# **Completing the food waste management loop: Is there market potential for value-added surplus products (VASP)?**

# **Abstract**

Addressing the social, environmental and economic consequences of food waste has become an urgent issue for governments and industry stakeholders. This study investigates the factors influencing consumer acceptance of novel value-added surplus products (VASP) which could advance industry action to reduce food waste. Consumers’ perceptions and potential acceptance of VASP is under-explored in the academic literature. A survey with a panel of 687 consumers in Australia and the UK was conducted to examine the factors that influence consumers willingness to buy VASP and to identify potential consumer segments. Almost half of the participants are willing to buy VASP, such as a vegetable powder, a snack and a fermented product, with Australian respondents being more likely to buy these types of foods (47%, 51% and 44%) than respondents in the UK (43%, 49% and 39%). Consumers who are price conscious, convenience oriented, status seeking and concerned about the consequences of food waste are more willing to buy VASP than others. Cluster analysis reveals two consumer segments that show promise for the targeted marketing of VASP: the ‘status and convenience seeker’, which is a larger segment in Australia (76%) than in the UK (59%), and the ‘price and environmentally conscious’ consumer, which is larger in the UK (41%) than in Australia (24%). Respondents generally rank ‘other-oriented’ benefits, such as farmers’ welfare, as more important drivers of purchasing than ‘self-oriented’ benefits, such as healthy food. The results not only advance the theoretical understanding about consumer acceptance and segmentation of novel products, but also provide a valuable indication of the market potential of VASP, along with positioning strategies to assist marketers and policy makers in preventing pre-consumption food waste.

**Keywords:** Pre-consumer food waste; value-added surplus products (VASP); novel foods; market segmentation; perceived benefits of VASP.

------ GRAPHICAL ABSTRACT HERE ------

**Highlights**

* Potential markets for VASP exist in both Australia and the UK
* Two market segments: status & convenience seeker and price & environmentally conscious
* Other-oriented benefits matter more than self-oriented benefits for VASP acceptance

# **1. Introduction**

Food waste is a global problem with environmental, economic and social consequences (Garcia-Herrero et al., 2018; Jurgilevich et al., 2016). Food production demands land, water and energy, which are scarce resources in the light of the projected growth of the global population. The breakdown of food in landfills emits methane and carbon dioxide, increasing GHG emissions, while the economic cost of wasted food has been estimated to be US$ 680 billion in industrialized countries and US$ 310 billion in developing countries (FAO, 2019). The United Nations Sustainable Development Goals, therefore, call for halving “per capita global food waste at the retail and consumer levels” and reducing “food losses along production and supply chains, including post‐harvest losses” by 2030 (UN, 2015, p. 22). Morone et al. (2019) conclude that a holistic approach, in both social and scientific realms, that incorporates waste reduction and valorization strategies is necessary. This paper adds to the waste valorization literature by looking at products made from food waste.

Food waste arises at two different stages in the food systems: pre-consumer waste, as part of the manufacturing, processing, distribution and retailing of food, and post-consumer waste, as part of household food consumption (Dorward, 2012). Existing research has a strong focus on initiatives to address post-consumer food waste (Secondi et al., 2015) but it tends to overlook some important options for reducing food waste at the pre-consumption stage in the food supply chain (Reynolds et al., 2019), although research on solutions such as clean energy, waste treatment and valorization is attracting increasing attention (Chen et al., 2017).

At the pre-consumption stage, surplus, underutilized or even ‘inedible’ food, which is safe and healthy for consumption, such as broccoli stems or carrot peels, can be kept and transformed into functional foods with enhanced concentrations of micro-nutrients (Miller and Welch, 2013). These foods, made from surplus ingredients that would have been otherwise wasted, are termed ‘value-added surplus products’ (VASP) and “can be a promising solution to the food waste crisis, if appropriately marketed to consumers” (Bhatt et al., 2018, p. 57).

Despite numerous scientific and technological studies exploring the different ways of converting food surplus to value-added products, such as value-added food ingredients (Wolfe and Liu, 2003) and functional foods (Miller and Welch, 2013), consumers’ perception and potential acceptance of VASP is under-explored in the academic literature. To our knowledge, only one study investigated consumers’ use of cues and perceptions of VASP (see Bhatt et al., 2018), though policy and marketing challenges have been identified around the development and acceptance of novel foods (Veeman, 2002). Given that the commercialization of VASP will not be possible without consumers’ acceptance, this study aims to examine consumers’ willingness to buy novel VASP by identifying promising consumer segments as well as shedding light on purchasing motivations.

This research is the first attempt to assess consumers’ willingness to buy VASP focusing on consumers across two countries, Australia and the UK, and makes three original contributions to this developing field of research and business practice. Firstly, the results reveal the market prospects for VASP in two culturally similar countries, supporting the feasibility of commercializing VASP to deal with the food waste problem. Secondly, the factors that influence the acceptance of VASP are identified, advancing the theoretical and practical understandings in the area of novel product acceptance and ethical consumption. Thirdly, the two market segments emerging from the cluster analysis can assist with targeted and more effective communication strategies from a policy and marketing point of view.

# **2. Context and rationale for study**

## **2.1 VASP’s importance**

More food is wasted in the pre-consumption and production phase than in any other phase of the food lifecycle (Bhatt et al., 2018) particularly for horticultural commodities in Europe (Beretta et al., 2013) and Australia (McKenzie et al., 2017). It is challenging to prevent waste at the source, the farm or processing stage (Mourad, 2016) due to various cultural, social or economic choices made by producers. For example, farmers dispose ‘abnormal’, ‘ugly’ or ‘substandard’ fruit and vegetables that do not meet buyers’ stringent aesthetic requirements (Aschemann-Witzel et al., 2017). Farmers are incentivised to over-produce to deal with short-term demand fluctuations, the vagaries of weather, and high consumer expectations of a broad range of products available on supermarket shelves (Devin and Richards, 2016). Although sustainable food projects have emerged to redistribute the food that farmers cannot sell (Ribeiro et al., 2018), food waste is still a major problem in the supply chain.

Instead of challenging primary food chain’s economic choices, one of the emerging novel solutions to food waste at the processing level is VASP. For the purpose of this study, novel VASP is defined as “new foods that make use of surplus or underutilised food, ‘ugly’ or abnormal food, ‘inedible’ food and by-products, that are thrown away at different stages in the food chain and then transformed into value-added products” [adapted from the concepts discussed in Bhatt et al. (2018)]. In this definition, ‘inedible’ food and by-products can include leaves, stalks, seeds, unused flesh, pomace and peelings.

The promotion of VASP may help meet multiple policy goals of reducing food waste, improving public health and reducing greenhouse gas emissions associated with food waste (Miller and Welch, 2013), through waste valorization (Kourmentza et al., 2018). For example, broccoli is a vegetable with high nutritional value but highly perishable, so, waste from the broccoli industrial processing sectors could be used to develop products that meet consumer demand for healthy and nutritious foods (Lafarga et al., 2018). Nevertheless, consumers may be reluctant to consume VASP as they may perceive them as waste or destined for the trash bin (Bhatt et al., 2018). This study aims to assess consumer acceptance of VASP which can provide support for managerial and policy decisions.

## **2.2 Market Segmentation**

Appropriate segmentation and targeting are important for the acceptance of novel products (Murekezi et al., 2017). Consumer segmentation studies divide consumers into groups that are internally homogenous but differ from other groups within the same market (Kaufman and Rousseeuw, 2009). This can inform effective and efficient food waste reduction policies because different consumer profiles tend to require different initiatives tailored to suit their needs (Di Talia et al., 2019). The main variables used for segmentation related to pro-environmental behaviors are socio-demographic, attitudinal and behavioral, with the latter being perceived as better starting points for constructing market segments (Verain et al., 2012). This study considers attitudinal and behavioral aspects to identify the segments most responsive to VASP. To provide meaningful segmentation, the selection of the variables should be theory based (Kaufman and Rousseeuw, 2009). As a result, theoretically-based aspects that could inform consumer segments for VASP are discussed in the next section.

# **3. Theory**

VASP are a novel food category and previous studies have identified several important drivers and barriers to the adoption of novel products. These motivators mainly fall into two categories, i.e. ‘other-oriented’ factors, which include environmental concern, concern about future generations’ and farmers’ welfare and additional jobs, and ‘self-oriented’ factors, which are price consciousness, convenience orientation and status seeking.

With regard to ‘other-oriented’ benefits, consumers tend to have positive attitudes towards pro-environmental products when such products highlight benefits to others (Yang et al., 2015). Numerous theories, such as identity theory (Stets and Biga, 2003), the theory of planned behavior (Ajzen, 1991) and Schwartz’s value theory (Schwartz, 1992), suggest that consumers’ environmental concern is associated with anthropocentric altruism (Stern, 1992) and influences intentions towards environment-related behaviors (Ajzen, 1991). There is evidence that consumers who are environment conscious and feel guilty about food waste are likely to respond to advertising appeals that link the purchasing of pro-environmental products with the welfare of the society (Yang et al., 2015). Such environmentally conscious consumers are also more likely to adopt various pro-environment behaviors, such as shopping routines to minimize food waste (Stefan et al., 2013), taking home restaurant leftovers (Hamerman et al., 2018) and preventing food waste through recycling (Diaz-Ruiz et al., 2018). Likewise, research on sub-optimal food (i.e. abnormally shaped food or close to the expiry date) shows that awareness of food waste issues and a strong pro-environmental self-identity drive purchase intention (De Hooge et al., 2017). VASP are considered pro-environmental products because their main purpose is the reduction of food waste (Bhatt et al., 2018). It is expected that consumers’ concern for the negative consequences of food waste on the environment would encourage a pro-environmental behavior of purchasing VASP to reduce food waste and the following hypothesis is proposed:

*Hypothesis 1: Concern about the consequences of food waste for society will have a direct, positive effect on the willingness to buy VASP.*

Price influences consumers’ purchasing decisions, such as reducing purchase likelihood and leading to faster decision-making (Rihn et al., 2018). With regard to VASP, consumers might perceive it as made of suboptimal food and research has suggested that consumers would need price discounts before buying suboptimal products (Verghese et al., 2013). Similarly, Tsiros and Heilman (2005) show that consumers’ willingness-to-pay decreases with the extent of the remaining shelf-life. Rohm et al. (2017) find that consumers appear to carefully assess their ability to consume the price-reduced suboptimal food by considering date issues and product quality. These studies suggest that the choice of suboptimal food is an interaction between price discounts and perception of quality of the product which, according to the social exchange theory, works as a form of a psychological contract, between the seller and the consumer (Rousseau, 1989). In buyer-seller relationships, a psychological contract is the belief of a mutual obligation between the two parties and an example of a psychological contract violation is when the quality of a product is not in line with the consumer’s expectations based on what it has been communicated by the seller. In relation to VASP, when the suboptimal food goes through proper processing and is turned into VASP, its shelf-life is prolonged and its quality is guaranteed, which eliminates any psychological contract violations and has a positive effect on brand quality image (Theotokis et al., 2012). If this is properly communicated, consumers will have fewer concerns regarding its consumption suitability. It is argued that consumers who are price conscious will perceive VASP as a value-for-money choice and react positively.

*Hypothesis 2:**Price consciousness will have a direct, positive effect on the willingness to buy VASP.*

Although social factors such as symbolic value are associated with novel foods (Ellis, Coulton, and Mauger, 2015), status-seeking tends to be accorded less analytical emphasis in the literature, with the focus being on individual cognitions, such as attitudes towards personal health and the environment (Bartels and Onwezen, 2014). In a literature review on consumer acceptance of novel foods, House (2016) concluded that social factors such as status seeking behavior, could influence consumers’ food choices. According to signaling theory (Griskevicius et al., 2010), status seeking drives consumers to purchase conspicuous products to enhance their sense of self and social image, or own personal sense of taste (O'Cass and McEwen, 2004). Research indicates that the pursuit of status motivates not only the demonstration of extravagance but also the display of charity and other pro-social behaviors (Sexton and Sexton, 2014). Green consumption has been connected to social status, being positioned as an opportunity for consumers to signal their social status conspicuously when choosing more visible green products (Griskevicius et al., 2010). Elliott (2013) argues that even low-involvement and non-luxury goods can accomplish social differentiation through the individual expressions of taste. Empirical evidence shows that some people differentiate themselves from others and gain a positive self-image and identity by consuming organic food (Puska et al., 2018) and functional food (Barauskaite et al., 2018), or paying a premium for organic groceries (such as milk and apples) (Kim et al., 2008) and organic items in a restaurant (Shin et al., 2019). There is little evidence that status seeking can successfully predict willingness to buy VASP. Given VASP’s attributes of being green, pro-environmental and innovative, it is possible that consuming VASP could enhance consumers’ self-esteem or social acceptance, and the following hypothesis is proposed:

*Hypothesis 3:**Status seeking will have a direct, positive effect on willingness to buy VASP.*

Theories on the allocation of time and role overload explain why the demand for convenience is an important aspect of consumer behavior (Candel, 2001). Evidence has shown that convenience has an immense impact on food choice (Buckley et al., 2007). ‘Convenience foods’ encompass a wide variety of processed and semi-processed food (i.e. pre-cut vegetables, frozen and canned foods, ready meals) and are frequently contrasted with ‘fresh’ foods using raw ingredients that are cooked from scratch (Jackson and Viehoff, 2016). Novel VASP, if provided as a plant-based snack or cracker in or outside of the home (i.e. while exercising, at work or school), will enable the consumer to consume them easily and conveniently. The following hypothesis is formulated:

*Hypothesis 4:**A convenience orientation will have a direct, positive effect on willingness to buy VASP.*

To test the generalizability of this study and the relevance of VASP in more than one country, the same survey was conducted in two culturally similar countries, i.e. Australia and the U.K. In the two countries, consumption patterns of convenience foods and fresh produce might vary in terms of the total amounts consumed and preferred types of products (due to climate variations for instance). However, drawing from the Hofstede model of national cultures (Hofstede et al., 2010), the two markets are culturally similar as they both belong to the Anglo countries group (House et al., 2004) and their pro-environmental attitudes will be similar (Gifford and Nilsson, 2014). Previous research shows that consumers’ ratings of food and health concerns are similar across Western countries (Worsley and Scott, 2000). This leads to the hypothesis that Australian consumers will be similar to UK consumers in terms of willingness to buy VASP.

*Hypothesis 5: There is no significant difference between Australian and UK consumers in terms of willingness to buy VASP.*

# **4. Methods**

This section describes the study design and includes descriptions and justifications of the method used, the data collection instruments, and the sample characteristics.

## **4.1 Product Scenarios**

To examine participants’ intentions to consume VASP, three hypothetical VASP were conceived and were termed ‘product scenarios’. As there is scant literature on VASP, these three product scenarios were developed using descriptions provided by Australia’s national science agency, Commonwealth Scientific and Industrial Research Organisation(CSIRO, 2018), after two industry-oriented workshops held in 2018. The three product scenarios were: (i) a vegetable powder made from 100% whole carrot that can be used as a healthy ingredient for smoothies, dips, sauces, etc.; (ii) a vegetable snack product made from 20% broccoli that is an ideal on-the-go healthy snack; (iii) a fermented product based on vegetables that is rich in nutrients and fibre and can be used in baby food, dips, smoothies, etc.

In all the three product scenarios, health benefits were highlighted since labeling VASP foods to align with consumers’ health consciousness is critical in increasing acceptance (Bhatt et al., 2018). These product scenarios solely focused on vegetables because they are one of the main foods wasted both in the UK (De Laurentiis et al., 2018) and Australia (Hamilton et al., 2005). Vegetables require greater amounts of agricultural inputs, such as irrigated water, pesticides and fertilisers, than most other crops, and reducing their waste and environmental impact is of critical focus globally (Conrad et al., 2018).

## **4.2 Data Collection and Sample**

The study focuses on consumers in Australia and the UK for two reasons: they represent similar cultures (Hofstede et al., 2010) and their citizens tend to generate high food waste. In Australia, consumers annually throw away around 3.1 Mt of edible food costing approximately $20 x 10^9 (Department of the Environment and Energy, 2018) while in the UK, household food waste is estimated at 7.1 Mt costing about £15 x 10^9 (WRAP, 2018).

Food buyers from Australia and the UK exhibit similarities in their food choices and shopping behavior. Both the UK and Australia are high-income countries where consumers tend to demand high quality meat, seafood and fresh produce (Tey et al., 2009). In 2018, the annual spend for fruit and vegetables in the UK was £13,239 and £9,568 M (Statista, 2019) and the average weekly purchase of fruits and vegetables per person in 2016/17 was 2.873 kg (DEFRA, 2018). In Australia, industry revenue for fruit and vegetables reached $3.97 x 10^9 in 2018. Average annual household consumption was 101.2 kg per capita and consumption is expected to rise at a rate of 1.2% per annum, due to growing health consciousness, the aging population and increase in households’ disposable income (IBISWorld, 2018a). In both countries, several trends have emerged, including consumer demand for organic goods, the popularity of healthy eating (IBISWorld, 2018b) and increasing demand for ready-to-eat and prepared meals (Mintel, 2017). These trends make both countries promising markets for VASP.

A total of 689 consumers in Australia and the UK were surveyed using an online panel. The panel was maintained by a leading professional research agency, Qualtrics, which continually performs quality assurance procedures. Internet access in both countries is very high, with a penetration rate of 87% for Australia and 95% for the United Kingdom in 2017 (World Bank, 2017), therefore, the bias towards households with internet access is minimal. The use of online consumer panels is becoming increasingly common in food waste studies (Stancu et al., 2016) and panels are considered to be a valid and reliable data source for social science research (Birau and Faure, 2018) when compared with conventionally sourced data (Walter et al., 2018). To ensure a diverse and comparable sample across the two countries, quota sampling was employed by taking into account gender, age and income. After removing participants with missing data, a total of 329 Australian and 358 UK responses were analyzed. Ethics approval for the study was secured from the Ethics Committees in the authors’ Universities.

## **4.3 Variables and Measures**

Willingness to buy VASP was measured using product scenarios developed by CSIRO (2018) with a seven-item scale ranging from extremely unwilling (=1) to extremely willing (=7) to buy the above mentioned VASP.

To achieve the highest quality responses, items with high internal reliability (Cronbach’s alphas) were selected from previous studies (see Table 1). Regarding respondents’ motivations for buying VASP, a scale for awareness of food waste consequences was adapted from three studies using three items from Delley and Brunner (2017), one item from Gjerris and Gaiani (2013) and one item from Stefan et al. (2013). The scale for price consciousness was derived from a food-related lifestyle survey (Grunert et al., 2001). The scale for convenience orientation was adopted from Aschemann-Witzel et al. (2018). The scale for status seeking was taken from a study by Bao et al. (2003). For all the measures on motivational factors participants were asked to “rate the level of agreement or disagreement with the following statements”. The response format was a seven-point Likert scale, anchored from very strongly disagree (=1) to very strongly agree (=7).

The factor analysis of the 19-item scales resulted in a 5-factor solution, the loading of which is shown in Table 1. Reliability tests were conducted to check the internal consistency of measurement items, and Cronbach’s alpha and average variance extracted (AVE) (Fornell and Larcker, 1981) were calculated (see Table 1). As Table 1 shows, the Cronbach’s α for the factors ranges from .723 to .887, providing evidence for acceptable internal consistency (Field, 2013). Almost all AVE values are above the suggested threshold (Fornell and Larcker, 1981); values above 0.7 are considered good, while a value of 0.5 is acceptable.

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Data was also collected on socio-demographics including age, employment status, education, household size, children in household and household income level (Table 2). The Australian sample, has more female (69%) than male participants, while there are equal numbers of males and females in the UK sample. Overall, the survey participants are diverse in terms of income, education, age and employment characteristics. Tables 3a and 3b report the descriptive statistics and correlation matrix of all the variables. Ordinary Least Squares (OLS) regression and Cluster Analysis were performed in STATA 12.0.

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-------INSERT TABLES 3a & 3b ABOUT HERE-------

# **5. Results**

## **5.1 Willingness to buy VASP**

The results in Figure 1 reveal that around 50% of consumers in Australia and the U.K. are willing, very willing or extremely willing to purchase two types of VASP, the vegetable powder and snacks made from surplus food. Fewer consumers (around 40%) are keen on purchasing the fermented baby product made from surplus food. A T-test comparing the acceptance level between Australia and the U.K. shows Australian consumers are significantly more willing to buy VASP (AU: 4.23; UK: 3.96; diff = .27; *p* < 0.01), so, hypothesis 5 is not supported.

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## **5.2 Motivational factors explaining consumers’ willingness to buy VASP**

OLS regression analysis was conducted to investigate which factors matter in consumers’ willingness to buy VASP. The results are shown in Table 4. There is a significant, positive relationship between awareness of food waste consequences, status seeking, convenience orientation, and willingness to buy three types of VASP, supporting Hypotheses 1, 3 and 4. Hypothesis 2 is partially supported because price consciousness shows a significantly positive relationship with willingness to buy only for the vegetable snack.

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Tests were then conducted to ascertain if the impact of the four motivators differs across Australian and UK consumers. A dummy variable was created to indicate country of residence and its interactions with the four factors (awareness of food waste consequences, price consciousness, status seeking and convenience orientation) was explored. None of the interactions show any significant result, suggesting that the four factors do not have significantly different impacts across the two countries. Such results confirm the appropriateness of using the same four motivators for market segmentation in Australia and the U.K.

Other than the main motivator variables, several demographic variables also show significant results (see Table 4). In the Australian sample, willingness to buy VASP is positively related to income (for the vegetable snack only), but negatively related to age (for all VASP product scenarios). Such results suggest that VASP could be more appealing to Australian consumers who are younger and with higher income. In the UK sample, willingness to buy VASP is positively related to household size, but negatively related to age. Gender is significant, with males being less likely to purchase VASP than females. These results suggest that VASP tend to be more attractive for U.K. female consumers who are younger and have more family members than others.

## **5.3 Segmentation based on cluster analysis**

Given that all the four factors show significant results in influencing consumers’ acceptance of VASP, cluster analysis, using Ward’s (Hair et al., 1987) method in STATA, was conducted to identify consumer segments in the Australian and UK samples. The stopping rule based on Calinski–Harabasz pseudo-F index (1974)1 was used to decide the number of clusters. Large values of the Calinski–Harabasz pseudo-F index indicates distinct clustering. The 2-cluster solution shown in Table 5 emerges as the best solution as it shows the greatest pseudo-F value (100.17 for the Australian sample and 129.94 for the UK sample).

As shown in Table 5, in both countries’ samples, the first cluster is featured by significantly higher status and convenience seeking behavior, which is termed “status and convenience seekers”. The second cluster is featured by significantly higher price consciousness and environment consciousness, which is categorized as “price and environmentally conscious”. After comparing the two countries, it is found that in Australia, there are more status and convenience seekers (76.06%). In the UK, the distribution of the two clusters is relatively balanced.

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To develop a more comprehensive segment profile, T-tests for observed means were conducted in the two clusters in terms of demographic characteristics, acceptance of VASP and influential factors. Results in Table 6 show the two clusters differ in relation to some demographic characteristics. Most of Cluster 1 (status and convenience seekers) are young (below 40 yr old), have a full-time or part-time job, and more of them have a larger family size (more than 3 family members), while Cluster 2 (price and environmentally conscious) are older (40 yr old or above), do not have a job, and more of them have a smaller family size (1-3 household members) in both Australia and the UK. There are slightly more consumers with a degree and above among the price and environmentally conscious than among the status and convenience seekers in the two countries.

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Table 7 further compares whether the willingness to buy VASP varies across the two clusters. Results show that in Australia the two clusters do not show significant differences in relation to consumers’ acceptance of VASP, while in the UK the status and convenience seekers show significantly higher level of acceptance towards VASP for all three types of VASP than the price and environmentally conscious. Such results suggest that companies could target both segments of consumers in Australia, yet in the UK they should focus more on the status and convenience seekers.

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Consumers in the two countries were asked to rank several potential self-oriented and other-oriented factors that motivated them to buy VASP. These included four other-oriented factors (helping farmers, job creation, effects on the natural environment, helping society), and two self-oriented factors (healthy food and good price). Consumers ranked six factors from 1 to 6, with 1 indicating the most important factor and 6 indicating the least important factor. T-tests were conducted on their ranking for the six factors across the two clusters. A significant lower mean of ranking score indicates a higher level of importance perceived by the consumers. Results in Table 8 show that in both countries, consumers rank other-oriented factors as more important than self-oriented factors when asked why they would like to buy VASP. When comparing the two clusters, in Australia the status and convenience seekers rank healthy food as more important than the price and environmentally conscious group.

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# **6. Discussion and Implications**

Although research has identified VASP as a new market solution to reducing food waste, and numerous scientific and technological studies have explored different ways of converting food surplus, including spent coffee grounds (Kourmentza et al., 2018) and broccoli co-products (Lafarga et al., 2018) to value-added products, consumers’ perceptions and acceptance of VASP is under-explored in the academic literature. Given the high failure rates associated with new products (Stewart-Knox and Mitchell, 2003) and the fact that not all consumers would like to accept the suboptimal food surplus (Aschemann Witzel et al., 2017), an understanding of the potential market is necessary to shed light onto the marketing strategies and policies needed for promoting VASP. This study uses a large sample covering two countries and a robust methodological approach to investigate the willingness to buy VASP and the factors that influence the purchase decision along with potential consumer segments. Being the first to identify consumers segments for VASP, this study enriches the literature on market segmentation for novel foods (Zhang et al., 2010).

The findings indicate that consumers are interested in VASP, a novel product to reduce food waste, in two culturally similar countries, i.e. Australia and UK. Approximately 50% of Australian and UK consumers are willing to buy two types of VASP, a snack product and a vegetable powder, and approximately 40% are willing to buy a fermented food product (see Figure 1). Such results are comparable with extant studies on preference for novel foods. For example, Ikiz et al. (2018) report that 67% of the panel like the sliced pears, while Silvestri et al. (2018) report that 73.2% of the sample are willing to buy a red-fleshed apple. A comparison between Australia and UK shows that Australian consumers are significantly more willing to buy VASP than UK consumers, which might be explained by their higher level of awareness of food waste consequences (5.15 vs. 5.00, the difference is significant at p<0.05) and concern about price (5.23 vs. 4.93, the difference is significant at p<0.001). The results show a market potential for VASP. Food processors could explore commercialization opportunities for VASP in the UK and Australia as well as in culturally similar markets such as New Zealand, USA and Ireland. At a policy level, the results support an avenue towards the circular economy (Murray et al., 2017) and the call for technological solutions (Papargyropoulou et al., 2014), i.e. recovering more fruit and vegetables from the food system and transforming them into novel products.

Drawing from the wider literature on ethical and sustainable consumption, this study shows that acceptance of novel VASP and engagement with ethical behaviors are multifactorial. In line with other studies, this study shows VASP could appeal to environmentally conscious consumers (De Hooge et al., 2017; Loebnitz et al., 2015). Due to its pro-social stance emanating from food waste reduction campaigns along with its innovative processing method, VASP may also be very attractive to the status seeking consumers. This study provides further empirical evidence of the impact of status seeking on food choices (Puska et al., 2018). VASP could also attract the convenience-oriented consumers (Aschemann-Witzel et al., 2018) since several factors contribute to convenience, such as being quick and easy to eat, and fitting in with consumers’ domestic routines and busy lives (Jackson and Viehoff, 2016). Despite the dual role of price (Erickson and Johansson, 1985), where a higher price could discourage purchase intention, but can also signal quality, safety or health cues, the results suggest a higher price may not be appropriate for VASP. Instead, it is more realistic to target the price-conscious consumers with a lower price, since consumers may expect it to be discounted due to its association with food waste and sub-optimal food. This is consistent with van Giesen and de Hooge’s findings (2019) that a sustainability positioning works best when combined with a moderate price discount.

The cluster analysis reveals two segments which were similar in both countries, i.e. status and convenience seekers and price and environmentally conscious. These two segments show similarities and differences. In both segments, respondents ranked ‘other-oriented benefits’ (e.g., farmer-welfare) as more important than self-benefiting factors (e.g., health, price). Policy makers and businesses can use these insights to frame their public education programs and marketing appeals and link purchase of VASP with good practices in the supply chain. Rich narratives with positive and emotional language could be used to highlight societal benefits, such as new markets for surplus food that would otherwise be wasted; increased income for the farming community; reduction in the emissions of methane and carbon dioxide from degrading food in landfill, and better use of scare land, water and energy resources.

The two segments have different motives and demographic profiles. Such results are in line with the general food marketing literature, which suggests that there are multiple types of sustainability-conscious consumers with different expectations, attitudes, and demographics, and companies should implement targeted strategies instead of a “one size fits all’ mentality (Balderjahn et al., 2018). The differences across the two segments found in this study could have important implications for marketers and policy makers. For the status and convenience seekers who are younger and holding a full-time or part-time job, messages could highlight the novelty and convenient attributes of the product, use status appeals and celebrity endorsement to create a positive social image. The price and environmentally conscious segment includes older consumers and many are not working. For them, setting the right price and using a sustainability based positioning strategy is probably the key to consumer acceptance.

# **7. Limitations and Future Research**

This study is not free from limitations and they underpin guidelines for future research. The survey respondents were not asked to compare VASP with conventional, fresh produce. Health-conscious individuals are likely to consume fresh or raw produce rather than processed products. Future studies could compare VASP to other healthy alternatives to understand the relative willingness to buy VASP.

This study focuses on behavioral/attitudinal factors that influence consumers’ purchase intention for a hypothetical novel food that is vegetable-based and has a healthy image, but many constructs can directly affect willingness to buy. For example, consumers who have specific liking of broccoli will be more likely to buy VASP made from broccoli surplus, but not willing to buy VASP made from other ingredients. Future studies could test other constructs that might influence purchase or non-purchase, such as taste qualities, eating habits, visual appearance, texture, brand name and labelling, as well as the impact of setting/situational factors on purchase decisions (i.e. in home and out-of-home consumption). Qualitative research, experimental research designs and tasting tests would also be useful in exploring consumers’ perceptions of those constructs.

Developing countries also waste large quantities of food (FAO, 2019). Although these findings are not directly generalizable to the developing world, VASP may find acceptance in developing markets where large clusters of price-conscious consumers are likely to exist and the prevalence of obesity is growing fast, with experts calling for increase in vegetable intake and higher quality, nutritious foods (Popkin et al., 2012).

# **8. Conclusion**

This paper provides several contributions to the food waste and ethical and sustainable consumption literatures. The data from consumers in Australia and the UK, which are culturally similar, shows the market feasibility of VASP, a novel product that may help reduce food waste. Consumer acceptance of VASP is positively related to consumers’ price consciousness, convenience orientation, status seeking and awareness of food waste consequences. Two segments are identified from a cluster analysis, the ‘status and convenience seekers’ and the ‘price and environmentally conscious consumers’. The study provides insight into key consumer segments which may help curb food waste and benefit fruit and vegetable processors, marketing practitioners and policy makers.

**Note**

1. There are many cluster stopping rules. Milligan and Cooper (1985) evaluate 30 stopping rules, singling out the Calinski–Harabasz index and the Duda–Hart index as two of the best rules. Everitt et al. (2011) and Gordon (1999) discuss the problem of determining the number of clusters and describe several stopping rules, including the Caliński and Harabasz (1974) pseudo-F index.

**Declaration of Conflicting Interests**

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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**Ethical Standards**

All procedures performed in studies involving human participants were in accordance with the ethical standards of the authors’ institution and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**TABLE 1** Variables, Factor Loadings and Reliability Indices.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Australia | | | UK | | |
|  | Factor loading | Cronbach's α | AVE | Factor loading | Cronbach's α | AVE |
| Awareness of food waste consequence |  | .846 | .513 |  | .875 | .563 |
| Food waste is a big environmental issue (Delley and Brunner, 2017). | .783 |  |  | .807 |  |  |
| Food waste is an important social issue (e.g. world hunger) (Delley and Brunner, 2017). | .815 |  |  | .794 |  |  |
| Foods are scarce over the world and should be consumed consciously (Delley and Brunner, 2017). | .819 |  |  | .847 |  |  |
| Foods are gifts of nature and have to be treated as such (Gjerris and Gaiani, 2013). | .746 |  |  | .823 |  |  |
| In my country, the food waste generated by households has great financial consequences (Stefan et al., 2013). | .649 |  |  | .715 |  |  |
| Price consciousness  (Grunert et al., 2001) |  | .872 | .616 |  | .793 | .505 |
| I always check prices, even on small items. | .809 |  |  | .817 |  |  |
| I notice when products I buy regularly change in price. | .819 |  |  | .766 |  |  |
| I watch for ads (in the newspaper) about store specials and plan to take advantage of them when I go shopping. | .825 |  |  | .598 |  |  |
| I compare prices between product variants (i.e. various brands of the same products) in order to get the best value for money. | .837 |  |  | .821 |  |  |
| Convenience orientation  (Aschemann-Witz el et al., 2018) |  | .757 | .509 |  | .723 | .473 |
| I/we use a lot of ready-to-eat foods in our household. | .862 |  |  | .715 |  |  |
| Frozen foods account for a large part of the food products I/we use in our household. | .829 |  |  | .569 |  |  |
| I/we frequently order dinner to be delivered, such as pizza, empanadas, etc. | .657 |  |  | .703 |  |  |
| Status seeking  *(*Bao et al., 2003*)* |  | .772 | .502 |  | .823 | .548 |
| It is important that others like the products and brands I buy. | ..610 |  |  | .538 |  |  |
| Sometimes I buy a product because my friends do so. | .736 |  |  | .804 |  |  |
| Name-brand purchase is a good way to distinguish people from others. | .783 |  |  | .820 |  |  |
| Name products and brands purchase can bring me a sense of prestige | .845 |  |  | .836 |  |  |
| Willingness to buy VASPs  (CSIRO, 2018) |  | .886 | .724 |  | .887 | .727 |
| A vegetable powder made from 100% whole carrot that can be used as a healthy ingredient for smoothies, dips, sauces etc. | .900 |  |  | .916 |  |  |
| A vegetable snack product made from 20% broccoli that is an ideal on-the-go healthy snack. | .878 |  |  | .880 |  |  |
| A fermented product based on vegetables that is rich in nutrients and fibre and can be used in baby food, dips, smoothies etc. | .893 |  |  | .847 |  |  |

**TABLE 2** PROFILE OF RESPONDENTS IN AUSTRALIA (N=329) AND UK (N=358)

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Australia % | UK % |
| Gender | Male | 31.52 | 50 |
|  | Female | 68.48 | 50 |
| Age | Under 20 yr | 2.42 | 6.98 |
|  | 21-29 yr | 22.12 | 25.7 |
|  | 30-39 yr | 26.97 | 15.92 |
|  | 40-49 yr | 14.55 | 8.94 |
|  | 50-59 yr | 10 | 8.38 |
|  | 60 yr or over | 23.94 | 34.08 |
| Employment status | Full-time employed | 25.76 | 43.85 |
|  | Part-time employed | 23.33 | 14.8 |
|  | Seeking work | 5.45 | 5.31 |
|  | Retired | 19.09 | 18.72 |
|  | Home duties | 18.79 | 7.26 |
|  | Student | 5.45 | 6.15 |
|  | Other | 2.12 | 3.91 |
| Education | No qualification | 2.73 | 2.79 |
|  | Yr 10 or 12 certificate | 33.64 | 29.61 |
|  | Trade certificate/vocational | 8.48 | 17.04 |
|  | Certificate | 14.85 | 4.19 |
|  | Diploma | 11.21 | 10.89 |
|  | Bachelor’s degree | 21.52 | 24.3 |
|  | Post-graduate degree | 7.58 | 11.17 |
| Household size | One-person household | 13.33 | 14.8 |
|  | Two-person household | 31.82 | 31.84 |
|  | Three-person household | 21.52 | 23.74 |
|  | Four-person household | 21.52 | 17.6 |
|  | Five-person household | 7.58 | 6.98 |
|  | Six-person household or more | 4.24 | 5.03 |
| Children in household | One child | 19.7 | 16.2 |
|  | Two children | 17.88 | 13.41 |
|  | Three children | 3.64 | 3.35 |
|  | Four children | 1.82 | 2.23 |
|  | Five or more children | 0.6 | 0.56 |
|  | None | 56.36 | 64.25 |
| Household income level | Less than $19,999 (£ for UK) | 13.94 | 22.23 |
|  | $20,000–$39,999 | 18.49 | 28.93 |
|  | $40,000–$59,999 | 18.78 | 16.36 |
|  | $60,000–$79,999 | 15.46 | 12.45 |
|  | $80,000–$99,999 | 16.06 | 10.50 |
|  | $100,000–$199,999 | 15.76 | 6.31 |
|  | $200,000 or more | 1.52 | 3.24 |

TABLE 3a. Descriptive statistics and correlation matrix (Australia sample)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | Willingness to buy VASP | 1 |  |  |  |  |  |  |  |  |  |  |  |
| 2 | Awareness of food waste consequence | 0.221\* | 1 |  |  |  |  |  |  |  |  |  |  |
| 3 | Convenience orientation | 0.129\* | -0.089 | 1 |  |  |  |  |  |  |  |  |  |
| 4 | Status seeking | 0.141\* | -0.009 | 0.456\* | 1 |  |  |  |  |  |  |  |  |
| 5 | Price consciousness | 0.096 | 0.453\* | -0.099 | -0.054 | 1 |  |  |  |  |  |  |  |
| 6 | Household size | 0.109\* | -0.095 | 0.135\* | 0.128\* | 0.007 | 1 |  |  |  |  |  |  |
| 7 | Number of children | -0.039 | 0.003 | -0.214\* | -0.089 | -0.006 | -0.502\* | 1 |  |  |  |  |  |
| 8 | Gender | -0.042 | -0.096 | 0.067 | 0.096 | -0.157\* | -0.150\* | 0.156\* | 1 |  |  |  |  |
| 9 | Income | 0.110\* | 0.071 | -0.129\* | 0.007 | -0.031 | 0.243\* | -0.131\* | 0.062 | 1 |  |  |  |
| 10 | Age | -0.128\* | 0.099 | -0.335\* | -0.051 | 0.124\* | -0.321\* | 0.422\* | 0.204\* | -0.012 | 1 |  |  |
| 11 | Employment status | -0.041 | -0.068 | -0.119\* | -0.123\* | 0.003 | -0.060 | 0.113\* | -0.201\* | -0.360\* | 0.090 | 1 |  |
| 12 | Education | 0.082 | 0.088 | -0.01 | 0.027 | 0.105 | 0.056 | 0.010 | 0.134\* | 0.312\* | -0.005 | -0.217\* | 1 |
|  | Mean | 4.234 | 5.154 | 3.513 | 3.636 | 5.233 | 2.918 | 5.279 | 0.313 | 6.545 | 3.794 | 3.067 | 3.930 |
|  | Std. Dev. | 1.325 | 0.909 | 1.253 | 1.120 | 1.076 | 1.349 | 3.155 | 0.464 | 3.354 | 1.548 | 1.744 | 1.826 |
|  | Min | 1 | 1.4 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
|  | Max | 7 | 7 | 7 | 7 | 7 | 8 | 8 | 1 | 13 | 6 | 7 | 7 |

Note: \*p<0.05

TABLE 3b. Descriptive statistics and correlation matrix (UK sample)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | Willingness to buy VASP | 1 |  |  |  |  |  |  |  |  |  |  |  |
| 2 | Awareness of food waste consequence | 0.119\* | 1 |  |  |  |  |  |  |  |  |  |  |
| 3 | Convenience orientation | 0.319\* | -0.012 | 1 |  |  |  |  |  |  |  |  |  |
| 4 | Status seeking | 0.280\* | -0.078 | 0.627\* | 1 |  |  |  |  |  |  |  |  |
| 5 | Price consciousness | 0.112\* | 0.432\* | 0.111\* | -0.008 | 1 |  |  |  |  |  |  |  |
| 6 | Household size | 0.221\* | 0.011 | 0.261\* | 0.159\* | 0.060 | 1 |  |  |  |  |  |  |
| 7 | Number of children | -0.147\* | 0.052 | -0.257\* | -0.271\* | 0.065 | -0.247\* | 1 |  |  |  |  |  |
| 8 | Gender | -0.075 | 0.048 | -0.088 | 0.024 | -0.06 | -0.061 | 0.024 | 1 |  |  |  |  |
| 9 | Income | -0.147\* | -0.003 | -0.179\* | -0.136\* | -0.135\* | -0.017 | 0.139\* | 0.067 | 1 |  |  |  |
| 10 | Age | -0.306\* | 0.049 | -0.422\* | -0.318\* | -0.045 | -0.336\* | 0.292\* | 0.217\* | 0.236\* | 1 |  |  |
| 11 | Employment status | -0.085 | -0.038 | -0.145\* | -0.235\* | 0.040 | 0.016 | 0.159\* | -0.160\* | 0.074 | 0.027 | 1 |  |
| 12 | Education | -0.013 | 0.051 | -0.059 | 0.004 | -0.008 | 0.004 | -0.034 | 0.230\* | 0.077 | 0.038 | -0.224\* | 1 |
|  | Mean | 3.960 | 5.001 | 3.554 | 3.642 | 4.934 | 2.880 | 5.788 | 0.500 | 6.193 | 3.883 | 2.648 | 4.084 |
|  | Std. Dev. | 1.579 | 1.094 | 1.286 | 1.289 | 1.061 | 1.424 | 3.024 | 0.501 | 4.150 | 1.805 | 1.856 | 1.923 |
|  | Min | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
|  | Max | 7 | 7 | 7 | 7 | 7 | 8 | 8 | 1 | 14 | 6 | 7 | 7 |

Note: \*p<0.05



TABLE 4. OLS regression results (Note: \*\*\*p<0.001; \*\*p<0.01; \*p<0.05; +p<0.1)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | All sample | | | | Australia | | | | UK | | | |
| DV: | VASP | vegetable powder | vegetable snack | fermented product | VASP | vegetable powder | vegetable snack | fermented product | VASP | vegetable powder | vegetable snack | fermented product |
| Awareness of food waste consequence | **0.24\*\*\***  **(0.24)** | **0.26\*\*\***  **(0.26)** | **0.22\*\***  **(0.22)** | **0.25\*\*\***  **(0.25)** | **0.34\*\*\***  **(0.34)** | **0.38\*\*\***  **(0.38)** | **0.32\*\***  **(0.32)** | **0.32\*\***  **(0.32)** | **0.19\***  **(0.19)** | **0.18\***  **(0.18)** | **0.16+**  **(0.16)** | **0.21\***  **(0.21)** |
| Convenience orientation | **0.1+**  **(0.1)** | 0.08  (0.08) | **0.14\***  **(0.14)** | 0.08  (0.08) | 0.09  (0.09) | 0.08  (0.08) | **0.14+**  **(0.14)** | 0.07  (0.07) | **0.15+**  **(0.15)** | 0.13  (0.13) | **0.16+**  **(0.16)** | **0.16+**  **(0.16)** |
| Status seeking | **0.17\*\***  **(0.17)** | **0.13\***  **(0.13)** | **0.11+**  **(0.11)** | **0.28\*\*\***  **(0.28)** | 0.12  (0.12) | **0.17\***  **(0.17)** | 0.03  (0.03) | **0.16\***  **(0.16)** | **0.16\***  **(0.16)** | 0.05  (0.05) | 0.14  (0.14) | **0.3\*\***  **(0.3)** |
| Price consciousness | 0.05  (0.05) | 0.02  (0.02) | **0.11+**  **(0.11)** | 0.03  (0.03) | 0.03  (0.03) | 0  (0) | 0.05  (0.05) | 0.03  (0.03) | 0.03  (0.03) | 0  (0) | 0.15  (0.15) | -0.05  (-0.05) |
| Household size | 0.1\*  (0.1) | 0.11\*  (0.11) | 0.11\*  (0.11) | 0.09+  (0.09) | 0.09  (0.09) | 0.08  (0.08) | 0.06  (0.06) | 0.11  (0.11) | 0.12\*  (0.12) | 0.13+  (0.13) | 0.14\*  (0.14) | 0.09  (0.09) |
| Number of children | 0.01  (0.01) | 0.03  (0.03) | 0.01  (0.01) | 0  (0) | 0.04  (0.04) | 0.03  (0.03) | 0.03  (0.03) | 0.06+  (0.06) | 0  (0) | 0.03  (0.03) | 0  (0) | -0.03  (-0.03) |
| Gender | -0.12  (-0.12) | -0.14  (-0.14) | -0.24+  (-0.24) | 0.02  (0.02) | -0.02  (-0.02) | -0.04  (-0.04) | 0  (0) | -0.03  (-0.03) | -0.1  (-0.1) | -0.12  (-0.12) | -0.37\*  (-0.37) | 0.2  (0.2) |
| Income | 0  (0) | -0.01  (-0.01) | 0  (0) | 0  (0) | 0.04  (0.04) | 0.02  (0.02) | 0.06\*  (0.06) | 0.04  (0.04) | -0.02  (-0.02) | -0.03  (-0.03) | -0.02  (-0.02) | -0.02  (-0.02) |
| Age | -0.14\*\*\*  (-0.14) | -0.14\*\*  (-0.14) | -0.11\*\*  (-0.11) | -0.15\*\*\*  (-0.15) | -0.12\*  (-0.12) | -0.09  (-0.09) | -0.13\*  (-0.13) | -0.13\*  (-0.13) | -0.14\*\*  (-0.14) | -0.18\*\*  (-0.18) | -0.08  (-0.08) | -0.16\*\*  (-0.16) |
| Employment status | -0.01  (-0.01) | -0.02  (-0.02) | 0.01  (0.01) | -0.02  (-0.02) | 0.03  (0.03) | 0.01  (0.01) | 0.08  (0.08) | 0.02  (0.02) | -0.03  (-0.03) | -0.03  (-0.03) | -0.02  (-0.02) | -0.03  (-0.03) |
| Education | 0.02  (0.02) | 0.03  (0.03) | 0.01  (0.01) | 0.01  (0.01) | 0.02  (0.02) | 0.03  (0.03) | 0  (0) | 0.04  (0.04) | 0  (0) | 0.02  (0.02) | 0.01  (0.01) | -0.03  (-0.03) |
| Constant | 4.29\*\*\*  (4.29) | 4.23\*\*\*  (4.23) | 4.37\*\*\*  (4.37) | 4.29\*\*\*  (4.29) | 3.76\*\*\*  (3.76) | 3.87\*\*\*  (3.87) | 3.86\*\*\*  (3.86) | 3.55\*\*\*  (3.55) | 4.45\*\*\*  (4.45) | 4.39\*\*\*  (4.39) | 4.45\*\*\*  (4.45) | 4.52\*\*\*  (4.52) |
| R-square | 0.14 | 0.10 | 0.11 | 0.15 | 0.11 | 0.10 | 0.09 | 0.10 | 0.18 | 0.12 | 0.15 | 0.21 |
| Adj R-squared | 0.13 | 0.09 | 0.10 | 0.13 | 0.08 | 0.07 | 0.06 | 0.07 | 0.15 | 0.10 | 0.12 | 0.19 |
| N | 687 | 687 | 687 | 687 | 329 | 329 | 329 | 329 | 358 | 358 | 358 | 358 |

TABLE 5. Cluster Analysis

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cluster 1: status and convenience seekers | Cluster 2: price and environmentally conscious | Difference |
| **Australia** | 251 (76.06%) | 79 (23.94%) |  |
| Status seeking | 3.82 | 3.04 | .78\*\*\* |
| Convenience orientation | 4.01 | 1.93 | 2.08\*\*\* |
| Food waste problem awareness | 4.99 | 5.68 | -.69\*\*\* |
| Price consciousness | 5.02 | 5.89 | -.87\*\*\* |
|  |  |  |  |
| **UK** | 210 (58.66%) | 148 (41.34%) |  |
| Status consciousness | 4.42 | 2.53 | 1.89\*\*\* |
| Convenience orientation | 4.22 | 2.61 | 1.61\*\*\* |
| Food waste problem awareness | 4.91 | 5.13 | -.21\* |
| Price consciousness | 4.93 | 4.94 | -.02 |

\*\*\* p < 0.001; \* p < 0.05

TABLE 6. Demographic distribution of two clusters

|  |  |  |
| --- | --- | --- |
|  | Cluster 1: status and convenience seekers | Cluster 2: price and environmentally conscious |
| **Australia** | 251 | 79 |
| Male | 33.07% | 26.58% |
| Female | 66.93% | 73.42% |
| Below 40 | 59.36% | 26.58% |
| 40-59 yr | 23.51% | 27.85% |
| 60 yr or older | 17.13% | 45.57% |
| Below undergraduate | 71.31% | 69.62% |
| Undergraduate and above | 28.69% | 30.38% |
| 1-3 members in household | 61.75% | 82.28% |
| More than 3 members in household | 38.25% | 17.72% |
| Full-time employment | 28.29% | 17.72% |
| Part-time employment | 23.90% | 21.52% |
| Seeking work or not in the labor force | 47.81% | 60.76% |
|  |  |  |
| **UK** | *210* | *148* |
| Male | 48.10% | 52.70% |
| Female | 51.90% | 47.30% |
| Below 40 | 62.86% | 28.38% |
| 40-59 yr | 15.71% | 19.59% |
| 60 yr or older | 21.43% | 52.03% |
| Below undergraduate | 68.10% | 59.46% |
| Undergraduate and above | 31.90% | 40.54% |
| 1-3 members in household | 66.67% | 75.68% |
| More than 3 members in household | 33.33% | 24.32% |
| Full-time employment | 50% | 35.14% |
| Part-time employment | 16.67% | 12.16% |
| Seeking work or not in the labor force | 33.33% | 52.7% |

TABLE 7. Willingness to buy VASP for two clusters in Australia and UK.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cluster 1: status and convenience seekers | Cluster 2: price and environmentally conscious | Difference |
| **Australia** | **251 (76.06%)** | **79 (23.94%)** |  |
| *Willingness to buy VASP* |  |  |  |
| *VASPa* | 4.27 | 4.11 | .16 |
| *vegetable powder* | 4.27 | 4.06 | .20 |
| *vegetable snack* | 4.42 | 4.22 | .21 |
| *fermented product* | 4.13 | 4.05 | .08 |
| **UK** | **210 (58.66%)** | **148 (41.34%)** |  |
| *Willingness to buy VASP* |  |  |  |
| *VASPa* | 4.25 | 3.54 | .71\*\*\* |
| *vegetable powder* | 4.2 | 3.68 | .52\*\* |
| *vegetable snack* | 4.38 | 3.78 | .59\*\*\* |
| *fermented product* | 4.19 | 3.17 | 1.02\*\*\* |

a *this is the average of the three VASP products; \*\*\* p < 0.001; \*\* p < 0.01*

TABLE 8. Ranking of factors influencing VASP acceptance

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cluster 1: status and convenience seekers | Cluster 2: price and environmentally conscious | Difference |
| **Australia** |  |  |  |
| *Other-oriented* |  |  |  |
| Helping farmers/growers to prevent food waste | 2.32 | 2.25 | .06 |
| Job creation | 3.29 | 3.72 | -.43\* |
| Positive effects on the natural environment | 3.32 | 2.93 | .39\* |
| Helping society | 3.86 | 3.58 | .28+ |
| *Self-oriented* |  |  |  |
| Healthy food | 3.69 | 4.19 | -.51\* |
| Good price | 4.43 | 4.27 | .16 |
|  |  |  |  |
| **UK** |  |  |  |
| *Other-oriented* |  |  |  |
| Helping farmers/growers to prevent food waste | 2.78 | 2.65 | .13 |
| Job creation | 3.65 | 4.06 | -.40\* |
| Positive effects on the natural environment | 3.40 | 2.99 | .41\* |
| Helping society | 3.55 | 3.46 | .09 |
| *Self-oriented* |  |  |  |
| Healthy food | 3.68 | 3.80 | -.12 |
| Good price | 4.18 | 4.04 | .15 |

*\* p < 0.05; + p < 0.1*

# **References**

Ajzen, I., 1991. The theory of planned behavior. Organizational behavior and human decision processes 50, 179-211.

Aschemann-Witzel, J., Giménez, A., Ares, G., 2018. Convenience or price orientation? Consumer characteristics influencing food waste behaviour in the context of an emerging country and the impact on future sustainability of the global food sector. Global Environmental Change 49, 85-94.

Aschemann-Witzel, J., Jensen, J.H., Jensen, M.H., Kulikovskaja, V., 2017. Consumer behaviour towards price-reduced suboptimal foods in the supermarket and the relation to food waste in households. Appetite 116, 246-258.

Balderjahn, I., Peyer, M., Seegebarth, B., Wiedmann, K.-P., Weber, A., 2018. The many faces of sustainability-conscious consumers: A category-independent typology. Journal of Business Research 91, 83-93.

Bao, Y., Zhou, K.Z., Su, C., 2003. Face consciousness and risk aversion: do they affect consumer decision‐making? Psychology & Marketing 20, 733-755.

Barauskaite, D., Gineikiene, J., Fennis, B.M., Auruskeviciene, V., Yamaguchi, M., Kondo, N., 2018. Eating healthy to impress: How conspicuous consumption, perceived self-control motivation, and descriptive normative influence determine functional food choices. Appetite 131, 59-67.

Bartels, J., Onwezen, M. C., 2014. Consumers' willingness to buy products with environmental and ethical claims: the roles of social representations and social identity. International Journal of Consumer Studies 38(1), 82-89.

Beretta, C., Stoessel, F., Baier, U., Hellweg, S., 2013. Quantifying food losses and the potential for reduction in Switzerland. Waste management 33, 764-773.

Bhatt, S., Lee, J., Deutsch, J., Ayaz, H., Fulton, B., Suri, R., 2018. From food waste to value‐added surplus products (VASP): Consumer acceptance of a novel food product category. Journal of Consumer Behaviour 17, 57-63.

Buckley, M., Cowan, C., McCarthy, M., 2007. The convenience food market in Great Britain: Convenience food lifestyle (CFL) segments. Appetite 49, 600- 617.

Birau, M. M., Faure, C., 2018. It is easy to do the right thing: Avoiding the backfiring effects of advertisements that blame consumers for waste. Journal of Business Research 87, 102-117.

Caliński, T., Harabasz, J., 1974. A dendrite method for cluster analysis. Communications in Statistics-theory and Methods 3, 1-27.

Candel, M.J.J.M., 2001. Consumers' convenience orientation towards meal preparation: conceptualization and measurement. Appetite 36, 15-28.

Chen, H., Jiang, W., Yang, Y., Yang, Y., Man, X., 2017. State of the art on food waste research: a bibliometrics study from 1997 to 2014. Journal of Cleaner Production 140, 840-846.

Conrad, Z., Niles, M.T., Neher, D.A., Roy, E.D., Tichenor, N.E., Jahns, L., 2018. Relationship between food waste, diet quality, and environmental sustainability. PLoS ONE 13, e0195405.

CSIRO, 2018. Converting food waste into nutritious ingredients. <https://www.csiro.au/en/Research/AF/Areas/Food-manufacturing/Making-healthier-foods/Converting-food-waste-into-nutritious-ingredients> (accessed 4 August 2019)

DEFRA, 2018. National Statistics. Family Food 2016/17: Purchases. <https://www.gov.uk/government/publications/family-food-201617/purchases#purchases> (accessed 6 August 2019).

Ellis, M., Coulton, R., Mauger, M. (2015). Empire of tea: The Asian leaf that conquered the world. Reaktion books.

De Hooge, I.E., Oostindjer, M., Aschemann-Witzel, J., Normann, A., Loose, S.M., Almli, V.L., 2017. This apple is too ugly for me!: Consumer preferences for suboptimal food products in the supermarket and at home. Food Quality and Preference 56, 80-92.

De Laurentiis, V., Corrado, S., Sala, S., 2018. Quantifying household waste of fresh fruit and vegetables in the EU. Waste management 77, 238-251.

Delley, M., Brunner, T.A., 2017. Foodwaste within Swiss households: A segmentation of the population and suggestions for preventive measures. Resources, Conservation and Recycling 122, 172-184.

Department of the Environment and Energy, 2018. Tackling Australia’s food waste. <https://www.environment.gov.au/protection/waste-resource-recovery/food-waste> (accessed 6 August 2019)

Devin, B., Richards, C., 2016. Food waste, power, and corporate social responsibility in the Australian food supply chain. Journal of Business Ethics, 1-12.

Diaz-Ruiz, R., Costa-Font, M. and Gil, J.M., 2018. Moving ahead from food-related behaviours: an alternative approach to understand household food waste generation. Journal of Cleaner Production 172, 1140-1151.

Di Talia, E., Simeone, M. and Scarpato, D., 2019. Consumer behaviour types in household food waste. Journal of Cleaner Production 214, 166-172.

Dorward, L.J., 2012. Where are the best opportunities for reducing greenhouse gas emissions in the food system (including the food chain)? A comment. Food Policy 37, 463-466.

Elliott, R., 2013. The taste for green: The possibilities and dynamics of status differentiation through “green” consumption. Poetics 41, 294-322.

Erickson, G. M., Johansson, J. K., 1985. The Role of Price in Multi-Attribute Product Evaluations. Journal of Consumer Research 12, 195-99.

Everitt, B., Landau, S.L., Stahl, M., 2011. Cluster Analysis. John Wiley & Sons, Chichester.

FAO, 2019. SAVE FOOD: Global Initiative on Food Loss and Waste Reduction. Key facts on food loss and waste you should know. <http://www.fao.org/save-food/resources/keyfindings/en/> (accessed 6 August 2019).

Field, A., 2013. Discovering statistics using IBM SPSS statistics. Sage.

Fornell, C., Larcker, D.F., 1981. Structural equation models with unobservable variables and measurement error: Algebra and statistics. Journal of marketing research, 382-388.

Garcia-Herrero, I., Hoehn, D., Margallo, M., Laso, J., Bala, A., Batlle-Bayer, L., Fullana, P., Vazquez-Rowe, I., Gonzalez, M., Durá, M., 2018. On the estimation of potential food waste reduction to support sustainable production and consumption policies. Food Policy 80, 24-38.

Gifford, R., Nilsson, A., 2014. Personal and social factors that influence pro‐environmental concern and behaviour: A review. International Journal of Psychology 49, 141-157.

Gjerris, M., Gaiani, S., 2013. Household food waste in Nordic countries: Estimations and ethical implications. Etikk i praksis-Nordic Journal of Applied Ethics, 6-23.

Gordon, A., 1999. Classiﬁcation, Chapman & Hall. CRC, London.

Griskevicius, V., Tybur, J.M., Van den Bergh, B., 2010. Going green to be seen: status, reputation, and conspicuous conservation. Journal of personality and social psychology 98, 392.

Grunert, K.G., Brunsø, K., Bredahl, L., Bech, A.C., 2001. Food-related lifestyle: a segmentation approach to European food consumers, in: Frewer L.J., Risvik E., Schifferstein H. (Eds.), Food, people and society. Springer, Berlin, Heidelberg, pp. 211-230.

Hair, J., Anderson, J., Tatham, R., 1987. Multivariate Data Analysis With Reading. (Eds.) Mc. Millan Pub. Co., New York.

Hamerman, E.J., Rudell, F., Martins, C.M., 2018. Factors that predict taking restaurant leftovers: Strategies for reducing food waste. Journal of Consumer Behaviour 17, 94-104.

Hamilton, C., Denniss, R., Baker, D.G., 2005. Wasteful consumption in Australia. Australia Institute Canberra.

Hofstede, G., Hofstede, G.J., Minkov, M., 2010. Cultures and organizations: Software of the mind, 3rd ed. McGraw-Hill, New York.

House, R.J., Hanges, P.J., Javidan, M., Dorfman, P.W., Gupta, V., 2004. Culture, leadership, and organizations: The GLOBE study of 62 societies. Sage publications.

House, J., 2016. Consumer acceptance of insect-based foods in the Netherlands: academic and commercial implications. Appetite, 107, 47-58.

IBISWORLD, 2018a. IBISWorld Business Environment Profile. Apparent fruit and vegetable consumption. September 2018.

IBISWORLD, 2018b. IBISWorld Industry Report G4111 Supermarkets and Grocery Stores in Australia. October 2018.

Ikiz, D., Gallardo, R.K., Dhingra, A., Hewitt, S., 2018. Assessing consumers’ preferences and willingness to pay for novel sliced packed fresh pears: A latent class approach. Agribusiness 34, 321-337.

Jackson, P., Viehoff, V., 2016. Reframing convenience food. Appetite 98, 1-11.

Jurgilevich, A., Birge, T., Kentala-Lehtonen, J., Korhonen-Kurki, K., Pietikäinen, J., Saikku, L., Schösler, H., 2016. Transition towards circular economy in the food system. Sustainability 8, 69.

Kaufman, L., Rousseeuw, P.J., 2009. Finding groups in data: an introduction to cluster analysis. John Wiley & Sons.

Kim, S.-W., Lusk, J.L., Brorsen, B.W., 2018. “Look at Me, I’m Buying Organic”: The Effects of Social Pressure on Organic Food Purchases. Journal of Agricultural and Resource Economics 43, 364-387.

Kourmentza, C., Economou, C.N., Tsafrakidou, P. Kornaros, M., 2018. Spent coffee grounds make much more than waste: Exploring recent advances and future exploitation strategies for the valorization of an emerging food waste stream. Journal of Cleaner Production 172, 980-992.

Lafarga, T., Gallagher, E., Bademunt, A., Bobo, G., Echeverria, G., Viñas, I., Aguiló‐Aguayo, I., 2018. Physiochemical and nutritional characteristics, bioaccessibility and sensory acceptance of baked crackers containing broccoli co‐products. International Journal of Food Science & Technology 54(3), 634-640.

Loebnitz, N., Schuitema, G., Grunert, K.G., 2015. Who buys oddly shaped food and why? Impacts of food shape abnormality and organic labeling on purchase intentions. Psychology & Marketing 32, 408-421.

McKenzie, T.J., Singh-Peterson, L., Underhill, S.J., 2017. Quantifying postharvest loss and the implication of market-based decisions: A case study of two commercial domestic tomato supply chains in Queensland, Australia. Horticulturae 3, 44.

Miller, D.D., Welch, R.M., 2013. Food system strategies for preventing micronutrient malnutrition. Food Policy 42, 115-128.

Milligan, G.W., Cooper, M.C., 1985. An examination of procedures for determining the number of clusters in a data set. Psychometrika 50, 159-179.

Mintel, 2017. Ready meals and ready-to-cook foods – UK – July 2017. <https://store.mintel.com/ready-meals-and-ready-to-cook-foods-uk-july-2019> (accessed 4 August 2019).

Morone, P., Koutinas, A., Gathergood, N., Arshadi, M., Matharu, A., 2019. Food waste: Challenges and opportunities for enhancing the emerging bio-economy. Journal of cleaner production. 221, 10-16.

Mourad, M., 2016. Recycling, recovering and preventing “food waste”: competing solutions for food systems sustainability in the United States and France. Journal of Cleaner Production 126, 461-477.

Murekezi, A., Oparinde, A., Birol, E., 2017. Consumer market segments for biofortified iron beans in Rwanda: Evidence from a hedonic testing study. Food policy 66, 35-49.

Murray, A., Skene, K., Haynes, K., 2017. The circular economy: An interdisciplinary exploration of the concept and application in a global context. Journal of Business Ethics 140, 369-380.

O'Cass, A., McEwen, H., 2004. Exploring consumer status and conspicuous consumption. Journal of Consumer Behaviour 4, 25-39.

Papargyropoulou, E., Lozano, R., Steinberger, J.K., Wright, N., bin Ujang, Z., 2014. The food waste hierarchy as a framework for the management of food surplus and food waste. Journal of Cleaner Production 76, 106-115.

Popkin, B.M., Adair, L.S. and Ng, S.W., 2012. Global nutrition transition and the pandemic of obesity in developing countries. Nutrition reviews, 70(1), pp.3-21.

Puska, P., Kurki, S., Lähdesmäki, M., Siltaoja, M., Luomala, H., 2018. Sweet taste of prosocial status signaling: When eating organic foods makes you happy and hopeful. Appetite 121, 348-359.

Reynolds, C., Goucher, L., Quested, T., Bromley, S., Gillick, S., Wells, V.K., Evans, D., Koh, L., Kanyama, A.C., Katzeff, C., 2019. Consumption-stage food waste reduction interventions–What works and how to design better interventions. Food Policy 83, 7-27.

Ribeiro, I., Sobral, P., Peças, P., Henriques, E., 2018. A sustainable business model to fight food waste. Journal of Cleaner Production 177, 262-275.

Rihn, A., Khachatryan, H., Wei, X., 2018. Assessing Purchase Patterns of Price Conscious Consumers. Horticulturae 4, 13.

Rohm, H., Oostindjer, M., Aschemann-Witzel, J., Symmank, C., L. Almli, V., De Hooge, I.E., Normann, A., Karantininis, K., 2017. Consumers in a Sustainable Food Supply Chain (COSUS): Understanding Consumer Behavior to Encourage Food Waste Reduction. Foods 6, 104.

Rousseau, D.M., 1989. Psychological and implied contracts in organizations. Employee responsibilities and rights journal 2, 121-139.

Schwartz, S.H., 1992. Universals in the Content and Structure of Values: Theoretical Advances and Empirical Tests in 20 Countries, in: Zanna, M.P. (Ed.), Advances in Experimental Social Psychology. Academic Press, pp. 1-65.

Secondi, L., Principato, L., Laureti, T., 2015. Household food waste behaviour in EU-27 countries: A multilevel analysis. Food Policy 56, 25-40.

Sexton, S.E., Sexton, A.L., 2014. Conspicuous conservation: The Prius halo and willingness to pay for environmental bona fides. Journal of Environmental Economics and Management 67, 303-317.

Shin, Y.H., Im, J., Jung, S.E., Severt, K., 2019. Motivations behind Consumers’ Organic Menu Choices: The Role of Environmental Concern, Social Value, and Health Consciousness. Journal of Quality Assurance in Hospitality & Tourism 20, 107-122.

Silvestri, C., Cirilli, M., Zecchini, M., Muleo, R., Ruggieri, A., 2018. Consumer acceptance of the new red-fleshed apple variety. Journal of food products marketing 24, 1-21.

Stancu, V., Haugaard, P., Lähteenmäki, L., 2016. Determinants of consumer food waste behaviour: Two routes to food waste. Appetite 96, 7-17.

Statista, 2019. Food & Nutrition: Statistics and facts on Food & Nutrition. <https://www.statista.com/markets/415/topic/468/food-nutrition/> (accessed 6 August 2019).

Stefan, V., van Herpen, E., Tudoran, A.A., Lähteenmäki, L., 2013. Avoiding food waste by Romanian consumers: The importance of planning and shopping routines. Food Quality and Preference 28, 375-381.

Stern, P.C., 1992. Psychological Dimensions of Global Environmental Change. Annual Review of Psychology 43, 269-302.

Stets, J.E., Biga, C.F., 2003. Bringing identity theory into environmental sociology. Sociological Theory 21(4), 398-423.

Stewart-Knox, B., Mitchell, P., 2003. What separates the winners from the losers in new food product development? Trends in Food Science & Technology 14, 58-64.

Tey, Y. S., Suryani, D., Emmy, F. A., Illisriyani, I., 2009. Food consumption and expenditures in Singapore: implications to Malaysia’s agricultural exports. International Food Research Journal 16(2), 119-126.

Theotokis, A., Pramatari, K., Tsiros, M., 2012. Effects of expiration date-based pricing on brand image perceptions. Journal of Retailing 88, 72-87.

Tsiros, M., Heilman, C.M., 2005. The effect of expiration dates and perceived risk on purchasing behavior in grocery store perishable categories. Journal of marketing 69, 114-129.

UN, 2015. Transforming our world: The 2030 Agenda for Sustainable Development United Nations General Assembly. Resolution adopted by the General Assembly. United Nations, New York.

van Giesen, R. I., de Hooge, I. E., 2019. Too ugly, but I love its shape: Reducing food waste of suboptimal products with authenticity (and sustainability) positioning. Food Quality and Preference 75, 249-259.

Veeman, M., 2002. Policy development for novel foods: issues and challenges for functional food. Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie 50, 527-539.

Verain, M.C., Bartels, J., Dagevos, H., Sijtsema, S.J., Onwezen, M.C. and Antonides, G., 2012. Segments of sustainable food consumers: a literature review. International Journal of Consumer Studies 36(2), 123-132.

Verghese, K., Lewis, H., Lockrey, S., Williams, H., 2013. The role of packaging in minimising food waste in the supply chain of the future. CHEP Australia, Sydney, Australia.

Walter, S. L., Seibert, S. E., Goering, D., O’Boyle, E. H. 2018. A tale of two sample sources: Do results from online panel data and conventional data converge? Journal of Business Psychology, 1-28.

Wolfe, K.L., Liu, R.H., 2003. Apple peels as a value-added food ingredient. Journal of Agricultural and Food Chemistry 51, 1676-1683.

World Bank, 2017. Individuals using the Internet (% of population). <https://data.worldbank.org/indicator/IT.NET.USER.ZS?end=2017&start=2017&view=map> (accessed 6 August 2019).

Worsley, A., Scott, V., 2000. Consumers’ concerns about food and health in Australia and New Zealand. Asia Pacific Journal of Clinical Nutrition 9, 24-32.

WRAP, 2018. Household food waste: restated data for 2007-2015. The Waste and Resources Action Programme, Oxon, UK.

Yang, D., Lu, Y., Zhu, W., Su, C., 2015. Going green: How different advertising appeals impact green consumption behavior. Journal of Business Research 68, 2663-2675.

Zhang, X., Huang, J., Qiu, H., Huang, Z., 2010. A consumer segmentation study with regards to genetically modified food in urban China. Food policy 35, 456-462.