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Bridging the "chasm": identifying factors to accelerate the adoption of plant-based meat alternative products

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Introduction: Plant-based meat alternatives (PBMAs) present a promising pathway towards a more sustainable and healthier food system. However, the rate of adoption of PBMA products must accelerate to meet global health and sustainability targets.

Methods: A cross-sectional questionnaire categorised respondents (n = 325) according to Roger's Diffusion of Innovation and measured perceptions of, and key food choice motives (FCM) and barriers influencing the adoption of PBMAs within Innovators/Early Adopters (11.7%), Early Majority (35.9%), Late Majority (35.6%) and Laggards (16.8%).

Results: Our findings revealed plant-based burgers, 'chicken' and sausage products were perceived more favourably in Innovators/Early Adopters and Early Majority versus Late Majority and Laggards. Relative importance of FCM and barriers to adoption of PBMAs varied between groups. However, both the Early Majority and Late Majority demonstrated identical ranked priority for motives (*sensory appeal, health*, and *affordability*) and barriers (*degree of processing, cost*, and *taste*).

Discussion: These groups represent over two thirds of the sample population and therefore jointly targeting these groups with evidence-informed strategies has the potential to increase the rate of adoption of PBMA products. This highlights the need for manufacturers to address the sensorial and health quality of PBMA products whilst also considering the degree of processing and their affordability. Such evidence-based manufacturing practice may facilitate sustainable behaviour change across the wider population and support the environmental and public health agenda.

KEYWORDS

plant-based meat alternatives, consumer segmentation, diffusion of innovation, consumer perceptions, behavioural drivers

1 Introduction

Overconsumption of meat is negatively impacting public health, environmental sustainability and animal welfare (Willett et al., 2019; Rust et al., 2020; Szenderák et al., 2022; Zahari et al., 2022) while extensive evidence supports the benefits associated with plant-based diets (Harland and Garton, 2016; Dinu et al., 2017; Naghshi et al., 2020). Cross-sector consensus and collaboration now promote a transition to reduce meat and increase plant-based consumption (Willett et al., 2019; Rust et al., 2020; Kwasny et al., 2022). Many consumers are already transitioning to more plant-based dietary patterns; fueled by increased concern for animal welfare, environmental sustainability and personal health (Flint et al., 2023; Szejda and Parry, 2020). However, this needs to accelerate if global targets are to be met. Plant-based meat

alternatives (PBMAs) that mimic the sensorial properties of meat may provide a steppingstone for this accelerated transition (Weinrich, 2019; Giacalone et al., 2022).

Although the number of PBMA products tripled between 2018 and 2022 (Mintel, 2023), recent market challenges have seen leading brands go into receivership (Food Navigator, 2023; The Guardian, 2023) and market growth projections dramatically reduced (Mintel, 2021; Mintel, 2022). Understanding the multifactorial influences affecting consumer engagement may help to revitalize growth in this market and thus accelerate sustained adoption of PBMAs.

The influence of animal and environmental welfare upon adoption of PBMAs is variable, possibly due to differences in their relative importance across different population segments (Hartmann and Siegrist, 2017; Szejda et al., 2020; Michel et al., 2021a; Onwezen and Dagevos, 2024). Meanwhile it has been suggested that personal health may exceed altruistic motives with respect to consumer engagement with PBMA products (Bryant, 2019; Dhont and Ioannidou, 2024; Flint et al., 2023). Grasso et al. (2022) found that participants categorised plant-based burgers to be healthier than their meat-based counterpart. This perceived healthiness may be driven by the purported health benefits associated with plant-based dietary patterns (Dinu et al., 2017; Naghshi et al., 2020) and influence consumer purchase and consumption behaviour (Ang et al., 2023; Erfanian et al., 2023; Malek and Umberger, 2023). Notably, health motives typically exert greater influence on younger individuals, females and meat-eaters when considering the adoption of PBMA products (Apostolidis and Mcleay, 2016; Bryant, 2019; Michel et al., 2021b; Röös et al., 2022).

Historically, meat consumption has been integral to Western social and cultural norms (Alcorta et al., 2021; Jahn et al., 2021). This may contribute to high levels of meat attachment and/or food neophobia both of which are significant barriers to the adoption of PBMAs (Graça et al., 2019; Appiani et al., 2023; Rini et al., 2024). Novelty of PBMAs may simultaneously attract those willing to try new foods while high neophobia may reduce likelihood to try or buy such products (Hoek et al., 2011; Coucke et al., 2023). Strategies to increase familiarity including sensorial and contextual replication of meat characteristics (e.g., direct replacement for mincemeat in spaghetti Bolognese), making explicit reference to the meat-like similarities and repeated exposure to novel PBMA products may mitigate against food neophobia (Elzerman et al., 2011; Hoek et al., 2013; Jahn et al., 2021). Such approaches may facilitate earlier dietary transition, but the relative influence varies across consumer subgroups (Neville et al., 2017; Collier et al., 2021; Giacalone et al., 2022; Sijtsema et al., 2022). For example, simulation of meat characteristics has been cited as a major barrier to adoption of PBMAs among meat avoiding individuals (Hoek et al., 2011; Ruby and Heine, 2011). Kuosmanen et al. (2023) suggested that low familiarity with plant-based foods was associated with limited capacity to access and cook pulse-based alternatives. Despite the increased availability of PBMAs, designed as appropriate meat substitutes requiring no additional cooking skills, consumers cite inconvenience, difficulty to cook and affordability as barriers to adoption (Alae-Carew et al., 2022; Bryant, 2019; Röös et al., 2022; Sijtsema et al., 2022).

Sensorial properties are also key to increasing the adoption of PBMAs yet replicating desirable meat characteristics poses a significant challenge (Beacom et al., 2021; Beacom et al., 2022; Ahmad et al., 2022; Appiani et al., 2023). Recent studies identified PBMAs to be perceived as less tasty versus meat-based equivalents and a general dissatisfaction regarding sensory quality in commercial plant-based products (Michel et al., 2021b; Giacalone et al., 2022; Erfanian et al., 2023). Previous negative experiences with traditional PBMAs (e.g., Tofu) may influence this alongside the perceived superior sensorial qualities of meat (Jahn et al., 2021; Begho et al., 2023; Kuosmanen et al., 2023). Again, the relative importance of taste may be influenced by factors including dietary pattern, demographic characteristics and familiarity with PBMA products (Hoek et al., 2011; Beacom et al., 2021; Michel et al., 2021a; Michel et al., 2021b; Giacalone et al., 2022). Although actual sensorial experience does not always align with perceived expectations, sensory evaluation studies consistently demonstrate PBMAs to be less acceptable than their meat-based equivalents (Ettinger et al., 2022; Flint et al., 2025; Godschalk-Broers et al., 2022; Neville et al., 2017; Sogari et al., 2023). Manufacturers are developing strategies to address the perceived negative image (e.g., "Tastes Like Meat" slogans). However, to meet these sensorial expectations requires both novel ingredients and extensive processing which may compromise health motives that drive consumers to adopt PBMAs (Fiorentini et al., 2020; Boukid, 2021; Jahn et al., 2021; Alae-Carew et al., 2022). Although subject to debate, there is a growing body of evidence that associates ultra-processed foods with adverse health outcomes (e.g., increased risk of non-communicable diseases) (Elizabeth et al., 2020; Pagliai et al., 2021; Wickramasinghe et al., 2021).

While meat is an important vehicle for nutrient delivery (Rust et al., 2020; Tso and Forde, 2021) evidence regarding the capacity of PBMAs to replicate the nutritional profile of meat-equivalents is inconclusive and highlights variation within and between PBMA product categories (Bohrer, 2019; Curtain and Grafenauer, 2019; Fresán et al., 2019; Alessandrini et al., 2021; Boukid and Castellari, 2021). Key concerns relate to high sodium and insufficient micronutrient content (Clark and Bogdan, 2019; Nolden and Forde, 2023; Caputo et al., 2024; Faber et al., 2024). Hence, simulating meat may require ingredients that compromise the naturalness and nutritional value of PBMAs (Clark and Bogdan, 2019; Jahn et al., 2021; Caputo et al., 2024). The terms "too many preservatives," "unnatural," and "too processed" have been associated with reduced purchase intent and a negative image of healthiness (Circus and Robison, 2019; Clark and Bogdan, 2019; Noguerol et al., 2021; Knaapila et al., 2022; Ford et al., 2024). Evidence underpinning traditional plant-based diets has driven the perceived health value of PBMAs (Tso et al., 2021). Although a limited number of emerging studies have investigated the impact of PBMA consumption on a range of cardiovascular disease risk factors (Crimarco et al., 2020), cardiometabolic health benefits (Toh et al., 2024), satiety (Kahleova et al., 2021; Klementova et al., 2019) and the gut microbiome (Toribio-Mateas et al., 2021), there remains a paucity of evidence with regard to the health outcomes associated with these products (Del Bo et al., 2024; Flint et al., 2023; Santo et al., 2020; Tso and Forde, 2021). Despite ultra-processed foods being perceived as unhealthy, many consumers endorse PBMAs due to the health halo surrounding plant-based foods (Estell et al., 2021; Wickramasinghe et al., 2021; Nolden and Forde, 2023; Rini et al., 2024). For example, the term "plant-based" was associated with "health" and "vegetarian" was associated with "lower calories" (Besson et al., 2020; Sucapane et al., 2021).

Understanding what factors influence the adoption of PBMAs in a consumer population is nuanced as current evidence demonstrates variability within different subgroups. Hence facilitating sustainable changes in dietary behaviour will not be a one-size-fits all approach.

A greater awareness is needed to define specific drivers and barriers within different consumer subgroups to facilitate evidence-based manufacturing and marketing of PBMAs. Theories of segmentation divide populations according to discrete characteristics into smaller subgroups. Previous examples within the field often rely on relatively static segmentation methods including geographical location, sociodemographic profile, dietary pattern and product usage (Clark and Bogdan, 2019; Beacom et al., 2021; Michel et al., 2021b; Noguerol et al., 2021; Malek and Umberger, 2023; Ford et al., 2024). Conversely, the application of segmentation methods rooted in behaviour change theory may facilitate segmentation based on predisposition to adopt PBMAs. This would enable the identification of key drivers and barriers that need to be addressed in order to accelerate dietary change.

Transtheoretical Model (TTM) has been applied to various contexts including smoking cessation, alcohol consumption and physical activity (Spencer et al., 2007; Armitage, 2009). More recently it has been used to explore dietary transition to reduce meat and increase plant-based food consumption (Hoek et al., 2011; Tobler et al., 2011; Hielkema and Lund, 2021). TTM describes an individual's change journey and therefore its application may be limited to individual and small group interventions (Prochaska and Velicer, 1997). An effective population-level dietary shift demands a broader understanding of the behaviour change across defined groups. Roger's Diffusion of Innovations (DOI) theory presents an appropriate model to investigate this process (Rogers, 2003). Critics argue that DOI gives limited consideration to broader systemic factors (e.g., economic and political factors) (Palm, 2020; Cardol et al., 2025). However, unlike other behaviour change theories such as the TTM, DOI considers the social-relational context influencing behaviour change (Rogers, 2003). DOI denotes that the rate at which different individuals within a population adopt innovative products or behaviours varies (Rogers, 2003). Thus, DOI segments the population into five adopter subgroups based upon predisposition to adopt innovations: Innovators, Early Adopters, Early Majority, Late Majority and Laggards. This offers the potential to inform targeted interventions to accelerate the diffusion of PBMA adoption throughout the consumer population. The model identifies two crucial leverage points for population change that promote early adoption through social interaction (The "Chasm") and a "Tipping Point" at which the proportion of the population adopting the change makes it more likely to be embedded and sustainable (Aschemann-Witzel and Schulze, 2023; Gladwell, 2001; Moore and McKenna, 1991; Rogers, 2003).

To the authors' knowledge only two studies have considered this theory in relation to plant-based dietary transition (Gonera et al., 2021; Szejda et al., 2021). However, the segmentation methods used in these studies were not validated to identify the adopter groups described in Roger's DOI. For example, Szejda et al. (2021) classified Early Adopter using purchase frequency alone as opposed to questions specifically related to innovativeness. Therefore, the current study aimed to address these limitations by using tools validated to segment consumer populations into adopter categories according to Roger's DOI and investigate perceptions of, and key food choice motives (FCM) and barriers influencing the adoption of PBMAs. This work is the first to apply validated methods to segment a population into distinct adopter subgroups according to their predisposition to adopt PBMAs. The research demonstrates an original contribution to knowledge with regard to consumer perceptions of, FCM and barriers influencing engagement with PBMAs in subgroups more predisposed to adopt PBMAs. A greater understanding of the specific factors that must be addressed within key change groups to bridge the "chasm" may facilitate the production of products that are more acceptable to target consumers. Such evidence-based practice has the potential to accelerate the diffusion of PBMA throughout the wider consumer population.

2 Materials and methods

2.1 Study design

The study adopted a quantitative cross-sectional design to measure perceptions of, and key FCM and barriers influencing the adoption of PBMAs within specific consumer subgroups.

2.2 Participants

UK adults, aged 18 or older, were recruited via physical and electronic poster, social media platforms, virtual learning environment messaging to students at Sheffield Hallam University and other convenience sampling methods. Respondents were invited to complete an online questionnaire, distributed via Qualtrics (Qualtrics, Provo, UT) to facilitate data collection across a larger geographical location. Published literature and validated tools informed the design of the study questionnaire (Clark and Bogdan, 2019; Food Standards Agency, 2022; Goldsmith and Hofacker, 1991; Knaapila et al., 2022; Estell et al., 2021; Onwezen et al., 2019). The initial questionnaire was pre-tested with a small sample (n = 10) and feedback was gathered regarding the participants' ability to understand and interpret the questions as intended. Small adjustments were then made (e.g., refinement of wording) before the final questionnaire was distributed to ensure clarity and promote validity (see Supplementary material S1). Data collection was conducted between June 2022 and September 2023. A total of 454 eligible participants attempted the questionnaire. The data were cleaned for obvious errors and any biologically implausible and contradictory data were removed. From the 447 remaining responses, 325 were deemed valid for analysis based on participants answering any question beyond the demographic information section of the questionnaire. This sample size is comparable with that used within similar studies (Clark and Bogdan, 2019; Culliford and Bradbury, 2020; Lea et al., 2006). Table 1 presents an overview of participant characteristics.

2.3 Study materials

This study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of Sheffield Hallam University (Date 23/05/22; Reference ER41114039). All participants provided informed consent before completing the online questionnaire which was divided into four subsections (described in sections 2.3.1–2.3.4). A definition was provided to ensure participants understood what types of plant-based foods constitute PBMAs and participants were exposed to a series of familiarisation tasks at the start of the questionnaire.

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TABLE 1 Overview of participant characteristics (n = 325).

Participant characteristic	%
Age (y)	
18–24	18.4
25–34	34.9
35–44	17.3
45–54	13.7
55–64	6.7
65 or over	9.0
Sex	
Male	26.5
Female	73.1
Prefer not to say	0.3
Is the gender you identify with the same as your sex registered at birth?	
Yes	99.1
Prefer not to say	0.9
Highest level of education	
Secondary school	3.4
Level 3	10.2
Undergraduate	27.5
Postgraduate	44.8
PhD	11.1
Other	3.1
Predominant employment status (over the last 2 years)	
Unemployed	1.5
Student full time	16.4
Retired	8.7
Employed full time	56.3
Employed part time	17.0
Occupation	
Senior managers/administrators occupations	14.4
Traditional professional occupations	16.6
Modern professional occupations	24.3
Middle/junior managers occupations	7.0
Clerical and intermediate occupations	8.6
Technical and craft occupation occupations	3.2
Semi-routine manual and service occupation	5.8
Routine manual and service occupation	3.5
Other	16.6
Gross annual household income	
Up to £51,999	67.5
Over £52,000	32.5
Living environment	
Urban	80.4
Rural	19.6
Dietary pattern	

(Continued)

TABLE 1 (Continued)

Participant characteristic	%
Omnivore (individuals who do not exclude meat, poultry, fish or dairy from their diet)	53.9
Flexitarian (individuals who primarily consume plant-based foods but occasionally include animal-based products in their diet)	26.9
Pescatarian (individuals who exclude meat from their diet but still consume fish and other seafood products)	4.6
Vegetarian (individuals who exclude meat and fish products from their diet but consume eggs and dairy products)	6.8
Vegan (individuals who exclude meat, fish, eggs, dairy and any other animal-derived products from their diet)	7.7

Presented as percentage (%) of respondents.

2.3.1 Participant characteristics and segmentation

Participants completed demographic questions (Table 1), and previously validated questions were included to assess individuals' predisposition to adopt PBMA products according to Roger's DOI (Rogers, 2003; Goldsmith and Hofacker, 1991). Goldsmith and Hofacker's (1991) Domain-Specific Innovativeness scale was used to classify participants into Roger's five adopter groups. Domain-Specific Innovativeness is a validated scale which is quick, inexpensive and easy-to-use (Goldsmith and Hofacker, 1991; Goldsmith, 2001). Respondents replied to 6 items on a 5-point Likert scale which was adapted to the context of PBMA products. For example, "In general, I am among the last in my circle of friends to know the names of the latest plant-based convenience food products" (see Supplementary material S1 for full details). The sum of each participant's responses was then calculated to create a Domain-Specific Innovativeness score; with higher scores representing higher level of innovativeness. Using standard deviation intervals around the mean as described in Roger's (2003) DOI theory, respondents were identified as "Innovators," "Early Adopters," "Early Majority," "Late Majority," and "Laggards" using the scores of (25–30), (21–24), (18–20), (14–17), and (6–13), respectively. Domain-Specific Innovativeness has previously been used in various contexts such as fast fashion (Okur, 2022), internet shopping (Blake et al., 2003), rock music (Goldsmith and Hofacker, 1991) and wine (Goldsmith, 1998) but to the authors' knowledge, it has not previously been applied to PBMA products.

2.3.2 Frequency of consumption

Participants reported their frequency of consumption for both meat and PBMA products (informed by the work of Knaapila et al., 2022) via the response categories never/rarely, 1–3 times per month; 1–3 times per week; 4–6 times per week and daily. Questions regarding current and future consumption of specific PBMA categories were also asked.

2.3.3 Perceptions of PBMA products

Perceptions of PBMA products were measured using 4-point Likert scales. Respondents were presented with images of plant-based burgers, "chicken" and sausage products and were instructed to express their level of agreement with the following statement "I would perceive these products to be…" (adapted from Estell et al., 2021). Response options included more environmentally friendly; more nutritious; more natural; cheaper; and tastier versus their meat-based alternatives.

2.3.4 Food choice motives and barriers influencing adoption of PBMA

The Food Choice Questionnaire is a well-recognised validated tool that has been used extensively to measure drivers underpinning individual food choice (Steptoe et al., 1995). The original instrument consists of 36 items which measure underpinning motivations across nine domains of food choice; generating a score for each domain. Onwezen et al. (2019) shortened 11-item scale, designed to reduce questionnaire fatigue, was used in the current study to identify primary FCM for different segments of the sample population. The 11 items measured were *healthy, affordable, sensory appeal, animal friendly, weight management, environmentally friendly, fairly traded, convenient, natural, mood management*, and *familiarity*. Participants responded to statements starting with "It is important to me that the food I eat on a typical day is…" on a 7-point Likert scale ranging from "Not at all important" to "Extremely important." To investigate perceived barriers toward adoption of PBMA products, participants responded to statements, informed by current literature (Clark and Bogdan, 2019; Food Standards Agency, 2022). Participants expressed their level of agreement to the statement "I would not engage/be willing to engage with PBMA because…" on 4-point Likert scales (anchored strongly disagree to strongly agree) for 14-items corresponding to 7 domains (2-items per domain): *cost*; *taste*; *health*; *familiarity*; *convenience*; *degree of processing* and *peer influence*. An overall score variable was created for five out of the seven domains. However, overall score variables were not computed for health and peer influence due to a Cronbach's alpha <0.6 indicating low reliability (Daud et al., 2018; see Supplementary material S2).

2.4 Data analysis

IBM SPSS Statistics, version 26 (SPSS Inc., Chicago) was used to undertake all statistical analyses. Similar to other published literature, Roger's adopter groups were recoded into four subgroups: Innovators/Early Adopters, Early Majority, Late Majority and Laggards (Mahajan et al., 1990).

Shapiro–Wilk tests indicated that the data were not normally distributed and therefore, non-parametric methods were used. Descriptive statistics were used to measure central tendency, variation and frequencies. Pearson chi-squared tests were conducted to explore the association between adopter subgroups and the frequency of consumption of PBMA and meat-based products. Friedman Rank tests were conducted to identify the relative importance of FCM and barriers to PBMA adoption within the adopter subgroups. Kruskal-Wallis tests were conducted to identify any significant differences in the perceptions of plant-based burger, "chicken" and sausage products, the key factors driving individual food choice and barriers impacting adoption of PBMA products across different consumer subgroups. Where appropriate, Dunn's *post-hoc* tests with Bonferroni adjustment were performed to make comparisons between each pairing of groups. For example, whether Innovators/Early Adopters were more likely to perceive plant-based burger products as "cheaper" than their

meat-based equivalents versus Laggards or whether *taste* was considered a significantly greater barrier to adoption of PBMAs within the Late Majority versus the Early Majority. Statistical significance was set at $p < 0.05$ for all tests.

3 Results

Participants were segmented according to Roger's DOI to identify similarities and differences regarding perception of PBMAs, FCM and barriers influencing the adoption of these products within specific consumer subgroups. Figure 1 exemplifies how our sample closely mirrors the distribution of the established adopter categories outlined in Roger's (2003) DOI theory.

3.1 Consumer engagement with meat and PBMA products

Figure 2 displays the frequency with which respondents engage with both PBMA and meat-based products across consumer subgroups and highlights prior consumption and intended future consumption

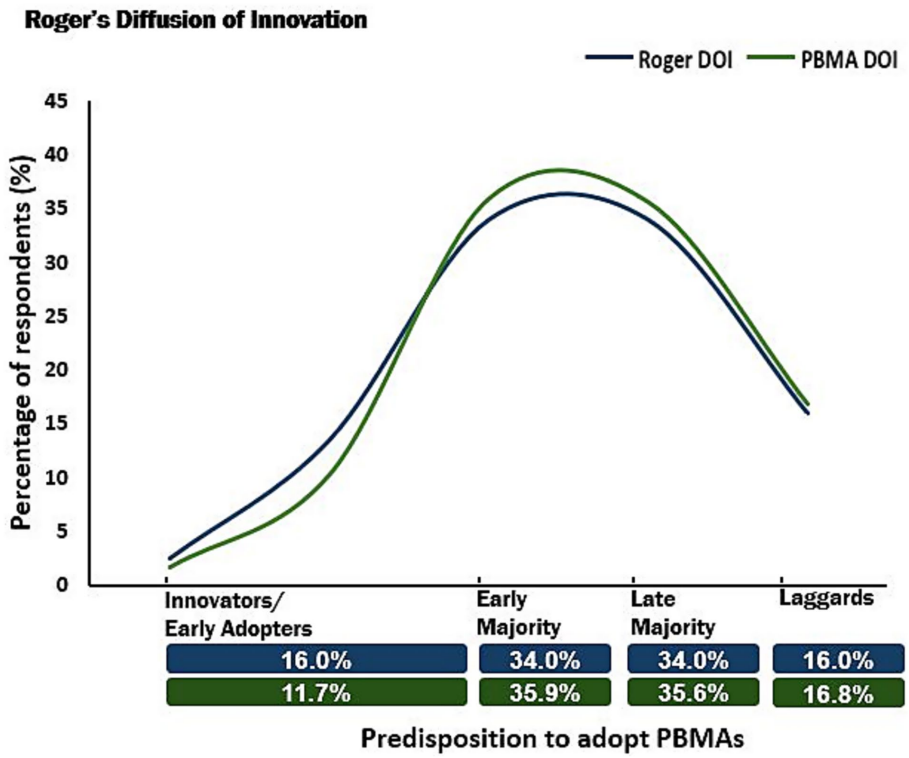

FIGURE 1
Distribution of our sample according to predisposition to adopt PBMA products compared with Roger's Diffusion of Innovation's population distribution for predisposition to adopt innovative ideas and behaviours.

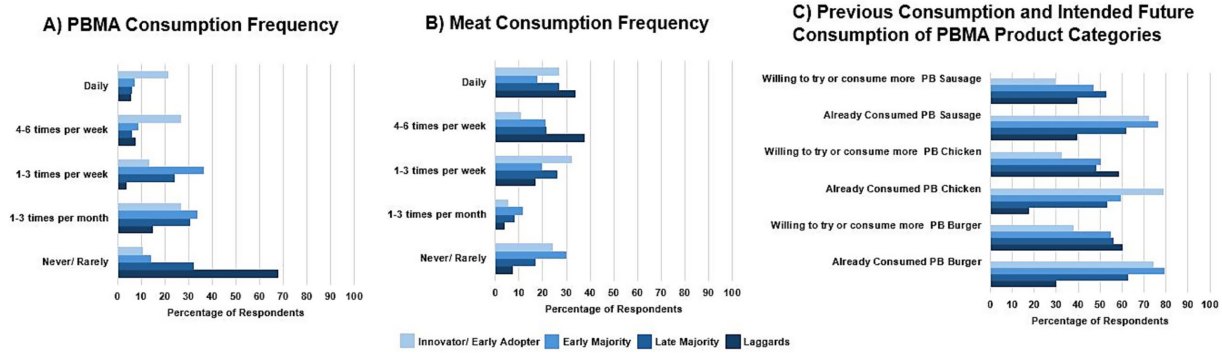

FIGURE 2
Frequency of **A**, current PBMA and **B**, meat-based product consumption, and **(C)** prior consumption and intended future consumption of PBMA products amongst consumer subgroups segmented according to Roger's Diffusion of Innovation. Presented as percentages (%).

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of PBMA product categories. Pearson chi-squared tests revealed a significant association between adopter subgroup and the frequency of PBMA consumption ($X^2(12) = 84.980$, $p < 0.001$), meat consumption ($X^2(12) = 28.487$, $p = 0.005$) and previous consumption of plant-based burger ($X^2(3) = 33.417$, $p < 0.001$), "chicken" ($X^2(3) = 30.793$, $p < 0.001$) and sausage ($X^2(3) = 19.426$, $p < 0.001$) products. Laggards reported lower consumption of PBMA (Figure 2A) and greater consumption of meat-based products (Figure 2B) versus other consumer subgroups. For example, approximately 70% of Laggards indicated they had never/rarely consumed PBMA products. Conversely, Innovators/Early Adopters, Early Majority and Late Majority demonstrated more frequent consumption of PBMA products. Not unexpectedly, the same Roger's subcategories also reported they are already consuming plant-based burger, "chicken" and sausage products more frequently than Laggards (Figure 2C). However, Laggards concurrently expressed a willingness to try for the first time or consume more of these products.

3.2 Perception of PBMA products

Kruskal-Wallis tests demonstrated significant differences for all perception measures across the Roger's adopter categories. Dunn's *post hoc* tests with Bonferroni adjustment revealed PBMAs were generally perceived more favourable in individuals who are more predisposed to adopt PBMAs (Figures 3–5). For example, plant-based burgers (Figure 3, VI), "chicken" (Figure 4, VI) and sausage (Figure 5, VI) products were perceived to be comparatively tastier than their meat-based equivalent among Innovators/Early Adopters and Early Majority versus the Late Majority and Laggards (all $p < 0.05$). Similarly, plant-based "chicken" products were significantly less likely to be perceived as cheaper than their meat-equivalents among Laggards versus the Innovators/Early Adopters, Early Majority and Late majority (Figure 4, V; $p = 0.001$, $p = <0.001$, $p = 0.002$, respectively).

3.3 Food choice motives

3.3.1 Within adopter subgroups

Friedman Rank tests with Dunn-Bonferroni *post hoc* tests demonstrated significant differences in relative importance of FCM within each of the Roger's adopter categories. Table 2 highlights that while rank order varied between groups, *health*, *sensory appeal* and *affordability* were perceived the three most important motives driving food choice in all adopter groups. *Health* was perceived the most salient driver of food choice within Innovators/Early Adopters [ranked significantly higher than *familiarity* and *mood management* ($p = 0.001$, $p = 0.015$, respectively)]. Laggards identified *affordability* as the most important FCM [ranked significantly higher than *fair trade, environmental friendliness, familiarity, mood management* and *animal welfare* (all $p < 0.05$)]. Notably, the Early Majority and Late Majority subgroups demonstrated identical ranked priority for the top three FCM. Both groups ranked *sensory appeal* as the most salient driver of food choice. *Post hoc* tests revealed *sensory appeal* was perceived a significantly greater priority versus *animal welfare*, *mood*

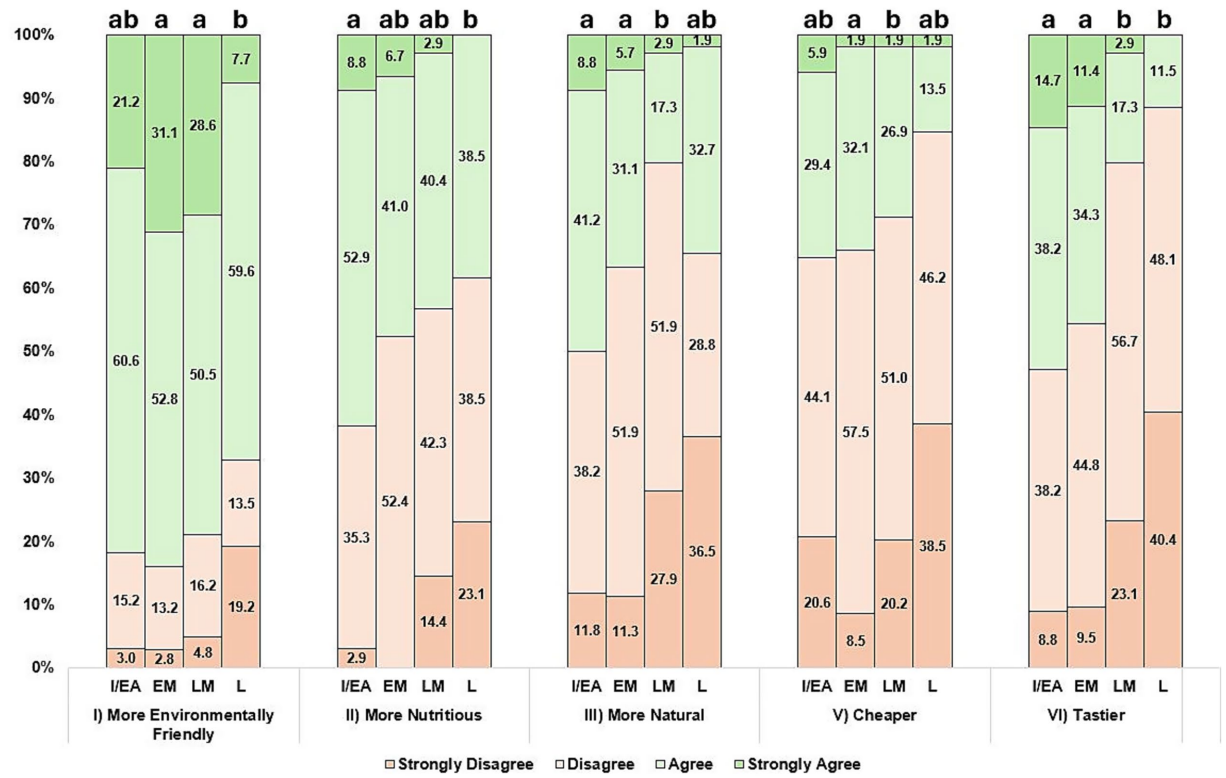

FIGURE 3
Consumer perceptions of PB burgers across Roger's adopter subgroups. For each perception, different superscript letters represent statistically significant between group differences according to Kruskal-Wallis and Dunn's *post-hoc* tests with Bonferroni adjustment ($p < 0.05$).

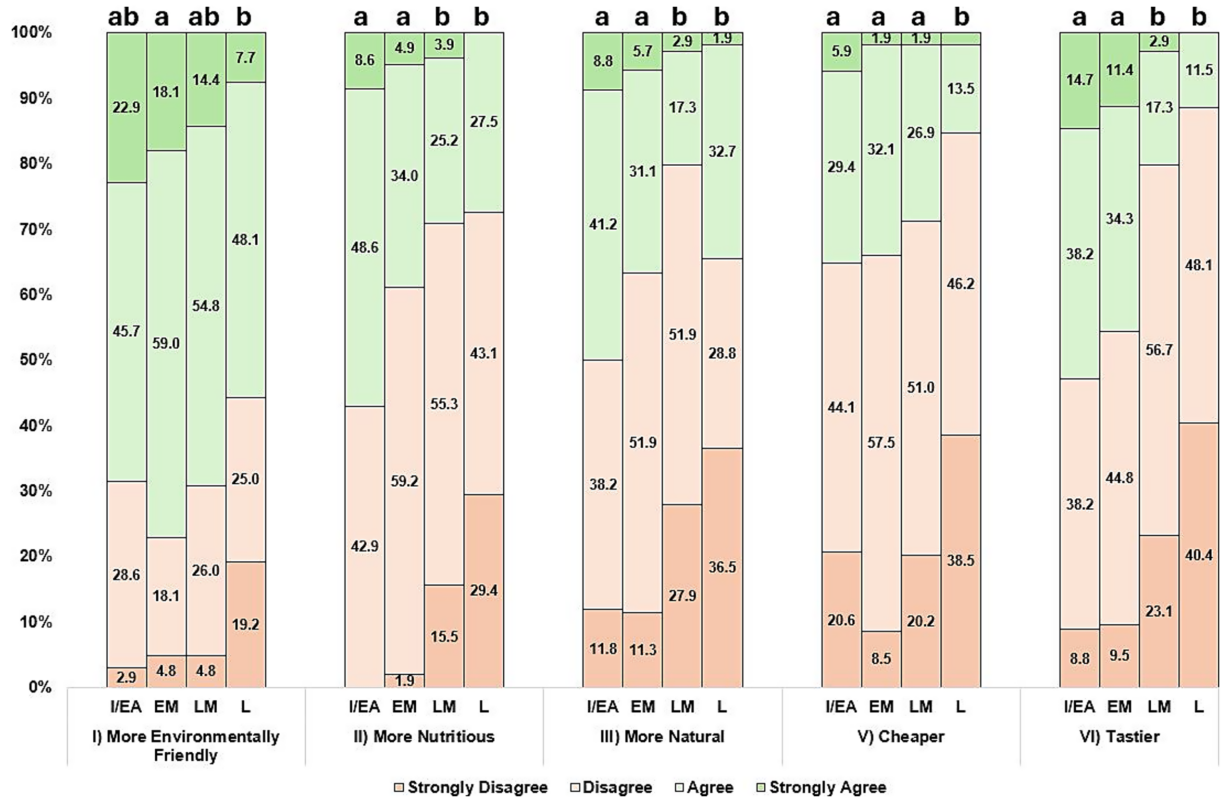

FIGURE 4
Consumer perceptions of PB "chicken" alternatives across Roger's adopter subgroups. For each perception, different superscript letters represent statistically significant between group differences according to Kruskal-Wallis and Dunn's *post-hoc* tests with Bonferroni adjustment ($p < 0.05$).

management, *familiarity*, *environmental friendliness*, *fair trade*, *naturalness*, *convenience* and *weight management* within both Early Majority and Late Majority subgroups (all $p < 0.05$). Table 2 also highlights that across all adopter groups *familiarity* and *mood management* were generally ranked of lower importance.

3.3.2 Between adopter subgroups

Figure 6 presents the mean scores for each FCM among the adopter categories to exemplify variation in the degree of importance assigned to each motive. A Kruskal-Wallis test was conducted to determine whether factors driving individual food choice were significantly different across the subgroups.

This revealed significant differences between the adopter groups regarding the motives *environmentally friendly* ($X^2(2) = 29.609$, $p = <0.001$) and *animal friendly* ($X^2(2) = 32.854$, $p = <0.001$). Dunn's *post hoc* tests with Bonferroni adjustment demonstrated a greater importance for *environmental friendliness* among Innovators/Early Adopters versus Laggards ($p = 0.036$). In addition, Innovator/Early Adopters and Early Majority placed greater importance on *animal welfare* compared to Laggards ($p = 0.005$, $p = 0.011$, respectively).

3.4 Barriers to adoption of PBMA products

3.4.1 Within adopter subgroups

Friedman Rank tests with Dunn-Bonferroni *post hoc* tests demonstrated significant differences regarding the degree to which specific factors were perceived as barriers to the adoption of PBMAs within the Roger's adopter subgroups. Table 3 highlights variation in the ranking of barriers influencing the adoption of PBMAs. Similar to FCM, the Early Majority and Late Majority subgroups ranked the top three barriers (*degree of processing, cost*, and *taste*) in the same order. *Post hoc* tests highlighted that *degree of processing* was perceived to be a significantly greater barrier versus *convenience, insufficient protein, perceived unhealthy*, and *having someone else cook* (all $p < 0.05$). Innovators/Early Adopters also ranked *degree of processing* the greatest barrier to PBMA adoption [ranked significantly higher than *perceived unhealthy* ($p = 0.009$)]. While Laggards identified *taste* to be the key barrier to the adoption of PBMAs [ranked significantly higher than *familiarity, perceived unhealthy, convenience* and *having someone else cook* (all $p < 0.05$)]. Notably, having *someone else cook* received a low ranking within all adopter subgroups.

3.4.2 Between adopter subgroups

Figure 7 illustrates variation in the degree to which specific barriers influence the adoption of PBMAs between the adopter subgroups. Kruskal Wallis tests were conducted to determine any significant difference in barriers influencing adoption of PBMAs across the subgroups.

Findings revealed significant differences between the adopter groups regarding the barriers having *someone else cook* ($X^2(2) = 8.491$, $p = 0.037$), *other household members food choice* ($X^2(2) = 12.290$, $p = 0.006$), *convenience* ($X^2(2) = 10.380$, $p = 0.016$),

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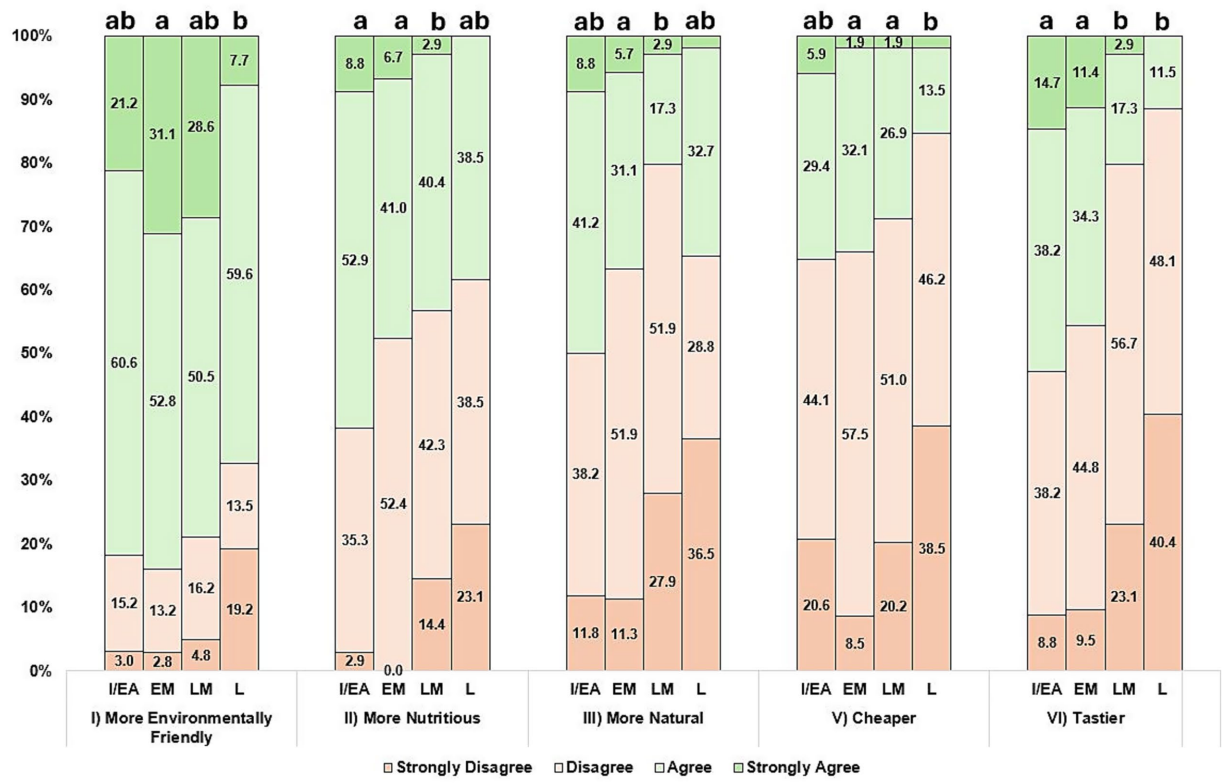

FIGURE 5
Consumer perceptions of PB sausages across Roger's adopter subgroups. For each perception, different superscript letters represent statistically significant between group differences according to Kruskal-Wallis and Dunn's *post-hoc* tests with Bonferroni adjustment ($p < 0.05$).

TABLE 2 Friedman rank test for food choice motives within the Roger's adopter categories.

Food choice motive	Innovator/early adopters		Early majority		Late majority		Laggards	
	Friedman test = 35.145 $P < 0.001$		Friedman test = 196.229 $P < 0.001$		Friedman test = 175.338 $P < 0.001$		Friedman test = 73.611 $P < 0.001$	
	Mean rank	Friedman rank	Mean rank	Friedman rank	Mean rank	Friedman rank	Mean rank	Friedman rank
Healthy	7.64^{a}	1	7.95^{ad}	2	7.78^{a}	2	6.86^{abc}	3
Affordable	6.69^{ab}	2	7.26^{ade}	3	7.53^{ad}	3	8.26^{a}	1
Sensory appeal	6.67^{ab}	3	8.13^{d}	1	8.2^{a}	1	8.00^{ae}	2
Animal friendly	6.39^{ab}	4	5.86^{beg}	6	5.23^{bce}	6	4.38^{d}	11
Weight management	6.28^{ab}	5	5.38^{bcg}	8	5.96^{bcd}	5	6.06^{acd}	4
Environmentally friendly	6.11^{ab}	6	5.98^{beg}	5	5.62^{bc}	8	5.24^{bcd}	8
Fairly traded	6.03^{ab}	7	6.51^{ag}	4	5.93^{bc}	5	5.68^{cde}	7
Convenient	5.91^{ab}	8	5.12^{cg}	9	5.66^{c}	7	5.99^{abd}	5
Natural	5.55^{ab}	9	5.55^{bcg}	7	5.55^{bc}	9	5.92^{acd}	6
Mood management	4.63^{b}	10	4.80^{bcf}	10	4.93^{bce}	10	4.81^{bcd}	10
Familiarity	4.11^{b}	11	3.46^{f}	11	3.69^{e}	11	4.81^{cd}	9

For each adopter category, different letters denote significant differences in relative importance of food choice motive ($p < 0.05$).

familiarity ($X^2(2) = 9.699$, $p = 0.021$) and *taste* ($X^2(2) = 25.938$, $p < 001$). Dunn's *post hoc* tests with Bonferroni adjustment revealed that Laggards perceived *taste* and *other household members food choice* to be a significantly greater barrier versus Innovators/Early Adopters ($p < 0.001$, $p = 0.040$, respectively) and the Early Majority ($p < 0.001$, $p = 0.018$, respectively). In addition, the Early Majority

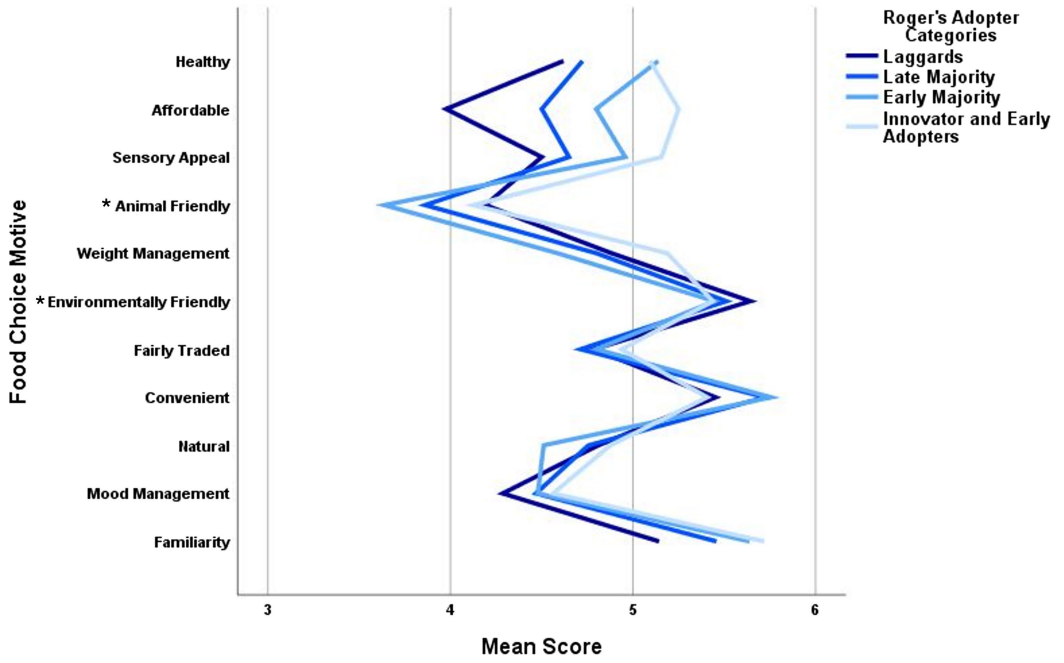

FIGURE 6
Mean rating of Food Choice Motives (FCM) among consumer subgroups segmented according to Roger's Diffusion of Innovation. *Indicates statistically significant differences in FCM rating between the adopter groups ($p < 0.05$).

TABLE 3 Friedman Rank test for barriers to PBMA adoption within the Roger's adopter categories.

Barriers to PBMA adoption	Innovators/early adopters		Early majority		Late majority		Laggards	
	Friedman test = 29.958 $P < 0.001$		Friedman test = 120.941 $P < 0.001$		Friedman test = 110.802 $P < 0.001$		Friedman test = 62.930 $P < 0.001$	
	Mean rank	Friedman rank	Mean rank	Friedman rank	Mean rank	Friedman rank	Mean rank	Friedman rank
Degree of processing	6.40^{b}	1	6.43^{a}	1	6.47^{a}	1	5.65^{ab}	4
Cost	5.82^{ab}	2	5.99^{ac}	2	6.02^{a}	2	5.73^{ab}	3
Convenience	5.12^{ab}	3	4.39^{bd}	7	4.19^{d}	8	4.45^{acd}	6
Others in the household will not eat them	5.04^{ab}	4	5.47^{ab}	4	5.53^{ac}	4	5.92^{bd}	2
Taste	4.82^{ab}	5	5.54^{ab}	3	5.74^{ab}	3	6.66^{b}	1
Insufficient protein	4.82^{ab}	6	5.01^{bc}	5	4.32^{cd}	7	5.12^{abc}	5
Familiarity	4.69^{ab}	7	4.41^{bd}	6	4.57^{bcd}	5	3.85^{ac}	8
Someone else cooks for me	4.31^{ab}	8	3.42^{d}	9	3.75^{d}	9	3.63^{c}	9
Perceived unhealthy	3.97^{a}	9	4.35^{bd}	8	4.41^{cd}	6	3.99^{ac}	7

For each adopter category, different letters denote significant differences in relative importance of barriers to PBMA adoption ($p < 0.05$).

perceived *convenience* to be less of a barrier versus Laggards ($p = 0.018$) and *familiarity* less of a barrier versus the Late Majority ($p = 0.019$). While the Kruskal-Wallis test demonstrated a significant difference for the motive *someone else cooks*, Dunn's *post-hoc* tests revealed no significant difference between the adopter groups.

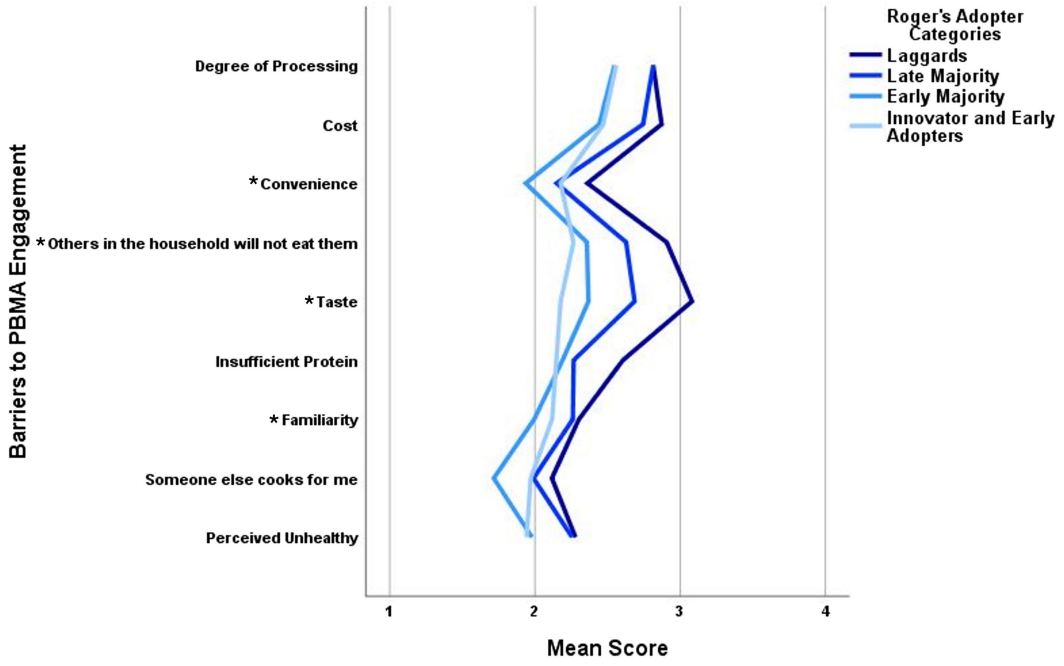

FIGURE 7
Mean rating of barriers to PBMA adoption among consumer subgroups segmented according to Roger's Diffusion of Innovation. *Indicates statistically significant differences in barrier rating between the adopter groups ($p < 0.05$).

4 Discussion

Our study demonstrates how Roger's DOI theory could be used to identify specific factors that need to be addressed within key change groups. This information may inform group specific interventions that have the potential to accelerate the rate of adoption of PBMAs and sustain population-level behaviour change. Our findings highlighted the importance of sensory appeal and health while recognising the need to consider the affordability and degree of processing associated with PBMA products. Aschemann-Witzel and Schulze (2023) describe how as the Early Majority subgroup begin to adopt PBMAs, the rate of change in the consumer population begins to accelerate, passing the so-called "tipping point" after which the dietary shift becomes irreversible. DOI theory also identifies the need to create social contexts whereby Early Adopters become key opinion leaders within their peer groups (Rogers, 2003). Identifying common influences that bridge the "chasm" between Innovator/Early Adopters and Early Majority subgroups may support tailored approaches to maximise the adoption of PBMA products throughout the consumer population.

4.1 Consumer engagement with meat and PBMA products

The current study provides evidence to support the application of the domain-specific innovation tool to segment consumers into categories that align with Roger's DOI theory in the context of PBMA products. For example, Innovators/Early Adopters (more predisposed to adopt PBMAs) reported more frequent PBMA consumption compared to later adopter subgroups. Conversely, Laggards (characterised as more resistant to adoption of PBMAs) demonstrated comparatively less frequent PBMA consumption and more regular consumption of meat-based products. However, our findings also indicate that Laggards concurrently expressed a willingness to try PBMAs. This is difficult to explain because Laggards are typically considered the least receptive to behaviour change. Indeed, Szejda et al. (2020) recommended directing PBMA marketing resources away from this subgroup to improve efficacy. However, Owusu-Antwi and Amenuvor (2023) suggested that despite their initial resistance, Laggards can become valuable advocates for innovations once they successfully engage. Thus, further research, using qualitative methods, is required to better understand the motives underpinning Laggards intention to try PBMAs.

While PBMA products may offer a steppingstone toward healthier more sustainable dietary patterns, manufacturers face significant challenges regarding product acceptability (Andreani et al., 2023; Caputo et al., 2024). In addition, market data indicates that consumer adoption of these products is less ubiquitous (Mintel, 2023). Radical transformation of global food systems to meet challenging health and sustainability targets demands a significant step-change to accelerate adoption of PBMA products. This requires a greater understanding of the needs and barriers that influence key consumer subgroups to inform more effective manufacturing and marketing strategies. Therefore, if primed with resources and opportunities, these change groups have the potential to accelerate the rate of adoption and promote sustained population-level behaviour change.

4.2 Consumer perceptions of PBMAs versus meat-based equivalents

Our findings demonstrated Innovators/ Early Adopters and Early Majority consistently perceived plant-based burgers, "chicken" and

sausage alternatives to be tastier than their meat-based equivalents in contrast to the Late Majority and Laggards. While it is impossible to know why, it may be that individuals within Innovators/ Early Adopters and Early Majority subgroups are more familiar with PBMA products due to an increased exposure within the adoption cycle. The influence of familiarity on product acceptability is well documented (Faber et al., 2024; Fiorentini et al., 2020; Giacalone et al., 2022) and previous studies have demonstrated repeated exposure and habitual consumption of PBMAs to have a positive influence on consumer acceptability (Hoek et al., 2013; Neville et al., 2017).

Another possible explanation could be the distinctive characteristics of different adopter subgroups. Innovators/Early Adopters and Early Majority are typically described as more adventurous and may therefore be more attracted to the novelty of PBMAs (Dearing, 2009; Gonera et al., 2021; Szejda et al., 2021). For example, Mullee et al. (2017) identified that "new tastes" were a key driver toward vegetarian food consumption. Alternately, the Late Majority and Laggards are more risk-averse than other groups and are often considered to be skeptical toward innovative change (Bernstein and Singh, 2008; Mahajan and Muller, 1998). This resistance might be rooted in individual food neophobia and/or meat attachment both of which have been noted to have a significant negative impact on acceptance of PBMAs (Appiani et al., 2023; Graça et al., 2019; Rini et al., 2024). However, it is important to note that our study did not investigate these variables, and future research may be warranted to explore the influence of these characteristics on consumer perception of PBMAs within adopter subgroups.

Our findings also highlighted a degree of variability regarding other perceptions between adopter groups. However, PBMA products were generally perceived to be more favourable than their meat-based counterparts among subgroups more predisposed to adopt PBMA products (e.g., Innovators/Early Adopters and Early Majority) versus later adopter subgroups (e.g., Late Majority and Laggards). Given the current debate surrounding "ultra-processed foods" (Astrup and Monteiro, 2022), it is surprising that PBMA products, which are typically ultra-processed, were perceived to be more natural than their meat-based counterparts (in Innovators/Early Adopters and Early Majority versus later adopter subgroups). Our findings may be attributed to the so-called health halo surrounding these products whereby the purported benefits associated with traditional plant-based dietary patterns are ascribed to PBMAs (Tso and Forde, 2021). For example, previous studies have highlighted the term "plant-based" and/or "vegetarianism" to be perceived as inherently healthy, natural and environmentally friendly (Ang et al., 2023; Sucapane et al., 2021; Wickramasinghe et al., 2021).

4.3 Food choice motives

Our findings highlighted that all groups prioritised *sensory appeal, health,* and *affordability* when making dietary choices. Segmentation enabled the identification of the most important FCM within Roger's adopter subgroups. Both the Early Majority and Late Majority demonstrated the same ranked order, with *sensory appeal* being the most salient motive followed by *health* and *affordability*, respectively. This is interesting as these two groups constitute a large majority (over two thirds) of the sample population. Thus, if they can be jointly targeted with evidence-informed intervention strategies, the rate of change might be accelerated. In addition, once the majority of the two groups have moved to greater PBMA adoption, the process will have reached the so-called "tipping point" meaning that further change should be self-sustaining (Aschemann-Witzel and Schulze, 2023).

While food choice is multifaceted, it is not surprising that sensorial quality is widely recognised as a salient determinant of individual choice (Drewnowski and Monsivais, 2020; Onwezen and Dagevos, 2024). A recent International Food Information Council (2024) survey indicated that taste was ranked the most important driver of food purchasing. Hence, ensuring PBMA products offer a desirable sensory experience, particularly regarding taste and texture, is crucial in achieving consumer acceptance (Appiani et al., 2023; Caputo et al., 2023). This reinforces the need for improved product development strategies to promote adoption across the consumer population.

Our findings corroborate previous research highlighting health motives as a key determinant of general food choice (Culliford and Bradbury, 2020; Jaeger and Giacalone, 2021). PBMAs are often perceived to be healthier than their meat-equivalents and health is frequently cited as a key driver of consumer engagement (Beacom et al., 2021; Dean et al., 2024; Erfanian et al., 2023; Giacalone et al., 2022). In addition, consumers often evaluate product healthiness based on product packaging and credence attributes (Ang et al., 2023; Baptista and Schifferstein, 2023; Ketelings et al., 2023). However, although manufacturers often market PBMAs as superior versus their meat-based equivalents (Appiani et al., 2023; Boukid, 2021), investigation of the health outcomes associated with displacing meat with PBMAs is currently limited (Del Bo et al., 2024; Flint et al., 2023; Santo et al., 2020). Thus, future research is required to understand the specific health benefits associated with PBMAs to facilitate marketing strategies and promote informed adoption.

The importance of affordability may be amplified by the current cost-of-living crisis with recent data highlighting an increase in the degree to which food price determines individual food choice (Skalkos and Kalyva, 2023). Graça et al. (2019) reported that consumers may choose plant-based proteins if they are considered a cheaper alternative to meat. However, the current premium price of PBMAs, coupled with the perception meat is better value for money may restrict consumer engagement (Clark and Bogdan, 2019; Giacalone et al., 2022).

Surprisingly, *familiarity* received a relatively lower ranking within all adopter categories despite being widely recognised to have a positive influence on consumer adoption of PBMAs (Jahn et al., 2021; Malek and Umberger, 2023; Onwezen and Dagevos, 2024). In addition, the relative importance of altruistic motives within subgroups (*animal welfare* and *environmental friendliness*) declined across adopter subgroups with significant variation observed between Innovators/Early Adopters and Early Majority versus Laggards.

These findings suggest that individuals more predisposed to adopt PBMAs place greater importance on ethical motives. Animal and environmental welfare have previously been reported as motives among consumers of PBMA products (Beacom et al., 2021; Hoek et al., 2011; Knaapila et al., 2022) and individuals who are seeking to transition from a meat- to plant-based diet (Bryant et al., 2019; Faber et al., 2024; Hielkema and Lund, 2021). Furthermore, Gonera et al. (2021) suggested that "flexitarian" and those "open to vegetarian

foods" aligned with Roger's Innovator/Early Adopter categories and considered animal and environmental welfare to be important determinants of food choice. Alternately, Laggards may have lower awareness of the environmental impact involved in meat production and the ethical benefits of PBMAs. Several studies cite lack of awareness as a key barrier to increased plant-based consumption among meat eaters (Hartmann and Siegrist, 2017; Jahn et al., 2021). However, conclusive evidence regarding the negative environmental impact of meat production, may demonstrate cognitive dissonance, ignoring the facts in favour of personal convenience (Onwezen and Dagevos, 2024; Rothgerber, 2020; Sanchez-Sabate and Sabaté, 2019). It is important to note that while altruistic drivers may have some influence on individual food choice, they are not recognised as key drivers for adoption of PBMAs (Neff et al., 2018; Szejda and Parry, 2020). Thus, manufacturers should prioritise sensory appeal, health and affordability when promoting PBMA products.

4.4 Barriers to PBMA adoption

Similar to FCM, the top three barriers influencing adoption of PBMA products were ranked identically within both the Early Majority and Late Majority subgroups. Both groups cited *degree of processing, cost* and *taste* as key barriers against adoption. This further reinforces the potential for manufacturers to accelerate the rate of change across a large majority through tailored future product development and marketing strategies.

Cost was identified as one of the most important barriers to adopting PBMAs within all adopter subgroups. Our findings add to the current body of evidence identifying the negative association between affordability and willingness to engage with PBMAs (Caputo et al., 2024; Knaapila et al., 2022; Michel et al., 2021a; Szenderák et al., 2022). This reinforces the urgent need to address the discrepancy between the cost of meat-based and PBMA products (Jahn et al., 2021; Szenderák et al., 2022), particularly considering affordability was also noted a key motive driving food choice behaviour within all subgroups.

Our finding that *degree of processing* was ranked the top barrier to adoption of PBMAs within all subgroups apart from the Laggards highlights the current debate regarding ultra-processing (Pagliai et al., 2021; Wickramasinghe et al., 2021). This aligns with previous published findings which report the extensive processing involved in simulating meat-like properties has led to these products being labeled "unnatural" and "too processed" (Clark and Bogdan, 2019; Estell et al., 2021; Ford et al., 2024). The considerable list of complex ingredients may also compromise the perceived healthiness of PBMAs (Birke Rune et al., 2022; Caputo et al., 2024; Giacalone et al., 2022) and trigger neophobia (Abe-Inge et al., 2024; Alcorta et al., 2021). In addition, the adverse health outcomes associated with ultra-processing have led to consumer skepticism (Bogueva et al., 2022; Hartmann et al., 2022) and contradict the "better for you," "better for the planet" motive (Boukid, 2021; Estévez et al., 2024; van der Weele et al., 2019). Thus, manufacturers should address food manufacturing practice to promote use of natural ingredients and novel processing techniques which do not compromise any associated health benefits.

Paradoxically, extensive processing is often used to enhance consumer experience and simulate organoleptic characteristics of meat-equivalents (Appiani et al., 2023; Sha and Xiong, 2020). Therefore, manufacturers must manage the crucial balance between healthier processing techniques and demand for desirable sensory quality. While our findings identified *sensory appeal* to be a key motive of food choice, negative sensory experience is widely cited as a major barrier to adoption of PBMAs (Faber et al., 2024; Fiorentini et al., 2020; Giacalone et al., 2022). Thus, it is unsurprising that *taste* was ranked within the top three barriers to adopting PBMAs in all groups apart from Innovators/Early Adopters. Our findings thus support the results of previous studies examining both consumers perceived and actual sensory evaluation of PBMAs which have consistently identified the challenge in delivering desirable substitutes for conventional meat and the need to address the sensorial quality (Ettinger et al., 2022; Flint et al., 2025; Hoek et al., 2011; Michel et al., 2021b).

Our findings also demonstrated *taste* to be perceived as a significantly greater barrier within Laggards versus Innovators/Early Adopters and the Early Majority. A possible explanation could be a reluctance to reduce meat consumption among Laggards who may also demonstrate greater meat attachment and may thus be more likely to reject the perceived inferior sensorial properties of PBMAs. Notably, existing literature highlights that meat-eaters and individuals with greater meat-attachment are comparably less tolerant of PBMAs sensorial quality (Appiani et al., 2023; Bryant et al., 2019; Michel et al., 2021b). Future research is warranted to further understand the sensorial evaluation of PBMAs within adopter subgroups to support evidence-based development of PBMA products, thus ensuring a positive sensory experience which meets consumer needs.

The current study demonstrated the Late Majority to perceive *familiarity* as a significantly greater barrier to the adoption of PBMA products compared to the Early Majority. Thus, any variation could be exploited to further drive adoption. Previous research indicates peer influence and convenience may also play a role in determining familiarity (Kuosmanen et al., 2023; Sijtsema et al., 2022). Our study found that both *convenience* and the dietary behaviour of *other household members* was a significantly greater barrier to adoption of PBMAs for Laggards compared to earlier adopter groups. This further reinforces the need for a greater understanding of how increased familiarity may influence adoption of PBMAs and inform effective strategies to achieve this.

4.5 Theoretical and practical application

Our study identified pivotal factors influencing subgroups more predisposed to adopt PBMAs. This may enable the development of interventions that bridge the "chasm" and thus facilitate increased adoption of PBMAs within the Early Majority subgroup. Such approaches may have the potential to rapidly accelerate sustainable adoption across the wider population. Our findings highlight the need for manufacturers to address the sensorial and health quality of PBMA products while considering their degree of processing and affordability. Once the Early Majority begin to adopt PBMAs, the rate of change accelerates rapidly; reaching the "tipping point." After this, further adoption throughout the consumer population becomes self-sustaining. Notably, the two largest subgroups in our sample (Early Majority and Late Majority) demonstrated identical ranking for the key FCM and barriers to adoption of PBMAs. As these two subgroups comprise a large proportion of the sample population, the development of evidence-based interventions that target both these

groups may have the potential to accelerate adoption of PBMAs across the wider consumer population.

Effective and sustainable population-level behaviour change requires a coordinated, multifaceted approach including a wide range of stakeholders. The food industry should give consideration to identifying novel processing techniques that improve sensorial quality of PBMA products without compromising any associated nutritional and health benefits. In addition, comprehensive evaluation of the nutritional profile of PBMAs versus their meat-equivalents could also identify opportunities to enhance their health value. This would support clear nutritional labeling to promote informed consumer choice. Manufacturers should also utilise marketing strategies that highlight desirable sensorial qualities and health credence claims. For example, use of descriptive language to draw on familiar meat-like characteristics (Szejda and Parry, 2020). Public health bodies should consider targeted education campaigns to improve consumer understanding regarding the adverse consequences associated with overconsumption of meat (particularly red and processed products) and the benefits of PBMAs in facilitating the transition from a meat-to plant-based diet. While current agricultural subsidies support excessive production of low-cost meat, no subsidies are provided for PBMAs, which may contribute to the lack of price parity and reduced market competitiveness of these products (Bryant Research, 2024). Given the importance attributed to affordability, government should consider fiscal policies such as a meat tax (Bryant et al., 2024; Kmeťková et al., 2025) and subsidies on PBMA products (Ford et al., 2024; Michel et al., 2021a; Onwezen and Dagevos, 2024). Such financial incentives have the potential to support the development of more affordable PBMAs while an increase in the price of meat-based products may help to position PBMAs as an attractive substitute for their meat-based equivalents. Improved accessibility of PBMAs may also facilitate increased exposure and willingness to purchase. Such evidence-based practice may facilitate sustainable population-level behaviour change and support public health and climate change agendas.

4.6 Limitation and future research

The current study has several limitations which should be acknowledged. Firstly, while convenience sampling was used to overcome logistical constraints, this method increases the risk of self-selection bias with individuals interested in the topic being more likely to participate. Consistent with existing literature our sample included a large proportion of females and highly educated individuals, sociodemographic characteristics noted to influence consumer perceptions and engagement with PBMAs (Beacom et al., 2021; Culliford and Bradbury, 2020). This limits the representability and thus extrapolation of our findings to the wider population. Nevertheless, the distribution of our sample was comparable to the distribution of the established adopter categories outlined in Roger's (2003) DOI theory. Future research should apply probability sampling techniques to ensure more diverse samples and improve the generalisability of findings.

The cross-sectional nature of our study is limited to correlative analysis and does not consider changes in consumer perceptions and behaviour over time. Furthermore, self-reported data may have a negative impact on external validity. For example, through social desirability bias, under or over-reporting attitudes/behaviours and the discrepancy between perceptions and behaviour. Future experimental and observational studies are warranted to address this "attitude-behaviour-gap." For example, conducting longitudinal studies to monitor changes in consumer's attitudes toward and adoption of PBMAs over time. While the Food Choice Questionnaire is a validated tool for measurement of general FCM, it is not contextualised to PBMA products. Thus, future studies should consider measuring PBMA-specific motives in addition to additional characteristics not measured in the current study that may also influence the adoption of PBMA products (e.g., food neophobia and meat-attachment). Finally, the importance attributed to the sensorial and health quality of PBMAs warrants more comprehensive audits of the nutritional value, degree of processing and healthiness of commercially available PBMA versus meat-based equivalents to promote consumer literacy and identify opportunities to improve their health value. Meanwhile, sensory evaluation studies are required to understand consumer acceptability and characterisation of plant-versus meat-based equivalents across a broad range of product categories to facilitate the production of sensorially desirable PBMAs.

5 Conclusion

Our research offers an important theoretical framework that enables the identification of factors facilitating the adoption of PBMAs across distinct adopter subgroups. The findings highlighted the importance of health, sensory quality, affordability and degree of processing as the salient characteristics within key change groups. This emphasises the need for manufacturers to improve the health and sensorial quality of PBMA products, while considering the affordability and extent to which these products are processed. Thus, future research, underpinned by Roger's DOI, is warranted to explore the specific health drivers and desirable sensory characteristics within key change groups to further inform future product development to meet consumer needs.

Data availability statement

The datasets presented in this article are not readily available because they are informing an ongoing doctoral research program. Requests to access the datasets should be directed to Megan Flint, m.flint@shu.ac.uk.

Ethics statement

The studies involving humans were approved by Sheffield Hallam University Research Ethics Committee (Date 23/05/22; Reference ER41114039). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

MF: Writing – original draft, Writing – review & editing, Investigation, Conceptualization, Validation, Project administration, Visualization, Methodology, Formal analysis, Data curation. SB: Methodology, Conceptualization, Funding acquisition, Writing – review & editing, Supervision. JP: Funding acquisition, Methodology,

Writing – review & editing, Conceptualization, Supervision. AL: Funding acquisition, Supervision, Writing – review & editing, Methodology, Conceptualization.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2025.1637567/full#supplementary-material

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