April 2026

Phase 4 – Consumer Acceptance of Upcycled Food

2.4.2 Accelerating Food Transformation

ENDFOODWASTE COOPERATIVE RESEARCH CENTRE

Australian Government
Department of Industry, Science and Resources

AusIndustry
Cooperative Research Centres Program

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Executive Summary

A new category of food products, known as "upcycled food" or "food waste valorisation," has emerged to address the growing issue of organic food waste. Upcycled food involves transforming surplus and waste food into new, value-added products. Consumer acceptance of upcycled food, however, remains a significant barrier to the potential of upcycled food to reduce food waste. While there is emerging research that focuses on understanding the factors that support consumers' uptake of upcycled food, relatively little is known about Australian consumers' response to upcycled food. This research examines Australian consumer perspectives on three types of upcycled food: food from excess or surplus (e.g., vegetable powder from unsellable vegetables), food nearing its date label (e.g., breadcrumbs from near-expiry bread), and food from previously inedible by-products (e.g., snack bars from coffee fruit).

The research methodology included six focus groups with 45 Australian consumers to explore factors that may influence their acceptance of upcycled food. Additionally, an approximately nationally representative (on the parameters of age, gender, and place of residence) online survey with 2,557 Australians was conducted to generalise the findings from the focus groups.

The findings reveal that consumer awareness and knowledge of upcycled food are generally low, with only 31.7% of Australian consumers aware of the term 'upcycled food'. Awareness levels in Queensland are approximately 28%. The term 'upcycled food' was preferred by 45.7% of consumers, indicating a general acceptance of the terminology, though the focus group data highlight that some consumers questioned whether upcycled foods needed to be labelled as such or whether upcycling was simply the responsible use of resources in the food supply chain.

Consumers expressed a preference for upcycled food to contain over 50% upcycled ingredients. The research also highlighted better market opportunities for plant-based upcycled foods in categories such as breakfast foods, baked goods, snacks, pastas, sauces, and soups, as opposed to upcycled foods or ingredients made from animal-based foods or ingredients.

Overall, on average, consumers demonstrated a positive intention to purchase upcycled food, particularly those made from surplus products, as opposed to food nearing its date label or food previously thought to be inedible. The research also found that younger, female, and higher-educated consumers are more likely to purchase upcycled food.

Consumers generally thought upcycled food would offer environmental benefit over and be less costly than conventional food alternatives, while being safe to consume. However, while environmental benefit was found to support consumers' intention to purchase upcycled food, it was not a strong determinant of consumers' willingness to pay the same price for upcycled food as their conventional food counterparts. Overall, there is a high level of price sensitivity among consumers, with many expecting upcycled food to be cheaper than conventional alternatives. The results suggest that enhancing the perceived quality of upcycled food supports consumers' willingness to pay the same price as they would for conventional food.

Consumers identified several strategies they thought would increase their intention to purchase upcycled food including price discounting, clear labelling of upcycled ingredients in upcycled food products, an upcycled food certification program, a clearer definition of upcycled food, public education/advertising campaigns, and the availability of upcycled food in local supermarkets. Consumers thought that price discounting and clear labelling of the upcycled ingredients in upcycled food would be most effective.

The report highlights several considerations for the implementation of the aforementioned strategies to increase consumer acceptance of upcycled food. Certification programs, for example, need to consider consumer expectations that upcycled food should contain over 50% upcycled ingredients. In terms of public education/advertising campaigns, trusted sources of information for consumers that were identified include family, friends, research organisations, and government institutions. Focus group findings highlighted that some consumers did not believe that advertising campaigns were necessary, suggesting a focus on

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education about food safety standards around upcycled food instead. This finding could be related to consumers' expectation that they would encounter greenwashing about upcycled food.

Consumers on average were at least slightly willing to seek more information about upcycled food. Most of them wanted further information about upcycled food provided on the packaging of upcycled food (60.7%), on government websites (43.9%), on TV programs such as documentaries or investigative series (41.5%), and on retail signage (e.g., signage within a food retailer) (35.8%). Most consumers wanted to know more about food safety standards in relation to upcycled food (78.1%) and the type of ingredients used in upcycling (74.3%) with less interest in further information about the environmental benefits of upcycled food (57.9%) or the definition of upcycling (57.3%).

The report also identified several areas for future research to further support the development of the upcycled food sector, including:

- Investigating levels of consumer acceptance of different types of upcycled food;
- Profiling potential target audiences for different types of upcycled food;
- Message/information testing of the information provided to consumers; and/or
- Testing consumer price sensitivity for different types of upcycled food.

Overall, this research provides valuable insights for industry and government to develop strategies that enhance consumer acceptance and adoption of upcycled food products. However, the insights provided are drawn solely from the findings of the research conducted and as such, the operational environment and other relevant circumstances should be taken into account when considering any of the recommendations provided. Nonetheless, this report provides an important first step toward addressing Australian consumer concerns and preferences, with the goal of significantly reducing food waste and promoting sustainable consumption practices through the adoption of upcycled food.

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1. Introduction

A new category of food products has emerged as a solution to organic food waste in recent years. This new category is often referred to as “upcycled food” or “food waste valorisation” and involves the transformation of food surplus and waste into new, value-added products. This report is part of a research project investigating upcycled foods in Australia with a focus on the challenges and opportunities faced by the upcycled food sector. A key challenge that has been identified in emerging research is consumer acceptance of upcycled food. In particular, relatively little is known about Australian consumers’ response to upcycled food.

The aim of this research, which is Phase 4 of the broader research program entitled ‘Accelerating Food Transformation’, is to provide advice to industry and to government about consumer perspectives on upcycled food products including how best to develop consumer acceptance and adoption.

In this research, upcycled food is considered a food product for people containing ingredients that would otherwise be wasted or discarded, and includes the following:

1. Upcycled food that comes from excess or surplus food. For example, a vegetable powder that is made from excess vegetables that farmers can’t sell to supermarkets because they don’t look perfect although they are edible.
2. Upcycled food that comes from food that is safe to eat but nearing its date label. For example, bread nearing/passing its date label reprocessed into breadcrumbs.
3. Upcycled food which uses food components or by-products that were previously thought to be inedible. For example, a snack bar made from coffee fruit, which is the cherry covering the coffee bean that is often discarded during processing.

The research involved (a) six (6) focus groups with Australian consumers (n=45) to explore and develop an in-depth understanding of the factors impacting their acceptance of products created from food surplus or waste, followed by (b) an approximately nationally representative (on the parameters of age, gender and place of residence) online survey (n=2,557) to test the generalisability of the findings from the focus groups with a larger sample of Australian consumers.

The report is structured as follows. First, an overview of the data collection methods used is provided. Then, the findings from both the interviews and the survey are presented together. Finally, implications for supporting consumer acceptance are provided, followed by directions for future research.

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2. Data collection methods

This research employed a sequential qualitative-quantitative mixed method design. Employing a mixed method design is advantageous as different methods can be used to triangulate the findings. The first study comprised focus groups to develop an in-depth understanding of how consumers perceive upcycled food and the reasons for their acceptance or non-acceptance of upcycled food. A survey was then conducted to enable the results to be more generalisable to the Australian population. The methodology used for each of these studies is explained in more detail in the below sections.

The research received ethical clearance from the Queensland University of Technology's Human Research Ethics Committee (Ethics approval number LR 2024-8538-19217).

2.1 Focus Groups

A reputable market research agency was used to recruit participants for the focus groups. They contacted potential participants who were at least 18 years old and have some role in the food choices made by their household. Participants were eligible to participate if they indicated that they were either 'somewhat' or 'entirely' responsible for the types of food bought in their household. The focus groups were conducted via Zoom, an online video conferencing platform, and the sessions were video recorded for analytical purposes. On average, the focus groups lasted approximately 90 minutes.

2.1.1 Participants

A total of 45 consumers participated in six focus groups, each organised by age group: 18–24, 25–34, 35–44, 45–54, 55–64, and 65+ years old. Grouping participants by age enhances the quality of discussions, as individuals within similar age ranges often share common experiences, values, and perspectives. This approach fosters a comfortable environment, while also minimising potential barriers, such as generational differences, that could inhibit interaction or rapport within the group (Krueger, 2014). Table 1 provides further details about the participants. Sample was balanced in terms of gender (49% females, 49% males, 2% non-binary), with an average of 2.89 persons per household. Close to two-thirds of the participants were entirely responsible for food buying decisions in the household.

Table 1 Focus group participants' demographics

Participant Alias	Gender	Age Group	Level of influence on household food purchase decision	Resident state	Annual Income	No. of people in household
P1-F-18-24	Female	18-24 years old	Somewhat responsible	Queensland	More than AUD $200,000	4
P2-F-18-24	Female	18-24 years old	Somewhat responsible	Queensland	More than AUD $200,000	5
P3-M-18-24	Male	18-24 years old	Somewhat responsible	Victoria	Between AUD $30,000-$49,999	5
P4-M-18-24	Male	18-24 years old	Somewhat responsible	New South Wales	More than AUD $200,000	5
P5-M-18-24	Male	18-24 years old	Entirely responsible	New South Wales	More than AUD $200,000	3
P6-F-18-24	Female	18-24 years old	Somewhat responsible	Victoria	More than AUD $200,000	6
P7-M-18-24	Male	18-24 years old	Somewhat responsible	New South Wales	Between AUD $150,000-$199,999	4
P1-M-25-34	Male	25-34 years old	Somewhat responsible	Queensland	Between AUD $150,000-$199,999	4

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Participant Alias	Gender	Age Group	Level of influence on household food purchase decision	Resident state	Annual Income	No. of people in household
P2-M-25-34	Male	25-34 years old	Entirely responsible	Victoria	Between AUD $100,000-$149,999	2
P3-F-25-34	Female	25-34 years old	Somewhat responsible	Queensland	Between AUD $50,000-$79,999	3
P4-M-25-34	Male	25-34 years old	Entirely responsible	Queensland	Between AUD $100,000-$149,999	2
P5-F-25-34	Female	25-34 years old	Entirely responsible	New South Wales	Between AUD $50,000-$79,999	3
P6-F-25-34	Female	25-34 years old	Entirely responsible	New South Wales	Between AUD $150,000-$199,999	3
P1-F-35-44	Female	35-44 years old	Entirely responsible	Queensland	Between AUD $30,000-$49,999	1
P2-M-35-44	Male	35-44 years old	Entirely responsible	Queensland	Between AUD $100,000-$149,999	4
P3-F-35-44	Female	35-44 years old	Entirely responsible	Queensland	Between AUD $150,000-$199,999	4
P4-M-35-44	Male	35-44 years old	Entirely responsible	Victoria	Between AUD $100,000-$149,999	4
P5-NB-35-44	Non-binary /third gender	35-44 years old	Entirely responsible	Victoria	Less than AUD $30,000	1
P6-F-35-44	Female	35-44 years old	Entirely responsible	New South Wales	Between AUD $150,000-$199,999	2
P7-F-35-44	Female	35-44 years old	Entirely responsible	New South Wales	Between AUD $150,000-$199,999	2
P8-M-35-44	Male	35-44 years old	Entirely responsible	New South Wales	More than AUD $200,000	3
P1-M-45-54	Male	45-54 years old	Entirely responsible	Queensland	Less than AUD $30,000	3
P2-M-45-54	Male	45-54 years old	Entirely responsible	Queensland	Between AUD $150,000-$199,999	1
P3-F-45-54	Female	45-54 years old	Entirely responsible	Victoria	More than AUD $200,000	4
P4-F-45-54	Female	45-54 years old	Entirely responsible	Victoria	Between AUD $100,000-$149,999	2
P5-F-45-54	Female	45-54 years old	Entirely responsible	New South Wales	Between AUD $50,000-$79,999	3
P6-F-45-54	Female	45-54 years old	Entirely responsible	New South Wales	Between AUD $150,000-$199,999	4
P7-M-45-54	Male	45-54 years old	Somewhat responsible	Victoria	More than AUD $200,000	4
P8-M-45-54	Male	45-54 years old	Entirely responsible	Queensland	More than AUD $200,000	2
P1-F-55-64	Female	55-64 years old	Entirely responsible	Queensland	Between AUD $80,000-$99,999	2
P2-M-55-64	Male	55-64 years old	Entirely responsible	Victoria	Between AUD $150,000-$199,999	5
P3-M-55-64	Male	55-64 years old	Somewhat responsible	New South Wales	Between AUD $100,000-$149,999	2
P4-M-55-64	Male	55-64 years old	Entirely responsible	Victoria	Between AUD $100,000-$149,999	4
P5-F-55-64	Female	55-64 years old	Entirely responsible	Victoria	Between AUD $100,000-$149,999	2
P6-F-55-64	Female	55-64 years old	Entirely responsible	Queensland	Between AUD $80,000-$99,999	2

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Participant Alias	Gender	Age Group	Level of influence on household food purchase decision	Resident state	Annual Income	No. of people in household
P7-M-55-64	Male	55-64 years old	Somewhat responsible	Queensland	Between AUD $100,000-$149,999	2
P8-F-55-64	Female	55-64 years old	Entirely responsible	New South Wales	Between AUD $150,000-$199,999	3
P1-M-65+	Male	65+ years old	Somewhat responsible	Queensland	Between AUD $80,000-$99,999	2
P2-F-65+	Female	65+ years old	Entirely responsible	Queensland	Between AUD $80,000-$99,999	2
P3-M-65+	Male	65+ years old	Somewhat responsible	Victoria	Between AUD $30,000-$49,999	2
P4-F-65+	Female	65+ years old	Entirely responsible	New South Wales	Between AUD $50,000-$79,999	2
P5-F-65+	Female	65+ years old	Somewhat responsible	Victoria	Between AUD $50,000-$79,999	2
P6-F-65+	Female	65+ years old	Entirely responsible	Queensland	Between AUD $30,000-$49,999	1
P7-M-65+	Male	65+ years old	Somewhat responsible	New South Wales	Between AUD $80,000-$99,999	2
P8-M-65+	Male	65+ years old	Somewhat responsible	Queensland	Between AUD $100,000-$149,999	2

2.1.2 Interview Guide

The research team employed an interview guide when conducting focus groups among participants. The interview guide began with questions about participants' general understanding of upcycled food. This was followed by a definition and examples of upcycled food to ensure all participants shared the same understanding of the term. The subsequent questions explored participants' buying behaviours related to upcycled food, their willingness to pay the same price as conventional alternatives, perceived benefits and risks, and strategies to promote upcycled food acceptance.

2.1.3 Data Analysis

Focus group data analysis was conducted using NVivo 12 software, a qualitative data analysis tool that facilitates systematic organisation of textual data (Jackson & Bazeley, 2019). The data was categorised into pre-identified codes that aligned with the research objectives (e.g., 'perceived benefits of upcycled food', 'purchase intentions'). Subsequently, the data within the codes were analysed thematically to identify patterns that would provide insight into the development of the survey and address the research objectives.

2.2 Survey

This study was conducted to assess Australian consumers' awareness and perceptions of, as well as purchase intentions toward, upcycled food. An approximately nationally representative online survey was conducted to collect data from Australian consumers who are at least 18 years old and have some role in the food choices made by their household. Participants were eligible to participate if they indicated that they were either 'somewhat' or 'entirely' responsible for the types of food bought in their household.

2.2.1 Participants and Recruitment

Participants were recruited using the online consumer panel provider Dynata (https://www.dynata.com/). Data was collected online between 20th September 2024 and 10th October 2024. A total of 3,437 Australians participated in the survey. After data cleaning

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based on participants' age and their role in the household food decision-making, in addition to removal of incomplete responses, the sample size was reduced to 2,557 participants.

Overall, the sample (n=2,557) approximates national representativeness on the three demographic factors that were used to quota the sample: gender, age and place of residence.

The sample consists of 51.5% females, 48.1% males, and 0.4% identifying as non-binary. Comparatively, as per ABS data on 30 June 2023, Australia has 50.35% females and 49.65% males (Australian Bureau of Statistics, 2024).

The sample includes a diverse range of ages (see Table 2). A direct comparison with ABS data on the Australian population's age distribution is difficult owing to the exclusion from the survey, for ethical reasons, of people under the age of 18. Nonetheless, the sample provides a reasonable distribution across different age groups.

Table 2 Participants' age distribution compared to the Australian population

Participants' Age Groups			Population Age Groups	
Age (in years)	Count	%	Age (in years)	% of Total Population
18-24	302	11.8%	20-24*	6.5%
25-34	439	17.2%	25-34	14.7%
35-44	488	19.1%	35-44	14.0%
45-54	447	17.5%	45-54	12.4%
55-64	387	15.1%	55-64	11.4%
65 and above	494	19.3%	65 and above	17.1%
Total	2557	100%		76.1%

*ABS reports data in 15-19 and 20-24 age groups

Source: Australian Bureau of Statistics, National, state and territory population March 2024

Table 3 reports participants' place of residence, indicating that the sample included participants from all Australian States and Territories. A comparison of the sample with the Australian population suggest that the sample is reasonably representative.

Table 3 Participants' place of residence compared to the Australian population

Participants' Resident State			Population Distribution by State	
Participants' Place of Residence	Count	%	Population at 31 March 2024 ('000)	% of Total population
Australian Capital Territory	50	2.0%	472.8	1.7%
New South Wales	812	31.8%	8,469.6	31.2%
Northern Territory	19	0.7%	254.3	0.9%
Queensland	523	20.5%	5,560.5	20.5%
South Australia	180	7.0%	1,873.8	6.9%
Tasmania	51	2.0%	575.7	2.1%
Victoria	666	26.0%	6,959.2	25.7%
Western Australia	256	10.0%	2,951.6	10.9%
Total	2557	100%	27,122.4	100.0%

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Source: Australian Bureau of Statistics, National, state and territory population March 2024

Approximately 41% of the sample held a Bachelor's degree or higher (see Table 4). In contrast, only 26.4% of the sample had completed schooling up to secondary school only.

Table 4 Participants' educational level

Participants' Education Level		
	Count	%
Primary	10	0.40%
Some Secondary	177	6.90%
Secondary	488	19.10%
Vocational or similar	617	24.10%
Some University but no degree	219	8.60%
University -Bachelor's degree	766	30.00%
Graduate or Professional degree	268	10.50%
Prefer not to say	12	0.50%
Total	2557	100%

In terms of income, Table 5 shows that around 25.5% of participants reported earning less than A$50,000 annually, while nearly 38% had an annual income exceeding A$100,000.

Table 5 Participants' income level

Participants' Income in last 12 months		
	Count	%
Less than A$30,000	299	11.7%
Between A$30,000 - $49,999	356	13.9%
Between A$50,000 -$79,999	540	21.1%
Between A$80,000 - $99,999	394	15.4%
Between A$100,000 - $149,000	511	20.0%
Between A$150,000 - $199,999	271	10.6%
More than A $200,000	186	7.3%
Total	2557	100%

Figure 1 illustrates the household size of participants in the sample. The largest group consists of two-person households, making up 34.5% of the sample, followed by three-person households at 19.9%. Nearly the entire sample (91%) comprises households with one to four members, who live together for at least half of the time.

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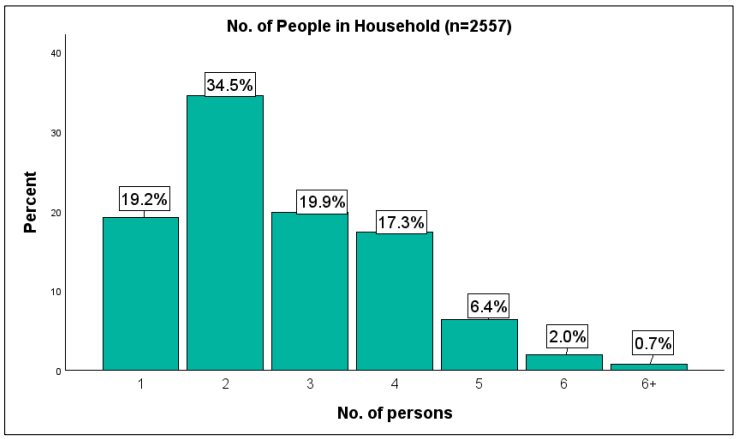

Figure 1 Number of people living or staying in the household at least half the time

Figure 2 shows the number of children under 18 living in participants' households. Almost two-thirds of the sample (66.8%) reported having no children, while 17.9% had one child and 11.5% had two children.

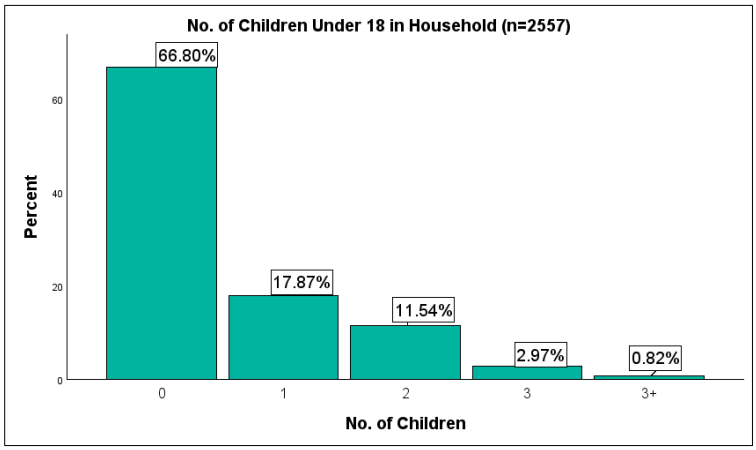

Figure 2 Number of children under the age of 18 living in the household

2.2.2 Survey Questions

The survey comprised several sections to capture participants' awareness, perceptions, and purchase intentions related to upcycled food. The initial section filtered out ineligible participants based on age and the extent to which they influenced the food purchased for their household. The next section collected demographic information including participants' age group, gender, and state of residence. Quotas were set on these demographic variables to ensure that the sample approximated national representativeness. Subsequent sections assessed participants' unprompted and prompted awareness of the term 'upcycled food', their perceived familiarity with the concept of upcycled food, and then their self-reported knowledge about upcycled food. Participants were asked to share their preferred terminology for upcycled food, their perceptions of its environmental, health, and product-related benefits as well as risks, and their attitudes towards purchasing upcycled food. The survey then measured their willingness to pay for upcycled food, their purchase intentions across various upcycled food categories, and explored their opinion about factors that could enhance consumer acceptance of upcycled food, such as public education campaigns and certification

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programs. Finally, data on participants' preferred sources of information about upcycled food (e.g., food packaging, magazines, social media) were collected.

2.2.3 Data Analysis

Data analysis was conducted using IBM SPSS v29.0 and SmartPLS software. A comprehensive analytical approach was employed to examine the data and derive key insights. Descriptive analysis was conducted to summarise key trends and participant characteristics, while frequency distribution analysis provided insights into varying levels of responses that existed among the participants. Chi-square analysis was used to assess differences in responses across demographic groups, and multiple response analysis was applied to evaluate patterns in participants' selections of more than one choice in a question. Independent samples t-tests and analysis of variance (ANOVA) tests were performed to compare means across different groups. Additionally, Partial Least Squares Structural Equation Modelling (PLS-SEM), a technique widely used for its flexibility in estimating relationships between different variables of the model (Hair et al., 2019), was utilised to explore relationships between variables, providing a robust framework for understanding determinants of consumers' purchase intentions and willingness to pay for upcycled foods. Across the analyses, $p<0.05$ were considered significant.

3. Findings

The following sections outline outcomes of the two studies described in the Methodology section of the report. The findings of the studies are presented together, with findings from the focus groups used to provide deeper insight into the results obtained from the more generalisable statistical analysis of the survey.

3.1 Consumer awareness of and knowledge about upcycled food

This section presents findings related to the level of consumer awareness of upcycled food in Australia, including how much consumers report they know about upcycled food.

Key takeaway/s:

- There is low consumer awareness of upcycled food, with 68.3% of participants indicating they had not previously heard of upcycled food.
- Almost half of participants that reported being familiar with upcycled food misunderstood the meaning of the term.
- Awareness of upcycled food was higher in younger age groups, for males, and for those living in New South Wales and Victoria.
- Familiarity with the concept of upcycled food, even if participants were not aware of the term 'upcycled food', was also low.
- The largest group of participants (45.7%) indicated they thought 'upcycled food' was the most appropriate label for this food category.
- Focus group findings suggest that some participants question the need for bespoke terminology (i.e., upcycled food).

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3.1.1 Awareness of the term ‘upcycled food’

The survey asked participants: ‘Have you ever heard of the term ‘upcycled food’? This question was asked without an explanation of what the term means to determine ‘unprompted’ awareness of upcycled food. The majority (68.3%) of the people surveyed (n=2,557) were unaware of the term 'upcycled food' (*Figure 3*).

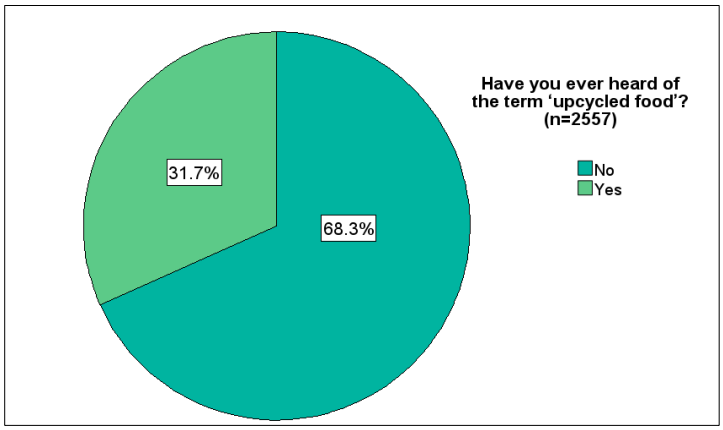

Figure 3 Unprompted awareness of upcycled food

3.1.2 Awareness of the term ‘upcycled food’ across groups

The data analysis revealed some differences in awareness levels across different groups within the sample. The following sections outline those differences.

3.1.2.1 Age

Participants' unprompted awareness of upcycled food varied significantly across age groups [$\chi^2(5, 233.07)$ $p<.001$)]. There is a tendency toward a decline in awareness as age increases (Figure 4).

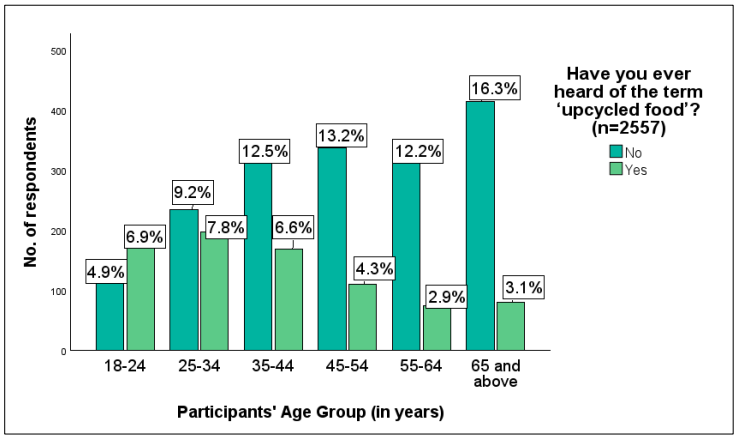

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Figure 4 Participants' awareness of upcycled food: Differences between age groups

3.1.2.2 Gender

In terms of participants' gender, males exhibit a slightly higher awareness of upcycled food as compared to females [$\chi^2(1, 8.7)$ p=.003)] (Figure 5).

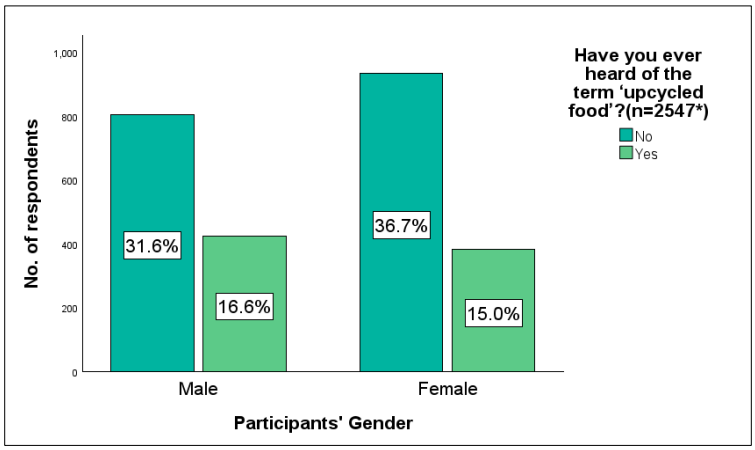

Figure 5 Participants' awareness of upcycled food: Differences between sexes

**Ten participants reported gender as non-binary, who are excluded from this analysis owing to the very small sample size.*

3.1.2.3 Place of Residence

The analysis shows that awareness of the term upcycled food varies significantly across the states and territories within Australia [$\chi^2(7, 42.29)$ p<.001)]. For instance, the awareness levels are greater than 30% in New South Wales and Victoria and less than 20% in Tasmania. The data shows that awareness levels in Queensland are approximately 28% (Table 6).

Table 6 Participants' awareness of upcycled food: Differences between places of residence

	Have you ever heard of the term 'upcycled food'?				
	No		Yes		Total
Place of Residence	N	%	N	%	N
Australian Capital Territory	37	74.0%	13	26.0%	50
New South Wales	492	60.6%	320	39.4%	812
Northern Territory	15	78.9%	4	21.1%	19
Queensland	375	71.7%	148	28.3%	523
South Australia	134	74.4%	46	25.6%	180
Tasmania	41	80.4%	10	19.6%	51
Victoria	456	68.5%	210	31.5%	666
Western Australia	197	77.0%	59	23.0%	256
Total	1747	68.3%	810	31.7%	2557

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3.1.3 Knowledge about upcycled food

Among those aware of the term ‘upcycled food’ (n=810, 31.7%), their self-reported level of knowledge varied significantly, ranging from minimal to extensive (Figure 6). Of those familiar with the term, 53.5% (n=433) rated their knowledge between 1 and 4 on a 7-point scale, indicating that they thought that they limited knowledge about upcycled food. In contrast, only around 21% (n=173) reported having substantial knowledge about upcycled food (Mean=4.28, Standard Deviation=1.51).

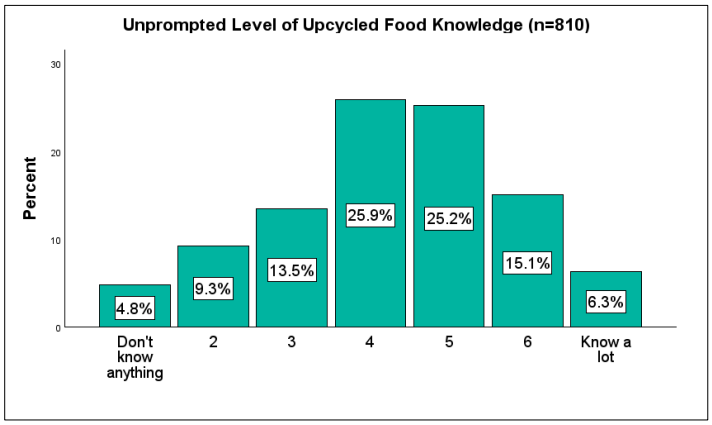

Figure 6 Levels of knowledge about upcycled food among participants who heard the term before

Among participants familiar with the term 'upcycled food' (n=810), their understanding of its meaning also varied. Figure 7 illustrates that a significant proportion (50.9%) of those participants that reported being familiar with the concept misunderstood the meaning of the term. Most of these participants associated upcycled food with surplus food donated to charities for distribution to those in need (39.5%).

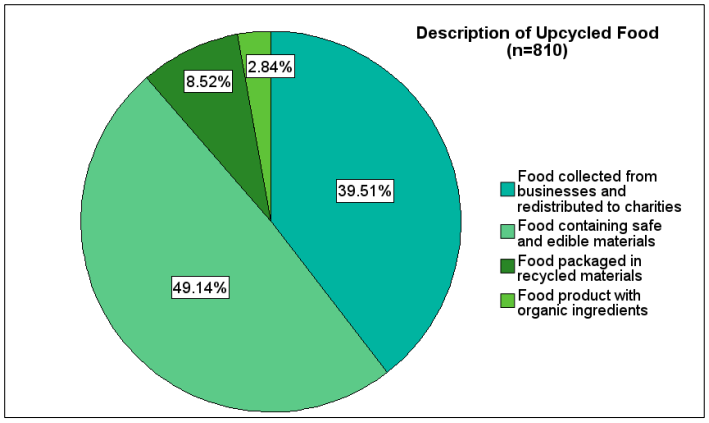

Figure 7 Understanding of upcycled food by participants who heard the term before

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3.1.4 Consumer familiarity with the concept of upcycled food

All participants were provided with an explanation of the concept of upcycled food and subsequently asked whether they were familiar with the concept even if they did not know the term before they started the survey. Their response was measured on a 7-point scale from 'Not familiar at all' to 'Extremely familiar'. Participants were provided with the following information:

> Upcycled food is generally considered a food product for people containing foods that would otherwise be wasted or discarded. There are different types of upcycled food.
>
> 1. There is upcycled food that comes from excess or surplus food. For example, **a vegetable powder that is made from excess vegetables that farmers can't sell to supermarkets** because they don't look perfect although they are edible.
> 2. There is upcycled food that comes from food that is safe to eat but nearing its date label. For example, **bread nearing/passing its date label reprocessed into breadcrumbs**.
> 3. There is also a type of upcycled food which uses food components or by-products that were previously thought to be inedible. For example, **a snack bar made from coffee fruit**, which is the cherry covering the coffee bean that is often discarded during processing.

Familiarity with the concept of upcycled food was generally low (Mean=3.64, Standard Deviation=1.87). As shown in Figure 8, 62.1% of participants rated their familiarity between 1 and 4, indicating limited familiarity with the concept of upcycled food, while only 17.3% rated their familiarity between 6 and 7, indicating higher levels of familiarity with the concept.

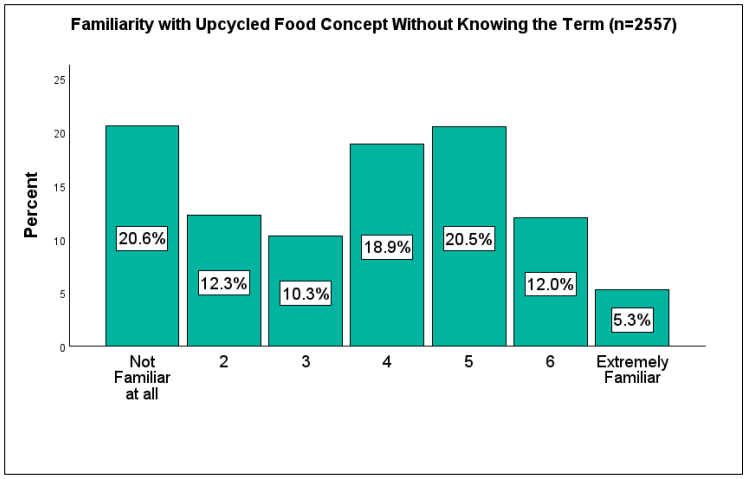

Figure 8 Familiarity with the concept of upcycled food without knowing the term

3.1.5 Consumers' preferred term for upcycled food

When participants were asked to indicate their preferred term to describe the concept of upcycled food, the responses were divided across several options. As shown in Figure 9, while the largest segment of the sample favoured 'upcycled food' as the term they preferred (45.7%), a notable portion of the sample (54.3%) preferred alternative terms. For example, 'Rescued Food' was selected by 16.5% of participants, followed by 'Recycled Food' (12.9%). A small component of the sample (2.6%) preferred their own

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terminology rather than the options provided to them, such as ‘repurposed food’ (mentioned by multiple participants), ‘smart food’, ‘reformed produce’, ‘value-added food’, ‘waste-not food’, ‘reusable food’, ‘left-over food’, ‘excess-cycled food’, ‘refurbished food’, ‘salvaged food’, ‘zero waste food’, ‘recertified food’, and ‘holistic food’.

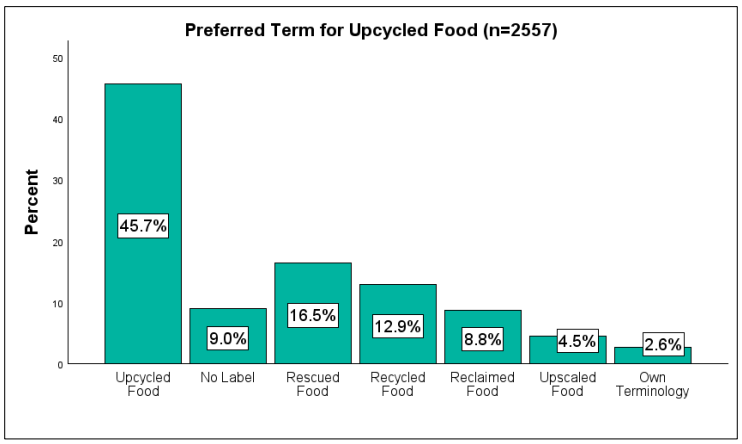

Figure 9 Preferred term for upcycled food

Interestingly, around 9% of participants felt there was no need for a specific term to describe upcycled food. The analysis of the focus group data suggests several reasons for this preference not to label upcycled food as such. First, some participants thought that it may avoid triggering food neophobia i.e., the reluctance to try new food.

> *Just call it food, don’t call it upcycling. Just call it food. When it's just basic products from a farm, I think that’s better than saying, we’re doing something different, it's just a food product. P8-M-45-54*

> *It's just the term. If they don't tell me it's upcycled, I'm going to eat it without thinking. If it's labelled food, I'm going to eat it, but just the term, it's just negative to me. It throws me off. P8-M-65+*

Second, there was also a sense that labelling upcycled food as such could have unintended consequences like increasing or decreasing the price of upcycled food.

> *My biggest concern would be whether as soon as someone slaps on an upcycled sticker on it, I'm going to pay more for it. P7-M-45-54*

> *If it was all Australian byproducts, that's fine, and then price, is the price going to be cheaper because it's food that's been re-upcycled, or is it going to be more expensive, because they've gone into more work to upcycle it. P2-F-65+*

There was also some acknowledgement from participants, particularly some older participants, that the concept of upcycling food at a household level was not foreign to them and as such, did not necessarily need bespoke terminology. Often these participants also highlighted that upcycling was simply the responsible use of resources in the food supply chain.

> *Yeah, I just wanted to say from the start, that's all been done. My grandmother used to, and people of her era because they went through the War and the Depression and everything, everything was upcycled, everything was recycled. So, it's not actually a new concept. It's just being made out to a broader audience to try to get*

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people. I know us older ones probably do it, but I'm not too sure how you would grab the young ones into buying foods like that. I don't know whether they'd go, ew. P2-F-65+

3.2 Consumer expectations of upcycled food

This section presents findings related to the expectations that consumers have about upcycled food in Australia, including the composition of upcycled food and the perceived suitability of different product categories for upcycling.

Key takeaway/s:

- On average, participants indicated that they thought a food product should consist of approximately 58.6% upcycled ingredients to be labelled 'upcycled food'.
- Similarly, participants on average indicated that they would expect an ingredient to contain around 59.3% upcycled content to qualify as an 'upcycled ingredient'.
- Over two-thirds of participants supported the upcycling of plant-based ingredients, while animal-based categories received the least support.
- More than half of the participants view breakfast foods, baked foods, snack foods, pastas, sauces, and soups as products they perceived to be suitable to contain upcycled ingredients.

3.2.1 Expectations about upcycled food composition

Participants were asked to indicate the percentage of upcycled ingredients required for a food product to be considered 'upcycled.' Similarly, they were asked how much upcycled content an ingredient should contain to be labelled as an upcycled ingredient. Their responses were measured on a sliding scale from 0-100%.

On average, participants indicated that a food product should consist of approximately 58.6% upcycled ingredients to be labelled as 'upcycled food', though responses varied widely (Median=60%, Standard Deviation=23.6%). Likewise, they felt that an ingredient should contain around 59.3% upcycled content to qualify as an upcycled ingredient, again with considerable variability in responses (Median=60%, Standard Deviation=25.1%).

3.2.2 Perceived suitability of products for upcycling

Participants were asked to identify which food categories they consider suitable for upcycling, with the option to select multiple categories.

On average, participants selected four categories from the nine provided. The data shows that a substantial majority of participants view vegetables (73.4%), cereal (69.6%), and fruits (68.9%) as the most suitable ingredients for upcycling, with over two-thirds of participants supporting these categories (Table 7). In contrast, meat (32.4%) and fish (25.5%) were perceived as the least suitable for upcycling. This is consistent with the focus group findings, where participants reported varying levels of comfort with upcycled food determined in part by the type of upcycled product:

It would depend on what the product was. There are some products that I would eat upcycled and some that I probably wouldn't. P2-F-65+

Notably, nearly 10% of participants believed that none of the listed food categories are appropriate for upcycling, indicating a small portion of consumers who remain sceptical about the concept.

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Table 7 Food categories selected by participants as suitable for upcycling

Food category	% of sample that selected food category
Fish	25.5%
Cereal	69.6%
Dairy	36.5%
Oilseed	49.4%
Meat	32.4%
Fruit	68.9%
Vegetable	73.4%
Spent grain	54.9%
None of the above	10.1%

Participants were asked to select the food categories they consider suited to containing upcycled ingredients, with the option to select multiple categories.

On average, participants selected 4.5 categories from the 11 options provided. The data shows that more than half of the participants view breakfast foods, baked foods, snack foods, pastas, sauces, and soups as suitable to contain upcycled ingredients. In contrast, dairy, meat and fish were perceived as the least suitable (Table 8). Notably, 13.5% of participants believed that none of the listed food categories are appropriate for reintroducing upcycled ingredients, reiterating again that a small portion of consumers are sceptical about the concept.

Table 8 Food categories selected by participants as suitable for reintroduction of upcycled ingredients

Food category	% of sample that selected food category
Breakfast foods (e.g., cereals, granola, porridge)	55.7%
Sauces (e.g., jams, chutneys, pasta sauces)	54.0%
Dairy products (e.g., yogurts, cheeses, ice-creams)	29.5%
Soups (e.g., including broths and stocks)	50.3%
Meat products (e.g., chicken nuggets, meatballs, deli meats)	26.5%
Snack foods (e.g., sweet and savoury snacks such as cereal bars, crisps, crackers, sweets)	54.8%
Baked foods (e.g., biscuits, muffins, breads)	55.6%
Fish products (e.g., fish balls, canned fish)	22.6%
Drinks (e.g., smoothies, juices, soft drinks, alcoholic drinks)	36.5%
Pastas (e.g., dry pasta, noodles)	54.6%
None of the above – I do not like the concept of upcycled food	13.5%

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3.3 Consumers' perceptions of the characteristics of upcycled food

This section presents findings related to the perceived characteristics of upcycled food, that is, it examines consumers thoughts about the attributes possessed by upcycled food.

Key takeaway/s:

- Participants on average thought upcycled food would offer environmental benefit, be safe to consume, and be less costly than conventional food alternatives. Environmental benefit was seen as the defining characteristic (of those tested) of upcycled food.
- Relative to other characteristics, participants thought upcycled food would offer lower health benefits and be lower quality—although it is important to note that participants on average did not think upcycled food would be unhealthy or low quality.
- In terms of the potential environmental benefits provided by upcycled food, analysis of the focus group data suggests many participants considered the "whole-of-product-life" environmental impact of upcycled food.
- In terms of the health benefits and quality of upcycled food, analysis of the focus group data indicates that there is some concern about the effects of additional processing on the nutritional value of the food and the number of preservatives in upcycled food.
- Participants generally appear to trust the food safety standards in Australia and their application to upcycled food.

3.3.1 Comparison of the perceived characteristics of upcycled food

Participants were asked to indicate their level of agreement that upcycled food provides environmental benefit and health benefit, and are high quality, taste good, lower cost compared to conventional food, and safe. Their responses were measured on a 7-point scale ranging from 'completely disagree' to 'completely agree'.

Table 9 shows the averages and standard deviations for each characteristic measured. On average, most participants agreed that upcycled food would benefit the environment (e.g., upcycled food would reduce waste, be processed in an environmentally friendly way, and lower resource consumption). The analysis revealed that the average score for the perceived environmental benefit of upcycled food differed significantly from all other characteristics (all $p<.001$). This indicates that it was the characteristic most commonly and positively associated with upcycled food when compared to the other five characteristics tested.

Table 9 Perceived characteristics of upcycled food

Upcycled Food Characteristic	Mean	SD
Environmental Benefits	5.40	1.04
Health Benefits	4.79	1.08
Food Safety	5.04	1.10
Quality	4.73	1.30
Taste	4.94	1.23
Less Costly	5.02	1.31

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Participants on average also rated the perceived food safety of upcycled food—such as being low in additives, free from contamination, and made with safe ingredients—positively. This was closely followed by the perception that upcycled food would cost less compared to conventional food (e.g., upcycled food would be priced lower than conventional food) (Figure 10).

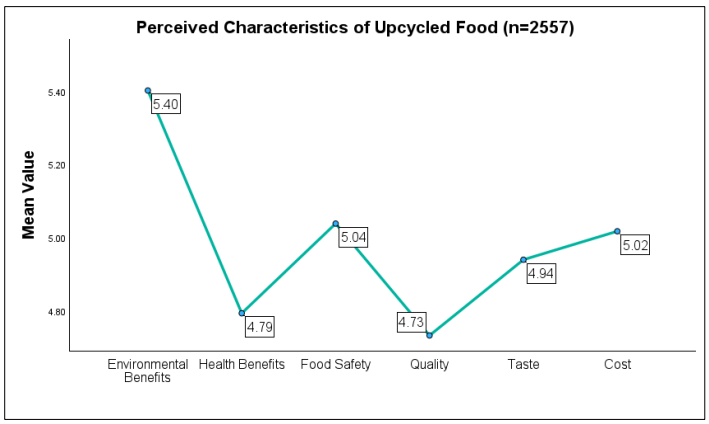

Figure 10 Mean comparison between different characteristics of upcycled food

In contrast, health benefits (e.g., minimal processing, nutritional value) and quality perceptions received comparatively lower ratings. The mean score for health benefits differed significantly from all other characteristics (all $p<.001$, except for quality where $p=.007$). Although the average ratings for the perceived health benefits and quality of upcycled food were not negative, they were not as positively perceived as the other characteristics.

The following sections provide some additional information about the factors that may have informed participants' perceptions of the upcycled food characteristics tested, drawing on the focus group findings.

3.3.2 Perceived environmental benefits of upcycled Food

Participants were asked to evaluate the perceived environmental benefits of consuming upcycled food using three questions: Upcycled food would (1) 'contribute to food waste reduction' (2) 'be processed in an environmentally friendly way,' and (3) 'reduce resource consumption'.

Participants were generally inclined to agree that upcycled food would have environmental benefits (Mean=5.52, Standard Deviation=.97). The analysis of the focus group data revealed that some participants carefully considered the likely impact of upcycled food on waste reduction and more broadly the environment. One participant from the focus groups, as an illustrative example, discussed the need to understand the "whole-of-product-life" environmental impact of upcycled food—including the impact of reprocessing upcycled ingredients—in comparison with alternative uses of the waste:

> *I also think that with the benefits—you're obviously talking about the reduction of waste. Then you might also be building on that and saying, lower carbon footprint. But then I think it's also important to include transporting the by-products to waste facilities and maybe the water that's involved. Then also the energy that's involved, so the carbon footprint of that. How potentially it might even be better using this for something different, whether it be fertiliser or—I don't know. That whole-of-life environmental impact assessment, I think would really come into use there as well. P2-F-18-24*

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Interestingly, the analysis of the focus group data also suggested that some participants weighed the perceived environmental benefits of upcycled food against potential unintended consequences that may reduce other societal benefits. One participant from the focus groups, as an illustrative example, explained their concern about whether the upcycling of food that would normally be donated to food charities would reduce the availability of food for Australians in need.

> *I suppose one of the drawbacks, if it is a drawback, a lot of this food, [close to] their use by date would go to the foodbank, a lot of these places. If they were going to upcycle a lot of this food, is that going to leave all those other charities short-changed with a lot of their supply? Which are at breaking point already now. P7-M-55-64*

3.3.3 Perceived health benefits of upcycled food

Participants were asked to evaluate the perceived health benefits of consuming upcycled food using three questions: Upcycled food would: (1) 'be minimally processed,' (2) 'have health benefits,' and (3) 'be nutritious'.

The results indicate that participants were generally inclined to neither disagree nor agree that upcycled food would offer health benefits, although there is some lean toward agreement (Mean=4.79, Standard Deviation=1.08).

Insights from the focus groups potentially shed light on this response. For example, analysis of the focus group data revealed that participants expected upcycled food to undergo additional processing relative to food that was not upcycled:

> *I just want to echo what P6-F-35-44 was saying that as a family we're trying to eat less processed foods, so that at its simplest it is best. So these upcycled foods are processed and processed again—that's just something we're not trying to be a part of. P2-M-35-44*

Some participants also had concerns over the number of preservatives that upcycled food would contain considering the additional processing required for these products and this may have contributed to lower perceived health benefits relative to other benefits such as environmental benefits.

> *I would be looking for how much preservatives are going into upcycled food compared to the normal, say muesli bar we're getting or some other food we're getting. Because obviously with upcycled food–I don't know–I just had this thought that there'll be more preservatives in upcycled food compared to the normal ones. P4-M-35-44*

3.3.4 Perceived quality of upcycled food

Participants were also asked to indicate their level of agreement with the statement that 'Upcycled food would be high quality'.

On average, participants were generally inclined to neither disagree nor agree that upcycled food would be high quality, but there is some lean toward agreement (Mean=4.73, Standard Deviation=1.30).

Analysis of the focus group data revealed the nutritional value of the upcycled product and the nature of ingredients it contained contributed to quality perceptions. One participant, for example, explained the process through which they would come to a conclusion about the perceived quality of an upcycled product, highlighting how they would compare against non-upcycled alternatives:

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I think one thing for me would be understanding the nutritional value behind it and also the ingredients that make up the product. I think I'd like to compare it to the non-by-product equivalent and then make a decision based on that. Because questions of whether it's processed or not do come into play. P3-M-18-24

The findings also suggest that some participants had concerns about the nutritional value of upcycled food. This may have contributed the survey finding that quality perceptions were lower relative to other characteristics:

I think the nutritional value for upcycled would have to be less than fresh. P3-M-65+

3.3.5 Perceived taste of upcycled food

Participants were also asked to indicate their level of agreement with the statement that 'Upcycled food would taste good'. Participants' responses were measured on a 7-point scale from 'completely disagree' to 'completely agree'.

On average, participants were generally inclined to somewhat agree that upcycled food would taste good (Mean=4.94, Standard Deviation=1.23).

Analysis of focus group data suggested that some participants may be comparing the perceived taste of upcycled food relative to their conventional food counterparts. This may mean that taste expectations differ according to whether the upcycled food is novel (i.e., upcycled food which uses food components or by-products that were previously thought to be inedible) or whether it is an upcycled version of a conventional product (e.g., cupcake mix that contains upcycled ingredients).

I would be concerned that the upcycled one might have a different type of taste depending on what was put into it. P4-M-25-34

3.3.6 Perceived cost of upcycled food

Participants were also asked to indicate their level of agreement with the statement that 'Upcycled food would cost less than conventional food'. Participants' responses were measured on a 7-point scale from 'completely disagree' to 'completely agree'.

On average, participants 'somewhat' agreed that upcycled food would cost less than conventional food (Mean=5.02, Standard Deviation=1.31). Analysis of focus group data suggested that there are two key reasons that participants expect upcycled food to cost less than conventional food. First is the view that upcycled food is made from ingredients that would otherwise be wasted – which in turn were presumed to be more cost effective – and that this would therefore allow cost savings to be passed on to consumers.

Aside from the sort of options I said before, the only point I would see to it is cost effectiveness [from a business perspective]. I would imagine that this would only be an undertaking if there was smaller production costs…Like there's more of a profit for whoever's creating these food items so it would—it's got to be cheaper to use an older product to recreate something new rather than just creating it from scratch in the first place. P1-M-25-34

Second, some participants thought that because upcycled food is made from ingredients that would otherwise be wasted, the quality of the final product would be lower, thus necessitating a lower price point. One participant, as an example, explains this reasoning through comparison with products sold under private labels:

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I think that's something that all these home brands—Coles home brand for example—probably do really well. They use very cheap ingredients. That's the reason they're able to sell these products at really low prices. So, I kind of get the benefit from that perspective. P5-M-18-24

3.3.7 Perceived safety of upcycled food

Participants were asked to rate their level of agreement with statements regarding the safety of upcycled food consumption, including that upcycled food is: (1) low in additives and preservatives, (2) made from safe ingredients, and (3) free from contamination. Participants' responses were measured on a 7-point scale from 'completely disagree' to 'completely agree'.

Taken together, participants generally leaned toward agreement that upcycled food was safe (Mean=5.04, Standard Deviation=1.10). This is consistent with the analysis of the focus group data. The findings suggest that the perception, on average, that upcycled food would be safe stems at least partially from participants' confidence or trust in Australia's food safety standards:

We've got pretty strict food guidelines in this country so I can't see why it's a problem because they've still got to – all factories and food manufacturers – they have guidelines that they need to abide by. P1-F-35-44

I have a fair bit of faith in FSANZ and our regulatory bodies. If I was living in a [developing] country, I may feel differently. But I'm confident the testing is being done... P7-M-45-54

Analysis of the focus group data highlighted that participants that were worried about the safety of upcycled food had concerns about the processing of upcycled food, the freshness of the upcycled ingredients that were being used, and the extent to which upcycling affected the date labels of food:

I think [it's] the natural things that come from processing of food, you've got like heath-and-safety risks. If it's waste, then is there something bad going into it? Are there additional bugs or mould or is it out of date? Then you've got the risk of the people actually preparing it. The more hands that handle something, the more risk you're going to have, in that sense. My other thing would be, I just cook for myself, so how quickly is that food going to expire? Is it going to be worth me buying it because it's not going to last as long as the not-upcycled version. P1-F-18-24

There was also a small group of participants who were concerned about the risk of potential allergens not being appropriately labelled owing to the incorporation of upcycled ingredients in the product:

Especially in this day and age, there are so many allergies, kids with lots and lots of different allergies, not knowing what the product is and how it's been upcycled can determine the safety of it. Normally, most things may have traces of nut trees, or eggs, how can you then determine the new upcycled product will have all those correct labelling? P6-F-45-54

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3.4 Consumer acceptance of upcycled food

This section presents findings related to participants' intentions to purchase upcycled food.

Key takeaway/s:

- Participants had a slightly positive intention overall to purchase upcycled food generally.
- The highest purchase intentions were for 'upcycled food made from excess or surplus products, such as vegetable powder,' followed by intentions for 'upcycled food nearing its best before date, like breadcrumbs'.
- There were some group differences in participants' intention to purchase upcycled food generally.
    - The 25-34 group was significantly more likely to intend to purchase upcycled food than the 55-64 and the 65 and above groups.
    - Females expressed higher intentions to purchase upcycled food.
    - While higher education levels were typically associated with increased intentions to purchase upcycled food in general, not all educational differences between groups were statistically significant.
    - Similarly, while there is a general trend toward higher upcycled food purchase intentions as participants' reported income increased, not all income differences between the groups were statistically significant.
- Participants' state of residence did not affect their intention to purchase upcycled food.
- The perceived environmental and product (quality, taste and price) benefits of upcycled food influenced participants' intention to purchase upcycled food to the greatest extent.

3.4.1 Purchase intentions towards upcycled food

Purchase intentions were measured through three questions measuring the probability, likelihood, and willingness to buy upcycled food from 'extremely low' to 'extremely high' on a 7-point scale. In addition to participants' purchase intentions towards upcycled food in general, their purchase intentions towards specific types of upcycled food were also measured. The following explanations of different types of upcycled foods were provided to participants in the survey:

> Upcycled food is generally considered a food product for people containing foods that would otherwise be wasted or discarded. There are different types of upcycled food.
>
> 1. There is upcycled food that comes from excess or surplus food. For example, **a vegetable powder that is made from excess vegetables that farmers can't sell to supermarkets** because they don't look perfect although they are edible.
> 2. There is upcycled food that comes from food that is safe to eat but nearing its date label. For example, **bread nearing/passing its date label reprocessed into breadcrumbs**.
> 3. There is also a type of upcycled food which uses food components or by-products that were previously thought to be inedible. For example, **a snack bar made from coffee fruit**, which is the cherry covering the coffee bean that is often discarded during processing.

Table 10 provides a summary of consumers' purchase intentions toward upcycled food. Overall, participants demonstrated an only slightly positive intention to purchase upcycled food generally (Mean=4.64, Standard Deviation=1.54). Participants showed the highest purchase intentions for 'upcycled food made from excess or surplus products, such as vegetable powder,' followed by

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intentions for 'upcycled food nearing its best before date, like breadcrumbs.' The lowest purchase intentions were observed for 'upcycled food previously considered inedible', such as coffee fruit.

Table 10 Participants' intentions to purchase upcycled food

Purchase intentions toward:	Upcycled food in general	Upcycled food from excess or surplus e.g., vegetable powder	Upcycled food nearing its best before date e.g., breadcrumbs	Upcycled food previously considered Inedible e.g., coffee fruit
Mean	4.64	5.14	4.91	4.61
Mode	4.00	7.00	5.00	5.00
Std. Deviation	1.54	1.60	1.61	1.61

This is supported by the results which show that purchase intention towards 'upcycled food in general' differs significantly from 'upcycled food made from excess or surplus food' (t=-21.08, *p*<.001) and 'upcycled food nearing its best before date' (t=-11.49, *p*<.001), but did not differ from 'upcycled food previously considered inedible' (t=1.32, *p*=.188). Similarly, the three specific types of upcycled food differ significantly from each other in terms of participants' purchase intentions (all t>9.00, all *p*<.001).

3.4.2 Group differences in purchase intentions toward upcycled food

The data analysis revealed some differences in purchase intentions across different groups within the sample. The following sections outline those differences.

3.4.2.1 Age

Figure 11. Intentions to purchase upcycled food: Age differences illustrates how mean purchase intentions toward upcycled food generally varies across different age groups. Specifically, the 25-34 group was significantly more likely to intend to purchase upcycled food than the 55-64 group and the 65 and above group.

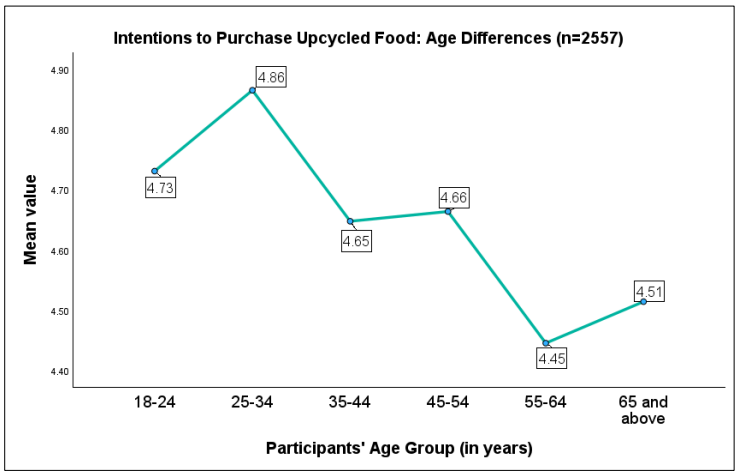

Figure 11. Intentions to purchase upcycled food: Age differences

This is supported by the results which indicate significant differences in mean purchase intentions among the age groups (F=4.03, *p*=.001). Group-wise comparisons reveal that the mean purchase intentions of the 25-34 age group were significantly higher than

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those of the 55-64 age group (SE=.107, *p*=.001) and the 65 and above age group (SE=.101, *p*=.008). However, no significant differences were identified between the other age groups.

3.4.2.2 Gender

Purchase intentions differ significantly between the sexes (Mean $_{Female}$=4.76, SD=1.54, Mean $_{Male}$=4.50, SD=1.53; F=17.21, *p*<.001), with female participants expressing higher intentions to purchase upcycled food compared to male participants.

Note: Ten participants who identified their gender as non-binary were excluded from analysis due to the small sample size.

3.4.2.3 Education

Figure 12 shows how the average purchase intentions vary across participants with different educational levels, with a general trend toward participants with higher education levels having greater intentions to purchase upcycled food. There are significant differences in purchase intentions among the groups (F=4.86, *p*<.001). Group-wise comparisons indicate that participants with 'Some secondary' education have significantly lower purchase intentions compared to those with 'Some university but no degree' (SE = .154, p = .02), 'University-Bachelor's degree' (SE=.128, *p*=.005), and 'Graduate or professional degree' (SE=.148, *p*=.004). Similarly, participants with 'Secondary' education show significantly lower purchase intentions than those with a 'University-Bachelor's degree' (SE=.089, *p*=.02) and a 'Graduate or professional degree' (SE=.12, *p*=.03).

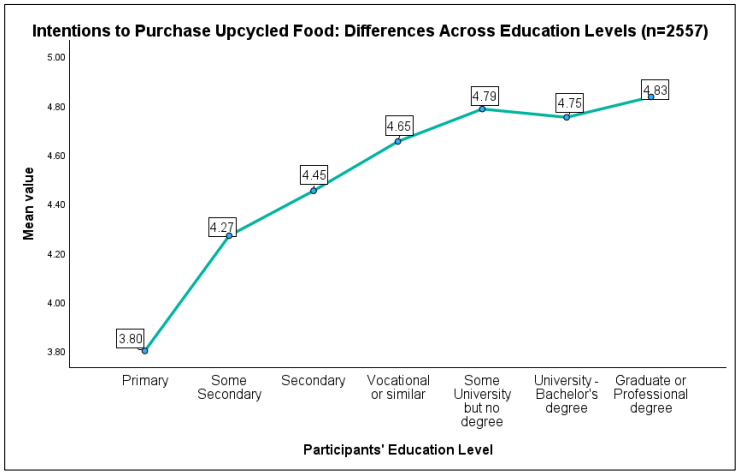

Figure 12 Intentions to purchase upcycled food: Differences across education levels

3.4.2.4 Income

Figure 13 illustrates how mean purchase intentions vary across participants with different income levels. The ANOVA test reveals significant differences in purchase intentions among the groups (F=7.10, *p*<.001). Group-wise comparisons show that participants with an annual income of 'Less than A$30,000' have significantly lower purchase intentions compared to all other income groups, indicating the least interest in purchasing upcycled food. Additionally, the 'A$80,000-99,999' group differs significantly from the 'A$100,000-149,999' group (SE=.102, *p*=.04). No other significant differences were observed between the remaining groups.

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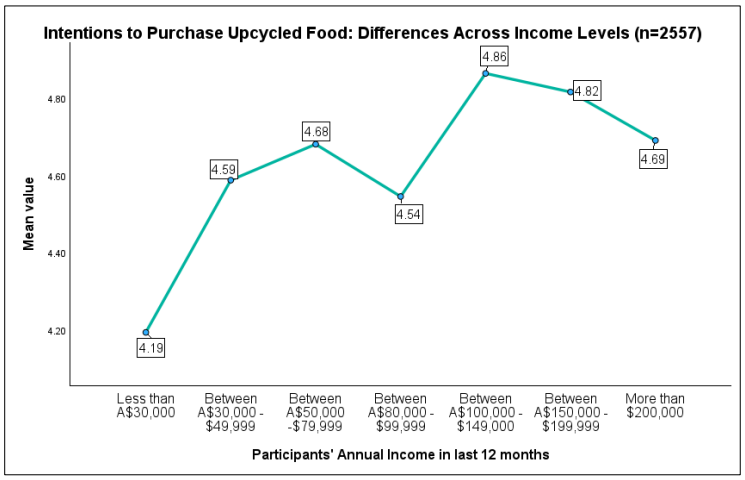

Figure 13 Intentions to purchase upcycled food: Differences across income levels

3.4.2.5 Place of Residence

No significant differences in purchase intentions toward upcycled food were observed among participants from different states and territories (F=0.78, p=0.60). This finding suggests that participants exhibit similar purchase intentions toward upcycled food, regardless of place of residence.

3.4.3 Product characteristics that predict purchase intentions of upcycled food in general

SmartPLS software was utilised to model how various upcycled food characteristics—such as environmental benefits, health benefits, product-related benefits (encompassing three components: quality, taste, and cost), and perceived food safety—influence participants' purchase intentions toward upcycled food. The analysis employed Partial Least Squares Structural Equation Modelling (PLS-SEM), a technique widely used for its flexibility in estimating relationships between different variables of the model (Hair et al., 2019).

As shown in Figure 14, all upcycled food characteristics significantly influence purchase intentions, collectively explaining about 42.9% of the variance in purchase intentions.

Among the four characteristics, **environmental benefit** (β=.236, p=.000) has the most effect on participants' purchase intentions. Specifically, the more participants perceive upcycled food as contributing to reducing food waste, being processed in an environmentally friendly manner, and minimising resource consumption, the stronger their intention to purchase such products.

Perceived product-related benefits (β=.202, p=.000) had the next largest influence on participants' intention to purchase upcycled food. When consumers believe that upcycled food is **high quality, tastes good, and is more affordable** than conventional alternatives, their intention to purchase these products increases.

Food safety (β=.183, p=.000) is another key determinant of purchase intentions. Consumers who perceive upcycled food as low in additives and preservatives, free from contamination, and made with safe-to-eat ingredients are more inclined to buy these products.

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Lastly, perceived **health benefits** (β=.128, *p*=.000) has the weakest influence on purchase intentions. While consumers who associate upcycled food with being minimally processed, nutritious, and beneficial to health are more likely to purchase it, it is a less influential characteristic.

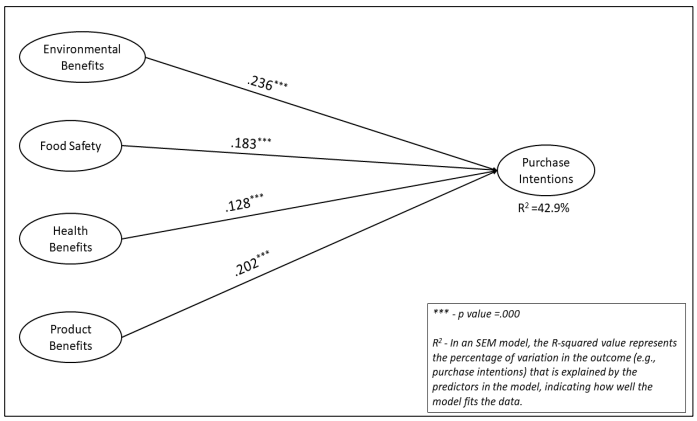

Figure 14 Upcycled food characteristics as predictors of purchase intentions

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3.5 Consumers' willingness to pay for upcycled food to pay the same price for upcycled food as conventional food

This section presents findings related to participants' willingness to pay the same price for upcycled food as conventional food. In other words, it examines participants' pricing expectations for upcycled food products compared to their conventional food product counterparts. This section may not be applicable to novel upcycled food products (i.e., where there is not already an equivalent conventional food product).

Consumers were asked about their willingness to pay for upcycled food compared to conventional food by providing their level of agreement with the following statements: (1) 'It is acceptable to pay the same price for upcycled and conventional foods of the same type, (2) I would accept paying the same price for upcycled and conventional foods of the same type, and (3) I would be willing to spend the same amount of money on upcycled and conventional foods of the same type.

Key takeaway/s:

- Participants generally expect to pay less for upcycled food compared to their conventional food counterparts.
- There were group differences in participants' willingness to pay the same price for upcycled food as conventional food.
    - Participants' willingness to pay decreases with age, with younger participants showing a higher willingness compared to older age groups.
    - Participants with higher education levels generally exhibit a stronger willingness to pay the same price for upcycled food as conventional food, but the differences were not consistent across all education groups.
    - Participants with incomes less than A$30,000 were significantly less likely to be willing to pay the same price for upcycled food as conventional food.
    - No gender-based or place of residence-based differences in participants' willingness to pay were identified.
- While participants' expectation of environmental benefit from upcycled food was the strongest predictor of consumers' purchase intentions, it is the weakest predictor in participants' willingness to pay.
- Participants that expect upcycled food to be high quality are more likely to be willing to pay the same price for upcycled food as conventional food.

3.5.1 Consumers' willingness to pay the same price for upcycled food as conventional food

The findings on participants' willingness to pay for upcycled food reveal a general reluctance to pay the same price as they would for conventional food (Mean=3.92, Standard Deviation=1.61). The results show a significant deviation below the mid-point value (i.e., 4.0) of the scale (t=-2.37, *p*=.009). This suggests that participants expect upcycled food to be priced lower than conventional alternatives.

3.5.2 Group differences in willingness to pay

The data analysis revealed some differences in willingness to pay for upcycled food across different groups within the sample. The following sections outline those differences.

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3.5.2.1 Age

Figure 15 shows the mean willingness of participants to pay for upcycled food compared to conventional food across various age groups. Overall, the results suggest that willingness to pay decreases with age, with younger participants showing a higher willingness compared to older age groups.

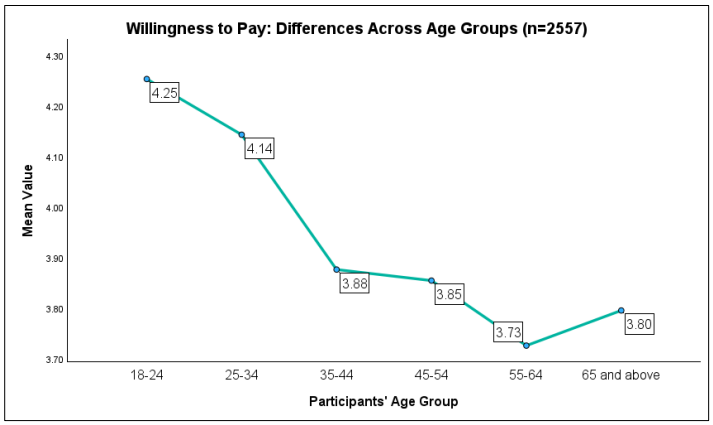

Figure 15 Willingness to pay: Differences across age groups

The analysis revealed significant differences among age groups in their willingness to pay the same price for upcycled food as conventional food (F=6.206, p<.001). Specifically, the 18–24 years age group differed significantly from all other age groups except the 25–34 years group. Similarly, the 25–34 years group differed significantly from the 55–64 years (p=.003) and 65+ years (p=.01) age groups. The overall mean willingness to pay across all participants was 3.92, but only the 18–34 years age group demonstrated a higher willingness compared to this overall average. Among all age groups, participants aged 55–64 years exhibited the lowest willingness to pay, with their willingness differing significantly from the 18–24 years and 25–34 years groups.

3.5.2.2 Gender

The analysis revealed no statistically significant difference in willingness to pay for upcycled food compared to conventional food across gender groups (F=1.551, p=.213). This suggests that gender does not play a role in determining participants' willingness to pay the same as conventional food for upcycled food products.

3.5.2.3 Place of residence

The analysis indicates that there is no statistically significant difference in the willingness to pay the same price for upcycled food as conventional food among participants from regions in Australia (F=1.78, p=0.087). These findings suggest that the participants' place or residence does not appear to influence their pricing preferences for upcycled versus conventional food products, indicating a consistent perception of value across geographic regions.

3.5.2.4 Education

Table 11 presents the mean willingness of participants with different education levels to pay for upcycled food compared to conventional food.

Significant differences were observed between groups based on education level regarding their willingness to pay the same price for upcycled food as conventional food (F=6.501, p<.001). The results indicate a general trend where individuals with higher

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education levels demonstrate a greater willingness to pay the same price for upcycled food as conventional food. However, not all pairwise comparisons were statistically significant.

Table 11 Willingness to pay: Differences across education levels

Participants' Education Level	Mean	Std. Deviation	N
Some Secondary	3.57	1.55	177
Secondary	3.79	1.62	488
Vocational or similar	3.79	1.61	617
Some University but no degree	4.02	1.68	219
University -Bachelor's degree	4.12	1.56	766
Graduate or Professional degree	4.12	1.67	268
Total	3.93	1.61	2535

**Note - Two groups, 'Primary education' (n=10) and 'Prefer not to say' (n=12) were excluded from analysis due to low sample size.*

Specifically, participants with some secondary education differed significantly from those with a university–bachelor's degree (p<.001) and those with a graduate or professional degree (p=.006). Additionally, the secondary education group differed significantly from the university–bachelor's degree group (p=.006). Furthermore, participants with vocational or similar education also showed significant differences compared to those with a university–bachelor's degree (p=.002). No significant differences were found between other groups.

3.5.2.5 Income

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Table 12 presents the mean willingness of participants with different income levels to pay for upcycled food compared to conventional food.

Significant differences were observed among groups based on their income levels (F=2.864, *p*=.009). The less than A$30,000 income group showed significant differences when compared to the A$80,000 - A$99,999 (*p*=.03), A$100,000 - A$149,000 (*p*=.007), and A$150,000 - A$199,999 (*p*=.049) income groups. However, no significant differences were found among the other income groups. Overall, these findings suggest that while there are income-based differences in willingness to pay the same price for upcycled food as conventional food, the data does not conclusively establish a relationship between income and increased willingness to pay.

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Table 12 Willingness to pay: Differences across income levels

Participants' Income in last 12 months	Mean	Std. Deviation	N
Less than A$30,000	3.63	1.65	299
Between A$30,000 - $49,999	3.89	1.59	356
Between A$50,000 -$79,999	3.86	1.63	540
Between A$80,000 - $99,999	4.02	1.52	394
Between A$100,000 - $149,000	4.05	1.61	511
Between A$150,000 - $199,999	4.04	1.67	271
More than A $200,000	3.93	1.65	186
Total	3.92	1.62	2557

3.5.3 Product characteristics that predict willingness to pay

SmartPLS software was utilised to model how various upcycled food characteristics—such as environmental benefits, health benefits, product-related benefits (encompassing three components: quality, taste, and cost), and perceived food safety—influence participants' willingness to pay the same price for upcycled food as conventional food.

As shown in Figure 16, all upcycled food characteristics, except taste, significantly influence participants' willingness to pay the same price for upcycled food as conventional food, collectively explaining about 26% of the variance in willingness to pay.

The extent to which participants expect upcycled food to **cost less** than conventional food is negatively associated with their willingness to pay the same price for upcycled food (β=- .268, *p*=.000) and is the strongest predictor of willingness to pay in this model. That is, the stronger participants held the belief that upcycled food should cost less than conventional food, the less willing they were to pay the same price for upcycled food as conventional food irrespective of the perceived quality, environmental benefit, health benefit or expected taste of the upcycled food.

Participants expectation of the **quality** of upcycled food is the second strongest predictor for willingness to pay (β=.254, *p*=.000), indicating that participants that expect upcycled food to be high quality are more likely to be willing to pay the same price for upcycled food as conventional food.

Importantly, while expectation of **environmental benefit** from upcycled food was the strongest predictor of consumers' purchase intentions, it is the weakest predictor in participants' willingness to pay (β=.091, *p*=.001).

Both the perception of **food safety** (β=.165, *p*=.000) and expectation of the **health benefit** (β=.130, *p*=.001) from upcycled food maintain a relatively small, but still significant, influence on participants' willingness to pay. The expectation that upcycled food would **taste good** does not appear to be important in predicting participants' willingness to pay, as it is not a significant predictor (β=.024, *p*=.467). This may be owing to an expectation that food that is available for purchase would taste good in order to be released to the market, that is, it may be a baseline expectation of any food available for purchase regardless of price.

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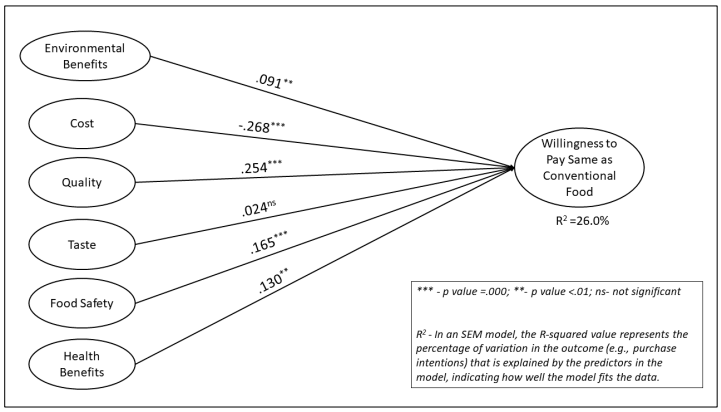

Figure 16 Upcycled food characteristics as predictors of willingness to pay

Analysis of the focus group data also highlighted participants' decision-making process in terms of their expectation that upcycled food would cost less than conventional food, but that this expectation is mitigated by the perceived quality of the upcycled food product:

> *I think the sacrifice is that people want the perfect thing, and they're choosing to not have the perfect thing [upcycled food product] because there's that social responsibility involved in it. So if they're going to be having the thing [upcycled food product] and the thing is saving people from spending more money to make that thing, then we deserve to not spend as much money on that thing, or at least the quality of that thing should be very good as well. P1-F-35-44*

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3.6 Improving consumer acceptance of upcycled food

This section presents findings related to participants' opinions about different approaches to encouraging consumer acceptance of upcycled food, as well as factors that may influence these approaches, specifically, participants' expectations around potential greenwashing and the perceptions of who benefits most from upcycled food.

Key takeaway/s:

- Participants indicated, on average, that price discounting, clear labelling of the upcycled ingredients in upcycled food, an upcycled food certification program, a clearer definition of upcycled food, public education/advertising campaigns and the availability of upcycled food in local supermarkets, would increase their acceptance of upcycled food to varying degrees.
- Price discounting and clearly labelling upcycled ingredients in upcycled food were generally perceived to be the most effective of the approaches provided to participants in supporting their intention to purchase upcycled food.
- In relation to price discounting, the largest proportion of participants ranked consumers (followed by growers/farmers) as the primary beneficiaries of upcycled food, with focus group findings outlining an expectation from consumers that upcycled food would benefit them by costing less than conventional food.
- In relation to public education/advertising campaigns, focus group findings highlighted that some participants did not believe that advertising campaigns were necessary, suggesting that emphasising the 'upcycled' nature of products could lower both price and quality expectations. Instead, a focus on education around food safety standards around upcycled food was recommended.
- In relation to advertising campaigns, participants on average considered it at least somewhat likely that they would encounter 'greenwashing' in relation to upcycled food.

3.6.1 Approaches to support consumer acceptance of upcycled food

Participants were asked to rate the extent to which they believed six approaches could improve their intention of purchasing upcycled food: a public education/advertising campaign, an upcycled food certification program, clear labelling of the upcycled ingredients, a clearer definition of upcycled food, the availability of upcycled food in local supermarkets and price discounting. Responses were measured on a 7-point scale ranging from 'not at all' to 'very much'.

The results (Table 13) show that participants, on average, thought that all six approaches could improve their acceptance of upcycled food to some degree.

Table 13 Consumer opinion of strategies to improve acceptance of upcycled foods

	Public Education / Advertising Campaign	Upcycled Food Certification Program	Clear Labelling of the Upcycled Ingredients	Clearer definition of upcycled food and/or a different term to describe this type of food	Availability of Upcycled Food in Local Supermarkets	Price Discounting of Upcycled Food
Mean	5.14	5.23	5.40	5.19	5.10	5.40
SD	1.52	1.52	1.47	1.48	1.53	1.52

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Among the approaches, clear labelling of upcycled food and price discounts emerge as the most influential approaches, significantly outperforming all other options (F=65.87, *p*<.001) (Figure 17). Interestingly, availability in supermarkets and public education or advertising campaigns were, on average, considered the least likely by participants to improve their intention to purchase upcycled food.

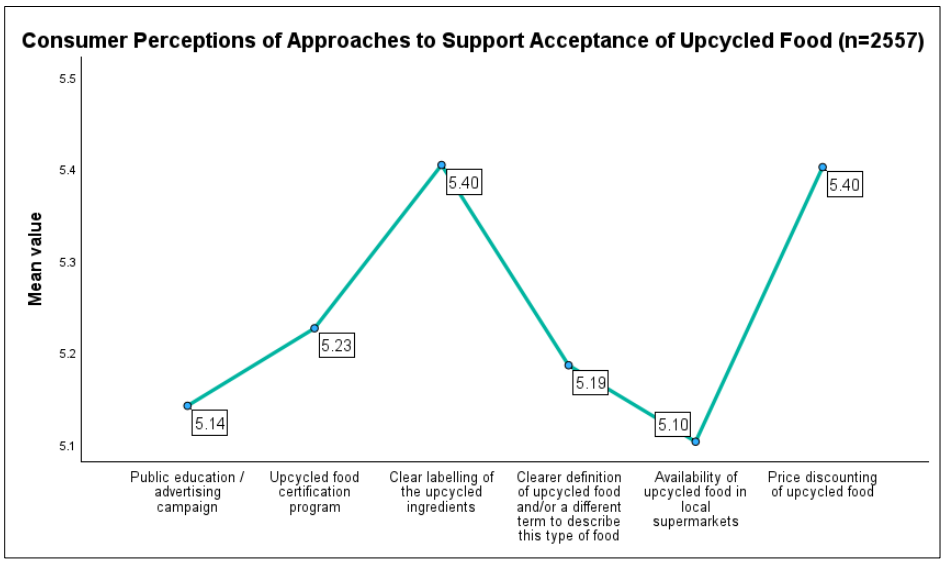

Figure 17 Consumer perceptions of approaches to support acceptance of upcycled food

The analysis of the focus groups provides some insight that may explain why some participants considered public education or advertising campaigns less useful in supporting consumer acceptance of upcycled food. Some participants mentioned that drawing attention to the fact that the product was upcycled could have an unintended consequence of lowering expectations of product quality and, consequently, price. These participants explained that this concern stemmed from the associations with the process of upcycling 'waste'. One participant highlights how not labelling a product as upcycled (even though it may be) may circumvent this risk:

> *I'm a bit conflicted. On one hand, I agree that consumers knowing more would be better. But on the other hand, I feel like ignorance might be bliss. Hearing the word 'upcycled', it doesn't bring the best initial impression image to my mind. It sounds like a bit of a dirty word. Like, I'm eating food that—just offcuts, kind of thing. Then with that, that means I'd expect lower price, lower quality—all that kind of thing. If you really want to sell it, just sell it as a normal thing. Like we've mentioned, Vegemite, breadcrumbs, all those kinds of things, we don't think about them as upcycled products, but we just eat them. P7-M-18-24*

Some of these participants thought that initiatives to support upcycling of food could be directed at educating consumers about food safety standards in relation to upcycling or the process of upcycling, rather than utilising 'upcycled' as a point of difference for the product:

> *I'd like to see it on the policy end where it's just something that happens and we know it's regulated and it's safe. Personally, I don't think people will need to know [that they are purchasing upcycled food], necessarily… But it's not something that needs to be made a big flap about. It just happens and it's done, and it's regulated and it's safe, like many other things. P1-F-35-44*

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I think definitely maybe a short synopsis of the process on the food packaging itself would be beneficial. How like on organic food they'll say it's organically sourced and grown, no pesticides, that sort of thing on it. Something similar. P1-M-25-34

Interestingly, the analysis of the focus group data also provides additional insight into what participants may have understood clear labelling of upcycled ingredients to constitute, highlighting the focus on the inclusion of ingredients rather than labelling the food itself as upcycled:

I guess how far away it goes from what's normal in that food item. So if you use the muesli bar example and you've gotten breadcrumbs and you've put it in there, that seems quite a normal thing to do, but if you've gotten, I don't know, crushed prawn shells put in there.. fish scales, that's a bit of a further leap, so that labelling I guess should define how far from 'normal' it is. P2-M-35-44

3.6.2 Expectations about potential greenwashing in relation to upcycled food

It is important to understand consumers' expectations around potential greenwashing as a consideration in any approaches to supporting consumers' acceptance of upcycled food, particularly public education/advertising campaigns. Greenwashing was explained to participants as: (1) making misleading environmental claims, (2) presenting pro-environmental information in a selected or distorted way, or (3) engaging in pro-environmental actions to cover up poor environmental performance. Participants were asked: 'How likely do you believe it is that you will encounter 'greenwashing' in relation to upcycled food?' Their response was measured on a 7-point scale from 'highly unlikely' to 'highly likely'.

When participants were asked about their perceptions of greenwashing in relation to upcycled food, their responses indicated a belief that encountering greenwashing is somewhat likely (Mean=4.94, Standard Deviation=1.39).

Analysis of the focus group data provided insight into why participants, on average, believe that it is somewhat likely that they will encounter greenwashing in relation to upcycled food. The analysis suggested that this perception may stem in part from consumers' previous experiences with other products making environmental claims. That is, they are aware of greenwashing that has occurred in other types of products claiming to have environmental benefit:

I can really imagine it [information about upcycled food] as an ad on TV highlighting the environmental impacts, like you see with a lot of—and some of it is greenwashing, sure—but with a lot of other products. P3-M-18-24

The analysis also highlighted the complexity of substantiating environmental claims, particularly when considering "whole-of-product-life" environmental impact, may be another factor in participants' view that it is somewhat likely that they will encounter greenwashing in relation to upcycled food:

Yeah, there's a café in North Melbourne that roasts the coffee cherry to use as a drink – it's a tea, which is weird. It's all well and good saying, this usually goes to landfill or waste, but how much energy is going into that to actually make it a viable product in comparison to reintegrating it back into earth as food for the next crop of coffee? How much energy is going into that in regards to [generating] market demand? Have you done your research? P5-NB-35-44

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3.6.3 Perceived beneficiaries of upcycled food

It is important to understand consumers' beliefs around who the primary beneficiaries are in relation to upcycled food to inform strategies to support consumer acceptance of upcycled food. Consumers were asked to rank who they believe would benefit the most from their purchase of upcycled food, with six options provided: farmers/growers, consumers, the environment, upcycled food manufacturers/distributors, retailers who sell upcycled food and others.

As shown in Figure 18, 51.4% of participants ranked consumers themselves and farmers/growers as the top beneficiaries, with the largest proportion (approximately 26%) identifying consumers as the primary group to benefit from upcycled food. The environment was identified as the next largest beneficiary of adopting upcycled food (18.7%) and retailers selling upcycled food were seen as the top beneficiaries by 11.9% of the participants.

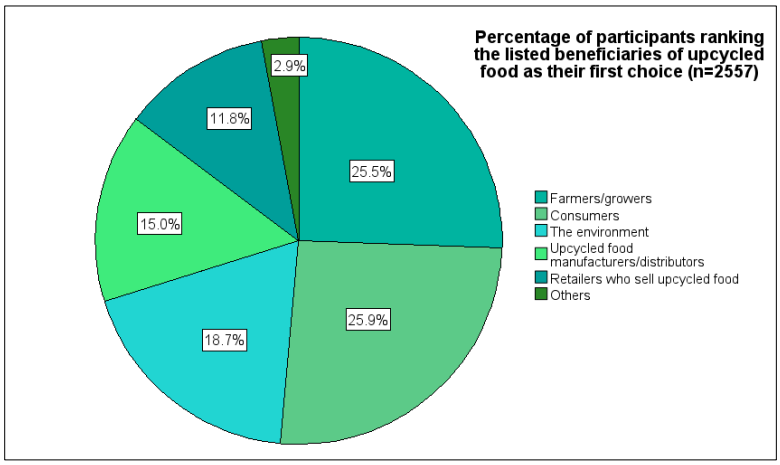

Figure 18 Percentage of participants ranking the listed beneficiaries of upcycled food as their first choice

Participants in the focus groups reported their desire for upcycled food to directly benefit farmers/growers, but highlighted that they thought consumers would benefit from upcycled food owing to their expectation that upcycled food would cost less than their conventional food counterparts:

> *The benefit obviously is farmers being able to still sell their food. But I think the main benefit will be in cost of living. So, those who are below the poverty line or are really struggling to keep up with rent or mortgage—they'll be able to afford it more, and it will benefit them. I would assume, with it being upcycled, it'll likely be cheaper, if it's repurposed into something else. (P6-F-18-24)*

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3.7 Providing information about upcycled food

This section presents findings related to participants' willingness to seek further information about upcycled food and provides insights into the sources and channels perceived to be most suitable by participants for providing information about upcycled food.

Key takeaway/s:

- Consumers on average 'slightly' agreed that they would search for additional information on upcycled food.
- The majority of consumers want information about upcycled food available on the packaging of the upcycled food (60.7%), followed by government websites (43.9%), and TV programs such as documentaries or investigative series (41.5%). However, the focus group findings highlight that caution around upcycling claims provided on the packaging of upcycled food is needed owing to consumer concerns about greenwashing.
- The largest proportion of participants selected 'family and friends' (18.3%), followed by 'research organisations' (15.6%), and 'government institutions' (12.8%) as the most trusted sources of information about upcycled food.
- The majority of participants wanted to know more about 'food safety standards' (78.1%) and the 'type of ingredients used in upcycling' (74.3%).
- The lowest proportion of participants indicated that they would like to know more about the 'environmental benefits of upcycling' (57.9%) and the 'definition of upcycling' (57.3%).

3.7.1 Likelihood of seeking information about upcycled food

Participants were asked to indicate their level of agreement with the statement, "I would search for more information about upcycled food." Responses were measured on a 7-point scale ranging from 'strongly disagree' to 'strongly agree'.

Overall, while responses varied, participants on average 'slightly agreed' that they would seek additional information on upcycled food (Mean=4.89, Standard Deviation=1.51).

3.7.2 Preferred channels for seeking information about upcycled food

Participants were asked to identify where they would want additional information about upcycled foods to be available, with the option to select multiple categories.

On average, participants selected 3.7 categories from the 13 options provided (

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Table 14). The data reveals that a substantial majority of participants indicated that they would want information available on packaging of upcycled food (60.7%), followed by government websites (43.9%), TV programs such as documentaries or investigative series (41.5%), and on retail signage (e.g., signage within a food retailer) (35.8%).

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Table 14 Preferred channels for information on upcycled food

Channels	% of sample
On the packaging of the upcycled food product	60.7%
Retail signage (e.g., signage within a food retailer)	35.8%
Retail catalogues/magazines	29.3%
Billboards	10.2%
Food magazines	34.9%
Emails	19.7%
SMS	6.2%
News media	34.3%
Social media	34.8%
Radio	15.9%
Government websites	43.9%
TV programming (e.g., documentary, special investigation)	41.5%
Other	5.3%
Total	

The analysis of the focus group data clarifies that participants desire information beyond the percentage of upcycled ingredients contained in the product on the packaging. That is, participants expected a summary of what was meant by upcycling specifically in the context of the product specifically:

> *I think definitely maybe a short synopsis of the process [upcycling] on the food packaging itself would be beneficial. How like on organic food, they'll say: "It's organically sourced and grown, no pesticides", that sort of thing on it. Something similar. P1-M-25-34*

While the packaging of the upcycled food product provides a convenient channel for consumers to learn more about upcycled food, an important consideration emerged from the analysis of the focus group data. Some participants reported that claims regarding upcycling from companies on the packaging of their products would need to be carefully evaluated given their concerns about greenwashing:

> *It sounds like a bit of like a greenwashing word [upcycled food] I feel like. I don't know. It sounds like it's trying to guilt you into making a more socially conscious decision or something…like it's not always clear-cut that upcycled equals good. Unless I'm specifically aware of what in particular about that upcycled product—what are the benefits of it—then I think just slapping on the label upcycled, it's not going to—it's probably going to make me annoyed at the product. P7-M-18-24*

Other commonly selected information channels included social media (34.8%), food magazines (34.9%), and news media (34.3%), with nearly a third of participants selecting these options. The least preferred channels were emails (19.7%), radio (15.9%), billboards (10.2%), and SMS (6.2%).

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3.7.3 Trusted sources of information about upcycled food

Participants were asked to rank 10 options in terms of who they would trust most to provide information about upcycled food (Figure 19).

The results were relatively fragmented in terms of the source of information selected most commonly as a first choice among participants. The largest proportion of participants selected 'family and friends' (17.8%), followed by 'research organisations' (15.6%), and 'government institutions' (12.8%). On the other hand, news publishers (3%) and retailers (3.5%) were the least likely to be selected first as a trusted source of information about upcycled food.

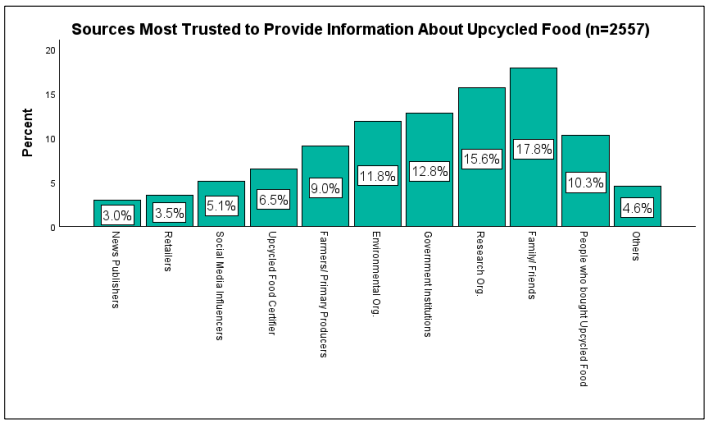

Figure 19 Sources most trusted to provide information about upcycled food

The analysis of the focus group data highlighted that the Government was seen as a trusted source of information about upcycled food for many participants as Government was seen to be more impartial compared to other sources and less likely to engage in greenwashing:

> *I was going to say, yeah, let's not do that [use influencers]. My thought is unless this kind of education comes from… some kind of food consumer board… unless it comes from someone like that, in my view, it is just a marketing ploy. You get a chef, you get some kind of farmer guy, an actor playing a farmer, whoever you get to spruik this idea, it's going to seem like there's people in the back who have their own... It needs to come from a body, some kind of board that actually has these interests [e.g., waste reduction] at the heart of what they do. Government preferred. P7-F-35-44*

3.7.4 Type of information sought about upcycled food

Participants were asked if they wanted to know more about upcycled food, what topics they thought would be useful, with the option to select multiple categories (Table 15). On average, participants selected 3.4 categories from the six options provided.

The results reveal that over three-quarters of participants indicated interest in learning about 'food safety standards' (78.1%) and the 'type of ingredients used in upcycling' (74.3%). Additionally, slightly more than two-thirds of participants expressed interest in the 'process of upcycling' (67.4%). The lowest proportion of participants indicated that they would like to know more about the 'environmental benefits of upcycling' (57.9%) and the 'definition of upcycling' (57.3%).

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Table 15 Type of information sought about upcycled food

Topic	% of sample
Definition of upcycling	57.3%
Food safety standards	78.1%
Type of ingredients used in upcycling	74.3%
Process of upcycling	67.4%
Environmental benefits of upcycling	57.9%
Other	2.2%

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4. Implications of key findings

The following section outlines key findings and their possible implications and applications for consideration. The implications and applications outlined are drawn solely from the findings of the research conducted and contained within this report. The operational environment, and other relevant circumstances, should be taken into account when considering any of the implications or applications outlined.

4.1 Consumers awareness, knowledge and expectations of upcycled food

Summary of key findings:

- Consumer awareness (31.7%) and knowledge of upcycled food is generally low across Australia (see Section 3.1). Awareness levels in Queensland are approximately 28%.
- Consumers expected that a majority of a food product's ingredients should be upcycled for it to be labelled 'upcycled food' (58.6%) and likewise, they felt that an upcycled ingredient should constitute a majority of upcycled content (59.3%) to qualify as an upcycled ingredient (see Section 3.2.1). Consumers generally thought that an upcycled food certification program would support their intention to purchase upcycled food (see Section 3.6.1), even though price discounting and clear labelling of upcycled ingredients were seen to be more supportive of upcycled food acceptance.
- Consumers typically supported the upcycling of plant-based ingredients, while animal-based categories received much less support. Breakfast foods, baked foods, snack foods, pastas, sauces, and soups as products were perceived to be the most suitable to contain upcycled ingredients (see Section 3.2.2).
- The largest proportion of consumers surveyed preferred the term 'upcycled food' (45.7%) as opposed to other the terms provided or their own terms (see Section 0). However, survey and focus group findings highlighted a proportion of consumers that believe there was no need for a specific term to describe upcycled food and who viewed ‘upcycling’ as simply the responsible use of resources in the food supply chain (see Section 0).

Possible implications:

There is scope to improve consumer awareness and understanding of upcycled food in Australia, including Queensland. There was no strong evidence for using different terminology to describe the concept of upcycled food, with the largest proportion of consumers surveyed preferring this term.

There may be greater market opportunity in Australia for upcycled food made from plant-based ingredients from the following food categories: breakfast foods, baked foods, snack foods, pastas, sauces, and soups.

Consumers expectation that upcycled food would contain more than 50% upcycled ingredients has implications for any future third-party certification of upcycled food in Australia. For example, in the United States of America, the Upcycled Food Association (UFA) has developed the Upcycled Certified Standard which provides that a product containing upcycled ingredients should be composed of: (1) An aggregate of ≥10% Input(s), UI(s), and/or PUI(s) by weight OR (2) Meet or exceed a threshold for total tonnage of Input(s) based on production records over the previous year (preceding 12 months upon date of certification application (see https://www.wherefoodcomesfrom.com/upcycled).

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4.2 Consumer acceptance of upcycled food

Summary of key findings:

- Consumers had a slightly positive intention overall to purchase upcycled food and the highest purchase intentions were for 'upcycled food made from excess or surplus products, such as vegetable powder,' followed by intentions for 'upcycled food nearing its best before date, like breadcrumbs'. There was less acceptance of upcycled food that comes from food components or by-products that were previously thought to be inedible (see Section 3.4.1).
- Consumers on average thought upcycled food would offer environmental benefit, be safe to consume, and be less costly than conventional food alternatives (see Section 3.3.1). Consumers, followed by growers/farmers, were perceived to be the primary beneficiaries of upcycled food (see Section 3.6.3). Focus group findings suggest that consumers thought that they would benefit from the lower prices they expected to pay for upcycled food (see Section 3.3.6).
- Modelling shows that belief in the environmental benefit of upcycled food supports consumers' intention to purchase upcycled food (see Section 3.4.3), but it does not enhance consumers' willingness to pay the same price for upcycled food as conventional food to the same extent (see Section 3.5.3). However, focus group findings also suggest that many consumers have a sophisticated understanding of "whole-of-product-lifecycle" environmental impact (see Section 3.3.2) and consumers also believe that it is at least somewhat likely that they would encounter greenwashing in relation to upcycled food (see Section 3.6.2).
- Modelling shows that high quality perceptions support consumers' willingness to pay the same price for upcycled food as conventional food (see Section 3.5.3).
- Some differences in different groups' intentions to purchase upcycled food were identified (see Section 3.4.2). Female consumers and the 25-34 group (compared with the 55-64 and the 65 and above groups) were more likely to intend to purchase upcycled food. Higher education and income levels were also generally associated with greater intentions to purchase upcycled food, but not all differences between groups were statistically significant. Participants' state of residence did not affect their intention to purchase upcycled food.

Possible implications:

Overall, consumers report a positive intention to purchase upcycled food in Australia, particularly for 'upcycled food made from excess or surplus products, such as vegetable powder'. There may be greater market demand for upcycled food products in this category.

Emphasising the environmental benefits of upcycled food could support consumers' intention to purchase upcycled food. However, care would need to be taken given consumers' sensitivity to greenwashing and sophisticated understanding of the concept of environmental impact. Highlighting the positive environmental impact of upcycled food is also unlikely to greatly support consumers' willingness to pay the same price for upcycled food as conventional food, with a stronger market expectation that upcycled food should/would offer a cost benefit for consumers. Emphasising the quality of the upcycled food could support consumers' willingness to pay for the upcycled food.

There may be more market demand from female, younger consumers with higher levels of education and income. There were no differences across states or territories in consumers' intention to purchase upcycled food.

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4.3 Approaches to support consumer knowledge and acceptance of upcycled food

Summary of key findings:

- Consumers, on average, however, supported the following approaches to improving consumer acceptance of upcycled food: price discounting, clear labelling of upcycled ingredients in upcycled food products, an upcycled food certification program, a clearer definition of upcycled food, public education/advertising campaigns and the availability of upcycled food in local supermarkets (see Section 3.6.1). Price discounts and clear labelling of upcycled ingredients in upcycled food products were seen by consumers, on average, to have the greatest potential to support consumer acceptance of upcycled food (see Section 3.6.1).
- Consumers, on average, 'slightly' agreed that they would seek additional information on upcycled food (see Section 3.7.1), and most consumers expressed their interest in learning more about 'food safety standards' (78.1%), the 'type of ingredients used in upcycling' (74.3%), and the 'process of upcycling' (67.4%) (see Section 3.7.4). Generally, consumers thought that upcycled food would be safe and focus group findings suggested that consumers trust Australian food safety standards (see Section 3.3.7).
- The largest proportion of consumers selected 'family and friends' (18.3%), followed by 'research organisations' (15.6%), and 'government institutions' (12.8%) as their most trusted sources of information about upcycled food, however, there were a wide range of sources selected (see Section 3.7.3). Consumers indicated that would prefer information be provided on packaging of upcycled food (60.7%), government websites (43.9%), TV programs such as documentaries or investigative series (41.5%), and on retail signage (e.g., signage within a food retailer) (35.8%) (See Section 4.7.2).

Possible implications:

Considering the findings of the research together, one approach to promoting the uptake of upcycled food may be to not explicitly label upcycled food as such, but to provide education around the concept of upcycling so that if consumers become aware a product is made from upcycled ingredients, they already understand and have access to information explaining that these products comply with food safety standards. This type of approach would leverage consumers trust in food safety standards (see Food Standards Australia New Zealand, 2024) to support consumer acceptance of upcycled food. Public education campaigns could focus on food safety, upcycled food ingredients, and the process of upcycling in line with consumers' preference for this type of information. A key advantage of this approach could be that consumers would not expect a price discount because the food would not be labelled as upcycled.

Another approach is to emphasise the environmental benefits of upcycled food, as this was identified as a key driver of consumers' intention to purchased upcycled food. The disadvantage of this approach is that the perceived environmental benefit of upcycled food does not support consumers' willingness to pay the same price for upcycled food as conventional food to the same extent, which is problematic given that consumers generally expect to pay less for upcycled food. Any communication about the environmental benefits of upcycled food would also need to consider consumers' sensitivity to greenwashing and their sophisticated understanding of 'whole-of-product-life' environmental impact. However, consumers' pricing expectations could be managed in this approach either though subsidies or by emphasising the quality of upcycled food, which was found to support consumers' willingness to pay.

Overall, government and research organisations were identified as trusted sources of information about upcycled food and consumers preferred that information to be provided on packaging of upcycled food, government websites, TV programs such as documentaries or investigative series, and on retail signage (e.g., signage within a food retailer).

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4.4 Limitations and future directions

All research has limitations that should be considered when interpreting and applying findings. This section outlines some of the considerations for this research.

The research was undertaken in an environment where the cost-of-living crisis in Australia was top-of-mind for consumers (during 2024). This may have increased their price sensitivity to upcycled food. However, the existing literature on consumer acceptance of upcycled food does suggest that consumers generally expect upcycled food to have a lower price point (e.g., Bhatt et al., 2022).

While the sample of the survey aimed for representativeness of the Australia population, the parameters used to manage this through quotas were age, gender and place of residence. The sample may not be representative of the Australian population on other parameters.

This research also highlights several directions for future investigation that may further support consumer acceptance of upcycled food including:

- Investigating levels of consumer acceptance of different types of upcycled food;
- Profiling potential target audiences for different types of upcycled food;
- Message/information testing of the information provided to consumers; and/or
- Testing consumer price sensitivity for different types of upcycled food.

Overall, this research has identified several facilitators and inhibitors of Australian consumers acceptance of upcycled food. It provides an important first step to enhancing the market opportunity of upcycled food, and toward the ultimate goal of reducing food waste and promoting environmental sustainability in Australia.

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