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Completing the food waste management loop – is there market potential for value-added surplus products (VASP)?

Abstract

Consumer acceptance of novel value-added surplus products (VASP) is under-explored in the academic literature, despite having important consequences for society because they contribute to food waste reduction. A survey of 687 consumers in Australia and the UK was undertaken to examine influential factors on willingness to buy VASP and identify potential consumer segments. Regression analysis indicates that consumers who are price conscious, convenience oriented, status seeking and concerned about food waste consequences are more willing to buy VASP than others. Through cluster analysis, two consumer segments are identified: the 'status and convenience seeker' and the 'price and environmentally conscious' consumer. Respondents mainly link benefits associated with purchasing VASP with 'other-oriented' benefits, such as farmers' welfare, rather than 'self-oriented' benefits, such as healthy food. This study provides 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.

Highlights

- There is potential market for VASP in both Australia and the UK

- Two market segments: status & convenience seeker and price & environmentally conscious

- Other-oriented are more important than self-oriented benefits for VASP acceptance

1. Introduction

Food waste is a global problem with environmental, economic and social consequences (Brosius et al., 2013; Garcia-Herrero et al., 2018; Jurgilevich et al., 2016; Wiener et al., 2018). The United Nations Sustainable Development Goals 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). 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). Food waste has received increased attention in research with a strong focus on initiatives to address post-consumer food waste, however, scholars tend to overlook some important options for reducing food waste early in the food supply chain (Chen et al., 2017; Reynolds et al., 2019; Secondi et al., 2015).

At the pre-consumption stage, surplus, underutilized or even 'inedible' food, which is perceived to be safe and healthy for consumption, such as broccoli stems or carrot peels, can be kept and transformed into 'ready-to-eat' foods with enhanced concentrations of micro-nutrients products or functional foods (Miller and Welch, 2013; Wolfe and Liu, 2003). 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).

However, research on novel VASP is sparse and to our knowledge, only one study investigated consumers' use of cues and perceptions of VASP (see Bhatt et al., 2018). In addition, policy challenges have been identified around the development and acceptance of novel foods (Veeman, 2002). Thus, the aim of this study is to examine consumers' willingness to buy novel VASP by identifying promising consumer segments as well as shedding light on purchasing motivations.

To our knowledge, the current research is the first attempt to assess consumers'
willingness to buy VASP, particularly on consumers across two countries: Australia and the
UK. This paper therefore makes two original contributions to this developing field of
research. Firstly, it identifies the factors that influence the acceptance of VASP, thus
advancing the theoretical and practical understandings in the area of novel product
acceptance and ethical consumption. Secondly, it provides an insight into different market
segments for VASP, which can lead to targeted and therefore more effective communication
strategies from a policy and marketing point of view (Balogh et al., 2016; Garrone et al.,
2014; Kreuter and Wray, 2003; Veeman, 2002; Visschers et al., 2013).

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
(Beretta et al., 2013; McKenzie et al., 2017). However, it is challenging to prevent waste at
the source, the farm or processing level (Mourad, 2016) due to various cultural, social or
economic choices made by producers. For example, farmers dispose of 'abnormal', 'ugly' or
'substandard' fruit and vegetables that do not meet buyers' stringent aesthetic requirements
(Aschemann-Witzel et al., 2017). Furthermore, farmers are incentivised to over-produce in
order 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). Sustainable food projects have emerged to redistribute the food that
farmers cannot sell through conventional channels (Ribeiro, Sobral, Peças, and Henriques,
2018).

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 purposes of this study, we define novel VASP 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-product 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, Economou, Tsafrakidou, and Kornaros, 2018). For example, broccoli is a vegetable with high nutritional value but highly perishable; hence, 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). So, this study aims to assess consumer acceptance of VASP which can provide support for managerial and policy decisions (Delmond et al., 2018).

2.2 Market Segmentation

Appropriate segmentation and targeting are important for the acceptance of novel products (Gielens and Steenkamp, 2007; Zhang et al., 2010; 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, Simeone, and

Scarpato, 2019). The main variables used for segmentation related to pro-environmental behaviors are socio-demographic, attitudinal and behavioral, with the later being perceived as better starting points for constructing market segments (Verain et al., 2012). So, our study considers both socio-demographic and behavioral aspects to identify the segments most responsive to VASP, which will lead to practical recommendations for marketers and policy makers to improve VASP acceptance (Balogh et al., 2016). To provide meaningful segmentation, the selection of the variables should be theory based (Kaufman and Rousseeuw, 2009). Therefore, in the next section we discuss theoretically-based aspects that could inform consumer segments for VASP.

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, 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). Essentially, consumers forgo personal gains and experience less concern/guilt if they feel that purchasing pro-environmental products will contribute to the welfare of the society (Griskevicius et al., 2010; Stefan et al., 2013; Yang et al., 2015). Hamerman et al. (2018) argue that environmental concerns will encourage various pro-environment behaviors among consumers, such as taking home restaurant leftovers. VASP are considered pro-environmental products because their main purpose is the reduction of food waste (Bhatt et al., 2018). Research on food waste has found that environmental concern has a significant

indirect effect towards food waste through recycling and prevention (Diaz-Ruiz, Costa-Font, and Gil, 2018). Likewise, research on sub-optimal food (i.e., abnormally shaped food or close to the expiry date) shows that an awareness of food waste issues and having a strong pro-environmental self-identity drives purchase intention (De Hooge et al., 2017; Loebnitz et al., 2015). Numerous theories have been applied to studies of sustainable behavior, including identity theory (Stets and Biga, 2003), the theory of planned behavior (Ajzen, 1991) and Schwartz's value theory (Schwartz, 1992). Environmental concern is treated as a value orientation such as universalism (Schwartz, 1992) and is associated with anthropocentric altruism (Stern, 1992), where people attach importance to acting for the good of others or nature. It is also treated as an attitude that influences intentions towards environment-related behaviors (Ajzen, 1991) and attitudes are revealed through the 'New Ecological Paradigm' (Dunlap et al., 2000). Therefore, it is expected that consumers' concern for the negative consequence of food waste on the environment would encourage a pro-environmental behavior of purchasing VASP to reduce food waste. Thus, 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) showed that consumers' willingness-to-pay decreases with the extent of the remaining shelf-life, and Rohm et al. (2017) found that consumers

appear to carefully assess their ability to consume the price-reduced suboptimal food by considering date issues and product quality. So, the choice of suboptimal food is an interaction between price discounts and perception of quality of the product that works, according to the social exchange theory, as a form of a psychological contract between the seller and the consumer (Rousseau, 1989). 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 eliminating any psychological contract violations and having 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. We therefore argue that consumers who are price conscious will perceive VASP as value-for-money and react positively.

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

According to signaling theory (Griskevicius et al., 2010), status seeking drives consumers to purchase conspicuous products to enhance their sense of self, social image, or own personal sense of taste (Li et al., 2015; 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).

Social status has emerged as an important motivator for 'green' or 'environmentally-friendly' consumption. Scholars connect green consumption to social status, positioning it as an opportunity for consumers to signal their social status conspicuously (Elliott, 2013; Griskevicius et al., 2010; Puska et al., 2018). In addition, Elliott (2013) argues that even low-involvement and non-luxury goods can accomplish social differentiation through the

individual expressions of taste. For instance, scholars propose that some may consume organic food to differentiate themselves from others and to gain a positive self-image and identity (Aertsens et al., 2009; Belk, 1988; Kim et al., 2018; Shin et al., 2019) or as a form of social signaling among peers (Barauskaite et al., 2018). There is little evidence that status seeking can successfully predict willingness to buy VASP. However, VASP carries attributes of being green and pro-environmental, as well as innovation and creativity. It is possible that consuming VASP could enhance consumers' self-esteem or social acceptance. Hence, we propose the following hypothesis:

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 particularly around food decisions (Aschemann-Witzel et al., 2018; Candel, 2001; Jaeger, 2006). 'Convenience foods' encompass a wide variety of processed and semi-processed food (i.e., pre-cut vegetables, frozen and canned foods, ready meals), frequently contrasted with 'fresh' foods using raw ingredients that are cooked from scratch (Jackson and Viehoff, 2016). Novel VASP enable the consumer to consume food easily, for instance as a plant-based snack or cracker in or outside of the home (i.e. while exercising or at work/school). Hence, 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 our study and the relevance of VASP in more than one country, we replicated the same survey in two culturally similar countries, i.e. Australia and the U.K. Previous research examining consumers' ratings of food and health concerns across Western countries have found similar results (Worsley and Scott, 2000), hence we hypothesize that Australian consumers will be similar to UK consumers in terms of willingness to buy VASP. We expect that 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), but drawing from culture theory, the markets are culturally similar as they both belong to the Anglo countries group (House et al., 2004) and so their pro-environmental attitudes will be similar (Gifford and Nilsson, 2014; Hofstede et al., 2010). Thus, we hypothesize that:

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

4. Materials and 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 Scenarios

To examine participants' intentions to consume VASP, we developed three scenarios. As there is scant literature on VASP, these three 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 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 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 scenarios solely focused on vegetables as they are one of the main foods wasted both in the UK and Australia (De Laurentiis et al., 2018; Hamilton et al., 2005). In addition, vegetables require greater amounts of agricultural inputs, such as irrigated water, pesticides and fertilisers, than most other crops, hence reducing their environmental impact by reducing their waste is a critical focus globally (Conrad et al., 2018).

4.2 Data Collection and Sample

Empirically, our 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 million tons of edible food costing approximately \$20 billion (Department of the Environment and Energy, 2018) while in the UK, household food waste is estimated at 7.1 million tons costing about £15 billion (WRAP, 2018).

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. To ensure a diverse and comparable sample across the two countries, we used gender, age and income as quotas. After removing outliers and responses with missing data, we had 329 and 358 responses from Australia and the UK respectively. Ethics approval for the study was secured from the Ethics Committees in the authors' Universities.

4.3 Variables and Measures

We measured the willingness to buy for VASP using a seven-item scale ranging from extremely unwilling (=1) to extremely willing (=7) to buy the above mentioned VASP.
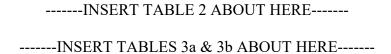
Regarding respondents' motivations for buying VASP, we selected measures of environmental concern and awareness of the consequences of food waste from previous studies by Gjerris and Gaiani (2013) and Delley and Brunner (2017). The scale for price consciousness was derived from the food-related lifestyle survey (Grunert et al., 2001). The scale for convenience orientation came from the work of Aschemann-Witzel et al. (2018). The scale for status seeking was taken from a study by Bao et al. (2003).

To achieve the best possible quality, we selected items with high internal reliability (Cronbach's alphas) from previous studies (see Table 1). For all the measures on motivational factors, instructions were included in the survey: "Please rate your 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 ranged 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.

-------INSERT TABLE 1 ABOUT HERE-------

Data was also collected on socio-demographics (age, employment status, education, household size, children in household and household income level). The demographic information of respondents from the two countries is presented in Table 2. Regarding the sample characteristics, in the Australian sample, more females (69%) than males participated in the survey. There were equal numbers of males and females in the UK sample. Overall, the survey participants were 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 square regression and cluster analysis were performed in STATA 12.0.

-------INSERT TABLE 2 ABOUT HERE-------

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

5. Results

Results are presented in the following section.

5.1 Willingness to buy VASP

Our results revealed 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. However, 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; $p < 0.01$). Hence, hypothesis 5 was not supported.

5.2 Motivational factors explaining consumers' willingness to buy VASP

We conducted Ordinary Least Squares regression analysis to investigate which factors matter in consumers' willingness to buy VASP. The results are shown in Table 4. There was a significant, positive relationship between concern about the consequences of food waste for society, status seeking, convenience orientation, and willingness to buy VASP, supporting Hypotheses 1, 3 and 4, while price consciousness shows a significantly positive relationship with willingness to buy, but only for the vegetable snack. Hence, hypothesis 2 was partially supported.

----------INSERT TABLE 4 ABOUT HERE----------

We further tested 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 interaction with the four factors (environmental concern, 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.

5.3 Segmentation based on cluster analysis

Given that all the four factors show significant results in influencing consumers' acceptance of VASP, we conducted cluster analysis to identify consumer segments in the Australian and UK samples respectively.

Using Ward's (Hair et al., 1987) method in STATA, a cluster analysis was performed on each case's factor means on the four factors for Australian and UK samples respectively. We used the stopping rule based on Calinski–Harabasz pseudo-F index (1974)[1] to decide the number of clusters. Large values of the Calinski–Harabasz pseudo-F index indicates distinct clustering. The 2-cluster solutions show the greatest pseudo-F value (100.17 and 129.94 for Australian sample and UK sample respectively).

As shown in Table 5, in both countries' samples, the first cluster is featured by significantly higher status and convenience seeking behavior, which we term as "status and convenience seekers". The second cluster is featured by significantly higher price consciousness and environment consciousness, which we term as "price and environmentally conscious". When looking into the two countries, we found 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, we further conducted T-test for observed means 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 some demographic characteristics. Most of Cluster 1 (status and convenience seekers) are young (below 40 years 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 years 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 status and convenience seekers in the two countries.

-------------INSERT TABLE 6 ABOUT HERE-------------

Results in Table 7 show that in Australia, the two clusters do not show significant difference in the consumers' acceptance of VASP, while in the UK, those 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 target one segment more, i.e., the status and convenience seekers.

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We also asked the consumers in two countries to rank several potential self-oriented and other-oriented factors that attract them to buy VASP. Consumers ranked six factors from 1 to 6, with 1 indicating most important and 6 indicating the least important factor. 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). We conducted t-test again on their ranking for the six factors across the two clusters. A significant lower mean of ranking indicates a higher level of importance perceived by the consumers. Results in Table 8 show that in both countries, consumers always rank other-oriented factors as more important than self-oriented factors when asked why they would like

to buy VASP. When comparing two clusters, in Australia, 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

It is noted that while there is a willingness to buy VASP, the high failure rates associated with new products are well documented in the literature (Stewart-Knox and Mitchell, 2003), therefore an understanding of the potential market is necessary to shed light onto the marketing strategies and policies needed for VASP acceptance. Our study responds to this call by examining willingness to buy VASP along with influential factors that motivate purchase and consumer segmentation. Our study contributes to the wider literature on ethical and sustainable consumption by examining why consumers are willing to buy VASP and engage in ethical behaviors (Bhatt et al., 2018; Komarova Loureiro et al., 2016). We used a large sample covering two countries, a robust methodological approach to investigate causal relationships and our study is the first to identify consumers segments willing to buy VASP.

Our findings show that 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. Our results are comparable with extant studies on preference for novel foods, which suggest that around 57% to 67% of consumers are willing to buy novel food made of vegetable or fruits (e.g. Ikiz et al., 2018; Silvestri et al., 2018). An interesting finding is that Australian consumers are significantly more willing to buy VASP than UK consumers. Further analysis of influential factors reveals that Australian respondents show higher level of awareness of food waste consequences (5.15 vs. 5.00, difference is significant at $p<0.05$) and more concern about price (5.23 vs. 4.93, difference is significant at $p<0.001$), which could explain the greater willingness to buy among Australian respondents than British

respondents. Nevertheless, overall, our results confirm the market potential for VASP, so food processors could explore commercialization opportunities for VASP in the UK and Australia as well as culturally similar markets such as New Zealand, USA and Ireland.

Our study integrates theory and research findings to recommend policy and marketing interventions covering the lack of theoretical informed interventions identified in previous studies (Reynolds et al., 2019). At the policy level, our findings of the market potential for VASP supports an avenue towards the circular economy (Murray et al., 2017), i.e. recovering more fruit and vegetables from the food system and transforming them into novel products. Meeting a food waste reduction goal necessitates "improved infrastructure and technological solutions in harvesting, storage, transport and distribution, supported by large-scale investment and local policies" (Papargyropoulou et al., 2014, p. 114). We, therefore, call for government support of advanced food processing as well as tax incentives to encourage members of the food supply chain to become involved in waste valorization activities. Government could push powerful supply chain members to build up the 'feedstock' needed for an advanced food processing industry and offer tax incentives or grants to the agri-food industry to invest in infrastructure, such as food recovery centers, distribution hubs and advanced manufacturing. Such measures targeting 'seconds' could be investigated in the UK and Australia.

In terms of understanding the factors that determine acceptance of VASP, the general food marketing literature highlights that consumer acceptance of novel foods is multi-factorial in nature, including food neophobia, sensory perceptions and demographics (Huang et al., 2019; Kamarulzaman et al., 2014). In line with other studies, VASP could be appealing to environmentally conscious consumers (De Hooge et al., 2017; Loebnitz et al., 2015). In addition, scholars note the dual role of price (Grunert, 2005; Jaeger, 2006) where a higher price could play

a negative role in purchase decisions, but can also play a positive role due to other factors, such as quality, safety or health cues. While VASP could be positioned as a healthy, premium-priced food, 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 associations with food waste and sub-optimal food. Due to its pro-social stance emanating from food waste reduction campaigns and innovative processing method, VASP may be very attractive to status seeking consumers. Such results provide further empirical evidence to the impact of status seeking on food choices (Aertsens et al., 2009; Barauskaite et al., 2018; Elliott, 2013; Kim et al., 2018; Puska et al., 2018; Shin et al., 2019). Lastly, the nature of ready-to-eat processed food could attract convenience-oriented consumers (e.g. Aschemann-Witzel et al., 2018; Jackson and Viehoff, 2016).

Based on these four factors, our clustering 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. On the one hand, in both segments, respondents ranked 'other-oriented benefits' (e.g., farmer-welfare) as more important than self-benefiting factors (e.g., health, price) when asked to rank the factors that would influence purchase of VASP. Policy makers and businesses can use these insights to frame their public education program and marketing appeals. For example, given the importance of 'other-oriented' benefits, it is recommended that messages could highlight empathy and care for farmer welfare and the consequences of food waste for the environment, such as the waste of resources and greenhouse gas emission along the entire food supply chain (World Resources Institute, 2013).

On the other hand, the two segments also show differences in demographics and perspectives. 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). Specifically, our findings of the differences across the two segments could have important implications for marketers and policy makers. For those status and convenience seekers who are typically younger and holding a full-time or part-time job, messages could highlight the creative, scientific method of processing VASP. Celebrities could be invited to endorse VASP to create a positive social image. Ready-to-eat and easy-to-store attributes could be promoted via social media to target these younger demographics. In relation to the price and environmentally conscious consumers, they have a greater concern for the environment and the price of a product. They are typically older and many are not working. As such, setting the right price is probably the key to consumer acceptance. Marketing messages could highlight the food waste problem and show how VASP help save the environment, without being expensive for the consumer.

7 Limitations and Future Research

We acknowledge some limitations and call for further research. Our research did not ask respondents to compare VASP with conventional, fresh produce. Health-conscious individuals are likely to consume fresh or raw produce rather than processed products, so future studies could compare VASP to other healthy alternatives to understand the relative willingness to buy VASP. This study focused on a limited number of motivating factors, but many constructs can directly affect willingness to buy, such as sensory-related attributes and marketing. Future studies could test other constructs that might influence purchase, such as appearance, taste, texture, brand name, product description and labelling, as well as impact of setting/situational factors on purchase decisions (i.e., in home and out-of-home consumption). Qualitative research

and experimental research designs would also be useful in exploring consumers' perceptions of these foods.

8 Conclusion

New products, derived from fruit and vegetable waste, offer environmental benefits by helping address the food waste crisis. VASP could potentially reduce the amount of food discarded as waste, promote health and open up novel commercial opportunities to food processors. This research, based on survey data from consumers in Australia and the UK, makes several novel contributions to the literature. Firstly, although research has identified the contribution of VASP as a market solution to solving food waste, this new food category has received scant attention by academic researchers. This study is thus one of the few studies to explore willingness to buy and the factors that influence the purchase decision and consumer segments in a large sample of consumers in two countries. Second, by incorporating 'self' and 'other-oriented' motives, we explored the factors that influence the purchase of VASP, thus augmenting the food waste and ethical consumption literature. Our study provides insight into what food processors, from the field of vegetable and fruit processing, as well as marketing practitioners and policy makers, can do to curb food waste at the pre-consumption stage.

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.

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.

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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 problem (Gjerris & Gaiani, 2013)		.846	.513		.875	.563
Food waste is a big environmental issue.	.783			.807		
Food waste is an important social issue (e.g. world hunger).	.815			.794		
Foods are scarce over the world and should be consumed consciously.	.819			.847		
Foods are gifts of nature and have to be treated as such.	.746			.823		
In my country, the food waste generated by households has great financial consequences.	.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 years	2.42	6.98
	21-29 years	22.12	25.7
	30-39 years	26.97	15.92
	40-49 years	14.55	8.94
	50-59 years	10	8.38
	60 years 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
	Year 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	Food waste problem awareness	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

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	Food waste problem awareness	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

FIGURE 1: Willingness to buy VASPs: vegetable powder, snack and fermented baby product.

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

DV:	All sample				Australia				UK			
	VASP	vegetable powder	vegetable snack	fermented product	VASP	vegetable powder	vegetable snack	fermented product	VASP	vegetable powder	vegetable snack	fermented product
Food waste problem awareness	**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 years	23.51%	27.85%
60 years 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 years	15.71%	19.59%
60 years 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. Response to VASP.

	Cluster 1: status and convenience seekers	Cluster 2: price and environmentally conscious	Difference
Australia	**251 (76.06%)**	**79 (23.94%)**	
Willingness to buy VASP			
VASP[a]	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%)**	
Preference to VASP			
VASP[a]	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			
Others-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			
Others-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

* $p < 0.05$; + $p < 0.1$