



PFR SPTS No. 23078

The value of distinctive and superior eating quality: final report

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October 2022

Report for:

Agribusiness and Economics Research Unit, Lincoln University

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PUBLICATION DATA

Harker R. October 2022. The value of distinctive and superior eating quality: final report. A Plant & Food Research report prepared for: Agribusiness and Economics Research Unit, Lincoln University. Milestone No. 77361. Contract No. 35501. Job code: P/262066/01. PFR SPTS No. 23078.

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Executive summary

The value of distinctive and superior eating quality: final report

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October 2022

This report summarises the outcomes from the sensory research on apples funded in the programme, 'Unlocking export prosperity' led by the Agribusiness and Economic Research Unit of Lincoln University. Three main components of research were conducted:

1. A literature survey leading to the development of a framework to aid exploration of the ways that physical properties affect consumer perception and choice of food.
2. A New Zealand-based pilot of methodologies for assessing impact of eating quality and environmental impacts on consumer choice of food, using apple as an exemplar food.
3. An overseas (USA) study assessing impact of eating quality, seasonality and environmental impacts on consumer choice of food, using apple as an exemplar food.

Outcomes from this research include the trialling of a number of protocols, including the use of: (1) Vickery and (2) Becker-DeGroot-Marschak experimental markets, (3) thought listing protocols, (4) best-worst scaling, and (5) measures of typicality. These methods were easily integrated alongside standard protocols for measuring sensory attributes and consumers' evoked emotional/conceptual responses. A collaboration was established with Ann Colonna at Oregon State University, which was critical to the delivery of results during New Zealand's COVID-19 lockdown. The research has been reported to a wide range of industries including stakeholders and research providers to the apple and kiwifruit industries. Science outcomes include the demonstration that, from an experimental perspective, the importance of 'eating quality' and 'sustainability' differ according to whether or not the trade-offs are made in studies that involve tasting or not. This observation is supported by studies that have previously demonstrated that imagined eating quality is an exaggeration of real experiences. There is a continuing need to understand the influence of data collection-conditions on consumer responses and without this knowledge, businesses should be cautious in interpreting data. Overall, these studies confirm that physical attributes such as flavour, texture, appearance, odour/aroma and convenience are essential elements of quality in the consumer's judgement of willingness to pay a premium.

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1 Introduction

The economic prosperity of New Zealand has been underpinned by its ability to produce quality agri-food exports from its natural resources and there is an increasing focus on shifting investment strategies towards knowledge-intensive, high value add and export growth areas. The programme: 'Unlocking export prosperity' led by the Agribusiness and Economic Research Unit (AERU) of Lincoln University has focused on identifying, understanding and promoting these opportunities for agri-food exports. The research was designed to test the hypothesis that New Zealand agri-food production systems across the primary sector can deliver combinations of physical, credence and cultural attributes that are highly valued by consumers in major global markets. The research also answers questions about exactly what attributes are most highly valued in different markets and which can produce the highest returns to New Zealand producers.

This particular component of the programme considered the role of sensory attributes with a focus on texture, flavour (which includes taste and aromatic components) and odour. The enjoyment that arises while experiencing the texture and flavour of food has a primary influence on consumers' decisions to select or re-select a particular product. It is the physical characteristics of these foods that contribute to this enjoyment and the complex emotions that are evoked. When blind tasting products, people quickly conclude whether the food is special or not, and what are the most appropriate situations and places to eat it (e.g. at home alone or when entertaining guests). A number of New Zealand export agri-food sectors tap into this sophisticated consumer perception to establish and enhance the distinctiveness of their foods.

2 Summary of data collection projects

There have been three components to the research:

1. Development of a framework to aid exploration of the ways that physical properties affect consumer perception and choice of food.
2. A New Zealand-based piloting of methodologies for assessing impact of eating quality and environmental impacts on consumer choice of food, using apple as an exemplar food.
3. An overseas (USA) study assessing impact of eating quality, seasonality and environmental impacts on consumer choice of food, using apple as an exemplar food.

The latter phases of research were affected by COVID-19 lockdowns in New Zealand.

2.1 Framework for distinctive foods

A framework was developed to aid exploration of the ways that physical properties affect consumer perception and choice of food. It was noted that perceived sensory experience evokes not only liking for the food, but also more complex emotions and the recognition of the most appropriate places and situations to use the food. These powerful drivers often differentiate New Zealand foods from those produced in other parts of the world. For example, Oz Clark's description of Marlborough Sauvignon blanc wine: *"...No previous wine had shocked, thrilled, entranced the world before with such brash, unexpected flavours of gooseberries, passionfruit and lime, or crunchy green asparagus spears ... An entirely new, brilliantly successful wine style that the rest of the world has been attempting to copy ever since"*. Arising from this framework, the focus was to understand how credence attributes (such as the sustainability of the production systems used to generate food) might interact with these distinctive flavours and textures. For full details, see Harker (2019).

2.2 New Zealand pilot on consumers' trade-offs between eating quality and a reduced contribution to global warming

This study piloted the use of Vickery auction (Section 3.1) to see how consumers valued eating quality of apples relative to use of orchard production systems that had reduced the contribution to global warming. A realistic scenario was developed based around the production of a disease-resistant apple cultivar, which was estimated to have 15% lower contribution to global warming than standard cultivars based on fewer applications of sprays and an associated reduction in petrol/diesel use. Consumers were provided information on the contribution to global warming associated with the disease-resistant and standard cultivars and then given an opportunity to taste the apples. There were two conditions, each presented to a different subset of consumers: (1) the eating quality of the disease-resistant cultivar was lower than the standard cultivar and (2) the eating quality of the disease-resistant cultivar was higher than the standard cultivar. In both conditions, there was a diversity of consumer responses with some indicating an increase, decrease or no change in willingness to pay after tasting the apples (which reflects the diversity in taste preferences and, for some consumers, a need to taste apples before they are willing to engage with the scenarios). However, there was a predominance of people who increased their bids when sustainability (15% reduction in contribution to global warming) aligned with better eating quality and a predominance of people who reduced their bids when improved sustainability was undermined by poorer eating quality.

There were comments from some consumers whether or not a 15% reduction to global warming was enough to motivate a change in consumption and/or whether these reductions were greenwashing. Overall, the Vickery method was somewhat repetitive and boring for participants. Rather than risking consumers disengaging during the overseas study, a different auction methodology was used. For full details, see Harker & Hunter (2021).

2.3 USA study of eating quality, seasonality and environmental impacts

This study compared apples of similar firmness (a key physical measure of eating quality) including stored New Zealand-grown 'Scilate', and newly harvested USA-grown 'Gala' and 'Red Delicious' by 122 consumers who resided in Portland, Oregon, USA, in November 2021. A multimethod approach characterised hedonic liking, sensory attributes, evoked emotional/conceptual associations, perceptions of freshness and country of origin, how eating quality was traded off against sustainability attributes. The monetary value of these apples was determined using a Becker-DeGroot-Marschak experimental auction (Section 3.3). The three apples presented as distinctly different in terms of eating quality, evoked emotions/conceptual positioning, liking and monetary value. The eating quality was associated with a perceived ranking of freshness and the extent that apples were typical of both USA and New Zealand apples (i.e. no bias was observed that USA apples were expected to be better eating quality than New Zealand apples and vice versa).

An important finding related to the way these distinctly different apples with distinct flavour profiles were traded off against a series of sustainability statements. After consuming the apples, consumers were provided with credence (sustainability) statements and a taste statement (*'tastes like the best of the apples eaten today'*) in a best–worst scaling task (Section 3.4). After consuming the apples (all of which were representative of quality in retail outlets) the consumers indicated that the most important statement was *'grown in a way that is sustainable and does not harm the environment'*, whilst *'tastes like the best of the apples eaten today'* was scored (best minus worst) as only 20% as important as the sustainability statement. Conversely, when these best–worst scaling questions were asked in an online setting with no consumption of apples – *'tastes like the best of the apples eaten today'* was changed to *'crisp, juicy and sweet'* – the order of importance was reversed. In this online study, *'crisp, juicy and sweet'* was the most important attribute and *'grown in a way that is sustainable and does not harm the environment'* was scored as only 30% as important. This outcome was consistent with literature suggesting that imagined food experiences can be exaggerations of actual experiences. Moreover, the online consumers may have imagined the counterfactual to *'crisp, juicy and sweet'* was an apple that was terrible to taste, whereas when consumers tasted the apples, they knew that all the apples were acceptable.

This interpretation is consistent with one of the key assumptions of this research programme, which is that physical attributes such as flavour, texture, appearance, odour/aroma and convenience are essential elements of quality in the consumer's judgement of willingness to pay a premium (Saunders et al. 2017, pp. 5–6). For full details, see Harker et al. (2022).

3 Methodological and protocol innovations

Throughout the project a number of new methodologies were trialled to assess the extent that they were able to inform researchers about trade-offs that consumers make when considering sensory properties of food and the impact of food production on the sustainability of the planet.

3.1 Experimental market – Vickery Auction

The auction was undertaken with a small group of people in a room. Participants were given one product (e.g. a 'Gala' apple), which they could keep or exchange for a new product (e.g. a disease-resistant apple) and \$NZ5 that they could keep or use in the auction. The auction was to exchange the free product for another and hence the bids represent the additional value (or not) associated with the new product. The Vickery 2nd price auction version was used – the winner pays the second highest price (this undermines attempts to win/gamble using unrealistic bids).

Participants were given the information about the sustainability advantages associated with the disease-resistant apple. The auction then ran for five bidding rounds, slices of both apples were tasted, and the auction ran for a further five bidding rounds. All bids were on paper ballots and no verbal communication was allowed. At the end of each bidding round, the winning price (second highest bid) and anonymous codes indicating the current winning bidders were displayed on a whiteboard.

At the end of this process, the binding bidding round (1 to 10) was drawn from a hat and the winner (or winners) exchanged their free apple for the new apple and paid the requisite price using some or all of their NZ\$5. Thus, the process was realistic in that the decisions participants made had a real consequence for them.

3.2 Thought listing

At key points during any experimental protocol, it is possible to give participants a ballot and ask them what they are thinking at that point in time. This is a useful way to understand what is in the mind of participants. For example, one often gets comments on the products, the participants interest in the products and strategy to get them (or not), the protocol being used, the environment and people in the study. This information gives a real indication participant engagement and motives that underpin their decisions.

3.3 Experimental market – Becker-DeGroot-Marschak Auction

This type of experimental auction was easier to implement in a COVID-19 environment as participants remained in individual sensory booths and did not need to interact with other participants. Participants were provided with US\$3 to use in the market. They were presented sequentially with the different product (in this case three apple cultivars). After tasting each apple, they were asked to write down a bid to take the apple away at the end of the study. After bids had been obtained for all apples the apple that would be sold was drawn from a hat (e.g. Product 1, 2 or 3) and the price that the experimenters were willing to sell it for was also drawn from a hat (e.g. a price between US5c and US\$3). Any participant who had a bid equal or higher than the drawn price for the selected for-sale apple, received the product and change for his/her US\$3, if any was owed. Thus, the process was realistic in that the decisions participants made had a real consequence for them.

3.4 Best–worst scaling

This is a simple protocol for determining the relative importance of different choice options, which are traded off against each other. Participants received a series of ballots each containing a series of statements from which they are asked to mark their best choice and worst choice. Each ballot contained a subset of all possible statements in a randomised design. For example, in the apple study, participants received 12 ballots each containing varying combinations of six out of the nine possible statements. These data have formulaic design structures, and analysis in its simplest form involves summation of best and worst choices for each statement and calculation of best minus worst choices.

3.5 Typicality

This protocol draws on methodology proposed and used by the wine consumer scientists, but has rarely, if ever, been used outside this product space. The protocol asks participants to imagine they are explaining a product space to a friend. They are then asked for each sample to indicate the extent that it is a very good example or a poor example of the product (i.e. the extent that it is typical of the product). The data are often collected on a 10-cm line scale anchored at the end with the phrase 0 cm = bad example and 10 cm = good example.

4 Development of collaborations

A key collaboration developed in the project was with Ann Colonna at Oregon State University's Food Innovation Center, Portland, Oregon, USA. The Sensory Facility at the Food Innovation Center collected all USA consumer data during the New Zealand COVID-19 lockdown. This collaboration was strengthened through the co-location in Portland of a PFR staff member with previous sensory science experience, Dr Cynthia Lund (VP Business Development, Marketing & Innovation, North America). Dr Lund spent time at the Sensory Facility working with Ms Colonna. Attempts to strengthen this collaboration are ongoing and are likely to provide longer-term access for New Zealand RS&T.

5 Outreach to industry and future opportunities

The development of protocols and results from studies were presented and discussed at AERU Advisory Board meetings for February 2020, March 2021, October 2021, and April 2022. The presentation of the research was positioned as broadly as possible to maximise applicability to diverse agri-food businesses. In addition, the results that were specifically relevant to fruit industries were presented informally and formally to T&G Global, New Zealand Apples & Pears Inc. (to the Board and the Research Consultative Group separately) as well as at an internal conference attended by staff from The New Zealand Institute for Plant and Food Research Limited (Plant & Food Research), Zespri Group Limited and the Kiwifruit Breeding Company. Within Plant & Food Research, the insights from the New Zealand Pilot and the USA study have been presented at seminars to research staff who have an interest in disease resistance and the sustainable production of apple crops. These researchers have close links to the apple industry and are responsible for developing new research initiatives. The insights gathered in this programme have informed research initiatives developed in Plant & Food Research, particularly in the Stakeholder Values and Metrics programme funded out of the Strategic Science Investment Fund.

6 References

Harker FR 2019. Distinctive physical attributes of New Zealand agri-food exports. A Plant & Food Research report prepared for: Agribusiness and Economic Research Unit. Milestone No. 77355. Contract No. 35501. Job code: P/262066/01. SPTS No. 16699.

Harker R, Hunter D 2021. Taste study of New Zealand food attributes. Presentation to the AERU Advisory Board on 19 & 22 March 2021 (via Zoom).

Harker R, Roigard C, Jin D, Ryan G, Chheang SL, Hedderley D, Colonna A, Dalziel P 2022. Unlocking export prosperity: USA sensory study on the value of distinctive and superior eating quality. A Plant & Food Research report prepared for: Agribusiness and Economics Research Unit, Lincoln University. Milestone 77359. Contract No.35501. Job code: P/262066/01. PFR SPTS No. 22246.

Saunders C, Dalziel P, Harker R, Reid J, Cammock P 2017. Unlocking export prosperity: An introduction to the research programme. AERU Research Report No. 344. Lincoln University: Agribusiness and Economics Research Unit.

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