Know-how for Horticulture™

Technology value planning study of value adding technologies for Australian horticulture

Ian Gould
Food Science Australia

Project Number: AH00023

AH00023

This report is published by Horticulture Australia Ltd to pass on information concerning horticultural research and development undertaken for Australian Horticulture.

The research contained in this report was funded by Horticulture Australia Ltd with the financial support of AusHort.

ISBN 0 7341 0915 6

Published and distributed by:
Horticultural Australia Ltd
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Know-how for Horticulture™

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CONFIDENTIAL PROJECT REPORT

A TECHNOLOGY MAPPING STUDY FOR MANUFACTURED HORTICULTURE BASED FOODS

(AH 00023, 19th March 2004)

Project Number 102014

Authors:
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19th March 2004

Horticulture Australia Project #AH00023

A Technology Value Mapping Study for Australia's Value Added Horticulture Industries

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Funding sources:

Horticulture Australia – Aushort Industries
Department of Primary Industries, Victoria
CSIRO

19th March 2004

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MEDIA SUMMARY

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The project seeks to address the challenge facing research investors, such as Horticulture Australia Ltd, CSIRO, Departments of Agriculture and industry to make better decisions on which programs of strategic research that will lead to technologies that are best placed to meet changing consumer trends with valued product opportunities.

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The project reviewed the drivers of value for consumers and businesses, and considered the drivers of perception of value, global and Australian consumer trends, and the changing business environment. Through a series on industry forums the review formed the basis of characterising the 'product embodiments' that future consumers could be expected to pay a premium for, and considered where technology could be applied to deliver that embodiment to the consumer – for example as a snack, beverage, meal, meal component or food ingredient.

A conceptual model was established linking valued product embodiments through new enabling technologies, technologies that may be applied at differing stages of the post-harvest, processing and ingredient processing value chain. The model is useful in mapping new technologies to product opportunities.

A range of fourteen new technologies we reviewed, and potential for benefit mapped using the framework developed. To demonstrate the concepts developed two case studies, one on apples and pears and one on potatoes were presented.

The conclusions drawn were that while generally useful, the full benefits of the techniques developed were constrained by a lack of public domain data. Recommendations included the need to collect improved value chain data.

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The conclusions drawn were that while generally useful, the full benefits of the techniques developed were constrained by a lack of public domain data. Recommendations included the need to collect improved value chain data. Findings are:

- Pictorial representation of the whole horticultural value chain demonstrates the significant contribution the horticultural production industry makes to the post-farm-gate economy.
- A lack of reliable and consistent 'thru-chain' statistics constrains the understanding of the horticultural value chain
- Significantly improved collection of statistics through the horticultural value chain in a way that enables chain-value to be mapped, should be supported by an alliance of interested parties, including producers, processors and government agencies. This would to enable a greater analysis of the future opportunities of these horticultural value chains.
- The Technology Map framework developed by this project has proven a useful tool to communicate and share concepts in which the market opportunities of processing can be developed.

- The analysis of fourteen new technologies has proven a useful basis to open discussion on future opportunities for developing greater value from manufactured horticulture based foods
- The tool Mapping Tool should be used as an aid to future strategic research planning in manufactured horticultural foods and ingredients.

1.0 THE NEED FOR MARKET DRIVEN TECHNOLOGY AND INNOVATION

1.1 Introduction

As the global market for fresh and value-added foods expands Australia's horticultural industries are faced with the challenges of a new era. Horticultural industries may focus solely on growth by expanding the successful "AUSTRALIA *fresh*" program, or choose to become more diversified and establish new opportunities in innovative value-added horticulture based foods and ingredients through processing and manufacturing.

Both scenarios carry some risk. A focus only on fresh foods can be seen as 'more of the same', and may result in a less certain and less diversified future for producers with an industry based on domestic and export sales of relatively undifferentiated fresh produce. Should this occur domestic markets for value added processed horticultural foods and ingredients may increasingly be supplied with imported products, targeted to meet the premium consumer markets, while existing processor operations may become less economically viable. Building on the existing processing base and diversify into new value added foods and ingredients also has risk. The inherent risk here exists in the successful prediction of future high-value products and ingredients, and technologies that will enable their competitive supply.

This project reports on the development of a qualitative process of technology value mapping designed to better understand market drivers, link market drivers to new processing technologies, and reduce the inherent risk associated with selecting strategic research programs in value adding by Australia's horticultural industries.

Success in this project will result in benefit to horticultural producers through increasing market opportunities for their produce, and to their regional communities through rational development of value adding industries targeting markets in which competition is based on customer value, rather than competitive price.

1.2 Role Of Innovation And Market Drivers

Innovation – either product innovation or process innovation are well known to be a major drivers of new market opportunities and profitability.

Instate (2000) concluded that innovation is a key to improved performance as products with high 'intrinsic value' do not rely on price for their marketability. These sentiments are supported by Price Waterhouse Coopers (2000) in their general review on innovation and growth in the economy, and who stress the importance on "customer-focused innovation" in contributing to additional growth and value.

The National Food Industry Advisory Committee has taken up this need for innovation as it develops of the National Food Industry Strategy (AFFA, 2001b). It notes the importance of leveraging science and technology and that product innovation is a dominant feature of fast moving consumer goods (including manufactured foods) and that Australia has low levels of innovation compared to its competitors. It also acknowledges the importance of building export strategy, developing competitive advantage, and building supplier power.

The National Food Industry Strategy (2002) delivered a strategy based on four key themes: (a) leveraging Australia's science; (b) education and training ensuring a better business environment;

(c) an international food market entry strategy, and (d) environmental sustainability. The strategy under the first theme is to make Australia a recognised centre for innovation in food product, process and systems development, anticipating and meeting consumer needs, and attracting follow-through investment.

1.3 Technology Value Mapping

This project seeks to apply a novel research and development qualitative management tool "Technology Value Mapping" to objectively link enabling science and technology to capture product opportunities arising from emerging consumer demand, as indicated in the following model:

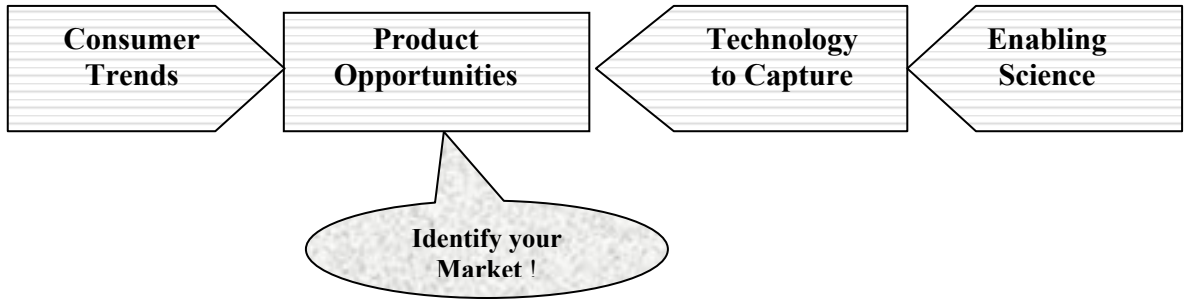

Figure 1.1: Innovation pathway

The model indicates that new product opportunities arise from underlying consumer trends, which are met by new technologies that arise from strategic enabling science.

The challenge facing research investors, such as Horticulture Australia Ltd, CSIRO, Departments of Agriculture and industry is to make better decisions on which program of enabling strategic science may lead to technologies that are best placed to meet consumer trends with valued product opportunities.

The project will contribute to securing a better financial future for the horticultural food industry, particularly the AusHort industries by:

- enhancing market-focussed innovation to develop competitive advantage,
- providing greater certainty in decision making by HAL, DPI-V, CSIRO and other co-investors in selecting or commissioning strategic research projects in value adding technologies for horticulture industries
- improve management throughout the life of a program to re-direct research investment in light of research findings and market opportunities, together with estimates of cost of further research and probability of success.

Benefits of this market-driven approach in research management will enhance Australia's horticultural industries capability to capture new markets, with benefits accruing through the value chain. Benefits will flow to:

- Farmers will have a greater range and size of markets for their crops
- Farm suppliers (eg seed, fertiliser, irrigation, farm equipment) will increase sales due to greater and varied farm production
- Food manufacturers, usually regionally based, will increase regional employment and be able to offer higher prices to growers as they will not be competing in established markets

- Suppliers to food manufacturers (eg equipment, ingredients, packaging) will increase business, often in regional communities
- Infrastructure for food manufacturers (eg gas, power, roads, transport, storage, shipping) will benefit through increased demand for services
- Profitable farming and food manufacturing businesses will support environmentally sustainable growing and manufacturing methods

1.4 Project Background & Methodology

It had initially been proposed to develop a quantitative R&D management tool "Technology Value Planning" to provide a numerical analysis to compare likely economic outcomes resulting from different investment scenarios in strategic research in value-adding food manufacturing technologies. Due to the lack of public domain data in value added horticulture products, and the complexity of a developing a numerical analysis across many horticultural industries this goal has not been possible to achieve.

Therefore, with agreement of Horticulture Australia Ltd (HAL), the scope of this project has been reduced.

The project plan adopted was:

- Gaining an improved understanding of the overall value chain of the Australian Horticultural manufacturing industries, and document findings
- Review and document the literature in emerging drivers and trends influencing the choice by consumers in value added foods
- Through an industry workshop process identify 'un-met market needs' as seen by horticultural processors and industry leaders, through forums held in Melbourne, Sydney and Brisbane (Jan 2001).
- Design a framework of from which a value map may be constructed.
- In a separate workshop of technical specialists scope out a range of emerging food processing technologies that may offer opportunities to horticultural value adding.
- Bring these elements together in the form a Technology Maps.
- Document the project in the form of this report and provide two case studies.

The background methodology used in this project is based on techniques initially developed by Intergral Inc, Havard Square, Boston, USA (Intergral). The Integral technique has been developed has use within the corporate environment, and together Integral and Food Science Australia sought to develop the technique for use in strategic 'public invested' research projects.

Integral is a world leader in providing consulting services in the fields of strategic corporate and research planning. It provides these services to major US and trans-national corporations, and has gained significant experience in the FMCG (Fast Moving Consumer Goods) industries and particularly the food industry. Integral maintains its historic linkages to the Harvard Business School to continually improve its operations.

In the area of strategic research planning Integral has developed techniques to work within a corporation and with its stakeholders. The techniques enable rational and informed investment decisions in research programs, under a range of different scenarios.

In using the Integral techniques, it is typical for a company to fully discloses all corporate and strategic information to the planning process. Individuals from a range of company functional areas (marketing, research, production etc) and sometimes supply-chain stakeholders will work

together. Much consumer and economic information is known about the particular product markets of the company: eg consumer aspirations, sensory traits, future demand profiles, size, growth forecasts and value, production costs, distribution costs and profit margins for individual products and product classes. The process achieves agreement and ownership across a corporation by a structured and consultative process that embraces changes and drives investment in new technologies that serve the corporations interests.

Analysis of the data produces a Technology Map and a Research Value Map, from which a research strategy is developed. The strategy integrates market opportunity, technology solutions, probability of success for the technology, costs and benefits to all stakeholders in the corporation. The process identifies a portfolio of research projects that have a high probability of providing a significant return on investment to the company.

The challenge faced by Food Science Australia has been to re-develop processes to suit the more generalised and diverse client group within the Australian 'AusHort' set of commodities (industries) and associated food processing industries.

The team initially identified the following differences, consequence and strategies to overcome these differences. They are presented below in Table 1.1.

Table1.1

Difference	**Consequence**	**Strategy to overcome**
• Corporations fully disclose strategy during internal planning processes. • Participants in this consultative process cannot be expected to share such information.	• Process may not collect the important information, or may collect mis-information.	• Ensure information collection is public domain and at 'industry' and 'generic' level.
• Industries are geographically dispersed.	• Industry participants may not be able to attend at one site for consultation.	• Hold consultative processes in Melbourne, Sydney and Brisbane.
• Potential for economic impact varies with industry, but all industries are contributors to AusHort.	• Project may not create significant opportunities for all industries.	• Provide two case studies.
• Lack of public data in value added foods on market size, market value, costs and profit margin at an industry level	• Quantitative models may be inaccurate.	• Use qualitative models.
• Uncertainties in developing economic models suitable to this exercise.	• Economic modelling may not be achievable within the scope of this project	• Determine further collaborators.

2.0 THE AUSTRALIAN HORTICULTURAL INDUSTRIES VALUE CHAIN

2.1 Introduction

A simplified representation of the horticultural industry value chain is shown in Fig 2.1 and demonstrates that way vale can be added through the chain, and the influence of imports and exports. Markets are driven by opposing forces of consumer demand for value and available supply for a particular price point.

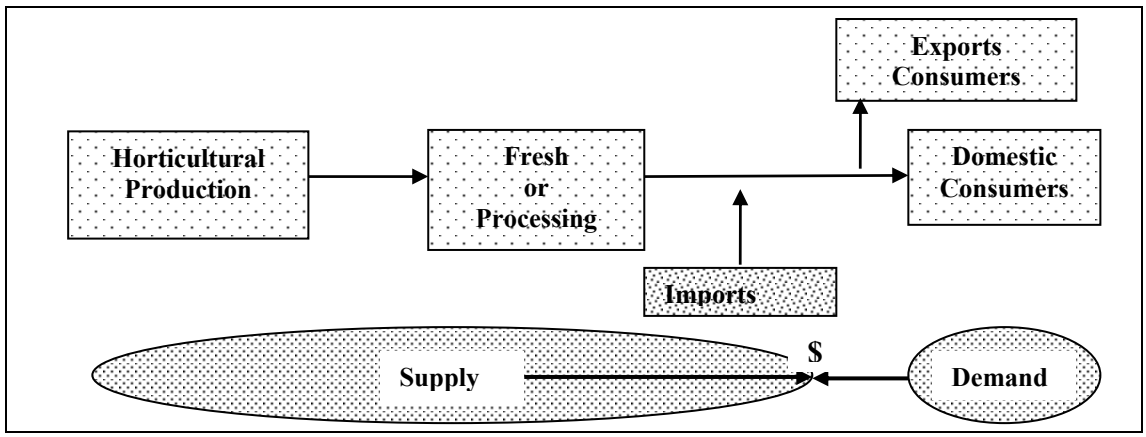

Figure 2.1: Simplified horticultural industry value chain

The Australian population drives domestic demand, and is forecast to grow at 1% over the short term, and decline in the longer term under current policy settings (Access Economics, 2001). This scenario provides little scope for significant market or income growth for the producer, processor and allied industries without adding product features valued by the consumer. During 1999-2000 Australian retail food sales increased by 2.8% in real terms (less than the 10 year average of 3.5%; AFFA, 2001a), achieved by adding benefits for which consumers were prepared to pay a premium. While gaining local market share from other commodities horticultural or non horticultural in origin) will provide short term and limited opportunities, if the gains are at the expense of other domestic agri-food sectors - a share that may be lost in following years. If the gains are against imported products, then local producers and manufacturers will have demonstrated themselves to be internationally competitive, providing prospects for continuing growth to export markets too.

In the globalised market for fresh horticultural produce, it is anticipated continuing cost competition on local and export markets from China, South America and other low labour cost countries will become dominant.

Processed foods constitute the largest and fastest growth component of world agri-food trade. World trade in processed food products is growing at twice the rate of world trade in unprocessed primary products. In the year 2000 they constituted about 75% of global agri-food trade, compared with 50% in 1985 (P Smith, Pers. Comm.).

As Australia is a technologically advanced country in both horticultural production and industrial technologies, it creates a substantial opportunity for Australian horticulture to position itself to expand both its production and processing base to meet the needs of affluent and discriminating global consumers by supplying foods and ingredients for which a premium will be paid.

A part of this study has been therefore to review the economic impact of Australian Horticulture post-farm gate, to show the significant role horticulture has in Australia's food production and processing industry.

Chapter 2 provides further detail through a review of current literature on the drivers of value for consumers and food businesses.

2.2 Maping The Australian Horticultural Value Chain

About the data

Development of a detailed value chain for Australian horticultural industries provides some challenges. Public domain data is collected on a different basis by both governmental statistics agencies and commercial market intelligence services at each point along the food chain. Statistics describing on-farm production, in-factory manufacturing, exports / imports, and at the point foods pass to the consumer all use differing classification systems.

Even publications of statistical data on Australia's horticultural industries report only on-farm production data, rather than describing the whole value chain. For example, the Horticulture Australia Ltd's publication 'The Horticultural Statistics Handbook 2002' provides no data past the farm gate.

At the on-farm level crop production data is collected, and classified on a commodity species and variety basis, eg apples (Gala or Granny Smith), apricots, potatoes, carrots etc. by Australian Bureau of Statistics (ABS) through annual farm or market surveys. Horticulture Australia Ltd. (HAL) also commissions data collection from time to time, but has not published data processed fruit and vegetable industry only.

Manufacturing production (or value adding) data is collected by the ABS based on the MIOCC code (Manufacturing Input Output Commodity Classification), describing the products produced (eg jams, breakfast cereals, etc). This classification does not enable, for example, the tracking of value in say a pizza that is provided by constituent commodities eg tomatoes or other vegetables, meat or flour. On an ad hoc basis manufacturing data can be collected from trade magazines and press releases, but full manufacturers marketing data is often tightly held in commercial confidence.

Exported and imported products are classified by ANZSIC / AHECC code which does readily enable sorting into degree of value addition based on primary product base ingredient (eg oranges, apples), but suffers the same problem in areas as the MIOCC codes system. Appendix 1 shows manufacturing and fresh import data for horticultural products in the year 2000.

Publicly available data at the retail level is limited to ABS data on turnover by type of sale outlet (eg supermarket, restaurant, take-away etc) or based either on annually published surveys of food manufacturers on the basis of supermarket category (Retail World, 2003) or within ad hoc press releases. Detailed marketing data at the retail level is held in commercial confidence, or available on subscription at a significant cost and sometimes limitations on publication.

In recent years the Commonwealth Department of Agriculture, Fisheries and Forestry – Australia (AFFA), Supermarket to Asia Ltd and more recently National Food Industry Strategy (NFIS) has been active in publishing data, attempting to bring together numerical analysis of the whole of Australia's food value chain. Nevertheless current data collection makes it difficult to bring together a consistent value chain.

Figure 2.2 shows current estimates of the Australian fresh and manufactured value chain for horticultural products. There are however, gaps in the data.

For example reliable data in the split in value between fresh and processed fruit and vegetables is not readily available. There has not been a public study of how fresh fruit and vegetables, value added fruit and vegetable in meals or as value added ingredients map to the places that consumers buy foods: – supermarkets, takeaway food, café & restaurants and other retail outlets.

While generally informative, the data in Figure 2.2 need to be taken with some caution.

A significant statistic is that $577m of value added fruit and vegetables products are exported, that is equivalent to 80% of the value of fresh exports. The data also shows 57% of the value of all processed products produced are exported. Exports of value added fruit and vegetable products are probably more significant than realised by Australian food and horticultural industries.

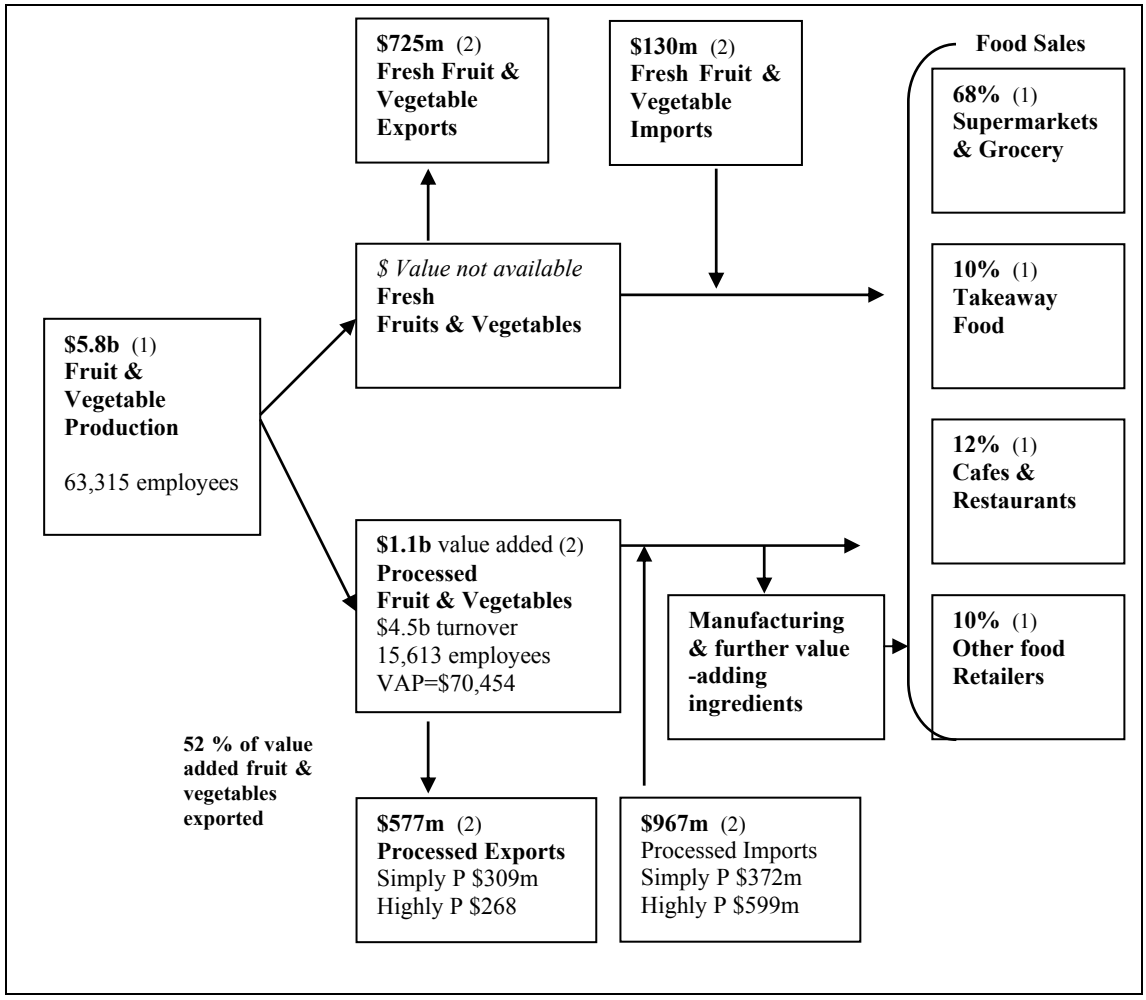

Figure 2.2: Australian Horticultural Value Chain 2000-01

VAP = Value added per employee
Simply P = Simply processed
Highly P = Highly processed
(1) AFFA (2003)
(2) NFIS (2003)

2.3 Economic Impact Of The Australian Processed Fruit And Vegetable Value Chain

Australia's Processed Food Exports

Australia's processed food exports contribute 3.4% to global world trade, increasing at a rate of 3.1% pa. (about twice the rate of trade in bulk commodities) against a global decrease of 2.3% in the same period. Australia ranks about 6th in a world ranking of unprocessed food exports and only 17th as an exporter of processed foods (P Smith, 2001). This occurs despite being a technologically advanced country and 64% of Australia's food manufacturing companies exporting in some way.

From 1991 to 2001-02 Australian exports of highly processed exports increased from 19.7% to 28.1% and the share unprocessed exports from 26.9% to 33.7%., at the expense of simply processed exports that fell from 53.4% to 38.3%. (STA, 2002).

Over the period 1994-1998 the United State's processed food exports grew by 21 %, Germany 9.9% and France by 9.2%, while Australia's processed food exports increased by just 1.8%, which resulted in Australia's global market share decrease from 3% to 2.8%. Instate (2000) highlighted these facts in its report on a study of attitudes and opinions of factors which determine the food industry's ability to export, and impediments to export performance.

Figure 2.3 shows the relative magnitude of Australia's manufactured food exports by Sector.

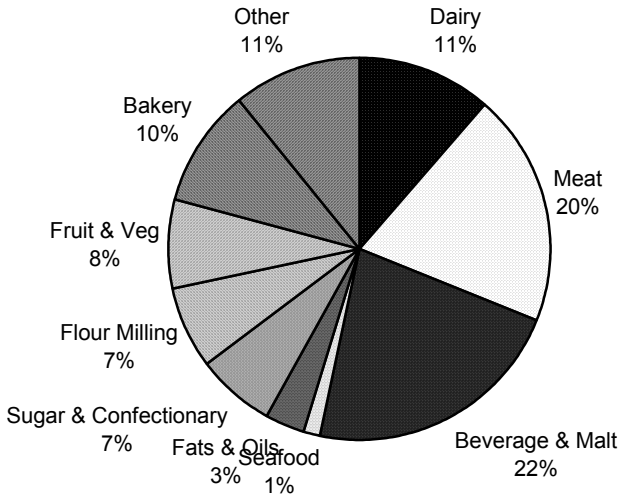

Figure 2.3: Australia's Exports by Sector

Fruit and Vegetable Processing in Australia

The fruit and vegetable processing sector is classified by ANZSIC codes in the series 213***. It includes businesses mainly engaged in manufacturing canned, bottled, preserved, quick frozen or dried (except sun-dried) fruit or vegetables products. Products produced include dehydrated vegetable products, soups, sauces, pickled and mixed meat and vegetable or cereal products.

Highlights of the fruit and vegetable processing industries are shown in the table below:

Highlights of Fruit and Vegetable Processing Industries

Recent increases in annual economic activity:

- Highest increase in employment: 4.7%
- Increasing turnover: 6.5%
- Increasing value added: 8.1%
- Value added as proportion of turnover: 24%
- Increasing capital expenditure: 1.1%
- Decreasing R&D expenditure: -4.7%
- Increasing profits: 14%
- Proportion of all processed food exported: 20%
- Profit margins: 4%
- Value added per employee: $70,454
- Labour as % operating expense: 16%
- Exports of processed fruit and veg are 0.7% of world traded products
- Export propensity: 10.9%
- Increasing imports: 5.2%
- Increasing exports: 6.6% pa
- Proportion of processed fruit & veg exported:

Snapshot

Fruit and vegetable processing on one of the fastest of the eight sectors of the Food and Beverage manufacturing industry, in terms of value added and employment. It is currently showing moderate growth in profits of 14%, and value adding per employees has declined in recent years.

Exports are growing at 6.6%, with 58% unprocessed. Asia (Hong Kong and Japan) is the dominant destination

Imports comprise the second largest import sector at 20% of all food imports, and growing at 5.2% annually. Just over 50% of imports are highly processed.

NFIS (2003) & AFFA (2001a)

Figure 2.4: Highlights of the Fruit and Vegetables processing industries

The fruit and vegetable processing sector comprises about 502 management units (in 2001) with an annual turnover of $4.6b and annual value added totalling $1.1b. Employee numbers increased from 10,281 from 1997/98 to 15,613 in 2000/01. Thirty six percent of management units are under $49,000 turnover range, indicating a 'cottage-industry tail'. Around 44% of turnover in fruit and vegetable processing is concentrated in Victoria, followed by NSW with 24%.

Within the greater food and beverage classification, fruit and vegetable processing represented 8% of both turnover and value added in 2000/01, with growth rates of 6.5% and 8.1% respectively since 1999/00. Value added represented 24% of enterprise turnover.

Capital expenditure totalled $163 million in 2000/01, increased only 1.1% over the past six years, and in aggregate represents 6% of total food and beverage capital expenditure. Research and development expenditure totalled $18m in 2000/01, a decline of 4.7% on the previous year.

Operating profit before increased 14% annually to $169m, with profit margins remaining at 4% over the past three years. Value adding per employee in current prices is $70,600 a decrease from $81,000 since 1997/98.

Imports of Fresh and Processed Fruits and Vegetables

Imports of horticultural products of $1.1b represented a significant 20% of Australian imported foods, and are increasing at 5.2 % annually. Highly processed products account for 54% of imports while simply processed account for 34%. Unprocessed horticultural imports show the

highest annual growth at 9%. Around 91% of horticultural imports originate from Asia. Processed imports are made up of:

- 27% Vegetables other, including dried and preserved vegetables
- 21% Fruit and nuts
- 17% Other horticultural
- 5% Jams and jellies, increasing by 27%

Exports of Fresh and Processed Fruit and Vegetables

Exports of $1.3b (2000/01) made up 6% of Australia's total food exports, being $725m unprocessed (fresh), $309m simply processed and $268m highly processed. Processed exports were made up of:

- 62% Vegetables other, including dried and preserved vegetables
- 14% Fruits, nuts etc.
- 10% Other fruit juices

Frozen vegetables, tomato products and mushrooms exports increased in the range 70% to 130% in the 12 months to 2000-02.

World leaders in traded processed horticultural products are the US, Netherlands, Italy and China.

2.4 Capturing The Value – Technology Maps

This project considered the innovation pathway presented in Fig 1.1 and the Value Chain model established in Figure 2.2. The project team also considered a number of ways to represent the way generic technology, in this cases focussed on manufacturing technology (but also applicable to production technologies), for this study.

The project developed a simplified linear model representing a market driven opportunity being matched to a generic technology arising from strategic research, then being applied to a particular product. At this stage it is usual for the generic application to, subject to further research and development, being applied to a particular product, at which time the generic technology becomes very specific propriety knowledge, or knowhow.

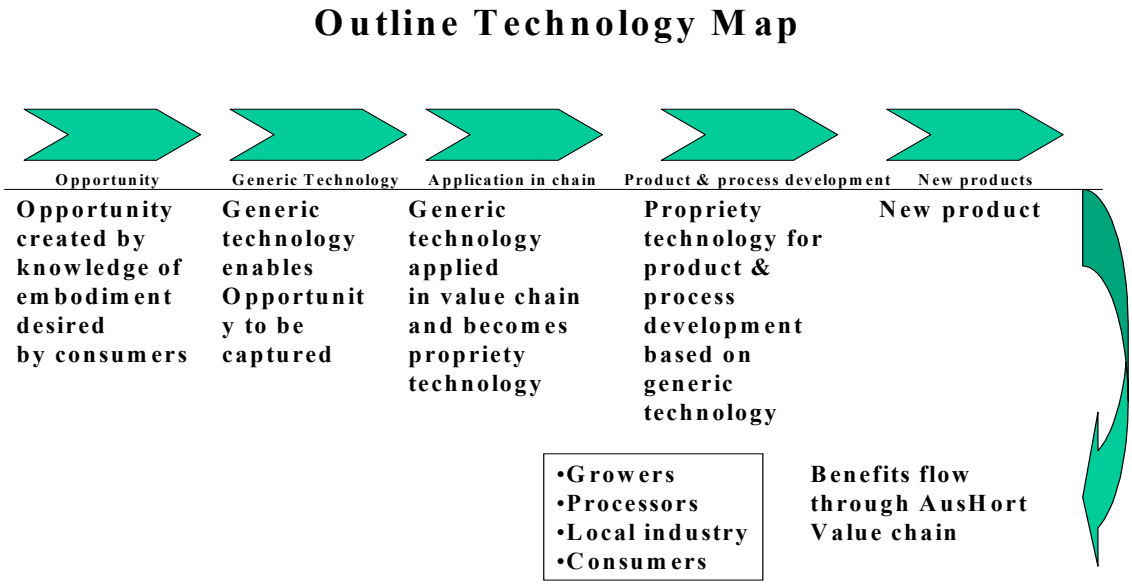

Figure 2.5: Outline Technology Map

It is rare that a single generic or propriety technology alone creates a new opportunity. In reality it is application of multiple technologies that create the significant future opportunities. In such cases Figure 2.6 provides a better representation of reality.

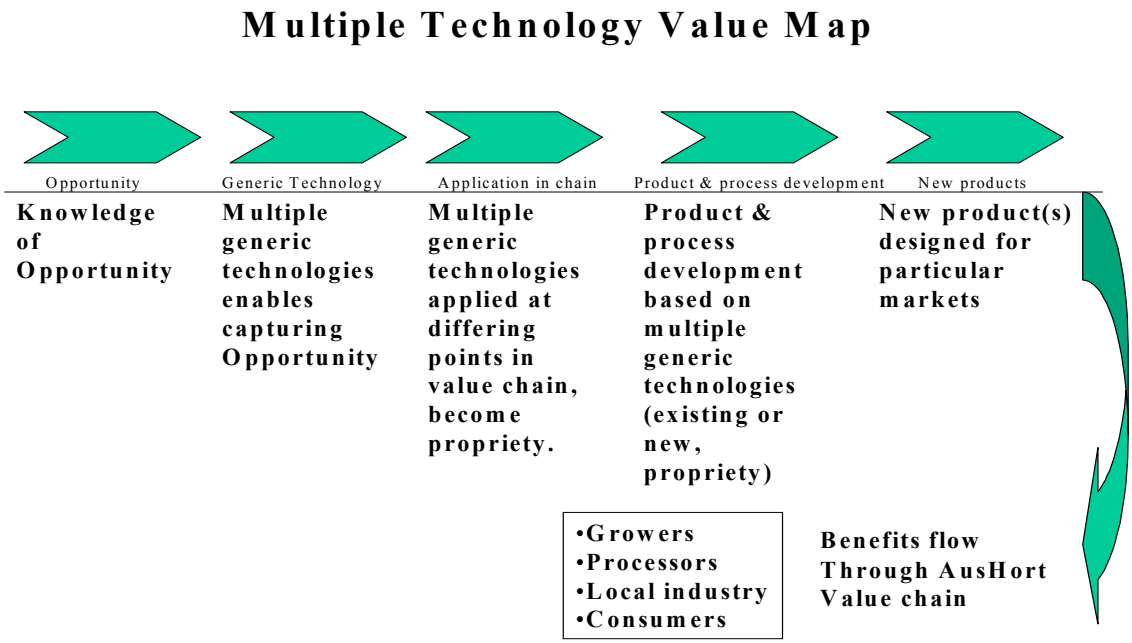

Figure 2.6: Multiple Technology Map

The critical questions that public research investors have to ask when investing in strategic research, or private investors are investing in proprietary research relate to their estimates of the magnitude of benefits, the likelihood of capturing the benefits (given research is a risky business) and the timing over which the investment and returns may occur. These are shown in the Value

Map in the figure below. As indicated in section 1.4 numerical answers to these questions are beyond this project. We will propose a qualitative approach.

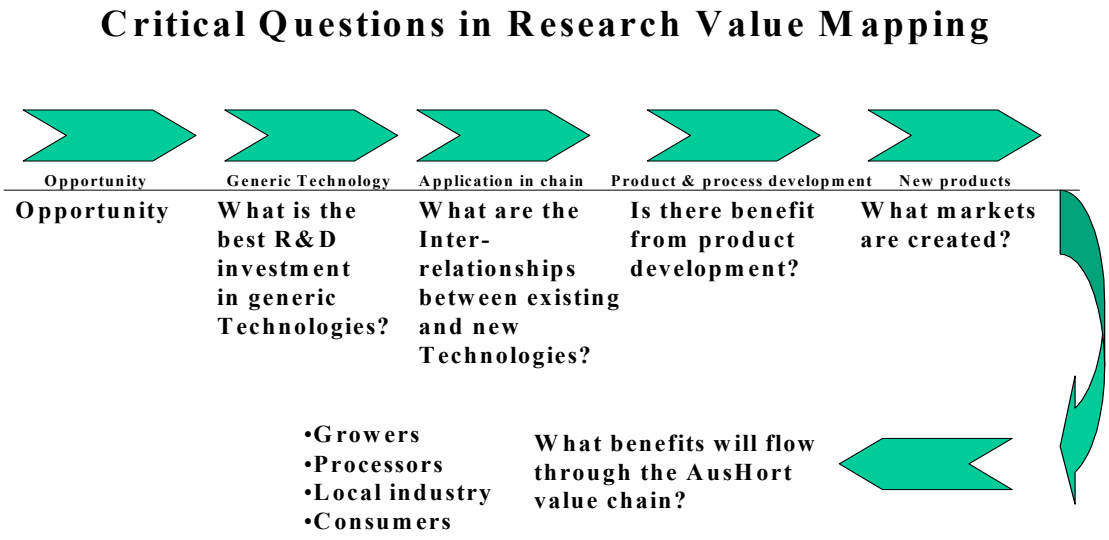

Figure 2.7: Critical Questions in Value Mapping

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3.0 REVIEW: THE DRIVERS OF VALUE FOR CONSUMERS AND BUSINESS

3.1 The Food That Consumers Want Drives The Perception Of Value

Introduction
Much public and propriety research is conducted to better understand the evolving preferences for food by consumers in the relatively wealthy economies, that is economies in which the role of food is greater than providing essential nutrition. The cost of developing a new food product and delivering it to the market is significant. During 1990 in the US for example, it is estimated (Lundahl, 2001) that failed new food products cost companies $14b – compared to food company profits in the same year of $7b. During 2000 Retail World (2001) report 161 new and 96 line extensions to food, beverage and food ingredient products were launched in Australia. The number of product withdrawals is not presented.

So understanding what will make a future new food product successful is critically important, as it only from this understanding that inherent risks in investment innovation and introduction of new technology can be minimised.

What are consumers of the future wanting ?

Consumers' are demanding **'Miracle Foods'** that are:

- Totally natural
- Have zero calories, fats and cholesterol
- Delicious taste
- Low price
- Environmentally friendly production
- 'Green' packaging
- ……. and that guarantee perfect bodies, romance and immortality

Carol Brookins (1999)

Foods will address mood, mental vitality and weight management needs - new foods for the brain and the body will be formulated as:

- Eat on the go brain foods (rich in essential amino acids , esp tyrosine)
- Stress reducing meal and snack foods (to increase serotonin levels)
- Foods that prevent the symptoms of jet lag
- Foods that may help with age related memory loss

McDermott (1999)

While these are attention raising statements, they are indicative of current and future aspirations of consumers who will be willing to pay a premium for such foods. Global and Australian market trends are explored further below. High on the agenda are the opportunity for functional foods, that is food that provide health benefits beyond nutritional benefits. Many published papers indicate to the interest in this area (Sloan, 2001; Cobcroft, 2001)

Global Consumer Trends

The global food industry, especially the manufactured foods segment, continues to inform itself of the emerging determinants of consumer choice.

For developed western markets consistent market trends are discussed by many authors, including Finkelstein & Kurth (1999), Marcure (1999), Spence (1999), EuroMonitor (2000), AFFA (2000 &200a), Anon (2001a), Baghurst (2001) and Everitt (2001). These can be summarised as

- ***Time vs income poor consumers***

  Consumers are becoming increasingly short of time as they match longer working hours and more complex family and social networks. While for some working households the 'two income no kids' means people are time poor and income rich, for most working households incomes are increasingly stretched. In cases where households are not in work, or are only working part time, people will be income poor. While for some cost is less of an issue than others, in all cases food products need to be seen as value for the target market group. Convenience is a key driver, and this translates either convenient 'traditional' meals, or meals as 'snacks', '(car) dash-board dinners' or 'snack drinks'.

- ***Lacking in cooking skills***

  As an increasing number of women, the traditional meal preparer's, enter the workforce and continue in the workforce on a full or part-time basis less time is available to maintain or pass on cooking skills to the next generation. Further, social behaviour has become more diverse, and the regular family or neighbourhood meals less frequent, so the social needs and expectations for an ability to cook on a daily basis do not exist. Thus a significant market exists for convenient easy to prepare meals, meal components (eg chicken with simmer sauce) and convenience foods. Concurrently, and in contrast to this, for special occasions, 'gourmet' dinner meals are in demand. Recent US data shows savoury snacks sales increased by about 100% , meal replacement drinks exceeded 50%, and snack bars, spreads and confectionary all grew by 30%

- ***Smaller households***

  The longer life span, especially of women, the increasing financial independence of women, and the more frequent forming and dissolving of relationships has resulted in smaller households. For example in the Melbourne municipality of Port Phillip ??% of households are single households. These social changes create a new demand for single and/or two person meals.

- ***Market fragmentation***

  Many factors are leading to an increased market fragmentation, including :
  - Demand for many differing ethnic cuisines, and 'fusion' or mixes of differing cuisines.
  - Strong interest in health promoting 'functional foods'. Recent US data shows the world market in functional foods has increased by 53% since 1995 to US$31b, of which the US accounts for 60% and Europe 17%
  - Growing demand for 'organic' food - since 1997 the global market has doubled with the largest markets being the US, Japan and Germany. In Denmark, Austria and Switzerland 2-3% of the food and drink market is organic, while other EU countries averaged 1.8%
  - Changing socio-economic split between "price point" of low-price value foods and high-price gourment foods (eg sausages, cheeses, icecream..etc)
  - Increased diversity and markets in food components eg simmer sauces

- Market demand for 'eat-on-the-run' hand held meals
- 'Westernisation' of Asian diets
- Perceptions of value (quality vs cost) vary increasingly and markedly
- Brand loyalty high in some markets, low in others, fragile in all.
- Packaging critical to some markets: functional, appealing, biodegradable, recyclable, MAP and active headspace gas modification
- Market desire for 'something new' to try each week, and resultant competition
- Eating is becoming a 'secondary' activity, as consumption on-the-go becomes the norm, and the traditional three-meals-a-day gives way to five or more snacks, timed to fit around more important activities.

- ***Gratification of individual desires***

Consumers are seeking flavour in eating experiences with reduced energy intake, low fat, high fibre, less meat, children demanding (and parent wishing to provide) their children with their particular preferences at meal time. 'Pester-power' of children to achieve their influence over purchases, assurances of food traceability, animal welfare, good environmental practices,

- ***Expenditure on food prepared outside the home is increasing***

In the US, about 50% of meals are based on foods from retail outlets and 50% provided by the food service industry. Similar trends occur in developing Asian cities. In the US 'take-away' and 'delivery' sales are growing nearly seven times faster than the rest of the food industry, and three times faster than 'on-premises' meals. Globally, the four major food service companies (McDonalds, Tricon Global Restaurants, Burger King and Compass Group) have sales of over US$85b pa, while less than the US$191b turnover of worlds largest supermarket Wal-Mart stores, greater than the US$60b turnover of Carrefour, the worlds second largest supermarket.

Many writers agree that consumer research has, and continues to be, a priority in understanding market needs and the ability to tailor and evolve a product (or family of products) to meet those needs.

The major messages consumers are telling the industry are:

- For 'convenience innovations' respondents felt innovations would reduce their control or lead to loss of choice, and may make people lazy
- For health, packaging and product related innovations, chemicals and /or additives were a concern
- Information on products about health or safety were the manufacturers responsibility and consumers right
- Some convenience innovations were undermining the family meal and loss of family bonding
- A few convenience innovations were liked for reducing waste, or disliked for contribution to waste

Of consumers surveyed, their view for new product benefits was that:

- 30% would pay a premium for convenience benefits, especially for younger consumers
- 22% would pay a premium for health, food safety, quality and environmental benefits
- 30% to 45% would pay a premium were health benefits dominated

Marcure (1999)

Australian Trends: Retail Purchasing Behaviour
The average grocery bill in Australia, as indicated by the Australian Retailers Association (2000), was $126 per week – having not risen since 1998.

While 90% of shoppers visit a Supermarket once per week, a significant proportion (28%) shop three to six times a week, while the proportion shopping daily has increased 50% since 1998 to 6%. Variety of products, general convenience and competitive process are the principle reasons for Supermarket shopping.

People completing all their shopping needs at one-stop (ie Supermarket) has now reached 57%, up from 44% in 1996. Only 5% of shoppers visit four or more shops when shopping, down from 12% in 1996. However, those likely to shop around more are single with no children and in the age range 18-24. Retirees, despite having more time, are the group most likely to complete their shopping at one store. Across all demographics, Melbourne shoppers are less likely to shop at one store. (Australian Retailers Association, 2000)

It is noted (Australian Retailers Association, 2000) that 98% of shoppers agree with the statement 'I Love' or 'I Like' to Cook'. While 9% of shoppers agree with 'I don't have time to cook or prepare food', and 34% agree with 'I cook because I have to'. It should be noted that statements of desire such as these, and reality can vary significantly.

Australian Retailers Association (2000) report Australian purchasers prefer branded product. Private label penetration in Australian Supermarkets remains low at 10% in value in 2000, compared to the UK where 50% of Supermarket expenditure would be on private label. The influence of the newly arrived German Supermarket chain Aldi, who principally markets private label products may influence Australian buying habits.

They also report there has seen an increase in shoppers wanting freshly prepared meals that they can eat at home – a concept having appeal to about 50% of Australian metropolitan grocery shoppers. Men are the main grocery buyers in about one-fifth of households, and female shoppers who have children are more likely to be older than previously and also be in the workforce.

With respect to new technology Australian Retailers Association (2000) report Australia is ranked 7th in the world as an Internet using nation, however so far purchasers have not embraced this new purchasing channel. The report indicates 27% of shoppers interviewed are likely to purchase on-line in the future. It seems clear however that net purchasing will provide a significant opportunity for food sales into the future.

Australian Trends: Meal Purchases Place, Preparation & Consumption
On the basis of retail turnover (AFFA, 2001a) foods sales across Australia occur across a range of outlets:

- Supermarkets and grocery stores 67%
- Takeaway food outlets 10%
- Cafes and Restaurants 12%
- Other food retailing 10%
- Liquor retailing 1%

Thus significant opportunity exists for horticultural based foods in the non-supermarket segments.

A survey, conducted in winter of main grocery buyers by Australian Retailers Association,2000) indicated that of the evening meals in the previous week:

- 85% were eaten at home, and of these:

  - 73% were prepared from scratch
  - 8% were heat-up, pre-prepared
  - 4% were take-away
- 15% were eaten away from home, and of these:
  - 2% were meals prepared at home, and eaten away
  - 3% were at someone else's house
  - 7% were at restaurants
  - 3% were eaten at fast food outlets

The survey indicated that wealthier people eat fewer meals at home, and also spent greater amounts at the Supermarket each week. Also older people are more likely to eat at home and to cook meals from scratch.

Population Trends - Australia
The June 1999 Australian census indicated the population was 18.9 million, living in 7.2 million households.

The number of people in households is continuing to change, and is now made up of:

- 47% households with double income, or single income, and no children
  - two people without children 24.5%
  - single person households 22.8%
- 36% households of two parents and children
- 10% of households one parent and children

The proportion of males participating in the workforce is 73% an of these 65% work full time, while the proportion of females in the workforce is 54%., and which only 25% work full time.

The changing demographics in Australia, like that of other developed third world economies, will influence the demand for food products.

The rapid post second-world war population increase in western countries led to a disproportionate increase in people born in the late 1940's, 1950's and 1960's. This generation, known as the "Baby Boomers", has passed through their youth, formed relationships, had families, and are now generally experiencing their families leaving home, and are soon to commence "retirement" and "older age" phase of life.

Access Economics (2001) have recently characterised and studies the effect this demographic phenomenon will have on the Australian Economy. Key findings are presented below.

- In 1976 1.3million people or 9% of Australia's population was over 65 years, and one in six of these people were aged over 80 years. By 2000 the number of people over 65 had nearly doubled to 2.3 million or 12% of the population, and now one in five are aged over 80
- In fifteen years time, by 2016 there will be 3.6 million people or 16% of the population over 65 years of age – of whom one in four will be over 80.
- In the year 2012 the number of 65 year olds in Australian society will reach a peak growth rate of 4%. (Year 2012 is which the greatest number of baby boomer generation reach 65). The year 2022 will see the peak baby-boomer generation reach 75. By the year 2050. 40% of Australia's population will be over 65 years – after which a plateau is expected, based on current population and immigration policies. Over the twenty year period the number of people aged 65 to 74, and also 55 to 64 will increase by about 70%.

- In contrast to the above, the total population growth in Australia during this period is expected to be 1%, and even decline below 1%.

This changed demographic will have profound impact on the purchasing power and markets for a diverse range of products. How will this effect foods ?

In concert with these demographic changes, there are associated economic changes too. The baby boomer consumers have enjoyed an economically prosperous and stable working life, and therefore are the wealthiest group in the country. They have a large proportion of wealth invested in family homes, investments and superannuation. While in the past these assets were 'locked up' for their later years, when reached they become available as housing is 'down sized' and investment strategies shift from accumulation to income provision phase.

Those over 55 in 2001 account for 21% of the population, and already own 39% of household wealth and account for 25% of disposable income available for consumption. By 2009 growing prosperity of over 55's will see their share of Australia's disposable income increase to 29%.

The population that is over 55 on 2001 (21% of the population) will account for 43% of total growth in retail spending in the next decade. Baby boomers as consumers will make up more than half of the expected growth in many spending categories.

Access Economics' (2001) study indicates that with 'baby boomers' about to reach 55, the revolution about to hit consumer markets has begun.

Already for many mature consumers (pre-retirement baby boomers) they have more time, more money and less direct role with children. They worry about their health, are happy to outsource and secure in home life.

During 1999 (Access Economic's, 2001) a study of the spending habits of households of those aged over 55 was compared to the 'average' household. Their findings are that over the next decade 43 % growth in retail expenditure is expected, will be due to the expenditure of over 55's.

Expenditure increases by 2009 due to the over 55's are expected as follows:

- Pharmaceuticals Up 50%
- Health Insurance Up by 49%
- Holidays Up by 49%
- Food and non-alcoholic beverages Up 47%
- Fast foods and Restaurants Up by 39%,

Much of this new expenditure will be discretionary, as mortgage and child rearing expenses will have been completed. Expenditure has been classified as '*happy to dabble'* –eg car, boat, holidays, gambling, telephone (communications), or *'indulge the grandkids'* gift and toy giving, but not education nor rearing.

This emerging "silver baby boomers" generation is exists in other western developed economies. It provides significant market opportunities for Australian food manufacturing industries, domestically and in export markets. Similarly it offers competitor food manufacturing countries opportunities to competitively export to Australia.

Recent Australian Statistics

A vast amount of data is published annually relating to the food industry, by the industry itself, social researchers, financial analysts, journalists and others.

The following data provides some interesting insights to the industry, and whee opportunities for Australian horticulture may emerge:

- Food Australia (Anon, 2001) reports on increased sales in the out-of-home food market by the Australian Food and Grocery Council:
    - Sales of Australia's food and grocery sector grew to $54b
    - The "out-of-home" market for food and grocery manufacturers increased 8.3% in December 2001 quarter
    - Direct sales to institutions, commercial customers and convenience stores grew 3.5% over previous years
    - Annual sales of out-of-home sector of packaged food and grocery products are estimated at $6.5b, and represent up to 30% of totalled packaged food and grocery sales.

- Anon (2002) reports in The Age:
    - Annual spending at fast food takeaways: $7.5b
    - Number of fast food snacks sold per year 1.2b
    - Average household spend on takeaways $20 per week
    - Number of fast food outlets: 17,000
    - Most popular takeaway food: sandwiches followed by hot chips
    - Money spent each year on fast food advertising: $130m
    - Number of hamburgers eaten each year: 11 per person
    - Share of takeaway market controlled by McDonald's, KFC, Pizza Hut, Hungary Jack's and Red Rooster: about 42% or $3.1b

The Future Food Consumer

Baghurst (2001) presents data on the attitude of Australian consumers. Her findings are that Australian experience will be consistent with much of the US and EU experience already reported.

A major Australian study (Marcure, 1999), that also included international industry specialists and included younger Australians, reported on the opportunities benefiting consumers. These are:

Opportunities Benefiting Future Consumers

- Shopping:
  - Multi-purpose outlets
    - eg: shop for food while your car is washed, you are entertained with music or theatre, or you attend cooking, nutrition or cultural event
  - Information:
    - Shopping trolleys scan and tally price, advise on products based on you health or preference profile
    - Menu selection is via Internet, TV or phone
  - Virtual shopping:
    - Products delivered to your home
    - 'Pantry sensors' reorder automatically
- Packaging:
  - Customised convenience (portion size)
    - Reusable, recycled and/or microwave able
  - Information:
    - Sensors to detect micro-organisms, spoilage
    - Scratch-and-sniff to provide experience of food aroma prior to purchase
  - Safety:
    - Guidelines to substantiate food health claims
    - Packaging and coating technology to keep foods fresh
- New Food Products:
  - Convenience
    - Customised labels
  - Health
    - Tasty, calorie free
    - Reduced fat, sodium, sugar, alcohol products
    - Foods customised to your health requirements
- Food products and processing:
  - Freshness
    - Reduced manufacturing and 'smart' home processing
    - Networked supply chains
  - Environmental
    - Foods sourced from sustainable production regimes
  - Health
    - Vaccines from foods (eg plants)
- Dining & Meal Times
  - Convenience
    - Customised menus for each family member
    - 'Gourmet' meals anywhere
    - 'Home made' foods
    - 'Freeway Meals'

3.2 The Changing Business Environment

Global business trends in food manufacturing
Wilton (1999) reported on the effect of global consumer trends on the changing business environment facing manufacturer's. He summarised these as:

- Continued global restructuring of industries, leading to enhanced access to capital markets, globalised management of technology, market deregulation and global competitiveness between supply chains
- Increasingly sophisticated and demanding consumers, with diversifying wants
- Increasing aggressiveness of competitors, on a global basis
- Competition built on rapid exploitation of new technologies (base and Applications R&D) to provide consumer benefits in product features or cost competitiveness
- Increasing market segmentation and fragmentation to meet diversifying consumer needs - if harnessed correctly will lead to increased customer commitment
- To capitalise on increasing segmentation the industry will move from mass production to mass customisation – requiring new shorter product development cycles, shorter product cycles, and flexible production to gain production efficiencies
- Competition will increasingly be based upon 'competing with customer intimacy' or 'information-based competition' as the information rich environment of informed consumers will see new marketing strategies built around providing customised product and service knowledge (via internet commerce and customer applications)
- Successful value-creators are likely to transform their industries by shifting to market ideal points by understanding the interactions of :
    - Technology opportunities
    - Customer requirements
    - Customer information and knowledge requirements (about the new product)
- Successful companies will understand how to gain increasing customer commitment and profit by positioning the customer in the 'supporter', 'advocate' and even 'partner' positions of the customer loyalty ladder by understanding what customers recognise as a value added (rather than cost added) product.

Changes in the food retail industry
The food retail industry is driven by competition between retailers (often supermarkets) and the food service industry (restaurants, take-away, institutional catering). This competition is increasingly global in the retail and fast-food areas, and traditional distinctions at shop level are becoming blurred as fast food categories in supermarkets compete and emulate those of the food service, and other distribution channels (Rabobank, 2001).

The increasingly urbanised global population spends US$4,000 b on food, three quarters in supermarkets and other retail outlets, and the remainder at food service outlets. In the US the ratio is 50:50. Previous non-food channels such as petrol stations, drug stores (US), department stores, discount stores and the internet are emerging as further competition for supermarkets. Against this background, and recent global mergers, the worlds largest 20 supermarkets have a dominant effect on world food markets

The top 10 global retailers have combined sales of US$578b, compared to global sales of US$328 for the top 10 global food processors. Wal-Mart has an annual turnover twice that of Phillip Morris and four time that of Nestle. Annual sales of the top 10 worlds retailers from 1996-2000 grew by 50%, and the top 10 European supermarkets account for 50% of the European grocery

market. The world's top 10 retailers (except Edeka/AVA and Metro AG) sell between 99% and 20% of product as private label. To compete against private label manufacturers will have to develop and maintain strong manufacturers brands, probably while also processing the private label products.

European retailers are expanding strongly into Asia (AFFA, 2000a), and recently Aldi have opened stores in Australia.

- **Supply chain partnerships.**
  Increasingly supermarkets are setting production, processing and formulation requirements for manufactured foods, so they are assured of meeting consumer needs. Consequently building supply chain partnerships with a consumer focus will be essential (AFFA, 2000 & 2000a) that meet the global sourcing requirements of global retailing.

- **Pressures on fruit traders**
  A recent industry report (Rabobank, 2001a) has considered the pressures on US and EU fruit supply. It has concluded that in Western countries fruit consumption is reaching saturation, despite it being below that recommended by health organisations. It also concludes that fruit production over the last decade has

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4.0 DETERMINING 'UNMET NEEDS OF CONSUMERS' AND 'PRODUCT EMBODIMENTS'

4.1 Introduction:

The characteristics of food products that will be valued by 'consumers of the future' need to be determined, and placed in a model that informs development of strategic research programs to deliver these desired characteristics in horticultural foods. This Chapter reports how this project:

Identified the "unmet" food related needs, desires or aspirations that consumers have, or are expected to have in the future, and that may be satisfied from horticultural based products.
Interpreted and translated of the unmet needs identified, into
the characteristics of foods, or "product embodiments" (ie the material form or expression of desirable characteristics) that may be achieved by one or a combination of technologies.
A framework of product and market opportunities

The information from this Chapter is, in Chapter 6 related to new manufacturing technologies described in Chapter 5, and Case Studies of potato products and pome fruits.

4.2 Identification Of Unmet Needs:

The task of determining the unmet needs of consumers or end-point customers of a commercial firm is somewhat different to analysing the unmet needs of end-point customers of the 20 industries within AusHort.

Within a commercial firm there will often already be a large body of specific market research and industry intelligence already available relating to the companies products and brand name. A second important difference is that the range of products or market segments that the company markets to is substantially more narrowly defined. Further, commercial firms are usually highly focussed in particular markets / product categories, or for strategic reasons limit their markets to families of technologies that meet the requirements of frozen, chilled, fresh or shelf stable products. Few companies span all these product classes, or are therefore interested in technologies that provide innovation in these areas.

The interests of the 20 industries within AusHort however encompass all these product classes, and therefore enhanced product embodiments that may be delivered by technology.

In contrast to the task at hand for AusHort, the process of identifying unmet consumer needs in commercial firms becomes highly specific to that company. The process is usually based on extremely commercially sensitive information relating to company strategic direction, market intelligence, internal research and technology licensing / strategic alliances. If external consultants to the company are involved, their involvement is controlled by agreements of confidentiality.

As the purpose of this project is to provide public information, it was inappropriate to gather any information regarded as company confidential.

Consequently a process different to that used within companies was developed especially for this project that relied on the use of public domain information. Participants were expected not to disclose any confidential company information.

4.3 Industry Workshops

A two-stage process was developed to identify the unmet consumer needs. The first stage was to conduct a literature review of the current trends and future predictions of food products, and much of this information is reported in Chapter 2. The second stage was to hold participatory-based workshops with industry.

Participatory-based industry workshops were chosen, rather than relying on Food Science Australia interpretation of the literature and our own experience, because the process would enable:

- Capturing the greatest possible range of views and experience
- Provide technical input to better understand the interactions within the supply chain
- Improved understand by industry participants and encourage an open sharing of non-competitive ideas
- Develop ownership of the project by industry

Purpose of the Workshops
The purpose of the workshops were to develop a description of 'unmet needs of consumers' or 'product embodiments' (ie the material form or expression of desirable characteristics) of foods, or food ingredients:

- derived from horticultural crops, and
- expected to be in high demand by consumers and food service industry in the coming 5 - 10 years.

The scope of products includes:
manufactured foods, beverages and food ingredients,
products that may be either fresh, chilled, shelf stable, and frozen.

Workshop Participants and Locations:
Participation was by invitation, with invitees selected from those in industry recognised as leading thinkers in their field. Participants included

- Horticultural producers, ingredient processors, food manufacturers, food marketing specialists, retailers, food service industry, exporters, horticultural industry and Horticulture Australia representatives, and Government, both Departments of Industry Development and Researchers
- Approximately 20 people in each of Melbourne, Brisbane and Sydney held during 2001.

Outline of Workshop Sessions:
The following is an outline of the presentations and activities of half-day facilitated Workshops:

- Presentation: Background to project, overview of program, all comments made are regraded as public
- Presentation: Setting the Scene
    - Current Australian / export trends – food industry and Horticulture (Ian Gould)
    - Future of the food industry: Project Cassandra -future of the food industry (Judy Marcure)
    - Provision of a 96 page 'Resource Book' developed especially for the workshops. The book was based on selected press clippings, and contains a range of thought

stimulating new product, packaging and ingredient ideas plus statistics on Australian supermarkets product categories and market share. Participants could retain the Resource Book and hard copies of all presentations made, in recognition of their contribution to the workshop.

- Workshop sessions:
  - In groups of 4-6 people, each group identified their perspectives of the "Un-met needs of consumers" in foods based on, or containing, horticultural ingredients, and without being constrained by current technology. Use of the Resource Book was encouraged, and each group was provided with a person to record the discussion on openly on 'butchers paper'.
- Plenary session
  - Within the whole group, each workshop presented their ideas. These were developed further in open discussion, and priorities agreed on. A person recorded the discussion openly on 'butchers paper'.

Following each workshop all recorded information was transcribed into a word processor for future analysis.

4.4 Unmet Needs Translated Into Product Embodiments

The information from the eight groups that took part in the three Workshop sessions was carefully analysed by the project team for common themes and summarised. This information was compared to published information discussed in Chapter 3.

The interpretation of this data is presented below in the form of product "embodiment themes" and examples that the product embodiments may take (ie the material form or expression of desirable characteristics).

EMBODIMENT THEME	**EXAMPLES OF PRODUCT EMBODIMENT SOUGHT BY CONSUMERS OF THE FUTURE**
ENVIRONMENTAL	• Recyclable and/or multi-use inner and outer packaging • Biodegradable packaging • Reduced packaging overall • Low environmental impact manufacturing systems • Utilisation / value adding to waste (in-factory and on-farm), • Produced from sustainable agricultural systems • Maintaining the 'clean and green' image – low chemical and fertiliser production systems
CONVENIENCE	• Speed and ease of purchase – just when/where I want it • Greater proportion of income spent on food outside home, but products need to be suited to low and/or high incomes • Pre-prepared meals and meal components for reduced preparation time • 'User-friendly' to the unskilled domestic and food service cook - labour & time saving, • Customised meal/meal-kits to suit tastes, desires and emotions of all household members • 'Traditional family' meals for special occasions • Fast preparation time – speed of eal 'assembly' and heating

	(eg micro-wave-able) • Meals/snacks suited to: Eat in, eat out, eat in car • 'Mess free', snacking and dining
HEALTH	• Provision of good or enhanced nutrition • 'Functional foods' - Providing health benefits above those of basic nutrition, eg disease prevention & treatment and mood altering, with substantiated claims (ingredients and foods) • Functional food may be fresh produce, processed product or bioactive ingredient for manufactured food • Diet, low calorie foods that satisfy hunger and are tasty and enjoyable • 'Energy boosted / fortified' sports foods • Foods for disease prevention eg vaccines in foods • Consumer suspicion of technology • Substantiation of health claims needed
EATING QUALITY / SATISFACTION	• Freshness, or 'fresh-like' • Reliable quality and availability through year, • Demonstrated or guaranteed ripeness, taste, appearance • Flavour, texture, palatability, appearance, freshness tailored to market expectation • 'Like traditional' meals • Taste sensation – 'just right' (not overcooked) • Taste and texture related to life stage – eg infant, juvenile, adult, older person
SHELF LIFE	• Extended freshness for fresh and minimally processed foods • Shelf stable 'fresh-like' foods • Retained flavour and texture
COMMUNICATION	• Information/labelling enabling informed purchasing, product differentiation, trust • Traceability of supply • Presentation to display benefits, be appealing
SPECIFIC NEEDS GROUPS	• Infants, children • Teenagers, young adults, adults • Older persons • Vegetarian meal opportunities • Cultural/religious preferences provide opportunities • Freedom or declaration of Allergens, • Disease/illness related purchases (preferred or excluded foods) • Ease of opening, preparing and consuming for particular disease conditions
SAFETY	• Reliably safe to eat, • Seeking 'guaranteed safe'

PACKAGING	• Environmentally friendly (see above) • Improves appearance, make desirable (see-through) • Carry label information (eg health claims) • Plastic pouches and cans vs metal cans • Ease of opening

Figure 4.1: Product embodiment themes

4.5 Capturing Product Embidoments Through The Value Chain

Analysis also identified the various stages of production and manufacture where the desired embodiments could be maintained or created in the products, as they progress through the value chain.

While to focus for this project is to value map the desired embodiments during the processing/manufacturing stages of the value chain, the analysis includes consideration of the production components of the value chain too.

STAGE OF PRODUCTION & MANUFACTURE	**WAYS OF CREATING OR MAINTAING DESIRABLE PRODUCT EMBODIMENTS**
ON-FARM PRODUCTION	• Environmentally sustainable farming systems • Selection of appropriate crop variety • Production system to optimise yield and desirable embodiments (eg canopy design to provide evenness in ripening) • Consideration of indigenous species and 'Bush foods'
HARVESTING & POST HARVEST	• Optimising harvest systems to minimise damage • Harvest to provide consistent maturity • Optimise post harvest temperature control and physical handling for the market • Reduction of waste
PRIMARY PROCESSING	• Freezing • Retorting (canning & pouches) • Juicing • Jams • Pickling • Drying
SECONDARY PROCESSING	• Fractionation and concentration (flavours, colourings, essences, functional ingredients) • Meal/meal ingredient production: Soups, meals, desserts, • Snack foods and confectionary • Supplies to food service (fast-food, restaurant and institutional)
PACKAGING	• Material manufacture • Package manufacture • Assembly in food manufacture plant

	• Disposal / re-use at food-service or retail outlet
LOGISTICS/SUPPLY CHAIN	• Maintaining desired temperature, humidity and physical environment for no longer than planned
RETAILING & FOOD SERVICE	• Appropriate handling and display in-store • Appropriate post purchase handling

Figure 4.2: Stage of production or manufacture vale may be added

4.6 Opportunities To Deliver The Desired Embodiments To Custumers

The product opportunities were identified that may deliver the desired embodiments to customers.

The product opportunities were verified against the Workshop discussion and white board notes and reviewed literature, as a check on the validity or the project logic developed.

The analysis is presented below.

OPPORTUNITY TO DELIVER DESIRED 'EMBODIMENTS'	**EXAMPLE OF PRODUCT FORM**
SNACKS	• Beverages & juices • Fruit bar, fresh fruit / vegetable segment • Biscuits and cakes • Savoury snacks • Snack 'pack' of say biscuit, cheese and fresh or preserved fruit/vegetable • Confectionery substitution
MEAL OCASSIONS	• Traditional: • Breakfast – fruit – dried, semi-dried, preserved, juices • Lunch - • Dinner • Continuous Grazing or Snacking
MEAL TYPE	• Fully home prepared • Home prepared from bought-in pre-prepared components (HMR, self selected ingredients) • Eaten at home, brought-in fully pre-prepared and heated at home • Eaten at home, brought in warm from 'Take-Away' outlets • Eaten away from home at work, in-the-car, or at 'eat-in'/'take-away' outlets • Eaten in a café or restaurant.
FOOD INGREDIENT	• For processed foods • For prepared at home • For Food Service • Beverages and juices

Figure 4.3: Opportunities when value can be delivered to consumers

Opportunities to capture valued product embodiment may vary between export and domestic market. Issues identified in targeting these markets are shown below.

TARGET MARKET	
DOMESTIC	• Tailored to meet market needs • Adding value to second grade or waste fruit / vegetables • Meeting regulatory requirements
EXPORT	• Use of manufacturing step to overcome phyto-sanitary barriers or non-tariff trade barriers • Use of sea freight rather than air freight • Need for more market specific information – to suit regional, religious and ethnic requirements • Meeting regulatory requirements of importing country (packaging declarations, ingredients, processing

Figure 4.4: Market opportunities

4.7 Conclusions – Applicaton To Value Maps:

The logic developed is that the opportunities exist to develop products that will attract a premium price from consumers because they exhibit desirable product embodiments. These desirable product embodiments can be imparted to the products at one or more stages along the value chain, and delivered in a range of product forms. These new products will be need application of new technology to enable the desirable embodiments to be achieved.

The diagram below outlines this concept, and will be applied after consideration has been given to new processing technologies that may capture valuable product embodiments, presented in Chapter 5

Translating Product Embodiments to Value Map

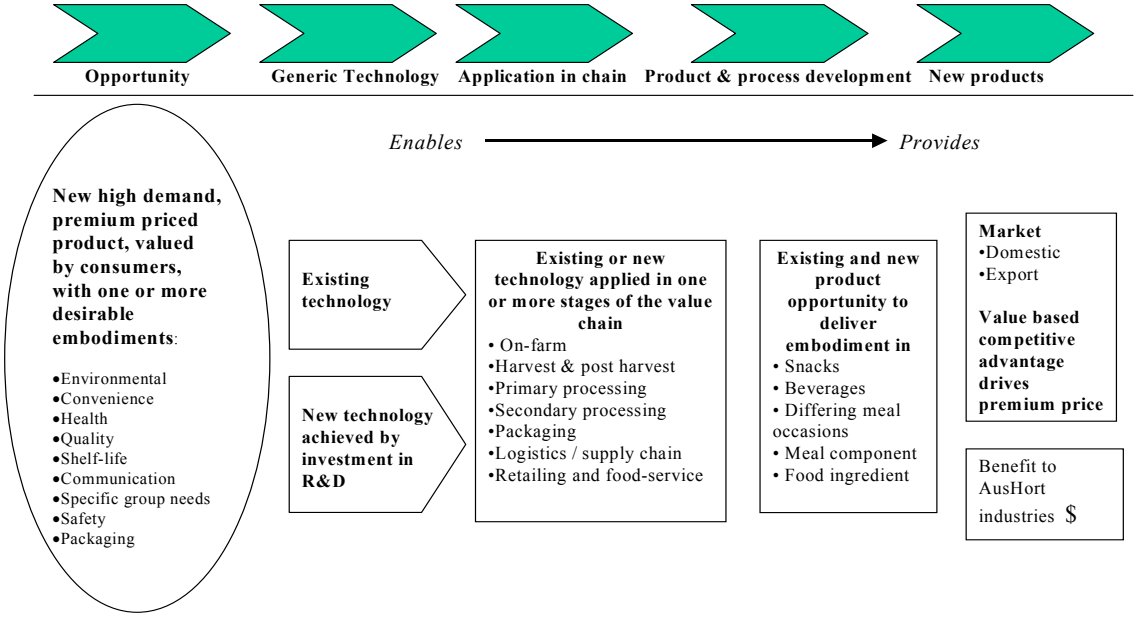


Figure 4.5: Mapping product embodiments, technology, stage of production to product opportunities

5.0 IDENTIFICATION OF TECHNOLOGIES THAT MAY CAPTURE VALUABLE PRODUCT EMBODIMENTS

5.1 Introduction

Having successfully identified the product embodiments (ie the material form or expression of desirable characteristics), the need is to identify those areas of technology that now, or with further research investment, may enable food products with the market-premium characteristics.

To achieve this a workshop of specialist scientists, engineers and technologists from Food Science Australia was held.

If this project was carried out within a food manufacturing company, this component would usually be provided by the company's research and development team, and may involve third party research organizations. Third parties would be bound by confidentiality agreements.

5.2 Technology Workshop

Purpose:
The purpose of the Technology Workshop was to:

- Develop a list of technology options that will / may deliver the product embodiments previously identified,
- Conduct a SWOT (Strength, Weaknesses, Opportunities and Threats) for the technology
- Construct Value Maps for each technology, within the framework established for this project.

Participants and Location:
Participants were selected from Food Science Australia senior and experienced staff on the basis of:

- cross discipline approach
- their knowledge of a diverse range of current and emerging technologies and
- their creativity in workshop sessions

A single half-day workshop session was held in Melbourne. In addition significant participation by a range of selected staff across Food Science Australia in Brisbane, Sydney and Melbourne have contributed to this work.

Outline of Workshop Session:
The following is an outline of the presentations and activities of half-day facilitated Workshops. Participants, based on their knowledge and experience, were asked to act as 'advocates' for particular technologies.

A facilitated workshop, to be held in Melbourne

- Presentation: "Explaining the process" – providing background to this project.

- Workshop 1:
  - Identify the technical constraints to meeting 'un-met' needs.
  - Identify the possible technology option/ options to deliver the "Un-met needs of consumers" in foods based on, or containing, horticultural ingredients

- Workshop 2:
  - Review technology options
  - Develop Value

As in Workshop 1, records were kept of the meeting.

5.3 SWOT Technology Analysis

The technologies identified as having potential to provide the product embodiments across the range of AusHort industries, are briefly described and presented together with an analysis of their strengths, weaknesses, opportunities and threats and a Value Map are shown in the following pages.

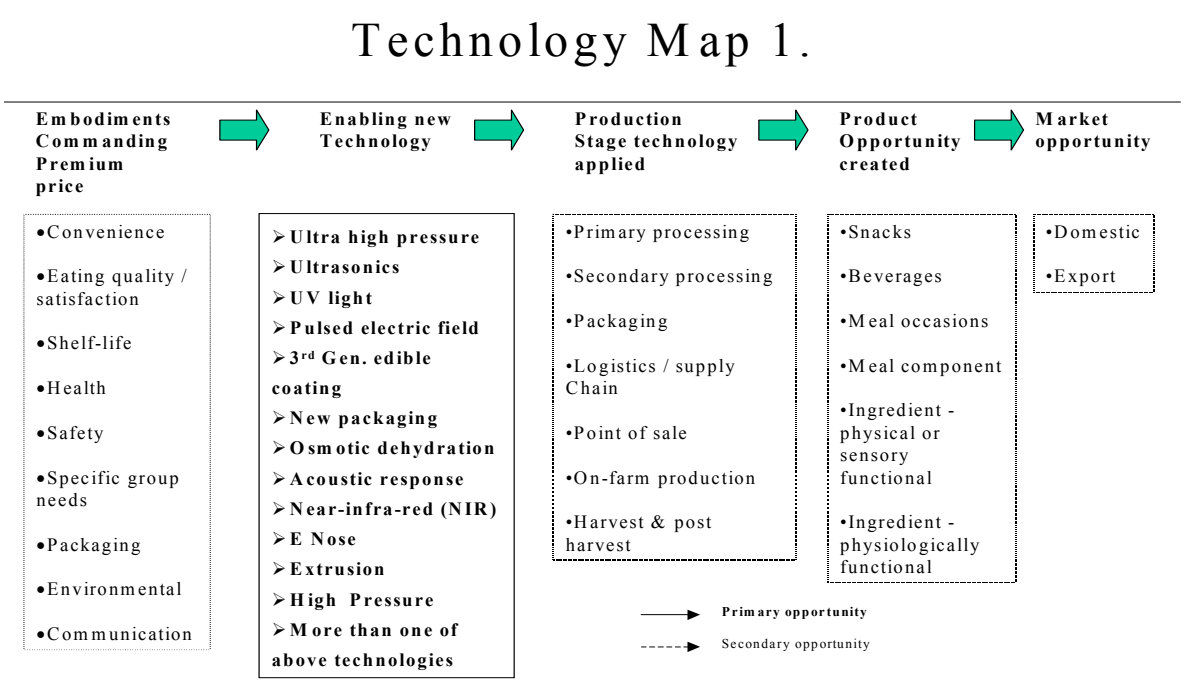


Figure 5.1: Technology Summary

ULTRA-HIGH PRESSURE

Description:

High hydrostatic pressure processing (HPP) or ultra high pressure (UHP) is a nonthermal processing technology that uses pressures of approximately 300 to 700 MPa for a few seconds or minutes to treat foods. The first commercial applications of HPP target microbial inactivation, and can be thought of as a "cold pasteurisation" process. Several food products are currently on the international market including pressurized sliced ham in Spain, guacamole, salsa and oysters in the US, jellies and juices in Japan and juice products in France. Juice and prepared meats will soon be available in the US as well. One of the major processing advantages is that pressure is transmitted uniformly and instantaneously throughout the food product, therefore there is no gradient of effectiveness from outside to inside as there is with thermal processing.

Microorganisms are variable with regard to their sensitivity to HPP, with Gram-positive bacteria, such as *Staphylococcus* and *Listeria* requiring higher pressures for inactivation than Gram-negative bacteria such as *Salmonella* and *E. coli*. Bacterial spores are highly resistant to HPP, and hence a combined treatment of parameters such as pressure, mild heat and low pH is typically required for inactivation. The mechanisms of high-pressure inactivation of microorganisms are not fully understood but it is thought that several different effects are involved. High pressure can induce a number of changes to cell morphology, biochemical reactions, genetic mechanisms, cell membranes and cell walls

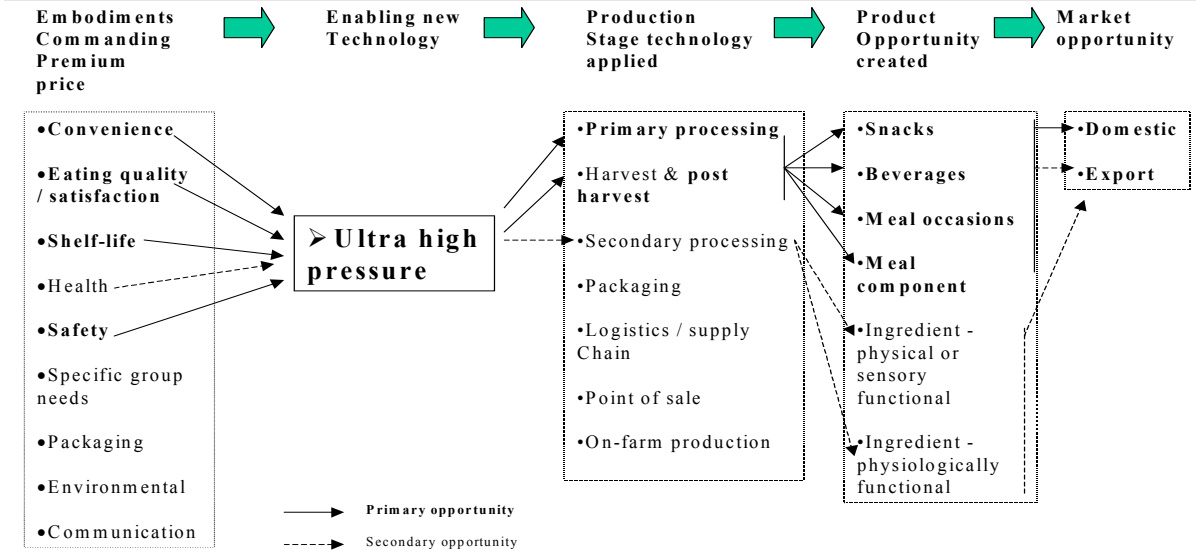
The chemical effects of HPP are quite different from the effects of heat. The fundamental difference is that both heat and HPP causes perturbation of hydrophobic and ionic bonds in molecules, while heating to extreme temperatures also affects covalent bonds. For example, proteins are affected differently by high-pressure treatment than by thermal processing. Structural changes may occur which can lead to unique texture changes in high protein foods. This assessment is based on evidence in the literature in which several groups have shown that high pressure processing reproducibly modifies protein structure and function. No group has yet shown a basis on which the change in structure/functionality after pressurization can be predicted from initial protein structure or from changes due to thermal processing

Enzyme response to HPP also varies. Some enzymes can be partially or fully inactivated by high-pressure treatment while others are actually stimulated. Effects on the activity of enzymes may be due to a pressure induced conformational change in the protein, effect of pressure on the reaction itself, effect on accessibility of the substrate, or the disassociation of the enzyme into subunits.

STRENGTH	***WEAKNESS***
• Extended shelf-life and improved food safety • Potential to minimize/eliminate thermal processing and/or chemical preservatives • Minimal effect on vitamins, flavour and colour compounds • Commercially available systems offering scale and multiple units can provide for continuous operations • Commercial success already exhibited for jams, fruit sauces, fruit juices (eg. orange and grapefruit), guacamole, salsas, modified rice products, raw	• Cannot inactivate bacteria spores alone, but requires combination of processing factors to do so • Limited/minimal effect on some food enzymes • Can alter the texture of foods with high protein or starch content • Cost is a factor, but technological advances have brought equipment cost down and made commercialisation possible

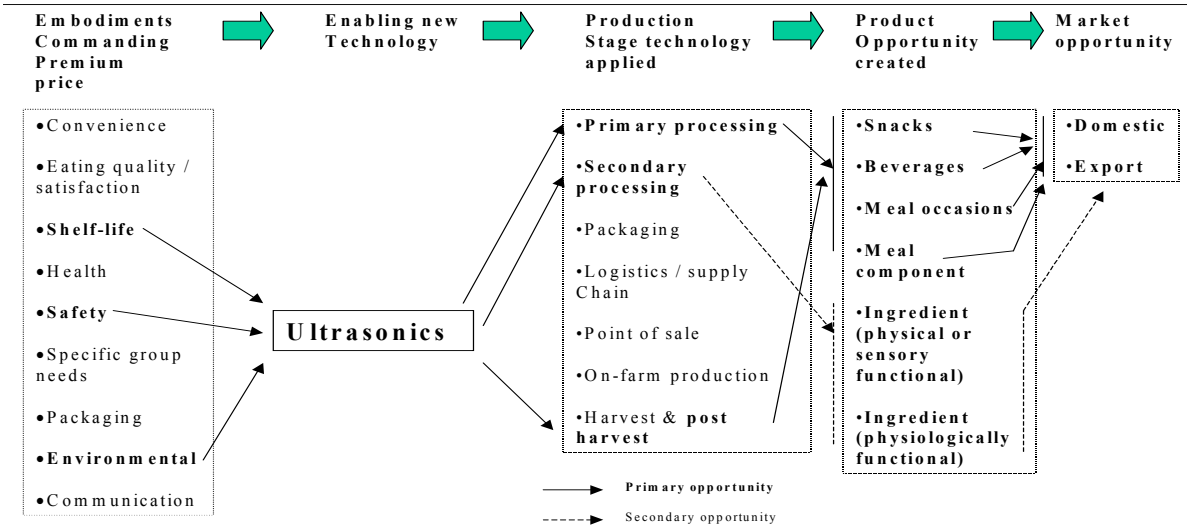
oysters and pre-packaged sliced ham. • Unique textures created via modification of proteins and starches	
OPPORTUNITIES • Prolonged shelf-life for the export of value-added horticultural products • Application for pre-packaged products of solid or liquid nature • Improved quality and potential for marketing as fresh • Improved food safety	***THREATS*** • Occupational health and safety and regulatory issues associated with the technology (need to be addressed in Australia; already have high pressure units operating commercially in the US and Europe)

Technology Map - UHP



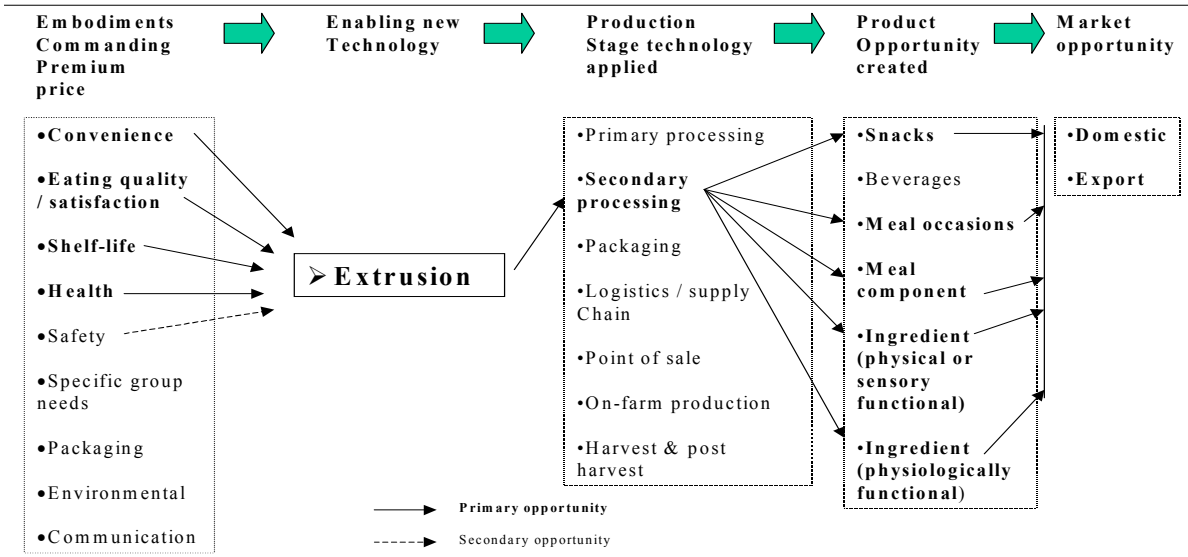
<table>
<tr><th colspan="2">ULTRASONICS</th></tr>
<tr><td colspan="2">Description:
Ultrasonics are high frequency sound pressure waves, with frequencies above about 20 kHz. They propagate in gas, liquid or solid media in a similar manner to sound waves, and reflect, echo, resonate and form interference patterns. Power ultrasonics has high amplitude, typically 15 to 150 μm, with frequencies of 18 to 1,000 kHz, depending on the application. In liquid media, ultrasonic pressure waves induce cavitation, increase diffusion rates and create mechanical disturbances. Increases in both rates of reaction and heat transfer are observed in many systems, as a result of these effects. When ultrasonics is applied to solid media, it can induce molecular excitation, leading to changes in crystal structure.</td></tr>
<tr><td><u>STRENGTH</u>
Lower cost equipment (relative to other emerging technologies)</td><td><u>WEAKNESS</u>
Some materials are opaque to ultrasound, so the ultrasonic energy is absorbed strongly, reducing its effect on the rest of the system. This can be a problem when particulates are present, as they can cause shadowing of particles further from the source.
Historically, the availability of sonication equipment has been limited. With the emergence of several manufacturers in this area, making equipment for a range of specific applications, the application of ultrasonics in the food industry has the potential to increase quite rapidly.</td></tr>
<tr><td><u>OPPORTUNITIES</u>
Surface disinfestation and cleaning of produce
In combination with mild heat treatment pasteurisation of liquid and semi-liquids in-line
Enhancing mass transfer from liquid to solid products
Activating or deactivating enzymatic activity in products
Food structure modification to modify texture/rheology and nutrient bio-availability
Ultrasonic knife-cutting
Foam management
Low temperature drying</td><td><u>THREATS</u>
Need to establish critical limits for performance with respect to food safety
Current lack of process development suited to produce applications
May not currently be scalable to very large production volumes
Occupational health and safety and regulatory issues associated with the technology</td></tr>
</table>

Technology Map - Ultrasonics



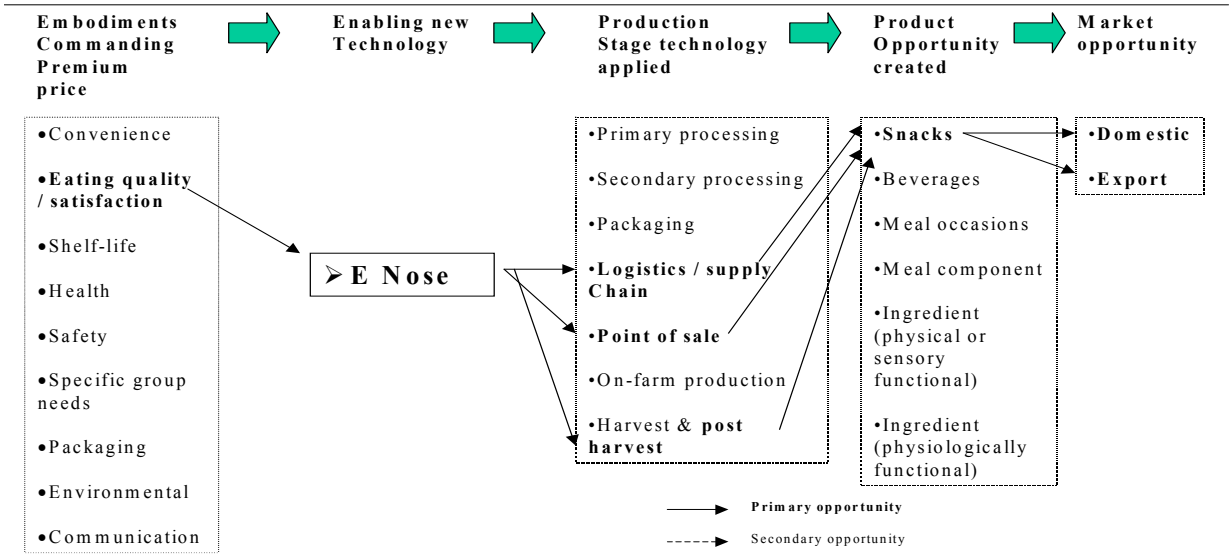
<table>
<tr><th colspan="2">EXTRUSION</th></tr>
<tr><td colspan="2">Description:
In extrusion cooking, a starch base is mixed with water or another liquid and the material is conveyed with a single or a twin screw along the barrel of the extruder to the die. As the material is conveyed, heat is generated by the conversion of mechanical energy through friction. External heat can also be added is required. As the material reaches the die end of the extruder, there is a rapid increase in temperature and pressure and the material becomes a ‘melt’. When this melt is extruded through the die, the water in the product rapidly evaporates because of the sudden drop in pressure and the product expands to gives a characteristic texture.</td></tr>
<tr><td><u>STRENGTH</u>
• Versatile process involving mixing, conveying, heating, shearing, cooking, shaping and forming
• Continuous operation
• Energy efficient
• Proven technology. Many commercial plants</td><td><u>WEAKNESS</u>
• Twin screw extruders can be expensive</td></tr>
<tr><td><u>OPPORTUNITIES</u>
• Value addition to fruit waste. Combining fruit waste (after extracting juice) with cereals and extruding to make high fibre products for human and animal consumption. It may also be possible to use vegetable waste to make value added extruded products.
• Extruding fruit purees with cereals to make snacks / breakfast cereals. Vegetable powders / purees could be used to make extruded snacks.</td><td><u>THREATS</u>
• Development of extruded products with fruit and vegetable waste / purees may be limited because the technology is not well understood</td></tr>
</table>

Technology Map - Extrusion



ELECTRONIC NOSE	
Description: Electronic/artificial noses are being developed as systems for the automated detection and classification of odours, vapours, and gases. An electronic nose is generally composed of a chemical sensing system (e.g., metal oxide sensor array or mass spectrometer) and a pattern recognition system (e.g., artificial neural network). The sensor array "sniffs" the vapours (aroma compounds) from a sample and provides a set of measurements; the pattern-recogniser compares the pattern of the measurements to stored patterns for known materials. The electronic nose gives a simple answer like "recognized", "good", or "bad" or a more sophisticated response such as odour intensity or a molecular concentration. Electronic nose technology can be used to differentiate fresh or processed foods on the basis of their aroma properties.	
STRENGTH • Applications currently being developed in Europe for monitoring fruit quality	***WEAKNESS*** • Requirement for R&D to calibrate system for different fruit varieties and storage or processing systems • Portable systems can be developed • Need for correlation with consumer acceptability
OPPORTUNITIES • Monitoring fruit ripeness and quality, storage effects (eg. apples and pears) • Application in storage rooms, packing plants • Differentiation of fruit by sensory quality to suit particular markets	***THREATS*** • Development of commercially user-friendly systems • Ability to provide sensory based product differentiation valued by consumer groups

Technology Map – E Nose



NEAR-INFRA-RED (NIR) TECHNOLOGIES

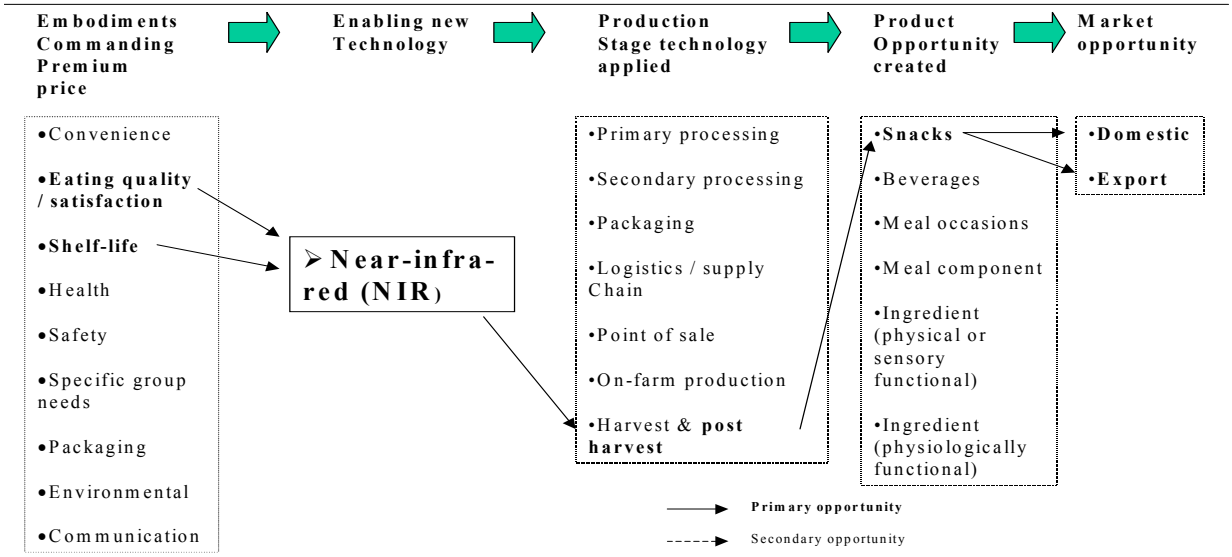
Description:

Near-Infra Red (NIR) sorting technologies have been used to grade fresh horticultural products for major physiological properties and quality indices. This technology scans wavelengths and measures either absorption, reflectance or interactance (a combination of the previous two). This spectral response is then correlated to physical parameters of interest (for example it has to-date shown promise for dry matter, colour, firmness in kiwifruit and softening of the flesh, total soluble solids content and acidity in mangoes). It is widely concluded that by using the NIR spectrometry measurement system, in the appropriate spectral range, it is possible to non-destructively assess the maturity factors of many fruits.

This technology utilises wavelengths of 300 – 1130 nm, though some fruits have been assessed at greater than 1200 nm. There are a number of useful, inexpensive hand-held NIR spectrometers options available (costing approximately $US 1,000 – 2,000). There are also far more expensive systems for rapid-speed on-line assessment.

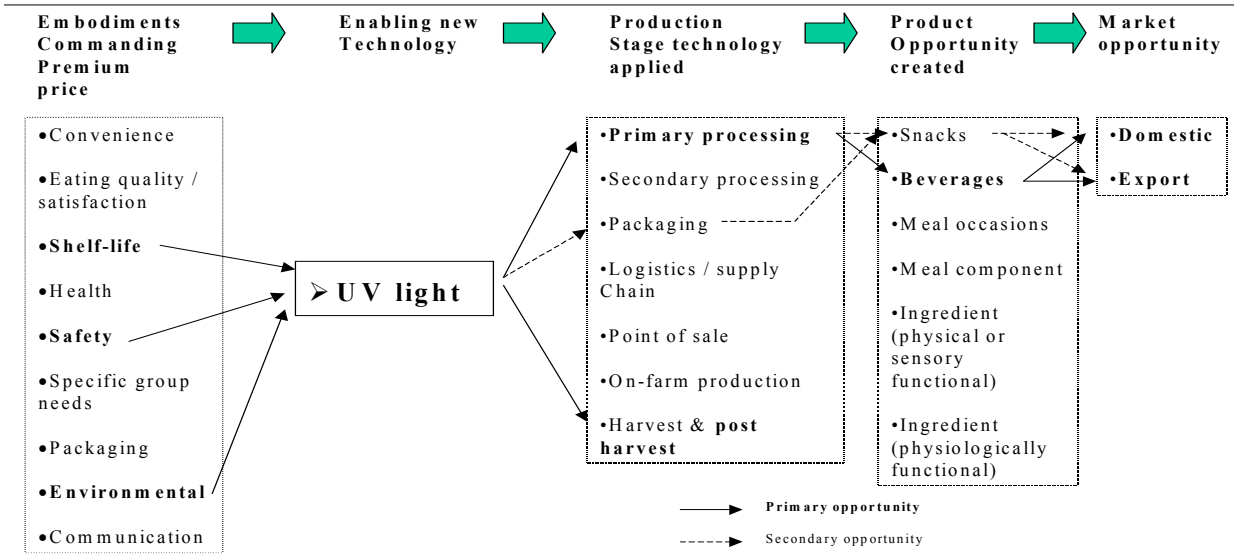
STRENGTH	***WEAKNESS***
• Available in high speed online and hand held applications	• Currently higher cost equipment (relative to other emerging technologies) • May not be able to analyse large fruit due to penetration
OPPORTUNITIES	***THREATS***
• Application to almost all fruits and vegetables • Likely to also be able to assess for internal disorders non-destructively	• Need to establish correlations with existing equipment in commercial use

Technology Map - NIR



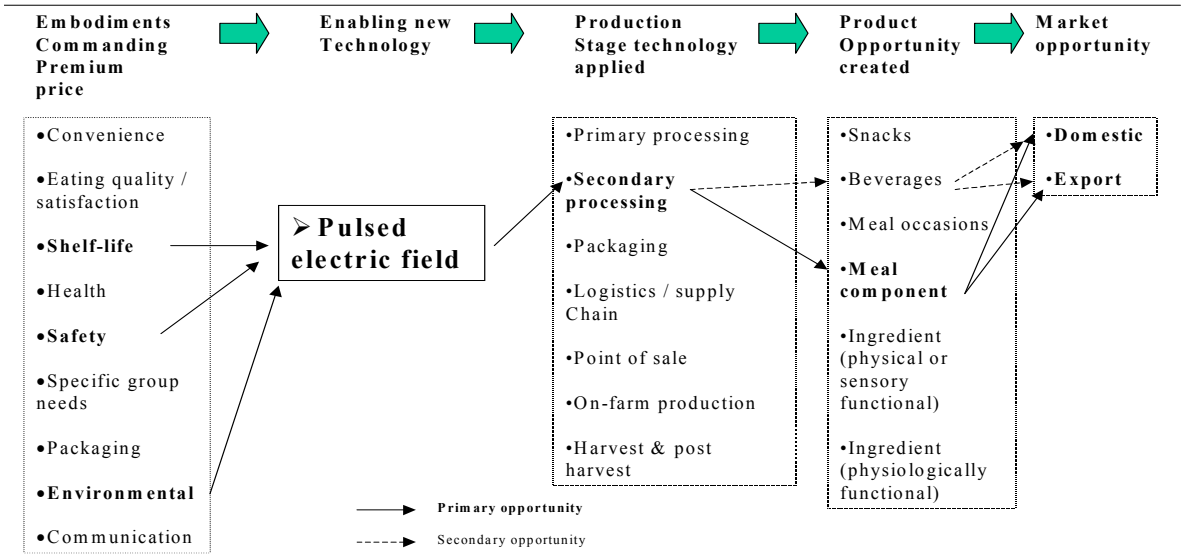
ULTRA-VIOLET LIGHT	
***Description**:* Ultra-violet light can be used successfully for anti-microbial effect. At wavelengths of around 260 nm, electrons in the carbon-carbon double bonds of polyaromatic hydrocarbon molecules absorb ultraviolet light. The bond energy in these bonds is reasonably low, so electrons in these molecules can be reasonably easily "activated" to a higher energy level for short periods of time. As a result of these exited states, molecular rearrangements occur, causing small changes in the structure of DNA molecules. This is thought to be the main mechanism of inactivation, as it affects the reproductive ability of the cells.	
STRENGTH • Two commercially available systems approved by FDA for flow-through treatment of clear juices (Salcor Inc. "Light Process ™ " and "CiderSure ™ " systems)	***WEAKNESS*** • Effectiveness on surfaces limited by shadowing • Effectiveness in liquids limited by transparency and particulate shadowing • Photo-oxidation compounds may be undesirable • Scale up of the process to large scale processing
OPPORTUNITIES • Potential low cost option for treatment of juices • Extend shelf-life for high quality fresh juices • Combination with ozone or ultrasonics to enhance performance	***THREATS*** • Need to establish critical limits for performance with respect to food safety • Occupational health and safety and regulatory issues associated with the technology

Technology Map – UV Light



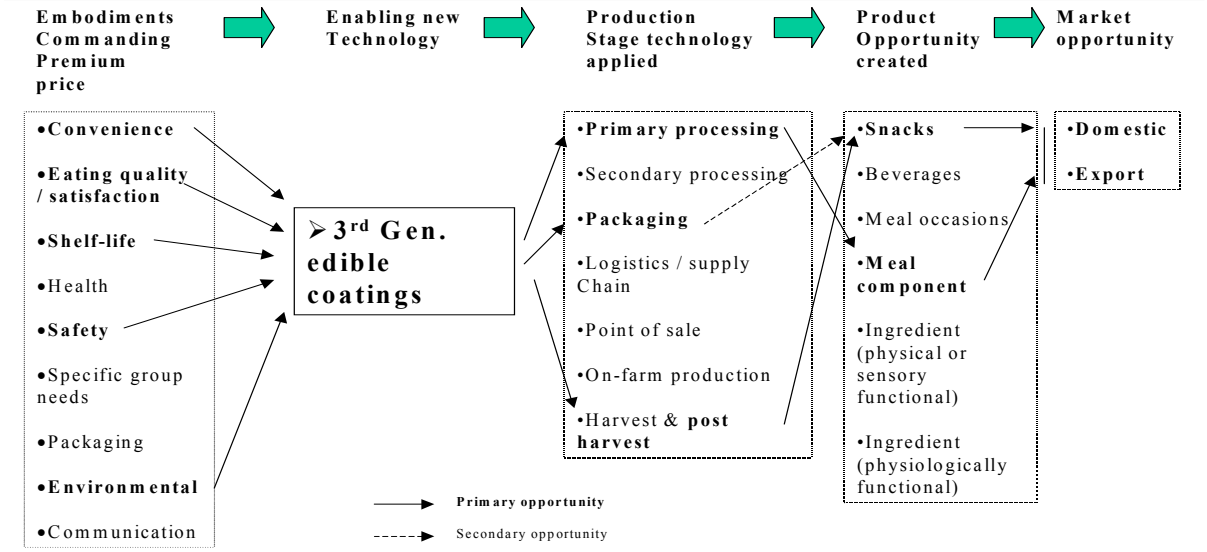
<table>
<tr><th colspan="2">PULSED ELECTRIC FIELD AND REVERSE PULSED ELECTRIC FIELD</th></tr>
<tr><td colspan="2">Description:
PEF processing involves the application of short pulses of high voltage electric field to a pumpable fluid flowing through a narrow gap between two electrodes. High voltage is applied across the electrodes by means of a high voltage power supply, a pulse generator, a capacitor and switch, causing very short pulses of DC current to pass through the food. Very high electric potential differential across the cell walls causes small holes to form (electroporation), which results in the absorption of water into the cell and the rupture of cell membranes. Reverse pulse PEF is a modification to PEF technology, which is understood to yield the same effect, but at a substantially lower energy level.</td></tr>
<tr><td><u>STRENGTH</u>
In the food systems for which it is suitable, it has been shown to be able to produce high quality liquid food products with extended shelf-life.</td><td><u>WEAKNESS</u>
PEF is only applicable to liquid systems and aseptic filling into sterile packages is required after treatment, as for all pre-package treatment processes. The presence of gas bubbles can cause problems such as non-uniform field strength and electric sparking, but treating under sufficient pressure to prevent gas formation can potentially eliminate this.
Yet to be commercially developed and the equipment designs currently in use will probably not be commercialised successfully.</td></tr>
<tr><td><u>OPPORTUNITIES</u>
If reverse PEF can be developed effectively, it has the potential to reduce both capital and operating costs to a level where it could become cheaper as well as more environmentally desirable than thermal pasteurisation.
There is room for considerable improvement on the current equipment designs in terms of electronic engineering to improve operating efficiency and safety.
PEF has yet to be applied commercially, but has been the subject of considerable laboratory based research studies in a number of major research centres in USA and Europe. Potentially suitable for fruit juices, acidified dairy products and apple juice.</td><td><u>THREATS</u>
Need to establish critical limits for performance with respect to food safety
Occupational health and safety and regulatory issues associated with the technology
Reverse PEF turns out to be a red-herring</td></tr>
</table>

Technology Map - PEF



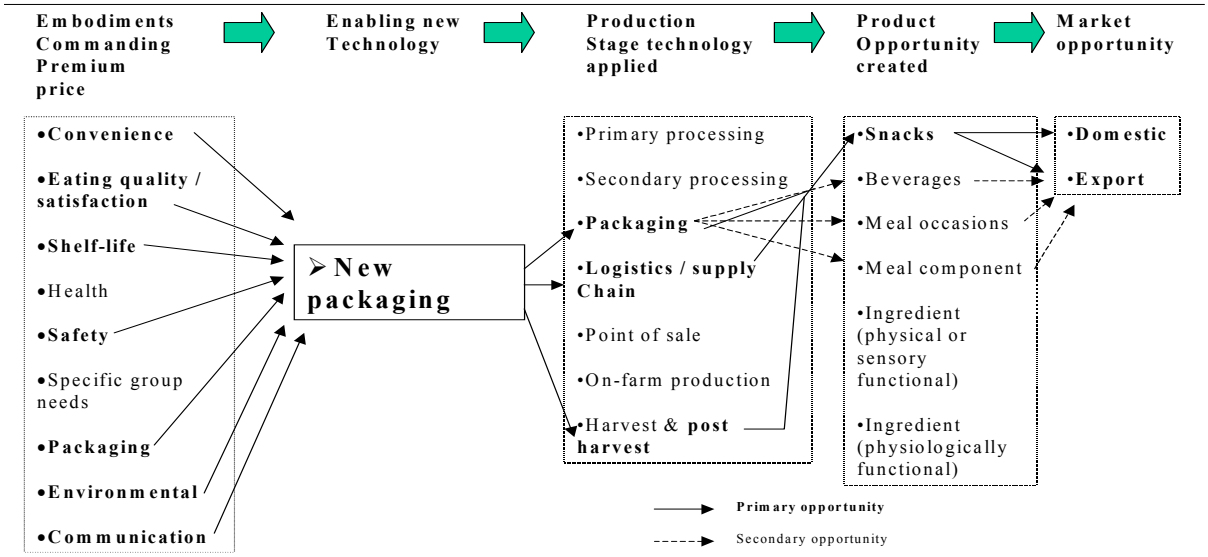
3RD GENERATION EDIBLE COATINGS TECHNOLOGIES	
Description: The application of Food Grade natural gums, acids and acidulants to provide edible coatings on fresh-cut and whole produce.	
STRENGTH • Demonstrated capability of coatings to prevent physiological disorders (ie. browning, lignification and water loss) • Formulation to provide improved food safety	***WEAKNESS*** • Can be limited by consumer acceptability for appearance and flavour depending on type, thickness and textural properties of the coatings • Development and formulation to meet individual produce requirements • Improved technology for application
OPPORTUNITIES • Alternative to controlled atmosphere storage, by individually coating fruits to prolong storage • Shelf-life extension of fresh-cut produce for domestic and retail markets • Added value by incorporating additional flavours and spices.	***THREATS*** • Achieving consumer acceptability • Ability to formulate coatings from low-cost ingredients and cost-effective application technologies will determine extent of application

Technology Map –3rd Gen Coatings



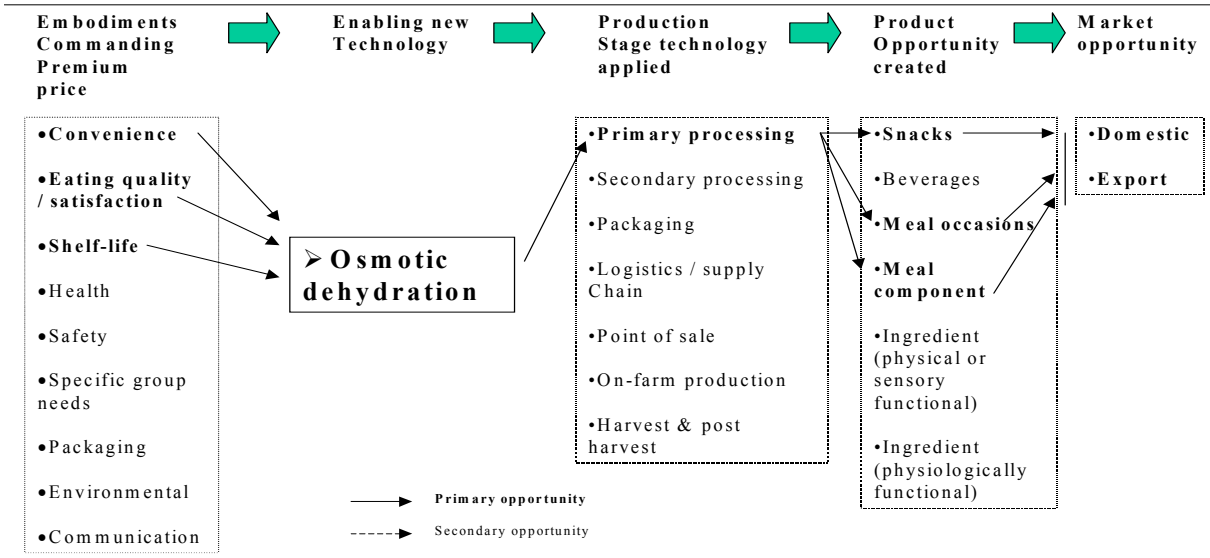
ACTIVE & INTELLIGENT PACKAGING	
Description: Development of improved modified atmosphere packaging for value-added horticultural produce. Also packaging applications with novel gases, ethylene suppression and anti-microbial packaging.	
STRENGTH • Recent developments increasing the degree of packaging film permeability to suit higher respiration products. • New formulations, which can improve textural properties of the films (ie. crispy feel), without greatly reducing permeability, to provide better consumer acceptance.	***WEAKNESS*** • The improvements providing increased permeability and textural of packaging films require further development to extend to a broader range of fresh-cut product
OPPORTUNITIES • Improvement in product quality and shelf-life extension • Reduce ethylene product by gaseous inhibitors.	***THREATS*** • Higher cost of new packaging films may limit extent of introduction

Technology Map – Active & Intelligent Packaging



OSMOTIC DEHYDRATION	
Description: The application of osmotic solutions and drying to provide shelf-life stable, pre-sliced and peeled horticultural products, as snackfoods and for food manufacturing.	
STRENGTH • Can develop products ranging from soft sugary confectioneries to crisp chips depending on market target and application • Ability to add value-to low grade produce	***WEAKNESS*** • Time consuming process, need for process development to improve efficiency • Vacuum infusion quicker but costly
OPPORTUNITIES • Provide shelf-life stable snack products and food manufacturing ingredients for domestic and export market. • Ultrasound could reduce processing time by approximately one third.	***THREATS*** • Process improvement required to improve cost-effective production

Technology Map – Osmotic dehydration

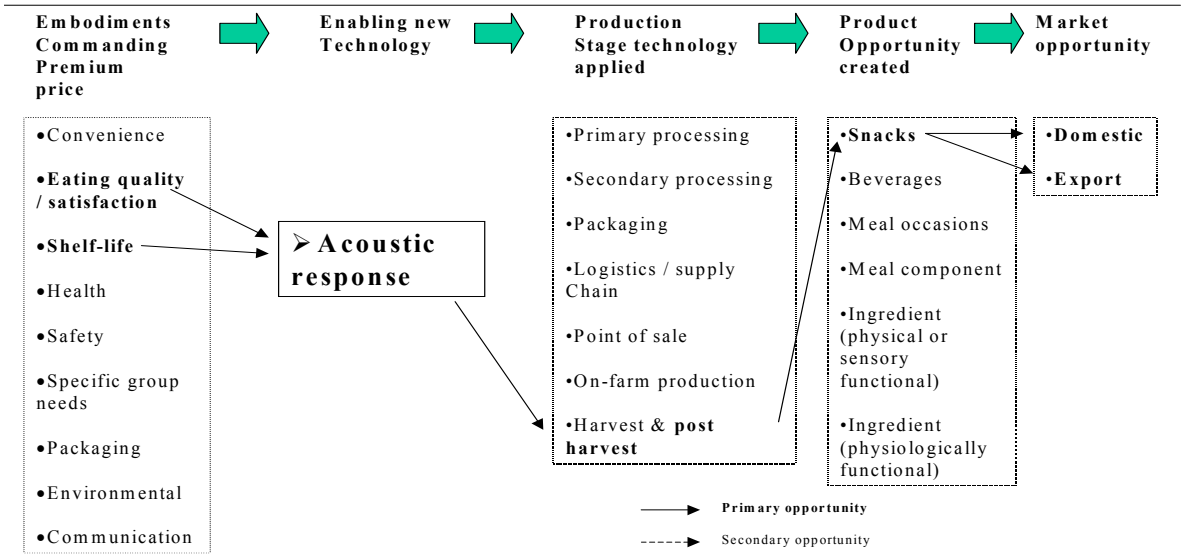


<table>
<tr><th colspan="2">ACOUSTIC RESPONSE</th></tr>
<tr><td colspan="2">Description:
A number of different non-destructive methods for quality evaluation and sorting of agricultural products have been developed based on the physical properties of products. One group of non-destructive methods developed to determine the internal quality of fruit is based on the vibrational characteristics of the product. These characteristics are governed by the elastic modulus (firmness), mass and geometry of the fruit. Analysis of these frequencies can be used to identify changes in texture and thus determine the internal quality of a fruit in a non-destructive way.

The acoustic impulse response method makes use of the sound signal emitted by a fruit as a result of a short duration shock, produced by hitting the fruit with a rod or pendulum. The resonant frequencies obtained can then be calculated using a fast Fourier transform (FFT). These frequencies can be used to determine the internal quality of the fruit. Low frequency ultrasonic imaging technology is also useful in this context.

Given the non-destructive nature of acoustic response measurements, the method appears to have considerable promise as a technique for the evaluation of the post-harvest condition of fruits. Using this technique, the second resonant frequency can be used along with the mass of the fruit to calculate the overall firmness. This value would enable products with internal defects such as internal browning to be identified and separated from good fruit during the sorting process.</td></tr>
<tr><td><u>STRENGTH</u>
• Lower cost equipment (relative to other emerging technologies)</td><td><u>WEAKNESS</u>
• Currently available in bench top versions only, yet to be successfully scaled up to commercial grading systems
• May not be able to cope with all fruits, especially those with stones.</td></tr>
<tr><td><u>OPPORTUNITIES</u>
• Application to almost all fruits and vegetables
• Likely to also be able to assess for internal disorders non-destructively
• Non contact ultrasonic imaging offers scope for commercial grading and stone fragment detection in primary processing.</td><td><u>THREATS</u>
• Need to establish correlations with existing equipment in commercial use (penetrometer data)
• Other technologies that are more advanced that this technology in terms of development</td></tr>
</table>

Technology Map – Acoustic response



6.0 CASE STUDIES AND RECOMMENDATIONS

Two case studies, one on apples and pears, the other on potatoes, were conducted to demonstrate the principles developed during the project, and are presented below. The lack of public domain data shows the difficulty in establishing an industry value chain, and also to numerate industry stakeholder benefits from technology maps.

The case studies demonstrate the need for collection of public domain data, or the purchase of data that may be available on a basis it can be sued for strategic research planning.

6.1 Apples & Pears

A value chain was developed from public domain data, for the apple and pear industry, as shown below.

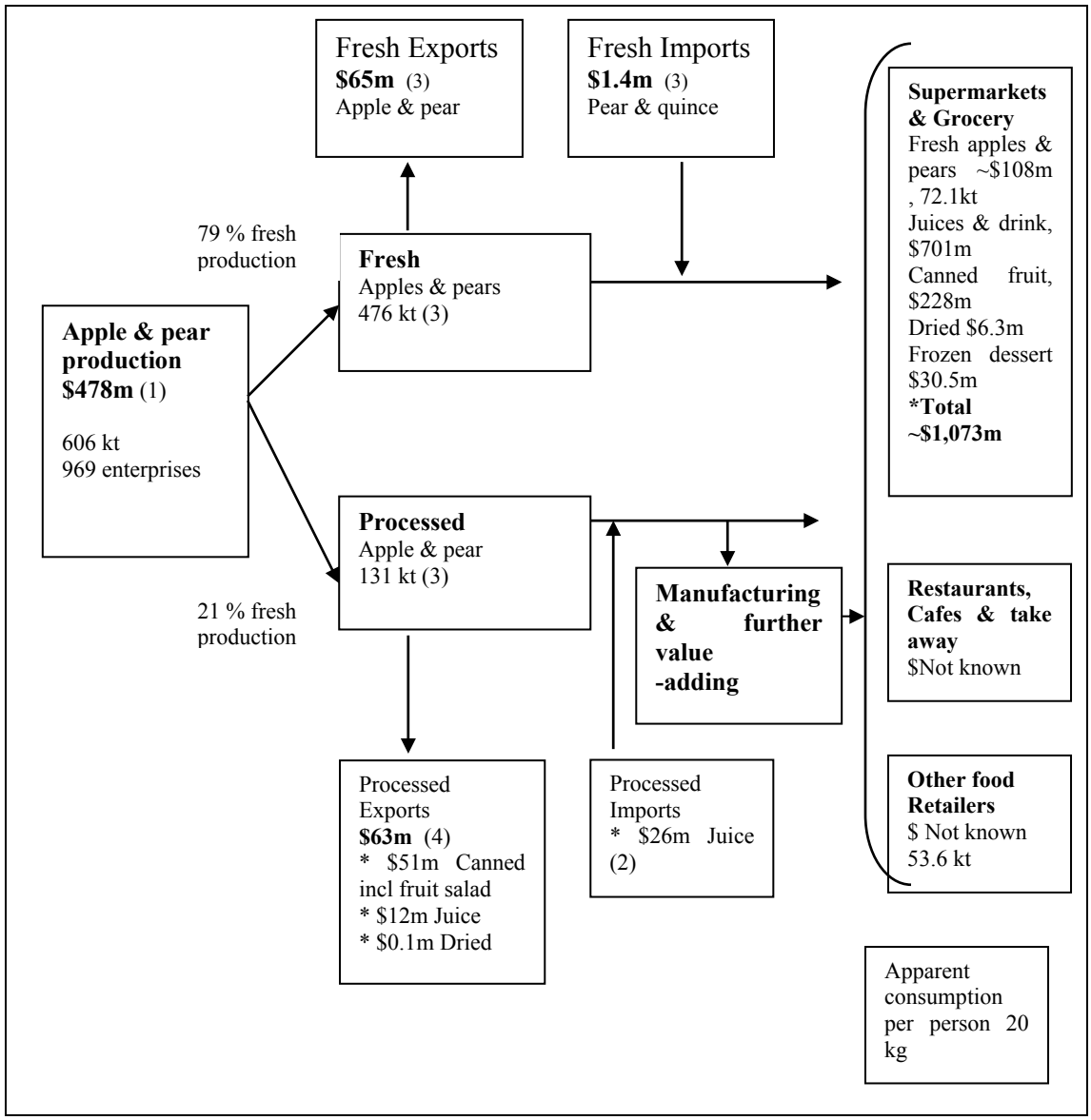


Figure 6.1: Apple & Pear Value Chain 2000-01

VAP = Value added per employee
(1) AFFA (2003)
(2) NFIS (2003)
(3) HAL (2002)
(4) Department of Primary Industries (Pers. Com., Peter Myers)

The data shows that on a tonnage basis, 79% of apple and pear production goes to fresh fruit, while 21 % to processed foods. Fresh exports have a value of $65m pa, similar to the $63m value of exported processed canned fruit, juice and dried apple and pear fruit.

It has proven impossible to disaggregate the value added and market outlets for processed and valued added apple and pear products.

The data shows that apple and pear based foods sold through supermarkets have a value on the order of $1b pa. However the value of apple and pear based food sold through restaurants, cafes and takeaways (22% of the retail food market) are not known, neither is the value of such foods sold through other food retailers (generally responsible for 10% of food sales.

This lack of data makes it impossible to develop Value Maps. Value Maps are Technology Maps that also indicate the value of product that may be added by the subject technology, and include probability of success on various stages of resarch.

As an example of the applying the technique, a Technology Map of applications of ultra-high pressure processing applied to apple and pear products is shown below.

Technology Map – UHP applied to apples and pears

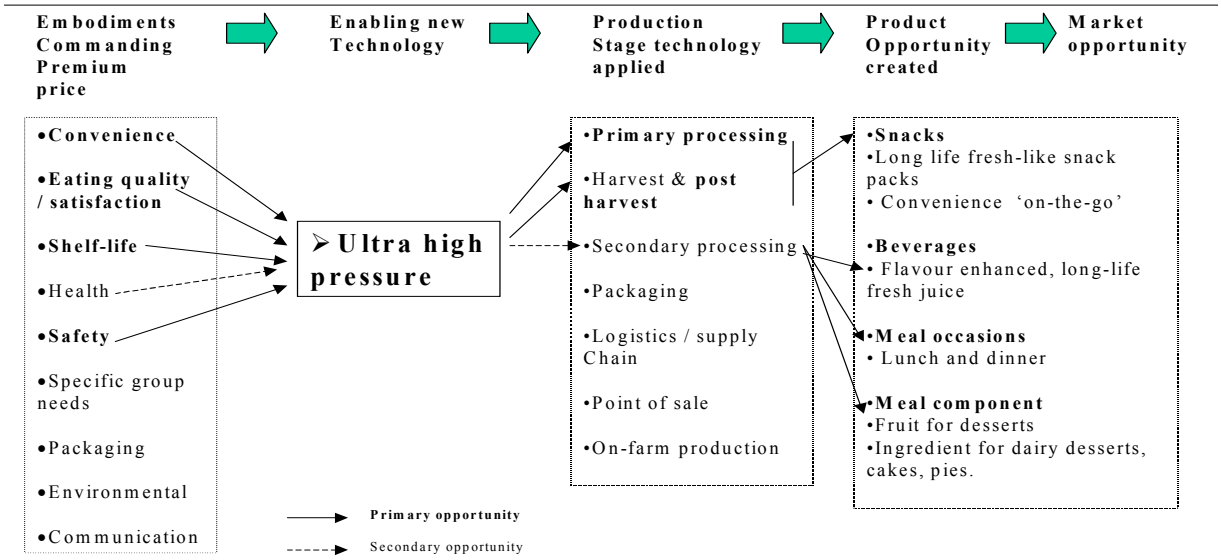


Figure 6.2 Technology Map showing UHP applications to apples and pears

Figure 6.2 shows how the valued product embodiments of convenience, eating quality, shelf life enhancement and food safety may be achieved through ultra high pressure and applied in primary and post harvest stages. Product opportunities that may be developed are shown and indicated as snacks, beverages, meal occasions and meal components.

The Technology Map could be converted into a Value Map if a dollar value could be attached to each of the possible product opportunities that could be achieved by applying UHP. This potential benefit could then be summed with all other fruit and vegetable with the AusHort portfolio which would have a benefit from the application of the technology. Such data could enable a more rational conclusion to be made on the value of investing in the strategic research in UHP for apple and pear products, and the AusHort portfolio.

6.2 Potatoes

Similarly a value chain has been developed for the potato industry, from public domain data.

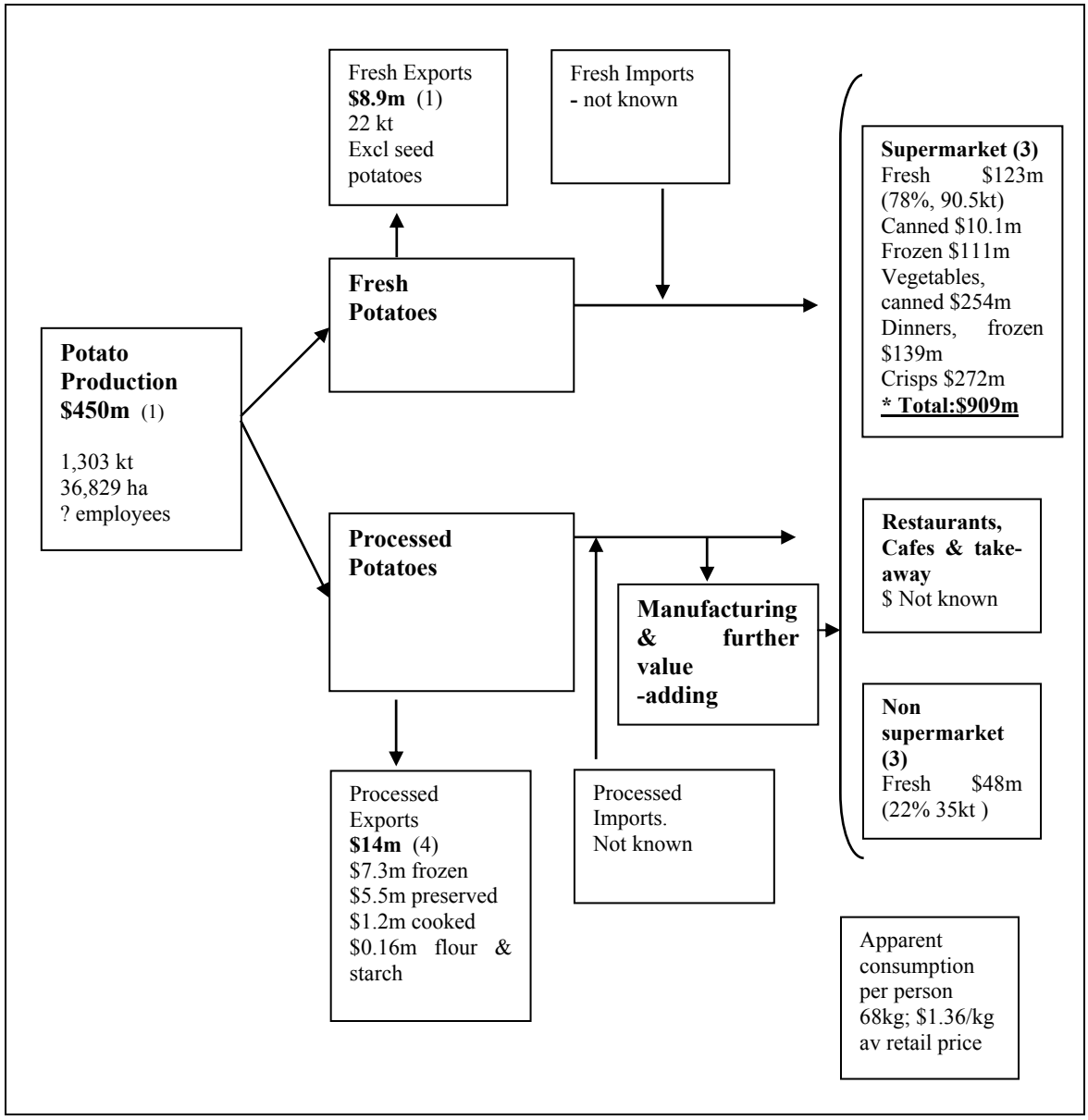


Figure 6.3: Potato Value Chain 2000-01

VAP = Value added per employee
(1) AFFA (2003)
(2) NFIS (2003)
(3) HAL (2002)
(4) Department of Primary Industries (Pers. Com., Peter Myers)

The value chain diagram indicates the difficulty in mapping value through the chain in a consistent way. The largest value added component of the supermarket is crisps, while frozen French Fries account for $111m, canned potatoes $10m.

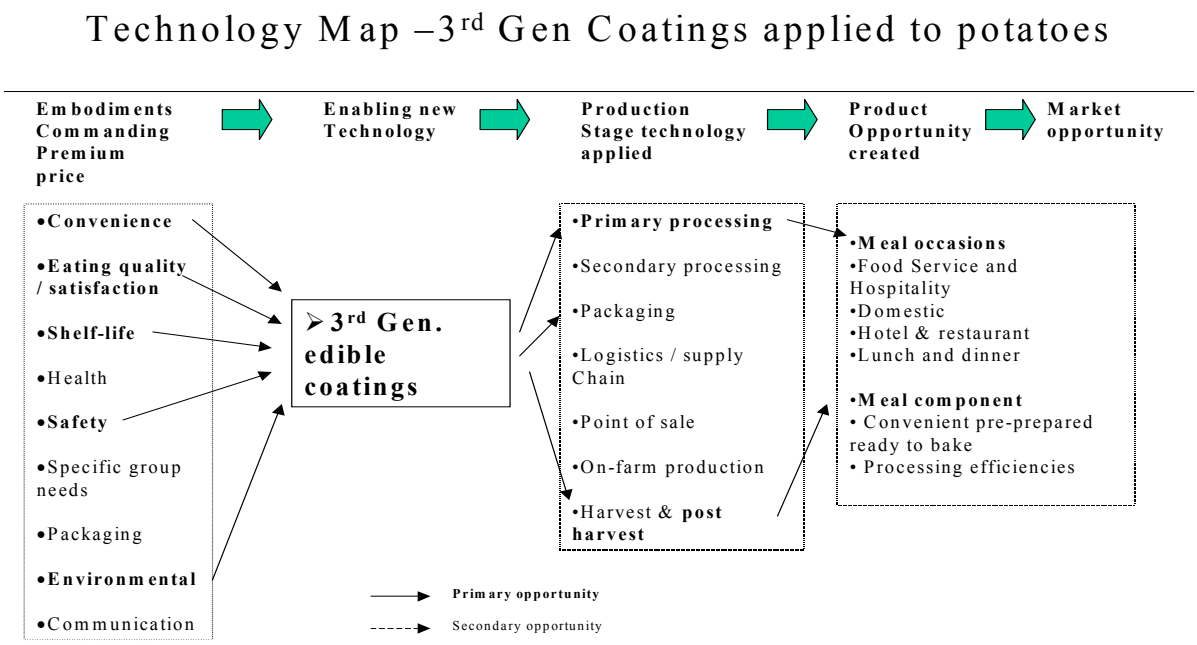


Figure 6.4 Technology Map showing 3rd Generation Coatings applied to potatoes

The technology map in Fig 6.4 shows the opportunities for edible coatings projected for the potato industry that may provide enhanced embodiments of convenience, eating quality, shelf life reduced wastage and safety.

6.3 Conclusions and Recommendations

VALUE CHAINS

- Pictorial representation of the whole horticultural value chain demonstrates the significant contribution the horticultural production industry makes to the post-farm-gate economy.
- Exported manufactured horticultural products are valued at $580m pa, 80% of the value of fresh exports and 20% of all processed food exported and is growing at 6.6% pa. The importance of these value chains to the horticultural industries sectors poorly understood and not included in published industry statistics. The long-term benefits of the whole value chain should be self-promoted by industry.
- A lack of reliable and consistent 'thru-chain' statistics constrains the understanding of the horticultural value chain
- Significantly improved collection of statistics through the horticultural value chain in a way that enables chain-value to be mapped, should be supported by an alliance of interested parties, including producers, processors and government agencies. This would to enable a greater analysis of the future opportunities of these horticultural value chains.

TECHNOLOGY MAP FRAMEWORKS

- The Technology Map framework developed by this project has proven a useful tool to communicate and share concepts in which the market opportunities of processing can be developed.
- The analysis of fourteen new technologies has proven a useful basis to open discussion on future opportunities for developing greater value from manufactured horticulture based foods
- The tool should be used as an aid to future strategic research planning in manufactured horticultural foods and ingredients.

Appendix 1

Market Sizes and Shares 2000				
	Grocery value	Value change (%)	Grocery volume	Volume change (%)
BEVERAGES – COLD				
Carbonated /still beverages	$1,300,000,000	+ 6.4	1,200,000,000 litre	+ 4.4
Cordials	$190,600,000	- 2.5	127,000,000 litre	n/a
Fruit juices & drinks	$701,800,000	+ 1.3	467,800,000 litre	+ 0.7
Soy drinks	$21,000,000	+ 6.9	11,200,000 litre	+ 6.0
BEVERAGES – HOT				
Coffee	$440,600,000	- 0.8	11,759 tonne	+ 3.3
Milk modifiers	$134,200,000	+ 5.3	14,310.1 tonne	+ 5.1
Milk products	$773,000,000	- 0.9	18,024.7 tonne	- 2.0
Tea	$243,500,000	+ 1.5	6,200,000,000 cups	+ 0.7
BISCUITS				
Total	$884,300,000	+ 5.0	112,056.2 tonne	+ 2.5
Chocolate	$147,800,000	- 0.2	15,945.6 tonne	- 1.0
Cookies	$54,100,000	- 1.5	82,38.3 tonne	- 4.6
Crackers	$71,100,000	+ 2.0	8,809.7 tonne	- 0.4
Creams	$94,100,000	+ 7.5	14,785.8 tonne	+ 4.0
Crispbread	$87,300,000	+ 2.6	11,978.4 tonne	- 2.5
Flavoured Snacks	$110,600,000	+ 0.1	12,747.9 tonne	+ 4.1
Fruit	$19,600,000	-9.8	2,392.3 tonne	- 13.0
Plains	$103,600,000	+ 2.6	19,031.8 tonne	+ 4.7
Premium	$4,000,000	+ 39.3	181.4 tonne	+ 31.2
Rice crackers & snacks	$90,000,000	+ 46.1	4,855.1 tonne	+ 48.2
Shortbread	$38,700,000	+ 2.3	5,410.4 tonne	+ 0.3
Topped	$17,800,000	+ 3.3	2,009.7 tonne	+1.4
Wafers	$11,800,000	- 8.1	1,525.9 tonne	+ 1.4
BREAD, ROLLS & HOTPLATE				
Total	$686,400,000	+ 7.0	32,7000,000 units	+ 2.1
Loaf bread	$519,000,000	+ 6.3	236,000,000 units	+ 1.0
Rolls & buns	$32,800,000	- 3.6	14,900,000 units	- 5.9
Hotplate	$83,200,000	+ 9.2	52,100,000 units	+ 3.5
BREAKFAST CEREALS				
Total	$736,300,000	+ 1.4	128,611.1 tonnes	+ 3.5
Ready to eat cereals	$670,300,000	+ 0.4	109,130 tonnes	+ 0.4
CAKE NEEDS				
Cake mixes	$73,900,000	+ 7.8	14,519 tonnes	+ 3.1
Cooking chocolate	$27,400,000	+ 6.6	3,737 tonnes	+ 2.5
Flour & bread mixes	$59,800,000	- 3.3	51,912 tonnes	- 2.4
CONDIMENTS				
Dips	$27,400,000	+ 7.3	12,000,000 units	+ 0.1
Mustards & Horseradish	$19,700,000	+ 3.8	10,000,000 units	+ 6.0
Picked vegetables	$67,200,000	+ 6.0	13,043 tonnes	+ 1.7

	Grocery value	Value change (%)	Grocery volume	Volume change (%)
Relishes % Pickles	$19,500,000	+ 5.2	11,900,000 units	+ 1.0
Salad dressing	$108,300,000	+ 5.0	15,435.3 tonnes	+ 2.4
Vinegar	$21,900,000	+ 3.2	13,199 litres	+ 2.5
CONFECTIONERY				
Chewing gum	$93,000,000	+ 15.0	9.5 m (100 stick equiv)	+ 3.0
All Confectionery	$1,019,500,000	+ 4.5	582,500,000 units	+ 2.5
COOKING NEEDS				
Herbs & spices	$104,000,000	+ 6.6	54,600,000 units	+ 3.3
Salt	$19,200,000	+ 3.5	12,375.7 tonnes	- 0.7
Stock	$43,800,000	+ 9.5	33.2 m (ten dozen equiv cubes	+ 5.9
Vegetables - canned	$254,900,000	+ 0.9	97,287.4 tonnes	- 0.8
COOKING OIL	$218,200,000	+ 5.8	526,600,000 litres	+ 2.5
DAIRY CASE				
Total cheese	$845,900,000	+ 2.9	10,8127 tonnes	+ 3.3
Chilled dairy	$503,500,000	+ 5.8	123.3m kg	+ 2.8
Milk	$82,400,000	+ 9.2	34m litres	+ 10.5
Yellow spreads	$71,800,000	- 3.2	17,339.6 tonne	- 3.6
DESSERT - SHELF STABLE				
Canned fruit	$228,400,000	- 0.4	3.6 m basics	- 2.9
Jellies	$21,600,000	+ 1.7	2,958.2 tonne	- 1.2
Toppings	$30,400,000	- 2.3	5.5m litres	- 4.0
DRIED FRUIT				
Total	$142,300,000	- 0.4	21,922.7 tonnes	- 3.8
Tree	$70,800,000	+ 4.5	9,669.5 tonnes	-3.8
Vine	$58,600,000	- 5.8	11,378.9 tonnes	- 9.7
EGGS				
Total	$124,700,000	+ 1.5	39,800,000 dozen	- 2.9
Barn laid	$11,400,000	+ 26.4	2,900,000 dozen	+ 26.3
Free range	$20,400,000	+ 29.9	4,800,000 dozen	+ 25.0
Omega enriched	$4,900,000	+ 13.7	1,300,000 dozen	+ 10.4
Regular	$87,100,000	- 5.8	30,600,000 dozen	-8.2
Vegetarian	$931,400	- 29.9	234,100 dozen	- 28.9
FISH				
Canned	$348,900,000	+ 3.4%	31,345.5 tonnes	+ 4.3%
Frozen	$113,000,000	+ 7.3%	13,104 tonnes	+ 4.2%
FROZEN FOODS				
Burgers	$155,000,000	- 1.5	3,494.4 tonnes	- 1.2
Chicken	$76,700,000	+ 7.3	7,516.7 tonnes	+ 2.8
Desserts	$104,100,000	+ 6.3	16,504.5 tonnes	- 1.6
Dinners	$139,100,000	+ 7.2	36,207.9 tonnes	+ 6.7
Ice cream	$463,100,000	+ 3.9	119m units	+ 2.7
Pizza	$75,800,000	+ 6.2	20.4m units	+ 6.0
Vegetables	$258,700,000	+ 3.6	83,092 tonnes	+ 1.0
INTERNATIONAL MEALS				
Asian	$22,700,000	+ 19.3	4.9m kg	+ 20.9

	Grocery value	Value change (%)	Grocery volume	Volume change (%)
Indian meals	$27,700,000	+ 16.5	8,604 tonnes	+ 14.2
Mexican food & dips	$95,300,000	+ 8.7	38.6m units	+ 8.0
JAMS & SPREADS				
Honey	$60,400,000	+4.9	12,181.6 tonnes	+ 1.1
Jam	$119,300,000	+ 2.6	23,875.7 tonnes	+ 0.8
NOODLES				
Fresh	$19,300,000	+25.6	4,537 tonnes	+ 25.2
Shelf stable	$112,300,000	+ 7.8	17,544.8 tonnes	+ 6.0
HOT/COLD PACKS				
Canned meat	$3,790,000	+ 5.6	4,195 tonnes	+ 3.7
Baked beans	$78,100,000	- 0.3	31,177.7 tonnes	- 1.1
Canned meals	$38,500,000	+ 1.8	6,956 tonnes	+ 0.2
Spagetti	$52,800,000	- 0.1	20,956.7 tonnes	- 0.9
NOODLES				
Fresh	$19,300,000	+25.6	4,537 tonnes	+ 25.2
Shelf stable	$112,300,000	+ 7.8	17,544.8 tonnes	+ 6.0
PASTA/PASTA SAUCE				
Pasta	$148,600,000	+ 2.0	52,124 tonnes	+ 2.6
Pasta sauce	$17,200,000	- 1.8	1.94m kg	- 2.6
POTATO				
Canned	$10,100,000	+ 1.2	2,664.3 tonnes	- 1.6
Frozen	$110,800,000	+ 11.3	40,275 tonnes	+ 9.5
RICE				
Dry	$94,400,000	+ 4.4	61,866.8 tonnes	+ 1.1
Value-added rice	$27,800,000	+ 9.1	1.4m doz std pack equiv	+ 5.5
SAVOURY PASTRIES FROZEN	$154,000,000	+ 7.0	33,633.3 tonnes	+ 4.0
SIMMER SAUCES				
Dry	$16,700,000	+ 0.4	671.4 kg	+ 0.5
Wet	$62,200,000	+ 12.6	11.1m kg/litres	+ 10.0
SMALLGOODS				
Total	$218,400,000	+ 8.6	25,291 tonnes	+ 2.2
Bacon	$61,000,000	+ 10.1	5,999.6 tonnes	+ 4.1
Continental meats	$31,700,000	+ 8.2	4,285.2 tonnes	+ 2.8
Lunch meat	$14,600,000	- 2.9	4,802.4 tonnes	- 0.6
Salami knob	$11,900,000	+ 7.0	907.3 tonnes	+ 0.9
Sausages & frankfurters	$19,200,000	+ 14.3	3,118.4 tonnes	+ 8.6
Shaved meat	$26,300,000	+ 28.2	1,286.5 tonnes	+ 26.2
Sliced meat	$29,500,000	+ 3.8	1,881.5 tonnes	- 2.6
SNACK FOODS				
Nutritious	$281,800,000	+ 21.7	20,878 tonnes	+ 17.5
Nuts	$82,100,000	+ 2.0	7,586 tonnes	- 2.7
Salty snacks	$487,500,000	+ 5.4	26,658.2 tonnes	+ 6.9
SOUP				
Canned	$112,400,000	+ 7.8	31,730 tonnes	+ 3.3

	Grocery value	Value change (%)	Grocery volume	Volume change (%)
Packet/dry	$64,700,000	+ 9.7	2.8m doz equiv units	+ 3.7
SWEETENERS				
Sugar	$153,100,000	- 1.9	126,243.7 tonnes	- 1.6
Sugar substitutes	$27,800,000	+ 1.5	1,430.9m tsp	+ 1.9
YEAST SPREADS	$78,500,000	+ 2.9	6,624.2 tonnes	+ 0.9

Appendix 2

Table 1 AusHort non-processed fresh exports grouped by industry

ahecc	AusHort fresh exports, grouped by industry	AusHort crop	Processed	2000	1999	1998	1997	1996
08081001	Fresh Delicious apples (red, ordinary, golden, earlidel)	A&P	no	$19,103,049	$9,314,292	$10,075,554	$12,495,070	$10,921,013
08082002	Fresh Packham pears	A&P	no	$15,539,365	$12,829,819	$14,156,392	$18,066,166	$22,279,686
08081005	Fresh apples (excl. Delicious (red, ordinary, golden, earlidel), Democrat, Fuji and Granny Smith)	A&P	no	$14,070,511	$15,330,725	$17,277,650	$14,265,624	$9,109,869
08082001	Fresh Buerre Bosc pears	A&P	no	$5,217,631	$4,750,316	$4,853,750	$5,975,110	$3,986,548
08081004	Fresh Granny Smith apples	A&P	no	$3,001,629	$1,996,507	$4,884,287	$4,622,768	$3,451,678
08081003	Fresh Fuji apples	A&P	no	$2,939,167	$2,791,182	$1,734,358	$1,693,200	$1,363,977
08082005	Other fresh pears (excl. Buerre Bosc, Packham and Nashi Pears) and quinces	A&P	no	$1,526,958	$2,168,585	$1,376,055	$1,563,239	$1,007,045
08081002	Fresh Democrat apples	A&P	no	$1,487,968	$1,216,663	$486,982	$1,156,550	$1,087,931
08082004	Fresh Nashi pears	A&P	no	$795,597	$942,568	$714,741	$1,257,874	$774,964
	Total for fresh Apples & Pears			**$63,681,875**	**$51,340,657**	**$55,559,769**	**$61,095,601**	**$53,982,711**
08021100	Fresh or dried almonds, in shell	Alm	no	$3,151,837	$5,925,774	$11,312,142	$5,865,093	$166,228
08044000	Avocados, fresh or dried	Ava	no	$740,750	$228,343	$313,495	$271,736	$393,971
08030000	Fresh or dried bananas (incl. plantains)	Ban	no	$48,672	$134,992	$91,654	$339,808	$752,547
08029090	Nuts, fresh or dried, whether or not shelled or peeled (excl. almonds, hazlenuts or filberts, walnuts, chestnuts, pistachios and pecans)	Chn	no					
23081000	Acorns and horse-chestnuts	Chn	no		$3,925	$10,440		$71,820
08024000	Fresh or dried chestnuts	Chn	no	$39,810	$27,098	$34,807	$38,892	$115,417
	Total for fresh Chestnut			**$39,810**	**$31,023**	**$45,247**	**$38,892**	**$187,237**
08092000	**Fresh Cherries**	**Chy**	**no**	**$5,946,800**	**$4,181,094**	**$5,495,450**	**$4,647,793**	**$3,296,326**
08051000	Fresh or dried oranges	Cit	no					
08051010	Navel oranges, fresh or dried	Cit	no	$107,340,329	$83,482,017	$77,088,516	$68,243,205	$70,308,536
08052000	Fresh or dried mandarins (incl. tangerines and satsumas), clementines, wilkings and similar citrus hybrids	Cit	no	$36,490,785	$26,387,537	$18,366,327	$23,159,277	$19,673,778
08051020	Valencia oranges, fresh or dried	Cit	no	$29,059,627	$40,856,609	$43,671,027	$27,278,687	$36,913,912
08053000	Fresh or dried lemons and limes	Cit	no	$4,313,005	$7,511,568	$5,532,061	$5,063,703	$4,981,220
08051090	Oranges (excl. navel and valencia), fresh or dried	Cit	no	$1,805,837	$805,091	$724,287	$2,600,384	$2,723,840

ahecc	AusHort fresh exports, grouped by industry	AusHort crop	Processed	2000	1999	1998	1997	1996
08059000	Fresh or dried citrus fruit nes	Cit	no	$979,826	$931,193	$1,310,151	$5,962,745	$3,973,707
08054000	Fresh or dried grapefruit	Cit	no	$173,955	$92,001	$307,000	$154,663	$212,939
	Total for fresh Citrus			**$180,163,364**	**$160,066,016**	**$146,999,369**	**$132,462,664**	**$138,787,932**
08093000	Fresh peaches (incl. nectarines)	Fst	no					
08094010	Fresh plums	Fst	no		$17,448,744	$12,811,260	$11,807,349	$9,667,889
08094020	Fresh sloes	Fst	no			$3,300	$8,000	$9,550
08093020	Fresh nectarines (excl. peaches)	Fst	no	$16,738,974	$12,808,980	$5,913,688	$1,479,949	$1,668,865
08094000	Fresh plums and sloes	Fst	no	$15,989,441	$241,202			
	Total for fresh Stone Fruit			**$32,728,415**	**$30,498,926**	**$18,728,248**	**$13,295,298**	**$11,346,304**
08045010	Fresh guavas, mangoes and mangosteens	Man	no					
08045011	Fresh mangoes	Man	no	$11,469,564	$9,554,970	$11,633,386	$13,061,234	$8,789,859
08071020	Fresh melons (incl. watermelons), not pulped	Mel	no					$6,595,439
08071900	Fresh melons (excl. watermelons)	Mel	no	$14,984,747	$10,972,033	$10,300,374	$8,350,903	$3,985,079
08071100	Fresh watermelons	Mel	no	$1,209,311	$2,438,529	$2,528,694	$3,800,580	$3,002,136
	Total for fresh Melons			**$16,194,058**	**$13,410,562**	**$12,829,068**	**$12,151,483**	**$13,582,654**
08072000	Fresh pawpaws (papayas)	Paw	no		$1,206			
08072020	Fresh papaws (papayas), not pulped	Paw	no			$66,032	$156,583	$43,081
	Total for fresh Pawpaw	**Paw**		**$-**	**$1,206**	**$66,032**	**$156,583**	**$43,081**
08043010	**Fresh pineapples**	**Pin**	**no**	**$793**	**$171,564**	**$438,388**	**$185,170**	**$281,303**
07142000	Fresh or dried sweet potatoes	Pot	no					$5,642
07019000	Potatoes (excl. seed), fresh or chilled	Pot	no	$8,740,010	$8,893,538	$8,176,718	$8,042,955	$5,942,240
07011000	Seed potatoes, fresh or chilled	Pot	no	$5,957,622	$3,367,131	$2,531,027	$1,749,109	$1,349,422
07142001	Fresh, chilled, frozen or dried sweet potatoes	Pot	no	$1,820	$2,560			
	Total for fresh potatoes	**Pot**		**$14,699,452**	**$12,263,229**	**$10,707,745**	**$9,792,064**	**$7,297,304**
08101020	Fresh strawberries, not pulped	Str	no		$551,559	$8,291,019	$11,280,532	$9,788,524
08101000	Fresh strawberries	Str	no	$8,793,530	$4,145,935			
08093010	Fresh Peaches (excl. nectarines)	Str	no	$2,743,009	$2,235,969	$1,877,001	$1,868,121	$1,627,469
08091000	Fresh apricots	Str	no	$757,105	$430,049	$379,985	$436,218	$568,453
	Total for fresh strawberries			**$12,293,644**	**$7,363,512**	**$10,548,005**	**$13,584,871**	**$11,984,446**
07020000	**Tomatoes, fresh or chilled**	**Tof**	**no**	**$6,290,157**	**$7,669,352**	**$7,331,864**	**$8,885,524**	**$9,519,736**
07061010	Carrots, fresh or chilled	Veg	no		$20,655,271	$39,914,502	$32,206,627	$29,231,191
07061020	Turnips, fresh or chilled	Veg	no		$122,107	$41,683	$160,650	$15,335
07092000	Asparagus, fresh or chilled	Veg	no	$44,144,795	$46,397,784	$45,799,315	$30,698,852	$30,465,918

ahecc	AusHort fresh exports, grouped by industry	AusHort crop	Processed	2000	1999	1998	1997	1996
07061000	Carrots and turnips, fresh and chilled	Veg	no	$37,110,654	$20,354,431			
07041010	Cauliflowers, fresh or chilled	Veg	no	$26,105,678	$22,766,895	$22,528,316	$25,039,304	$24,872,162
07031011	Brown onions, fresh or chilled	Veg	no	$13,849,802	$14,131,618	$10,450,931	$4,149,906	$9,245,608
07041020	Headed broccoli, fresh or chilled	Veg	no	$13,525,735	$16,407,564	$17,490,335	$17,158,551	$18,670,812
07099000	Vegetables, nes, fresh or chilled	Veg	no	$10,683,066	$12,084,684	$17,158,532	$24,606,251	$19,654,432
07049010	Chinese cabbage, fresh or chilled	Veg	no	$5,265,182	$5,451,128	$5,767,353	$5,072,669	$5,962,604
07051100	Cabbage lettuce (head lettuce), fresh or chilled	Veg	no	$4,939,023	$4,472,138	$5,172,712	$5,014,653	$4,415,224
07081000	Peas, fresh or chilled	Veg	no	$3,012,688		$59,069	$26,580	$38,043
07051900	Lettuce (excl. cabbage (head) lettuce), fresh or chilled	Veg	no	$2,801,155	$2,364,806	$2,385,437	$2,562,180	$2,458,971
07096000	Fruits of the genus Capsicum or of the genus Pimenta, fresh or chilled	Veg	no	$2,187,709	$2,384,082	$2,039,543	$1,753,429	$1,559,439
07094000	Celery (excl. celeriac), fresh or chilled	Veg	no	$1,913,723	$1,993,870	$3,523,605	$2,294,056	$2,731,762
07049090	Cabbages (excl. chinese), kohlrabi, kale and similar edible brassica (excl. headed broccoli and brussels sprouts), fresh or chilled	Veg	no	$1,894,628	$2,176,236	$2,113,840	$2,237,781	$2,507,754
07082000	Beans, fresh or chilled	Veg	no	$1,715,802	$1,749,091	$1,741,898	$1,328,667	$1,696,782
07031019	Onions (excl. brown), fresh or chilled	Veg	no	$1,417,017	$13,943,109	$19,358,350	$6,127,578	$14,813,674
07069000	Salad beetroot, celeriac, radishes and similar edible roots (excl. carrots and turnips), fresh or chilled	Veg	no	$1,301,209	$1,733,697	$2,231,924	$1,981,764	$2,324,377
07039000	Leeks and other alliaceous vegetables (excl. onions, shallots and garlic), fresh or chilled	Veg	no	$1,116,692	$1,398,797	$1,190,077	$1,689,654	$1,590,282
07070000	Cucumbers and gherkins, fresh or chilled	Veg	no	$790,429	$885,130	$539,333	$532,475	$310,233
07032000	Garlic, fresh or chilled	Veg	no	$481,949	$800,819	$866,810	$499,365	$937,275
07042000	Brussels sprouts, fresh or chilled	Veg	no	$233,547	$262,395	$368,603	$372,047	$488,673
07091000	Globe artichokes, fresh or chilled	Veg	no	$217,822	$190,955	$39,976	$24,764	$34,681
12129900	Vegetable products used primarily for human consumption, nes	Veg	no	$216,834	$280,429	$271,125	$151,999	$102,805
07052900	Chicory (excl. witloof), fresh or chilled	Veg	no	$72,418	$141,984	$18,170		$11,500
07089000	Leguminous vegetables (excl. peas and beans), fresh or chilled	Veg	no	$40,880	$9,997	$9,938	$9,707	$2,666
07031020	Shallots, fresh or chilled	Veg	no	$35,035	$131,387	$25,928		$2,080
07052100	Witloof chicory, fresh or chilled	Veg	no	$27,246	$59,397	$26,817	$28,174	$18,504
07093000	Aubergines (egg-plants), fresh or chilled	Veg	no	$3,058	$1,110			$3,334
07097000	Spinach, New Zealand spinach and orache spinach (garden spinach), fresh or chilled	Veg	no	$2,908		$18,000		$5,692
	Total fresh Vegetables			**$175,106,684**	**$193,350,911**	**$201,152,122**	**$165,727,683**	**$174,171,813**

Table 2 Non AusHort non-processed fresh exports grouped by industry

ahecc	Non - AusHort Industries (fresh exports)	AusHort crop	Processed	2000	1999	1998	1997	1996	
07141001	Fresh, chilled, frozen or dried manioc (cassava)	Z	no				$27,882	$1,243	
07149000	Fresh or dried arrowroot, salep, Jerusalem artichokes and similar roots and tubers (excl. manioc and sweet potatoes); sago pith	Z	no					$23,386	
08011000	Fresh or dried coconuts	Z	no					$52,322	
08012000	Fresh or dried brazil nuts	Z	no					$155,421	
08013000	Fresh or dried cashew nuts	Z	no					$630,980	
08023100	Fresh or dried walnuts, in shell	Z	no		$12,729	$18,000	$1,413	$16,740	
08062010	Unseeded raisins	Z	no			$110,066	$17,665	$8,439	
08102020	Fresh raspberries, blackberries, mulberries and loganberries, not pulped	Z	no		$52,690	$299,710	$151,967	$106,965	
08103020	Fresh black, white or red currants and gooseberries, not pulped	Z	no		$960	$194,640	$36,640	$88,787	
08104020	Fresh cranberries, bilberries and other fruits of the genus Vaccinium, not pulped	Z	no		$279,807	$1,533,996	$214,553	$487,323	
08109020	other fruits not pulped	Z	no						
08109021	Fresh kiwi fruit, not pulped	Z	no					$1,892,427	
08061000	Fresh grapes	Z	no	$73,574,933	$68,053,397	$51,770,541	$66,499,068	$46,677,423	
08029021	Macadamia nuts, in shell	Z	no	$20,480,848	$8,952,507	$8,815,911	$7,598,506	$7,600,619	
08104000	Fresh cranberries, bilberries and other fruits of the genus Vaccinium	Z	no	$6,573,784	$4,087,189				
08105000	Kiwifruit	Z	no	$6,344,884	$3,831,349	$3,350,842	$1,820,301	$413,163	
08109022	Fresh fruit,(excl bananas, dates, figs, pineapples, avocados, guavas, mangoes, mangosteens, citrus, grapes, melons, papaws, apples, pears, quinces, apricots, cherries, peaches, nectarines, plums, sloe	Z	no	$6,276,698	$6,369,214	$9,667,727	$10,741,291	$6,719,620	
12071000	Palm nuts and kernels	Z	no	$3,078,113	$19,908	$29,859	$3,115	$900	
08029091	Nuts, fresh or dried, whether or not shelled or peeled (excl. almonds, hazelnuts or filberts, walnuts, chestnuts, pistachios, pecans and macadamias)	Z	no	$2,929,337	$4,001,375	$9,876,092	$8,940,132	$1,386,492	
07095100	Mushrooms, fresh or chilled	Z	no	$2,277,223	$2,124,981	$4,786,796	$1,887,890		
07149001	Fresh, chilled, frozen or dried arrowroot, salep, Jerusalem artichokes and similar roots and tubers (excl. manioc and sweet potatoes); sago pith	Z	no	$937,126	$648,575	$236,563	$12,005		
08025000	Fresh or dried pistachios	Z	no	$903,946	$379,839	$289,452	$418,395	$483,762	
08062011	Raisins	Z	no	$789,689	$653,707				
08045012	Fresh guavas and mangosteens (excl. mangoes)	Z	no	$584,174		$74,987	$12,880	$20,550	

ahecc	Non - AusHort Industries (fresh exports)	AusHort crop	Processed	2000	1999	1998	1997	1996	
08029011	Pecan nuts in shell	Z	no	$384,348	$739,199	$571,661	$1,018,010	$853,010	
08102000	Fresh raspberries, blackberries, mulberries and loganberries	Z	no	$318,701	$867,824				
08013100	Fresh cashew nuts in shell	Z	no	$147,308	$119,635	$76,348	$12,927	$11,986	
08041010	Fresh dates	Z	no	$124,508	$82,221	$58,577	$94,590	$125,097	
08011900	Coconuts other than desiccated (fresh or dried)	Z	no	$65,233	$36,698	$37,870	$6,147	$29,221	
08042000	Fresh or dried figs	Z	no	$52,005	$646,601	$1,098,905	$504,199	$264,318	
08022100	Fresh or dried hazelnuts or filberts, in shell	Z	no	$43,780	$59,433	$20,387	$65,000	$22,317	
08012100	Fresh brazil nuts in shell	Z	no	$37,859	$20,513			$18,068	
08103000	Fresh black, white or red currants and gooseberries	Z	no	$22,200					
12129100	Fresh or dried sugar beet	Z	no	$7,857					
12129200	Fresh or dried sugar cane	Z	no	$6,192	$23,112	$15,403	$15,540	$344,605	
	Total Fresh Non-AusHort			**$125,960,746**	**$102,063,463**	**$92,934,333**	**$100,100,116**	**$68,435,184**	
	Total Horticulture Exports Fresh			**$648,516,621**	**$598,255,594**	**$586,186,317**	**$541,661,613**	**$503,018,636**	

Table 3 AusHort processed fresh exports grouped by industry

ahecc	AusHort pocessed exports, grouped by industry	AusHort crop	Processed	2000	1999	1998	1997	1996	
20084000	Pears otherwise prepared or preserved, nes	A&P	yes	$32,056,939	$27,776,267	$37,297,989	$34,568,423	$31,086,552	
20097000	Apple juice, unfermented and not containing added spirit	A&P	yes	$11,507,376	$4,917,435	$4,869,857	$5,973,391	$6,665,016	
08133000	Dried apples	A&P	yes	$109,892	$56,636	$63,221	$80,123	$88,393	
	Total for Apples and Pears Processed			**$43,674,207**	**$32,750,338**	**$42,231,067**	**$40,621,937**	**$37,839,961**	
08021200	Fresh or dried almonds, shelled	Alm	yes	$7,348,777	$3,834,596			$14,767,963	
20089211	Peaches and pears combined (two fruits), canned or bottled but not pulped, otherwise prepared or preserved, nes	Cfr	yes		$1,220,781	$796,448	$998,990	$724,606	
20089212	Tropical fruit salad, canned or bottled but not pulped, otherwise prepared or preserved, nes	Cfr	yes		$326,022	$791,063	$534,671	$625,484	
20089213	Fruit salad (excl. tropical fruit salad), canned or bottled but not pulped, otherwise prepared or preserved, nes	Cfr	yes		$12,117,695	$21,543,844	$17,257,648	$18,265,905	
20089219	Fruit mixtures, canned or bottled but not pulped, otherwise prepared or preserved, nes	Cfr	yes		$1,833,302	$2,110,487	$1,144,293	$502,657	
20089921	Apples, canned or bottled but not pulped, otherwise prepared or preserved, nes	Cfr	yes		$303,449	$346,143	$575,046	$635,731	
20089922	Berry fruits (excl. strawberries), canned or bottled but not pulped, otherwise prepared or preserved, nes	Cfr	yes		$33,070	$44,340	$9,377	$7,593	
20089929	Fruit, canned or bottled but not pulped, otherwise prepared or preserved, nes	Cfr	yes		$309,576	$568,365	$418,356	$356,717	
20089215	Fruit salad, canned or bottled, (excl. pulped)	Cfr	yes	$23,228,163	$10,968,979				
20089216	Mixtures of fruit (excl. fruit salad), canned or bottled but not pulped	Cfr	yes	$3,047,045	$4,234,731				
20087000	Peaches otherwise prepared or preserved, nes	Cfr	yes	$19,424,916	$23,352,771	$16,689,336	$12,102,331	$12,525,461	
21069050	Fruit cordials	Cfr(*)	yes					$1,161,458	
21069051	Fruit cordials	Cfr(*)	yes			$1,362,934	$1,479,251	$638,571	
20099010	Fruit juice mixtures, unfermented and not containing added spirit	Cfr(*)	yes	$13,699,016	$11,460,813	$11,012,214	$14,826,007	$13,318,619	
21069052	Fruit cordials	Cfr(*)	yes	$12,337,603	$1,082,317				
20098010	Fruit juice, unfermented and not containing added spirit, (excl. citrus fruit, pineapple juice, tomato juice, apple juice or any single vegetable juice)	Cfr(*)	yes	$3,757,299	$9,749,281				

ahecc	AusHort pocessed exports, grouped by industry	AusHort crop	Processed	2000	1999	1998	1997	1996	
20079900	Jams, fruit jellies, fruit or nut puree and fruit or nut pastes (excl. citrus fruit and homogenised preparations), cooked	Cfr(*)	yes	$6,645,342	$7,484,514	$6,549,317	$8,841,374	$7,390,529	
20079100	Jams, jellies, marmalades, purees and pastes, of citrus fruit, cooked (excl. homogenised)	Cfr(*)	yes	$811,655	$815,504				
20089291	Mixtures of fruit and other edible parts of plants, prepared or preserved, whether or not containing added sugar, other sweetening matter or spirit	Cfr(*)	yes	$4,850,194	$3,675,606	$1,998,547	$950,094	$913,411	
20060010	Fruit preserved by sugar	Cfr(*)	yes	$4,436,922	$3,301,923	$3,443,485	$3,892,899	$3,311,808	
20071000	Homogenised preparations of jams, fruit jellies, marmalades, fruit or nut puree and fruit or nut pastes, cooked	Cfr(*)	yes	$1,627,547	$2,894,422	$3,677,582	$2,804,161	$2,375,215	
	Total for Canned Fruit Processed			**$93,865,702**	**$95,164,756**	**$70,934,105**	**$65,834,498**	**$62,753,765**	
20086000	Cherries otherwise prepared or preserved, nes	Chy	yes	$433,656	$250,708	$173,279	$228,075	$179,124	
08121000	Cherries provisionally preserved, but unsuitable in that state for immediate consumption	Chy	yes	$252,865	$299,037	$399,898	$206,579	$89,674	
	Total for Cherries Processed			**$686,521**	**$549,745**	**$573,177**	**$434,654**	**$268,798**	
20060021	Citrus fruit peel preserved by sugar	Cit	yes		$178,300	$707,217	$945,333	$1,197,782	
20079110	Marmalades (excl. homogenised preparations), cooked	Cit	yes		$441,556	$1,048,346	$921,941	$500,929	
20079190	Jams, jellies, purees and pastes of citrus fruit (excl. marmalades and homogenised preparations), cooked	Cit	yes		$490,474	$884,623	$1,001,038	$1,172,141	
20092010	Grapefruit juice, in containers not exc 4.6 l, unfermented and not containing added spirit	Cit	yes		$495,032	$277,836	$212,819	$213,946	
20092020	Grapefruit juice, in containers exc 4.6 l, unfermented and not containing added spirit	Cit	yes		$66,804	$119,310	$95,104	$577,263	
20093011	Lemon juice, in containers not exc 4.6 l, unfermented and not containing added spirit	Cit	yes		$228,666	$224,037	$161,839	$159,141	
20093019	Juice of any single citrus fruit (excl. orange, grapefruit and lemon juice), in containers not exc 4.6 l, unfermented and not containing added spirit	Cit	yes		$21,235	$173,161	$741,592	$280,447	
20093021	Lemon juice, in containers exc 4.6 l, unfermented and not containing added spirit	Cit	yes		$134,645	$668,281	$684,016	$506,541	
20093029	Juice of any single citrus fruit (excl. orange, grapefruit and lemon juice), in containers exc 4.6 l, unfermented and not containing added spirit	Cit	yes			$58,667	$209,892	$19,621	

ahecc	AusHort pocessed exports, grouped by industry	AusHort crop	Processed	2000	1999	1998	1997	1996	
20091910	Orange juice, in containers not exc 4.6 l, unfermented and not containing added spirit, not frozen	Cit	yes	$14,410,434	$15,856,008	$11,429,708	$11,452,660	$11,096,775	
20091920	Orange juice, in containers exc 4.6 l, unfermented and not containing added spirit, not frozen	Cit	yes	$4,967,092	$1,106,843	$1,581,240	$1,898,244	$1,138,751	
20092000	Grapefruit juice, unfermented and not containing added spirit	Cit	yes	$1,782,315	$271,481				
20093000	Juice of any single citrus fruit (excl. orange or grapefruit), unfermented and not containing added spirit	Cit	yes	$1,482,787	$423,910				
20091100	Frozen orange juice, unfermented and not containing added spirit	Cit	yes	$878,793	$703,180	$1,557,479	$2,557,441	$5,870,372	
08140000	Peel of citrus fruit or melons (incl. watermelons), fresh, frozen, dried or provisionally preserved	Cit	yes	$323,309	$57,477	$11,751	$1,055	$6,000	
20083000	Citrus fruit otherwise prepared or preserved, nes	Cit	yes	$48,082	$46,378	$25,348	$60,993	$157,022	
	Total for Citrus Processed			**$23,892,812**	**$20,521,989**	**$18,767,004**	**$20,943,967**	**$22,896,731**	
08134010	Dried peaches	Fst	yes		$2,605	$7,683	$145,792	$458,440	
20019020	Fruits, nes prepared or preserved by vinegar or acetic acid	Fst	yes		$80,575	$173,134	$170,692	$120,517	
20085000	Apricots otherwise prepared or preserved, nes	Fst	yes	$2,286,244	$2,870,150	$3,328,670	$3,482,895	$2,570,301	
08131000	Dried apricots	Fst	yes	$1,410,628	$1,216,176	$2,320,039	$2,106,842	$2,978,221	
08132000	Dried prunes	Fst	yes	$703,408	$514,140	$590,746	$585,946	$607,871	
08119000	Frozen fruit and nuts, uncooked or cooked by steaming or boiling in water (excl. strawberries, rasperries, blackberries, mulberries, loganberries, black, white or red curents and gooseberries)	Fst	yes	$752,426	$173,898				
20089290	Mixtures of fruit and other parts of plants (excl. canned, bottled and unpulped fruit), otherwise prepared or preserved, nes	Fst(*)	yes					$854,147	
20089998	Other fruit and edible parts of plants otherwise prepared or preserved, nes	Fst(*)	yes		$440,963	$799,674	$499,697	$424,343	
20089999	Fruits and other edible parts of plants otherwise prepared or preserved, nes	Fst(*)	yes					$28,307	
20089997	Fruit, nuts and other edible parts of plants, otherwise prepared or preserved (excl peanut butter)	Fst(*)	yes	$1,202,405	$452,081				
	Total for Stone Fruit Processed			**$6,355,111**	**$5,750,588**	**$7,219,946**	**$6,991,864**	**$8,042,147**	
08045020	Dried guavas, mangoes and mangosteens	Man	yes	$3,680	$554	$15,000	$28,260	$67,935	

ahecc	AusHort pocessed exports, grouped by industry	AusHort crop	Processed	2000	1999	1998	1997	1996	
08071010	Fresh melons (incl. watermelons), pulped	Mel	yes					$260,568	
08072010	Fresh papaws (papayas), pulped	Paw	yes				$5,618	$2,128	
08043020	Dried pineapples	Pin	yes			$3,560	$11,155	$34,536	
20082000	Pineapples otherwise prepared or preserved, nes	Pin	yes	$3,140,245	$4,768,749	$4,077,164	$3,601,032	$3,919,898	
20094000	Pineapple juice, unfermented and not containing added spirit	Pin	yes	$1,070,558	$1,455,609	$1,005,827	$1,016,840	$852,808	
	Total for Pineapples Processed			**$4,210,803**	**$6,224,358**	**$5,086,551**	**$4,629,027**	**$4,807,242**	
07121000	Dried potatoes	Pot	yes					$25,549	
11051000	Flour and meal of potatoes	Pot	yes					$543,676	
11052000	Flakes of potatoes	Pot	yes						
20041000	Potatoes prepared or preserved otherwise than by vinegar or acetic acid, frozen	Pot	yes	$7,249,978	$8,084,911	$7,328,365	$8,572,709	$9,962,624	
20052000	Potatoes prepared or preserved otherwise than by vinegar or acetic acid, not frozen	Pot	yes	$5,502,527	$2,450,961	$3,039,673	$819,625	$2,472,915	
07101000	Frozen potatoes, uncooked or cooked by steaming or boiling in water	Pot	yes	$1,189,288	$1,171,621	$1,324,131	$1,475,320	$1,194,962	
11051001	Flour, meal and powder of potatoes	Pot	yes	$121,756	$1,707,747	$1,809,904	$2,491,728	$762,660	
11081300	Potato starch	Pot	yes	$40,335	$5,991	$17,929		$1,160	
	Total for Potatoes Processed			**$14,103,884**	**$13,421,231**	**$13,520,002**	**$13,359,382**	**$14,963,546**	
08101010	Fresh strawberries, pulped	Str	yes		$4,355	$68,215	$170,398	$151,132	
08111010	Frozen strawberries, not containing added sugar, uncooked or cooked by steaming or boiling in water	Str	yes		$739	$155,097	$76,641	$37,428	
08111050	Frozen strawberries, containing added sugar, uncooked or cooked by steaming or boiling in water	Str	yes			$25,199		$24,841	
08111000	Frozen strawberries, uncooked or cooked by steaming or boiling in water	Str	yes	$95,343	$40,040				
20088000	Strawberries otherwise prepared or preserved, nes	Str	yes	$93,626	$156,812	$24,280	$16,825	$16,597	
08122000	Strawberries provisionally preserved, but unsuitable in that state for immediate consumption	Str	yes	$11,119			$2,887	$41,936	
	Total for Strawberries Processed			**$200,088**	**$201,946**	**$272,791**	**$266,751**	**$271,934**	
20029010	Tomato pulp, puree or paste; juice containing more than 7% by weight of dry solids	Top	yes		$4,928,549	$9,292,625	$2,101,218	$1,494,764	
20095000	Tomato juice, unfermented and not containing added spirit	Top	yes	$765,686	$574,001	$418,064	$340,387	$465,226	

ahecc	AusHort pocessed exports, grouped by industry	AusHort crop	Processed	2000	1999	1998	1997	1996	
20029000	Tomatoes, other than whole or in pieces, prepared or preserved otherwise than by vinegar or acetic acid	Top	yes	$2,767,243	$3,539,350				
20021000	Tomatoes, whole or in pieces prepared or preserved otherwise than by vinegar or acetic acid	Top	yes	$1,204,067	$775,997	$719,615	$1,293,817	$766,084	
20029090	Tomatoes, nes prepared or preserved otherwise than by vinegar or acetic acid	Top	yes		$41,455	$311,429	$152,761	$72,237	
	Total for Tomaotes Processed			**$4,736,996**	**$9,859,352**	**$10,741,733**	**$3,888,183**	**$2,798,311**	
07119010	Asparagus, provisionally preserved, but unsuitable in that state for immediate consumption	Veg	yes			$136,406	$8,771	$620	
07119020	Beans, provisionally preserved, but unsuitable in that state for immediate consumption	Veg	yes		$2,410	$6,395	$31,345	$3,473	
07119030	Peas, provisionally preserved, but unsuitable in that state for immediate consumption	Veg	yes			$133,550			
07119040	Sweet corn, provisionally preserved, but unsuitable in that state for immediate consumption	Veg	yes			$23,642	$244,370	$56,260	
07119090	Vegetables nes, and mixtures thereof, provisionally preserved, but unsuitable in that state for immediate consumption	Veg	yes		$268,662	$474,783	$208,089	$269,598	
07129000	Dried vegetables and mixtures thereof (excl. potatoes, onions, mushrooms and truffles)	Veg	yes					$391,763	
20019031	Asparagus prepared or preserved by vinegar or acetic acid	Veg	yes		$9,114	$4,832	$29,546	$15,854	
20019032	Beans prepared or preserved by vinegar or acetic acid	Veg	yes			$201,962	$271,511	$176,579	
20019039	Vegetables, nes prepared or preserved by vinegar or acetic acid	Veg	yes		$500,047	$1,822,425	$1,447,731	$1,345,768	
20049010	Beans prepared or preserved otherwise than by vinegar or acetic acid, frozen	Veg	yes					$55,728	
20049011	Beans prepared or preserved otherwise than by sugar, vinegar or acetic acid, frozen	Veg	yes		$525	$29,158	$74,148	$11,545	
20049020	Peas prepared or preserved otherwise than by vinegar or acetic acid, frozen	Veg	yes					$295,853	
20049030	Sweet corn prepared or preserved otherwise than by vinegar or acetic acid, frozen	Veg	yes					$154,211	
20049090	Vegetables, nes and mixtures prepared or preserved otherwise than by vinegar or acetic acid, frozen	Veg	yes					$508,844	

ahecc	AusHort pocessed exports, grouped by industry	AusHort crop	Processed	2000	1999	1998	1997	1996	
20049091	Vegetables prepared or preserved otherwise than by vinegar or acetic acid, frozen, other than products of 2006	Veg	yes		$929,146	$2,450,715	$3,873,603	$3,790,859	
20053000	Sauerkraut prepared or preserved otherwise than by vinegar or acetic acid, not frozen	Veg	yes						
20054000	Peas prepared or preserved otherwise than by vinegar or acetic acid, not frozen	Veg	yes					$116,427	
20055100	Shelled beans prepared or preserved otherwise than by vinegar or acetic acid, not frozen	Veg	yes					$57,639	
20055900	Beans (excl. shelled beans), prepared or preserved otherwise than by vinegar or acetic acid, not frozen	Veg	yes					$252,821	
20056000	Asparagus prepared or preserved otherwise than by vinegar or acetic acid, not frozen	Veg	yes					$29,972	
20058000	Sweet corn prepared or preserved otherwise than by vinegar or acetic acid, not frozen	Veg	yes					$563,597	
20059010	Vegetables with the addition of other foodstuffs prepared or preserved otherwise than by vinegar or acetic acid, not frozen	Veg	yes					$1,925,892	
20059011	Vegetables and mixtures of vegetables with the addition of other foodstuffs nes in chapter 20 of the AHECC, prepared or preserved otherwise than by sugar,vinegar or acetic acid, not frozen	Veg	yes		$36,744	$222,260	$504,804	$486,006	
20059090	Vegetables nes and mixtures of vegetables prepared or preserved otherwise than by vinegar or acetic acid, not frozen	Veg	yes					$688,510	
20059091	Vegetables & mixtures of vegetables(excl. homogenised vegetables,potatoes,peas,beans,asparagus,olives, & sweet corn),prepared or preserved otherwise by sugar,vinegar or acetic acid,& vegetables with t	Veg	yes		$795,514	$3,043,760	$3,359,398	$1,359,107	
20060091	Vegetables, Nuts and other parts of plants, preserved by sugar (drained, glace or crystallised)(excl. fruit, fruit peel and ginger)	Veg	yes		$31,281	$24,279	$25,663	$74,098	
21069020	Vegetable extracts, put up as prepared foodstuffs	Veg	yes					$643,415	
20098020	Juice of any single vegetable, unfermented and not containing added spirit	Veg	yes	$21,130,919	$3,412,422	$2,670,264	$1,398,723	$3,956,333	
23089000	Vegetable products used for animal food nes (excl. acorns and horse-chestnuts)	Veg	yes	$5,704,917	$3,242,847	$2,290,177	$992,402	$707,962	
07109000	Frozen mixed vegetables, uncooked or cooked by steaming or boiling in water	Veg	yes	$5,626,698	$5,915,982	$5,419,999	$3,451,218	$4,922,362	

ahecc	AusHort pocessed exports, grouped by industry	AusHort crop	Processed	2000	1999	1998	1997	1996	
20055901	Beans (excl. shelled beans), prepared or preserved otherwise than by sugar,vinegar or acetic acid, not frozen	Veg	yes	$4,488,950	$1,755,063	$1,820,482	$1,237,131	$154,822	
20099020	Vegetable juice mixtures, unfermented and not containing added spirit	Veg	yes	$3,085,584	$11,638,925	$12,463,540	$4,327,035	$7,931,575	
20049092	Vegetables prepared or preserved otherwise than by vinegar or acetic acid, frozen, other than products preserved by sugar (excl. potatoes, peas, and sweet corn)	Veg	yes	$2,984,418	$2,417,383				
07119000	Vegetables and mixed vegetables, provisionally preserved, but unsuitable in that state for immediate consumption (excl. onions, olives, capers, cucumbers and gerkins)	Veg	yes	$2,164,382	$334,559				
07104000	Frozen sweet corn, uncooked or cooked by steaming or boiling in water	Veg	yes	$1,751,817	$3,450,599	$3,549,129	$1,787,790	$897,598	
20058001	Sweet corn prepared or preserved otherwise than by sugar, vinegar or acetic acid, not frozen	Veg	yes	$1,637,188	$1,610,869	$1,692,854	$1,811,776	$671,833	
20049021	Peas prepared or preserved otherwise than by vinegar or acetic acid, frozen, other than products of 2006	Veg	yes	$1,607,825	$95,973	$2,251,681	$3,266,794	$633,101	
20012000	Onions prepared or preserved by vinegar or acetic acid	Veg	yes	$1,586,584	$51,451	$37,141	$8,388	$35,700	
21069021	Vegetable extracts, put up as prepared foodstuffs	Veg	yes	$1,495,571	$1,490,917	$3,731,713	$1,900,146	$936,699	
07129001	Dried vegetables and mixtures thereof (excl. onions, mushrooms and truffles)	Veg	yes	$1,258,554	$2,792,474	$1,679,420	$2,973,593	$646,085	
07114000	Cucumbers and gherkins, provisionally preserved, unsuitable in that state for immediate consumption	Veg	yes	$1,126,966	$512,791	$204,173	$31,485	$19,407	
07111000	Onions, provisionally preserved, but unsuitable in that state for immediate consumption	Veg	yes	$938,518	$143,041	$88,931	$49,651	$98,177	
20059000	Vegetables and mixtures of vegetables prepared or preserved otherwise than by sugar, vinegar or acetic acid, not frozen (excl. homogenised vegetables, potatoes, peas, beans, asparagus, olives and sweet corn)	Veg	yes	$572,248	$595,712				
07108000	Frozen vegetables (excl. potatoes, leguminous, spinach and sweet corn), uncooked or cooked by steaming or boiling in water	Veg	yes	$519,133	$1,599,009	$1,218,591	$960,217	$1,194,285	
07102900	Frozen leguminous vegetables (excl. peas and beans), uncooked or cooked by steaming or boiling in water	Veg	yes	$341,544	$123,800		$39,735	$270,425	

ahecc	AusHort pocessed exports, grouped by industry	AusHort crop	Processed	2000	1999	1998	1997	1996	
07102100	Frozen peas, uncooked or cooked by steaming or boiling in water	Veg	yes	$328,426	$774,948	$114,786	$123,343	$115,635	
20055101	Shelled beans prepared or preserved otherwise than by sugar, vinegar or acetic acid, not frozen	Veg	yes	$327,299	$100,818	$75,391	$148,158	$83,742	
07102200	Frozen beans, uncooked or cooked by steaming or boiling in water	Veg	yes	$303,712	$300,816	$380,952	$144,878	$247,801	
20031000	Mushrooms prepared or preserved otherwise than by vinegar or acetic acid	Veg	yes	$277,874	$404,047	$625,168	$338,620	$655,067	
20011000	Cucumbers and gherkins prepared or preserved by vinegar or acetic acid	Veg	yes	$270,838	$348,585	$364,519	$91,614	$63,423	
20054001	Peas prepared or preserved otherwise than by sugar,vinegar or acetic acid, not frozen	Veg	yes	$156,455	$1,156,272	$495,776	$101,150	$55,890	
20051000	Homogenised vegetables prepared or preserved otherwise than by vinegar or acetic acid, not frozen	Veg	yes	$137,012	$106,318	$103,025	$76,514	$65,241	
20049031	Sweet corn prepared or preserved otherwise than by vinegar or acetic acid, frozen, other than products of 2006	Veg	yes	$106,530	$74,208	$1,476,568	$291,985	$95,515	
07122000	Dried onions	Veg	yes	$96,993	$256,779	$144,490	$390,942	$261,870	
20056001	Asparagus prepared or preserved otherwise than by sugar, vinegar or acetic acid, not frozen	Veg	yes	$29,325	$102,055	$165,643	$56,231	$151,416	
07103000	Frozen spinach, New Zealand spinach and orache spinach (garden spinach), uncooked or cooked by steaming or boiling in water	Veg	yes	$6,266	$14,115	$6,096	$8,198	$26,784	
20019080	Vegetables, fruit, nuts and other edible parts of plants, prepared or preserved by vinegar or acetic acid (excl cucumbers and gherkins, onions, pickles and chutney)	Veg	yes	$3,277,977	$1,529,362				
20060092	Vegetables, fruit peel, nuts, and other parts of plants, preserved by sugar(excl fruit, and ginger)	Veg	yes	$241,804	$45,637				
20019010	Pickles and chutney prepared or preserved by vinegar or acetic acid	Veg	yes	$1,466,407	$1,177,154	$2,020,139	$1,556,783	$416,733	
	Total for Vegetables Processed			**$65,048,734**	**$50,148,374**	**$53,664,815**	**$37,643,479**	**$38,589,920**	

Table 4 Non AusHort processed fresh exports grouped by industry

ahecc	Non - AusHort Industries (processed exports	AusHort crop	Processed	2000	1999	1998	1997	1996	
15162060	Vegetable fats and oils and their fractions; wholly or partly hydrogenated or solidified or hardened by any other process; or prepared waxes, not emulsified or containing solvents(excl. fixed oils)	Z	yes	$354,636	$108,868				
15162050	Fixed vegetable fats and oils and their fractions, hydrogenated, inter-esterified, re-esterified or elaidinised but not further prepared (excl. cotton-seed and safflower-seed)	Z	yes	$1,900,224	$583,105				
08129000	Fruit nes, and nuts provisionally preserved, but unsuitable in that state for immediate consumption	Z	yes	$133,133	$54,754	$402,568	$590,528	$43,444	
08109011	Fresh fruit pulped(excl. bananas, dates, figs, pineapples, avocados, guavas, mangoes, mangosteens, citrus, grapes, melons, pawpaws, apples, pears, quinces, apricots, cherries, peaches, nectarines, plu	Z	yes	$32,187	$41,482	$84,453	$139,867		
08134000	Dried fruit (excl. apricots, prunes, apples, bananas, dates, figs, pineapple, avacado, guava, mangoes, mangosteens, citrus fruits and grapes)	Z	yes	$82,331	$49,689				
08112000	Frozen raspberries, blackberries, mulberries, loganberries, black, white or red currants and gooseberries, uncooked or cooked by steaming or boiling in water	Z	yes	$126,790	$52,002				
20081100	Ground-nuts otherwise prepared or preserved, nes	Z	yes	$331,523	$632,990	$457,632	$478,355	$936,893	
08062020	Seeded raisins	Z	yes		$465,813	$1,042,412	$1,347,625	$1,043,592	
08062030	Currants (dried grapes)	Z	yes		$256,452	$180,716	$144,394	$1,362,084	
08062050	Dried mixed fruits (grapes)	Z	yes		$29,258	$28,039	$23,417	$70,661	
08102010	Fresh raspberries, blackberries, mulberries and loganberries, pulped	Z	yes				$26,757	$114,143	
08103010	Fresh black, white or red currants and gooseberries, pulped	Z	yes		$8,500			$41,552	
08104010	Fresh cranberries, bilberries and other fruits of the genus Vaccinium, pulped	Z	yes				$35,190	$35,000	
08109010	Fresh fruit pulped(excl. bananas, dates, figs, pineapples, avocados, guava s, mangoes, mangosteens, citrus, grapes, melons, pawpaws, apples, pears, quinces, apricots, cherries, peaches, nectarines, pl	Z	yes					$243,569	

ahecc	Non - AusHort Industries (processed exports	AusHort crop	Processed	2000	1999	1998	1997	1996	
08112010	Frozen raspberries, blackberries, mulberries, loganberries, gooseberries and black, white or red currants, not containing added sugar, uncooked or cooked by steaming or boiling in water	Z	yes		$47,462	$279,747	$172,846	$81,400	
08112050	Frozen raspberries, blackberries, mulberries, loganberries, gooseberries and black, white or red currants, containing added sugar, uncooked or cooked by steaming or boiling in water	Z	yes			$540	$82,638	$6,112	
08119010	Frozen fruit nes, and nuts, not containing added sugar, uncooked or cooked by steaming or boiling in water	Z	yes		$469,434	$698,380	$545,085	$465,072	
08119050	Frozen fruit nes, and nuts, containing added sugar, uncooked or cooked by steaming or boiling in water	Z	yes			$1,667	$92,642	$59,208	
08134090	Dried fruit (excl. apricots, prunes, apples and peaches), other than of 0801 to 0806	Z	yes		$42,808	$1,412,582	$3,824,298	$7,293,633	
11062000	Flour and meal of sago, roots or tubers of 0714	Z	yes						
11063000	Flour, meal and powder of the products of Chapter 8	Z	yes					$72,162	
11081400	Manioc (cassava) starch	Z	yes						
20019090	Nuts and other edible parts of plants prepared or preserved by vinegar or acetic acid	Z	yes		$191,251	$564,447	$511,749	$394,261	
20032000	Truffles prepared or preserved otherwise than by vinegar or acetic acid	Z	yes					$2,836	
20060029	Fruit peel (excl. citrus fruit peel), preserved by sugar	Z	yes		$2,137	$18,779	$144,505	$44,751	
20060090	Nuts and other parts of plants, preserved by sugar (drained, glace or crystallised) (excl. fruit, fruit peel and ginger)	Z	yes					$33,836	
20098011	Blackcurrant juice, unfermented and not containing added spirit	Z	yes		$52,342	$638,447	$71,657	$78,106	
20098019	Juice of any single fruit nes, unfermented and not containing added spirit	Z	yes		$2,424,427	$7,205,502	$10,604,735	$14,800,700	
08029022	Macadamia nuts, shelled	Z	yes	$68,066,838	$54,072,391	$42,589,126	$47,457,351	$45,505,927	
08062040	Sultanas	Z	yes	$17,031,394	$17,864,713	$36,085,867	$34,909,844	$45,344,624	
20096000	Grape juice (incl. grape must), unfermented and not containing added spirit	Z	yes	$11,243,014	$11,687,698	$9,971,640	$10,364,981	$7,693,124	
20060030	Ginger preserved by sugar	Z	yes	$5,877,464	$5,240,451	$4,554,611	$4,119,790	$4,863,777	
20089910	Ginger in syrup, nes	Z	yes	$4,391,954	$6,160,187	$5,684,528	$5,824,639	$3,181,978	
20081900	Nuts (excl. ground-nuts), other seeds and mixtures thereof, otherwise prepared or preserved, nes	Z	yes	$4,215,847	$5,151,244	$6,893,407	$5,555,998	$5,201,618	
20089991	Peanut butter	Z	yes	$4,059,420	$4,687,156	$2,333,422	$2,371,532	$1,843,521	

ahecc	Non - AusHort Industries (processed exports	AusHort crop	Processed	2000	1999	1998	1997	1996	
08029019	Pecan nuts, shelled	Z	yes	$2,085,505	$5,896,433	$2,595,782	$2,893,336	$2,290,663	
08011100	Desiccated coconuts	Z	yes	$452,850	$168,474	$44,849	$104,608	$20,553	
08062090	dried grapes (excl. rasins and sultanas)	Z	yes	$452,487	$57,611				
11081900	Starches (excl. wheat, maize (corn), potato and manioc (cassava))	Z	yes	$160,678	$150,544	$742,132	$874,329	$366,458	
11052001	Flakes, granules and pellets of potatoes	Z	yes	$123,490	$160,217	$67,146	$58,757	$16,046	
08135000	Mixtures of edible dried fruits and nuts	Z	yes	$105,059	$37,184	$83,424	$144,378	$235,183	
08013200	Fresh or dried cashew nuts shelled	Z	yes	$84,049	$370,002	$901,105	$30,051	$25,149	
07112000	Olives, provisionally preserved, but unsuitable in that state for immediate consumption	Z	yes	$69,735	$30,391	$102,200	$13,309	$27,897	
08023200	Fresh or dried walnuts, shelled	Z	yes	$64,966	$93,628	$148,788	$151,615	$69,729	
08012200	Fresh or dried brazil nuts shelled	Z	yes	$25,303	$33,712	$57,970	$111,504	$21,595	
07123000	Dried mushrooms and truffles	Z	yes	$20,974	$57,813	$37,937	$54,531	$169,264	
08041020	Dried dates	Z	yes	$20,655	$114,777	$163,227	$161,495	$71,460	
07113000	Capers, provisionally preserved, but unsuitable in that state for immediate consumption	Z	yes	$15,803	$2,635	$9,195	$585	$2,631	
11063001	Flour, meal and powder of the products of chapter 08 (edible fruit and nuts; peel of citrus fruit or melons)	Z	yes	$14,001	$1,564	$54,776	$34,853	$8,998	
08022200	Fresh or dried hazelnuts or filberts, shelled	Z	yes	$11,382	$138,012	$163,297	$164,872	$182,094	
20089100	Palm hearts otherwise prepared or preserved, nes	Z	yes	$899		$25,545	$7,150	$20,450	
	Total for Z Processed			**$121,554,591**	**$117,689,611**	**$126,325,885**	**$134,245,796**	**$144,385,754**	
	Horticulture Exports Processed			**$385,678,226**	**$356,116,884**	**$349,337,076**	**$328,859,538**	**$352,386,072**	

AusHort Industry	Code	AusHort Industry	Code
Almond	Alm	Melon	Mel
Apple & pear	A&P	Passionfruit	Pas
Avacado	Ava	Pawpaw	Paw
Banana	Ban	Pineapple	Pin
Canning Fruit	Cfr	Potato	Pot
Cherry	Chy	Fresh stone fruit	Fst
Chestnut	Chn	Strawberry	Str
Citrus	Cit	Tomato - fresh	Tof
Custard Apple	Cap	Tomato - processed	Top
Macadamia	Mac	Vegetable	Veg
Mango	Man		