

Consumer acceptance of insects and ideal product attributes

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Abstract

Purpose – Insects can be sustainably produced and are nutrient rich. However, adoption of insects in western culture, including New Zealand (NZ) is slow. The purpose of this paper is to explore consumer attitudes, drivers and barriers towards entomophagy and uncover consumer expectations surrounding what their ideal insect product attributes are.

Design/methodology/approach – In total, 32 participants took part in three product design workshops. This involved two sections. First, focus groups discussion took place surrounding consumer acceptance. Second, following adapted consumer idealised design, groups of three or four designed their ideal liquid and solid product incorporating extracted insect protein. Designs included the ideal product, place, price and promotional attributes.

Findings – Participants were both disgusted and intrigued about entomophagy, with common barriers including; culture, food neophobia, disgust sensitivity, lack of necessity and knowledge. Motivational drivers were novelty, health, sustainability and/or nutrition. Most of the liquid and solid food products were designed as a premium priced sweet snack, drink or breakfast option, as opposed to a meat substitute. The convenience, health and sustainability benefits of certain products were promoted towards health and fitness oriented consumers. Whereas, other designs promoted the novelty of insects to kids or the general population, in order to introduce the idea of entomophagy to consumers.

Originality/value – The study is the first attempt at uncovering what insect products NZ consumers are accepting of; therefore, contributing to both limited research and product development opportunities for industry.

Keywords Product attributes, Marketing mix, Consumer acceptance, Entomophagy, Consumer idealised design, Insect protein

Paper type Research paper

1. Introduction

Usually, insects are kept away from food; however, there has been a growing interest to purposely and creatively incorporate them into the diets of consumers around the world. Insects are eaten in food cultures covering 2bn people mostly in Africa, Asia and Latin America (van Huis *et al.*, 2013). They can be eaten at various life stages including eggs, nymphs and adults, depending on the species and processing method (Ramos-Elorduy, 2009). Whether it is whole fried scorpions in the streets of Thailand, or a protein bar packed full of ground cricket flour, all 1,900 edible species are unique and have significant potential as a food source (van Huis *et al.*, 2013).

Food and meat production have a large impact on the environment. The agricultural sector alone utilises 70 per cent of the limited land and fresh water resources (van Huis *et al.*, 2013; Pimentel *et al.*, 2004). Combined with increases in population and food demand, especially meat in both developed and undeveloped countries, there has been a push for more sustainable options (Verbeke, 2015). Production of insects is a very sustainable practice compared to livestock farming, as they require significantly less feed, land and water, and produce considerably less ammonia and greenhouse gas emissions (Oonincx *et al.*, 2011; van Huis *et al.*, 2013). Additionally, insects compare favourably in terms of nutrition, with high amounts of protein, unsaturated fatty acids, minerals and certain vitamins (Rumpold and Schlüter, 2013). Composition varies largely depending on species, habitat and diet; however, protein contents can reach up to 81 per cent (dry basis) (Raksakantong *et al.*, 2010), making them a potential protein or meat substitute for the future. Furthermore, extracting insect protein not only increases the protein content (per 100 g) and digestibility (Yi *et al.*, 2013), but is a potential application as a value-added



ingredient in food or liquid products, as well as overcoming consumer acceptance barriers to whole insects.

Even with the benefits of entomophagy, most western consumers are averse to the idea, with common attitudes consisting of disgust, fear and curiosity (Yen, 2009). With no innate aversion identified, western culture of viewing larger animals as a source of protein, and insects as disease transmitting “bugs”, has influenced consumers to be “grossed out” by the idea of entomophagy (Ramos-Elorduy, 2009). This enculturation has created deep-seated ideas about what is and is not acceptable to eat, consequently generating food neophobia towards edible insects (Caparros Megido *et al.*, 2014). Food neophobia is the rejection or reluctance to try new or novel foods. This rejection can be a result of unknown tastes, origins or expected harmful consequences from consumption, especially for foods of an unknown animal origin (Martins and Pliner, 2006). Studies have identified food neophobia to be a large contributing factor for insect (Balzan *et al.*, 2016; Verbeke, 2015) and meat substitute consumption (Hoek *et al.*, 2011). An interesting study conducted by La Barbera *et al.* (2018) however, suggested that the implicit association between insects and disgusting attitudes is independent to food neophobia. Consumers may be unfamiliar with insects creating reluctance to try it; however, overcoming neophobia could be done through increased awareness. Conversely, even if insect products are more familiar, consumers may still be disgusted by it. The study identified disgust was a greater indicator of willingness to eat insects compared to food neophobia, illustrating the many barriers to overcome in order for entomophagy to be adopted by the majority. In addition, researchers have also found gender, education, familiarity and age can impact willingness to try insects or other meat substitutes. Commonly men, higher educated consumers, or those with higher familiarity, are less neophobic towards insects or meat alternatives (Cicatiello *et al.*, 2016; Verbeke, 2015; Verneau *et al.*, 2016; Hoek *et al.*, 2011; Schöslér *et al.*, 2012).

Encouraging consumers to try new products, especially one so controversial and unique as insects, is difficult. There are so many intertwining factors that impact food choice motives, and the consequent incorporation into normal eating habits. The sustainability and nutrition of insects is a motivation for certain consumers who value these aspects (Rigter *et al.*, 2016; Vanhonacker *et al.*, 2013). In a study conducted by House (2016), motivations for trying Insecta® products were curiosity (42 per cent), sustainability (33 per cent), health (24 per cent) and finally novelty (18 per cent). However, these alone are generally not enough to encourage consumers to try or repurchase insect products. Other factors such as, sensory expectation (i.e. taste appeal), price and degree of fit were found to be more influential towards acceptance of insects or meat substitutes in general (House, 2016; Tan *et al.*, 2015; Tucker, 2014). Additionally, how insects are presented also have a significant impact on acceptance. Many studies have found western consumers are more willing to try insects when they cannot be visually seen (Balzan *et al.*, 2016; Caparros Megido *et al.*, 2014; Tan *et al.*, 2015). The visual appearance of insects, such as legs and eyes, is a contributing factor to the feelings of disgust and fear (Yen, 2009; Rozin and Fallon, 1980). Gmuer *et al.* (2016) found that Swiss participants had less negative emotions (e.g. disgust), greater taste expectations and were more willing to try crickets when incorporated into corn chips, rather than whole roasted crickets. By removing the visual aspect of insects and placing them into familiar foods, it should improve adoption of such a novel product for certain consumer segments (Martins and Pliner, 2006; Verneau *et al.*, 2016).

New Zealand (NZ) is an interesting country on which to focus entomophagy research. Although it is a small country (4.7m), it is one of the biggest meat producers and consumers in the world (Stats NZ, 2016). With a large agricultural focus, getting consumers to consider eating insects could lead the way for other western cultures. Only two known studies have investigated NZ opinions regarding insect consumption. Rigter *et al.* (2016) identified five different consumer groups that had varying discourses towards entomophagy.

Tucker (2014) studied the impact sensory appeal had on willingness to adopt meat substitutes, such as entomophagy. They found 52 per cent would consider eating insect, most of which (78 per cent) were males. Currently insects are classified as a novel food by the Food Standard Australia New Zealand code. The super mealworm, house cricket and mealworm beetle were recently reviewed and accepted as a food source (non-novel food), due to lack of safety concerns; therefore, leading the way for other insects in the future. Although a few products, such as flours, protein bars and chips are available online, insect products in NZ and other western countries still remain a novelty.

Limited research has investigated consumer expectation and preference for insect product attributes. Alemu *et al.* (2017) investigated what termite-based food product (TBFPs) attributes were preferred by Kenyan participants using the choice experiment (CE) method. They found recommendation from other people, nutritional value and food safety information are important attributes in driving acceptance of TBFPs. Incorporating consumers into the initial stages of insect product development to identify important attributes would be beneficial for entomophagy adoption. One way to do this is using consumer idealised design. This is a relatively new task-orientated method, developed by Ackoff (1994) and explained by Ciccantelli and Magidson (1993). Unlike other consumer-orientated product development methods, such as surveys, focus groups or questionnaires, which ask consumers about their wants and needs, this method instructs potential end consumers to actually design their own ideal product or service. It is similar to a focus group, in which a small group of participants are involved and a moderator facilitates the session. However, the method aims to reach a consensus about a particular product or service; therefore, uncovering underlying consumers wants, needs and expectations. This method has been used by roofing, service stations and financial software companies (Ciccantelli and Magidson, 1993); however, food industries have yet to utilise the method thus far.

Entomophagy has significant potential, however, encouraging consumers to adopt them into their diet is complex and still a reasonably unknown issue. This study aims to identify the key drivers and barriers using focus group discussions, in order to gain a general understanding of entomophagy acceptance. The second part of the study will outline the ideal product attributes consumers are looking for in solid and liquid products (containing extracted insect protein as opposed to whole insects) using adapted consumer idealised design, in the hope to improve adoption of entomophagy in the future.

2. Materials and methods

2.1 Participants

Three product design workshops, involving 10 or 12 participants were conducted. Department level ethics approval (category B) was accepted by the Food Science Department (17/06B) after detailed description of the method was outlined. Participants were then recruited via physical and electronic posters distributed around Dunedin, including the University. An online survey screened participants regarding age (18–75), and willingness to try new or novel foods (FNS above 4). An FNS is a six item list, scored using a seven-point scale developed by Pliner and Hobden (1992). The survey also included basic demographic data.

Overall, 32 people (23 females, 9 males) aged between 18 and 75, with an average FNS of 5.7, participated in the three different product design workshops. Majority of the participants (90 per cent) were working or studying in Tertiary education. Most, 62 per cent, were aged between 18 and 44, 15.2 per cent were aged between 25 and 34 and 22 per cent were aged between 35 and 75. Majority (62.5 per cent) were NZ European, other ethnicities included: Maori, Pacific, Middle Eastern, American and British. Some (37.5 per cent) had eaten insects before with mixed experiences and opinions.

2.2 Method

Each session lasted three hours. On arrival participants were asked to write down three words that came to mind when considering entomophagy. They completed the same task at the conclusion of the workshop. The words before and after the study were used to identify the attitudes of participants towards entomophagy. During the workshop, the study consisted of two parts that followed different adapted methodologies.

2.2.1 Part 1: focus group. The semi-structured focus group method followed general outlines described by Kitzinger (1994). The moderator asked questions and facilitated group discussion concerning consumer acceptance drivers and barriers involved with eating insects.

2.2.2 Part 2: consumer idealised design. After an informative presentation about entomophagy and current insect products on the market, participants were then asked to design two products of their own, following adapted consumer idealised design methodology (Ciccantelli and Magidson, 1993). In this reasonably novel methodology, potential end consumers are asked to design, discuss and reach consensus about the ideal attributes in a product, in order to indicate consumer's underlying wants and needs from such a product or service. In the current study, participants were separated into groups of three or four and asked to design two hypothetical products; one liquid product using water-soluble locust protein and one solid food product containing water-insoluble locust protein. These proteins were extracted as part of another study conducted by the researcher (Clarkson *et al.*, 2018). Each group was given 30–40 min to write down their ideal product attributes including; product name, ingredients, flavour, shape, size, packaging design, price, place, benefits and promotional strategies using coloured pencils and A3 paper. After group presentation and discussion about the advantages and disadvantages of each design, each group was given 15 min to further develop and make any changes or improvements to their designs (liquid and solid). Once the moderator was content with the discussion concerning the designs, participants were given a questionnaire to fill out concerning their health and environmental orientation using five-point scale, following similar methodology by Verbeke (2015). Health orientation of participants was measured using three items selected from the general health interest scale developed by Roininen *et al.* (1999), for example, "The healthiness of food has little impact on my food choices" (R) and "I am very particular about the healthiness of the food I eat". Environmental concern was measured based on Roberts (1996) item "When I buy foods, I try to consider how my use of them will affect the environment".

2.3 Data analysis

Audio recordings of the three product design workshops were fully transcribed and coded following thematic qualitative analysis (Braun and Clarke, 2006) using Nvivo software (Version 11.4.1). Comments made by participants who had similar attitudes or ideas were grouped together by the author and presented as a percentage. However, these results come from a qualitative analysis carried out on a small number of participants. Direct quotes from participants are presented with participant number, gender (M or F) and FNS.

3. Results and discussion

The first section presents the qualitative data surrounding participant attitudes and opinions regarding entomophagy. The second section describes the product designs and the main attributes that were common among them, uncovering the underlying wants and needs of consumers towards insect products.

3.1 Consumer acceptance of entomophagy

3.1.1 Attitudes. Before the workshop, around half of the participants were interested in the idea of eating insects, with words, such as “curious” used often. Around 16 per cent participants were “excited”, 28 per cent were disgusted and a large number (56 per cent) were also uncertain about entomophagy, using words such as “different” and “weird”. Mixed responses are common (Yen, 2009), Caparros Megido *et al.* (2014) found Belgium consumers curiosity motivated them to try insects, even though a large percentage considered them disgusting. Adverse responses have been linked to the sensory perception (i.e. appearance, taste, texture) of insects and other meat substitutes (Tucker, 2014). Words associated with the texture (“crunchy” and “wriggly”) were mentioned by 60 per cent of the participants, indicating how important sensory perception is.

Initially, nutritional and sustainability benefits of insects were only mentioned a few times, contradicting Balzan *et al.* (2016) results, which found three quarters had already heard about the health benefits, even though only one had eaten insects before. Information about the benefits of edible insects may be less known in NZ compared to European countries.

After the workshops, however, positive attitudes increased from 16 to 32 per cent with words such as “exciting” and “future”. Comments about the benefits of insects (e.g. health and sustainability) by participants increased from 12.5 to 56 per cent, and disgusting references decreased from 28 to 6 per cent. Other literature also found consumers were more receptive to eating insects after educational information, demonstrating how important appropriate marketing and promotional strategies are (Verneau *et al.*, 2016; Schösler *et al.*, 2012). It should be noted, however, that after discussion and opinions from other participants in the workshop, attitudes are likely to evolve. Following the mere exposure effect by Zajonc (1968), participants could have improved attitudes merely due to repeated exposure to the idea of entomophagy. Furthermore, social desirability to be perceived as conscious consumers by other participants could have prompted positive responses towards eating insects.

3.1.2 Barriers. When questioned about why insects are not commonly eaten in western countries, there was a range of barriers uncovered from the group discussions. Culture, and specifically NZ culture, was a noteworthy obstacle:

We are so dependent on our agriculture. So, I think it would take a lot to change New Zealander's minds, because we have grown up to farm. (P22, F, 5.5)

Growing up in a country with a large agricultural sector and high meat consumption, creates reluctance towards alternative meat substitutes, especially something so novel as insects. Additionally, participants (22 per cent) mentioned how the large meat production in NZ creates a lack of necessity and demand for meat and protein alternatives:

If we want protein we'd go for a hunk of meat, not a little crawly thing. (P22, F, 5.5)

Culture is a common barrier found in many studies (Hartmann *et al.*, 2015; Balzan *et al.*, 2016). However, the traditional breeding and consumption of meat in NZ is unique and only investigated by Tucker (2014) and Rigter *et al.* (2016) who also identified cultural barriers.

The notion that insects are “dirty” pests, is another barrier towards acceptance, as found in many studies (Verbeke, 2015; La Barbera *et al.*, 2018; Looy *et al.*, 2014; House, 2016; Hanna, 2016). Tan *et al.* (2015) linked this again to enculturation, with cultural norms of viewing livestock as protein and insects as pests or disease transmitters. Out of the eight participants who made comments about the disgusting nature of insects, only one was male, which is similar to other findings that females are more sensitive to disgust than men (Verbeke, 2015; Rozin and Fallon, 1980). However, it should be noted that majority of the participants involved in the study were female, influencing the interpretation of the qualitative data. Safety and health concerns around entomophagy were not mentioned by the participants, unlike other studies (Alemu *et al.*, 2017;

Caparros Megido *et al.*, 2016; Verbeke, 2015; Balzan *et al.*, 2016), indicating consumers aren't concerned about the safety but rather the idea of eating them. Moreover, lack of knowledge and experience was mentioned as a potential barrier by 6 per cent of participants:

And I think it's quite hard knowing how to incorporate them into our current meals and stuff. There aren't really recipes that people know at this stage. (P21, F, 5)

The limited knowledge increases the perceived complexity, which affects adoption of innovative products like insects (Shelomi, 2015). Participants in studies conducted by Schösler *et al.* (2012) and Balzan *et al.* (2016) were more willing to eat insects for the first time at a restaurant, as they lacked knowledge on how to prepare and eat them at home. Furthermore, lack of sensory experience is a significant factor mentioned in most entomophagy research, however was less of a focus for the current study. Before trying an unknown food, consumers make inferences about how it will taste, which is often negative for insects, leading to a reluctance to try them (Rozin and Fallon, 1980). Hartmann *et al.* (2015) found taste expectations of silkworm and cricket products were a greater contributing factor than food neophobia score, country and previous eating experience.

3.1.3 Drivers. When questioned about the motivational drivers and food preference, there were mixed opinions among participants. The novelty of eating something "scary" and "new" was exciting and preferred by 15.6 per cent of the participants:

You could be eating it and be like, "is that it's little leg?" It's a conversation in itself. (P9, F, 5.33)

Interestingly, many of these same participants would prefer to see and eat the whole insect, as opposed to an ingredient processed into food. There were comments that the experience and reason for eating insects in the first place would be taken away if it was hidden. Similar to a study conducted by Rigter *et al.* (2016), 21 per cent of the NZ participants (six male and eight female) were "enthusiastic adventurers" seeking the thrill from entomophagy. Conversely, Caparros Megido *et al.* (2014) identified only 1 per cent of participants would prefer to eat them in their natural shape. Interestingly, 60 per cent of the participants in the current study who would prefer to eat whole insects were male, consistent with some studies that found males are less neophobic (Verbeke, 2015; Schösler *et al.*, 2012; Hartmann *et al.*, 2015), whereas others have not found a significant difference in gender (Caparros Megido *et al.*, 2014). As Hanna (2016) outlined, consumers who desire a product that resembles its origin may be linked to the early adopter and innovator categories, creating separate potential markets for insect products.

Other participants (12.5 per cent) expressed interest towards the practical health benefits or sustainability (15.6 per cent) of insects. The latter group had higher environmental scores (4.6) compared to the group average (3.6), indicating greater ecological orientation. Many of these participants were female, similar to a group of consumers in Rigter *et al.* (2016) called the "benefit seekers". Many studies have identified that although health and sustainability are important for some consumers, they alone are not enough to drive adoption. The sensory properties, product attributes and presentation of insects are also crucial factors. A high number of participants (37.5 per cent) made comments about greater willingness to eat insects if they were an ingredient they could not see. By having it, "out of sight, out of mind" consumers would be more willing to eat "familiar foods" as the disgust factor is reduced. Majority of these participants were aged between 18 and 24 (66 per cent) or older than 55 (25 per cent). One female participant claimed she would only eat insects as a health supplement as opposed to food product. This reluctance could be linked to her vegetarian status and the fact she joined last minute so had a low FNS of 2.13.

The majority of participants would prefer not to visually see the insects, similar to many other studies (Balzan *et al.*, 2016; Caparros Megido *et al.*, 2016; Tan *et al.*, 2015). The visual appearance of insects such as legs and eyes is a contributing factor to the feelings of disgust

and fear (Yen, 2009; Rozin and Fallon, 1980). By removing insects and placing them into familiar foods, it should improve adoption of such a novel product by this particular type of consumers (Martins and Pliner, 2006; Verneau *et al.*, 2016).

3.1.4 Future. Discussion around the prospective future of entomophagy in NZ surfaced varying opinions. Some were sceptical due to lack of necessity and demand. However, many expressed opinions that insects would become established in the near future (5–10 years) as a novel food trend, comparing it to the “superfood” ideal:

I think, it might become a novel trend, that is fairly wide spread quite soon. But not an actual viable protein alternative. I think, that's going to take a lot longer. (P4, M, 5.33)

This “superfood” phenomenon has seen the rapid increase for foods such as quinoa and chia seeds (Shelomi, 2015). Moreover, eating raw fish provoked feelings of disgust and fear when first introduced; however, sushi is now a popular meal for many countries worldwide (van Huis *et al.*, 2013). The general optimistic view by participants in the study demonstrates the potential for product development of insect products.

3.2 Product designs

A total of 21 products (10 solid and 11 liquid) were designed. Table I summarises the product attributes of each. Recurring attributes from all designs were identified and explained using the 4P's from the marketing mix (product, promotion, price and place) tailored for specific target markets, as explained by Kotler and Armstrong (2010).

3.2.1 Product. Interestingly, most of the products (76 per cent) were designed as a convenient sweet snack, drink, or breakfast option. These included; two muesli bars, two cluster based cereals, bread, chocolate chip cookies, nut substitute, sweet or savoury yoghurt, three health drinks, three protein powders, overnight oats, ice cream and a lolly supplement. Many of these were designed as a quick, healthy and sustainable option for kid's, fitness and/or health oriented consumers. Incorporating insects into familiar products may help consumers gain positive taste experiences, reducing neophobia to try other insects or insect products.

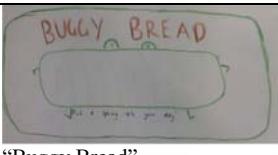
The majority of the literature surrounding entomophagy have identified insects as a meat substitute, comparing them to other products, such as tofu and tempeh (Tucker, 2014; Schöslér *et al.*, 2012). However, the current results indicate that consumers would be more accepting of a sweet snack or breakfast option, rather than a substitute for a steak at dinner time. This could be attributed to the lack of necessity for meat alternatives in NZ and the smaller size of insects, as discovered in earlier discussions. Studies have found consumers would rather reduce their meat consumption, or use other meat substitutes that mimick meat in terms of familiarity and taste, than eat insects as a meat substitute (Hoek *et al.*, 2011; Tucker, 2014). Consequently, instead of viewing insects as a substitute for meat, they could be used as a protein packed ingredient for convenient snack, drink, or breakfast products.

Furthermore, Shelomi (2015) indicated adoption of insects may be more successful as a nut substitute as opposed to meat. This is consistent with 33 per cent of designs such as muesli bars, cereals, overnight oats, and bread that usually contain nuts. “Locuq-nut Snack” was even designed specifically as a nut substitute, with just insect protein extruded into a brazil nut shape.

Two products in the current study (“Critter Crumbs and Bug Out”) did, however, use the insect protein as a seasoning or coating for meat. Caparros Megido *et al.* (2016) found participants rated fully vegetarian patties lower than a burger with both beef and mealworms. Incorporation of insects into patties or sausages, instead of a total meat substitute could therefore be a potential application. It should be noted that the focus of the present study was on powdered protein compared to whole insects, which could impact how they were perceived

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Food Products	Attributes
 “Bug Out”	Product: seasoning salt for meat, packaged in glass shaker or grinder Promotion: novel gift for general population, e.g. Father’s Day Place: farmer’s market and supermarket Price: premium
 “Critter Crumbs”	Product: breadcrumbs to coat meat. Recyclable paper bag Promotion: high protein, convenient option for health orientated consumers. Endorsement by sports and fitness celebrities Place: premium supermarkets and farmers markets Price: premium
 Insect Pie	Product: pie with protein in the pastry and filling. Whole locust on top Promotion: novel product as a meat alternative for general population Place: bakeries, café and dairies Price: premium
 Muesli Bars (“Bug Bars and “Locust for Lunch”)	Product: muesli bars with honey and chocolate, or carob, oats, fruit and coconut. Individually packaged in recyclable paper, with bright colours and insect cartoon Promotion: convenient, novel, healthy and sustainable lunchbox option for kids Place: supermarkets and health food stores Price: premium
 Cereal (“Locust Pocus” and “Bug Bites”)	Product: cluster cereal for breakfast or savoury snack option. Packaged in recyclable cardboard box with insect cartoon Promotion: convenient, high protein option for kids and health oriented consumers Place: health food stores and supermarkets Price: moderate to premium
 “Buggy Bread”	Product: sliced bread (natural or fruit flavours) packaged in recyclable paper bag and clear window Promotion: novel and high protein product to sustain children Place: supermarkets Price: moderate
 “Mr Cricket’s Cookies”	Product: chocolate chip cookies in recyclable box and cartoon insects Promotion: high protein, sustainable and novel product for children Place: supermarkets Price: moderate price

(continued)

Table I.
Solid and liquid product designs including ideal image, product, promotion, place and price attributes

 <p>Locq-nut Snack</p>	<p>Product: nut substitute. Protein with flavourless gum extruded into brazil nut shape. Packaged in re-useable clear plastic pouch. Promotion: convenient, high protein, organic snack for health orientated consumers (gym goers) Place: gyms and supermarkets Price: premium</p>
<p><i>Liquid Products</i></p>  <p>Instant soup mix</p>	<p>Product: scoop out dry powder and add to hot water to make a gourmet tomato or mushroom soup. Re-sealable, compostable packaging. Serves 15. Alternatively sell in individual sachets. Promotion: convenient, high protein, organic, sustainable and healthy options for hikers and outdoor types Place: health food stores and supermarkets, outdoor stores Price: premium</p>
 <p>Yoghurt</p>	<p>Product: sweet (banana and chocolate) or savoury (garlic/mint dressing for curries or salads) coconut yoghurt. Recyclable packaging. Promotion: convenient, sustainable, and high protein option for children or fitness industry Place: supermarkets and farmers markets Price: premium</p>
 <p>"Jimini Juice"</p>	<p>Product: health juice (apple) in 250 ml plastic bottle. Promotion: convenient, high protein drink for fitness and health orientated consumers. Alternatively, smaller option for kids Place: supermarkets, health food stores and gyms Price: premium</p>
 <p>Drinks ("Hop and Go")</p>	<p>Product: meal replacement health drink (chocolate, caramel or coffee) fortified with vitamins. Recyclable cardboard with cartoon insect with straw. Promotion: high protein, convenient meal replacement for kids and fitness industry. Endorsed by sports teams Place: supermarkets and health food stores Price: moderate</p>
 <p>Protein Powder ("Sustainable Strength", "Insect Protein" and "Hopping into Health")</p>	<p>Product: powder to add to milk/water (chocolate, caramel) for protein drink. Packed in re-useable glass container (1.25 kg), apple shaped pouch, or recyclable paper bag (100 g). Promotion: convenient, sustainable protein source for fitness industry and health oriented consumers (females). Endorsed by sport and fitness celebrities Place: supermarket and health food stores Price: premium</p>

Table I.

(continued)

 <p>Overnight Oats</p>	<p>Product: insect protein, oats, milk powder, nuts, and dried fruit. Add to water and eaten next morning for breakfast</p> <p>Promotion: quick, healthy and sustainable option for health and environmentally concerned consumers</p> <p>Place: supermarket and health food stores</p> <p>Price: premium</p>
 <p>"Locq-swirl Ice Cream"</p>	<p>Product: gourmet vanilla ice cream with chocolate insect protein swirl. Recyclable cardboard carton</p> <p>Promotion: protein and minerals for growing foetus that satisfies pregnancy cravings.</p> <p>Endorsed by Plunket</p> <p>Place: supermarkets</p> <p>Price: premium</p>
 <p>"Bug Booster"</p>	<p>Product: insect shaped gummy lolly. Berry flavour, fortified with vitamins and minerals.</p> <p>Plastic bottle</p> <p>Promotion: novel options for kids to get their nutrients</p> <p>Place: supermarkets and pharmacies</p> <p>Price: moderate</p>

Table I.

and then consequently the designs that were created. Additionally, focus away from meat could be linked to the examples of insect products given during the presentation in the workshops, including flours, bars, cereals, pasta, sauces, chips and cookies.

For flavour specifications, chocolate was a popular flavour among 46 per cent of the products. Likely due to the information given to the participants that soluble protein would become a dark colour when dissolved (as discovered in other studies conducted by the researcher). However, other studies have also identified use of chocolate, due to familiarity and positive taste expectations (Caparros Megido *et al.*, 2014; Schösl *et al.*, 2012).

Many of the products (43 per cent) specified "sustainable" packaging to go along with the sustainable image of insects. Also, majority of the products (62 per cent) had an insect on the packaging as a differentiating factor to similar products on the market. Limited literature has looked into the use of insect pictures on the packaging. de-Magistris *et al.* (2015) found consumers were willing to pay a premium price for foods with a nutritional health claim and logo, but not when a visualised insect was used. Hanna (2016) also found insect protein bars were more appealing in purchasing situation when no insect pictures were used. They recommended using abstract or cartoon pictures of insects as opposed to realistic images, similar to many of the products targeting children in the current study such as cereals, muesli bars, lolly supplement, health drinks, yoghurt, cookies and bread.

Some products (38 per cent) such as seasoning salt and other products for kids such as muesli bars, yoghurt and cookies all had packaging where the consumers could see inside, again to attract consumers to the novelty aspect. Other products such as Locq-nut and Critter Crumbs had a window to see inside, possibly to increase observability and consequently diffusion of innovative products (Rogers, 1987).

3.2.2 Promotion. When asked about the main benefits of their designs, the most frequently mentioned were; health, sustainability, novelty and convenience. All designs (except the insect pie and seasoning salt) promoted the high protein and/or other health benefits, such as, high mineral or vitamin content. Additionally, nearly all designs also

promoted the sustainability benefits. As mentioned earlier, although a motivational driver towards such products, they may not be enough to overcome acceptance barriers (House, 2016; Verbeke, 2015). Hartmann *et al.* (2015) found these benefits alone were not a significant predictor for willingness to eat two insect products (cookie and drink). Taste or sensory expectations among other factors, interact and impact food choice motives (Hoek *et al.*, 2011). Promoting both the benefits of insects, along with the positive taste and texture of such products may help acceptance by NZ and other western consumers.

The novelty of insect consumption was the focus for the insect pie and seasoning salt. Further discussions by the group identified the use of a whole insect on top of the pie or in the seasoning salt container. The target market for these could be linked to the participants in the study who would prefer to eat insect's whole, for the experience and thrill. Furthermore, products aimed towards children were also promoted as a novel experience, whereas the health and sustainability would attract the parents, who would ultimately purchase the product. Lastly, many of the products (37.5 per cent) were specified as a convenient snack or drink for either kids or active consumers. Schösler *et al.* (2012) also found deep freeze pizzas containing insect protein ranked higher than other insect options, and even higher than pasta with pesto, due to the additional convenience factor. Developing a convenient snack or light meal could therefore be a potential way to introduce insects into the stomachs of interested consumer segments.

When considering promotional strategies, products including the breadcrumbs, health drinks, protein powders and ice cream, used endorsement from celebrities, sports teams or not-for-profit organisations. By using familiar and trusted people it may motivate consumers to trial the product and gain more knowledge about insects and how they taste (Shelomi, 2015; Hanna, 2016). In CE by Alemu *et al.* (2017), Kenyan participants preferred termite-based products with high nutritional value that were recommended by officials, illustrating the impotence of both product attributes and circumferential factors. Marketing of insects is crucial to the adoption of such an innovative product. Even with the greater acceptance of insects when incorporated into food, there are still large discrepancies found between the same insect and non-insect containing snacks (Gmuer *et al.*, 2016).

3.2.3 Place. Majority of the products were sold at supermarkets and health food stores, therefore are easily accessible to the target market. Availability of insects and insect products has been a recurring barrier (Shelomi, 2015; House, 2016). The majority of the products currently sold in NZ are only available online or at speciality stores for a premium price. Increasing large scale production worldwide will not only improve availability, but also decrease price, helping improve the diffusion of innovative insect products, like the ones designed in the present study (van Huis *et al.*, 2013).

3.2.4 Price. Most of the designs were positioned as a premium product. Consistent with Shelomi (2015) statements and earlier discussions in the study, western societies such as NZ do not require insects for food security therefore, it would initially come in as a luxury snack. Consumers who perceive a relative advantage of insect over similar products would be willing to purchase a premium innovative product (Shelomi, 2015; Rogers, 1987). However, studies have identified price to be a barrier towards consumer willingness to eat or purchase insects (House, 2016) and meat substitutes (Hoek *et al.*, 2011). Currently 100 g of insect flour is around \$20 (NZD), six times higher than common supermarket steak. Again, large scale production, changes in legislation and further research and funding by both academics and industry will improve the costs and adoption of entomophagy in the future (van Huis *et al.*, 2013).

3.2.5 Target market. Children were a potential target market for 52 per cent of the products designed. When asked, many participants believed kids are adventurous enough to try insects. By marketing the novelty to kids through cartoon insects and bright colours,

and communicating the health and sustainable benefits to the parents, children are a prospective market. Comments were also made that children are the future generation who will grow up eating insects, making it a viable option later on:

Kids are the ultimate market as well. Cause they are going to be the ones who will grow up to normalise it from a young age. (P21, F, 5)

Children are curious and are not as aware of what is and is not culturally acceptable to eat, making them a potential target market. However, further research into kids is required.

Another popular target market for 42 per cent of the designs was fitness and health orientated consumers. Products such as protein powders, health drinks, overnight oats, yoghurt and the instant soup mix promoted the nutrient content and sustainable protein source.

4. Conclusion

Various strategies such as using insects in familiar foods and improving the availability, knowledge, cultural acceptability and necessity will all play a role in the diffusion of insects in the future. Entomophagy could ride the superfood or novel trend by promoting insect products as a premium, healthy and convenient snack, breakfast or drink option. Using insect protein, as opposed to whole insects used as a meat substitute, could be a potential application.

While the qualitative nature of the study allowed for an in depth understanding of consumer acceptance, future studies should include a survey, providing more generalisable data from a larger sample size with greater equality of female and male participants. Additionally, future studies could investigate how sensory perceptions of the designs (including taste, packaging, texture and price) impacts willingness to try and purchase the products.

Overall, the results from the study provided information about general acceptance of entomophagy and the desired product attributes from potential consumers in NZ, contributing to both industry product development and limited academic literature.

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