

**Understanding the attributes that inhibit
purchase and consumption of vegetables
- Cauliflower and Green Beans**

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CSIRO Preventative Health Flagship

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VG12070

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Understanding the attributes that inhibit purchase and consumption of vegetables - Cauliflower and Green Beans (VG12070)

Final report

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APPENDIX 1 Background questionnaire used in consumer study

Media summary

This project identified product characteristics and consumer issues that drive and inhibit the purchase and consumption of cauliflower and green beans. The relative importance of the drivers and inhibitors and commodity specific response plans prioritising specific actions for industry and stakeholders were determined.

A literature review and quantitative consumer studies were conducted. Literature found existing commodity specific information to be limited, rarely dealing with more than one issue at any one time and not necessarily relevant to Australian consumers.

On-line nationwide conjoint studies on a 1000 consumers were undertaken that modelled commodity attributes (colour, communication of sensory properties, health claims, price and convenience/portion) that previous literature suggested were important in influencing purchase intention. Commodities were explored as main meal and snack items. Consumers rated their intention to purchase the commodities with differing characteristics. Attitudes, liking and socio-demographics were also measured to identify different groups' interests.

Consumers were found to prefer current offerings: white, whole, cauliflowers at lowest cost, and green beans, loose at lowest cost. Both commodities had potential as snack items. Some health claims had small positive effects. Children's liking was low limiting purchase in three-quarters of families. Different group interests were found for cauliflower only: some consumers showed interest in a heart health claim, whereas others were interested in mixed coloured floret snack packs.

Key barriers to cauliflower and green beans were low acceptance, children's dislike, limited consumption opportunities, and price. Dislike of taste/flavour was a barrier specific to cauliflower. Key drivers for purchase and consumption for both were familiarity, increasing acceptance and early exposure in childhood.

Response plans were developed, and include 1) for cauliflower: development of white and/or multi-coloured snack packs; selection and/or development of cultivars with specific sensory properties; provision of preparation advice; and communication of a heart health claim, 2) for beans: development of snack packs, and 3) for both commodities: increasing children's acceptance through early exposure, adult's acceptance, and greater vegetable availability.

In conclusion, changing cauliflower and green beans characteristics has limited influence on demand. Rather, changing consumer behaviour towards vegetables is required. This would need collaboration with government and health organisations who also seek to increase vegetable consumption.

Technical summary

Improving the understanding of the key drivers of consumer behaviour and the barriers to greater consumption of vegetables will ensure that levy payers will be better placed to improve or promote their product offering. Considerable research has been undertaken on factors that influence consumers to purchase or not purchase vegetables. However, Horticulture Australia Limited and AUSVEG have identified that previously funded research has not always been targeted to specific commodities nor developed to the point where it offered useful and practical insights to levy payers. Commodity-specific projects were identified as a potential way to overcome this shortcoming, and the current project targets cauliflower (*Brassica oleracea var. Botrytis*) and green beans (*Phaseolus vulgaris L.*).

The aims of this project were to identify the commodity attributes that drive and inhibit the purchase and consumption of cauliflower and green beans, to determine the relative importance of these attributes as key barriers and drivers, and to develop response plans specific for cauliflower and green beans.

A literature review found that existing commodity specific information was limited and literature on vegetables in general was therefore included. A range of barriers were identified, but literature rarely dealt with more than one issue at any one time, and was not necessarily relevant to Australian consumers.

New research was undertaken through on-line nationwide consumer studies (n = 1002) using a conjoint method that modelled many attributes that previous literature suggested were important in influencing purchase intention, and could be modified within the product itself. Cauliflower and green beans were explored as main meal items, and as snack items (the latter as a potential opportunity for greater consumption). Attributes were presented as product profiles with colour, communication of sensory properties, health claims, price and convenience/portion varied by 3-4 levels each. Other measures included liking (participants, their children), food involvement attitudes, health, pleasure and sensory attitudes towards food, children's influence on food decision making and socio-demographics as segmenting variables. Analysis determined the relative importance of the attributes and the relative value (utility) of levels of those attributes.

Consumers were found to be conservative, prefer ring traditional offerings: white, whole, cauliflowers at lowest cost and green beans, loose. Both at the lowest cost. Both commodities had potential as snack items. Attributes most important were colour (typical colour preferred), price (lowest price preferred), and pack format (regular size or loose format preferred). Health claims had a small positive (FSANZ approved heart health; skin health) or no (calcium for green beans) effect. Children's liking was reported to be lower than adult's liking, and limited purchase of both commodities in three quarters of families.

Only for cauliflower was there consumer segmentation. Consumers with high food-health orientation showed interest in a heart health claim. Families with children, pleasure seeking and health orientated consumers expressed interest in mixed coloured floret snack packs. Families with children (46%) were equally interested in snack packs with mixed colour florets and white florets.

Thus, the consumer study found that changing the attributes of cauliflower and green beans seems to have limited potential to increase purchase and consumption. An alternative strategy, based upon evidence from the literature review, is to change consumer behaviour towards the commodities.

High, medium and lower priority barriers and drivers were identified on the basis of magnitude of barriers and drivers, the level of scientific evidence available, the ease or difficulty to overcome barrier or use driver, the size of the opportunity, and the level of influence the vegetable industry can exert. High priority barriers identified for both commodities were low overall acceptance, children's dislike, lack of consumption contexts and high price/cost. Dislike of taste/flavour was a high priority barrier specific to cauliflower. High priority drivers for both commodities were identified as familiarity, increasing acceptance and early exposure in childhood.

Response plans were developed for both commodities, including 1) for cauliflower: development of white and/or multi-coloured snack packs; selection and/or development of cultivars with specific sensory properties; communication of a heart health claim, 2) for beans: development of snack packs of green

beans, and 3) for both commodities: increasing children's acceptance, increasing adults acceptance and increasing channels of availability.

As many of the barriers to consumption were generic to vegetables, the vegetable industry is recommended to review whether the commodity approach provides the best opportunities to grow the category, or whether a more generic approach would better be suited to change consumer behaviour. That generic approach would benefit from stronger collaborations with governments and public health organisations that aim to increase vegetable consumption

1 Introduction

There are a range of factors that influence why consumers do or do not purchase different vegetables. Through improving their understanding of the key drivers of customer and consumer behaviour and the barriers to greater consumption levy payers will be better placed to improve their product offering.

Quite a considerable amount of work has been done in this area, and that it is important to ensure that this work is not duplicated but built upon. One of the issues Horticulture Australia Limited and AUSVEG have identified with work that has been done in the past is that it has not always been targeted to specific commodities nor developed to the point where it offers useful and practical insights to levy payers.

The prioritisation of barriers and opportunities and the creation of practical response plans on a commodity by commodity basis was identified as a way to overcome this shortcoming. Therefore, commodity specific projects were commissioned. The current project investigates cauliflower and green beans, and two other projects have been commissioned that investigate four other commodities.

The aims of the current project are:

- To identify the attributes that drive and inhibit the purchase and consumption of cauliflower and green beans
- To conduct consumer research on identified gaps if and where relevant.
- To identify and prioritise attributes (inhibitors and enhancers) as key drivers in response plans for cauliflower and green beans.
- To develop response plans specific for cauliflower and green beans
- To communicate these response plans to industry to ensure effective implementation by the vegetable industry and its partners.

Chapter 2 outlines the findings from literature review on existing research on drivers and barriers to purchase and consumption of cauliflower and green beans. There was a considerable knowledge gap, and Chapter 3 describes the results of a consumer study that was conducted to facilitate prioritisation of attributes and support the development of response plans. Chapter 4 considers the results from both the literature review and the consumer study for identification and prioritisation of attributes as key drivers in response plans for cauliflower and green beans. Response plans itself are provided in Chapter 5, followed by a more general Discussion and Recommendations (Chapter 6), and a summary of technology transfer in Chapter 7.

2 Literature review

2.1 Introduction

'In general, what many people want in the short-term is tasty, inexpensive, varied, convenient, and healthy foods – roughly in that order of benefit importance' p32 (Chandon and Wansink 2012).

To investigate existing research on barriers and drivers to cauliflower and green bean purchase and consumption, a literature review was conducted. This review focuses specifically on cauliflower and green beans, and the scientific literature regarding inhibitors of their purchase and consumption. The evidence is assessed for gaps, and the need for further consumer research to create an effective response plan for industry is outlined. Numerous research studies have been conducted on barriers to the consumption of vegetables in general, and various interventions to increase their intake. Where relevant, some research generic to vegetables has been included, in order to gain a clearer understanding of consumer purchase and consumption barriers, particularly where evidence on the particular commodities is lacking.

Research articles on cauliflower and green beans are described in detail in Table 1, and each of the 13 attributes are summarised in sections 2.2 and 2.3, respectively. Research on general vegetables is outlined in section 2.4 for the same 13 attributes and its relevance related to cauliflower and green beans outlined. Results are discussed in section 2.5, and provide a summary of barriers to purchase and consumption of cauliflower and green beans, along with the gaps identified in literature and recommendations for future research direction.

2.2 Methods

The following methods for the literature review were used:

- Literature review included peer-reviewed articles and reviews, HAL/AUSVEG reports, and book chapters/reviews (in English, last 20 years to maintain relevance)
- Computerised literature search of databases (AgEcon Search, Web of Knowledge (Medline, Web of Science, Food Science and Technology Abstracts, CAB Abstracts), Scopus, ScienceDirect, Summon (CSIRO search engine))
- Bibliographies and 'cited by' papers were also examined where relevant.

Search terms used (in various combinations)

- Cauliflower, *Brassica oleracea*, white curd, broccoflower, brassica, cruciferous, purple, green, orange
- Green (string, runner, French, snap, common) beans, *Phaseolus vulgaris*, legumes (climbing beans, pole bean, bean pods), yellow, butter, purple
- Consumer, attributes, characteristics, sensory, appearance, colour, taste, flavour (flavor), textur*, qualit*, sensorial quality, chemosensory, facilitate, purchase, consumption, demand, positive, negative, barriers, inhibit, factors, extrinsic, intrinsic, preference, acceptance (use * as wildcard for variations)
- Fresh, frozen, canned, vegetable, size, cut-ability/fracturability/crumble, 'Fresh-cut produce'

- Availability, price/cost, access, preparation skills, educational level, socio economic status, labelling, brand, health information, country of origin, variety
- Exclusion terms: coffee, chocolate, soy, dried

Criteria for inclusion/ exclusion in review

- Criteria for including papers in the review were their relevance to the research question on purchase and consumption of cauliflower and green beans (both intrinsic properties of the commodities and consumer behaviour regarding them). In addition, pertinent research on other vegetables that could be applied to our commodities, as well as segmentation of vegetable consumers and barriers to vegetable consumption in general, were also included. Thus, a comprehensive review of over 100 articles was carried out, including 20-30 articles for each of the categories of cauliflower, green beans, and vegetables in general, as well as approximately 20 HAL/AUSVEG reports. A full reference list is provided at the end of this report.
- Articles were excluded when they only related to pest/disease resistance, genetics unrelated to sensory/appearance attributes, production issues, effect of processing on composition, microbial quality, or other vegetable-specific papers (e.g. that happened to be described as 'cauliflower flavour').

2.3 Results cauliflower

2.3.1 VARIETIES AVAILABLE

Cauliflower (*Brassica oleracea var. botrytis*), like broccoli and cabbage, is one of several vegetables belonging to the species *Brassica oleracea*, in the family Brassicaceae. White cauliflower is the most common colour of cauliflower, but there are other types including Broccoflower (green cauliflower), Romanesco (light green pyramidal shape) (Lucera et al., 2012), orange-coloured cauliflower (Lu et al., 2006) and purple-coloured cauliflower (Chiu et al., 2010). In Australia, white or cream coloured cauliflower is the most popular variety and other colours such as green, purple and orange are available in addition to baby cauliflower (James, 2010). The details of research studies investigating different varieties of cauliflower are described in more detail in Table 1. The great diversity still present for cauliflower and broccoli in several germplasm banks, which could be exploited to provide new horticultural items, is important for breeding programmes aimed at satisfying new consumer requirements (Branca, 2008). For example, the unique Purple gene mutation in cauliflower confers an abnormal pattern of anthocyanin accumulation, giving the striking mutant phenotype of intense purple colour in curds and a few other tissues. The successful isolation of Purple gene mutation offers a genetic resource for development of new varieties with enhanced health-promoting properties and visual appeal (Chiu et al., 2010). Particular environmental conditions can allow the full expression of the violet colour, determined mainly by the presence of the anthocyanin pigments, the synthesis of which is favoured by wide temperature oscillation and high solar radiation levels. The curd is from pink to dark violet, convex in shape, less compact, great grain (flower bud size), and it is not covered by leaves (Branca, 2008). The Orange (Or) gene mutation in cauliflower confers the accumulation of high levels of β -carotene in various tissues normally devoid of carotenoids. Carotenoids provide important nutrients and antioxidants for human diets, so increasing carotenoid levels in major staple crops are expected to have a broad and significant impact on human nutrition and health (Lu et al., 2006).

However, careful consideration must be taken in the marketing of new varieties that consumers may not be familiar with. For example, U.S. consumers mentioned broccolini, broccoflower, and boysenberry as strong evidence of genetic engineering already present in the marketplace (in-depth interviewing of 32 respondents).

These foods were perceived to be a result of combining and mixing things found in nature in order to create a novel foodstuff which is not characteristic to nature. Broccoflower was perceived as borrowing a head from cauliflower, but a green colour and taste from broccoli (Kniazeva, 2006). Reactions of Australian and New Zealand consumers to horticultural products as functional foods includes suspicion that the food has been 'tampered' with in some unnatural way, and they make strong links between functional foods and GE/GMO products, which they are very dubious about (Richards, 2004). Sensory differences between varieties are another important consideration for consumer acceptance and marketing, for example green cauliflower being higher in bitter taste than white cauliflower (Poelman and Delahunty, 2011), and will be discussed in the following sections.

2.3.2 SENSORY DIFFERENCES AND CONSUMER PREFERENCE BETWEEN VARIETIES

Any targeted breeding strategy for cauliflower cultivars, characterised by high contents of health-relevant alkyl and indole glucosinolates, has to consider optimisation to the tastes of the consumer (Schonhof et al., 2004). Positive sensory attributes of cauliflower identified in multiple sensory and consumer studies include sweet taste, cauliflower flavour, and a crisp and juicy mouthfeel, while negative sensory attributes are bitter taste, cooked cauliflower 'sulfur' odour (see Table 1). Two studies suggested a way to improve cauliflower acceptance - raising intrinsic sugar content to mask the bitter taste of a group of glucosinolates (Schonhof et al., 2004) and to highlight the sweetness of the vegetable (Cox et al., 2012). Cooked cauliflower sulphur odours were a barrier to French consumers, therefore cultivars that have lower levels of Allyl isothiocyanate (AITC), dimethyl trisulfide (DMTS), dimethyl sulfide (DMS), and methanethiol (MT) could be selected (Engel et al., 2002). However the health implications of this strategy needs to be considered (Zabaras et al., 2013).

A large number of studies have conducted sensory descriptive analysis on cauliflower varieties as described in Table 1; however information on variety or specific cultivars and the preferences of Australian consumers is limited.

2.3.3 RANGE OF PRODUCT USES AND EFFECT OF COOKING ON SENSORY/LIKING

In Australia, the cauliflower market consists largely of the fresh market segment with some processing (largely for frozen use) taking place in Australia (James, 2010). Cauliflower is consumed both raw and cooked, and research has shown that cooking method and time of cooking can influence sensory profile and consumer preferences (Poelman et al., 2013). See Table 1 for further details.

2.3.4 CONVENIENCE

Two studies outline the importance of convenience with regard to cauliflower (see Table 1). Many Queensland consumers viewed a single cauliflower as being too large and therefore wasteful, and requiring special preparation to make it more appetising (Richards, 2004). However cauliflower can be marketed cut in florets and packed in small units (Simón et al., 2008), and the consumption of mini vegetables including mixed packaged mini vegetables, for example, mini broccoli and mini cauliflower, is on the increase in Germany due to a higher demand for healthy, single-serving snacks and convenience foods (Schreiner et al., 2006). Increasing consumption of cauliflower by providing it as a healthy, single-serve snack is an opportunity for the vegetable industry in Australia.

2.3.5 QUALITY ATTRIBUTES AND SHELF LIFE

The quality loss of cauliflowers is mainly due to yellowing of head and the development of undesirable odours, sharp increase of bitter taste, curd softening and leaf wilting (Lucera et al., 2012). Low density polyethylene films have been recommended for wrapping cauliflower, as weight loss was considerably lower than for polyvinylchloride PVC film – which may help to avoid wilting, shrivelling and other senescence symptoms of the cauliflower (Artés and Martínez, 1999).

However another study stated that the use of cling wrap films should be avoided as this leads to accumulation of excessive moisture resulting in huge spoilage loss, and instead recommended that cauliflower curds be individual packed in high density polyethylene bags with perforation. This method allowed storage up to 21 days with maximum retention of white colour of curd, minimum spoilage, weight and firmness loss and good sensory quality attributes (Dhall et al., 2010). Atmosphere modification (changes in CO₂ and O₂ levels) using non-perforated PVC and polypropylene film is another way to maintain quality of cauliflower for up to 20 days, and use of polypropylene film was found to result in better appearance was after 20 days of storage (Simón et al., 2008). See Table 1 for further details of past research.

2.3.6 COST

There was no published research available on how cost influences the purchase of cauliflower, however see section 2.5.6 for studies on the cost of vegetables in general.

2.3.7 HEALTH CLAIMS/BENEFITS

Cauliflower is low in calories, but is a good source of ascorbic acid and contains substantial amount of protein, and nutrients like phosphorus, calcium, and iron (Sharma et al., 2005). The contribution of Brassica vegetables to health improvement can be related to their antioxidant capacity (Podsędek, 2007); see Table 1 for further details of past research. In addition, health-promoting phytonutrients in cruciferous vegetables have been gaining attention for their powerful effects in combating cancer (Czapski, 2009). The presence of glucosinolates in brassica has been associated with beneficial anti-carcinogenic properties. An investigation on the glucosinolate proportions and contents in broccoli and cauliflower showed that for balanced human nutrition, consumers should not only eat green broccoli and white cauliflower, but would also benefit from consuming the green pyramidal, green and violet/purple cauliflowers as well. However, an increase in contents of bitter alkenyl glucosinolates and the health-relevant, but unfortunately bitter indole glucosinolates, was partly incompatible with consumer acceptability ('flavour' and 'overall liking') (Schonhof et al., 2004), as discussed in section 2.3.2. Different coloured cauliflower have additional health benefits - purple cauliflower has anthocyanin accumulation (Chiu et al., 2010) and orange cauliflower has high levels of β -carotene (source of nutrients and antioxidants) (Lu et al., 2006). With regard to consumer perception, an Australian study showed that a one-off provision of specific cancer protection information did not influence intention to consume cauliflower (but did slightly influence responses to the least liked Brassica studied, Brussels sprouts). Sensory perception tended to predict liking and intentions to consume Brassica vegetables, so addressing taste dimensions (while retaining healthy compounds) may be more important than promoting health information in order to increase the purchase and consumption of cauliflower (Cox et al., 2012). The health benefits of cruciferous vegetables in general has been widely researched, however exactly how cauliflower differs in its benefits is not clear.

2.3.8 CONSUMER UNDERSTANDING OF PORTION SIZE AND VEGETABLE VARIETY GROUPING

There is no information available about consumer perception of cauliflower portion sizes, however see section 2.3.4 for comments on the size of a single cauliflower being perceived as too large. Consumers in a U.S. study did not have a good understanding of the type/variety of vegetables cauliflower was – it was incorrectly mentioned as part of the 'starchy' subgroup by most consumers when it should have been in the 'other' subgroup (Britten et al., 2006). See Table 1 for further details of this research. It is unknown how Australian consumers perceive cauliflower in terms of type/variety of vegetables, or if this affects their desire to consume cauliflower as part of a variety of vegetables in the diet.

2.3.9 LABELLING/BRANDING

No published literature regarding the effect of labelling or branding on cauliflower purchase or consumption was found; however, see section 2.5.9 for suggestions on vegetable labelling in general.

2.3.10 CONSUMER SEGMENTATION

In 2011, Nielsen data showed that 64.6% of Australian households purchased cauliflower; with households spending on average \$11.9 on cauliflower during the year. Shoppers who buy cauliflower purchase the commodity about five times per year, spending an average of \$2.40 per occasion. More affluent households and Senior Couples (60+) accounted for a significant portion of cauliflower sales (see Table 2). High income households (\$70K+) accounted for the most significant contribution (40.8%) to cauliflower value sales, followed by medium income (\$35-70K) at 32.8% and low income (\$0-35K) at 26.4%, in line with total vegetable sales of 45.6%, 31.7% and 22.7% respectively. In addition 1-2 member households had the most significant contribution to the value of cauliflower sales (54%), compared to 3-member (19%), 4-member (17%) and 5+ member (9%) households (Nielsen, 2011b).

Consumers can also be segmented based on their sensory acuity or consumption; for instance non-consumers of cauliflower in France are more sensitive than medium and high consumers to compounds that are key odorants of cooked cauliflower sulphur odour (Engel et al., 2002, Engel et al., 2006). It is unknown if this would segment Australian consumers also. Post-consumption factors may also influence consumption of cauliflower – for example some participants in focus groups (in Canada) stated they ate broccoli and cauliflower less frequently because they associated them with gas (Utrecht et al., 1999).

Preferences of children

Children's rejection/acceptance of vegetables can influence household purchasing decisions, as lack of enthusiasm of children is one of the major barriers to increasing the consumption of vegetables (Kilcast, Cathro et al. 1996). A number of research papers have been published regarding children's consumption of Brassica vegetables including cauliflower (see Table 1). Recent research shows that Australian children's acceptance of Brassica vegetables, including cauliflower, may be altered by preparation method; therefore recommendations to increase consumption could be made to parents. For cauliflower, these include avoiding very short cooking times as that leads to an undesirable sensory profile for children and to cook by steaming rather than boiling, as children do not object to the flavour, and steaming is nutritionally preferable to boiling (Poelman et al., 2013). Another study on Australian children found that high odour intensity and browned flavour lowered acceptance of children for cauliflower, while differences in texture, flavour, sweetness or bitterness, did not affect acceptance. Atypical colour had a positive influence on expected preference but not on acceptance of children upon tasting, while preparation method impacted acceptance of children who liked fewer vegetables more than those who liked many vegetables. Familiarity, variety in the number of vegetables liked, and reported liking of target vegetables was associated with higher acceptance (Poelman and Delahunty, 2011).

2.3.11 CONTEXT/AVAILABILITY

In Australia during the year preceding June 2011, the value share of cauliflower trade was: Woolworths 31.6%, Coles 23.8%, non-supermarkets 27.1%, IGA 7.9%, Aldi 5.7% and other supermarkets 3.9%. Woolworths and Coles were successful in growing their share of trade at the expense of Independents, IGA and Green Grocers, through increased household reach and average spend per household – an opportunity was identified to drive higher purchase frequency within Independent Grocers (Nielsen, 2011b). See 2.5.11 for research on both the context of purchase and the context of consumption of vegetables in general.

2.3.12 COUNTRY OF PRODUCT ORIGIN

Australia runs a small positive balance of trade in cauliflower. Imports of fresh cauliflower are free to enter Australia whilst a 5% tariff applies on frozen cauliflower (4% for developing country status) however in 2009 imports were considered negligible (James, 2010). There was no published research available on whether Australian consumers prefer to purchase and consume cauliflower of Australian origin compared to imported cauliflower.

2.3.13 EMOTIONAL INVOLVEMENT IN DECISION MAKING

There was no published research available on the symbolism of cauliflower or the emotional involvement of consumers purchasing them.

2.4 Results green beans

2.4.1 VARIETIES AVAILABLE

The common bean (*Phaseolus vulgaris* L.) is a member of the family Fabaceae, tribe Phaseoleae, subfamily Papilionoideae (Koutsika-Sotiriou and Traka-Mavrona, 2008) and cultivated forms are grown on all continents except Antarctica (Gepts, 1998). Commonly grown species of *Phaseolus* are: *P. acutifolius* A. Gray (teparty bean), *P. coccineus* L. (scarlet or runner bean), *P. lunatus* L. (Burma, butter or Lima bean), and *P. vulgaris* L. (baked, canellini, common, dwarf, flageolet, frijoles, French, kidney, navy, pinto, snap, string, wax, haricot or Nunas bean) (Broughton et al., 2003). Green or snap beans are the pods harvested before the seed development phase, whereas shell beans are the seeds harvested at physiological maturity (before the desiccation associated with complete maturity sets in), and dry beans are the seeds harvested at complete maturity (Gepts, 1998). Beanettes are cultivars with short (<14cm), slim, round pods (O'Hare, 1997). This review and any subsequent research will focus solely on the green/snap bean pods. Table 1 outlines a large variety of cultivars available around the world that differ in their size, colour, colour intensity, shiny pod character, straightness of pod, sugar content and calcium content, indicating a large potential for variation to be offered to consumers.

2.4.2 SENSORY DIFFERENCES AND CONSUMER PREFERENCE BETWEEN VARIETIES

Snap bean pod colour is only one of many criteria considered by consumers – in one study panellists were able to make subjective distinctions among the cultivars based on colour (for details see Table 1). However, these differences did not necessarily correlate with the likelihood of purchase (Kahn and McGlynn, 2009). Spanish consumers like juicy texture beans with low fibrous texture and not too hard (Martinez et al., 1995) while Greek consumers like beans with strong colour, brightness, juiciness, tenderness and odour, which are characteristics associated with freshness and disliked hard texture and tart tasting beans (Khah and Arvanitoyannis, 2003). No published research is available on the sensory preferences for beans of Australian consumers.

2.4.3 RANGE OF PRODUCT USES AND EFFECT OF COOKING ON SENSORY/LIKING

Cooking method, time and temperature can all influence consumers' liking of beans, as shown in Table 1, in addition see section 2.5.5 for opportunities in snacking.

2.4.4 CONVENIENCE

Frozen green beans are very convenient since they can be stored frozen for a long time without losing many of their nutritional properties. 'French-cut' frozen green beans are cut in half lengthwise, running the knife down the flat part between the seams of the bean, while regular-cut and whole beans are other standard ways of packaging green beans. Only five out of sixty subjects in a U.S. study knew what 'French-cut' green beans meant, and all stated that type of cut does not matter to them (Miljkovic et al., 2009). See section 2.5.4 for additional comments on the convenience of vegetables.

2.4.5 QUALITY ATTRIBUTES AND SHELF LIFE

A previous industry report (Bunt and Piccone, 1999) outlined that unless consumers were able to purchase good quality fresh beans 'every time' then the entire industry suffered, so product quality must be achieved first in growing the product, and then maintained throughout distribution to the final point of sale. The quality of vegetables is related to their nutritive, chemo-protective properties and to sensory attributes, which represent acceptance by the consumer (Berger et al., 2007).

The shelf life of snap beans depends on the temperature and cultivar. In one study, snap beans stored at temperatures higher than 10 °C were less green, softer and more shrivelled, had higher weight loss, and lower acidity, soluble solids, ascorbic acid, and chlorophylls contents than those stored at lower temperatures. However chilling injury can develop if the temperature is too low. Weight loss was the first non-sensory quality attribute to reach the limit of acceptability, whereas firmness was the first sensory quality attribute, followed by colour, to reach the limit of acceptability and therefore limited the shelf life. Use of a film wrap was recommended to create a high relative humidity and therefore reduce water loss, maintain better overall quality, and extend the shelf life of snap beans (Proulx et al., 2010). Other ways to extend shelf life include a combination of gamma irradiation, citric acid treatment and modified atmosphere packaging. This extended shelf life by one week with acceptable sensory and nutritional quality (Gupta et al., 2012). With cooked green beans, a detrimental change in colour from green to olive green during storage observed was the limiting factor for shelf-life during storage, and undesirable quality changes in the odour and flavour of the green beans also occurred (Knøchel et al., 1997). See Table 1 for further details.

2.4.6 COST

There was no research available on how cost influences the purchase of green beans, however see section 2.5.6 for studies on the cost of vegetables in general.

2.4.7 HEALTH CLAIMS/BENEFITS

Green beans are a low calorie food and are also a source of many nutrients such as iron, dietary fibre, vitamin A, vitamin K, and vitamin C (Miljkovic et al., 2009). One study investigated high calcium beans (Grusak and Pomper, 1999), for further details see Table 1. No literature was found on the consumer perception of the health benefits of green beans, but see section 2.5.7 for information on communicating the health benefits of vegetables in general.

2.4.8 CONSUMER UNDERSTANDING OF PORTION SIZE AND VEGETABLE VARIETY GROUPING

There is no information available about consumer perception of green bean portion sizes, or if this affects their purchase behaviour. Most consumers in a U.S. study placed beans in the wrong vegetable type/variety grouping (Britten et al., 2006); see section 2.5.8 for recommendations on addressing this misunderstanding.

It is unknown how Australian consumers perceive green beans in terms of type/variety of vegetables, or if this affects their desire to consume green beans as part of a variety of vegetables in the diet. For example if consumers understood that beans were not in the 'dark-green' subgroup, they might buy them in addition to more commonly purchased green vegetables in the 'dark-green' subgroup such as broccoli (purchased by 77% of Australian shoppers, Nielsen data accessed October 2012 <http://ausveg.businesscatalyst.com/>).

2.4.9 LABELLING/BRANDING

Trivial attributes, although they do not reveal any useful information about the products themselves, may play an instrumental role in consumer choice when consumers are unable to differentiate and choose a product brand based on differences in substantive (important) quality attributes or economic variables such as price. Brands with product-related trivial attributes such as 'French-cut' green beans were more likely to be chosen (40%) than brands with promotional attributes that are unrelated to the food product such as 'free Tshirt iron-on' (23.3%). Results indicate that adding a product-related trivial attribute to the existing substantive health and nutrition attributes may increase sales of the brand of a certain product (Miljkovic et al., 2009). See section 2.5.9 for research on vegetable labelling in general, and Table 1 for more details on the study mentioned above.

2.4.10 CONSUMER SEGMENTATION

There may be segmentation in the textural preferences for green beans, as one U.S. study found that 57% of people preferred 'soft' and 43% preferred 'crisp' beans (see Table 1). People who preferred 'soft' bean texture liked steamed beans less than boiled beans for texture, flavour, and overall likability, while hedonic scores of people who preferred 'crisp' texture did not differ by preparation method (Baron and Penfield, 1993). The sensory attributes characterising different types/varieties of beans could be determined in order to communicate their differences to consumers so they could buy a product with the particular sensory traits they prefer (Talavera-Bianchi et al., 2010).

53.2% of Australian Households purchased beans within the year preceding June 2011; spending on average \$12.0 on beans during the year. Shoppers who bought beans purchased them 6.6 times over the year and spent on average \$1.80 per shopping trip. Beans peak season is June- October. Bean shoppers tend to be more affluent households and skew towards the Senior Couples lifestage (see Table 2), in line with total vegetable sales over the same year. Opportunity exists to increase household reach within the middle, low income and to increase household reach within the larger households, as 1-2 member households had the most significant contribution to value sales of beans, with a contribution of just over 54%, compared to 20% 3-member, 16% 4-member and 9% 5+ member households. High income households (\$70K+) accounted for the most significant contribution (46.7%) to bean value sales, followed by medium income (\$35-70K) at 32.3% and low income households (\$0-35K) at 20.9% (Nielsen, 2011a).

Preferences of children

More Australian children thought they would prefer the atypically coloured (yellow) green bean sample compared to the typical green-coloured bean, however acceptance upon tasting did not differ. The atypically coloured (yellow) green bean sample was relatively similar in flavour and texture to the typically coloured one prepared in the same way, which may explain the finding. Preparation method affected acceptance for beans, with baked/stir fried samples accepted less than boiled samples. Familiarity, variety in the number of vegetables liked, and reported liking of target vegetables was associated with higher acceptance. Preparation method was more important for acceptance for children who liked fewer vegetables than those who liked many vegetables (Poelman and Delahunty, 2011). In another study all participants preferred boiled and steamed vegetables over mashed, stir-fried, grilled and deep-fried. Children's vegetable liking is influenced by a complex mixture of a uniform appearance, easily controllable textures and a typical, familiar vegetable taste (Zeinstra et al., 2010). Salt level had a positive impact on the intake of green beans but should be considered cautiously (Bouhhal et al., 2011) because of health concerns over sodium intakes.

For infants, repeated dietary exposure to green beans, with or without peaches, resulted in greater consumption of green beans. Mothers should be encouraged to provide their infants with repeated opportunities to taste fruits and vegetables and should focus on their infants' willingness to continue feeding rather than the infants' facial expressions (Forestell and Mennella, 2007). Infants who experienced green beans alone or a variety of vegetables between meals also tended to eat more green beans after the exposure (Mennella et al., 2008). For school students, the addition of green bean and carrot photographs in cafeteria lunch trays resulted in twice as many students selecting green beans, although the amount of green beans eaten by students who took them did not increase (Reicks et al., 2012).

2.4.11 CONTEXT/AVAILABILITY

In Australia during the year preceding June 2011, the value share of green bean trade was: non-supermarkets 37.5%, Woolworths 24.7%, Coles 20.6%, Aldi 8.9%, IGA 5.3% and other supermarkets 3.0% (Nielsen, 2011a). In one study, green beans were found to be sensitive to monotony in the context of a meal (monotony week meal was served every day, whereas in the variety week, the meal was served Monday and Friday only (see Table 2 for details) (Meiselman et al., 2000). Thus, a larger variety of products within the green bean category may be important for reasons outlined section 2.4.1, as larger assortments can be more attractive to consumers (Chernev, 2011).

2.4.12 COUNTRY OF PRODUCT ORIGIN

In Australia, beans are produced for either the fresh or processed market. Exports have been on a gradual upward trend over recent years, and exports of fresh beans accounted for 68% of total exports of green beans in 2009-10. However, imports of beans (primarily from New Zealand and China) consistently exceed exports so Australia runs a negative balance of trade. Beans both fresh and frozen enter Australia tariff free - imports are dominated by frozen beans (\$7.7 million in 2009-10), which accounted for 89% of total green bean imports in 2009-10 (James, 2011). There was no research available on whether Australian consumers prefer to purchase and consume green beans of Australian origin compared to imported green beans.

2.4.13 EMOTIONAL INVOLVEMENT IN DECISION MAKING

There was no research available on the symbolism of green beans or the emotional involvement of consumers purchasing them.

Table 1 Factors influencing purchase and consumption of Cauliflower and Green Beans and research conducted in these areas

	Cauliflower	Green Beans (French beans, snap beans)
1. Varieties available	<ul style="list-style-type: none"> • White, purple/violet, Broccoflower (green cauliflower) and Romanesco (Roman cauliflower) (Lucera, Conte et al. 2012) (Branca 2008) • A Purple gene mutation in cauliflower (<i>Brassica oleracea var botrytis</i>) confers an abnormal pattern of anthocyanin accumulation, giving the striking mutant phenotype of intense purple color in curds and a few other tissues. The successful isolation of Purple gene mutation offers a genetic resource for development of new varieties with enhanced health-promoting properties and visual appeal (Chiu, Zhou et al. 2010). • The <i>Orange (Or)</i> gene mutation in cauliflower (<i>Brassica oleracea var botrytis</i>) confers the accumulation of high levels of β-carotene in various tissues normally devoid of carotenoids (Lu, Van Eck et al. 2006). • The healthy compounds contained in the produce of several brassicas which allows them to be defined as functional foods, are important for increasing the consumption of cauliflower and broccoli. The great diversity still present for cauliflower and broccoli in several germplasm banks, which could be exploited to provide new horticultural items, is important for breeding programmes aimed at satisfying new consumer requirements (Branca 2008). • Varieties accepted by the Australian export cauliflower industry include Monarch, Summer Love, Celsius and Omeo (Lancaster 2003). • Compared with the frozen white cauliflower (cultivar Planita F1), the frozen green variety (cultivar Trevi F1) was characterized by significantly greater contents of dry matter, vitamin C, carotenoids, β-carotene, polyphenols 	<ul style="list-style-type: none"> • In Spain, young pods of green climbing beans (<i>P. vulgaris</i> L. cv. Estefania) are very straight, long (22–24 cm) and flattened (Iborra-Bernad, Philippon et al. 2013). • The inheritance of the purple pod character in common bean (<i>Phaseolus vulgaris</i> L) was investigated in two bean cultivars, Royal Burgundy and Preto 146 (Bassett 1994) • Shiny pod character (less cutin resulting in a cuticle that has a smooth upper surface) is another variation that can be observed in <i>P. vulgaris</i> L. (Bassett 1997) • ‘Hystyle’ cultivar had higher pod calcium concentrations compared to ‘Labrador’ and narrower pods of all cultivars (‘Hystyle’, ‘Labrador’, ‘Tendergreen’, ‘Green Crop’, ‘BBL94’, and ‘Gold Crop’) had higher calcium concentrations (Grusak and Pomper 1999) • Of the 7 green bean varieties (Broker, Barracuda, Banquet, Phoenix, Milagrow, Teseo, Rapier and Sabre) trialled, Milagrow had the darkest green colour. A uniform size of 12-14cm is desirable for export. Customers in Japan indicated that Milagrow would be accepted but Broker would only be accepted in the North of Japan where a larger pod is preferred (Palmer 1997). • Sugars, including fructose, glucose, and sucrose, contribute significantly to the flavor and consumer acceptance of snap beans (<i>Phaseolus vulgaris</i> L.). Differences among snap bean cultivars in the patterns of accumulation of sugars have been observed in the U.S. In ‘Eagle’, a white-seeded, large-sieve snap bean cultivar, fructose and glucose concentrations in developing pods decreased while sucrose concentration increased with increasing pod size (VandenLangenberg, Bethke et al. 2012).

	<p>and a higher antioxidative activity (Gębczyński and Kmiecik 2007).</p>	
<p>2. Sensory differences and consumer preference between varieties</p>	<ul style="list-style-type: none"> • Raw, freshly cut florets of 3 varieties of cauliflower; Rosalind (purple), Minarett (green pyramidal) and Marine (white) and were assessed in 1998, 1999 and 2000 by a trained sensory panel (QDA, Germany) for taste, flavour, mouthfeel and aftertaste (Brückner, Schonhof et al. 2005). The varieties were significantly different in bitter and sweet taste; broccoli, cauliflower, green/grassy and pungent flavour; crisp and juicy mouthfeel; and bitter aftertaste all three years evaluated and in addition one year pungent aftertaste was significantly different between varieties. Sugar content also differed between varieties and years but higher sugar content did not coincide with increased sweet taste intensity. Consumers (German housewives 25-65yr; n=62, 98 and 99/year) preferred cauliflower samples with greater sweetness, juiciness and cauliflower flavour. The cauliflower variety 'Marine' was most liked by consumers all three years studied, and was rated highest in sweet taste and cauliflower-like flavour by the trained panel. More intense bitter, pungent and green/grassy notes reduced acceptability (Brückner, Schonhof et al. 2005). • Raw, freshly cut florets of four varieties of cauliflower; Marine (white), Minarett (green pyramidal), Alverda (green) and Rosalind (violet) were assessed in 1998, 1999 and 2000 by a trained sensory panel (QDA, Germany) for colour, taste, flavour, mouthfeel (Schonhof, Krumbein et al. 2004). Consumers (100 German housewives 25-65yr) preferred cultivars with a bright colour, a lower level of bitter tasting glucosinolates (alkenyl and indole glucosinolates) and a higher sucrose content. A not too intensively green colour was found to be acceptable; thus, a broader cauliflower product range seems possible (Schonhof, Krumbein et al. 2004). 	<ul style="list-style-type: none"> • The atypically coloured (yellow) green bean sample was relatively similar in flavour and texture to the typically coloured one prepared in the same way, as determined by sensory descriptive analysis (Australia) (Poelman and Delahunty 2011). • Fibrousness, juiciness and hardness (assessed by Spanish consumers aged 20-52yr, n=64) were the most important sensory variables for the overall acceptance of two cultivars (BINA and STRIKE) of cooked green beans. There was a weak relationship between the sensory attributes and the physico-chemical variables which define maturity. Colour ratings were significant higher for BINA while brightness ratings obtained in the same cultivar were significantly lower. There was no significant difference in juiciness, fibrousness, hardness, beany flavour and acceptance due to the cultivar studied. The development stage (size) affected the consumer scores of all the sensory attributes except for beany flavour in both cultivars. Sizes 1 and 3 of STRIKE beans received the highest scores for overall acceptance. Additionally the same samples were considered the most juicy, the least fibrous and least hard (Martinez, Ros et al. 1995) • The effects of textural preferences on sensory intensity and hedonic scores assigned by U.S. consumer panelists (50 preferred "soft" and 38 "crisp" beans) to green beans of two cultivars cooked by 2 methods were studied. 'Mustang' cultivar beans were scored more acceptable for colour, flavour, and overall likability than 'Strike' beans. People who preferred "soft" bean texture liked steamed beans less than boiled beans for texture, flavour, and overall likability, while hedonic scores of people who preferred "crisp" texture did not differ by preparation method (Baron and Penfield 1993)

	<ul style="list-style-type: none"> • Eleven varieties (un-named from Breton, France) of cauliflower were assessed by a trained sensory panel for flavour profile. The varieties differed mainly according to their “cauliflower odour note” and their “bitterness”. Various glucosinolates were correlated with bitterness intensity, while neoglucobrassicin and sinigrin were responsible for the bitterness of cooked cauliflower. Allyl isothiocyanate (AITC), dimethyl trisulfide (DMTS), dimethyl sulfide (DMS), and methanethiol (MT) were the key odorants of cooked cauliflower “sulfur” odors. Moreover, these volatile compounds corresponded to the main compositional differences observed between varieties (Engel, Baty et al. 2002). • Trained panel (Australia) descriptive analysis: green cauliflower was more bitter than white cauliflower (Poelman and Delahunty 2011). • Trained panel (Australia) descriptive analysis of the basic tastes: cauliflower sweeter than broccoli and Brussels sprouts; less salty than broccoli; less bitter than brussels sprouts, red cabbage and broccoli (Cox, Melo et al. 2012). Cauliflower and broccoli were the most liked, followed by broccolini, green cabbage, red cabbage and Brussels sprouts the least liked overall of the Brassicas evaluated by Australian consumers (n= 200, 18-55yr). Sensory perception tended to predict liking and intentions to consume Brassica vegetables. Highlighting the sweetness of Brassica vegetables (for example, by changing intrinsic sugar content) may be useful in changing acceptance (Cox, Melo et al. 2012). 	<ul style="list-style-type: none"> • In an affective test U.S. panelists (n=25, year 2 n=27) were asked to evaluate intensity of colour and likeliness to buy using a 5-point semantic differential scale. Sensory panelists were able to make subjective distinctions among the cultivars (‘Blue Lake 274’, ‘Brio’, ‘Charon’, ‘Jade’, and ‘Seville’) based on colour. However, these differences did not necessarily correlate with either objective colour measures or likelihood of purchase. Snap bean pod colour is not an overriding selection criterion, but only one of many criteria considered by consumers (Kahn and McGlynn 2009). • Overall consumer impression (pleasantness to consumers, n=50, Greece) was closely related to the sensory characteristics colour, odour, juiciness, tenderness and brightness (QDA) - ‘Larma’ cultivar was superior to ‘Montano’ in terms of desirable characteristics: high overall impression (very pleasant to consumers), sweetness, saltiness, colour and odour. However, hardness and tartness were two unfavourable characteristics attributed to ‘Larma’. Genomic characteristics were shown to be more powerful than the fertiliser treatments used (Khah and Arvanitoyannis 2003).
<p>3. Range of product uses and effect of cooking on sensory/liking</p>	<ul style="list-style-type: none"> • For cauliflower, preparation method was more important for acceptance for children who liked fewer vegetables than those who liked many vegetables – boiled cauliflower was more liked than baked cauliflower (Poelman and Delahunty 2011). • Trained sensory panel (Australia) sensory descriptive 	<ul style="list-style-type: none"> • Boiled French beans were more liked by children than stir-fried beans (Poelman and Delahunty 2011). • The effects of textural preferences on sensory intensity and hedonic scores (rated 1-8) assigned by U.S. consumer panelists (50 preferred “soft” and 38 “crisp” beans) to green beans (<i>Phaseolus vulgaris L.</i>) of two cultivars cooked

	<p>evaluation of appearance, odour, taste/flavour, texture: With increased cooking time, a decrease in firmness and chewing resistance, and an increase in cohesiveness were observed, as well as a shift from green to cooked odour and flavour notes. Cooking method (steamed vs boiled) affected odour, flavour and appearance (Poelman, Delahunty et al. 2013).</p> <ul style="list-style-type: none"> • Short-boiled (5min) cauliflower was more crunchy and firm, required more mastication effort and released less moisture in-mouth than boiled for 15min, but did not differ in odour/flavour characteristics. Baked cauliflower had a higher intensity in odour impact, oily flavour and oily mouthcoating (Poelman and Delahunty 2011). • Cauliflower is generally used as cooked vegetable either singly or mixed with potato, carrot, and peas. In raw form, it is also mixed with green salad or its pieces are dipped into sauces. It is also used in the preparation of pickle or mixed pickle with other vegetables (Sharma, Singh et al. 2005). • Brassica vegetables, including cauliflower, are consumed all over the year in Poland as the ingredients of different salads or after cooking of raw and frozen vegetables. Prior to freezing, vegetables are washed, sometimes cut, and steam or water blanched in order to inactivate enzyme systems, especially oxidative enzymes (e.g. polyphenoloxidase, ascorbic oxidase, peroxidase) (Podsedek 2007) • Sensory and consumer evaluation was done on uncooked brassica because it is often consumed raw in salads and could potentially be added as a nutraceutical additive to other foods (Brückner, Schonhof et al. 2005). 	<p>by 2 methods were studied. Boiled beans were rated lighter than steamed beans. Soft textural preference panelists liked steamed beans less than boiled beans for texture, flavour, and overall likability. Hedonic scores assigned by panelists of crisp textural preference did not differ by preparation method (Baron and Penfield 1993).</p> <ul style="list-style-type: none"> • Consumers (n=84, Spanish 18-40yr) preferred green beans (<i>P. vulgaris</i> Linnaeus cv. Estefania) that had the sous-vide treatment (firmer texture) compared to the cook-vide and traditional cooking (TC, 100 °C) due to the texture perceived in mouth and flavour (preference ranking). Sous-vide cooking: raw materials are cooked under controlled conditions of temperature and time inside heat-stable vacuumized pouches; cook-vide: raw food is cooked in boiling water at below 100 °C by lowering the pressure above the water to the vapor-pressure-of-water at the desired cooking temperature. The texture and color of green beans pods are a function of time and temperature conditions in sous-vide and cook-vide (Iborra-Bernad, Philippon et al. 2013). • Beans were reported by Queensland consumers to be largely used as a side vegetable or in a stir-fry if the preparer was short of other vegetables (Richards 2004).
<p>4. Convenience</p>	<ul style="list-style-type: none"> • Cauliflower can be marketed cut in florets and packed in small units overwrapped with an appropriate film to avoid excessive dehydration. This product must also be kept under refrigeration during marketing in order to maintain 	<ul style="list-style-type: none"> • The French prefer loose beans, and the British pre-packed, trimmed and microwave ready (Freidberg 2001).

	<p>its quality and enhance its shelf life (Simón, González-Fandos et al. 2008).</p> <ul style="list-style-type: none"> • Many Queensland consumers viewed a single cauliflower as being too large and therefore wasteful. It was also viewed as requiring special preparation as most consumers felt that it requires white or cheese sauce to make it more appetising (Richards 2004). 	
<p>5. Quality attributes and shelf life</p>	<ul style="list-style-type: none"> • High quality cauliflower is white to cream in colour, without yellowing or browning caused by sun exposure. Yellowing and black spots were the aspects that had the greatest influence on the decrease of acceptability (hedonically assessed by 12 cauliflower consumers). Visual acceptance of cauliflower decreased significantly with storage time, although scores remained on the borderline of acceptability after 20 days of storage. No significant effect of temperature was observed (4 or 8 °C), however a better appearance was observed in cauliflowers packed in polypropylene film after 20 days of storage, compared to perforated and non- perforated polyvinylchloride (PVC) films (Simón, González-Fandos et al. 2008). • The quality loss of cauliflowers is mainly due to yellowing of head and the development of undesirable odours, sharp increase of bitter taste, curd softening and leaf wilting (Lucera, Conte et al. 2012). • Less than 5% weight loss is permissible in order to avoid wilting, shrivelling and other senescence symptoms of the cauliflower (Artés and Martínez 1999). • Total sugars decreased about 27% after 20 days of storage, whereas ascorbic acid did not change. (Simón, González-Fandos et al. 2008). • Cauliflower curds individual packed in high density polyethylene bags (20 µm) with perforation (6 holes/bag) can be stored up to 21 days at 0 ± 1°C and 90–95% RH with maximum retention of white colour of curd, minimum spoilage, weight and firmness loss and good 	<ul style="list-style-type: none"> • Wholesalers and retailers in Australia prefer beans which are darkly coloured, picked young, uniform size and shape, straight, clean, and with a long shelf life (O'Hare 1997). • An extra millimetre of girth, a spot, wrinkle or bend ruins the market value of a 'fine' or 'extra-fine' green bean (Freidberg 2001). • Genotype × environment interaction was significant for fresh pod traits such as curvature, length/width and width/thickness ratios, and texture. significant differences among environments for pod curvature, pod and seed length/width ratio, seed volume, seed texture, crude fibre and starch content. The differences in rainfall and temperature conditions between the three environments were probably the most important factors contributing to this variation (Escribano, Santalla et al. 1997). • Chilling injury in green beans manifests itself as rust coloured streaking and flecks on the surface of the pod (Palmer 1997). • Snap beans (evaluated subjectively using a 1 to 5 visual rating scale) stored at temperatures higher than 10 °C were less green, softer and more shrivelled, had higher weight loss, and lower acidity, soluble solids, ascorbic acid, and chlorophylls contents than those stored at lower temperatures. When stored at 1, 5, and 10 °C, 'Leon' snap beans developed chilling injury (CI), whereas no visual symptoms (i.e., pitting, rusty spots, and discoloration) were noticeable in 'Opus' snap beans. Although CI might have indirectly affected the quality of 'Leon' snap beans, it

	<p>sensory quality attributes. The use of cling wrap films should be avoided as this leads to accumulation of excessive moisture resulting in huge spoilage loss (Dhall, Sharma et al. 2010).</p> <ul style="list-style-type: none"> • For commercial purposes 11 mm LDPE could be a good alternative to PVC for wrapping cauliflower because weight loss was considerably lower for all LDPE films than for PVC film (Artés and Martínez 1999). 	<p>was not considered a sensory quality-limiting factor. Overall, weight loss was the first non-sensory quality attribute to reach the limit of acceptability, whereas firmness was the first sensory quality attribute, followed by colour, to reach the limit of acceptability (3/5) and therefore limited the shelf life of 'Opus' and 'Leon' snap beans cultivars. As a result of excessive water loss and accelerated softening, shelf life of both snap bean cultivars was relatively short, ranging from 1 to 3.5 days, depending on the temperature and cultivar. Furthermore, the compositional value was considerably reduced at the point of poor sensory quality. The high weight loss obtained for beans stored at all temperatures suggests that the use of a film wrap may help create a high relative humidity and therefore reduce water loss, maintain better overall quality, and extend the shelf life of snap beans. Overall, maximum shelf life and best quality were obtained when 'Opus' and 'Leon' snap beans were stored at 10 °C (Proulx, Yagiz et al. 2010).</p> <ul style="list-style-type: none"> • A trained sensory panel described colour, odour, flavour and texture. An acceptable sensory quality was defined as the green beans retaining a green colour, a crunchy texture and bean flavour. A detrimental change in colour from green to olive green during storage, which had begun during the first week, was the limiting factor for shelf-life during storage of sous vide (vacuum cooked then rapidly chilled) cooked green beans (<i>Phaseolus vulgaris</i>, "very fine", diameter 6.5–8 mm (Denmark)). Subsequent reheating, however, resulted in further colour changes which partially obscured the initial differences observed during the storage period. Storage for more than 1 week resulted in undesirable quality changes in the odour and flavour of the green beans. Therefore, a maximum shelf-life of 8 days at 3°C was recommended (Knøchel, Vangsgaard et al. 1997).
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		<ul style="list-style-type: none"> • Combination of gamma irradiation, citric acid treatment and modified atmosphere packaging extended shelf life of French beans. Citric acid treatment demonstrated to alleviate gamma induced softening in texture. Under these conditions shelf life of the product could be extended by one week with acceptable sensory (trained panel QDA and hedonic testing) and nutritional quality as evaluated by total antioxidant, phenolics, flavonoids and vitamin C content (Gupta, Chatterjee et al. 2012). • The total ascorbic acid content of Paulista variety green beans (Germany) was positively correlated with a “squeaky” texture and negatively with a “musty” taste when assessed by a trained sensory panel (QDA on appearance, odour, taste and texture) during deep-frozen storage and storage at 4 °C and 20 °C. Compared to ascorbic acid, the flavonol content and the antioxidant capacity were more stable during the storage process and showed less correlation with sensory attributes (Berger, K�uchler et al. 2007).
6. Cost	No published research was available	No published research was available
7. Health claims/ benefits	<ul style="list-style-type: none"> • Health-promoting phytonutrients in cruciferous vegetables have been gaining attention for their powerful effects in combating cancer. Losses of nutrients and active compounds during cooking, microwaving, and blanching of vegetables may be more substantial than commonly perceived (Czapski 2009). • The contribution of Brassica vegetables to health improvement can be related to their antioxidant capacity. Phenolic compounds with vitamin C are the major antioxidants of Brassica vegetables, due to their high content and high antioxidant activity. On the contrary, lipid-soluble antioxidants (carotenoids and vitamin E) were responsible for up to 20% of the total antioxidant activity of Brassica vegetables. The content and composition of antioxidants vary significantly between 	<ul style="list-style-type: none"> • Developing new snap bean cultivars with enhanced pod Ca concentration has been investigated. Relative to other fruits and vegetables, snap beans contain a high concentration of Ca, which is present in a highly available form, (in teenagers, calcium absorption from snap beans was comparable to that from milk. Consumer selection or farmer harvest of lower grade-size pods (i.e., narrower diameter) might be an immediate way to enhance the dietary impact of snap bean with respect to calcium, because narrower pods of all cultivars (‘Hystyle’, ‘Labrador’, ‘Tendergreen’, ‘Green Crop’, ‘BBL94’, and ‘Gold Crop’) had higher Ca concentrations (Grusak and Pomper 1999).

	<p>and within their subspecies, antioxidant activity and stability of individual phytochemicals differ significantly, the vegetable processing (blanching, canning), as well as domestic cooking influence antioxidants content and activity (Podsędek 2007).</p> <ul style="list-style-type: none"> • Cruciferous vegetables including cauliflower, are unique in their high content of dithiolthiones and isothiocyanates; these are organosulfur compounds that have been shown to increase the activity of enzymes involved in the detoxification of carcinogens and other foreign compounds. Cruciferous vegetables also contain indole-3-carbinol, which has been shown to affect estrogen metabolism in human beings, which may protect against estrogen-related cancers such as breast and endometrial cancers (Steinmetz and Potter 1996). • A large series of studies provides evidence of a favourable effect of cruciferous vegetables on several common cancers. The multivariate odds ratio (OR) for consumption of cruciferous vegetables at least once a week as compared with no/occasional consumption was significantly reduced for cancer of the oral cavity/pharynx, esophagus, colorectum, breast, and kidney (Bosetti, Filomeno et al. 2012). 	
<p>8. Consumer understanding of portion size and vegetable variety grouping</p>	<ul style="list-style-type: none"> • In a study investigating consumer understanding of how to eat a variety of vegetables, cauliflower was incorrectly mentioned as part of the ‘starchy’ subgroup by most consumers (U.S., n=178, 75) when it should have been in the “other” subgroup. Most groups had difficulty when asked to name vegetables in each of the 5 Pyramid subgroups: dark-green leafy vegetables; orange vegetables; dry peas and beans; starchy vegetables; and other vegetables (Britten, Haven et al. 2006). 	<ul style="list-style-type: none"> • Green beans were incorrectly mentioned as part of the dark-green subgroup by most consumers (U.S., n=178, 25-60yr, >60yr group) when they should have been in the “other” subgroup. Manufacturers may want to provide additional information on food packaging to help consumers identify how to choose a variety of types of vegetables/which subgroups the food provides and the amounts for each in 1 serving (Britten, Haven et al. 2006).
<p>9. Labelling/branding</p>	<p>No published research was available</p>	<ul style="list-style-type: none"> • An example of a food product related trivial attribute would be “French-cut” green beans, these trivial attributes do not reveal any useful information about the

		<p>products themselves. French-cut beans are cut in half lengthwise, running the knife down the flat part between the seams of the bean. Regular-cut and whole beans are other standard ways of packaging green beans. In the case of green beans, brands differed along four attributes: calories per serving, content of iron, fiber per serving, and whether green beans are French-cut or not (trivial attribute). Green beans show strong support for our hypothesis that the same trivial attribute can have both a negative and positive impact on choice (U.S. consumers) (Miljkovic, Gong et al. 2009)</p>
<p>10. Consumer segmentation</p>	<ul style="list-style-type: none"> • The consumption of cauliflower consumers (non-, medium- and high-consumers) in France (n=267) has been related to the olfactory thresholds for allyl isothiocyanate and gustatory thresholds for sinigrin. The non-consumers were significantly more sensitive to SIN and AITC (Engel, Martin et al. 2006), which are key odorants of cooked cauliflower sulphur odour (Engel, Baty et al. 2002), than were the medium and high consumers. No effect of consumer's sensitivity to DMTS was observed (Engel, Martin et al. 2006). • The calculation of individual response to the product attributes revealed substantial differences between the individual consumers. A large majority of consumers indicated a greater preference for both, broccoli and cauliflower samples which had more sweetness and cauliflower flavour and low intensities of bitter and pungent notes (Brückner, Schonhof et al. 2005). • There was no difference in acceptance between low and high vegetable consumers (5-6yr children), although high vegetable consumers were more discriminating in acceptance for cauliflower (Poelman, Delahunty et al. 2013). 	

Children's liking and development of preferences

- A preference for the odour of the cheese and onion flavoured cauliflower compared to the plain boiled cauliflower was seen in 12-13yr UK children (n=33), but there were no significant differences in any other attributes, including acceptability (Wrieden and Burger 1998).
- Medium and long cooked cauliflower (boiled or steamed) that were medium firm and cohesive, with a balance of green and cooked flavour notes, were more accepted than short cooked cauliflower by Australian 5-6yr olds (n=82). Boiled samples were less intense in flavour and taste than steamed samples, but overall did not differ in acceptance over all cooking times (Poelman, Delahunty et al. 2013).
- An atypically coloured (green) cauliflower sample was chosen significantly more, and the baked sample significantly less often, as the sample that Australian 5-6yr olds (n=104) thought they would prefer. Boiled was accepted significantly more than baked white cauliflower. Ranked preference data were in agreement, but somewhat more discriminating. White and green boiled cauliflower were preferred to baked white cauliflower (Poelman and Delahunty 2011).

Children's liking and development of preferences

- The atypically coloured (yellow) green bean sample was chosen significantly more often ($p < 0.0001$), and the stir fried sample significantly less often as the sample the children (n=104, 5-6 year old Australian) thought they would prefer. Stir fried green beans were accepted less than yellow boiled beans. Ranked preference data were in agreement, but somewhat more discriminating - the boiled yellow beans and the short boiled green beans were preferred to stir fried green beans (Poelman and Delahunty 2011).
- Preparation method affected acceptance for cauliflower and beans, with baked/stir fried samples accepted less than boiled samples. A high odour intensity and the presence of a browned flavour were found to lower acceptance. Differences in texture and flavour characteristics imparted by different boiling times, as well as small differences observed in sweetness or bitterness, did not affect acceptance. Atypical colour had a positive influence on expected preference but not on acceptance upon tasting. Familiarity, variety in the number of vegetables liked, and reported liking of target vegetables was associated with higher acceptance (Poelman and Delahunty 2011).
- Children (4-6. years N= 46; 7-8. years N= 25; 11-12. years N= 23) and young adults (18-25. years N= 22) from the Netherlands tasted and ranked six preparation methods for carrots and French beans: mashed, steamed, boiled, stir-fried, grilled and deep-fried. In addition, the different vegetable preparations were rated on 15 attributes by the young adult consumers. All participants preferred boiled and steamed vegetables over the other preparations ($p < 0.05$). Boiled and stir-fried were the most familiar preparation methods for both vegetables. Vegetable liking was positively related to a uniform surface and the typical

vegetable taste, and moderately related to crunchiness, whereas brown colouring and a granular texture were negatively related to vegetable liking. On the basis of these results, we conclude that children's vegetable liking is influenced by a complex mixture of a uniform appearance, easily controllable textures and a typical, familiar vegetable taste (Zeinstra, Koelen et al. 2010).

- Green beans and pasta with varying salt (0, 0.6 and 1.2% added salt) or fat (0, 2.5 and 5% added butter) levels were investigated - during each meal, French children (n=74, 30months old) could eat as much as they wanted from the target foods. Salt level had a positive impact on the intake of the target foods while fat had no impact. This implies that fat addition could be avoided in foods for children without having an impact on palatability, allowing the energy density of children's diet to be limited. Salt addition should be limited, and its addition to vegetables, whose intake is to be promoted, should be considered cautiously (Bouhlal, Issanchou et al. 2011).
- For breastfed and formula-fed infants (n=45, U.S. 4-8 month-old), repeated dietary exposure to green beans, with or without peaches, resulted in greater consumption of green beans (56.8 vs 93.6 g). Only infants who experienced green beans with peaches displayed fewer facial expressions of distaste during feeding. Mothers were apparently unaware of these changes in acceptance. Once weaned, infants who receive repeated dietary exposure to a food eat more of it and may learn to like its flavour. However, because infants innately display facial expressions of distaste in response to certain flavours, caregivers may hesitate to continue offering these foods. Mothers should be encouraged to provide their infants with repeated opportunities to taste fruits and vegetables and should focus not only on their infants' facial expressions but also on their willingness to continue

		<p>feeding (Forestell and Mennella 2007).</p> <ul style="list-style-type: none"> • 8 days of vegetable variety both between and within meals led to increased acceptance of green beans, carrots and spinach by infants (4-9mo). Those infants who experienced green beans alone or a variety of vegetables between meals also tended to eat more green beans after the exposure (Mennella, Nicklaus et al. 2008). • With the addition of green bean and carrot photographs in cafeteria lunch trays, twice as many students (n=800 U.S.) selected green beans (14.8 % vs. 6.3 %) and three times as many selected carrots (36.8 % vs. 11.6 %). However, the amount of green beans eaten by students who took them did not differ between the control day and the photograph intervention day (mean of 19.0 -19.1g) (Reicks, Redden et al. 2012).
11. Context/availability	No published research was available	<p>Green beans were found to be sensitive to monotony in the context of a meal, while a potato product was resistant to monotony for both acceptance and intake. The study (n=23+24 in the U.S.) showed that acceptance and intake of a meal (Swedish-style meatballs with brown gravy, mashed potatoes, and green beans) declined in the monotony week (meal was served every day) and did not decline in the variety week (meal served Monday and Friday). Correlations between acceptance and intake were highly significant; they were moderate in the variety condition and lower in the monotony condition, suggesting how variety impacts normal varied eating. The decline in acceptance for the monotonous meal (5 days continuous) was significant for the whole meal and for the green beans; Swedish meatball ratings declined but not significantly, and mashed potato ratings were quite stable (Meiselman et al., 2000).</p>
12. Country of product origin	No published research was available	No published research was available
13. Emotional involvement in decision	No published research was available	No published research was available

Table 2 Distribution (%) of value sales of cauliflower, beans and total vegetable between different Australian household segments in the year preceding June 2011

Segmentation based on life stage and age (years)	Cauliflower (%)	Beans (%)	Total vegetable (%)
Young Transitionals (Any Size HHs, No Children, <35)	6.8	8.2	9.1
Start-Up Families (HHs with Young Children Only < 6)	7.6	5.8	7.1
Small Scale Families (HHs with Oldest Child 6-11)	8.9	10.7	10.2
Bustling Families (HHs with Children (Oldest 12+))	16.0	15.4	17.2
Independent Singles (1 Person HHs, No Children, 35+)	15.8	14.5	15.1
Established Couples (2+ Person HHs, No Children, 35 – 59)	20.6	20.1	20.8
Senior Couples (2+ Person HHs, No Children, 60+)	24.4	25.3	20.4

2.5 Vegetables in general

There is relatively limited research available on specific commodities, whereas ample research has been conducted on vegetable consumption and purchase in general. Therefore, research on drivers and barriers of general vegetable consumption that have relevance to the commodities of interest have been included in this review. In order to not simply cannibalise other vegetables that consumers purchase by substituting with the purchase of cauliflower and green beans, the broader issue of increasing consumer vegetable consumption must be considered.

While no studies have examined both intrinsic and extrinsic properties simultaneously of cauliflower or green beans, a number of studies have compared a range of factors influencing the consumption of vegetables in general. One study examined the factors accessibility, affordability, lack of motivation to eat more, cost, and specific preferences, on fruit and vegetable consumption. The authors concluded that more fresh produce should be offered in stores that are in areas of easy accessibility to low-income neighbourhoods and recommended that a follow-up study be done to compare the prices of the items available, and whether increasing their presence in the local grocery stores leads to increased consumption (Godwin and Tegegne 2006). In another study, satisfaction, and especially taste; perceived health consequences; social influences; skills and barriers; habit; and lack of awareness of health consequences or the recommended consumption rates, were determinants of fruit and vegetable consumption of adults (Brug, Debie et al. 1995). A similar finding on the perceived benefits of fruits and vegetables included a belief in their value for cancer prevention, contribution of vitamins and minerals, and low calorie content. Barriers included cost, availability, family acceptance, and concern about agrichemicals (Dittus, Hillers et al. 1995). Individual inhibitors to fruit and vegetable consumption in another study were their high costs and a perceived lack of time. Early home food environment was perceived as affecting fruit and vegetable consumption later in life (Yeh, Ickes et al. 2008). In a review on the psychosocial determinants of fruit and vegetable intake in adult populations, the most consistent variables predicting behaviour were habit, motivation and goals, beliefs about capabilities, knowledge, and taste; those explaining intention were beliefs about capabilities, beliefs about consequences and perceived social influences (Guillaumie, Godin et al. 2010).

In Western Australia, convenience, cost and perishability were all identified by focus group participants as minor barriers to greater vegetable consumption. By far the major barrier was their belief that they were already consuming sufficient quantities for good health (Carter, Pollard et al. 2010). Barriers to consumption for Australian adults aged 50 to 64 years who reported low vegetable consumption were: perceptions that vegetables are eaten only with evening meals, preference for eating meat, believing that recommended quantities were too big, and a lack of preparation time (Dixon, Mullins et al. 2004). Preparation time may be pertinent for cauliflower, and the perception of vegetables only being eaten with evening meals could be important for both cauliflower and green beans.

2.5.1 VARIETIES AVAILABLE

Variety of products within a category is important to consumers. It has been proposed that larger assortments might lead to stronger preferences because they offer option value and allow consumers to maintain flexibility in light of uncertainty about future tastes and accommodate their future variety-seeking behaviour. It has further been argued that consumers might experience additional utility simply from having multiple items in the choice set, a proposition consistent with the view that larger assortments might influence preferences by creating a perception of freedom of choice and perceived personal control. Larger assortments may also enhance the enjoyment of shopping and the overall choice satisfaction, as well as provide buyers with a greater opportunity to learn about the range of available products. Larger assortments offer a greater variety of options, which, in turn, increase the probability of a better fit between a consumer's preferences and the available choice alternatives (Chernev 2011). Findings in another study strongly support the proposed relevance of sensory-specific satiety to attribute-level variety seeking.

Across the three studies, consumers switched more intensively on flavour than brand in 14 of the 15 categories examined (foods un-named) and other factors such as preference heterogeneity and perceived risk failed to explain this difference (Jeffrey Inman 2001). In addition to optimizing the size, organization, and differentiation of their assortments, store managers can influence choice by optimizing the consumer decision-making process, for example by providing a default option, helping consumers articulate their preferences, and managing the decision focus (Chernev 2011). It is difficult to make an overall prediction on how assortment size will influence consumer preferences because increasing the number of options in a choice set can have both a beneficial and detrimental impact on choice, however in general, smaller assortments tend to be more preferred when the attractiveness of the options comprising the available assortments is high rather than when it is low. One of the key factors moderating the impact of assortment size on consumer preferences is the degree to which consumers have an available ideal point. Consumers with articulated preferences are simply trying to identify the option that best matches their ideal point — a task that can be better completed in the context of a larger rather than smaller assortment. Providing a default option can also influence the overall purchase probability from an assortment by providing a simple decision rule for consumers without well-articulated preferences; default-option strategies include showcasing specific options in marketing communications, end-of-aisle displays, and online (Chernev 2011).

Lessons can be learnt from other fresh produce categories, for example fresh and processed tomato consumption has increased 40% in the United States over the last two decades. Through better breeding, fresh tomatoes now are marketed in different forms, sizes, colours, and flavours. One study found that overall, production method (organic vs. conventional) had low relative importance in comparison to price and tomato type (cherry, grape, cluster, plum, and regular slicing) (Simonne, Behe et al. 2006). Increasing the variety of products available for purchase is an opportunity to increase purchase and consumption of both cauliflower and green beans.

2.5.2 SENSORY DIFFERENCES AND CONSUMER PREFERENCE BETWEEN VARIETIES

Flavour has a central role for fruit and vegetable quality as it triggers consumer acceptance. When flavour expectations are exceeded by experience, repeated purchase is fostered (Brückner 2008). The taste of vegetables, preparation knowledge, family response, and importance for health were all factors highly correlated with fruit and vegetable intake in a U.S. study; while cost, availability, preparation difficulty, and importance of increasing intakes were less correlated with fruit and vegetable intake (Anderson, Bybee et al. 2001). Liking the taste of vegetables was the highest association with vegetable intake for Australian women out of the individual, social and environmental measures taken, followed by rarely considering time as a barrier to healthy eating (Williams, Thornton et al. 2012). One barrier to vegetable consumption for Australian adults aged 50 to 64 years who reported low vegetable consumption was their preference for eating meat - thus one strategy the authors suggested to increase consumption was promoting the appealing sensory attributes of fruit and vegetables (Dixon, Mullins et al. 2004). In another study, baseline taste preferences, perceived benefits of healthy eating, fast-food intake, time spent watching television, family-meal frequency, and home food availability were all correlated with both fruit and vegetable intake during young adulthood. After adjusting for baseline intake, the only correlate of both fruit and vegetable intake during young adulthood across gender was taste preferences. The findings suggest that nutrition interventions for adolescents should provide opportunities for them to taste more fruit and vegetables, and should address supports for healthy eating both within and outside the home environment (Larson, Neumark-Sztainer et al. 2008). A similar result was found by Neumark-Sztainer, Story et al. (1999); major barriers to eating more fruit and vegetables included taste preferences for other foods and a lack of sense of urgency about personal health in relation to other concerns. Suggestions for helping adolescents eat a more healthful diet include making healthful food taste and look better, making healthful food more available and convenient, teaching children good eating habits at an early age, and changing social norms to make it “cool” to eat healthfully. Environmental factors, e.g. the increased availability and promotion of appealing, convenient foods within homes, schools, and restaurants, are important to address.

The sensory properties of cauliflower and green beans have already been identified as key influencers of their consumption in sections 2.3.2 and 2.4.2 respectively; however the research on general vegetables outlined in this section further highlights the important role that taste in particular plays in the acceptance and resulting consumption of vegetables.

2.5.3 RANGE OF PRODUCT USES AND EFFECT OF COOKING ON SENSORY/LIKING

Comments from older Australian participants viewed the preparation of vegetables as being very much a part of the normal routine of meal preparation: 'we have veggies with pretty much every meal' (Carter, Pollard et al. 2010). However, to increase consumption the perception of vegetables being solely an evening meal accompaniment needs to be changed (Smyth 2009). Many consumers lack even basic knowledge in how to select, store, prepare, cook and serve vegetables, so tips to maximise nutrient content and get daily needs were recommended for communication to consumers (BrandStory 2010a). Older adults tended to describe ready vegetable soups mainly making associations related to preparation, rather than on their own preferences and evaluations. Conversely, fresh vegetables requiring all preparation or considerable preparation (cut fresh vegetables) were mainly associated with attributes such as taste, freshness, health benefits and familiarity with the product. The encouragement of consuming 'ready-meals' might represent an opportunity to have healthier food choices and to reduce the risk a monotonous diet for older people who cannot or do not know how to cook, combined with a low interest in food-related activities such as cooking (Saba, Messina et al. 2008). General recommendations on cooking method and time of cooking cannot be made for all vegetables; instead, a systematic vegetable by vegetable approach to identify the optimal preparation and presentation methods is needed, at least with regard to increasing children's vegetable consumption (Poelman et al., 2009). The HAL Veggie tracker study (BrandStory 2010b) found that most under-consumers know they should eat more veg than they do and want to improve their cooking skills. Around half agreed that "Trying to eat the several portions of vegetables each day is hard work". Communicating cooking and serving tips to consumers could be a helpful strategy for both cauliflower and green beans, to extend their range and frequency of uses in meals.

2.5.4 CONVENIENCE

Value may be thought of as the benefits received from the product (or service) divided by price. Thus, perceived value can increase when price does not go down, if the benefits received increases. Consumers are seeking a wide variety of attributes when they consider produce purchase; these include price, convenience, quality, information, taste, safety, nutrition, and perhaps even fun. Value-added fresh produce like broccoli florets or baby carrots are good examples - although such products are simply new versions of "old" commodities, their new forms have proven to represent huge value to today's consumers, despite higher prices, due to their convenience (McLaughlin 2004). Recent trends providing fruits and vegetables in easy-to-consume forms (already washed and cut) help ease the burden of eating healthy and should be more prevalent, Hausman (2012) argues. For example, pre-packaged kits containing all the fresh ingredients necessary to make healthy foods at home, and require the consumer to simply add a meat source and cook to enjoy a healthy meal, should be more readily available (Hausman 2012).

Understanding the perceived importance of attributes influencing purchase and consumption of food are a key to better understand consumer behaviour. During their decision-making process, consumers rely on different attributes or cues before deciding whether or not to buy and which product to choose (Figure 1). Attributes can be divided into intrinsic and extrinsic ones, or classified in three categories, "search attributes" (like price, colour and appearance), "experience attributes" (like taste and flavour) and "credence attributes" (like health and microbiological safety). Search attributes emerge in terms of importance during the purchasing stage, while experience attributes gain importance after consumption. The credence attributes health and nutritional value scored relatively low in importance during the purchasing and consumption stages of minimally processed vegetables, however consumers with a high awareness of the relationship between food and health attached significantly more importance to these credence attributes.

Sales of minimally processed vegetables are rapidly increasing due to their image of convenience and healthiness. The likelihood of buying minimally processed vegetables tends to be higher among better-educated consumers and among consumers with young children (consumer study in Belgium n=294 + 237). The most important motivation for purchasing minimally processed vegetables was found to relate to convenience and speed, especially for consumers who buy this product during weekends (Ragaert, Verbeke et al. 2004).

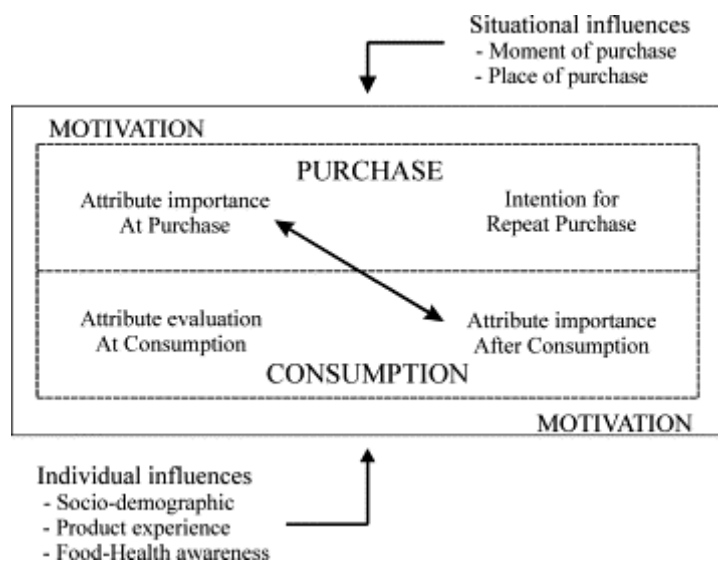


Figure 1 Framework for understanding consumer behaviour in purchase and consumption of food (Ragaert, Verbeke et al. 2004)

Packaging is important for both retention of quality and freshness throughout a product's shelf life, as well as convenience for the consumer (Koutsimanis, Getter et al. 2012). However UK consumers have been found to hold varying views on the merits of pre-pack vegetables – in one study, some were distrustful of the potential hygiene factors, while others thought pre-packed vegetables were attractive because manufacturers only peeled and washed them, avoiding other preservatives. These contradictions present a range of (mis)conceptions held among respondents about the production side of the convenience food industry's processes (Carrigan, Szmigin et al. 2006). Snack food consumption amongst women has received limited research attention despite a body of evidence amongst children and adolescents highlighting an increase in snack food consumption over the past few decades that is linked to adverse health outcomes such as obesity. Energy-dense snack food is consumed by more than half of Australians; it is therefore important to identify health promoting behaviours associated with lower energy-dense snack food consumption and also higher healthy food consumption. Authors reported that self-efficacy for healthy eating and time-efficient strategies for shopping for and preparing healthy food may be important factors to consider when understanding behaviours associated with healthy eating (Williams, Thornton et al. 2012).

Younger Australian participants who had moved out of home tended to consider preparing any meal as somewhat 'inconvenient' and acknowledged their fruit and vegetable consumption suffered. However, most younger participants assumed that when they 'settled down' in their own established home they would be far more conscious of consuming vegetables frequently: 'my diet's pretty poor at the moment because I'm hardly ever at home. When I settle down and have kids and stuff I reckon I'll be much more conscious of eating fruit and veggies every day'. In comparison with vegetable consumption, fruit was generally considered more convenient. The convenient snacking quality of fruit was viewed by participants as being a great facilitator to its consumption, while participants' usual association with vegetables was as a side dish to the evening meal: 'I plan my meals around a protein source and a carbohydrate, and then fill it in with some veggies'. However, those participants who said they ate five servings of vegetables per day were somewhat more likely to consume vegetables as a snack: 'quite often I'll have a veggie for a snack'; and 'sometimes as a snack I'll have a carrot – but not every day' (Carter, Pollard et al. 2010).

Lessons can be learnt from other commodities here, for example value-adding concepts for globe artichokes including 'ready to cook' and 'ready to heat and eat' were reported to be convenient for consumption and accepted by Australian consumers – with the potential to improve the local marketability and increase the export potential. The authors also recognised that some varieties may be more suitable for processing than others (Goubran, Hale et al. 2001). However it is important that vegetables be convenient without losing consumer perceptions of freshness and naturalness (Smyth 2009).

One study investigated the vegetable-snacking approach however the intervention was unsuccessful possibly due to a number of limitations with the study that the authors acknowledged, and these are lessons that could be taken into future research. During the vegetable basket intervention (cut pieces of red peppers, tomatoes, and carrots), there was no smaller, cheaper portion of vegetables available. If a less expensive option had been available (eg, packets of carrot or celery sticks) its sales might have increased. In addition, the message may have been too long ("Revitalize yourself by snacking on a fresh basket of crisp red peppers, juicy tomatoes, and crunchy carrots. Easy to eat on the run!"), and overly focused on food texture rather than taste. Customers may have also doubted the freshness of the vegetable baskets, disliked particular vegetables included in the basket, or felt that the portion was too large, and thus chose vegetables from the salad bar instead (Buscher, Martin et al. 2001). Increasing the convenience of cauliflower (e.g. smaller size portions available) is a key opportunity for the vegetable industry, while for green beans a convenient option is already popular in frozen form – however there may be further opportunities for convenient fresh bean options (such as pre-tailed, washed and cut beans – ready to cook or snack on while raw).

2.5.5 QUALITY ATTRIBUTES AND SHELF LIFE

Everyone uses a different set of criteria to interpret the quality of a product. The term acceptability is a practical approach to quality by comparing it to a criterion, the quality limit, where below that limit the product is rejected. The acceptance limit is primarily defined by economic and psychological factors; the quality of a product is largely defined by its intrinsic properties. For fruit and vegetables it is product properties such as colour, firmness and taste change over time. Shelf-life is the time before the product attributes drops below the acceptance limit under standardised storage conditions (Tijssens 2000). The quality of vegetables is related to their nutritive, chemo-protective properties and to sensory attributes, which represent acceptance by the consumer (Berger, Kuchler et al. 2007). Quality of fresh-cut (minimally processed) fruit and vegetable products determines the value to the consumer and is a combination of parameters including appearance, texture, flavour, and nutritional value. The relative importance of each quality parameter depends upon the commodity or the product and whether it is eaten fresh (with or without flavour modifiers, such as dressings and dips) or cooked. Consumers judge quality of fresh-cut fruit and vegetables on the basis of appearance and freshness at the time of purchase. However, subsequent purchases depend upon the consumer's satisfaction in terms of texture and flavour of the product. Consumers are also interested in the nutritional quality and safety of fresh-cut products (Kader 2002). The appearance of fresh fruits and vegetables is a primary criterion in making purchasing decisions. Product appearance is characterized by size, shape, form, colour, condition and absence of defects. Appearance is utilized throughout the production–storage–marketing–utilization chain as the primary means of judging the quality of individual units of product. What is considered a desirable appearance changes for some products, depending upon where in the chain the product is assessed and who is making the assessment (Kays 1999). For Australian consumers, the length of time fresh vegetables keep before they spoil was a key area of dissatisfaction found in the Vegie tracker study (BrandStory 2010b). For produce packaging in general, 'extend the "best by" date' i.e. extend the shelf life, was ranked as the top convenience feature for U.S. consumers (Koutsimanis, Getter et al. 2012).

Quality cues can be intrinsic or extrinsic and are used by consumers to form more abstract beliefs about the quality of a product. Experience quality attributes are based on actual consumption while other belief-based quality attributes remain purely cognitive. The quality perception model can be used to bridge the gap between producer defined quality and consumer based quality perception (Oude Ophuis and Van Trijpp 1995).

Some Australian participants identified the perishable nature of fresh produce as a barrier to consuming more fruit and vegetables because it constrained them from purchasing large quantities: although when this issue was further explored, most participants disagreed that it was a major problem. Most acknowledged that it could be a problem at times, but rather than disposing of spoiling vegetables, many suggested ageing fruit and vegetables in refrigerators served as a prompt to consume them. Some participants also suggested that frozen vegetables were a convenient option for vegetables that made spoiling far less of an issue: 'frozen veggies are actually better at retaining their goodness' (Carter, Pollard et al. 2010). Consumer perception of packaging is also important - the type of packaging material was considered by over 90% of consumers to affect food product quality and containers made from bio-based materials were also highly appealing to consumers in the U.S (Koutsimanis, Getter et al. 2012). The supply of high quality cauliflower without yellowing/browning defects and green beans without specks or visible damage are important, and extending the shelf life may also be pertinent to both commodities although it does not represent a step-change in delivering to consumer needs.

2.5.6 COST

Compared with average-income Australian families, healthy food habits including vegetable consumption were found to be a fiscal challenge to welfare-dependent families (Kettings, Sinclair et al. 2009). Among Australian adolescents and adults, fruit and vegetable consumption was positively related to income. The only exception was vegetable consumption among adolescent males, which did not vary by income. Lower-income adults consumed a smaller variety of fruits and vegetables than their higher-income counterparts. Fruit and vegetable variety did not vary by income among adolescents. Lower-income adults expressed less desire to increase their fruit and vegetable consumption, and were more likely to report that price and storage were barriers to doing so. Socioeconomic differences in consumption and variety were more apparent for adults than for adolescents (Giskes, Turrell et al. 2002). Socio-economic inequalities in the quantities of fresh vegetables, in the spending on fresh and processed vegetables but not in the quantities of processed vegetables were found in a French study. About 60% of the vegetables bought by the sample households were fresh. Fresh vegetable consumption increased with the respondent's income, age and educational level, and with the number of adults but not with the presence of children aged <6 years. The quantity of processed vegetables purchased increased with the household size but was not dependent on age, education or household income, although the richest households spent more per kilogram on processed vegetables. Households with a child aged <6 years also purchased 10 kg of baby foods containing vegetables. (Plessz and Gojard 2012). The cost of fresh vegetables was a key area of dissatisfaction for Australian consumers in the Vegie tracker study (BrandStory 2010b).

In another study, participants between ages 39 and 57 years were the most price-sensitive, and female were less sensitive than males. Younger participants (<age 38 years) were less price-sensitive and placed more importance on the other attributes (production method, lycopene content, and tomato type) (Simonne, Behe et al. 2006). The most important attributes that affected the purchasing decisions of consumers of cherries, as an examples of a fresh produce product, were price (25%), shelf life (19%) and container size (17.2%) (Koutsimanis, Getter et al. 2012). Of course, economists assume that price is paramount in motivating consumers in their purchase of fresh fruits and vegetables, but marketers and retailers understand that price is only one of many attributes that consumers have in their decision calculus, and it may not be the primary factor. Authors suggested that in addition to price, further research is required to determine the importance of brands, convenience, labelling, organic standards, information (e.g., recipes), demonstrations, safety, and more. Measuring how consumers make trade-offs between their purchases of fresh produce with other foods, say, canned and frozen produce and meat, is another important aspect to consider (McLaughlin 2004). Coupons had a direct effect on increasing fruit and vegetable consumption behaviour but no effect on attitudes of low income Michigan women - the maximum impact of the intervention was achieved through a combination of education and coupons. This study demonstrated that a low-income population may be more likely to increase its fruit and vegetable consumption behaviour when incentives such as coupons improve affordability (Anderson, Bybee et al. 2001).

With regard to cauliflower and green beans, a point of particular interest is whether consumers are willing to pay extra for convenience, or for particular types of cauliflower with increased health properties i.e. value-add opportunities for the vegetable industry.

2.5.7 HEALTH CLAIMS/BENEFITS

In a Western Australian study investigating the effectiveness of the Go for 2&5[®] fruit and vegetable campaign, nearly all participants agreed that regular consumption of fruit and vegetables is an essential component of a healthy diet and that consuming two servings of fruit and five of vegetables per day would be excellent for health: 'I don't love the taste of veggies but just know you've got to eat them to get all your vitamins and minerals'. However, they also believed that daily consumption of two servings of fruit and five of vegetables would confer no greater health benefit than one fruit and three vegetables –they believed that three servings of vegetables per day was ample to maintain sufficient intakes of vitamins and minerals (Carter, Pollard et al. 2010). The healthiness and chronic disease prevention aspects of vegetables were found to be well known by Australian consumers in the HAL Vegie tracker study. The majority believed that different vegetables have different health benefits and want to know what they are, although are not strongly concerned about preventing chronic diseases - fewer than 1 in 3 were concerned. Concern about chronic disease tended to increase with age and females were more likely to be concerned about preventing it than males. Communication needs to include the 'everyday'/ more immediate benefits of eating vegetables to engage younger consumers, as 65% of males and 45% of females under 35 stated they eat 3 serves or less (BrandStory 2010b).

There is conflicting research over the effectiveness of health claims on vegetable consumption. One study found that health information linking diet and health, has a significant impact on the consumption of grapes, bananas and citrus as well as in carrots, tomatoes and bell peppers. This suggests that raising public awareness about specific health benefits of eating fruits and vegetables can be an effective strategy to increase consumption (Padilla and Acharya 2000). Although health and nutritional value scored relatively low in terms of importance during the purchasing and consumption stages of minimally processed vegetables in the Belgian study outlined in section 2.3.7, consumers with a high awareness of the relationship between food and health attached significantly more importance to these credence attributes (Ragaert, Verbeke et al. 2004). However, a more recent review (van't Riet 2012) found no strong evidence for the effectiveness of product health information at the point of purchase on actual purchase behaviour in supermarkets and grocery stores. Interventions were more likely to be effective when they lasted for a longer time, when they included additional intervention components, and when they targeted the absence of unhealthy nutrients instead of, or in addition to the presence of healthy nutrients. Authors recommended that the effect of intervention duration, additional promotional activities and targeting of healthy versus unhealthy nutrients should be closely examined in future studies.

Intrinsic motivations for eating a healthful diet (e.g. to feel better) were strongly associated with both fruit and vegetable intakes, and these associations were stronger for fruit. Extrinsic motivations were not associated with either fruit or vegetable intakes. Dietary interventions based on a general 5-A-Day message may be more effective in increasing fruit intakes than vegetable intakes. Targeted interventions that focus specifically on vegetables are probably necessary. Intrinsic motives for eating a healthful diet should be key components of interventions to increase fruit and vegetable intakes (Trudeau, Kristal et al. 1998). Recently, interventions that advertise the consequences of behaviour for appearance have been successful in modifying sun-exposure habits and tobacco use, so Whitehead, Ozakinci et al. (2011) proposed that such an approach might also facilitate dietary improvement. Consumption of carotenoid-rich fruit and vegetables positively affects skin colour, which influences perceptions of health and attractiveness. Promoting this appearance-improvement affect of vegetables would be a novel way for the vegetable industry to motivate target audiences to increase consumption and could be an opportunity for orange-coloured high-carotenoid cauliflower in particular. Consumer perceptions of the health benefits of green beans could be of value if better understood.

2.5.8 CONSUMER UNDERSTANDING OF PORTION SIZE AND VEGETABLE VARIETY GROUPING

Size of a serve of vegetables has been identified as a key knowledge gap in Australian consumers (Pollard 2006). Confusion and possible overestimation of what constitutes five servings of vegetables was found to impact on Western Australian consumers' beliefs about whether consuming five servings of vegetables was achievable. Participants had little appreciation of how the '2&5' recommendation was originally derived, and incorrectly assumed that it is purposely exaggerated simply to encourage greater consumption. Education is required about the rationale underpinning the '2&5' message, emphasising that it is a minimum rather than aspirational recommendation (Carter, Pollard et al. 2010). For Australian adults aged 50 to 64 years who reported low vegetable consumption, believing that recommended quantities were too big was one of the barriers to consumption. Therefore the authors suggested one possible strategy for enabling consumers to achieve adequate fruit and vegetable consumption is education about the recommended number and size of servings and the distribution of fruit and vegetables relative to meat and carbohydrates (Dixon, Mullins et al. 2004).

In a Dutch study (N = 367) there were large differences between the self-rated and estimated objective consumption of fruit and vegetables - subjects rated their own intake as much higher than their estimated objective intake. Thus, authors recommended that any nutrition education aimed at stimulating fruit and vegetable consumption should especially focus on making people aware of their own fruit and vegetable intake, in addition to changing attitudes and self-efficacy expectations (Lechner, Brug et al. 1997). Not just the quantity, but also the variety of vegetables consumed is important. For instance, the concept of eating vegetables from a variety of different subgroups was a new focus in the U.S. 2005 Dietary Guidelines (Britten, Haven et al. 2006), so consumer understanding of different types/varieties of vegetables was investigated. Most consumers had difficulty when asked to name vegetables in each of the five Pyramid subgroups: dark-green leafy vegetables; orange vegetables; dry peas and beans; starchy vegetables; and other vegetables, and also had difficulty estimating one portion size accurately. The authors recommended that manufacturers provide additional information on food packaging to help consumers identify how to choose a variety of types of vegetables/which subgroups the food provides and the amounts for each that constitute one serving (Britten, Haven et al. 2006). Presenting cauliflower and green beans in packaging that communicates both the number of portions (of the five nutrition servings recommended daily) and the type of vegetable is an excellent opportunity for the vegetable industry to develop value-add products and increase purchase and consumption. Cauliflower and green beans could also be presented in single serve portions, in combination with other vegetables for consumers to conveniently buy their five portions per day (for example like individual serves of yoghurt with varying flavours in a six pack).

2.5.9 LABELLING/BRANDING

In a laboratory setting characterized by heightened attention, studies have found that subjects respond best to nutritional information when high levels of details (e.g., recommended daily values) are provided. However, it is not at all clear that these findings carry over to actual choice and purchase decisions in a shopping environment, where the best available evidence suggests that consumers prefer more simplified, easy-to-use labels and nutrition facts panels (Hieke and Taylor 2012). There is some compelling evidence that qualitative information such as "(very) low" has advantages in terms of weight attributed to the product information being evaluated by the consumer. These findings are particularly important in what has become a new topic in nutrition labelling—Front of Panel (FOP) labels, i.e., specifically designed excerpts of the original label which are put front-of-pack. As the informational content does not change, this new approach is rather a question of consumer perception and awareness and whether these can be increased by displaying nutritional information (more) prominently on the front of a package. As such, more behavioural research is needed to establish this finding as having a measureable impact on consumers (Hieke and Taylor 2012). Combining short health claims on the front of a package with full health claims on the back of the package leads consumers to more fully process and believe the claim. The basic finding that using two sides of a package (short claim on front; long on back) increases the believability of health claims is relevant for policymakers, consumers, and researchers (Wansink 2003).

Recent (Jan 2013) changes in permitted health claims in Australia may provide opportunities, for example a permitted high level health claim for a food containing no less than 90% fruit or vegetable by weight is ‘A high intake of fruit and vegetables reduces risk of coronary heart disease’; a general level health claim is ‘A diet containing a high amount of fruit and vegetables contributes to heart health.’
<http://www.comlaw.gov.au/Details/F2013L00054>.

In a U.S. study, children (n=39, mean age 3.9 yr) in a childcare setting ate a greater percentage of the target foods when they were labelled with fun names rather than healthy (e.g. edamame labelled as “Emerald dragon bites” versus “veggie beans”). Also, a larger percentage of the children tasted the foods when they were labelled with fun names. This simple strategy could be effective for increasing consumption of healthy foods among young children (Musher-Eizenman, Wagner Oehlhof et al. 2011). Nutrition labels that list the proportion of fruit and vegetables in a food by weight, or number of servings of fruits and vegetables among their ingredients—not just the nutrient content—are worth implementing and evaluating (Glanz and Yaroch 2004). The opportunity to move to convenient, value-add cauliflower and green beans could be magnified by branding and labelling of these commodities in more appealing, user-friendly ways (e.g. “gourmet stir-fry beans”) or fun ways for children (e.g. from Musher-Eizenman, Wagner Oehlhof et al. (2011) “emerald dragon bites”).

2.5.10 CONSUMER SEGMENTATION

Barriers to consumption, therefore strategies to overcome these are different depending on the consumer segment. Segmentation based on demographics may not be the best approach for food research (Sparke and Menrad 2011). Authors of a recent review of factors that affect food choice decisions of adults in relation to fruit and vegetable consumption, suggested that sub-groups could be based upon demographic data (for example, men and women), intake data (for example, low and high consumers of fruit and vegetables) or on health behaviour models, or a combination of all. The sets of priorities that different sub-groups (holding similar sets of values) of the population consider when making food choice decisions may be very different (Pollard, Kirk et al. 2002). Vegetable consumers have been segmented a number of different ways:

Lifestyle/behaviour

In a Horticulture Australia Limited-commissioned study, Australian adult consumers were segmented into the categories: Convenience Seekers, Experimental Gourmets, Pragmatists and True Vegetable Lovers. Under-consumers of vegetables were the segments Convenience Seekers, Experimental Gourmets and Pragmatists. Convenience Seekers and Pragmatists were most dissatisfied with the quantity of vegetables that they and their household, are currently eating – this presents the biggest opportunity to influence them to increase their consumption. Almost all (97%) Convenience Seekers eat three or fewer serves of vegetables per day, and think vegetables are hard-work and they do not have time for them. This group is comprised of younger singles, couples and young families who are not very knowledgeable about, engaged with, nor satisfied with vegetables (BrandStory 2010b).

Gender

Females report more fruit and vegetable intake than men, and females report more favourable attitudes and perceived behavioural control towards fruit and vegetable intake. Attitudes and perceived behavioural control explain this gender difference, therefore interventions aimed towards increasing men’s intake should promote favourable attitudes toward fruits and vegetables and enhance men’s perceptions of control over increasing fruit and vegetable intake (Emanuel, McCully et al. 2012). A possible intervention point to target nutrition messages for men might be sports events or sports-related media (Dittus, Hillers et al. 1995). Females were more likely to consume more vegetables than males, and single/never married individuals, individuals with higher levels of education, never smokers, former drinkers and older people reported more consumption of vegetables than others in a Canadian study (Dehghan, Akhtar-Danesh et al. 2011).

Low fruit and vegetable consumption of elderly people (aged 65+) in the UK was particularly associated with being male, smoking and having low levels of social engagement (Johnson, Donkin et al. 1998). In older adults (aged 55–64 years) men's poorer nutrition knowledge explained a significant part of their lower intake of fruit and vegetables (Baker and Wardle 2003).

High/low vegetable consumers

High vegetable consumers were characterized by a high level of control over family members and their eating patterns, with a high level of advance planning of meals. They showed an experimental approach to eating, with a strong food focus as part of their lifestyle. The respondents also exhibited high self-esteem regarding the family eating habits. Low vegetable consumers were characterized by a spontaneous response (reactive response) to food requests from the family, particularly to children. Those fruits and vegetables that were used were bought as a routine, with very little experimentation. These consumers felt a strong lack of control over family feeding, only being able to cope with the immediate needs of the family (Kilcast, Cathro et al. 1996).

Educational level was positively associated with vegetable consumption in the Nordic and Baltic countries. In the Mediterranean countries, education was not directly associated with the use of vegetables but, after adjusting for place of residence and occupation, it was found that those with a lower educational level consumed vegetables slightly more often. Manual workers consumed vegetables less often than non-manual workers, but otherwise there was no systematic association with occupation (Prättälä, Hakala et al. 2009).

Household characteristics

If social marketing campaigns are to be revised to promote the consumption of a varied mix of vegetables, then traditional marketing campaigns may be a reasonable starting point. However, campaign designers may want to further focus on obstacles associated with household characteristics, such as children's tastes and working parents. In particular, campaign designers need to be cognizant of children's tastes, large household sizes, young heads of household, working parents, race and ethnicity, and levels of education. These issues not only influence vegetable expenditures, but can further affect the variety of purchases for any level of spending. While larger households might purchase more basic ingredients to produce more meals at-home, they still do not purchase a greater variety of vegetables. In such households, the primary homemaker may have greater difficulty identifying meals that contain vegetables, are acceptable to all members, and which he or she has the necessary time to prepare (Stewart and Harris 2005).

Geographic

Geographical segmentation may also be important, as vegetable consumption has been reported to vary across Australian states: Western Australian adults had the highest mean self-reported fruit and vegetable intake in one study (Pollard 2006). Geographic location was also associated with low fruit and vegetable consumption of elderly people (aged 65+) in the UK - Johnson, Donkin et al. (1998) found that 51 percent of rural elderly did not meet fruit and vegetable recommendations (five portions a day), compared with 37 percent of those living in the urban areas.

Children

One of the major barriers to increasing the consumption of vegetables is the lack of enthusiasm shown by children. Vegetables are the least liked food category amongst children (Nicklaus, Boggio et al. 2005, Caporale, Policastro et al. 2009). Humans are born with an innate liking for sweet taste and an aversion for bitter taste. Humans also develop a liking for energy dense and salty taste early in life. Vegetables are mostly low in energy density, most of them do not have a sweet taste and some of them taste bitter. As a consequence, acceptance for vegetables is largely learned. Without acceptance of vegetable-based meals by children, it is unlikely that households will continue to persist with higher vegetable diets in the long term (Kilcast, Cathro et al. 1996). The pure taste of vegetables is not acceptable to children, however mixing vegetables with other foods may lead to gradual acceptance of vegetables through flavour-flavour and flavour-nutrient learning (Zeinstra, Koelen et al. 2009).

One study showed that parental consumption was a highly significant predictor of children's vegetable intake (n=564 parents of 2-6 yr children), which could be attributed to a combination of factors including modelling effects, availability in the home and other aspects of the shared environment, as well as genetics. In addition, lower food neophobia of children themselves and greater enjoyment of food in general were also related to higher intakes of vegetables by children (Cooke, Wardle et al. 2004). In Australian families with low and medium vegetable consuming parents, children's tastes and preferences were found to be a considerable barrier to increasing vegetable consumption, as the children influenced shopping behaviours. On the other hand, the children of high vegetable consuming parents were involved in all aspects of meal behaviours including growing vegetables, planning meals, and preparing and cooking meals (Smyth 2009). Recommendations based on research with Australian consumers was to include easy recipes with vegetable produce - particularly versions palatable to children (Smyth 2009), or use tangible rewards (positive reinforcement) with a repeated exposure strategy to facilitate the actual tastings of vegetables (including cauliflower) by children that are necessary to increase liking (Corsini and Cox 2010, Corsini, Slater et al. 2011). Similarly, a parent-led, exposure-based intervention involving daily tasting of a vegetable was found to be effective for improving children's acceptance of vegetables (Wardle, Cooke et al. 2003).

Education level and occupation

Educational level was positively associated with vegetable consumption in the Nordic and Baltic countries investigated. In the Mediterranean countries, education was not directly associated with the use of vegetables but, after adjusting for place of residence and occupation, it was found that those with a lower educational level consumed vegetables slightly more often. Manual workers consumed vegetables less often than non-manual workers, but otherwise there was no systematic association with occupation. The Mediterranean countries did not show a positive association between educational level and vegetable consumption. The positive association found in the Northern European countries is linked to the lower availability and affordability of vegetables there and their everyday cooking habits with no long-standing cultural tradition of using vegetables (Prättälä, Hakala et al. 2009). Education had a direct effect on attitudes to fruit and vegetable consumption and seemed to exert an effect on consumption behaviour through attitudes - maximum impact of the intervention was achieved through a combination of education and coupons (Anderson, Bybee et al. 2001).

Genetic

Genetic variation in taste (measured by multiple phenotypes or TAS2R38 genotype), can explain differences in overall consumption of vegetables, and this was not restricted to vegetables that are predominantly bitter. Non-tasters by phenotype or genotype reported greater consumption of vegetables, regardless of their type (i.e., the effect generalized to all vegetables and was not restricted to those typically thought of as being bitter). Furthermore, non-tasters with more papillae reported greater vegetable consumption than non-tasters with fewer papillae, suggesting that when bitterness does not predominate, more papillae enhance vegetable liking (Duffy, Hayes et al. 2010).

Taste sensitivity and preference of consumers is of particular importance to cauliflower, while segmentation in texture preference of green beans has been identified. Any further research on these commodities needs to consider these sensory preference-based segments, as well as the various consumer segments outlined above.

2.5.11 CONTEXT/AVAILABILITY

Foodservice

The Australian Food Service industry plays a significant role in the consumption of food in Australia - not only do they influence the foods people eat within their restaurants and cafes, but they are an important source of ideas that filter back into homes and kitchens. Therefore a communication program for increasing use of almonds by food service professionals including key health benefits, taste characteristics and versatility of the product, was recommended to increase demand for almonds (Ebbage 2010).

The growth in the amount of food consumed through food service was also recognised as an important area to address in further developing and implementing the 'Go for 2&5[®]' fruit and vegetable health campaign (Pollard 2006). Simply increasing vegetable portion size, or substituting vegetables for meat or grain can increase vegetable consumption in adults (Rolls, Roe et al. 2010), which could be a straightforward recommendation to foodservice restaurants or institutions.

Schools/ childcare centres

Several new directions are emerging in the area of promoting fruit and vegetable consumption in school settings. These include school gardens, salad bars, free fruit distribution programs, and school policy and environmental change efforts (French and Wechsler 2004). Garden-based nutrition intervention programs may have the potential to promote increased fruit and vegetable intake among youth and increased willingness to taste fruits and vegetables among younger children (Robinson-O'Brien, Story et al. 2009). Results from a U.S. pilot study demonstrate the feasibility of a cooking, nutrition, and gardening after-school program in a garden-based setting, and suggest that such an intervention may be effective in influencing attitudes, perceptions, and preferences for fruit and vegetables (Gatto, Ventura et al. 2012). Programs to implement food and nutrition policies in child care centres in Australia are modelled after restaurant-based "award schemes" that provide incentives for food service offerings to include more healthy choices (Glanz and Hoelscher 2004). Farmers' markets could also be located near day care centres and in parking lots to be convenient for people heading home from their workplaces or (Glanz and Yaroch 2004).

Work places

In a UK study, the support of family and friends, food costs, time constraints and shopping were barriers to greater consumption of fruit, vegetable and vegetable dishes. Perceived situational barriers to increasing intakes of fruits and vegetables were: limited availability of vegetables, salads and fruit at work canteens, take-aways, friends' houses, at work generally and the number of visits to the shops. Practical issues and situational barriers need to be addressed, for example having fruit as a between-meal snack and eating two portions of vegetables with a meal (Anderson, Cox et al. 1998). In another study, a worksite-plus-family intervention was more successful in increasing fruit and vegetable consumption than was the worksite intervention. Worksite interventions involving family members appear to be a promising strategy for influencing workers' dietary habits (Sorensen, Stoddard et al. 1999).

Supermarkets

Key types of grocery-store-based interventions include point-of-purchase information; reduced prices and coupons; increased availability, variety, and convenience; and promotion and advertising. Providing more easy-to-use or -eat fruit and vegetables, or increasing the fruit and vegetable content in convenience foods sold as ready-to-eat/heat meals or snacks may be effective strategies to increase purchase. Cross-promotion of fruits and vegetables with other food items, for example, cereal sold with bananas is another potential strategy (Glanz and Yaroch 2004). There is also a general movement toward buying vegetables at grocers, markets and Farmer's Markets rather than supermarkets, as markets are thought to provide fresher produce of a higher quality (Smyth 2009), so this is another important distribution channel to consider.

Online shopping

Another promising strategy for increasing purchase of fruit and vegetables is using online grocers and home delivery to increase access to fresh produce (Glanz and Yaroch 2004).

Table 3 also includes a list of contexts for food consumption in general, including "on the go" and restaurants (Kniazeva and Venkatesh 2007). Increasing the occasions and locations to purchase and consume both cauliflower and green beans is an opportunity for the vegetable industry. Each different context may be more pertinent to particular segments of consumers than others, so these need to be considered in combination to maximise opportunities.

2.5.12 COUNTRY OF PRODUCT ORIGIN

There is little research available on consumer perceptions of vegetables from different geographical locations. However one study showed it can have an influence of purchase behaviour - for German and Dutch consumers (n=100/country), greater knowledge of products from a specific origin (Almeria, Spain) helped improve consumers' perception of the products' image. In contrast, for the British consumers the quality aspects were not important in the formation of an image of the fruit and vegetables, so these consumers used the brand as a reference point for this image (British consumers have the perception that Spanish products are generally poor quality). Commercial communication should consider not only the different perceptions about the product cues, but also the differences in product familiarity and use communication campaigns adapted to each market. Campaigns should communicate to the consumer the sector's enormous experience in the cultivation of fruit and vegetables, and the quality and safety processes used to obtain the end product, and campaigns should also include communications actions aimed at prescribers (e.g., restaurant owners, food specialists) so they recommend the product to the end consumers (current and potential consumers). Campaigns should aim at distinguishing the most important product cues in the formation of the image in each target market - messages should transmit the idea that the fruit and vegetables from the area of origin have the attributes that are the most important for the particular consumer (Gázquez-Abad, Jiménez-Castillo et al. 2012). Understanding consumer perceptions of cauliflower and green bean growing origin, and that influence on purchase, may be of more relevance in the future if imports become a larger threat to these commodities. On the other hand, marketing the commodities as having particular sensory or health attributes important to consumers because they are from a certain growing region in Australia may be an opportunity to explore.

2.5.13 EMOTIONAL INVOLVEMENT IN DECISION MAKING

Increasing emotional involvement in the selection, purchase, and consumption frequency of vegetables was identified in previous Australian research as a useful approach - direct marketing efforts could be targeted to particular segments and consumption moments, e.g. fathers and barbeques, or mothers and weekend roasts (Smyth 2009). Insight into how U.S. consumers relate to food has highlighted the symbolic aspect of food (such as 'comfort' or 'fun'), as well as individual, social, cultural, ritualistic, contextual and experience factors (see Table 3). For example, there were paradoxical juxtaposition of opposites by consumers that recollected having a gourmet meal of chicken marsala while enjoying pristine nature far from any civilization, and those who recalled savouring mundane green beans while sharing the company of a special friend (Kniazeva and Venkatesh 2007). Firat and Venkatesh (1995) stated that 'there is no natural link between a product and its use. Rather, the link is cultural and arbitrary' (p256). Purchase of organic produce is another emotion-based decision however one study showed that production method (organic vs. conventional) had low relative importance in comparison to price and tomato type (Simonne, Behe et al. 2006). For cauliflower and green beans, an opportunity to increase purchase could be through investigating and marketing based on some emotion-evoking symbolic aspects of these vegetables (e.g. home-made, comfort, friend).

Table 3 Categories of food consumption and their properties (Kniazeva and Venkatesh 2007)

Symbolic	Individual	Social	Cultural	Ritualistic	Contexts	Experience
Home made	Desire	Connection with family and friends	Body esthetic	Nostalgia	Work	Global
Sin	Self-concept			Mother/children	Home	Authentic
Filler versus real food	Self-discipline	Sharing	Sexual attraction	Meal Preparation / sharing	Kitchen	Adventure
	Sacrifice	Status	Role of media		Restaurant	Exotic
Power	Compromise	Interpersonal Relationships	Culture of abundance	Events	Coffee break	Different
Love/hate	Avoidance	People matter more than food	Taboos		Special occasions	Dinner party
Romance	Battle	Social pressures	Norms	Reward	Date	Exclusivity
Tradition	Guilt				Media culture	Cultural misunderstandings/ prejudices/ tolerance
Bonding	Indulgence	Laughter		Punishment	Grocery store	Escape
Enemy	Shame				Cooking	On the go
Friend	Satisfaction			Eating Out	Holiday dinner	Cool
Solace	Achievement					Bizarre
Comfort	Control					Excitement
Security						Caution
Harmony	Body/fitness Appearance					Vicarious
Fun	Sensuality					
Joy	Health					
	Depression					
	Time pressure					

2.6 Discussion

Research on the barriers to purchase and consumption of cauliflower and green beans has been reviewed. Where there was a lack of information available on these two commodities, literature concerning barriers to vegetables in general was included. The barriers identified were:

- **Cauliflower:** inconvenience, portion size too large, dislike of taste/flavour (bitter taste and cooked cauliflower sulphur odour), children’s dislike, lack of variety available, lack of consumption contexts (limited to evening meal), poor quality/defects visible, lack of understanding of vegetable type/grouping.
- **Green beans:** children’s dislike, lack of variety available, texture preference (segmented), method of cooking (segmented), lack of consumption contexts, poor quality/defects visible, lack of understanding of vegetable type/grouping.
- **Vegetables in general (that may be applicable to cauliflower and green beans):** low acceptance, cost, short shelf life, lack of awareness of low vegetable consumption, misunderstanding of portion size, lack of cooking skills/knowledge, family environment, lack of emotional involvement in decision.

In addition, drivers of purchase and consumption for vegetables in general (which may be applicable to cauliflower and green beans) include: liking, health benefits (may be small effect), early exposure in childhood, fun names/labelling (for children), atypical colour, convenience (when frozen), labelling/branding, and country of product origin (could also be barrier). Segmentation of vegetable consumers has to date been based on many different characteristics, including: taste preferences, lifestyle/behaviour, gender, high/low vegetable consumers, household characteristics, geographic, children/age, education level and occupation, and genetic variation in taste. The context or availability for purchase and consumption of vegetables was another important factor identified, and previous research has shown that foodservice, schools/ childcare centres, work places, supermarkets and online shopping are key purchase and consumption contexts.

Based on the literature to date, relatively little commodity specific information was available. In addition, the relative importance of various factors cannot be accurately evaluated as very rarely multiple factors have been assessed simultaneously for cauliflower or green beans. Most research was also conducted outside Australia. Thus, it was unknown whether identified factors would be of equal importance to Australian consumers

Therefore, to aid prioritisation of barriers to purchase and consumption of cauliflower and green beans, further consumer research with Australian consumers was deemed necessary. This research is described in the next chapter.

3 Consumer study

3.1 Introduction - addressing the knowledge gap

The literature review showed gaps in knowledge. Most research on barriers and drivers of purchase and consumption was done on single factors, and not commodity specific. This made it difficult to prioritize importance of attributes for inhibiting or driving consumer behaviour towards a commodity, as attributes could not be directly compared to each other. Most research was also conducted outside Australia. Thus, it was unknown whether identified factors would be of equal importance to Australian consumers

A consumer study was undertaken to collect further data to help prioritise barriers and drivers for Australian consumers. This consumer study addressed several factors simultaneously, so that their importance for Australian consumers could be established. A quantitative methodology was used in the form of conjoint analysis.

The consumer research aimed to achieve:

- An improved understanding of the importance of characteristics that inhibit the purchase and consumption of cauliflower and green beans.
- Support in the development of a practical response plan that will offer useful and practical insights to vegetable growers and industry partners to potentially improve cauliflower and green bean product offerings and subsequently improved demand.

3.2 Methods and materials

3.2.1 CONJOINT ANALYSIS

Conjoint analysis is a marketing research technique that aims to determine the relative importance of several factors for consumers in an indirect way (Hair, Anderson et al, 1998). Various forms of conjoint analysis exist, in the current study consumers were asked to rate product profiles. Product profiles consist of attributes and 'levels' of those attributes. Statistical analysis determines the relative importance of each attribute and the utility (perceived worth) of levels within an attribute, so this determines the levels within attributes that consumers are looking for. Simulations can be run to determine interest for all possible combinations of attributes, including combinations not tested by consumers.

3.2.2 CONSUMERS

Two surveys (one for cauliflower, one for green beans) with 500 consumers each were conducted. Consumers were recruited by an external agency according to the following criteria:

- Australian vegetable consumers
- Aged 18 -65 years
- Main grocery buyers
- Users of cauliflower and green beans (consume at least once every three months)

- Spread in gender and family situation

Ethics approval for this study was obtained by the CSIRO Low Risk Review Ethics Committee.

3.2.3 PRODUCT PROFILES

The experimental design was based on the literature review and included a combination of potential drivers and potential opportunities for cauliflower and green bean consumption. The study was specifically designed to include those factors deriving from the literature research that could be changed either within the product itself (intrinsic properties such as colour) or to the communication or marketing of the product (extrinsic properties such as health claim).

Each commodity was tested for two specific eating occasions: to purchase for a main meal, and to purchase as a snack.

The following attributes and their levels were used in the research on the commodities in the main meal context:

Colour: typical and atypical colours were tested. Typically coloured varieties (white for cauliflower, green for beans) are the standard product available on the market. Atypical colours (orange and purple for cauliflower, yellow and purple for beans) are commercially available varieties, however they are not widely available. This attribute was communicated to consumers as a colour picture of the vegetable (Figure 6).

Communication of sensory properties: literature review identified taste and specific sensory properties as barriers to consumption. In the case of cauliflower these barriers were bitter taste and cooked cauliflower odour and flavour. This factor tested whether communication of more desirable sensory properties would increase likelihood to buy. For green beans, consumers were segmented for texture preferences, one segment preferring more crisp texture. Hence, communication of this texture property was selected for green beans.

Health claims: Two health claims were tested in each condition to determine whether communication of health benefits of eating vegetables would increase willingness to buy. A heart health and skin health claim were used for cauliflower, which could refer to potential preventative health benefits and a positive health benefit, respectively. The heart health claim consisted of the recently approved FSANZ health claim, and stated “A high intake of fruit and vegetables reduces risk of coronary heart disease”. The skin health claim stated “Good for skin health”, which is at current not an approved health claim. This claim was included as one study (Whitehead, Re et al 2012) has demonstrated (fruit and) vegetable carotenoids confer beneficial skin colouring perceived to be attractive and that benefits to personal appearance may motivate dietary change. If such communication would increase willingness to buy, this claim would need substantiation. For green beans, a heart health claim (same as above) was used as well as a calcium claim. Research has identified there are bean varieties with higher calcium content (Grusak and Pomper 1999), and this research investigated whether consumers would be interested in such a product. The claim was stated as ‘High in calcium – calcium enhances bone mineral density’. Whilst this claim adopted the language permitted by FSANZ for high calcium products it is not a permitted claim for green beans and FSANZ permission to make a claim would require further substantiation. Hence one of the claims was a permitted claim that could be used by the industry today and the other two claims were hypothetical or exploratory (although both have some degree of substantiation).

Portion: The traditional format of the commodity (whole cauliflower, beans sold loose) was compared against two different pack formats in order to appeal to convenience and/or reduced wastage. Formats

were a smaller sized cauliflower and cauliflower florets in case of cauliflower, and a pre-packed and a pre-packed ready-to-eat bag in case of green beans.

Price: Three prices levels were used: baseline, +20% and +40%. A survey of online retail prices at a major retailer (Woolworths) in different socio-economic areas and different states was conducted just prior to data collection. It was found there were considerable price differences depending on where the commodity was purchased (up to 40%). Baseline levels were selected that reflected the lowest price point found.

In the snack context of both commodities, essentially the same attributes and levels were used as in the main meal context, with two differences:

- Mixed coloured packs were also tested in the snack context.
- Portion size was not a factor tested

Figure 2 to Figure 5 provide an overview of the factors and their levels used in each of the four conjoint experiments.

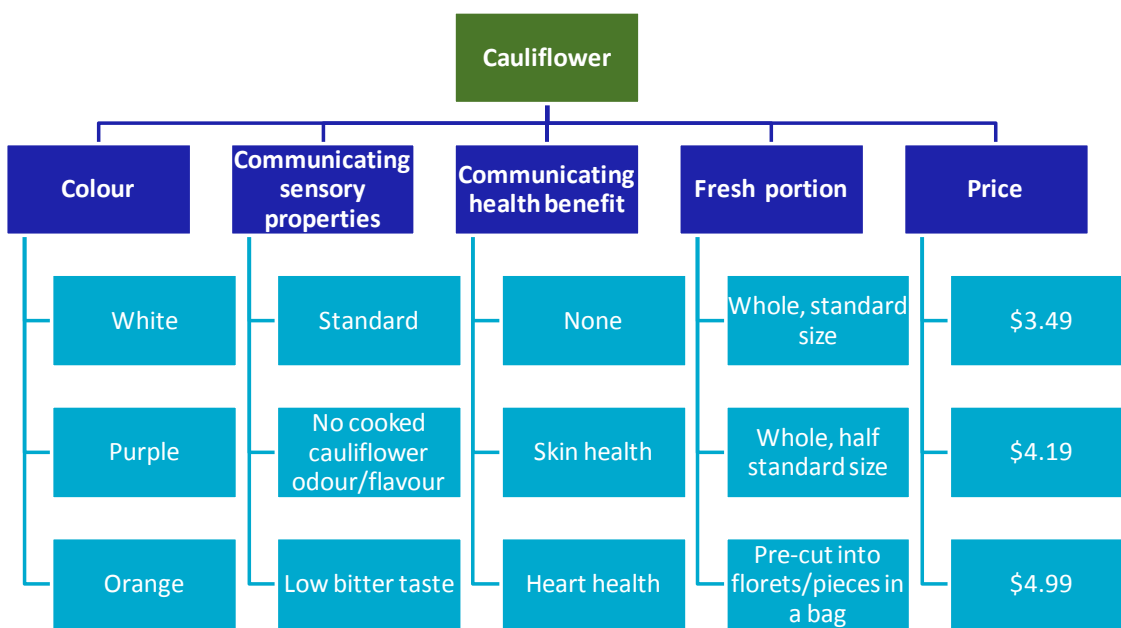


Figure 2 Factors and levels studied to determine purchase intent for cauliflower in a main meal context

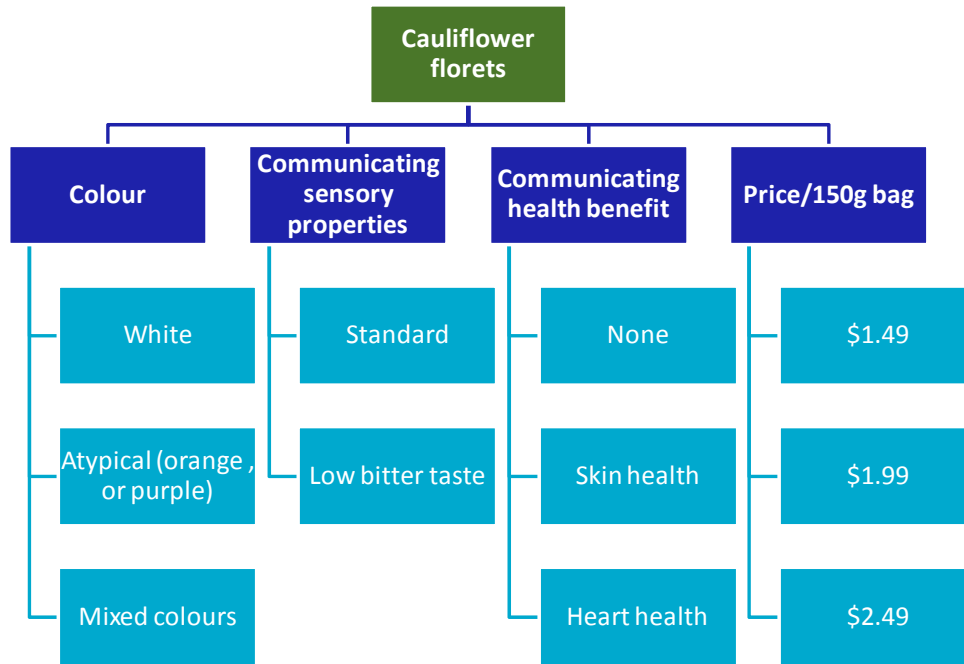


Figure 3 Factors and levels studied to determine purchase intent for cauliflower in a snack context

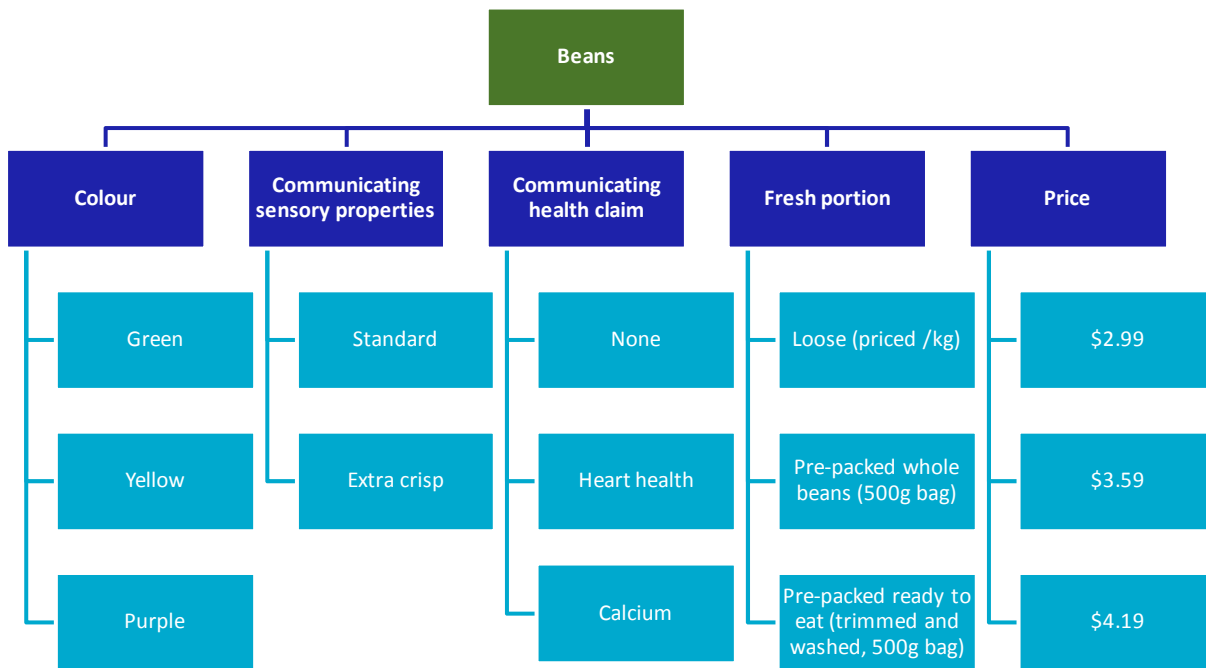


Figure 4 Factors and levels studied to determine purchase intent for (green) beans in a main meal context

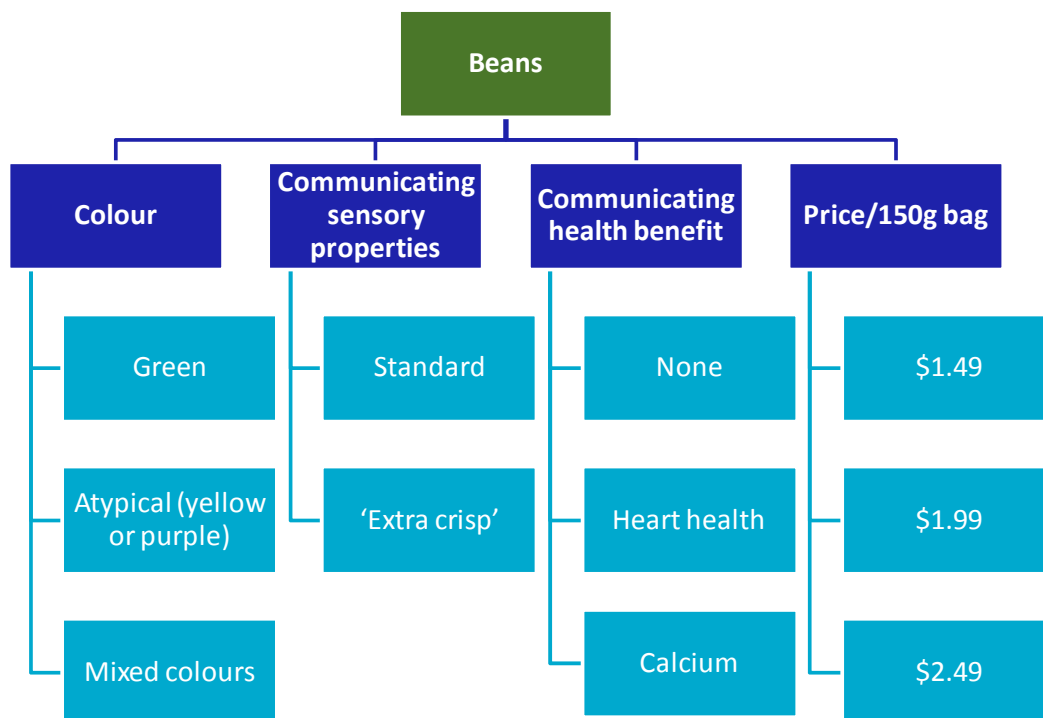



Figure 5 Factors and levels studied to determine purchase intent for (green) beans in a snack context

An example of the way product profiles were presented to consumers is provided in Figure 6.



White cauliflower (whole)

'A high intake of fruit and vegetables reduces risk of coronary heart disease'

\$4.99

How likely are you to buy this product?

Definitely would not buy
May or may not buy
Definitely would buy

Figure 6 Example of product profile and rating scale as presented to consumers during the on-line conjoint study

3.2.4 PROCEDURE

Consumers participated in the experiment on-line, so product profiles were rated by consumers on a computer. Different consumers (n=500 in each experiment) participated in the study on cauliflower and on green beans. The study was designed so that consumers did not have to rate all the product profiles individually, but only had to rate a relevant subset. This was done by generating orthogonal designs in SPSS (IBM SPSS Statistics, v20.0).

Consumers rated:

- 18 product profiles relating to the vegetable in main meal context
- 11 product profiles relating to the vegetable in snack context

For each product profile, consumers provided their response to the following question: “How likely are you to buy this product?” Consumers rated their likelihood to buy this product using a 9-point category scale, in which both end points (left anchor = “Definitely would not buy”, right anchor = “Definitely would buy”) and the middle point (“May or may not buy”) were labelled (Figure 6).

All consumers first responded to 18 product profiles relating to the vegetable in the main meal context, and then they rated 11 products relating to the same vegetable in a snack context. The order of presenting product profiles to consumers was randomised within each context, to control for the influence of positional bias.

Once consumers had rated all product profiles, they answered a short questionnaire, which collected relevant background information as potential segmenting variables.

The following data were collected:

- **Demographics:** gender, age, perceived cultural identity, educational level, household size and composition and income category
- **Vegetable purchase and consumption:** vegetable consumption in serves per day (Ball, Crawford et al, 2006), point of purchase of vegetables
- **Vegetable specific consumption and acceptance:** consumption of cauliflower / green beans, acceptance of cauliflower / green beans by the respondent, acceptance of cauliflower / green beans by children in the family, perceived influence of children's acceptance on purchase of cauliflower / green beans
- **Attitudinal scales:** three validated attitudinal scales were used
 1. Food involvement scale: this scale consists of 12 items that measure food involvement based on activities relating to food acquisition, preparation, cooking, eating and disposal (Bell and Marshall 2003)
 2. Health and Taste Attitude Scale: this scale measures the importance of health and taste aspects of foods in the food choice aspects (Roininen, Lahteenmaki et al, 1999). Three of the six relevant subscales were used, which were 1) General health interest (8 items), 2) Using food as a reward (6 items), and 3) Pleasure (6 items)
 3. Influence of children on food purchase decisions (Norgaard et al, 2007)

The background questionnaire is provided in Appendix 1.

3.2.5 DATA ANALYSIS

Data were analysed using SPSS (IBM SPSS Statistics, v.20.0). A criterion of $P \leq 0.05$ was used as a measure of statistical significance.

Conjoint analysis was conducted to estimate the relative importance of colour, communication of sensory properties, health claim, portion and price on likelihood to purchase. The "Factor Importance" scores or the contribution of the experimentally manipulated factors (in this case colour, communication of sensory properties, health claim, portion and price) to a predictor variable (in this case likelihood to buy) were calculated for each subject. In addition, conjoint analysis determines within each factor which level is preferred and to what extent that level is preferred.

Conjoint analysis was conducted on the whole group for each of the four conjoint experiments (cauliflower as main meal, cauliflower as snack, beans as main meal, beans as snack) separately.

In addition, conjoint analysis was conducted on segments of consumers to determine if the market was segmented on the importance of factors for buying cauliflower and green beans. Analyses were:

- Cluster analysis (K means) on consumer ratings of product profiles. Analysis of three identified clusters.
- Gender: men vs women
- Age: younger (18-40 years) vs older (41-65 years) consumers
- Usage frequency of vegetables: low vs high users
- Usage frequency of commodity: low vs high users
- Family life stage: singles/couples vs families with children
- Food involvement: low vs high involvement (lowest tertile and highest tertile)
- Susceptibility to children's influence: low vs high susceptibility (lowest tertile and highest tertile)
- Attitudes towards health: low vs high importance of health (lowest tertile and highest tertile)
- Use of food as reward: low vs high perception of food as reward (lowest tertile and highest tertile)
- Use of food as pleasure: low vs high perception of food as pleasure (lowest tertile and highest tertile)

3.3 Results

3.3.1 CHARACTERISTICS OF PARTICIPANTS

Characteristics of participants are outlined in Table 4. Consumers participating in the cauliflower and bean study had very similar characteristics. There was an even spread in gender and age, and the majority of participants felt that their main cultural identity was Australian or New Zealander. The consumer sample was comprised of different educational levels, household compositions, household sizes and household incomes.

Table 4 Characteristics of participants

	Cauliflower (n = 500)	Green beans (n=502)
Gender	%	%
Male	49	48
Female	51	52
Age		
18-30 years	25	25
31-40 years	24	25
41-50 years	26	26
51-65 years	26	24
Cultural identity		
Aboriginal / Torres Strait Islander	2	1
Australian / New Zealander	68	70
British/ English/ Scottish/ Welsh	11	11
Chinese	6	5
Dutch	1	1
German	2	2
Greek	1	0
Indian	6	5
Irish	2	2
Italian	3	3
Vietnamese	1	1
Other	11	11
Education		
Primary school	2	3
High school	27	29
Technical or trade	29	28
University	42	40
Household income		
\$1 – 33,799	4	3
\$33,800 – 62,399	23	22
\$62,400 – 103,999	28	27
\$104,000 – 155,999	15	14
\$156,000 +	7	7
Do not wish to say	23	28
Household size		
1-2 persons	47	50
3 persons	23	20
4 persons	19	18
5 or more persons	12	12
Household composition		
Single person	13	15
Couple	29	29
Family with children <12yr	23	19
Family with children >12yr	23	24
Group household	8	9
Other	4	4

3.3.2 VEGETABLE CONSUMPTION AND PURCHASE

The majority of consumers reported intake of 2-4 serves of vegetables per day, with only 7% of consumers reporting that they consumed the recommended intake of 5 serves of vegetables per day (Figure 7).

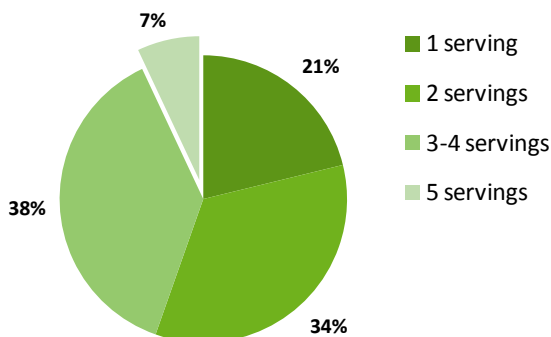


Figure 7 Reported vegetable intake (in servings per day) by consumer sample

Cauliflower and green beans were both reported to be frequently consumed (Figure 8). A recruitment criterion was that consumers needed to consume the vegetable at least once per three months. Of the consumers that took part in the study, more than half of the consumers reported consuming the vegetable at least weekly. A small percentage of consumers reported consuming cauliflower and green beans daily. These data should be interpreted cautiously as they are merely self report and it is well established that reported vegetable consumption is prone to exaggeration due to social desirability bias.

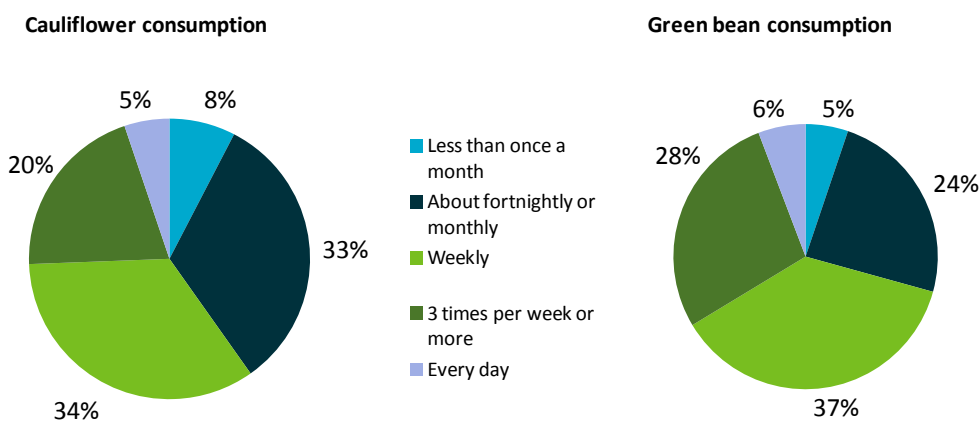


Figure 8 Reported cauliflower and green bean consumption frequency by consumer sample

Most consumers bought vegetables at one of the two major retailers, or at a non-supermarket outlet (e.g. green grocer or market) (Figure 9).

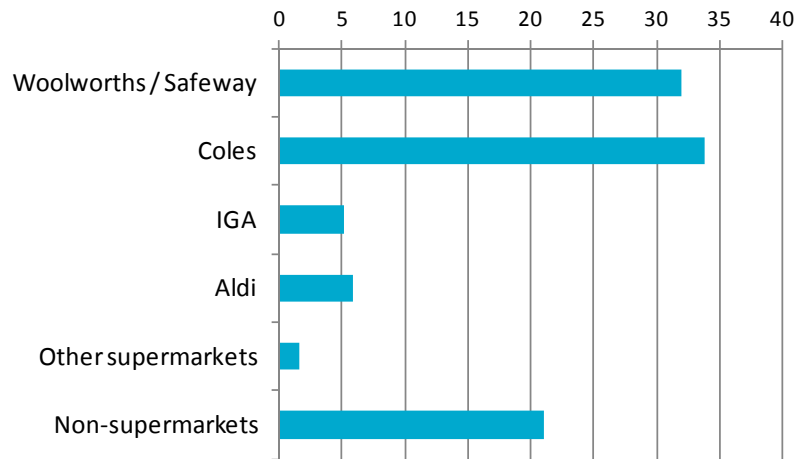


Figure 9 Point of purchase for vegetables

3.3.3 ACCEPTANCE OF CAULIFLOWER AND GREEN BEANS

Acceptance of cauliflower and green bean was around a 7 (on a 9-point scale) for the participants in the study, but these consumers reported that their children had a considerably lower acceptance of these vegetables. Children’s acceptance was estimated to be around 5, which represents the neutral point of the scale: neither like nor dislike (Figure 10).

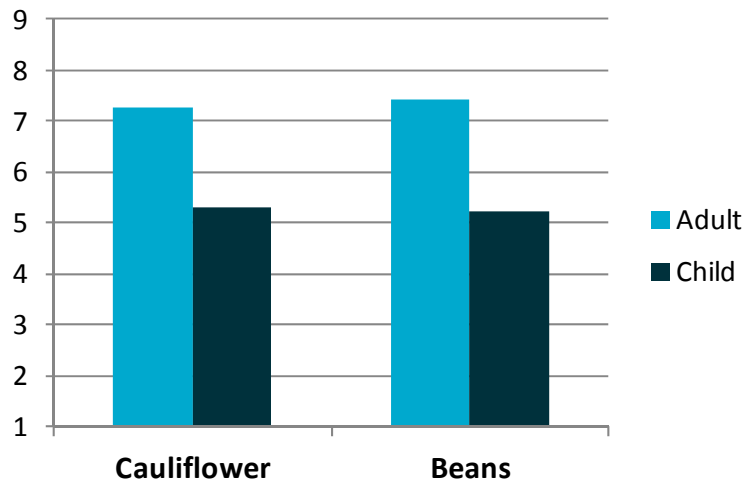


Figure 10 Acceptance of cauliflower and green beans by adult participants and their children

3.3.4 INFLUENCE OF CHILD ON PURCHASE FREQUENCY

A total of 70-80% of participating parents indicated that they would buy the commodity more often if their children would like it more (Figure 11).

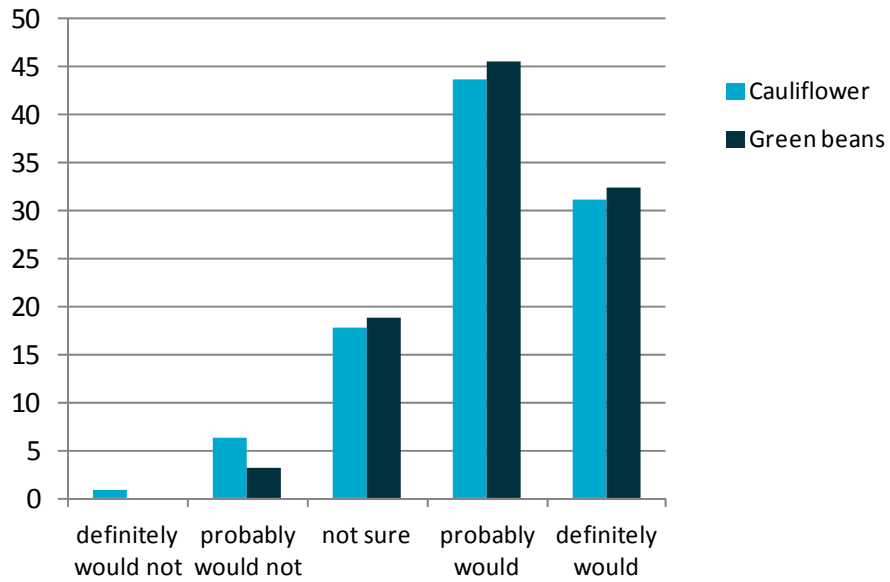


Figure 11 Participants response to the question: “Would you buy cauliflower / green beans more often if your child would like it more?”

3.3.5 FACTORS INFLUENCING CAULIFLOWER PURCHASED FOR MAIN MEAL

Table 5 shows the profiles that consumers evaluated and rated when considering buying cauliflower as a main meal item. This figure shows that consumers were most likely to buy the typical white whole cauliflower, without a health claim, without communication of specific sensory properties, and at the lowest price. The atypically coloured (orange and purple) cauliflower varieties, regardless of claims, price and portion size, had the lowest likelihood to buy.

Table 5 Likelihood to buy cauliflower for a main meal for the 18 profiles evaluated by consumers

Profile no	Colour	Sensory	Health	Portion	Price	Likelihood to buy	SD
3	white	standard	none	whole	3.49	7.72	1.65
11	white	standard	none	whole	3.49	7.69	1.64
2	white	standard	skin	whole	4.19	6.98	1.91
14	white	standard	heart	whole	4.99	6.66	2.11
6	white	low bitter	heart	half size	3.49	6.63	2.10
5	white	no odour	skin	half size	3.49	6.40	2.16
10	purple	no odour	none	whole	3.49	5.68	2.37
12	orange	no odour	heart	whole	4.19	5.30	2.29
9	white	low bitter	none	florets	4.19	5.24	2.42
17	white	low bitter	heart	florets	4.99	5.20	2.47
16	white	no odour	none	florets	4.99	5.19	2.47
4	orange	low bitter	none	whole	3.49	5.07	2.29
1	orange	standard	skin	florets	3.49	5.05	2.39
13	purple	low bitter	skin	whole	4.99	5.01	2.36
7	purple	standard	heart	florets	3.49	4.98	2.48
8	purple	standard	none	half size	4.19	4.93	2.23
18	orange	no odour	heart	half size	4.99	4.53	2.30
15	orange	standard	none	half size	4.99	4.38	2.25

Figure 12 presents the results of the conjoint analysis of the ratings of

Table 5. Importance of the factors overall are shown on the left. Colour was most influential on likelihood to buy, with a 32% contribution. Portion (25%) and price (17%) were the second and third most important factor. The most desirable properties within these factors are shown on the right. Positive utilities (score higher than 0) have a positive influence on likelihood to buy, whereas negative utilities (score lower than 0) decrease likelihood to buy. The longer the bar is, the higher the influence of this attribute on purchase interest (in positive or negative direction).

This figure shows that the following factors have a positive influence: white colour, no communication of sensory properties, communication of a health or a skin claim, lowest price, and whole cauliflower. White colour increases likelihood to buy a lot, whereas communication of a health claim only has a small positive influence. Large negative influences on likelihood to buy are the following levels: orange colour, purple colour, high price, and a pre-cut pack format.

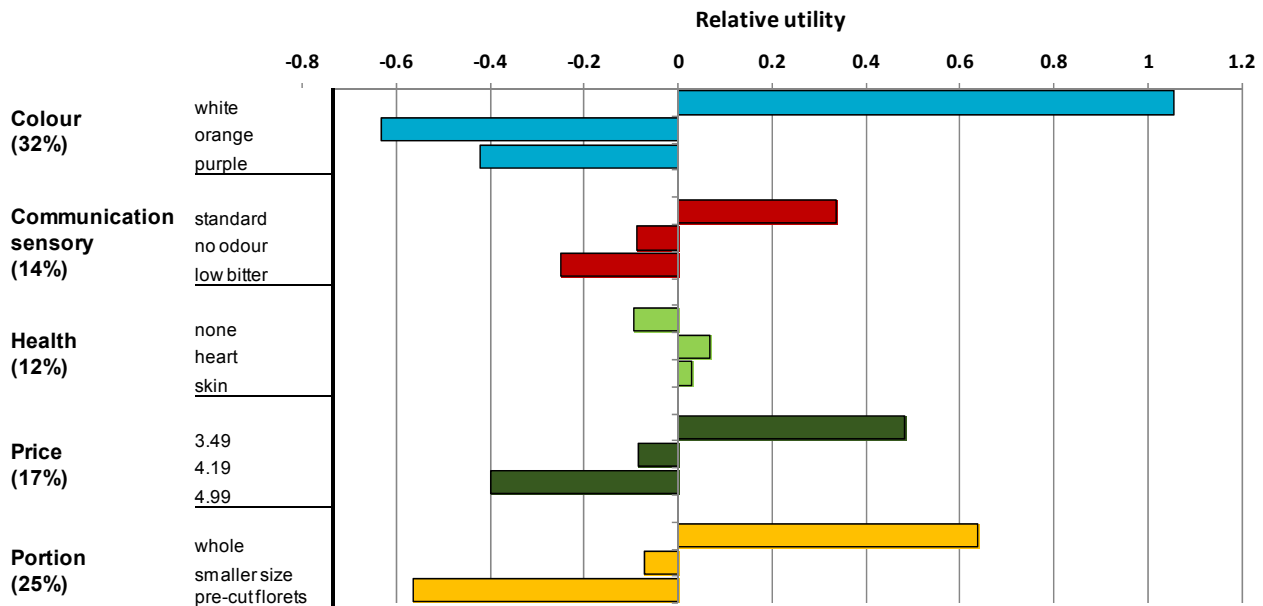


Figure 12 Results of conjoint analysis (factors and utilities) for cauliflower as main meal item

Simulations in conjoint analysis were conducted to simulate consumer responses to specific profiles. This allows to determine the likelihood of buying all possible combinations of factors and levels, not just the ones that consumers have actually responded to.

Figure 13 shows the relative influence of colour and price on likelihood to buy. The figure shows that consumers are more likely to buy white cauliflower than orange or purple cauliflower, regardless of its price. Thus, consumers are more likely to buy a white cauliflower at \$4.99 than a purple or orange cauliflower at \$3.49.

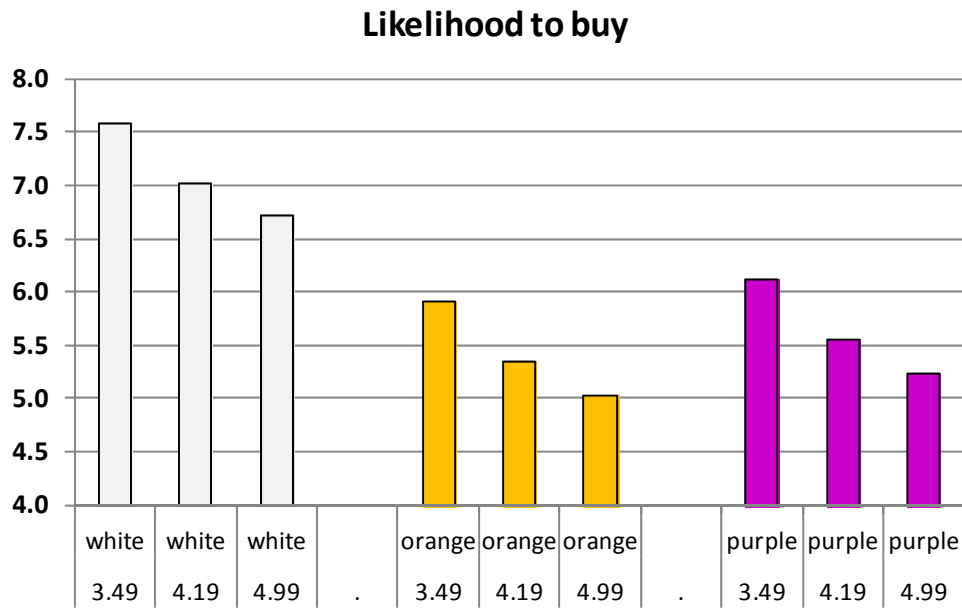


Figure 13 Likelihood to buy whole cauliflower as a factor a colour and price (simulation)

Communication of a health claim had a small but positive influence. The relative influence of health claim and price is shown in Figure 14.

This figure confirms that the health and skin claim have a small, positive effect on purchase interest, but not the extent that consumers would be willing to pay an additional 20% for the product accompanied by the health claim.

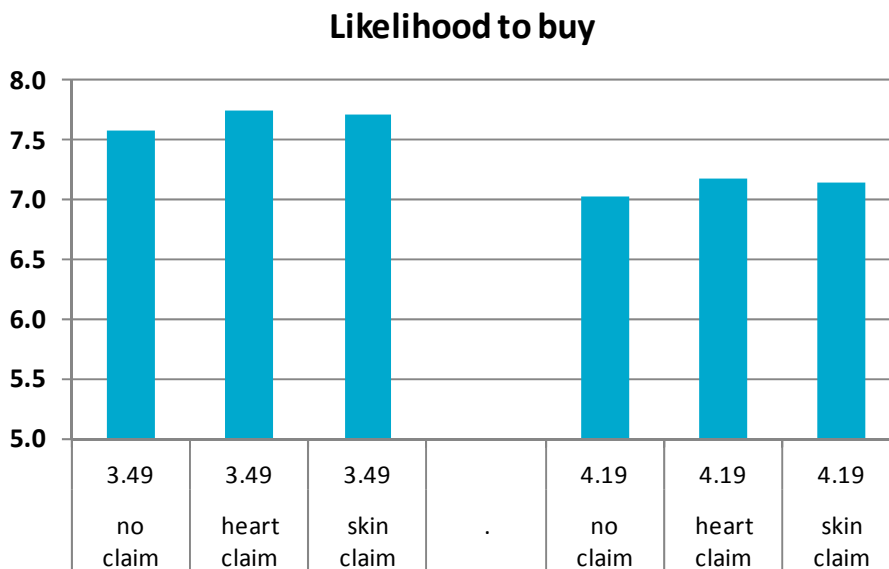


Figure 14 Likelihood to buy white whole cauliflower as a factor a health claim and price (simulation)

3.3.6 FACTORS INFLUENCING CAULIFLOWER PURCHASED AS A SNACK

There was interest to buy cauliflower as a snack item, but interest was lower than buying cauliflower as a main meal item (Table 6). Consumers were most interested in white florets without any claims at the

lowest price. Interest in mixed coloured packs was also relatively high, but lower than packs with white florets.

Table 6 Likelihood to buy cauliflower as a snack for the 11 profiles evaluated by consumers

Profile	Colour	Sensory	Health	Price	Likelihood to buy	SD
5	white	standard	none	1.49	5.93	2.48
1	white	low bitter	heart	1.99	5.67	2.47
6	mixed	low bitter	skin	1.49	5.65	2.59
7	mixed	standard	none	1.99	5.49	2.54
10	mixed	low bitter	none	1.99	5.42	2.56
3	white	standard	skin	2.49	5.32	2.52
4	atypical	standard	heart	1.49	5.24	2.52
2	mixed	standard	heart	2.49	5.08	2.55
9	atypical	standard	skin	1.99	5.06	2.47
11	atypical	standard	skin	2.49	4.57	2.46
8	atypical	low bitter	none	2.49	4.51	2.41

Colour (45%) and price (28%) were the key factors determining purchase interest in cauliflower snack florets. White colour and the lowest price contributed most positively, but mixed coloured packets and the intermediary price level also contributed positively to purchase interest (Figure 15).

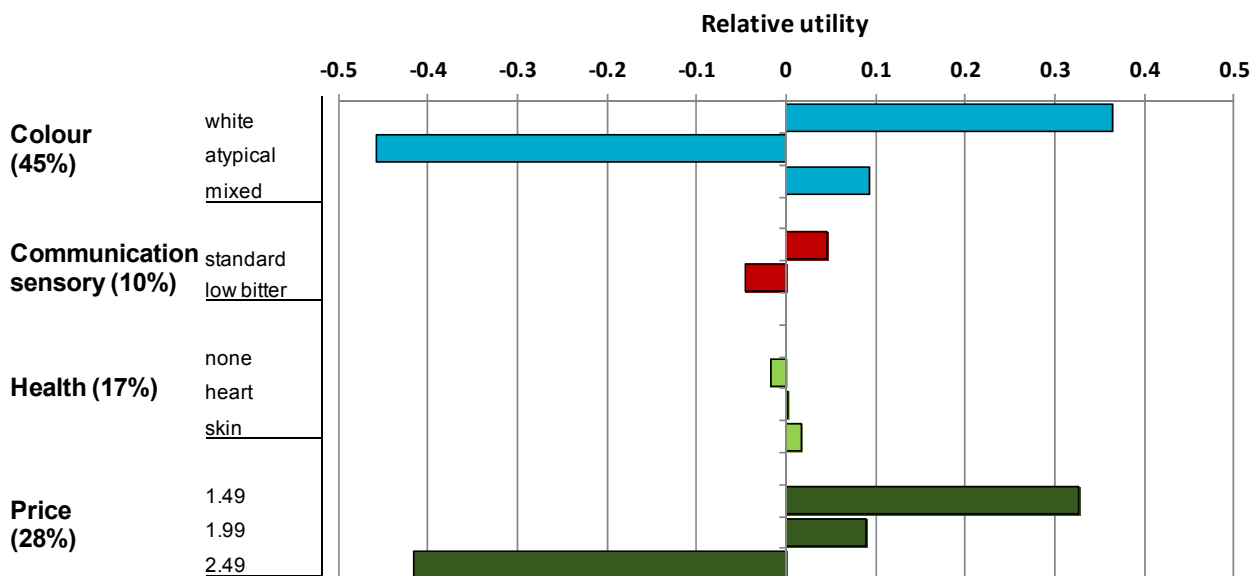


Figure 15 Results of conjoint analysis (factors and utilities) for cauliflower as snack item

Simulation of colour and price confirms that white florets at the lowest price are preferred, but consumers are just as willing to buy white florets at \$2.49 as a mixed pack at \$1.99 (Figure 16).

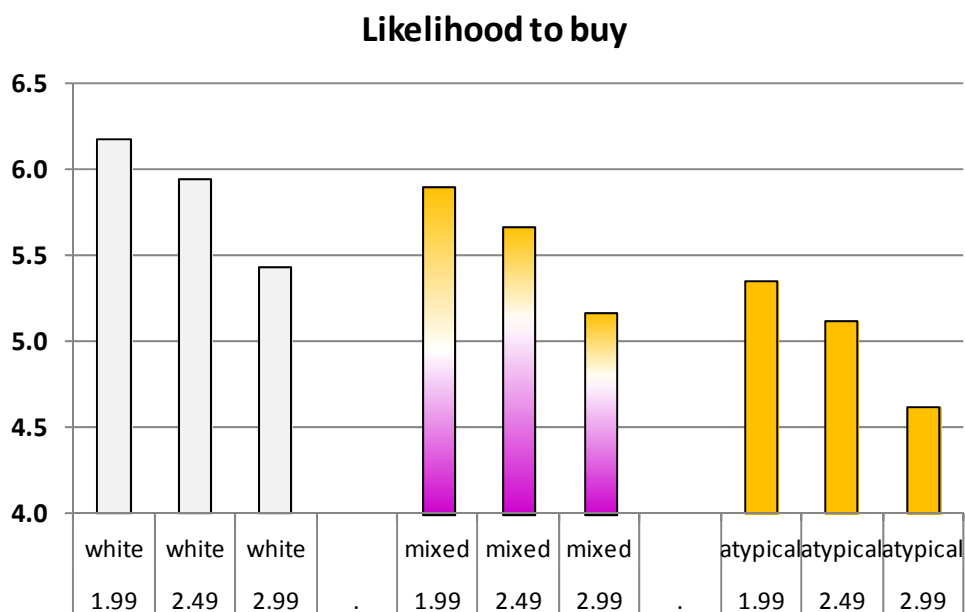


Figure 16 Likelihood to buy cauliflower florets as snack item as a factor a colour and price (simulation)

3.3.7 FACTORS INFLUENCING BEANS PURCHASED AS A MAIN MEAL

Similar to what was found for cauliflower, the most commonly available product profile had the highest likelihood of buying. This was the typically coloured green bean, without claims, sold loose at the lowest price. Atypical colours had the lowest likelihood of buying (Table 7).

Table 7 Likelihood to buy beans as a main meal for the 18 profiles evaluated by consumers

Colour	Sensory	Health	Portion	Price	Likelihood to buy	SD
green	standard	none	loose	2.99	7.77	1.45
green	standard	none	loose	2.99	7.75	1.43
green	extra crisp	heart	pre-packed whole	2.99	6.98	1.92
green	extra crisp	none	loose	3.59	6.98	1.74
green	extra crisp	heart	pre-packed RTE	2.99	6.94	1.93
green	standard	none	loose	3.59	6.90	1.80
green	standard	calcium	pre-packed RTE	3.59	6.35	1.96
yellow	extra crisp	calcium	loose	2.99	6.32	2.19
purple	standard	none	pre-packed whole	2.99	6.29	2.00
green	extra crisp	none	loose	4.19	6.19	2.10
purple	extra crisp	calcium	loose	2.99	6.02	2.38
yellow	standard	calcium	pre-packed RTE	2.99	5.77	2.25
yellow	standard	none	pre-packed RTE	2.99	5.75	2.27

green	standard	calcium	pre-packed whole	4.19	5.66	2.27
purple	standard	heart	loose	3.59	5.54	2.26
yellow	standard	heart	loose	4.19	5.29	2.22
yellow	extra crisp	none	pre-packed whole	3.59	5.28	2.18
purple	extra crisp	none	pre-packed RTE	4.19	4.61	2.30

Conjoint analysis showed that colour (31%), portion (21%) and price (17%) were the most important factors for buying beans for a main meal (Figure 17). The following levels have a positive influence: green colour, no communication of sensory properties or health claim, lowest price, and sold loose. Large negative influences on likelihood to buy are the following levels: yellow colour, purple colour, high price, and a ready-to-eat pack format.

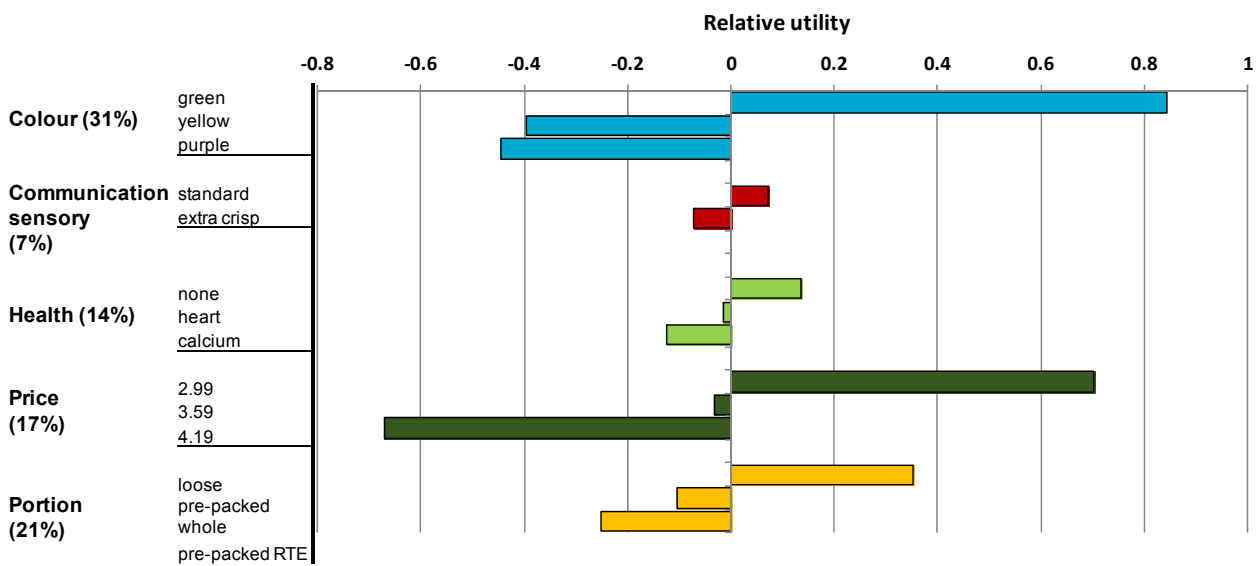


Figure 17 Results of conjoint analysis (factors and utilities) for beans as main meal item

Simulation of interest in colour and price confirms that green beans at the lowest price have the highest likelihood of buying. However, they are more interest in buying an atypically coloured bean at the lowest price than a green coloured one at the highest price (Figure 18).

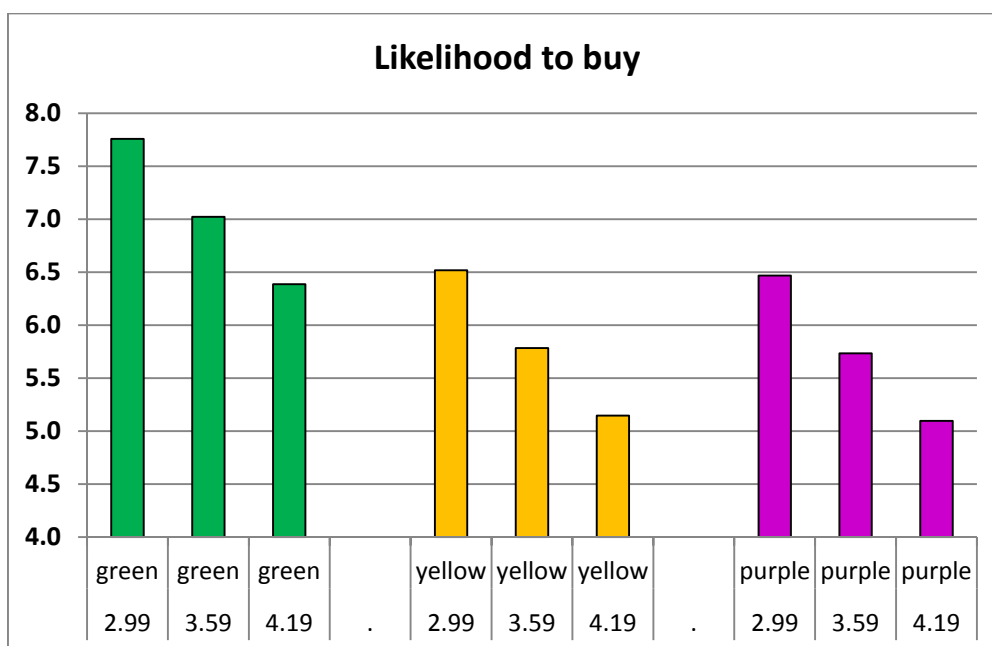


Figure 18 Likelihood to buy loose beans as a factor a colour and price (simulation)

3.3.8 FACTORS INFLUENCING BEANS PURCHASED AS A SNACK

There was interest to buy beans as a snack item, but interest was lower than buying beans as a main meal item (Table 8). Consumers were most interested in green beans without any claims at the lowest price.

Table 8 Likelihood to buy beans as a snack for the 11 profiles evaluated by consumers

Profile no	Colour	Sensory	Health	Price	Likelihood to buy	SD
5	green	standard	none	1.49	6.21	2.41
1	green	extra crisp	calcium	1.99	6.04	2.47
4	mixed	standard	calcium	1.49	5.55	2.53
11	green	extra crisp	none	2.49	5.52	2.55
8	green	standard	heart	2.49	5.52	2.60
10	green	standard	calcium	2.49	5.47	2.55
6	mixed	standard	heart	1.99	5.37	2.55
3	atypical	extra crisp	heart	1.49	5.25	2.54
7	atypical	standard	none	1.99	5.01	2.48
2	mixed	extra crisp	none	2.49	4.93	2.49
9	atypical	standard	calcium	2.49	4.68	2.44

Colour (43%) and price (29%) were the key factors determining purchase interest in beans as a snack (Figure 19). Green colour and the lowest price contributed most positively, but the intermediary price level

also contributed positively to purchase interest. Atypical colour and the highest price point had a strong negative influence.

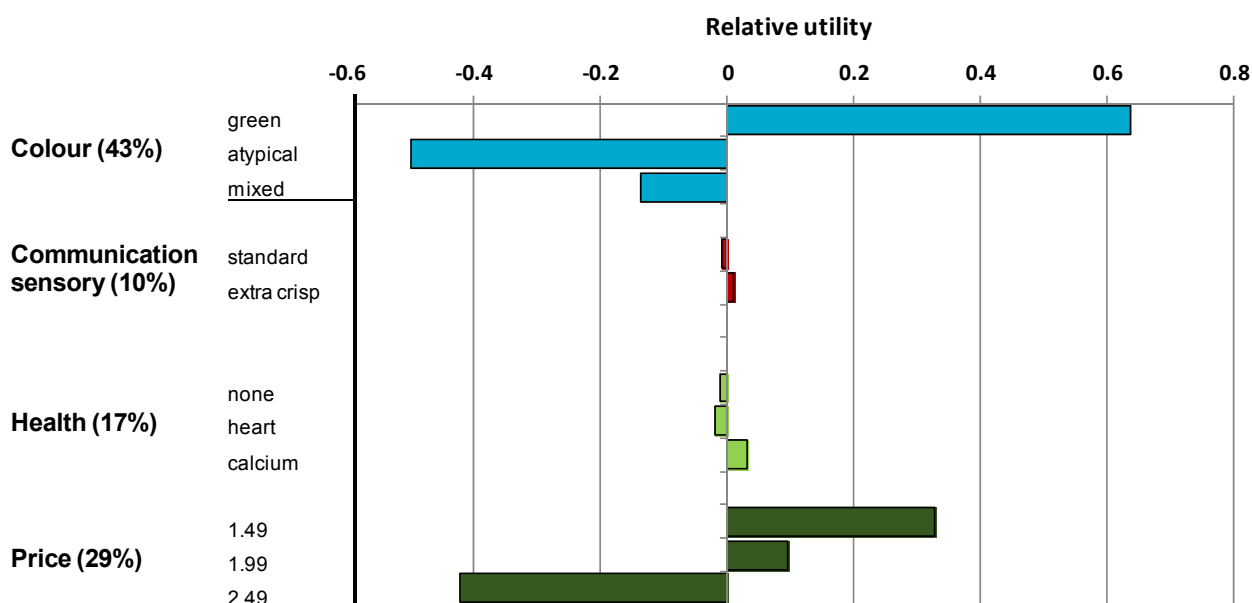


Figure 19 Results of conjoint analysis (factors and utilities) for beans as snack item

3.3.9 SEGMENTATION IN INTEREST IN CAULIFLOWER AND BEAN CONCEPTS

Conjoint analysis was conducted on segments of consumers to determine if the market was segmented on the importance of factors for buying cauliflower and green beans, for each of the two contexts (main meal and snack). The variables and segments that were analysed were:

- Clusters of consumers with similar ratings of product profiles (identified by cluster analysis)
- Gender: men vs women
- Age: younger (18-40 years) vs older (41-65 years) consumers
- Usage frequency of vegetables: low vs high users
- Usage frequency of commodity: low vs high users
- Family life stage: singles/couples vs families with children
- Food involvement: low vs high involvement
- Susceptibility to children's influence: low vs high susceptibility
- Attitudes towards health: low vs high importance of health
- Use of food as reward: low vs high perception of food as reward
- Use of food as pleasure: low vs high perception of food as pleasure

Segmentation was found for cauliflower, but not for green beans.

For cauliflower, segmentation was found in the following areas:

- Interest in health claim: consumers with a high health awareness showed more interest in products accompanied with a heart health claim than consumers with low health awareness. However, price was a more determining factor, and they were not willing to pay an additional 20% for cauliflower with a heart health claim.
- Interest in mixed coloured floret snack packs: there were several consumer segments with interest in mixed coloured floret snack packs. These were families with children, consumers who seek high

pleasure when eating food, and consumers with high health awareness. Interest in the mixed pack was slightly lower than interest in the white coloured floret pack, and neither of the groups were willing to pay 20% extra compared for a mixed coloured pack compared with a snack pack of white cauliflower florets.

- Segmentation results as a function of family composition is shown in Figure 20. This figure shows that families with children (46% of the consumer group) are interested almost equally in snack packs with mixed colour florets than with white florets.

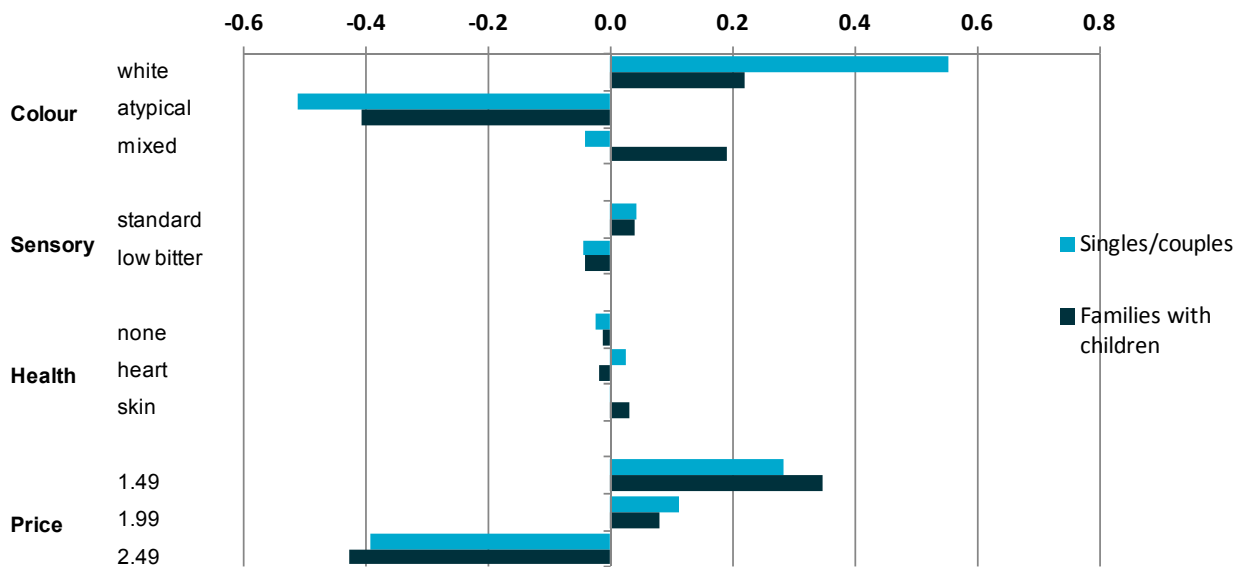


Figure 20 Results of conjoint analysis (factors and utilities) for cauliflower as snack item as a function of family composition

3.4 Conclusions and discussion

The consumer study used a method that modelled many attributes that previous literature had suggested might be important in influencing purchase intention, analysis determined the relative importance of the attributes and the relative value (utility) of levels of those attributes. Results indicated that consumers were most likely to buy the conventional products that are already widely commercially available: white whole cauliflower and green beans sold loose, respectively.

These results clearly show that consumers are conservative in nature, and are not swayed by engineering commodity attributes such as colour or size. Thus, the results indicate that changing specific attributes to replace the traditional products will not increase cauliflower or green bean purchase.

Familiarity is an important determinant of consumer preferences (Zajonc, 1968?). Consumers like what they know already, and it takes repeated exposure to increase familiarity and thereby consumer preferences.

Communication of specific sensory properties did not increase willingness to buy. Sensory research has shown specific taste barriers for cauliflower consumption. These results indicate that consumers have likes and dislikes for cauliflower sensory properties, derived through consumers tasting samples and indicating to what degree they like what they have tasted, but they are not consciously aware of what it is that they like and do not like. If varieties are developed that better suit consumer sensory preferences, a communication strategy will need to address how properties of these new varieties are communicated to consumers.

Communication of health claims had a very small or no positive effect on purchase interest. The recently FSANZ approved heart health claim had a small positive effect on cauliflower, but not to the extent that consumers were willing to pay 20% more for a product accompanied by a heart health claim. However, there was larger interest in this claim by health aware consumers. Novel health claims had no effect in the current study.

Consumers preferred the conventional packing format (whole head for cauliflower, loose for beans). A smaller (whole) cauliflower was thought to be perhaps more appealing to smaller households, but this was not the case. This study does not provide insights into the reasons for the preference for a whole cauliflower. We hypothesize it may be due to the perception of higher freshness, longer shelf life and/or the perception that preparation of a whole cauliflower is not inconvenient or simply perceived value for money.

Segmentation was found only for cauliflower, and limited to colours of snack packs and a heart health claim.

The following conclusions can be drawn from this research:

- Colour, price and pack format were the most important factors influencing buying decisions for cauliflower and green beans
- Consumers were more interested to buy conventional products (whole white cauliflower, green beans sold loose) than products with modified properties (atypical colour, convenience format or size)
- Communication of sensory properties had no positive influence on buying behaviour
- Health claims had a very small or no positive influence on buying behaviour
- There was interest in snack packs for both cauliflower and green beans, providing opportunity for differentiation in the category and increasing consumption by targeting another eating occasion than the main meal
- There was some segmentation in cauliflower consumers, providing opportunity for differentiation of the category, through the use of a heart health claim for health aware consumers, and the development of snack packs of mixed coloured florets for children, health aware and pleasure seeking adults
- Acceptance of the commodities, in particular by children, was a limiting factor to purchase

4 Documentation and prioritisation of barriers and drivers

This chapter documents and prioritises the barriers and drivers to purchase and consumption of cauliflower and green beans. The literature review identified a number of commodity specific barriers, and also a number of barriers generic to purchase and consumption of vegetables. Prioritisation on the basis of literature review alone was difficult as relatively little commodity specific information was available, and most studies had investigated single factors only. A consumer study including multiple factors was conducted specific for the commodities under investigation to help the prioritisation. A single commodity specific study cannot investigate all potential drivers and barriers. The study undertaken was focused primarily on factors directly related to the vegetable itself (intrinsic properties such as colour) or extrinsic factors of the vegetable (such as a health claim), as these would provide tangible and actionable output for the vegetable industry and its partners. Information from both literature review and the consumer study were then used to prioritise barriers and drivers for purchase and consumption of the two commodities. In prioritizing the following factors were considered:

- Magnitude (size) of barriers and drivers
- Level of scientific evidence available
- Ease or difficulty to overcome barrier or use driver
- Size of opportunity
- Level of influence the vegetable industry can exert:
 - Directly by industry (e.g. levy payers)
 - Indirectly through immediate partners of the vegetables (e.g. supply and value chain partners, seed manufacturers, retail)
 - Indirectly through partnering with others (e.g. DOHA, MLA, public health organisations)

Although collaboration with other project leaders working on relevant HAL projects was sought, no formal information was available for use in the current project.

4.1 Barriers and drivers for cauliflower purchase and consumption

Consumer research has identified that the main barriers related to cauliflower consumption are not related to factors that can be 'engineered' or changed to the product itself, since consumers were most interested in buying the product that was already widely available. Thus, changing consumer behaviour towards cauliflower seems a more viable approach than changing the product itself. Literature on consumer behaviour barriers was not available specific to cauliflower, but was available in literature on barriers towards vegetables in general, and was therefore included.

The following tables summarise barriers (Table 9) and drivers (Table 10) to cauliflower purchase and consumption. It prioritises factors specific to cauliflower, but includes vegetable generic factors where they were found to be relevant to cauliflower.

Table 9 Barriers to cauliflower purchase and consumption

Priority level	Barrier to purchase and consumption
High	Low acceptance**
	Children’s dislike*
	Dislike of taste/flavour*
	Lack of consumption contexts*
	Perceived value / cost*
Medium	Inconvenience*
	Lack of variety available*
	Lack of emotional involvement in decision making**
	Health benefits*
	Poor quality / defects visible*
Low	Portion size too large*
	Packaging size*
	Lack of understanding of vegetable type /grouping*

* Barriers identified specific to cauliflower

** Barriers identified as related to vegetables

Table 10 Drivers to cauliflower purchase and consumption

Priority level	Driver to purchase and consumption
High	Familiarity*
	Liking*
	Early exposure in childhood**
Medium / low	Atypical colour*
	Convenience*
	Labelling / branding**
	Health benefits*

* Drivers identified specific to cauliflower

** Drivers identified as related to vegetables

Rationale for prioritization is provided in the paragraphs below.

4.1.1 HIGH PRIORITY BARRIERS AND DRIVERS FOR CAULIFLOWER

- **Low acceptance:** Taste is a key determinant of purchase and consumption of any food. In literature reviews the taste of vegetables has been found to be amongst the key barriers of vegetable consumption. Thereby, increasing consumer liking for cauliflower is a priority driver to increase cauliflower consumption and purchase.

- **Children's dislike:** The consumer study provided direct evidence that low acceptance of cauliflower by children inhibited purchase behaviour in families, with three quarters of parents indicating that they would buy cauliflower more often if their child or children would like it more. Increasing children's acceptance of cauliflower could increase consumption in families, but can also have longer term benefits since consumer preferences and dietary behaviours often track from childhood to adulthood. Therefore, addressing this factor also provides opportunities to sustainably increase cauliflower consumption on the longer term. Ample scientific evidence is available that early exposure (in childhood) has a larger potential to change acceptance for vegetables, thereby this was identified as a priority driver to increase consumption.
- **Dislike of taste / flavour:** specific sensory properties were identified through literature research that influenced consumer's acceptance for cauliflower. Sweetness positively influenced consumer liking, whereas bitterness had a negative influence. At the same time, specific odour compounds that gave a typical cooked cauliflower odour and flavour were problematic for some consumers, although cauliflower flavour itself seems to be liked. Addressing sensory properties to make them more desirable may increase consumption by increasing consumer acceptance for the product.
- **Lack of consumption contexts:** literature review identified that context and availability were barriers to vegetable consumption. Further, our consumer study showed that there was interest in buying cauliflower florets as a snack item. Increasing consumption contexts (through expansion of opportunities in place and time) can increase consumption frequency.
- **Perceived price / cost:** Literature found cost of fresh vegetables to be a key area of dissatisfaction for Australian consumers, and our consumer study found that cost was the second most important factor (after traditional colour) influencing willingness to buy. Since price perception is directly related to value perception, perceived costs may be changed either by decreasing the actual monetary value of products offered to consumers, or by increasing the perceived value of the offering.
- **Familiarity:** our consumer study found that consumers were most willing to buy the products they were currently most familiar with. This does not mean that new concepts do not have a chance of succeeding, as they can meet other consumer benefits. However, it means that introduction of new concepts will require marketing effort and time to support their uptake. Such products should be viewed as additional to the traditional products, and not as replacements.

4.1.2 MEDIUM PRIORITY DRIVERS AND OPPORTUNITIES FOR CAULIFLOWER

- **Inconvenience / convenience:** our consumer study found that consumers preferred the traditional, familiar whole cauliflower head over the convenience concepts (florets, and a smaller size for smaller household sizes). However, convenience is a key driver for consumer behaviour in general, and therefore potentially other concepts that appeal to this trend may potentially be used to increase consumption.
- **Lack of variety available:** our consumer study found that the traditional, white cauliflower was the most preferred buying proposition. However, there was interest in snack packs, both those consisting of white florets and those consisting of mixed colours.
- **Lack of emotional involvement in decision making:** this factor was not directly studied in our consumer study, however has been identified as a barrier and driver in relation to vegetables in general. Branding and marketing in industry, including the processed foods industry is primarily aimed at emotionally involving consumers with their product, and therefore is considered as a promising pathway to increase perceived value.

- **Health benefits:** health benefits had a positive, but very small contribution to purchase intent. Communication of health benefits may appeal to health aware consumers, as was found for the heart health claim in our study.
- **Poor quality / defects visible:** poor quality was identified as a barrier to consumption of cauliflower in general. Quality relates to quality at point of purchase, and loss of quality during storage, i.e. related to shelf life. No published information was available on quality of produce sold in Australian supermarkets.

4.1.3 LOWER PRIORITY DRIVERS AND OPPORTUNITIES FOR CAULIFLOWER

- **Portion size too large / packaging size:** the size of a whole cauliflower head was not identified as problematic in our consumer study, regardless of household size.
- **Lack of understanding of vegetable type / grouping:** cauliflower was incorrectly perceived as a ‘starchy’ rather than an ‘other’ vegetable by American consumers. Such a misclassification, if existing amongst Australian consumers, would only be important when communicating messages that use a vegetable classification approach, for example, promoting brassicas or vegetable variety in the diet.

4.2 Barriers and drivers for green bean purchase and consumption

Similar to cauliflower, purchase intent was highest for the product already widely available, which indicates that changes in consumer behaviour rather than change of product properties offer the highest potential to best grow the category.

The following tables summarise barriers (Table 11) and drivers (Table 12) to green bean purchase and consumption. It prioritises barriers specific to beans, and includes barriers to vegetables where they were found to be in relevant to beans.

Table 11 Barriers to green bean purchase and consumption

Priority level	Barrier to purchase and consumption
High	Low acceptance**
	Children’s dislike*
	Lack of consumption contexts *
	Perceived price / cost*
Medium	Lack of emotional involvement in decision making**
	Lack of variety available*
	Poor quality / short shelf life*
	Inconvenience / convenience*
Low	Health benefits*
	Segmented taste preferences*
	Lack of understanding of vegetable type /grouping*

* Barriers identified specific to (green) beans

** Barriers identified as related to vegetables

Table 12 Drivers of green bean purchase and consumption

Priority level	Driver to purchase and consumption
High	Familiarity*
	Liking*
	Early exposure in childhood**
Medium / low	Atypical colour*
	Convenience*
	Labelling / branding**
	Health benefits*

* Drivers identified specific to (green) beans, ** Drivers identified as related to vegetables

Rationale for prioritization is provided in the paragraphs below

4.2.1 HIGH PRIORITY BARRIERS AND DRIVERS FOR (GREEN) BEANS

- **Low acceptance:** Taste is a key determinant of purchase and consumption of any food. In literature review the taste of vegetables has been found to be amongst the key barriers of vegetable consumption. Thereby, increasing consumer liking for (green) beans is a priority driver to increase their consumption and purchase.
- **Children’s dislike:** The consumer study provided direct evidence that low acceptance of green beans by children inhibited purchase behaviour in families, with three quarters of parents indicating that they would buy green beans more often if their child or children would like it more. Increasing children’s acceptance of green beans could increase consumption in families, but can also have longer term benefits since consumer preferences and dietary behaviours often track from childhood to adulthood. Therefore, addressing this factor also provides opportunities to sustainably increase consumption on the longer term. There is also good scientific research available on how this can be achieved.
- **Lack of consumption contexts:** literature review identified that context and availability were barriers to vegetable consumption. Further, our consumer study showed that there was interest in buying beans as a snack item. Increasing consumption contexts (through expansion of opportunities in place and time) can increase consumption frequency.
- **Perceived price / cost:** Literature found cost of fresh vegetables to be a key area of dissatisfaction for Australian consumers, and our consumer study found that cost was the second most important factor (after traditional colour) influencing willingness to buy. Since price perception is directly related to value perception, perceived costs may be changed either by decreasing the actual monetary value of products offered to consumers, or by increasing the perceived value of the offering.
- **Familiarity:** our consumer study found that consumers were most willing to buy the products they were currently most familiar with (e.g. green beans rather than atypically coloured ones...). This does not mean that new concepts do not have a chance of succeeding, as they can meet other consumer benefits. However, it does mean that introduction of new concepts will require

marketing effort and time to support their uptake, and should be viewed as additional to the traditional products.

4.2.2 MEDIUM PRIORITY DRIVERS AND OPPORTUNITIES FOR (GREEN) BEANS

- **Inconvenience / convenience:** our consumer study found that consumers preferred the traditional, loose beans over pre-packed and convenience concepts. However, convenience is a key driver for consumer behaviour in general, and therefore potentially other concepts that appeal to this trend may potentially be used to increase consumption.
- **Lack of variety available:** our consumer study found that the traditional, green beans were the most preferred buying proposition. No interest in atypical colours was observed, however, there was interest in snack packs of green beans.
- **Lack of emotional involvement in decision making:** this factor was not directly studied in our consumer study, however has been identified as a barrier and driver in relation to vegetables in general. Branding and marketing in industry, including the processed foods industry is primarily aimed at emotionally involving consumers with their product, and therefore is considered as a promising pathway to increase perceived value.
- **Poor quality / short shelf life:** poor quality was identified as a barrier to consumption of green beans in general. Quality relates to quality at point of purchase, and loss of quality during storage, i.e. related to shelf life. No information was available on quality of produce sold in Australian supermarkets.

4.2.3 LOWER PRIORITY DRIVERS AND OPPORTUNITIES FOR (GREEN) BEANS

- **Segmented texture preferences:** different preferences for texture of beans were identified. Consumer research indicated that 'extra crispy' as communication of an enhanced sensory property did not increase purchase intent. Moreover, texture differences could be derived at home through cooking, and the industry could communicate, through cooking guidelines, options for consumers. . However without sensory studies in Australia it is unknown how important or influential this advice would be.
- **Health benefits:** in the consumer study undertaken health benefits had no contribution to purchase intent.
- **Lack of understanding of vegetable type / grouping:** green beans were incorrectly perceived as a 'dark green' rather than an 'other' vegetable by American consumers. Such a misclassification, if existing amongst Australian consumers, would only be important when communicating messages that use a vegetable classification approach, for example to promote vegetable variety in the diet.

5 Response plans

The literature review and consumer research identified that consumers are quite conservative, and found that the main barriers to consumption of cauliflower and green beans are not related to specific product properties that can be 'fixed' to make these commodities more appealing to consumers. Rather, barriers seem related to vegetable consumption in general. Therefore, the response plan is broken down into three sections; a commodity specific section for those drivers and opportunities that were identified and specifically relate to that commodity, and a section that applies to both commodities and would be applicable to vegetables more general.

5.1 Actions specific to cauliflower

5.1.1 DEVELOPMENT OF WHITE AND/OR MULTI-COLOURED SNACK PACKS

Development of snack packs with cauliflower florets increases consumption of cauliflower on a different consumption situation than the traditional meal situation, and thereby grows the category.

There was interest in both white snack packs as well as multicoloured snack packs (our study tested the combination of white, purple and orange cauliflower florets). Multicoloured snack packs were of specific interest to families with children, health aware consumers, and consumers seeking high pleasure from food.

Snack packs are likely to compete with other snacks, including fruit but also more energy dense snacks (e.g. muesli bars, chips, biscuits). If snacking on vegetables would replace more energy-dense snacks, this will benefit the diet of consumers overall. This strategy could potentially gain support from other stakeholders, for example, the health sector.

An additional benefit of snack packs is that it increases the number of times consumers are exposed to the vegetable, which in itself has a beneficial on acceptance of the vegetable. So indirectly purchase of cauliflower for a main meal item may benefit also.

Further concept development and development of a marketing strategy for the snack pack (packaging, communication, pricing strategy) will need to be conducted. One specific element that can be considered, in particular when developing snack packs for children, is the addition of a dip. Provision of a dip increased acceptance of broccoli in children sensitive to bitter (Fisher, Mennella et al, 2012), which could be explained by the dip masking the slightly bitter taste of the vegetable. Since bitter taste was also found to be a barrier to cauliflower consumption, addition of a dip may have similar benefits in case of cauliflower.

5.1.2 SELECTION AND/OR DEVELOPMENT OF CULTIVARS WITH SPECIFIC SENSORY PROPERTIES

Specific sensory properties have been found to be a barrier to cauliflower consumption.

Bitter taste has a negative effect on consumer acceptance, whereas sweet taste positively influences consumer acceptance. At the same time, cooked cauliflower odour and flavour was a barrier to consumption for some consumers, although cauliflower flavour itself was found to be an aspect that was liked by consumers.

Sensory properties of cauliflower may be optimised to consumer preferences through selection and/or development of cultivars. The vegetable industry can collaborate with seed manufacturers to determine the availability of cultivars with specific sensory properties (e.g. higher sweetness/ lower bitterness) that are suitable to grow in Australia.

In particular if new varieties need to be developed or adapted to suit Australian growing conditions, it is recommended to validate the sensory preferences of Australian consumers. Although there are several studies that have pointed to the above described taste preferences, most of them did not include Australian consumers. Moreover, sensory consumer research on horticultural produce has found that consumers taste preferences are often segmented, i.e. there are different consumer groups that do not share similar likes and dislikes. For example, taste segmentation in apples and tomatoes is well documented, and has led to sensory variety in the commercial product offering. Segmentation for cauliflower preferences has not yet been investigated, but may offer potential for differentiation in the category.

The research technique of preference mapping is a well developed research methodology suitable to investigate consumer sensory preferences. Preference mapping collects hedonic (acceptance) data from a representative range of consumers, and collects information on sensory properties from the same products through the use of a trained sensory panel. Statistical techniques are used to determine the sensory drivers of likes and dislikes. If a sufficiently large consumer sample is used (200-300 consumers) then data can be analysed for market segments with similar sensory likes and dislikes. Statistical models can be developed that allow to predict consumer acceptance from sensory data alone, so there is no need to conduct consumer acceptance testing at every intermediate step of new product development and in breeding programs. The advantage of collecting separate acceptance and sensory property data is that unbiased information on likes and dislikes from consumers can be obtained. Although consumers are very well able to indicate to what degree they like something when they taste it, they are often unaware of their likes and dislikes, and cannot adequately describe their sensory preferences. Another advantage is that objective sensory data can be linked to instrumental or other objective data from cultivars (e.g. sugar content) to provide seed manufacturers with quality specifications that they are familiar with and can measure in-house as part of their development program. Preference mapping ideally requires around 10-12 different cauliflower samples (e.g. different varieties and/or preparations) that differ as much as possible in their sensory properties (e.g. odour, flavour, taste, texture).

5.1.3 PROVISION OF PREPARATION ADVICE

Provision of preparation advice is a second strategy that can be applied to make sensory properties of cauliflower more acceptable to consumers, since preparation with other ingredients can change perception of sensory properties. Bitterness is masked by salty taste, so for example serving cauliflower with a cheese sauce is likely to reduce perception of bitter taste. Development and marketing of recipes, and preparation advice targeted at consumers could be provided in order to reduce undesirable odours, mask bitterness or enhance sweetness of the vegetable. However, caution may be needed when promoting the addition of fat or salt relative to the interests of the health sector.

Preparation advice, and provision of recipes, can also stimulate demand by promoting new ways to prepare cauliflower.

For example, recent research that we conducted found that consumption of cauliflower in mixed dishes was lower than that of boiled and steamed cauliflower, but was generally well liked by children (Poelman, Delahunty et al, submitted for publication). Providing consumers with new ideas that promote the versatility of the vegetable can increase its use both in main meal contexts as well as for lunch and snack use.

5.1.4 COMMUNICATION OF HEART HEALTH CLAIM

Communication of a health claim had a positive, but very small effect on consumer's willingness to buy cauliflower. The heart health claim tested was the recently approved FSANZ health claim: "A high intake of fruit and vegetables reduces risk of coronary heart disease". Interest to buy cauliflower when presented with this claim increased amongst health aware consumers. The advantage of this heart health claim is that it can be used without further substantiation, thus path to adoption is relative easy, straight forward and cost efficient. However, likely benefits are small and wording must use the cautious and contextual framing required by FSANZ.

5.2 Actions specific to green beans

Very few actions specific to green beans were identified, as unlike to cauliflower, there was no segmentation for specific elements that could be tapped into.

5.2.1 DEVELOPMENT OF SNACK PACKS OF GREEN BEANS

Development of snack packs of green beans has the potential to increase consumption of green beans on a different consumption situation than the traditional meal situation, and thereby to grow the category.

There was interest in traditionally coloured snack packs only, with mixed snack packs (our study tested the combination of green, purple and yellow beans) receiving low purchase interest. Vegetable snack packs are likely to compete with other snacks, and if they would replace more energy-dense snacks, this will benefit the diet of consumers overall.

Similar to cauliflower snack packs, it will increase the number of times consumers are exposed to the vegetable, which in itself has a beneficial effect on acceptance of the vegetable. So indirectly purchase of the green beans for a main meal may benefit also.

Further concept development and development of a marketing strategy for the snack pack (packaging, communication, pricing strategy) will need to be conducted. One specific element that can be considered, in particular when developing snack packs for children, is the addition of a dip. Provision of a dip increased acceptance of broccoli in children sensitive to bitter (Fisher, Menella et al, 2012).

5.3 Actions related to both commodities (and vegetables in general)

5.3.1 INCREASE CHILDREN'S ACCEPTANCE

Vegetables are the category of foods least liked by children. Biologically, humans like sweet, salty and fatty (energy-dense) foods and are born with a dislike for bitter foods. Liking for foods that do not possess these properties needs to be learned, which means that liking for vegetables is largely learned.

It is important to note that food preferences are thus not a static property of a person that cannot be changed. Rather, food preferences can change and they mainly change through the experiences a person has in his or her life.

Increasing children's acceptance for vegetables has multiple benefits. First, it increases consumption in this age group, as research has demonstrated that increasing acceptance for vegetables in children increases consumption. Children's acceptance was a limiting factor to purchase cauliflower and beans in families, so increased acceptance by children will also increase consumption in the parents of the children. Moreover, sensory acceptance and dietary behaviours seem to track from childhood into adulthood, and therefore aiming to increase acceptance and consumption early in life is a viable way to increase vegetable consumption in the longer term.

In recent years there has been considerable research into mechanisms that promote vegetable acceptance in children. Mere exposure, also called repeated exposure, has been shown to be an effective way to increase children's acceptance of vegetables. Exposure with appropriate reward has been found to be even more effective. Repeated exposure consists simply of the child repeatedly eating a (small) piece of a particular vegetable. Actual tasting of the vegetable is necessary, looking alone is not effective. Good results have been found with exposure of 8 to 10 times, although the number of times needed depends on the initial liking of the vegetables, as well as on the child. Most parents stop offering foods that a child dislikes after 3-5 times, so it is clear that a repeated exposure approach does not come intuitive to parents. Past research funded by HAL (VG08002) succeeded in improving children's liking of vegetables through exposure and carefully selected rewards.

Because of its simplicity in design as well as ease in communicating to parents, exposure and appropriate reward are very suitable mechanisms for increasing vegetable acceptance in children. Its effectiveness has been demonstrated in small scale studies only. Studies have taken place in a lab, home, school and/or nursery environment, and the effectiveness of different environments on increasing acceptance is not clear. For example, whether the home or the school environment would be better remains yet to be seen, and this may in fact depend on the home environment of the child. It would be recommended that the vegetable industry have a role in facilitating research to demonstrate the effectiveness of exposure and reward in a larger scale intervention. Addressing parents' confidence in sustaining the exposure and dealing with refusals requires further work. Such a study would then develop and test methodologies and materials to ultimately implement exposure to vegetables outside of the research context.

There are potential other strategies to promote children acceptance of vegetables also, for example through associative conditioning. The principle of this strategy is that by repeatedly pairing a vegetable with something the child already likes, such as sweet taste, the child learns to like the vegetable itself. Two forms, flavour-flavour learning and flavour-nutrient learning, have research recent attention as a way to increase vegetable acceptance, but so far does not seem to be beneficial over mere exposure.

Low consumption of vegetables is a public health concern, because of the role that vegetable play in a healthy diet. Consumption of vegetables is below recommendations in children and adults in Australia.

Therefore, it is anticipated that the path to adoption of any validated methodologies for larger scale interventions could be supported and/or even adopted by governments and public health officials.

5.3.2 INCREASE CONSUMER ACCEPTANCE OF ADULT CONSUMERS

Increasing consumer acceptance for vegetables in adults is expected to have positive effects on consumption of vegetables also, and the same types of learning mechanisms could be used in adults as in children.

Research on increasing acceptance of vegetables in adults is relatively scarce, so much less is known about its effectiveness. In general, food preferences of children are easier to change than those of adults, since adults have much more firmly established habits, preferences and eating behaviours.

However, because of the size of the consumer group, the potential to increase consumption of the category is large. So although achieving change may be harder, research into innovative approaches to increase vegetable acceptance in adults would be a worthwhile investment of the vegetable industry.

Because of the interest the vegetable industry shares with organisations that aim to change dietary behaviours for public health reasons (governments, public health organisations, public health research funding bodies), strengthening of collaborations with such organisations is highly recommended.

5.3.3 INCREASE EMOTIONAL INVOLVEMENT

Low emotional involvement was found to be a barrier to consumption of vegetables. Increasing emotional involvement with products in the category can increase perceived value and thereby decrease perceived cost of vegetables. Foods have many different functions in people's lives, including symbolic, individual, social, cultural, ritualistic, contextual and experiential. It is recommended that the vegetable industry seek marketing advice from appropriate professionals to develop emotional involvement enhancing concepts for vegetables that can be tested.

5.3.4 INCREASE AVAILABILITY THROUGH OTHER CHANNELS

Vegetables are mainly consumed as part of the main meal, and consumption at other moments is relatively low. The development of snack packs provides opportunities to consume vegetables at other times (e.g. snacks or entrees) or locations (e.g. work, school). Snack packs could also be distributed via other channels than the retail channel (e.g. gas stations, convenience stores) to provide other contexts to consume vegetables.

The out-of-home channel is another important channel for opportunities to increase vegetable consumption. Stimulating demand in this area has a direct effect on growing the category. Another important advantage is that it can influence consumer's perceptions on what appropriate amounts of vegetables in a meal are. If restaurants serve meals with relative few vegetables, consumers may implicitly perceive this as the norm, and increasing the amount of vegetables in out-of-home meals may shift this norm to a higher level. Thus, increased out-of-home proportions of vegetables may have indirect positive benefits on at-home consumption.

Access and availability are one of the limiting factors of vegetable consumption, mainly due to the relatively short shelf life of vegetables compared with processed foods.

Novel approaches for development of other channels that increase availability could be explored, such as subscriptions to weekly delivery of vegetables at the work place.

5.3.5 WHAT DRIVES NON-CONSUMERS?

Our commodity-specific consumer study focused on regular consumers of cauliflower and green beans (at least once every three months). Exploring barriers to consumption specifically in non-consumers of commodities may provide additional information on how to grow consumption of the commodity. It is recommended to start with qualitative research to develop hypotheses that can be tested in quantitative research.

5.3.6 CHANGE CONSUMER BEHAVIOUR

Eating behaviour is very much driven by habit. In the abovementioned sections, a couple of ways to change consumer behaviour towards higher vegetable consumption have been outlined. However, there are many ways in which consumer behaviours can be changed towards increased vegetable consumption and thereby healthier eating behaviours. For example, behavioural change could be aimed increasing portion size of vegetables relative to other aspects of the meal, increasing consumption of vegetables for lunch, or increasing consumer awareness of what recommended intake of vegetables is, and identifying practical ways to achieve these behavioural changes.

The current study was specifically targeted towards two commodities, cauliflower and green beans. Literature on barriers towards vegetables in general was included because of a scarceness of commodity specific information, and in fact we have found that many barriers seem not related to specific product properties that can be overcome by modifying the product.

The results of this study would warrant a comprehensive investigation into the effectiveness of interventions to increase vegetable consumption through behavioural change. Because of its critical importance to the quality of the diet overall, the scientific community has devoted considerable research to this area already. Vegetable consumption in nearly all Western countries is below recommendations, so it is clear that it is not an easy task to change consumer behaviour towards increased vegetable consumption. The vegetable industry could greatly benefit from a systematic review into the effectiveness of interventions to increase vegetable consumption. Such a review could focus on identifying the interventions that were most successful, and that could be implemented on a larger scale in a cost-efficient way, as well as identifying potential new ways in which vegetable consumption can be increased. Again, collaboration with others that have a similar interest in changing consumer's food choices from a public health perspective (including governments and public health bodies) is highly recommended to provide leverage to investments of the vegetable industry.

Selected scientific references related to this chapter are provided in the Reference section.

6 Discussion and recommendations

The aim of this project was to identify the barriers and drivers to consumption of two specific vegetable commodities, cauliflower and green beans. A literature review found few commodity specific barriers, and most barriers seem generic to the category of vegetables in general. Moreover, our consumer research found that many of the factors that can potentially be modified around a specific commodity (such as colour or size), do not seem to have the potential to increase purchase behaviour.

Rather than changing the product properties, consumer behaviour towards the products needs to be changed.

Consumer behaviour is related to consumption of vegetables in general, and not specific to commodities. Thus, the vegetable industry is recommended to review whether the commodity-to-commodity approach provides the best opportunities to ultimately grow the category, or whether a more generic approach would better be suited to change consumer behaviour.

A separate chapter (Chapter 5 Response Plans) is devoted to the recommendations from this project, in which commodity specific actions as well as more generic actions, and the need for further research are discussed.

Increasing vegetable consumption is an objective of the vegetable industry to support the future and sustainability of its levy paying growers. However, vegetables also have a critical role in an overall healthy diet. Vegetables have direct health benefits, as an important contributor of dietary fibre and micronutrients in the diet, as well as broader health benefits as increased consumption tends to replace more energy dense foods, thereby decreasing overall energy intake. The Australian Government has identified obesity as one of the priority health areas, and increasing vegetable intake is one of the potential ways to halt and potentially reverse the increase in obesity rates in adults and children. Stronger collaborations with Australian governments (e.g. Departments of Health and Aging), local councils (e.g. OPAL initiatives¹) and other organisations with similar public health interests, provides strong opportunities for the vegetable industry to leverage investments into research to increase vegetable consumption, and to enhance adoption of outcomes on a national scale.

Consumer behaviour is complex, and processed food industries dedicate considerable effort into marketing to maximise appeal of their products to consumers. These industries typically have their own marketing department, which ensures uptake and translation of research results from a range of research providers in marketing strategies and action plans. The vegetable industry is strongly recommended to investigate how marketing intelligence generated through the various projects in which it invests can best be consolidated, harnessed and developed for the benefit of the vegetable industry.

¹

<http://www.sahealth.sa.gov.au/wps/wcm/connect/public+content/sa+health+internet/healthy+living/healthy+places/where+we+live+and+play/opal>

7 Technology transfer

Cox DN, Poelman AAM and Phillips, K (2013) Presentation given to Mulgowie Growers Ltd (green bean growers), June 2013.

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Poelman AAM and Cox DN (2013) Barriers and drivers to vegetable consumption – a case study. Abstract submitted to Nutrition Society of Australia Annual Scientific Meeting, 4-6 December 2013, Brisbane, Australia.

Shaw K (2013) Investigating inhibitions to fresh produce purchase. *Vegetables Australia*, May-June, pp22-23.

Further dissemination of results is anticipated in *Vegetables Australia*, at national and/or international conferences and in a peer-reviewed scientific journal.

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CHAPTER 2 LITERATURE REVIEW

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CHAPTER 3 CONSUMER STUDY

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CHAPTER 5 RESPONSE PLANS

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Appendix 1 Background questionnaire with segmentation variables used in conjoint consumer study

[items highlighted in yellow were made specific to the commodity]

You will be asked to provide some information about your vegetable consumption behaviour, preferences and some background information.

Q1. How many servings of vegetables do you usually eat each day?

(a serving of vegetables is 1/2 cup of cooked vegetables or 1 cup of salad vegetables)

None

1 serving 2 servings 3–4 servings 5 servings or more

Q2. Your vegetable habits

Think about your usual eating pattern over the **past three months**. How often do you usually eat **[cauliflower/ green beans]**? (Include: fresh, frozen, canned and juiced forms of the vegetable)

Please tick one box only.

Less than once a month	About fortnightly or monthly	Weekly	3 times a week or more	Every day
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q3. How much do you like **[cauliflower/ green beans]**?

Dislike extremely

like extremely

Q4. Please indicate your gender (tick one box)

1. Male

2. Female

Q5. Please indicate your age (tick one box)

1. 18-30 years

2. 31-40 years

3. 41-50 years

4. 51-65 years

Q6. There are many different ways in which people think of themselves. Which of the following describe the culture(s) you view yourself as being part of? (tick every option that applies)

- | | |
|---|--|
| 1. <input type="checkbox"/> Aboriginal / Torres Strait Islander | 7. <input type="checkbox"/> Greek |
| 2. <input type="checkbox"/> Australian / New Zealander | 8. <input type="checkbox"/> Indian |
| 3. <input type="checkbox"/> British/ English/ Scottish/ Welsh | 9. <input type="checkbox"/> Irish |
| 4. <input type="checkbox"/> Chinese | 10. <input type="checkbox"/> Italian |
| 5. <input type="checkbox"/> Dutch | 11. <input type="checkbox"/> Vietnamese |
| 6. <input type="checkbox"/> German | 12. <input type="checkbox"/> Other(s) <i>Please state</i>
..... |

Q7. What is your highest level of education achieved? (tick one box)

1. Primary school
2. Completed high school
3. Technical or trade certificate (not university)
4. University qualifications or equivalent qualification

Q8. What is your annual household income? (tick one box)

1. \$1 – 33,799
2. \$33,800 – 62,399
3. \$62,400 – 103,999
4. \$104,000 – 155,999
5. \$156,000 +
6. Do not wish to say

Q9. What is your household size? (number of persons who usually live in your household) (tick one box)

1. 1-2 persons
2. 3 persons
3. 4 persons

4. 5 or more persons

Q10. What is your household composition? (*tick one box*)

1. Single person
2. Couple
3. Family with children (at least one child <12yr)
4. Family with children (at least one child >12yr)
5. Group household
6. Other

Q11. Where do you most often buy your vegetables? (*tick one box*)

1. Woolworths / Safeway
2. Coles
3. IGA
4. Aldi
5. Other supermarkets
6. Non-supermarkets e.g. markets, grocers

Q12. Please indicate your agreement with the following statements by ticking the appropriate number on the scale.

		Strongly disagree					Strongly agree		
Q12_1	I am very particular about the healthiness of food	1	2	3	4	5	6	7	
Q12_2	I always follow a healthy and balanced diet	1	2	3	4	5	6	7	
Q12_3	It is important for me that my diet is low in fat	1	2	3	4	5	6	7	
Q12_4	It is important for me that my daily diet contains a lot of vitamins and minerals	1	2	3	4	5	6	7	
Q12_5	I eat what I like and do not care about the healthiness of food	1	2	3	4	5	6	7	
Q12_6	I do not avoid any foods, even if they may raise my cholesterol	1	2	3	4	5	6	7	
Q12_7	The healthiness of my food has little impact upon my food choices	1	2	3	4	5	6	7	
Q12_8	The healthiness of snacks makes no difference to me	1	2	3	4	5	6	7	
Q12_9	I do not believe that food should always be a source of pleasure	1	2	3	4	5	6	7	
Q12_10	The appearance of a food makes no difference to me	1	2	3	4	5	6	7	
Q12_11	It is important for me to eat delicious foods on weekdays as well as weekends	1	2	3	4	5	6	7	
Q12_12	When I eat, I concentrate on enjoying the taste of food	1	2	3	4	5	6	7	
Q12_13	I finish my meal even when I do not like the taste of food	1	2	3	4	5	6	7	
Q12_14	An essential part of the weekend is eating delicious food	1	2	3	4	5	6	7	
Q12_15	I reward myself by buying something really tasty	1	2	3	4	5	6	7	
Q12_16	I indulge myself by buying something really delicious	1	2	3	4	5	6	7	
Q12_17	When I am feeling down I want to treat myself with something really delicious.	1	2	3	4	5	6	7	
Q12_18	I avoid rewarding myself with food	1	2	3	4	5	6	7	
Q12_19	In my opinion, comforting oneself by eating is self-deception	1	2	3	4	5	6	7	
Q12_20	I try to avoid eating delicious food when I am feeling down	1	2	3	4	5	6	7	

Q13. Please indicate your agreement with the following statements by ticking the appropriate number on the scale.

		Strongly disagree					Strongly agree	
Q13_1	I don't think much about food each day	1	2	3	4	5	6	7
Q13_2	Cooking or barbequing is not much fun	1	2	3	4	5	6	7
Q13_3	Talking about what I ate or am going to eat is something I like to do	1	2	3	4	5	6	7
Q13_4	Compared with other daily decisions, my food choices are not very important	1	2	3	4	5	6	7
Q13_5	When I travel, one of the things I anticipate most is eating the food there	1	2	3	4	5	6	7
Q13_6	I do most or all of the clean up after eating	1	2	3	4	5	6	7
Q13_7	I enjoy cooking for others and myself	1	2	3	4	5	6	7
Q13_8	When I eat out, I don't think or talk much about how the food tastes	1	2	3	4	5	6	7
Q13_9	I do not like to mix or chop food	1	2	3	4	5	6	7
Q13_10	I do most or all of my own food shopping	1	2	3	4	5	6	7
Q13_11	I do not wash dishes or clean the table	1	2	3	4	5	6	7
Q13_12	I care whether or not a table is nicely set	1	2	3	4	5	6	7

Q14. Do you have children living at home with you?

1. Yes
2. No -> STOP

Q15. How often do your children

1. Express what food they want?
2. Find fruits and vegetables to buy?
3. Find food to buy?
4. Attempt to influence ideas for fruits and vegetables?
5. Attempt to influence ideas for food?

never

seldom

sometimes

often

always

Q16. How often do you

1. Make a positive response to your children's ideas for fruits and vegetables?
2. Make a positive response to your children's ideas for food?

never

seldom

sometimes

often

always

Q17. Who decides on what food products to choose for

1. Eating between meals
2. Breakfast
3. Lunch
4. Dinner

Parents
decide

Parents decide
more than children

Children and parents
decide the same

Children decide
more than parents

Children
decide

Q18. How often do your children help with

1. Writing items on the shopping list
2. Looking for information in sales materials
3. Finding good food offers
4. Comparing prices on food offers

never

seldom

sometimes

often

always

Q19. In the shop who decides to buy vegetables?

Parents
decide
(1)

Parents decide
more than children
(2)

Children and parents
decide the same
(3)

Children decide
more than parents
(4)

Children
decide
(5)

Q20. How much do your children like [cauliflower / green beans]? (if your children differ in their liking for [cauliflower/green beans], indicate for the child that likes it the least)

Dislike
extremely

like
extremely

Q21. Would you buy [cauliflower / green beans] more often if (one of) your children would like it more?

definitely
would not

probably
would not

not
sure

probably
would

definitely
would

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FOR FURTHER INFORMATION

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