobia scores.

Question		Pooled (n/%)	Cluster 1 (n/%)	Cluster 2 (n/%)	Cluster 3 (n/%)
	Number of Respondents	584 (100%)	204 (35%)	199 (34%)	182 (31%)
Identified gender	Woman	309 (53%)	93 (45%)↓	88 (42%)↓	128 (70%)↑
	Man	275 (47%)	110 (55%)↑	111 (58%)↑	54 (30%)↓
Generation group	Millennial	326 (56%)	121 (60%)	131(66%)↑	74 (41%)↓
	Gen X	258 (44%)	82 (40%)	68 (34%)↓	108 (59%)↑
Ethnicity	European	344 (59%)	122 (60%)	96 (48%)↓	126 (69%)↑
	Asian	117 (20%)	40 (20%)	40 (20%)	37 (21%)
	Māori	51 (9%)	18 (9%)	22 (11%)	11 (6%)
	Pacific Peoples	11 (2%)	6 (3%)	5(3%)	0 (0%)
	Other	61 (10%)	17 (8%)	36 (18%)↑	8 (4%)↓
Living location	Urban	398 (68%)	124 (61%)↓	136 (68%)	138 (75%)↑
	In between	61 (10%)	26 (12%)	9 (5%)↓	26 (14%)
	Rural	125 (21%)	53 (26%)↑	54 (27%)↑	18 (10%)↓
Personal Income level	$<20000	55 (9%)	22 (11%)	8 (4%)↓	25 (14%)↑
	$20,000-$49,999	122 (21%)	41 (20%)	31 (16%)↓	50 (27%)↑
	$50,000-$99,999	223 (38%)	81 (40%)	77 (39%)	65 (36%)
	$100,000-$199,999	136 (23%)	46 (23%)	68 (34%)↑	22 (12%)↓
	$200,000+	11 (2%)	2 (1%)	6 (3%)	3 (2%)
	Prefer not to say	37 (6%)	11 (5%)	9 (5%)	17 (9%)
Meat consumption	Low (fortnightly or less)	181 (31%)	65(32%)	83 (41%)↑	33 (18%)↓
	Medium (1–3 d/wk)	181 (31%)	59 (29%)	68 (34%)	54 (30%)
	High (4–6 d/wk)	222 (38%)	79 (39%)	48 (24%)↓	95 (52%)↑
PBP consumption	Low (fortnightly or less)	322 (55%)	123 (61%)	69 (35%)↓	130 (74%)↑
	Medium (1–3 d/wk)	140 (24%)	45 (22%)	61 (31%)↑	34 (19%)↓
	High (4–7 d/wk)	122 (21%)	35 (17%)	69 (35%)↑	18 (10%)↓
Fish consumption	Never	24 (4%)	13 (6%)↑	7 (4%)	4 (2%)
	Low (fortnightly or less)	280 (48%)	93 (46%)	83 (42%)↓	104 (57%)↑
	Medium (1–3 d/wk)	210 (36%)	64 (32%)	72 (36%)	74 (41%)
	High (4–7 d/wk)	70 (12%)	33 (16%)↑	37 (19%)↑	0 (0%)↓
Egg consumption	Never	11 (3%)	6 (0.5%)	1 (1%)	4 (3%)
	Low (fortnightly or less)	97 (17%)	49 (12%)	18 (9%)	30 (3%)
	Medium (1–3 d/wk)	241 (41%)	83 (24%)↓	66 (14%)↑	92 (17%)
	High (4–7 d/wk)	235 (40%)	65 (64%)↑	114 (77%)↓	56 (77%)
Dairy consumption	Never	8 (1%)	1 (<1%)	2 (<1%)	5(<1%)
	Low (fortnightly/ or less)	48 (8%)	25 (12%)↑	17 (9%)	6 (3%)↓
	Medium (1–3 d/wk)	106 (18%)	48 (24%)↑	27 (14%)↓	31 (17%)
	High (4–7 d/wk)	422 (72%)	129 (64%)↓	153 (77%)	140 (77%)
Neophobia	Score	35.07 ± 0.36	36.96 ± 0.5[a]	37.33 ± 0.52[a]	30.51 ±0.71[b]

†Percentages may not add up to 100 due to rounding. ↑↓ significantly higher/lower observed values than expected values within a row ($p < 0.05$; Chi square goodness of fit test). d/wk - days per week. [ab] - different letters indicate significant differences between cluster neophobia means within the row ($p < 0.05$, Tukey test).

consumption for some A-NZ consumers, other factors still have greater influence.

4.2.6. Trust

The control that government and the food industry have e.g., via food regulation and product development respectively, has been identified to impact consumer attitudes and behaviours towards food. Kemper (2020) reported participants 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. However, the factor related to trust only accounted for a small amount of variation across respondents in general, with Cluster 2 agreeing they trust these entities, and Clusters 1 and 3 tending to disagree, albeit not strongly.

4.3. Cluster characteristics

Cluster 2 portrays the characteristics of archetypal flexitarians (Campbell, 2021; Kemper & White, 2021, Peschel & Grebitus, 2023) who have many motivators for PBP consumption and, as evidenced by their low meat and high PBP consumption, actively reduce meat intake.

Table 7
Pooled and cluster mean agreement scores for sensory attributes a PBP should have.

Attributes	*Pooled Sample*	*Cluster 1*	*Cluster 2*	*Cluster 3*
Meat-like appearance	4.3 ± 0.06	3.8^{a} ± 0.10	4.7^{b} ± 0.11	4.9^{b} ± 0.09
Meat-like smell	4.0 ± 0.06	4.0^{a} ± 0.09	4.7^{b} ± 0.10	4.8^{b} ± 0.09
Meat-like taste/ flavour	4.4 ± 0.06	4.0^{a} ± 0.09	4.9^{b} ± 0.10	4.8^{b} ± 0.11
Meat-like texture	4.5 ± 0.06	4.2^{a} ± 0.10	5.0^{b} ± 0.09	4.3^{a} ± 0.13
Bleeds like meat	3.3 ± 0.07	3.4^{a} ± 0.11	4.0^{b} ± 0.11	2.2^{c} ± 0.09
Juicy/moist texture	5.0 ± 0.05	4.5^{a} ± 0.09	5.2^{b} ± 0.09	5.4^{b} ± 0.09
Savoury/umami flavour	4.9 ± 0.05	4.3^{a} ± 0.09	5.2^{b} ± 0.09	5.2^{b} ± 0.09
Spicy/flavourful	5.0 ± 0.05	4.5^{a} ± 0.09	5.2^{b} ± 0.09	5.2^{b} ± 0.09
Legume/beany flavour	3.8 ± 0.06	3.6^{a} ± 0.09	4.6^{b} ± 0.09	3.1^{c} ± 0.10
0.09Sweet flavour	3.8 ± 0.06	3.8^{a} ± 0.09	4.4^{b} ± 0.09	3.2^{c} ± 0.09
Sour flavour	3.4 ± 0.06	3.6^{a} ± 0.09	4.2^{b} ± 0.09	2.5^{c} ± 0.08
Bitter flavour	3.2 ± 0.06	3.5^{a} ± 0.09	4.1^{b} ± 0.09	2.2^{c} ± 0.07
Salty flavour	4.2 ± 0.05	4.0^{a} ± 0.09	4.7^{b} ± 0.07	3.8^{a} ± 0.09
Chewy texture	3.9 ± 0.06	3.8^{a} ± 0.08	4.7^{b} ± 0.09	3.3^{c} ± 0.11
Grainy texture	3.8 ± 0.06	3.7^{a} ± 0.08	4.5^{b} ± 0.09	3.1^{c} ± 0.10
Pasty texture	3.7 ± 0.06	3.7^{a} ± 0.09	4.6^{b} ± 0.09	2.7^{c} ± 0.09
Dry texture	3.4 ± 0.06	3.4^{a} ± 0.09	4.2^{b} ± 0.09	2.4^{c} ± 0.09

^{abc} means scores with different letter code are significantly different ($p < 0.05$).

This cluster contained more Millenials who are also more likely to reduce meat consumption (Hielkema and Lund (2021). It was also the cluster with the highest proportion of men which tends to contradict other literature indicating men have less preference for consuming meat alternatives (Aiking, 2011; de Boer et al., 2014; Hielkema & Lund, 2021; Kubberød et al., 2002; Rodrigues et al., 2020; Rozin et al., 2012).

Cluster 3 also indicated a range of motivators for PBP consumption/ meat reduction but this did not translate into consumption behaviours as this Cluster was associated with high frequncy meat consumption and low frequency PBP consumption. This cluster consisted mainly of women, with a higher proportion of Generation X and European ethnicities. It also comprosed more people in lower income brackets. The high proportion of women contradicts research inidictating women have higher preference for meat alternatives give the lower consumption of PBP in this cluster, but this difference may be explained at least partially by the higher proportion of Gen X in Cluster 3. Hielkema and Lund (2021) reported that only a minority (~37%) of Gen X (≥50 yrs) consumers intended to reduce their meat intake, whereas slightly more than half (~51%) of Millennials intended to do so, although notably Cordelle et al., (2022) reported no distinct effect of age on sensory acceptance of different PBPs. This suggests that consumers aged ≥50yrs may be less likely to purchase PBPs in the first place and may account for the high meat consumption in Cluster 3. Cluster 3 were also not that satisfied with the sensory experience of the PBPs they had consumed.

Cluster 1, which had a PBP consumption frequency similar to the total sample, was distinct from the other clusters in that no factor considered in this study was identified as motivating them to consume PBPs. They were the most dissatisfied with PBP sensory quality which could be a key barrier, but were ambivalent as to whether PBP should be meat-like (similar to Cluster 3) and only slightly disagreed to PBP possessing less meat-like properties. A slight agreement to eating PBPs to be healthy indicated some motivation but otherwise, underlying reasoning for Cluster 1 motivations to consume PBPs were unclear. Perhaps the PBPs they do consume are purchased and/or prepared by other household members for them and they do not feel strongly about any motivators for consumption of these products, or they consume other 'alternatives' such as pulses in meat-free meals.

4.4. Neophobia

Although Cluster 3 scored significantly lower for neophobia than Clusters 1 and 2, Cluster mean scores ranged from 30 to 37 indicating that all tended towards medium neophobia (Turorila et al., 2011) and was not highly discriminating across the groups. Overall, increasing neophobia scores associated with higher PBP consumption frequencies suggests that neophobia itself was not necessarily a barrier to PBP consumption in A-NZ flexitarians. Siegrist and Hartmann (2019), however, found differently in that Swiss consumers who had low disgust sensitivity, which is associated with low food neophobia (Modlinska & Pisula, 2018), ate meat less frequently and tended to consume meat substitutes more often than the consumers who had the opposite profile. Hoek et al., (2011) suggests that the willingness of food neophobic consumers to eat meat substitutes can increase once they become more familiar with meat substitutes, indicating a potential effect of familiarity as opposed to neophobia per se on PBP consumption.

4.5. Sensory preferences

Michel, Hartmann, et al., (2021) reported that both omnivores and flexitarians prefer their choice of meat alternatives to be similar in taste and texture to processed meat counterparts. Here, Cluster 3, who were ambivalent as to whether PBP should taste like meat were not tolerant of attributes that detracted from a meat like experience, particularly concerning texture. Like the other clusters they ranked 'Taste like meat' of lower importance compared to tasting good and environmental factors. Noticeably, they were low consumers of PBPs and had the highest meat consumption frequency. It could be posited that although this cluster do not eat many PBPs perhaps due to the sensory experience, when they do, they may not need to be meat-like if they taste good and have good environmental credentials, but they generally select meat products.

Hoek et al., (2011) found that regular and moderate users of meat-alternatives had a lower preference for meat alternatives to resemble the sensory characteristics of meat than non-users. Similarly, Vanhonacker et al., (2013) reported a cluster of Flemish consumers who consumed meat substitutes most frequently least enjoyed eating meat and least liked the taste of meat compared to other clusters. Here, however, Cluster 2 were the highest consumers of PBPs, as defined in this study, and although they ranked tastes like meat lower than other criteria, still indicated a preference for meat-like attributes, particularly meat-like texture. Cluster 1 neither agreed nor disagreed. The A-NZ population conventionally follow meat-based diets/lifestyles (Tucker, 2018; Wang & Scrimgeour, 2021; White & Potts, 2008) and in 2018 about 94% of the population were reported to eat meat (Milfont et al., 2021) which may account for why amongst A-NZ flexitarians meat-like characteristics are a key sensory driver of acceptance for the majority, and no clusters explicitly favouring non meat-like characteristics were identified. Had vegetarians and vegans been included, who currently account for 6–10% of the population (Health Navigator Trust (2022), this may have been different.

4.6. Limitations and future work

To date, this study provides the largest investigation of the issues driving A-NZ flexitarian engagement with PBPs. Nevertheless, some limitations exist. Flexitarianism was defined based on meat consumption frequency but explicitly collecting self-reported data on whether

respondents identify themselves as flexitarians along with meat intake data may have provided a different perspective and warrants further investigation. Collecting information on participant involvement in food purchasing and preparation decisions may have been additionally beneficial in interpreting cluster characteristics on animal and PBP consumption. This study focused on Millennials and Gen X and it is unknown to what extent the findings can be generalised to other age groups.

Type of meat consumed was not investigated in this study. A-NZ flexitarians could be eating chicken/fish to replace beef rather than PBPs, considering the lower environmental impact of poultry production compared to beef (Swain et al., 2019). Additionally, flexitarians may be using other plant-based alternatives such as legumes or mushrooms as their protein sources rather PBPs, which was also not investigated.

'Tastes good' was identified as the key motivator for PBP selection and so, importantly, a sensory study investigating the key sensory drivers of PBP acceptance is warranted including how this might vary across the different flexitarian segments identified in this study.

5. Conclusions

Tastes good being ranked as the most important criteria for PBP selection highlights the importance of PBP sensory properties for A-NZ flexitarians, as with other global cohorts. Generally, flexitarians were dissatisfied to marginally satisfied with the sensory experience of PBPs currently available in the A-NZ market and there was a preference for PBPs to be meat-like. Further, respondents ranked protein and micronutrients (vitamins/minerals) as the most important nutritional considerations when selecting PBPs. Improving the sensory profiles of PBPs whilst delivering these nutritional requirements present as key issues for future product development and research.

The current study identified three A-NZ flexitarian clusters based on similarities/differences in key motivators/barriers for PBP consumption. Whereas nutrition/health, social status and environmental factors motivated most to consume PBPs, clusters were also differentiated by the relative impact of perceived food safety issues driving their meat and PBP consumption. The research highlights that A-NZ flexitarians are not a homogenous group of people.

The findings reveal the importance of understanding values, attitudes and behaviours of different flexitarian consumers rather than investigations generalising flexitarians as one group. From an industry point of view, these findings highlight the need to develop PBPs that incorporate a range of sensory properties catering to different flexitarian cohorts and associated marketing messaging that appeals to different motivating factors depending on the target flexitarian consumer.

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CRediT authorship contribution statement

Maheeka Weerawarna N.R.P.: Formal analysis, Supervision, Writing – original draft, Writing – review & editing, Conceptualization, Methodology. **Caroline Giezenaar:** Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. **Petra Coetzee:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **A. Jonathan R. Godfrey:** . **Meika Foster:** Conceptualization, Formal analysis, Funding acquisition, Supervision, Writing – original draft, Writing – review & editing. **Joanne Hort:** .

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Appendices

Appendix Ai. Survey questions and response scales

Criteria	Questions
Part A: Demographics questions	
Age	Please indicate your age a. 18–24 yrs b. 25–40 yrs c. 41–55 yrs d. 56 + yrs
Identified gender	Please indicate which gender you identify with a. Male b. Female c. Another gender (please specify) d. Prefer not to say
Ethnicity	Please indicate your ethnicity a. New Zealand European b. Māori c. Samoan d. Cook Islands Māori e. Tongan f. Niuean g. Chinese h. Indian i. Other(please specify)
Area of residence	How would you most describe your area of residence? a. Rural b. Urban c. In-between rural and urban

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Criteria	Questions	
Annual income	Please indicate your annual personal income a. Less than $20,000 b. $20,000-$49,999 c. $50,000-$99,999 d. $100,000-$199,999 e. $200,000+ f. Prefer not to say	
Consumption frequency	How often do you eat: a. Meat, including poultry b. Plant-based products c. Fish d. Eggs e. Dairy (milk, yoghurt, cheese)	1 = 7 days per week, 2 = 4–6 days per week, 3 = 1–3 days per week, 4 = fortnightly, 5 = monthly, 6 = meat: less than monthly/ plant-based products: I have tried them once, 7 = never
Food neophobia scale	Thinking about how you interact with food in general, how much you agree with the following statements? a. I'm constantly sampling new and different foods b. I don't trust new foods c. If I don't know what is in a food, I won't try it d. I like foods from different countries e. Ethnic foods are too wired to eat f. At dinner parties, I will try a new food g. I am afraid to eat things I have never had before h. I am very particular about the foods I will eat i. I will eat almost anything j. I like to try new ethnic restaurants	1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree
Part B: Survey questions		
Sensory satisfaction with PBP (Sn)	1. Thinking about the following sensory characteristics of PBPs in general, are you: a. Appearance b. Smell c. Taste/flavour d. Texture/mouthfeel	1 = always dissatisfied, 2 = mostly dissatisfied, 3 = sometimes dissatisfied, 4 = neither satisfied not dissatisfied, 5 = sometimes satisfied, 6 = mostly satisfied, 7 = always satisfied
Nutrition criteria for selecting PBP (CN)	2. When I choose PBPs, it is important to me that: a. It is low in fat b. It is low in sugar c. It is low high sodium d. It is high in protein e. It is high in fibre f. It is high in vitamins and minerals	1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree
Ingredient criteria for selecting PBP (CI)	a. It is made with wholefoods b. It is free of genetically modified ingredients c. It is organic d. It is eco friendly	
Taste criteria (CT) for selecting PBP	a. It tastes like meat	
Safety concern (S)	3. Thinking about the safety of foods you consumer, how much do you agree that you are concerned about: a. Pesticides/herbicides on plants b. Antibiotics used in meat production c. Genetically modified ingredients d. Diseases from meat	1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree
Industry/ Authorities (I/A)	4. Thinking about the food industry, the government and reducing meat consumption, how much do you agree with the following statements? a. I trust the food industry because they are open and transparent about their products b. I trust the government authorities (food safety, food regulation) because they are open and transparent about their work and intentions c. Meat reduction is the consumer's responsibility d. Meat reduction is the food industry's responsibility e. Meat reduction is the government's responsibility	1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree

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(*continued*)

Criteria	Questions	
Nutrition labelling (L)	5. When I choose PBPs, I often consider the following: a. I look at PBP's ingredients list b. I look at PBP's nutritional information table c. I look at PBP's protein content d. I look at PBP's health star rating	1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree
Health (H)	6. Thinking about health, how much do you agree with the following statements? a. I eat PBP to prevent diet-related disease b. I eat PBP to treat diet-related disease c. I eat PBP to manage weight d. I eat PBP to be healthy	1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree
Social status PBP (SS_PBP)	7. Thinking about how including PBPs in your diet makes you feel, how much do you agree with the following statements? a. Makes me feel masculine b. Makes me feel accepted c. Is part of my culture d. Makes me feel affluent e. Makes me feel virtuous f. Makes me feel healthy g. Makes me feel ethical	1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree
Social status meat (SS_meat)	8. Thinking about how including meat products in your diet makes you feel, how much do you agree with the following statements? a. Makes me feel masculine b. Makes me feel accepted c. Is part of my culture d. Makes me feel affluent e. Makes me feel virtuous f. Makes me feel healthy g. Makes me feel ethical	
Animal welfare (AW)	9. Thinking about how animal welfare issues affect your food choice decisions, how much do you agree with the following statements? a. I eat less meat because of animal welfare concerns b. I like meat but I don't like that animals have to die for it	1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree
Environment (E)	10. Thinking about your general habits, how much do you agree with the following statements? a. I eat less meat because I believe it helps sustainability of the environment b. I eat plant-based products because I believe it is more sustainable for the environment c. I actively avoid wasting food d. I often buy seasonal products e. I often buy local products f. I recycle glass, paper and/or plastic g. I avoid products with imported ingredients	1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree

Appendix Aii. Additional ranking questions

Ranking task 1	**Rank the following from most important to least important for you when selecting a PBP.** a. Tastes good b. Tastes like meat c. No genetically modified ingredients d. Organic e. Made with wholefoods f. Is environmentally friendly	N/A, ranking question 1 = most important to 6 = least important

Ranking task 2	**Please rank the following from most important to least important when considering nutrition of PBPs** a. Low in fat b. high in protein c. low in sugar	N/A, ranking question 1 = most important to 7 = least important

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(*continued*)

	d. High in fibre e. High in vitamins and minerals f. Low in starchy carbohydrates g. Low in sodium

Appendix Aiii. Additional sensory preference questions

Sensory Characteristic preferences	**For me an ideal PBP should:** a. Have a meat-like appearance b. Have a meat-like smell c. Have meat-like taste/flavour d. Have a meat-like texture/mouthfeel e. Bleed like meat f. Be juicy/moist g. Be savoury/umami h. Be spicy/flavourful i. Be sweet j. Be sour k. Be bitter l. Be salty m. Be chewy n. Be grainy o. Be pasty p. Be dry q. Taste of legumes	1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree

Appendix B. τ correlations between identified gender, age, neophobia, and meat, PBP, fish, egg and dairy consumption frequencies

	Meat consumption frequency		PBP consumption frequency		Fish consumption frequency		Egg consumption frequency		Dairy consumption frequency	
	τ	p	τ	p	τ	p	τ	p	τ	p
Identified gender	N/D		−0.09	0.017	−0.16	<0.0001	−0.02	0.68	0.48	0.029
Age group			−0.19	<0.0001	−0.026	0.52	−0.15	0.0001	−0.017	0.67
Meat consumption frequency			−0.27	<0.0001	−0.11	0.0026	0.017	0.656	0.17	<0.0001
PBP consumption frequency	−0.27	<0.0001			0.14	<0.0001	0.22	<0.0001	−0.003	0.94
Fish consumption frequency	−0.11	0.0026	0.14	<0.0001			0.09	0.014	−0.01	0.74
Egg consumption frequency	0.017	0.656	0.22	<0.0001	0.09	0.014			0.29	<0.0001
Dairy consumption frequency	0.17	<0.0001	−0.003	0.94	−0.01	0.74	0.29	<0.0001		
Neophobia class	−0.17	<0.0001	0.15	<0.0001	0.12	0.0010	0.02	0.68	−0.07	0.068

Correlations between meat and PBP intake and respondent demographics, determined using Kendall's tau (τ).N/D – Correlations between meat consumption frequency and identified gender and age group were not determined because respondent quotas for recruitment of these groups were used.

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