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Surely offal isn't that awful? An exploration of the mediating effect of expected product characteristics on the acceptance of offal-enriched foods☆

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ABSTRACT

Offal is a nutritious food source that has been identified in having a role to play in improving the environmental sustainability of meat. However, current research has not identified how offal can be more acceptable to UK consumers. This study aimed to examine whether acceptance improved when offal was combined with more familiar meat cuts within an uncooked product (i.e., offal-enriched minced meat). Furthermore, acceptance of cooked offal-enriched meals (e.g., spaghetti bolognese with beef mince and liver) were explored in a path model that focused on the interaction between psychological characteristics and expected product characteristics. In an online survey with UK meat eaters ($N = 390$), expected product characteristics and acceptance were measured in response to images and descriptions of hypothetical uncooked meat products and cooked meals. As expected, offal-enriched minced meat was more acceptable than offal in its typical form. The mediation analysis showed that the relationship between health motives and acceptance of offal-enriched meals was partially mediated by expected taste and curiosity. Also, the relationship between food neophobia and acceptance was completely mediated by familiarity, expected taste and curiosity. Finally, the relationship between impression management and acceptance was completely mediated by curiosity and expected taste. The results highlight a potential pathway for the inclusion of offal into the UK diet, particularly for male consumers. To convert curiosity into regular consumption, it is essential that the initial experience with offal is enjoyable and not deemed abnormal.

1. Introduction

Offal refers to the edible internal organs of butchered animals (e.g., liver, heart, kidney) (Ayman et al., 2020). Consuming more offal could improve the sustainability of food systems. For example, Xue et al. (2019) considered various dietary strategies to improve emissions and found that increasing offal consumption had the second largest potential to reduce greenhouse gases within the German meat supply chain. Additionally, further reductions were reported (proportionally as a 26 % reduction) when less offal was wasted during slaughter and used for human consumption instead, as less animals were required to produce the same amount of animal energy for consumption (Xue et al., 2019). Another notable benefit considers nutrition. Offal contains biologically active substances that protect the cells from damage, from cancer, high blood pressure and blood clots (Latoch et al., 2024). Furthermore, the vitamin and mineral content of offal is typically much higher than other muscle tissues (Biel et al., 2019). Therefore, increasing offal consumption not only facilitates more sustainable diets but also promotes better nutrition.

Yet, in the UK, consumption of offal is considerably lower than Non-Western countries (e.g., China, Mongolia, Saint Lucia) (Font-i-Furnols, 2023; Stewart et al., 2021) and other European countries. For example, UK consumers eat approximately eight calories per day from edible offal (FAOSTAT. Food Balances, 2010). Whereas consumers from Belgium, Serbia, Ireland, Belarus and Sweden eat approximately 52, 44, 40, 32 and 26 cal a day from offal, respectively (FAOSTAT. Food Balances, 2010). These findings highlight clear cultural differences in the perceived value of offal. Indeed, some countries consider offal to be a rare and highly desirable food (Babicz et al., 2020), whereas others do not recommend offal for human consumption due to potential health

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concerns (Said, 2019).

Previously, offal was a staple ingredient in the diet of UK consumers. During the Second World War, offal was not restricted by rations and provided a crucial source of protein (Mennell, 1991). However, changes to food infrastructure, economic development and technology influenced preferences for other meat cuts. For example, urbanisation created a disconnect between animals and consumers which resulted in consumers becoming more 'squeamish' in response to eating offal (Blyton et al., 2016). Also, poultry became the preferred meat choice due to agricultural innovations that improved its accessibility and affordability (Blyton et al., 2016). Consequently, offal was used within burgers, processed meats or other industries instead (e.g., pharmaceuticals, cosmetics) (Blyton et al., 2016). These findings indicate that the combination of lifestyle changes and technological advancements shaped preferences for meat products that did not resemble human organs.

Nevertheless, some consumers are demonstrating a renewed interest in offal. This could be explained by rapid price increases, particularly for lamb, pork and beef which are currently their highest on record (AHDB, 2025; Clarke, 2025). Therefore, purchasing offal could be a strategy to reduce food expenditure as it is typically cheaper than other meat cuts (Randall & Smith, 2025). Notwithstanding, the increased demand for offal could also lead to higher prices. Besides economic incentives, other consumers have adopted 'nose-to-tail' eating (i.e., encourages the use and consumption of as much of the animal as possible) because they enjoy the taste of offal and firmly believe that not using the entire animal would be disrespectful and wasteful (Great British Chefs, 2024; Tucker, 2014). Other motives for consuming offal include the avoidance of processed foods, increased awareness of the nutritional and environmental benefits and a desire to diversify food tastes, especially within multicultural societies (Elliott, 2020; Hall, 2025; Tucker, 2014). Considering these findings, offal could appeal to consumers who are price conscious, value nutrition and are motivated to consume meat that potentially contributes to environmental sustainability.

Despite the renewed interest, perceptions of the sensory properties of offal have been shown to inhibit consumption (Henchion et al., 2016). Therefore, previous research has considered a variety of approaches to improve acceptance. For example, Henchion et al. (2016) qualitatively explored consumer perceptions of offal that had undergone various levels of processing. Participants indicated that processing was necessary to improve the sensory properties of offal. However, beliefs were also held that highly processed products were less natural and could adversely affect health. Lavranou et al. (2023) reported that attitudes and acceptance of meat products (e.g., burger, sausage) that contained offal were more positive when beef liver (i.e., more familiar offal) was used as opposed to beef lung (i.e., less familiar offal). Also, a mixed-methods study by Llauger et al. (2021) reported negative beliefs regarding the sensory attributes (smell, taste, texture, pleasantness), health, natural appearance and safety of meat products that contained offal extracts. Yet, perceptions in the qualitative phase of the study were more positive when offal was considered as an ingredient within more familiar dishes, such as pâté.

Here, in the first part of our study, we expanded quantitatively on previous research by comparing whether uncooked meat products (i.e., as you would purchase them to cook later at home) that contained offal (i.e., a hybrid product containing both a traditional meat cut with offal) were more acceptable to consumers than offal in its typical form. We hypothesized that:

H1a: offal-enriched meat products (e.g., minced meat with beef, heart and liver) would be significantly more acceptable to consumers than offal.

H1b: The expected characteristics of offal-enriched meat products would be significantly more positive than offal.

In the second part to our study, we explored the factors that drive acceptance of hypothetical cooked offal-enriched meals (see Fig. 1). The

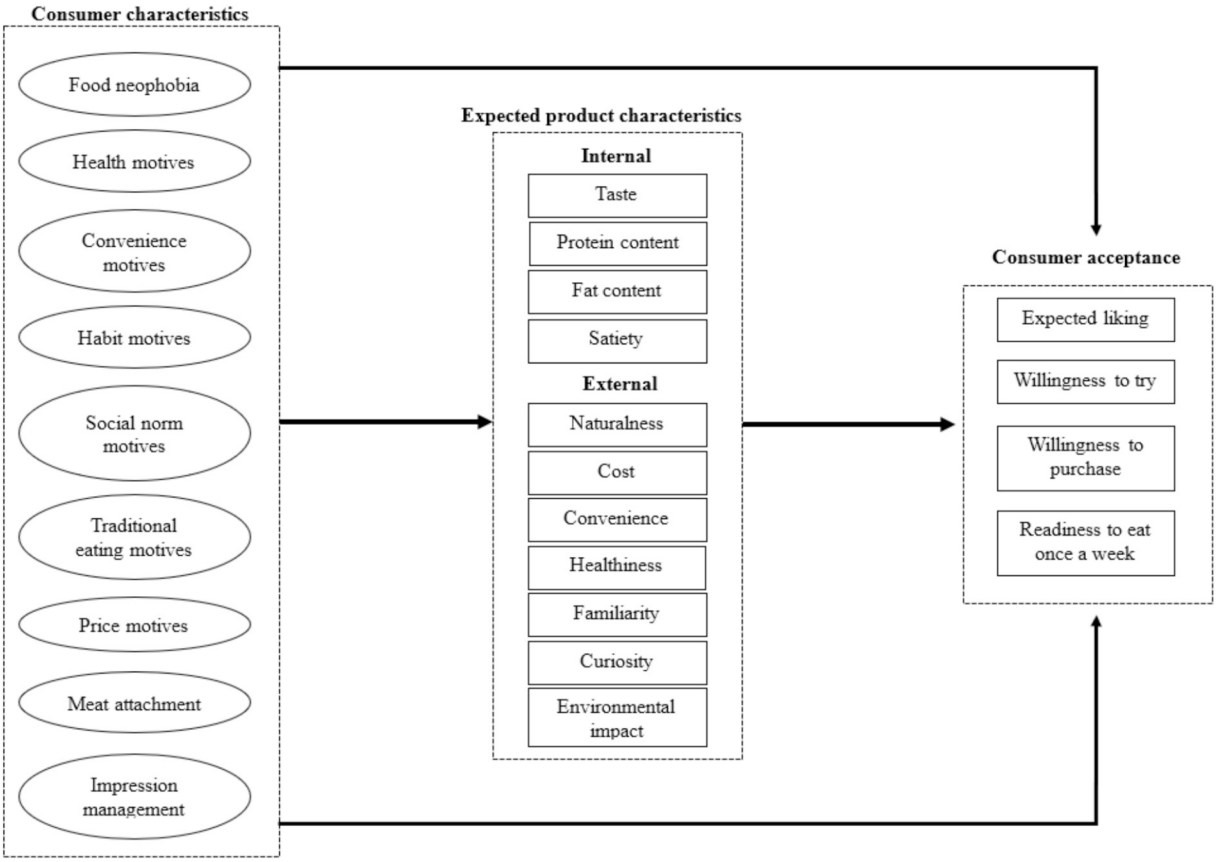

Fig. 1. Proposed conceptual path model for the acceptance of cooked offal-enriched meals.

available literature on offal has examined how psychological characteristics and food motives influence consumer acceptance. Bearth et al. (2021) reported that participants with more positive social norms (e.g., in my family it is normal to eat animal by-products) and higher levels of 'culinary-based drivers' (i.e., personal taste preferences, variation in diet, tradition and special culinary events) were more willing to engage with offal. Additionally, Henchion et al. (2016) reported that offal was deemed more acceptable if consumption benefitted health, body image, was tasty and appropriately priced. Whereas food neophobia and convenience negatively influenced acceptance (Llauger et al., 2021; Sabbagh et al., 2023). However, previous literature has not considered ambivalence (in the context of meat consumption, ambivalence refers to an aversive state whereby an individual simultaneously expresses strong but conflicting evaluations (Pauer et al, 2022)) and impression management (how individuals try to control the impressions others form of them (Leary & Kowalski, 1990)).

Expected characteristics of a food also have also been reported to influence acceptance. For example, Hoek et al. (2011) reported that non-consumers of meat substitutes expected meat to be better for health and mood, was more convenient, had more sensory appeal and was more satiating. Additionally, various studies have shown that acceptance of offal was influenced by expectations around taste (Henchion et al., 2016; Latoch et al., 2024), price (Alao, 2018; Tenrisanna et al., 2016), availability, nutritional value (Alao, 2018) and familiarity (Henchion et al., 2016). Product characteristics can be categorised by the physical characterisation and nutritional composition of a food (i.e., intrinsic) or is related to the product but is not physically a part of what is tasted or consumed (i.e., extrinsic) (Symmank, 2019). In this study, expected taste, protein content, fat content, and satiety were considered intrinsic product characteristics and expected healthiness, naturalness, familiarity, cost, curiosity, convenience, and environmental impact were considered extrinsic product characteristics.

Here, we sought to bring these factors into a single model as research from the broader literature has reported that the relationship between psychological characteristics and acceptance is indirectly influenced by the expectations a consumer holds about a product (Embling et al., 2022; Lang, 2020; Larson, 2019). Therefore, we hypothesized that:

H2a: acceptance and expected characteristics of cooked offal-enriched meals is negatively influenced by the following psychological characteristics: food neophobia, impression management, meat ambivalence and motives concerning habit, traditional eating and convenience.

H2b: acceptance of cooked offal-enriched meals is negatively influenced by the following product characteristics: fat content (intrinsic), expected cost, convenience and environmental impact (extrinsic).

H3a: acceptance and expectations about cooked offal-enriched meals is positively influenced by the following psychological characteristics: motives that value health, social norms and price.

H3b: acceptance of cooked offal-enriched meals is positively influenced by the following product characteristics: expected taste, protein content, satiety (intrinsic), healthiness, naturalness, curiosity and familiarity (extrinsic).

H4a: expected product characteristics mediate the relationship between psychological characteristics and acceptance of cooked offal-enriched meals.

2. Methods

2.1. Study design

Using a quantitative research design, the data for this study were collected from UK meat eaters between November 2023 to January 2024. A cross-sectional survey was designed in Qualtrics (n.d.) to capture participants rated expected characteristics and acceptance in response to images and text descriptions of hypothetical food products. Participants were informed that the research purpose was to understand their opinions on 'meaty meals'. The survey began after participants provided informed consent. Firstly, participants completed a bot check (e.g., only selecting photos of a bicycle) at the beginning of the survey to protect the data from fraudulent responses produced by bots (Storozuk et al., 2020). Then participants completed questions on their demographics (e.g., age, country of residence, highest completed qualification, employment status, ethnicity, combined family income), subjective social status (MacArthur Scale of Subjective Social Status; 3 items) (Adler et al., 2000) and self-reported preferences and frequency of meat consumption (chicken, turkey, beef, lamb, mutton, pork, and offal). For the main survey task, participants were required to view a series of nine images, one at a time, in a randomised order. Two of the images were of uncooked offal. One image was of uncooked offal-enriched minced meat. The remaining six images were of cooked offal-enriched meals. See Table 1 for the descriptions of the images used in the survey. Details on the amount of offal within uncooked and cooked products was not provided. Participants rated expected product characteristics (11 items) and acceptance (4 items) in response to each image. Then, participants completed questionnaires on their psychological characteristics and motives relating to food (the questionnaire order is detailed in **Section 2.3.1**). Finally, participants were debriefed at the end of the study with a debrief form. The hypotheses, methods and planned data analysis were preregistered on the Open Science Framework (OSF) prior to data collection (https://osf.io/52esrhttps://osf.io/52esr). Deviations from the protocol was necessary both during and after data collection. As recommended by Willroth and Atherton OE. Best Laid Plans: A Guide to Reporting Preregistration Deviations (2024), deviations are recorded in the supplementary materials (see Supplementary materials, Table S1). Ethical approval was granted by the Swansea University Psychology ethics committee (approval number:

Table 1
Descriptions of uncooked meat products and cooked offal-enriched foods.

Product	Description
Uncooked meat products	
Beef liver	Beef liver is typically fried in a pan and served with onions and gravy. Beef liver can also be used in a pate.
Lamb kidney	Kidneys can be pan-fried or grilled and can be served with rice, salad or on top of toasted bread.
Mince	The meat you can see is raw beef mince. This is made from a combination of beef, heart, and liver. This meat could be used in many meals, including burgers, spaghetti Bolognese and chilli con carne.
Cooked offal-enriched meals	
Beef and offal burger	This burger is made from beef mince and beef heart. The burger is also flavoured with different seasonings.
Beef and lamb meatballs (faggots)	These meatballs are made from beef mince, lamb's liver and wrapped with bacon. This meal would typically be served with mashed potatoes, vegetables, and gravy.
Shepherd's pie	This pie is made from a mixture of minced lamb and lamb's livers. The meat is cooked in a sauce made from chicken or lamb stock and vegetables for flavour. The pie is topped with mashed potato and is typically served with green vegetables.
Chicken and liver curry	The curry is made from a mixture of chicken breast or thigh and chicken livers. This curry can be changed to include more or less spices, depending on your taste preference. This meal is typically served with rice or chips, or a flatbread, such as a naan or roti.
Pork and vegetable stir-fry	The stir-fry is made from a mixture of pork medallions and pork heart. The meal can be customised to include your preferred vegetables and sauce, such as teriyaki, hoisin, sweet and sour etc. This meal is typically served with rice or noodles.
Spaghetti Bolognese	This is made from a combination of minced meat and minced offal (kidney and heart). The meat is cooked in a tomato sauce and is seasoned with herbs and can include vegetables, such as onion. This meal is typically served with pasta and bread.

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2.2. Participants

567 participants were initially recruited across Prolific. (n, d.) (2023) (n = 87, 15.3 %), social media (i.e., Facebook, Instagram) (n = 329, 58.1 %) and the Swansea University participant pool (n = 151, 26.6 %). Based on fair pay guidelines, participants recruited from Prolific were rewarded £3.20. Swansea University students were rewarded two credits. All other participants were provided with an option to enter a prize draw for a £25 Amazon voucher. The average completion time was 25 min.

2.3. Measures

2.3.1. Psychological characteristics and demographics

In line with previous studies on changing meat consumption patterns (Bryant et al., 2019; Malek et al., 2019; Van Gent et al, 2024), participants completed three short questionnaires to assess food motives and beliefs towards meat. Firstly, participants completed the 'Food Neophobia Scale' (FNS; 10 items) (Pliner & Hobden, 1992). This was followed by 'The Eating Motivation Survey' (TEMS; 21 items) (Renner et al., 2012), and finally 'The Meat Ambivalence Questionnaire – Sustainability based' (MAQ; 7 items) (Buttlar et al., 2023). All questionnaires were rated on a 7-point Likert scale. The MAQ and FNS scale ranged from "Strongly disagree" to "Strongly agree". The TEMS ranged from "Never" to "Always". Higher scores indicated greater levels of the respective trait (e.g., increased ambivalence towards meat, increased reluctance to try new foods). To check for social-desirability bias in responses, participants then completed the 'impression management' subscale (8 items) from the 'Balanced Inventory of Desirable Responding Short Form' (BIDR-16) (Hart et al., 2015). The 'Perceived Awareness of the Research Hypothesis Scale' (PARH; 4 items) was included at the end of the survey to measure the potential influence of demand characteristics (Rubin, 2017). This questionnaire included items such as "I knew what the researchers were investigating in this research" and was rated on a seven-point Likert scale, ranging from 'strongly disagree to 'strongly agree'. Two questions were included as attention checks throughout the survey. For instance, participants were asked to select "strongly agree" on a Likert scale. The first attention check was placed after the fifth item on the FNS, and the second attention check was placed after the fourth item on the BIDR-16.

2.3.2. Expected product characteristics

Based on the literature, the following intrinsic expected product characteristics were measured: taste (Embling et al., 2022), protein content (Michel et al., 2021; Thavamani et al., 2020), satiety (Michel et al., 2021) and expected fat content (Michel et al., 2021). Additionally, the following extrinsic expected product characteristics were measured: healthiness, naturalness, price, environmental sustainability, familiarity (Embling et al., 2022), convenience (Bryant, 2019; Michel et al., 2021; Sun et al., 2021) and curiosity (Stone et al., 2022). All ratings were provided on a series of 100-mm visual analogue scales (See Table 2). A 'neutral' label was included at the midpoint of each scale to guide responding.

2.3.3. Consumer acceptance

In accordance with Embling et al. (2022), consumer acceptance was measured with four items: willingness to try ("Would you personally be willing to try…?'), willingness to buy ("Would you personally be willing to buy the ingredients to make this meal?") and preparedness to eat the meal once a week ("I would be prepared to eat this meal once a week"). These items were measured using a scale with the following labels: "Definitely not (0)", "Might or might not" (50) and "Definitely yes" (100). Also, participants rated expected liking using the hedonic general labelled magnitude scale (Kalva et al., 2014) which ranged from the 'most disliked experience imaginable' (−100) to the 'most liked experience imaginable' (100). An overall acceptance score was formed by calculating the mean of these four items.

Table 2
Visual analogue scale labels used to measure expected product characteristics.

Visual analogue scale labels	Expected product characteristics
Not at all (0) - Extremely (100)	Healthiness, naturalness, convenience, price, curiosity, familiarity.
Very low (0) - Extremely high (100)	Protein content, environmental sustainability, fat content.
The most disgusting food ever to be eaten (−100) The tastiest food ever to be eaten (100)	Expected taste.
The greatest imaginable hunger (−100) The greatest imaginable fullness (100)	Expected satiety.

2.4. Data management and analysis

Analyses were conducted in JASP (program version 0.19). Of the original sample (N = 567), 165 participants were excluded from the analysis because they completed less than 98% of the survey Additionally, 12 participants were excluded because they reported that they did not eat meat in their diet. Therefore, the final dataset included 390 participants from Prolific (n = 87, 22.3 %), social media (n = 181, 46.4 %) and the Swansea University participant pool (n = 122, 31.3 %). This sample size was powered to detect a small-medium effect for the predictor – mediator path (i.e., α path) and a small-medium effect for the mediator outcome path (i.e., β path), using a bias-corrected bootstrap approach (Fritz & Mackinnon, 2007). This was also supported by Sim et al. (2022), whereby a minimum of 387 participants were required to detect an average effect size for the indirect effect. The first and second attention checks were failed by 35 and 32 participants, respectively. 18 participants failed both attention checks. As recommended by Muszyński (2023), analyses were conducted with and without participants who failed both attention checks (N = 372).

For the first analysis, only ratings of the uncooked offal and offal-enriched minced meat were considered. 15 repeated measures ANOVAs were conducted to compare acceptance (4 variables) and expected product characteristics (11 variables) between uncooked offal-enriched mince and uncooked offal. A Bonferroni corrected p value (0.003) was applied to reduce the risk of type I error (VanderWeele & Mathur, 2019). Repeated measures ANOVA was selected to allow for the inclusion of gender and recruitment platform within models as we noted differences in the focal variables as a function of recruitment platform. Indeed, one recruitment platform (Prolific) was used specifically to increase the number of males within our sample. Therefore, gender was also included in our analyses. Repeated measures ANOVA was also selected because it can withstand deviations in the normality assumption (Blanca et al., 2023) and our normality checks did indicate deviations for some variables.

For the second analysis, only ratings of the cooked offal-enriched meals were considered. A multiple mediation model based on psychological characteristics (i.e., independent variables) and expected product characteristics (i.e., mediating variables) was conducted to examine the drivers of cooked offal-enriched meals. Before running the model, independent, mediating and dependent variables were entered into a bivariate correlation matrix. The non-parametric Spearman's Rank correlation was used to interpret associations as the data was not normally distributed and contained outliers. Relationships between the mediating variables and dependent variable were examined. Expected product characteristics that were not moderately related (i.e., ± 0.50 or lower) to acceptance were not included in the mediation model. Then, relationships between the independent variables (i.e., psychological

characteristics) and mediating variables were examined. Again, psychological characteristics that were not moderately related (i.e., ± 0.50 or lower) to expected product characteristics were not included in the mediation model. A significant relationship between the independent and dependent variable was not a requirement for inclusion, as an indirect effect can still exist, even when the direct effect is not significant (Preacher and Hayes, 2008). The correlations between variables are detailed in the supplementary materials (**Tables S2, S3, S4**).

In addition, due to the different recruitment platforms utilised and the identified difference in gender as a function of recruitment platform, we ran versions of the model which controlled for these factors. Gender and recruitment platform were significantly related to some of the variables (see the supplementary materials, **Table S5**). Therefore, these were included in the final model. The final model (Fig. 2) was tested in Jasp. In accordance with Preacher and Hayes (2008), we applied bootstrapping with 5000 subsamples to test the indirect effects. Indirect effects were considered significant if the *p* value was less than 0.05 and the confidence intervals did not cross zero (Tan and Tan, 2010).

Common method variance (CMV) was analysed through Harman's single-factor test. CMV is the variance associated with the construct measurement (Podsakoff & Organ, 1986) and typically occurs when independent and dependent variables are measured using the same response method (e.g., ordinal scales) within the same survey and are completed by the same person (Kock et al., 2021). CMV can cause measurement errors that overestimate or underestimate the observed relationships between constructs (Noor et al., 2023). According to Podsakoff and Organ (1986), CMV is detected when one factor accounts for more than 50 % of the total variance. The results of Harman's single-factor test did not provide any evidence for CMV as one factor did not account for most of the variance (31.9 %).

Finally, an exploratory analysis was conducted to examine potential differences in expected product characteristics and acceptance across different types of cooked offal-enriched meals (e.g., would the willingness to try a beef and liver burger be significantly higher or lower than a chicken and liver curry). A series of Friedman's tests with a Bonferroni corrected *p* value (0.003) was applied. This test was selected over the repeated measures ANOVA as the variables contained outliers (i.e., greater than 1.5 standard deviations from the mean of each variable) and was not normally distributed. Significant results were further examined with Dunn's pairwise post hoc tests.

3. Results

3.1. Participant characteristics

Approximately half of the sample was female (51.5 %), and the mean age was 34.5 years old ($SD = 14.9$). The ethnic background of participants was representative of the UK population, based on the current census figures (Gov.UK. Ethnicity facts and figures, 2022). Most participants were in full time employment (40.5 %). Concerning education, 32.8 % and 26.9 % of participants reported completing college (i.e., A/AS levels) or an undergraduate degree, respectively. Household income was balanced. For instance, 26.9 %, 31.5 % and 30.2 % of participants earned up to £29,000, between £30 - £59,000 and above £60,000, respectively. Table 3 lists the full descriptive statistics. See the Supplementary materials (**Table S6**) for descriptive statistics for participants' reported meat consumption and for descriptives statistics of participants across recruitment platforms. (**Table S7**).

2.1. Comparisons between images of uncooked offal and offal-enriched minced meat

In line with our hypotheses (H1a, H1b), there were significant differences in the ratings for expected product characteristics and acceptance of images of uncooked offal-enriched minced meat and offal in its typical form (i.e., liver and kidney) (see Table 4). Indeed, the mean score for offal-enriched minced meat was significantly higher than offal for the following intrinsic characteristics: expected taste, fat content and satiety. Mean scores were also significantly higher for the following extrinsic characteristics: convenience, environmental impact, curiosity, familiarity. Additionally, acceptance of the offal-enriched minced meat was significantly higher than offal alone across all acceptance indicators (i.e., expected liking, willingness to try, willingness to buy, and preparedness to eat once a week). Whereas the mean score for offal was significantly higher for perceived naturalness. Expectations about the healthiness, cost (extrinsic) or protein content (intrinsic) of offal or offal-enriched minced meat did not significantly differ. Notably, the results did not change when inattentive participants ($n = 18$) (i.e., those who failed both attention checks) were filtered from the analysis.

2.2. The drivers of acceptance of cooked offal-enriched meals

Our hypothesis that psychological characteristics (i.e., food neophobia, impression management, meat ambivalence, habit motives, traditional eating motives and convenience negatively motives) negatively influences acceptance was partially supported (H2a). A significant and negative direct effect was found between healthy eating motives and acceptance of cooked offal-enriched meals ($\beta = -1.7$, $p = .001$). Conversely, all other direct relationships between psychological characteristics and acceptance were not significant: food neophobia and acceptance ($\beta = 0.02$, $p = .788$) and impression management and acceptance ($\beta = 0.46$, $p = .482$). Our results did not support the hypothesis that acceptance of cooked offal-enriched meals would be positively influenced by motives that value health, social norms and price (H3a).

Considering the direct relationships between expected product characteristics and acceptance, our result did not support the hypothesis that acceptance of cooked offal-enriched meals would be negatively

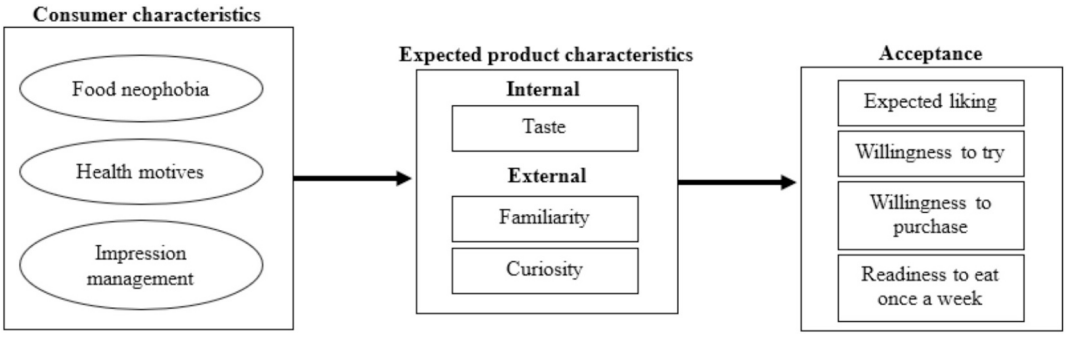

Fig. 2. Final model tested on the drivers of cooked offal-enriched meals, with expected product characteristics as mediators of the relationship between psychological characteristics and acceptance.
Note. Gender and recruitment platform were controlled in this model.

Table 3
Participant demographics and scores on psychological characteristics.

	Overall
	(N = 390)
Gender, *n (%)*	
Female	201 (51.5 %)
Male	163 (41.8 %)
Non-Binary	2 (0.5 %)
Other	1 (0.3 %)
Missing	23 (5.9 %)
Age distribution	
18–29	184 (47 %)
30–39	71 (18.2 %)
40–49	58 (15 %)
50–59	46 (11.7 %)
60–69	20 (5.1 %)
70–80	7 (2 %)
Ethnicity, *n (%)*	
Asian/Asian British	36 (9.2 %)
Black/Black British/African American	33 (8.5 %)
Latino or Hispanic	4 (1 %)
Multiracial or Multi-ethnic	18 (4.6 %)
White/Caucasian	290 (74.4 %)
Arab	1 (0.3 %)
Another ethnicity	4 (1 %)
Prefer not to answer	4 (1 %)
Employment status, *n (%)*	
Full time employment	158 (40.5 %)
Part-time employment	16 (4.1 %)
Self-employed	46 (11.8 %)
Unemployed (looking for work)	10 (2.6 %)
Unemployed (not looking for work)	2 (0.5 %)
A homemaker	6 (1.5 %)
Student	119 (30.5 %)
Retired	18 (4.6 %)
Unable to work due to disability/illness	5 (1.3 %)
Other	8 (2.1 %)
Prefer not to answer	2 (0.5 %)
Education, *n (%)*	
Postgraduate degree	45 (11.5 %)
First degree	105 (26.9 %)
HNC/HND/ BTEC higher or equivalent	24 (6.2 %)
Some college credit, no degree	13 (3.3 %)
A/AS levels or equivalent	128 (32.8 %)
Trade/technical/vocational training	8 (2.1 %)
O Level/GCSE A-C or equivalent	24 (6.2 %)
O Level/GCSE D-G or equivalent	10 (2.6 %)
No Qualifications	2 (0.5 %)
Other	31 (7.9 %)
Country of residence *n (%)*	
Wales	157 (40.3 %)
UK	144 (36.9)
England	67 (17.2 %)
Scotland	10 (2.6 %)
Ireland	1 (0.3 %)
Outside of the UK	10 (2.6 %)
Prefer not to answer	1 (0.3 %)
Income, *n (%)*	
£0 - £9999	14 (3.6 %)
£10,000 - £19,000	30 (7.7 %)
£20,000 - £29,000	61 (15.6 %)
£30,000 - £39,000	41 (10.5 %)
£40,000 - £49,000	41 10.5 %)
£50,000 - £59,000	42 (10.8 %)
£60,000 - £69,000	30 (7.7 %)
£70,000 - £79,000	20 (5.1 %)
£80,000 - £89,000	19 (4.8 %)
£90,000 - £99,000	19 (4.9 %)
£100,000 or more	30 (7.7 %)
Prefer not to answer	42 (10.8 %)
Unsure	1 (0.3 %)
MacArthur Scale of Subjective Social Status, mean (SD)	
Money ($n = 356$)	5.4 (1.7)
Job ($n = 333$)	5.4 (2.1)
Education ($n = 339$)	6.8 (1.7)
Reported offal consumption	
Never/zero days a week	316 (81 %)
At least once a month	53 (13.6 %)
At least 1 day a week	61 (15.6 %)
At least 3 days a week	4 (1 %)
Psychological characteristic	Range / M (SD)
Food neophobia (FNS)[1]	10–49 / 25.2 (8.0)
Convenience (TEMS)[2]	1–6 / 4.8 (1.1)
Social norms (TEMS) [2]	1–6 / 3.0 (1.2)
Natural concerns (TEMS) [2]	1–6 / 3.4 91.4)
Traditional eating (TEMS) [2]	1–6 / 3.6 (1.1)
Health (TEMS) [2]	1–6 / 4.5 (1.2)
Price (TEMS) [2]	1–6 / 4.0 (1.3)
Habit (TEMS) [2]	1–6 / 5.1 (1.1)
Meat ambivalence questionnaire (sustainability-based ambivalence)	1–7 / 3.4 (1.6)
Impression management (BIDR-16)	2–7 / 4.5 (1.0)

[1] Sum of item scores in scale.
[2] Mean scale score calculated across items

Table 4
Results of the repeated measures ANOVA tests assessing the differences between uncooked offal-enriched minced meat and uncooked offal for expected product characteristics and acceptance (main effects are shown below. All analyses also accounted for gender and recruitment channel. Please see supplementary information, Note S1 - Note S15 and Table S8 - Table S25, for any main effects or interaction effects associated with gender and/or recruitment).

	Offal-enriched minced meat		Offal[2]		F (1, 358)	ηp^2
Expected product characteristic	*M*	*SE*	*M*	*SE*		
Intrinsic						
Taste[1]	51.37	4.78	−37.45	5.56	**185.74*****	0.342
Protein content	73.87	1.79	74.88	1.77	0.301	<0.001
Fat content	56.41	1.9	42.07	2.16	**35.14*****	0.089
Satiety[1]	50.15	3.72	8.11	4.68	**66.63*****	0.157
Extrinsic						
Healthiness	63.93	2.24	64.57	2.44	0.061	<0.001
Naturalness	62.29	2.57	74.19	2.31	**19.19*****	0.051
Convenience	42.85	2.69	56.35	2.38	**17.94*****	0.048
Cost	50.89	2.13	46.24	2.27	3.21	0.009
Environmental impact	59.71	2.34	50.91	2.28	**19.25*****	0.051
Curiosity	62.15	3.3	36.3	3	**39.09*****	0.098
Familiarity	79.13	2.92	33.26	3.15	**124.59*****	0.258
Acceptance						
Expected liking[1]	49.04	4.71	−36.79	5.75	**180.55*****	0.335
Willingness to try	78.18	3.27	33.76	3.46	**129.16*****	0.266
Willingness to purchase	74.94	3.45	23.02	3.13	**175.14*****	0.331
Preparedness to eat once a week	69.82	3.61	20.49	2.97	**149.06*****	0.295

[1] Rating scales ranged from −100 to 100.
[2] Average scores for kidney and liver collapsed across individual items.
*** $p < .001$

influenced by expected cost, fat content, convenience and environmental impact (H2b). Alternatively, our hypothesis that acceptance of cooked offal-enriched meals would be positively influenced by expected product characteristics was partially supported by the results (H3b). Indeed, the direct relationships between expected product characteristics and acceptance showed that curiosity had the strongest association ($\beta = 0.42, p < .001$), followed by expected taste ($\beta = 0.38, p < .001$) and familiarity ($\beta = 0.23$, $p < .001$). The coefficient of determination (R^2) was 0.81, indicating that the model explained 81 % of the variance in acceptance ratings for cooked offal-enriched meals.

Table 5 shows the output for indirect effects. In line with our

Table 5
Indirect and total effects of the mediation model.

					95 % Confidence interval	
	β	SE	z-value	*p*	LLCI	ULCI
Indirect effects						
Healthy eating motives → Expected taste → Acceptance	1.69	0.581	2.911	0.004	0.672	2.83
Healthy eating motives → Curiosity → Acceptance	1.223	0.403	3.037	0.002	0.443	2.164
Food neophobia → Expected taste → Acceptance	−0.552	0.096	−5.758	<0.001	−0.741	−0.381
Food neophobia → Curiosity → Acceptance	−0.258	0.064	−4	<0.001	−0.406	−0.147
Food neophobia → Familiarity → Acceptance	−0.114	0.035	−3.266	0.001	−0.196	−0.057
Impression management → Expected taste → Acceptance	−1.664	0.711	−2.34	0.019	−3.369	−0.115
Impression management → Curiosity → Acceptance	−1.261	0.491	−2.569	0.01	−2.452	−0.286
Total effects						
Total effect of healthy eating motives on acceptance	1.565	1.104	1.418	0.156	−0.466	3.547
Total effect of food neophobia on acceptance	−0.901	0.171	−5.275	<0.001	−1.213	−0.581
Total effect of impression management on acceptance	−2.787	1.362	−2.047	0.041	−5.804	0.053
Total indirect effects						
Healthy eating motives → Acceptance	3.262	0.981	3.326	<0.001	1.532	5.047
Food neophobia → Acceptance	−0.923	0.153	−6.015	<0.001	−1.196	−0.656
Impression management → Acceptance	−3.247	1.208	−2.687	0.007	−6.181	−0.538

Note. → represents the indirect effect from psychological characteristics (independent variable) to expected product characteristic (mediating variable) and acceptance (dependent variable).

hypothesis (H4a), expected product characteristics were found to mediate the relationship between psychological characteristics and acceptance of cooked offal-enriched meals. For example, expected taste ($\beta = 1.6$, $p = .004$) and curiosity ($\beta = 1.22$, $p = .002$) significantly mediated the relationship between health motives and acceptance. Furthermore, the estimates indicated that both variables were competitive mediators. Although, the direct effect was stronger than the indirect effect, indicating that the mediating effect was partial. Additionally, expected taste ($\beta = -0.55$, $p \leq 0.001$), curiosity ($\beta = -0.26$, $p \leq 0.001$), and familiarity ($\beta = -0.11$ $p \leq 0.001$) mediated the relationship between food neophobia and acceptance. As the direct relationship was not significant, these were complete mediators. Additionally, curiosity ($\beta = -1.26$, $p = .01$) and expected taste ($\beta = -1.66$, $p = .019$), completely mediated the relationship between impression management and acceptance. Fig. 3 illustrates the significant pathways. The mediation results did not change when inattentive participants were filtered from the analysis. See the supplementary materials (**Table S26**) for the mediation analysis conducted without participants that failed both attention checks.

3.2. Differences in the expected characteristics of cooked offal-enriched meals (within category)

Bonferroni-corrected pairwise comparisons showed that the spaghetti bolognese was expected to be tastier, more intriguing (i.e., curiosity), familiar and satiating than other meals ($p < .001$). Furthermore, the spaghetti bolognese was rated significantly higher across all acceptance indicators than other meals ($p < .001$). The stir-fry was expected to be healthier and more natural than other meals ($p < .001$). The curry was expected to have a higher protein content than other meals ($p < .001$) but was also less familiar and convenient than other meals. ($p < .001$). The burger was expected to be less healthy and natural than other meals ($p < .001$). Finally, the preparedness to eat the shepherd's pie was lower than other meals ($p < .05$). See the supplementary materials (**Table S27**) for all other comparisons between individual foods. When inattentive participants were filtered from the analysis, there were subtle differences to comparisons. For example, there were no significant differences in curiosity ratings across for the curry, burger, stir-fry and spaghetti bolognese. See the supplementary materials (**Table S28**) for the full comparisons without participants who failed both attention checks.

4. Discussion

As expected, acceptance towards an uncooked offal-enriched minced meat product was significantly higher than offal. This could be explained by perceptions of the reputation of food, as previous work has shown that reputational beliefs and acceptance varied across preferred (i.e., pizza) and unpreferred food products (i.e., offal) (Cancellieri et al., 2022). Indeed, there were also notable differences in the expected characteristics of uncooked meat products in this study, whereby an offal-enriched meat product was expected to be tastier, more intriguing, satiating, familiar and convenient, albeit more impactful to the environment than offal (i.e., liver and kidney). Alternatively, offal was expected to be more natural. These findings suggest that including offal as an ingredient within a more familiar meat product could improve its reputation amongst UK consumers.

It could also be suggested that presenting images of uncooked offal may have elicited more negative evaluations. Indeed, previous work by Llauger et al. (2021) reported that barriers relating to the sensory properties of offal were exacerbated in its raw form. Whereas Bearth et al. (2021) reported that presenting appetising images of cooked offal did not influence participants' willingness to engage with animal by-products. These findings suggest that acceptance of offal is low amongst Western consumers, regardless of its depicted form (i.e., uncooked or cooked). This could be attributed to the ideation of eating organs as consumers typically reject food that resembles body parts (Toner, 2023; Henchion et al., 2016; Schroll, 2023), notwithstanding more familiar cuts of meat (e.g., chicken thigh) that may also resemble body parts but are likely more acceptable due to said familiarity. Therefore, the offal-enriched minced meat may have been preferred because the offal was concealed and presented in a more familiar format. However, future research should examine potential differences in acceptance and expected product characteristics for offal-enriched meat products and traditional minced meat without offal, as this was not examined in the current study.

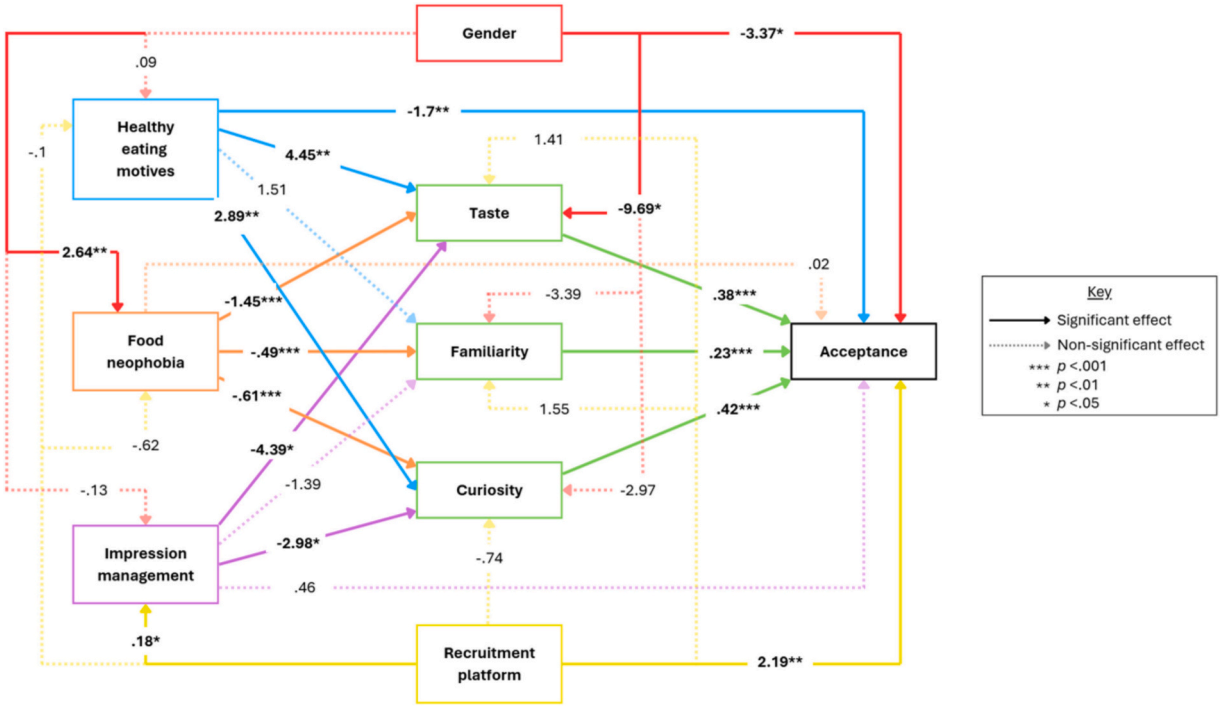

Fig. 3. Path model of the drivers of acceptance of offal-enriched meals. Significant effects are in bold text. Gender and recruitment platform were included as background confounders.

Regarding the drivers of acceptance, healthy eating motives was the only psychological characteristic to directly influence acceptance, indicating that participants who valued health were less accepting of cooked offal-enriched meals. Health and safety concerns over mixing offal with other meat was reported previously by Llauger et al. (2021). Although the current study also found that the indirect effect of healthy eating motives on acceptance was competitively mediated by expected taste, indicating that participants who valued health when choosing foods expected offal-enriched meals to be tastier and were therefore more accepting. This result could be interpreted through the 'intuition' that unhealthy foods are supposedly tastier than healthy foods (Raghunathan et al, 2006). For example, presenting a health claim (i.e., low sugar, light) lowered intentions to purchase a dessert because participants expected a 'healthier dessert' to be less tasty (Garaus et al., 2023). In this study, health-conscious participants may have expected offal-enriched meals to be tastier due to the assumption that such meals would be unhealthy. Alternatively, participants who were not health conscious may not have scrutinised the potential healthiness of offal-enriched meals and therefore, were less susceptible to the unhealthy-tasty intuition. Instead, these participants may have been less accepting of offal-enriched meals because they were guided by other psychological characteristics (e.g., food neophobia, impression management). Taken together, these findings can inform package design and product marketing to ensure that health and taste cues are balanced (Li et al., 2024).

Considering the indirect effects, curiosity was a competitive mediator of the relationship between health motives and acceptance. This meant that consumers who valued health were significantly more curious about trying offal-enriched meals and were significantly more accepting as a result. Previous research has demonstrated that curiosity could influence one's desire to seek information, despite potential negative consequences (FitzGibbon et al., 2020; Wang, 2019). Notably, Polman et al. (2022) found that curiosity can incentivize decisions that are less appealing but provide long-term benefits. In a grocery store field experiment, Polman et al. (2022) examined whether fruit and vegetables purchases were influenced by the curiosity to seek an answer to a joke. Specifically, placards were placed near fruit and vegetables that displayed a joke. The joke punchline was printed on bag closures that were placed in a plastic cup next to the placard. Compared to the pre-intervention phase and a separate control grocery store, fruit and vegetable sales significantly increased by 10 %. Taken together, these findings highlight the importance of curiosity for motivating engagement with offal-enriched meals. However, if the consumers' initial experience is not satisfying, then it is unlikely that the food will be eaten again. Therefore, it is essential that offal-enriched meals are as enjoyable as conventional meals to achieve continued consumption.

Another indirect effect was found for expected taste and curiosity as complete mediators of the relationship between impression management and acceptance. This indicated that participants who presented themselves in a socially desirable manner were less accepting of cooked offal-enriched meals due to lower expected taste and curiosity. Impression management has been shown to influence sustainable food choices. For instance, these foods are typically more expensive so could be used to signal socioeconomic status (Folwarczny et al., 2023; McCarthy et al., 2020). According to previous work, offal could represent an indicator of poverty and luxury (Lloyd, 2012; Toner, 2023). In the current study, participants may have expected that eating offal-enriched meals would have led to unfavourable judgements from others, so they may have rated meals more negatively to align with how they think others would have rated the meal. Another explanation by McCorkindale (1992) is the concept of socially constructed tastes which suggests that food perceptions (e.g., good or bad, masculine or feminine) depends on cultural context. For example, McWilliams (2017) reported that Japanese consumers believed that the most undesirable foods provided the most potent health qualities and that eating offal improved their energy levels and skin elasticity. McCorkindale (1992) suggests that many of these beliefs are learned during childhood when children become accustomed to eating food that is deemed culturally appropriate. Indeed, traditional Japanese feeding practices expose children to a varied diet which also promotes a flexible taste palate (Freeman., 2016). Therefore, the taste of offal is more likely to be accepted in these cultures. Generally, these findings suggest that promoting the health

benefits of offal may be important to persuade consumers. However, rejection will be inevitable unless social barriers are addressed. A future study could examine the importance of situational context to consumers. For instance, does the willingness to try offal-enriched meals vary within social settings and venues (i.e., with who or where the meal being consumed).

The final indirect effect in this study was that participants with higher food neophobic traits were less accepting of cooked offal-enriched meals because they were expected to be less tasty, familiar and participants were also less curious about trying meals. The indirect effect of food neophobia has been reported in the literature for various foods (Embling et al., 2022; Siegrist & Hartmann, 2020; Sabbagh et al., 2023). The purpose of food neophobia is to prevent the consumption of foods that are potentially harmful (Dovey et al., 2008). However, a food can become more acceptable by repeated consumption and through the process of learned safety (Kalat & Rozin, 1973). Repeated exposure increases familiarity and improves knowledge on the food's appearance, taste and context (i.e., how it should be presented) (Aldridge et al., 2009). In this study, cooked offal-enriched meals were rated somewhat familiar on average. Considering this, the presence of offal could have mediated perceptions of familiarity which may explain why participants expressed higher food neophobic tendencies. The importance of familiarity was also demonstrated by Lavranou et al. (2023) who reported that using beef liver in foods was rated more positively than lung (i.e., an unfamiliar ingredient). However, attitudes and acceptance of both organs were higher when participants were informed of the health and environmental benefits of offal. This suggests that highlighting product benefits could be effective to overcome the initial food unfamiliarity. Information on the benefits of eating offal were not provided in the current study. Therefore, future research could examine which benefits (e.g., health, low price, high protein) would be considered most important for the selection of an offal-enriched meal over a conventional meal without offal.

Gender differences were prevalent across our analyses. While uncooked offal-enriched mince was rated similarly between male and female participants, uncooked offal was rated more negatively by female participants, compared to male. Turning to the drivers of cooked offal-enriched meals, being male was associated with greater expected taste and acceptance. Whereas being female was associated with higher food neophobia. Taken together, these findings indicate that offal is more acceptable to males than females, regardless of how it is presented (i.e., in its natural form or concealed with other meat cuts within a cooked meal). Other studies have also found similar gender differences in reported perceptions and consumption of offal (Llauger et al., 2021; Sabbagh et al., 2023; Wu et al., 2023). Hopwood et al. (2024) attempts to explain this phenomenon through a 'paradoxical gender effect', whereby gender differences in psychological characteristics are prominent in more developed countries that also have greater gender equality. In these countries, differences in reported meat consumption were driven by increased consumption in men. This interpretation may be relevant to the current study as males were also more accepting and reported more positive perceptions than females. Consequently, these findings highlight an opportunity for a targeted intervention around offal consumption, based on gender. As males are typically less accepting of a plant-based dietary pattern (Rosenfeld and Tomiyama, 2021), this could be a key strategy to improve male engagement with more sustainable diets.

Acceptance and expected characteristics differed according to meal type. For instance, the spaghetti bolognese was more acceptable to participants than other meals, whereas the curry and the shepherd's pie were less acceptable to participants than other meals. Other studies have also reported differences in perceptions and acceptance across food types (Lu et al., 2024; Murillo et al., 2023). For instance, seafood byproducts were rated most appropriate for fish-based products and seasoning mixes, whereas drinks, confectionary and dairy products were considered the least appropriate (Murillo et al., 2023). Both the current and previous findings highlight the importance of examining a range of foods. This is necessary to understand the type of products that consumers would be willing to engage with. For example, as acceptance was highest for the spaghetti bolognese, a future study could conduct sensory testing to examine preferences for various offal-enriched minced meat-based products (e.g., chilli con carne, tacos). Similarly, offal from a range of animals could be tested to identify flavour preferences.

Although our findings have made a novel contribution to the offal literature, the limitations must be acknowledged, particularly with the study design, research sample and the sampling methods. Firstly, perceptions of uncooked offal-enriched meat products and cooked offal-enriched meals were obtained through images alone. This is a limiting factor because the importance of sensory attributes beyond appearance (i.e., meat quality, tenderness, aroma, colour) could not be assessed. Additionally, this study was based on self-reported acceptance, which limits the ecological validity of our findings because people do not always follow through with what they say or how they think they will behave in a situation (Baumeister et al., 2007). Indeed, a previous field study compared ratings of two beer samples before and after tasting. Prior to tasting, there were no expected differences in the sensory properties of the beer. However, after tasting the beer, participants reported significant differences between the two samples for experienced sourness (Rolschau et al., 2020). Although the self-reported acceptance of offal-enriched minced meat was higher than offal alone, this does not mean that participants would eat the product when given the opportunity. Additionally, expectations may have differed in a more realistic setting (i.e., a supermarket or food festival) where products are typically viewed prior to purchase or consumption (Otterbring et al., 2023). Relating to this limitation was the use of expected liking as one of the indicators of acceptance. Ratings of expected liking can significantly differ to actual liking (Bolos et al., 2021). We could not assess this relationship, as participants did not taste meals. Nevertheless, measures of the emotional, conceptual and situational associations with offal-enriched meals could be better predictors of behaviour (Giacalone et al., 2022). Another limitation of the design was the selection of brief measures to examine psychological characteristics, as our initial conceptual model was broad. However, these measures may not adequately reflect the underlying complexities of food motives. Also, there were some notable limitations with the research sample due to the recruitment platforms used. For example, approximately 53.6 % of participants were students or from Prolific (i.e., an online platform). These samples may not represent the views of target customers that are accessible within field settings (Otterbring et al., 2023; Pham, 2013). Additionally, 64 % of the sample was aged between 18 and 39, indicating that the sample contained primarily younger adults. However, if more older adults were surveyed, the observed differences may have been smaller due to greater preferences for offal in its original form. Indeed, research has shown that older consumers are typically more positive about the practice of nose-to-tail eating (Tucker, 2014; Randall & Smith, 2025). Also, it is possible that offal would have been more familiar than other meals (e.g., burger, stir-fry). Consequently, additional research is needed to determine whether the identified mechanisms in this study are also applicable to an older population and a non-student sample. Furthermore, targeting a sample with one recruitment platform that was representative of the UK population in terms of age, gender and ethnicity could have improved the generalisability of the current findings. Finally, a considerable number of participants were excluded from the data analysis due to participants not completing the survey or for not eating meat in their diet. This could be attributed to the survey length and repetitive nature of the rating tasks. The completion rate and response quality could have been improved by including less measures that were more detailed.

5. Conclusions

Offal has the potential to contribute to a more sustainable food

system, but it is not yet understood how we can improve acceptance within UK consumers. We addressed this by examining whether the inclusion of offal within an uncooked meat product was more acceptable than offal in its typical form. Additionally, we explored the factors that influenced offal acceptance within the context of an ingredient within a cooked meal. Notably, acceptance of an uncooked offal-enriched meat product (e.g., minced meat) was significantly higher than offal. Furthermore, acceptance of cooked offal-enriched meals was higher for health-conscious consumers because they expected that these meals would be tasty and intriguing. Whereas acceptance of cooked offal-enriched meals was lower for participants with neophobic traits because they were less familiar with meals and expected them to be less tasty and intriguing. Finally, acceptance was reduced in consumers with higher traits of impression management because they also expected cooked offal-enriched meals to be less intriguing and tasty. Our findings highlight that in order to convert curiosity into regular consumption; it is essential that the consumers' initial experience with offal is enjoyable and not deemed abnormal. This could be achieved through cooking demonstrations with professional chefs. Also, increasing public media and consumer education could address potential misconceptions towards offal as a food source. Indeed, mixed offal products may be an important avenue to engaging consumers who are not willing to adopt a more plant-based diet to engage with sustainability.

CRediT authorship contribution statement

Tennessee Randall: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Louise Neilson:** Writing – review & editing. **Menna Price:** Writing – review & editing. **Charlotte A. Hardman:** Writing – review & editing. **Laura L. Wilkinson:** Writing – review & editing, Supervision, Conceptualization.

Ethical statement

1. Ethical approval for the involvement of human subjects in this study was granted by Swansea University Research Ethics Committee, Reference number 42023 8008 7149, dtd 11/15/2023.
2. Participants gave informed consent via the statement "I am aware that my responses are confidential, and I agree to participate in this survey" where an affirmative reply was required to enter the survey. They were able to withdraw from the survey at any time without giving a reason.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Laura L Wilkinson reports a relationship with Mondelez International that includes: funding grants. Menna Price reports a relationship with Mondelez International that includes: funding grants. Tennessee Randall reports a relationship with Economic Social Research Council Wales Doctoral Training Partnership that includes: funding grants. Charlotte A Hardman reports a relationship with American Beverage Association that includes: funding grants. Charlotte A Hardman reports a relationship with International Sweeteners Association that includes: consulting or advisory and speaking and lecture fees. Louise Neilson reports a relationship with BIC Innovation Ltd. that includes: non-financial support. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodqual.2025.105710.

Data availability

Data will be made available on request.

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