



Australian Government

**Rural Industries Research and
Development Corporation**

Potential for Watercress Production in Australia

Scoping Study – June 2006

**A report for the Rural Industries Research
and Development Corporation**

John F M Fennell

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Foreword

Healthy and casual eating is very much a way of Australian life. Novel crops that offer new tastes and significant health benefits are always worthy of consideration. Watercress is a long established traditional salad crop in other parts of the world but is used in very limited quantities in Australia. Those people “in the know” that use it have generally encountered it from their overseas experiences. This book brings together available information about watercress production, its potential health benefits and the opportunities for it to take greater prominence in the Australian diet either as a flavoursome salad or in new cooked recipes.

The Rural Industries Research and Development Corporation invests in new and emerging industries on behalf of government and industry stakeholders. New industries provide opportunities to be captured by rural producers and investors. They also provide avenues for farmers facing adjustment pressure to diversify and manage change. The establishment of new industries contributes to community resilience and regional development. Increasingly, new industries are also contributing to a distinctive regional character in rural Australia.

New industries face a number of challenges – developing product quality and quantity, developing markets and supply chains, and industry leadership. Many of these issues are underpinned by research and development. Often, too, they are hampered by a lack of basic statistical information, which is why RIRDC has invested in this report.

The importance of this report is that it provides that basic information to stimulate investment into watercress production and marketing. The report will also help to inform RIRDC as it plans its research and development priorities into the future.

This project was funded from industry revenue which is matched by funds provided by the Australian Government.

This report, an addition to RIRDC’s diverse range of over 1500 research publications, forms part of our New Plant Products R&D program, which aims to facilitate the development of new industries based on plants or plant products that have commercial potential for Australia.

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Peter O’Brien

Managing Director

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Executive Summary

What the report is about...

Healthy and casual eating is very much a way of Australian life. Novel crops that offer new tastes and significant health benefits are always worthy of consideration. Watercress is a long established traditional salad crop in other parts of the world but is used in very limited quantities in Australia. Some may be wild harvested and may pose food safety issues but there are also hydroponic salad producers that produce small quantities of quality watercress to meet the current low level of demand.

Watercress may have considerable potential for expansion of production as consumers become aware of its attributes.

Who is the report targeted at?

This study was undertaken to assemble available information that would be useful for potential investors wishing to consider the potential for watercress production and marketing in Australia.

Background

There is an increasing interest in mixed salads in Australia and watercress may find a place as an important component of these mixes. This has certainly been the situation in the United Kingdom where mixed bags of watercress, rocket and baby spinach leaf form the most popular combination.

Aims/Objectives

This report aims to bring together available information about watercress production methods that are used in traditional production areas overseas. Also, the authors have investigated the potential health benefits of watercress and the opportunities for it to take greater prominence in the Australian diet, either as a flavoursome salad or in new cooked recipes.

Methods

This study has been based upon literature and website searches, correspondence with overseas producers and a visit to a major producer and marketer of watercress in the UK. Consumer research was also undertaken on a limited scale by New Focus Pty Ltd (www.newfocus.com.au) with four focus groups of grocery buyers in Melbourne and Adelaide for their responses to watercress, spinach, rocket and a salad mix containing watercress.

The industry partner to this project, Holla Fresh Pty Ltd, undertook hydroponic production of watercress with market testing to prove product potential.

Key Findings

Watercress is relatively easy to grow.

Whilst there is opportunity for watercress to be produced using hydroponic systems it is likely that the most cost competitive production would be achieved using traditional gravel beds combined with mechanical harvesting and handling. This statement, however, needs to be viewed with the understanding that hydroponics offers greater water-use efficiency and that mechanisation may be possible with some ingenuity. Hydroponic production is likely to offer the best first stage whilst the crop gains acceptance in the Australian market.

Watercress production may also offer opportunities for multiple water use in combination with other horticultural or aquaculture enterprises.

Strong consideration must be given to effective cool chain handling for successful presentation of the product through to the retail outlet and beyond to the consumer.

Future validation of the health benefits attributed to watercress is likely to encourage demand for this crop.

Results from the consumer trials done as part of this study indicate that some consumers enjoyed the taste of watercress but others found it to be too strong. The key finding was that consumers considered that watercress would be most acceptable when incorporated into a mix. This finding is consistent with the main way that watercress is sold in the UK supermarkets.

Recommendations

Watercress offers a new taste opportunity for Australian consumers and has potential. Acceptance of this crop would be enhanced by promotion of its benefits and the best way to use it. The food service industry, such as restaurants, can play an important role in presenting this crop to consumers in salad or cooked form through its use in meal experiences.

Introduction

Watercress

Family: Cruciferae

Rorippa nasturtium-aquaticum (L.) Hayek

Synonyms:

Nasturtium aquaticum, *N. officinale*, *Sisymbrium nasturtium-aquaticum*,
Radicula nasturtium..and various combinations of these names.

French *Cresson*, *Cresson de Eau*; German *Wasserkresse*; Dutch *Waterkers*; Italian *Crescione*; Spanish *Berro*; Portuguese *Agroiao*; Cantonese '*tsai yeung choy*'; Thailand *phakkat-nam*; Vietnamese '*xa lach son*'; Indonesian *selada air*; Philippines *Lampaken*; Japan *Votakuresu*.

Other names include *Brooklime*, *Cress*, *Habb Ar Rashad*, *Hurf Al May* and *Suteresi*

Rorippa nasturtium-aquaticum has largely replaced the use of *Rorippa microphylla* (commonly known as Brown Cress), which is sterile and propagated solely by vegetative methods.

The Plant

Watercress is an aquatic, hardy perennial with succulent, hollow branching stems. The creeping or floating stems root easily and bear fleshy, shiny, heart-shaped leaves. The leaves are very dark green or bronze, with a distinctive peppery taste. The floating, trailing stems and foliage of watercress may grow to a metre long, but usually only the top 100 to 150mm are visible above the water's surface. From early summer to mid-autumn, clusters of small white to purplish white flowers appear at the tips of the stems. They are characteristically mustard-like, each with four petals, and borne in clusters on terminal stalks that arise from the upper leaf axils. The flowers are hermaphrodite and are pollinated by insects. Watercress is self-fertile. The fruits are linear, 20 to 30mm long capsules, each containing two rows of tiny seeds.

Natural habitat

The plant is reasonably tolerant of frost and has been reported to survive temperatures as low as -15 degrees C. It prefers to grow in slowly flowing clean water about 5cm deep with an optimum pH 7.2. It therefore favours growing in streams fed from springs coming from chalk or limestone substrata.

The plant occurs naturally in Europe (including Britain) and Asia. Its current distribution is now reported to include parts of Africa, Dominican Republic, Haiti, Hawaii, Iraq, Mexico, USA and Venezuela, possibly as a result of introduction as a cultivated plant (www.ibiblio.org).

History of Cultivation and Use

Watercress is a popular salad vegetable in Europe and is also popularly used in Asian cooking. The leaves, rich in minerals and vitamins C and A have been prized since Roman times for biting, rich flavour, raw or cooked as a vegetable and in soup. Watercress was used by the early Greeks and is still popular in Greece today. Cress adds a peppery flavour to everything. Traditionally it was used to garnish parsnips or, in Ireland, boiled with bacon. In England it was considered a poor man's food and often eaten in sandwiches. Now it is used in soups, salads, sandwiches or stir-fries and has had a rapid upsurge in popularity in recent times driven by a shift towards salads and increased recognition of health benefits.

Commercial Cultivation

Commercially grown watercress is traditionally grown in prepared beds fed by clean, running water. The wild plant, however, may grow in still water of questionable quality and carry deadly parasites such as liver flukes, which are spread from cattle and sheep by water snails. Consumption of watercress was once a common source of typhoid infection.

Consumers should avoid wild-harvested watercress in favour of commercially produced product based upon appropriate HACCP principles that minimises the risks of human health issues.

Cultivation can be from seedlings or rooted plant pieces. They are traditionally planted into gravel beds irrigated with flowing water but can also be grown in trenches of fertile moist soil or hydroponically.

Watercress is a marginal plant and derives most of its nutrients from the water through roots embedded in the gravel. It also throws out aerial roots, tiny sprouts from the stem, to enable it to absorb even more nutrients. The plant does, however, respond positively to fertiliser application.

The Taste of Watercress

Watercress is a plant that is most usually eaten as a salad vegetable without cooking. However its use in cooked dishes is being increasingly exploited and has long been used this way in Asian cooking. Watercress soups are a popular use for the plant. Watercress is a nutritious foodplant and a valuable source of vitamins, minerals and fibre.

Watercress is a leafy paradox; as a fresh salad vegetable it is both cool, when first experienced and then hot, when chewed.

Pungency is an obvious characteristic of this plant and, like most brassicas, derives this from compounds called glucosinolates. Watercress has a strong, but pleasant, peppery taste. Crushing the cells of watercress releases the enzyme myrosinase, which in turn breaks down glucosinolates to form phenyl ethyl isothiocyanate (PEITC), thus enhancing the likely dose of taste-giving and beneficial compounds. Crushing or chopping has no detrimental impact upon the other vitamins and minerals and makes the watercress easier to digest.

UK producers believe that taste is enhanced when the crop grows slowly, especially during winter and that older leaves are more pungent than young leaves. There is also evidence that sulphur nutrition may enhance flavour (Freeman & Mossadeghi 1972). Similar effects have been shown in other Brassica crops (Mailer, 1989).

Watercress Seed Production

Watercress is a “long-day” plant which flowers in response to increasing the daylength in spring and summer (Bleasdale 1964). Growers have selected late flowering strains to minimise flowering during crop production. This increases the need for longer day lengths to initiate flower development and decreases the period available for seed production with this material. However, watercress seed production is generally straightforward. Deteriorating watercress beds with depleted plant populations may be left to go to flower for seed production. It is normal practice to rogue the plants to remove any that show symptoms of virus (although the most common virus, turnip mosaic virus is not seed transmitted), pale foliage or premature flowering.

Watercress flowers can be self- or cross-pollinated, and insects are the pollination agents (Johnson 1974). Seed pods of watercress are prone to shattering. Harvest is therefore timed when the seed has coloured (to a yellow or ochreous colour) but pods are still slightly leathery. The harvested stems are placed on sheets where further drying can occur and the seeds turn to a brown colour. When the pods are dry the seed can be extracted by basic seed threshing and cleaning equipment.

Watercress Production

Watercress Production in the United Kingdom

Information in this section has been obtained through the generous assistance of The Watercress Company, Geest PL and from literature and internet sources.

An old, but useful publication is the Watercress Reference Book (ADAS/MAFF, 1983). This summarises ADAS Reports on watercress experiments from 1969-70 to 1980-81.

Site selection

Watercress is traditionally grown in the chalk and limestone areas of Southern England where high quality alkaline water can be sourced from boreholes, generally in large quantity. This water is rich in trace elements and has a year round temperature of about 10 to 11.5 degrees Centigrade.

The water characteristics from chalk streams are typically:

pH	7.2 (may be as low as 6.0 from Greensands)
Nitrate	8.0 ppm
Phosphorus	0.01 ppm (slightly higher from Greensands)
Potassium	0.90 ppm

Watercress does not tolerate salinity and eC's are generally 1.6 to 2.0.

The flow required is estimated to be from 0.5 to 1.0 megalitre/ha/day in the UK. However this rate is required mainly for temperature protection during the winter when air temperatures fall below zero. The plant can grow in much slower flow rates. Flow rate has to be controllable and low speeds are needed at planting and are gradually increased as the plant grows to maturity.

The NFU has established a Code of Practice (1994) that requires water to be used close to source and free from other surface water contamination. Increasingly the water is being pumped due to insufficient artesian pressure. Water is generally used once only and discharged after accumulated solids are settled out. However recirculation is possible.

Watercress beds are established on flat land that has a high water table to reduce downward leakage of water, however a clay base can be used to assist both upward and downward water leakage. The beds are generally established close to rivers so that runoff can be discharged, however the beds need to be protected from potential flooding from these rivers.

Wind protection is also needed and the beds must not be shaded, therefore natural or artificial windbreaks must be positioned to accommodate these requirements.

Bed construction and layout

Beds are constructed in tiers to utilise the flow of water. A north/south orientation minimises shade problems. Traditionally beds were built 9 metres wide, this was followed by a trend to reduce bed width to 5 or 6 metres so that plastic covers could be put over the beds in winter. However the use of these covers has since declined because their use had negative impact on crop yield, leaf strength and quality. Bed width has generally returned to the wider dimension. Bed lengths are usually 50 to 70 metres. Size and layout is often influenced by topography and actual land ownership.

Water has to enter the bed with minimal force or turbulence. This can be controlled by a valve or by the use of baffles.

Walls of the bed and the water carrying channels are typically made of concrete. The concrete walls are sunk to about 120mm below the bed to prevent sideways water movement and are about 250mm high. The base of the bed is accurately levelled and graded. On soft substrata it is necessary to put down ballast and compact it. A thin (30mm) layer of small gravel (10 to 20mm) is then applied for the growing surface. Soil beds have been used but are less popular. The beds are separated by roadways that allow access for crop maintenance and harvesting.

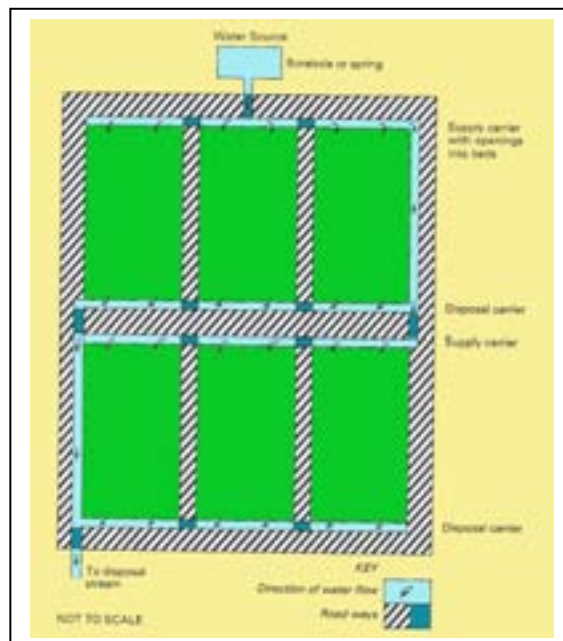


Figure 1. Example of bed layout, water supply and roadways
(Modified from “Watercress: ADAS/MAFF Reference book 136”)



Photo 1: Watercress beds in Dorset, UK

Discharge water is run through a series of settlement ponds that reduce the speed of flow and allow accumulated solids to be removed. The resultant water is of a suitable quality for return to the river systems and is generally tested by the Environmental Authorities at a discharge point.

Varieties and seeding

There has been very little breeding work done on watercress. The preferred strains used are American that have darker green foliage. Some growers have selected their own strains based on delayed flowering, vigour, leaf size and stem characteristics and winter hardiness. Some breeding was done at Wellesbourne (National Vegetable Research Station) in the 1970's but it is unknown whether named varieties were taken up by the industry. Larger producers generally arrange for their own seed production but seed can also be purchased from some seed companies.

Watercress can be propagated vegetatively or from seed.

Watercress seed is relatively small (approximately 3500 seeds per gram) and direct seeding can be done but is not usually successful because the surface of the bed is too coarse, temperatures are often low and low spots are often waterlogged.

A marketable crop is produced when stem numbers are in the range 1000-2000 stems/m² at harvesting which would be achieved by sowing 3000-5000 seeds/m².

The usual practice nowadays is to raise seedlings in greenhouses during February to July. A 30 to 50mm layer of peat is laid on to the concrete floor of the greenhouse and seed is sown as evenly as possible by hand at approximately 70 to 80 grams/m². It is then important to keep the peat moist using misted irrigation. "Damping-Off" is controlled by the use of the fungicide Aliette (Fosetyl AL from Rhône-Poulenc).

When a mat of seedlings has developed (in about 14 days) these are scooped up, broken up into small pieces and then distributed by hand onto the surface of the watercress bed. One square metre of nursery bed plants will plant 10 m² of production bed. At first the water flow is shallow and gentle to allow establishment.

Crop Management

The plant has two types of roots, anchorage roots that secure the plant to the substrate and adventitious roots that float in the water. Both types can take up nutrients.

The water that is naturally provided has sufficient nutrients, except phosphorus, to sustain basic plant growth. However, to achieve optimum growth additional nutrients are applied and the plant responds

well to fertilizer application. The application rates are balanced according to plant needs so that there is no residual in the discharge water. Despite the availability of sap testing technology this does not appear to be used at this time and applications are based upon experience. Trace elements are rarely applied. NPK fertilizer is applied as 19:14:14 (32 grams m²) and 0:24:14 (71 grams/m²). This is applied weekly by hand with alternate use of each fertilizer. The beds are rolled with light hand rollers after each fertilizer application.

Reduction in water flow and rolling stimulate the plant to root into the substrate and to tiller. This results in a thickening up of the bed and the production of more shoots.

Productivity

Beds are harvested about 6 times each year with renewal as required. Expected yields are generally in the range of 7,500 to 10,000 kg/hectare.

Pests and diseases

Because of the difficulties of using chemicals in aquatic situations management practices have been developed that avoid their use.

Several species of aphid occur on watercress, the commonest being *Aphis nasturtii*. They can cause leaf distortion and may transmit virus. Mustard beetle (*Phaedon cochleriae*) and Flea beetle (*Phyllotreta undulata*) are the other main insect pests that feed on leaves above water.

These insects can be successfully controlled by the frequent use of water sprinklers, the water droplets effectively knocking the insects into the water.

Insects feeding below water level are more problematic. These include caddis fly larvae (several species but *Limephilus lunatus* being the worst) and chironomid midge larvae (*Metriocnemus hirticollis*). Garlic oil has been used but its efficacy is not proven.

Snails may also occur in the watercress beds and can serve a useful function in removal of dying plant material. However their presence in the harvested product is undesirable. Snails and the aquatic insects mentioned above are generally uncontrolled and are removed in the washing stage prior to bagging.

Crook-root is a disease caused by a water-borne fungus (*Spongospora subterranea* f. sp. *nasturtii*) that causes root to swell, distort and become brittle. The disease mainly occurs in winter and plants lose vigour and may lose roothold and wash away. Addition of soluble zinc sulphate in minute quantity (0.05 to 0.10 ppm) to the intake water is an effective control strategy. Attempts have been made to breed resistant varieties (Sheridan *et al* 2001).

Other diseases that may occur are Leaf spot (*Septoria sisymbrii*), Downey Mildew (*Perenospora parasitica*), Turnip Mosaic and Turnip Yellow Mosaic viruses and Watercress Chlorotic Leaf spot virus.

There are no control measures for these diseases.

Some physiological disorders may occur such as Oedema but plants generally grow out of this problem.

Algae may develop in the beds and can be minimised by being broken up by overhead irrigation and adjustment to water flow to remove it.

Harvesting and product handling

Hand harvesting, as cutting or pulling, has generally been replaced by machine harvesting.

The requirement is to remove stem pieces approximately 150 mm in length and leave sufficient for rejuvenation. Although older watercress has stronger flavour, darker green leaves and longer shelf life it is necessary to cut the shoots before stems become too thick and leaves become too large.

Harvesting is done on a 4-weekly cycle in summer and 8-weekly in winter.

Machine harvesters have been developed that cut the crop and deliver into plastic crates. In Hampshire they generally use 11 – 12 kg crates and in Dorset the crate size is smaller at 5 – 6 kg capacity. It is possible to collect watercress into 150kg bins but some crushing can occur at the bottom of the bin.

After harvesting the beds are mown with a flail mower to even them up for regrowth to begin.



Photos 2 (top) and 3: Harvesting watercress in Hampshire

Watercress has a relatively short shelf life of about 8 days. The first step is therefore to cool the harvested crop. In the past this was done by hydro cooling but vacuum cooling is now favoured. Vacuum coolers can reduce the temperature of watercress within the crates from 25 degrees to 2 degrees Centigrade within 20 minutes. After cooling the crates are then accumulated in a refrigerated

store ready for despatch by refrigerated truck to the packing factory. The temperature must not exceed 6 degrees Centigrade throughout the supply chain. Quality assessments are done prior to despatch to advise the packing factory of any contaminants or defects that need to be addressed during the washing and packing process (Table 1).

Table 1: Post-harvest Quality Assessment requirements (The Watercress Company)

Plant Characteristics		Critical Contamination RED	Major Contamination AMBER	Minor Contamination GREEN
Stalk thickness	2.5-3.5mm	Large crickets and grasshoppers Mammals and birds (and parts) Beetles > 35 mm Amphibians and reptiles	Bugs/beetles 20-30mm Small crickets and grasshoppers (<50mm) Bees/wasps Centipedes/millipedes Slugs Snails Worms	Ladybirds Aphids Thrips Midges Small flies Spiders Caterpillars Moths Beetles <20mm
Stalk length	50-100mm			
Leaf size	15-35 mm			



Photo 4: Vacuum cooler



Photo 5: Harvested watercress



Photo 6: Quality Assessment



Photo 7: Pre-wash examination



Photos 8 (above) and 9: Washing and Packing

Environmental compliance

Water returning to natural watercourses must meet environmental standards for nutrient levels and suspended solids. Water is run through settling ponds to slow the flow and remove solids by sedimentation. Environment authorities collect and analyse samples at the discharge point.

The LEAF and LEAFMARK (has audit) protocols are available as EMS systems. In addition supplies to Tesco must meet their “Natures Choice” standards and “Field to Fork” standards for Marks & Spencer.

The important biodiversity offered by wetland habitats provides many opportunities such as provision of breeding sites for riparian species adjacent to the watercress beds.

The UK Market for Watercress

Total UK production was estimated as 80 tonnes per week in summer and 60 tonnes/week in winter. Total usage is estimated to be approximately 3.6 million kilos per year. However consumption has increased by 20-30% since August 2005 as a result of promotion.

The UK industry believes that consumer penetration rate has now reached 10% (=consumers that buy it) which will be approximately 6.5 million people. That is a consumption of 0.5 kilos per consuming person per year. It is estimated that purchasers buy 85-gram packs (or equivalent in mixed salads) 5 to 5.5 times per year which supports the estimated consumption figure.

Production costs for conventional watercress are estimated at £3.00 (A\$7.00) per kg. Retail values are shown in Table 2 and average £11.77 (A\$27.42) per kg for monopacks.



Photo 10: Bagged watercress in a UK supermarket

Table 2 : UK Supermarket Prices (Sept 2005)

Supermarket	Products	Weight	Price £ (A\$)
ASDA Walmart	Watercress Monopack	80 g	0.93 (2.17)
	Watercress Monopack (Organic)	80g	1.30 (3.03)
	Watercress/Spinach/Rocket/Red chard	90g	1.18 (2.75)
Marks & Spencer	Watercress/Spinach/Rocket	120g	1.79 (4.17)
Morrisons	Watercress Monopack	75g	0.95 (2.21)
Sainsbury's	Watercress Monopack	85g	0.99 (2.31)
	Watercress Monopack (Organic)	100g	1.49 (3.47)
	Watercress/Spinach/Rocket	135g	1.79 (4.17)
	Watercress/Spinach/Red chard/ lettuce	120g	1.69 (3.94)
Somerfield	Watercress Monopack	85g	0.95 (2.25)
	Watercress/Spinach/Rocket	120g	1.85 (4.31)
	Watercress/Baby leaf salad	120g	1.49 (3.47)
Tesco	Watercress Monopack	85g	0.99 (2.31)
	Watercress (Organic)	90g	1.29 (3.01)
	Watercress/Rocket/Spinach	140g	1.79 (4.17)
	Watercress/Baby leaf lettuce	120g	1.29 (3.01)
Waitrose	Watercress Monopack	100g	1.19 (2.77)
	Watercress (Organic)	bunch	1.09 (2.54)
	Watercress/Spinach/Rocket	149g	1.99 (4.64)

Watercress is the high value crop and the price of mixes can be modified by the percentage of each component. The commonest mix is Watercress (40%), Spinach (30%) and Rocket (30%) but may be 34%:33%:33%. In other mixes such as one produced for Sainsbury that included lettuce the percentage of watercress was only 20%.



Photos 11 and 12: Packed product as salad mix (left) and monopack (right)

The UK Watercress Market – a summary of information gathered during the in-market visit

Analysis done and presented by Elizabeth Gunner, Senior Demand Chain Consultant, Rural Solutions SA.

In the UK, watercress is a gateway to other salad products and the major salad producers have needed to take a position with this crop. The general aim in marketing has been to move consumer perception of watercress from being a herb or garnish to being a salad and cooking vegetable. Salad mixes including watercress have been a major success and many buyers of monopacks have switched to mixed packs. Experiments with salads presented in Pick & Mix style did not drive up penetration in the market.

The Watercress Alliance has funded major campaigns to educate consumers about the health and convenience benefits of watercress. This has involved nutrition experts, a celebrity chef and a well-known model.

The most successful promotion has been the “Not Just a Bit on the Side” Campaign.



Photos courtesy of Geest PL

The Watercress Alliance campaign.

Photos 15, 16 and 17: (From left to right)

- **Lyndel Costain - one of the UK's leading (and best known) nutritionists,**
- **Phil Vickery - celebrity chef and**
- **Jo Guest – the face of the “Not just a bit on the side” campaign.**

The promotion has included key messages such as “Good for you”, “Tastes great” and “Lots of things that you can do with it”. The promotion has been backed by Media Packs for journalists resulting in substantial exposure in newspapers and magazines, radio and TV shows, recipes and a high profile Street Fair. Point of Sale promotion has occurred at the same time.

During a period in the UK when fresh-cut salads have been openly criticised, for aspects such as poor flavour, use of modified atmosphere packaging, use of chlorine in washes, use of ethnic labour etc, watercress has not suffered from this negativity, largely due to the promotions.

Consumer Research

Although watercress would appear to be a fairly well established product category in the UK, by 2002, it was falling out of favour, with declining sales and decreasing market penetration. To combat this the Watercress Alliance¹, commissioned market research to provide a better understanding of consumer buying behaviour in order to develop a comprehensive PR/Marketing campaign.

The quantitative research conducted surveyed 129 shoppers across four retail outlets. Of the 129 respondents, 84 were buyers of watercress and 45 were non-buyers. It should be noted that the market research summarised above was taken from an extremely small sample, using a non-probability convenience technique that essentially results in the researcher randomly surveying, in this case, shoppers. What this means is the sample is chosen without use of a specific survey method and while it may be useful for exploratory work, it usually results in a small sample size, which is not representative of the broader population, this therefore limits the scope and subsequent validity of the research.

Some of the more interesting findings were:

For those buyers who were not brand loyal but had made a decision to purchase at the display, 35% were motivated to purchase by the “mix of leaves”. In the UK watercress is either packaged with a mixture of rocket and spinach or as a stand-alone bagged salad product. 17% of this category said they were motivated to buy as they had tried it and liked it and another 17% said the product’s ‘freshness’ motivated them to purchase.

Interestingly, motivations that rated poorly in the questionnaire were the product’s shelf life, pack size and that it was “something different.” It is worth noting that when considering launching a new product this is a major characteristic of the offering and the marketing effort must be directed to making that a positive. Watercress has been available in the UK for decades, with its followers accustomed to its strong, peppery flavour. To achieve rapid market penetration, significant investment would be essential in launching watercress in Australia to encourage trial and educate consumers about usage. There is, however, already some usage in Australia and the market is likely to have expansion potential.

Australia does not have the historical or cultural link with watercress that the UK does. It is not a product that most Australian consumers are familiar with and certainly this will need to be taken into account in any product development and launch plan. This could work in its favour as it formerly had a working class, unsophisticated image in the UK - probably not where the Australian market would wish to position itself. With regard to frequency of purchase, 43% of the UK buyers surveyed purchase watercress every 2 weeks with 24% occasional purchasers. 33% of the purchasers claimed to buy the product because they had tried it and liked it. 21% gave other reasons, including that fact that they had been brought up with watercress as a child.

Of the UK consumers who buy bagged watercress, 64% use it as part of a salad with the remainder nominating sandwiches. Both of these food styles suit the Australian market well, though the concept of year-round salads should be investigated further. Of the non-buyers surveyed in the UK, 20% of them claimed to only eat salad in summer.

¹ The Watercress Alliance is made up of, The Watercress Company (TWC), which is owned by Geest Pty Ltd, an extremely large supplier of fresh prepared foods and produce, Vitacress, a major salad producer and a few smaller independent watercress growers. Geest Pty Ltd also own Alresford Salads who deal with the packing and marketing of watercress from TWC.

Of the non-buyers most were unaware of the product’s health benefits, as opposed to the very large proportion (82%) of the watercress buyers who claimed to be aware of the health benefits of the product, with most citing ‘iron’ as its key attribute. While being aware a product is healthy is extremely positive, it should be noted that the product is not especially high in iron, but is in vitamins A and C. So, most people who already eat the product have a misunderstanding of the health benefits associated with watercress. Providing consumers with accurate information about the product’s health benefits could motivate trial purchase in new consumers and improve repeat sales.

69% of the purchasers of bagged watercress, (typically 80 – 85g for a watercress monopack and 100 – 140g for watercress/spinach/rocket combination), felt the bag size was fine, while 23% suggested it was too big. Certainly packaging types should be fully investigated when assessing the Australian market, not just size, but also the overall packaging concept, how it can attract purchasers and what it can add to the overall product offering. This is particularly relevant when considering the UK survey results, where it was identified that a large proportion of favourable purchasing decisions with regard to watercress are made at point-of-sale.

The UK quantitative survey went on to very briefly profile the buyers and non-buyers of bagged watercress as follows:

Buyers	Non-buyers
<ul style="list-style-type: none"> ▪ Like strong flavours 	<ul style="list-style-type: none"> ▪ Buy sweet products
<ul style="list-style-type: none"> ▪ Eat salad and buy watercress year-round 	<ul style="list-style-type: none"> ▪ Buy only in Summer
<ul style="list-style-type: none"> ▪ Buy watercress for a known purpose 	<ul style="list-style-type: none"> ▪ Don’t know how to use it
<ul style="list-style-type: none"> ▪ 82% were aware of health benefits 	<ul style="list-style-type: none"> ▪ Just 49% were aware of health benefits
<ul style="list-style-type: none"> ▪ A large number of buyers also buy salmon and chicken 	

PR/Marketing Campaign

The PR and marketing campaign undertaken by The Watercress Alliance to boost sales and increase market penetration was extensive and no doubt expensive. With a somewhat old fashioned, boring reputation, the product essentially needed to be repositioned in the marketplace. The strategies undertaken by the appointed PR firm included the following:

- Securing the services of a number of celebrities – a well-known nutritionist, a celebrity chef or two.
- Creating a ‘sexy’ ad campaign using the slogan “*Not just a bit on the side*”, using a ‘naked’ female model with strategically placed watercress as the focal point. *Assuming most purchasers in the UK are women, using a naked woman was an interesting choice. The campaign, it would seem, rather than attempting to appeal to a particular target market, was aiming to generate press coverage and create a sensation.*
- Radio campaign
- Press campaign
- Recipe development
- Recipe book development
- Television promotion via ‘Ready, steady, cook’
- Establishing British Watercress Week
- Holding a watercress festival in the town of Alresford, hiring celebrity chefs and others as ambassadors for the event. *Watercress growing around Alresford became industrialised in the 1860s with the arrival of the railway to carry the perishable product to London markets. Hampshire remains one of the main watercress producing areas in the UK.*
- Postcard mail drops to press and public
- Establishing a website

This far-reaching and professional campaign did result in significantly increased sales over a two year period, with market penetration lifting from 10.3% to 11.7%, with the combination of mono and mixes up from 13% to 17%. The campaign is credited with improving second year sales of 150 tonnes in as well as increasing forecast sales.

The campaign managers claimed to have achieved the following milestones:

Total number of press cuttings:	265
Total broadcast:	174 minutes
Total audience reach:	125.2 million
Total advertising value:	£860,460 (Approx AUS \$1.9 million)
Total PR value ² :	£2.5 million (Approx AUS \$5.8 million)

Health benefit claims

In an effort to further boost the market penetration of watercress through the examination of health benefits of the product, collaboration was formed between The Watercress Alliance and the University of Ulster, with the former paying for the study. The two-year project, with one year remaining, aimed to investigate of the anticancer properties of watercress in humans.

The basic premise revolves around the fact that watercress is a rich natural source of phenyl ethyl isothiocyanate, or PEITC, which gives the plant its peppery flavour and some scientific studies have claimed, that this compound has strong anti-cancer properties.

A number of studies using mammals have demonstrated that PEITC is not just a potent inhibitor of cancer development, but that it has the ability to kill cancer cells and prevent cancer-causing agents being metabolised into carcinogens and to stimulate enzymatic activity involved in detoxification of carcinogens.

The latest research project being conducted by Ulster University, expected to return publishable results at the end of 2005, has had some positive results. The project is specifically investigating the anti-cancer potential of watercress in relation to colorectal cancer. The two-year study includes a 23-week dietary trial involving 30 men and 30 women aged between 18 and 55.

Incidence of colorectal cancer in Australia is higher than the US, Canada and the UK, but less than New Zealand. Australia's mortality rates for colorectal cancer are also high by world standards, including above those of Canada, the US and the UK.

While Australia can take some pride in having one of the world's best cancer survival rates, the most common cancer in this country (excluding non-melanoma skin cancer) is colorectal with a relatively high incidence by world standards. Where the age-standardised incidence per 100,000 population is an average of 37 for more developed countries and 10 for less developed countries for males, in 2001 Australia had a very high rate by world standards of 50.³

Key Findings

The example of watercress in the UK illustrates a mature product and marketplace where despite a drop in penetration, a solid foundation in culture, cuisine and purchasing behaviour is evident. The PR/Marketing campaign summarised above was designed to boost market penetration and no doubt cost a significant amount of money.

² Note: This is not PR cost and there is no explanation given as to how this figure was calculated. PR and brand awareness is a notoriously difficult thing to place a value on.

³ Australian Institute of Health and Welfare, Australasian Association of Cancer Registries, Canberra 2001

This situation does not equate to the Australian market place where watercress is a relative unknown. Here a different approach would be required to launch watercress as a 'new' product, educate consumers and encourage trial and then repeat purchases. Without an existing network of growers or an established industry, it can be hard to gather the necessary funds for such an undertaking, with the most likely scenario being the identification of a progressive and willing industry 'pioneer'.

The UK experience does however provide useful background information regarding consumer profiles, product usage and product positioning. While it can be dangerous to transpose information from another country to our own and make assumptions about consumers, certainly having a better understanding of the situation in another market, not too dissimilar from our own, cannot be detrimental.

Key Points

Significant investment will be required to successfully launch watercress in Australia, even on a small scale, to encourage trial and educate consumers.

Australia does not have the historical or cultural link with watercress that the UK does and investment should be made into the possible appeal of the product's taste, flavour and usage.

The two main uses cited in the UK research are salads and sandwiches; two food styles suit the Australian market well.

The UK research profiles buyers of watercress as people who eat salad year-round, an important part of the product's success that needs investigation in the Australian marketplace.

The UK research profiles buyers of watercress as frequent purchasers, with 43% of those surveyed indicating they purchase watercress at least every two weeks. This figure includes 22% who purchase watercress weekly and 10% who buy watercress more than once a week. This is the mark of a well-established, near-staple product, the result of significant time and effort spent in the marketplace.

Providing consumers with information about the product's health benefits could motivate trial, purchase and repeat purchase.

Packaging will be an important element: offered alone or with other leaves, size of package, functionality etc. If the UK experience is to be considered, it should be noted a large number of purchases are made somewhat spontaneously at the merchandising display sale, so packaging there is especially important.

The health benefits of watercress, if proven, should not be underestimated as at a minimum a solid marketing tool, and at most, possibly a market unto itself. Consider wheat grass, which has no scientific evidence backing up its health claims, but sells for around \$3 a 'shot' at juice bars around Australia, equating to an earning of around \$800,000 per hectare. Imagine a product that was scientifically proven to have strong anti-cancer properties?

Watercress Production in the United States

Before becoming "Rocket City, USA," Huntsville, Alabama was known as "The Water Cress Capital of the World." For half a century, from the early 1900s through the 1960s, watercress was a significant crop shipped from the area. It is no longer significant.

Now the crop is available year round from California and Florida with much of the nation's winter supply is grown in Central Florida. Watercress is also an economically important vegetable crop in Hawaii and there is some production in Georgia and minor production in five other States (Table 3).

The US watercress industry is estimated to be worth over US\$20 million annually at farm gate prices.

Table 3: Watercress Production in the USA

State	Number of farms	Area in acres (hectares)	Average area per farm in hectares
California	21	258 (104.4)	4.97
Hawaii	19	33 (14.2)	0.75
Florida	10	341 (138.0)	13.80
TOTAL USA	60	699 (282.9)	4.72

Source: 2002 US Census of Agriculture (www.nass.usda.gov)

The largest producer of watercress in the USA (and possibly in the World) is B&W Quality Growers with headquarters in Florida. The family-owned business started in 1870 supplies the US market and also exports to Canada, France, England and the Caribbean. B&W website (www.watercress.com) supports their marketing thrust with health information and recipes. B&W produce watercress in Florida from November – April (winter) and in West Virginia, Pennsylvania, Maryland, Alabama and Tennessee from May – October (summer).

B&W believe that there will be expansion opportunities as the health benefits become more widely known. Although hydroponics certainly would be easier, they believe that the economics don't work. Their concern is that there is no where left in Europe, North America or Northern Africa that has enough fresh water to support watercress farms of the scope that they currently operate and agree that water is a critical issue going forward.

There is no central repository of watercress facts and data in the U.S., but B&W believes that easily over 60% of the watercress consumed in North America is eaten by Americans of Chinese origin who only eat it cooked.

There is currently a hydroponic grower in California and another in Montréal, but neither produces much volume and B&W tests show fairly short and unreliable shelf life. Some offer it with roots and some do not.

B&W supplies EuroWrap bunched watercress but favours 'cello' bags and has recently introduced resealable ziplock polyurethane 'cello'bags that better control freshness and shelf life.

Watercress is also increasingly being used as a key ingredient in everything from food, to soaps, lotions and in natural supplements. B&W advised that most of the bulk dried watercress used in the US comes from Europe's largest natural wetland connected to the Danube River. Wild watercress islands that float freely are harnessed, dragged to shore and harvested and open field dried. Watercress is especially appealing because it retains much of its nutritional and antioxidative characteristics through the conversion process.

There has been a slight decline in production in Hawaii in recent years due to the increased incidence of Aster Yellows phytoplasma, but with some compensation through increased price.

Yields in Hawaii in 2002 averaged 25,620 kg/ha. The yield of watercress varies seasonally with the best growth occurring during the cool, wet season from October to April. Seasonal fluctuations in watercress production concern growers because of their need to provide a consistent supply to their markets.

Most watercress is sold as bunches and packed in ice in heavily waxed one-piece fibreboard boxes or wire bound wood crates with film liners. Boxes hold either 12 bunches, 3 kg (7 lb) or 24 bunches, 6 kg (14 lb). Bunches also are placed in film bags in boxes. Prices vary according to season and market,

in October 2005 the price per carton of 12 bunches ranged from US\$5.50 (Miami) to US\$19.00 (St Louis) with most markets in the range of US\$7.00 to US\$12.00. (www.ams.usda.gov).

Production systems

Many of the beds used in the USA have soil or sand base compared to gravel as used in the UK. Water may come from bores or streams. The beds are often separated by earthen levees.



Photos 13 (top) and 14: Photos of watercress production in Florida (supplied by TWC).

Another interesting aspect of watercress is its potential benefits for purifying the water of cold-water fish farms. B&W reported that the University of North Carolina has conducted studies in conjunction with regional aquacultural associations that have shown watercress to be especially effective for effluent purification, almost to the point where direct discharge into streams is a more viable option for fish farmers. And the watercress that is used can be harvested for human consumption.

The combination of Aquaculture and Hydroponics is an established methodology referred to as Aquaponics. The University of Virgin Islands has reported on an aquaponic system suitable for production of fish and lettuce. (<http://rps.uvi.edu/AES/Aquaculture/aquaponics.html>)

Aquaculture is a man-made system to produce marketable fish under controlled conditions, especially by providing clean water, oxygen, and feed. In closed recirculating systems water treatment is accomplished by removal of solid waste and the biological breakdown of nitrogenous metabolites. Successfully performing these tasks greatly increases fish production many times compared to an untreated system. Water is continually pumped through the rearing tank and filters so that waste is removed and conditions for growth maintained at high levels. The incentives for the intensive production of fish in recirculating systems are driven by the high cost of land, the ability to locate close to markets, and the high quality/high value crop that can be produced. The disincentives are the large capital investment required, cost of water, high-energy use, and the high skill level (and cost) of labour.

Hydroponic systems are designed to concentrate production of a vegetable crop into areas smaller than that which would be required in field production of the same crop. This is done by providing water carrying an appropriate level of nutrients to the plants. The same incentives and disincentives that apply to intensive recirculating aquaculture systems apply to these systems as well.

An **Aquaponic** system is a symbiotic joining of aquaculture and hydroponics. Nitrogen waste from fish metabolites provides needed nutrients to the vegetable crop. By removing these wastes the vegetables filter and clean the water improving the environment for the fish promoting faster growth and healthier fish.

The University of Virgin Islands has a system of perforated floating polystyrene rafts on which crops, such as lettuce, are grown. The system may also have potential for other crops including watercress.

Research

Most of the research and development information found was based in Hawaii.

Water temperatures above 25.5 degrees Centigrade cause slow or poor growth. Research showed that optimum daytime air temperatures are 21 to 29 degrees Centigrade and watercress grows best during the winter season in Hawaii (McHugh et al 1981). Research by Kent Kobayashi and John McHugh, Jr. (1987) done at the Tropical Plant & Soil Sciences Dept., College of Tropical Agriculture & Human Resources of the University of Hawaii showed that yield of watercress was related to the amount of sunlight received (cal/cm²) during the crop cycle (Fig 2).

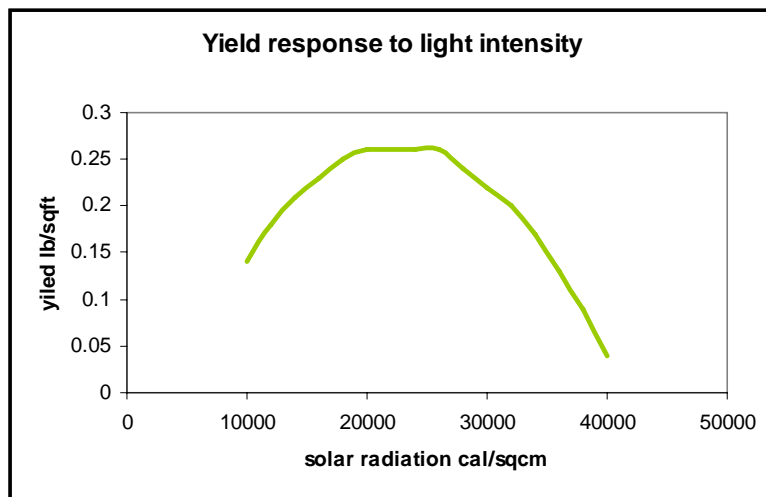


Fig 2. Yield of watercress in response to light intensity

Pests and diseases

The most important pests of watercress in Hawaii are diamondback moth (*Plutella xylostella*) and watercress leafhopper (*Macrostelus sp nr severina*). Diamondback moth has been a pest for over 50 years and has repeatedly developed resistance to the few insecticide options available to the watercress industry. Diamondback moth occurs in Australia and may prove to be a pest in open production situations especially if other Brassica's are produced in the vicinity. Diamondback moth was effectively controlled by water from overhead sprinklers and the use of a larval parasite, *Cotesia plutellae* (Nakahara et al 1986).

Other invertebrate pests include cyclamen mite (*Stenotarsonemus pallidus*), grass sharpshooters (*Draeculecephala californica* and *D. inscripta*), green peach aphid (*Myzus persicae*), cabbage white butterfly larvae (*Pieris rapae*), southern green stinkbug (*Nezara viridula*) and various species of slugs and snails.

The most serious disease of watercress in Hawaii is caused by a strain of the Aster Yellows phytoplasma and control can only be achieved by controlling its vector, the watercress leafhopper, roguing infected plants and complete fallow in severe situations. Leaf spotting diseases affecting watercress are black rot (*Xanthomonas campestre*) and Cercospora Leaf Spot (*Cercospora nasturtii*).

Because of the relatively small size of the industry there are always difficulties in the registration of control chemicals. Additionally the watercress beds are important habitats for wildlife. Since 1984 the industry has adopted IPM practices including the use of overhead sprinklers, biological control methods and minimised pesticide use after regular crop monitoring.

A Pest Management Strategic Plan for Watercress Production in Hawaii was produced in May 2004 following a workshop convened by the University of Hawaii at Manoa, Honolulu, Hawaii.

Watercress Production in New Zealand

In New Zealand it is difficult to obtain resource consent for taking clean stream water, adding nutrients (including nitrates), which are required for growth of the watercress plants and then putting all this back into a natural water source. Consequently hydroponic systems have found more favour in New Zealand.

In NZ, hydroponically grown watercress develops longer stems, larger leaves, and considerably more succulent growth than wild plants, which often struggle to obtain good nutrient levels. Water temperatures are generally 12 to 20 degrees Centigrade combined with air temperatures in the 20 to 26 degrees range during the day and 15-20 degrees at night. Yields with hydroponic watercress crops grown under these conditions range from 1.5 to 2.0 kilograms per square meter per month. However, in the cooler conditions of winter when light levels are also low, production can drop to below 500 grams per square meter per month unless some form of environmental control and heating is used. For this reason, hydroponic watercress is often produced year round under crop protection structures or in greenhouses.

Seeds are usually sown into cell trays of media or cubes of inert media such as rock wool, which retain high moisture levels. Germination will occur in about 7 to 10 days. Seed is sprinkled on the surface of the media and lightly covered with clear plastic to retain moisture. Stems will also form roots at each of the nodes, so stem and root cuttings can be taken at any time of the year. For commercial cultivation, flowers should not be permitted to form as this results in bitter flavours developing in the plant foliage. Regular cutting for harvest helps ensure that the plants do not flower, but any flower stalks that do develop should be removed from mature plants to encourage further leaf development.

Pest and disease control is vital to obtain acceptable yields and quality produce. Pests such as caterpillars (white butterfly caterpillar) can reduce yields by 80 percent during certain times of the year.

Watercress is not a high value crop unless markets can be obtained at the higher value end of the retail sector. Washed, prepared, and packaged watercress in supermarkets can receive good prices if it is of suitable quality. However, this market is limited to small volumes. Most fresh watercress is sold in bunches of 20 to 30 stems for NZ\$1 to 3, although prices can be higher in winter as there is little outdoor product available on the market.

Commercial watercress growers usually aim to sell some of their product into the higher value restaurant market, although obtaining these sales can take persistence.

As a higher value product, watercress may be sold as a "living plant" if grown in hydroponic NFT system. These systems allow the entire plant with the root system attached to be harvested and packaged into special clamshell packages or plastic sleeves. Living plants or herbs are often sold in this way through supermarkets and fresh vegetable outlets for NZ\$2 to 4 each (season dependent).

Wild watercress or crop that was cultivated in streambeds with no additional fertilizer frequently suffers from potassium deficiency. Phosphate and iron deficiencies are also common. Symptoms of potassium deficiency are shown as marginal scorch of older leaves in this crop. Iron deficiency is common in winter under cool temperature conditions and shows as yellowing between the veins on the newer foliage.

Hydroponically grown watercress should not show any deficiencies as the nutrient solution used contains all the nutrients required for growth in the correct ratios. Hydroponic growers generally have a water analysis carried out and then have a watercress nutrient solution formulated for their particular crop and water supply. Nutrient solution and leaf mineral level analysis can be carried out for hydroponic watercress crops where nutritional problems are suspected. Generally, watercress does not have a high nutrient demand.

In New Zealand, a franchised business for watercress production and marketing was established by Natures Way. A report on xtramsn.co.nz/business website dated 15 May 2003 reported that watercress was immediately accepted by NZ consumers. However a report in September 2003 issue of The NZ Grower magazine reported disenchantment from most of the growers that had bought in to the franchise business. At this time only 11 of 28 purchasers were still in production and few were achieving the productivity as claimed by the franchise owners. However there was still strong optimism about the prospects for the crop.

Watercress Production in Australia

Watercress is handled by a small number of merchants in the Brisbane, Sydney and Melbourne markets but volumes are generally low. Watercress is known to be readily available in most Asian grocery shops in Melbourne. Coles and Woolworths supermarkets carry small quantities of watercress including the open sleeves containing watercress with roots as produced by Holla-Fresh Pty Ltd in South Australia and by a few other producers.

Most of the production is done hydroponically or by overhead spraylines, however one grower at Stanthorpe in Queensland grows watercress in open pools that are fed by irrigation runoff from his other enterprises. This is not an ideal arrangement because the quality of the water used for production may be compromised.

At one stage watercress was declared a noxious weed in Queensland and this reduced production for a period. However this issue was overcome and production has resumed but levels are somewhat erratic. Watercress is no longer listed as a noxious weed in any of the states of Australia however there is concern that it should not become established in natural waterways. In many regions this is prevented by the periodic conditions of drought that occur, a condition that the plant is not well suited for.

Production from open situations is hampered when water supply runs low and during the winter when the plant goes into a reproductive stage. Production is also hampered by invasions of ducks and prevalence of aquatic life such as pond snails.

Water supply is a major issue in Australia that will determine whether the crop can be grown in a traditional gravel bed system or whether other systems will be preferred, such as hydroponics or whether there is possibility of dual use of water such as a linkage with aquaculture.

Bore water or natural spring water, especially from limestone areas, which in Australia are likely to have a temperature in the 15 to 17 degrees Centigrade range, may be ideal for production. However, in the southern states the current water licencing arrangements would deter the development of this crop if grown using licenced groundwater used once only. Water is expensive and licences do not currently have provision for credits for any water returned to an aquifer or to the environment, however volumetric conversion is being investigated. Watercress does not actually use a lot of water for growth, and the ability to return good water to the catchment or aquifer with a financial refund will remove a significant impediment.

Other options that could be considered are a) supplementary use of discharged water for other horticultural use or b) water recirculation to minimise the quantity needed (but as the plant prefers cooler conditions it may not perform so well as water temperature increases in the cycling process) or c) association of watercress production with aquaculture (with watercress production either pre or post fish tank), this would require further investigation although Aquaponics is already a recognised production methodology (see the section : Watercress production in the United States) .

Intensive hydroponic systems have been shown to be efficient for watercress production. New techniques are decreasing manual inputs and further advances may be possible to mechanise all phases from sowing to harvesting. Developments that will lead to reduced manual work are quite likely to be initiated and will enhance the potential for cost effective production.

Watercress is sold bunched or in open plastic rolls. Pack sizes are generally in the 150 to 250 grams range but are variable.

Production around Sydney has increased with a significant number of Asian growers producing the crop at low cost.

Market prices (August 2005)

Brisbane: \$1.00 to \$1.20 bunched, \$1.80 to \$2.00 wrapped (believed to be 250 grams average)
Melbourne: \$1.60 to \$2.00 bunched, \$1.80 to \$2.00 from hydroponics bunched
Sydney: \$0.60 to \$1.00 bunched (believed to be 150 grams average)

Growers that were interviewed commented on the perishability of the cut product and the importance of cool chain handling. Bunched or rolled watercress being generally transported in styrofoam boxes with ice. Watercress produced hydroponically under protective covering frequently had smaller and softer leaves and thinner stems and shelf life appears to be reduced compared to open-air crops. However hydroponic watercress sold with roots intact can have adequate shelf life. The use of vacuum cooling, although expensive will also improve the shelf life of the cut or root intact product.

Seed Suppliers in Australasia

Currently there are few suppliers of watercress seed in Australasia. There are about 3,500 to 4,000 seeds per gram and most suppliers generally offer the seed in relatively small quantities. However most of the suppliers have indicated they will be able to source bulk quantity when required from overseas producers.

There have been problems with soil contamination in imported seed lots. Current regulations allow lots below 10 kilograms to enter Australia without the need for sampling and testing. Therefore some importers tend to import in small batches, which adds to the handling costs relative to seed cost. Most suppliers currently only hold small stocks of seed but would increase this holding when demand increases. One commercial seed company indicated that it would be prepared to produce seed in Australia if there was sufficient demand.

Prices in Australia are in the range A\$390 to A\$660 per kilogram. Prices in New Zealand are NZ\$375 per kilogram but there would be further costs to import this seed.

Known suppliers include:

- *Charlcon Seeds*
Website: www.charlconseeds.com.au, Email: sales@charlconseeds.com,
Phone: (03) 97466622
- *Fairbanks Selected Seed Co Pty Ltd*
Website: www.Fairbanks.com.au, Phone: (03) 96894500
- *Kings Seeds*
Website: www.kingsseeds.co.nz , Email: kings.seeds@extra.co.nz
Phone: 0064 7 549 3409
- *Lefroy Valley*
Website: www.lefroyvalley.com, Phone: (03) 87706616
- *Royston Petrie Seeds P/L*
Email: rowena@roystonpetrieseeds.com.au, Phone: (02) 63727800

No varieties are known that are protected by Plant Breeders Rights. Therefore there are no restrictions to growers wishing to produce their own seed.

Watercress and the Consumer

The Australian Fresh Salad Market

1. Consumer Food Trends

Consumers are time poor; they demand convenience from the products they buy, while maintaining acceptable quality, food safety and satisfying ever-increasing demands for health benefits. People are increasingly living alone and with couples and families, both genders typically have busy roles in the work place.

In 1953 the average amount of time spent preparing meals was found to be 2.5 hours. In 1974 it had shrunk to 0.5 hours, in 1994 it was halved to 15 minutes and it has been forecast that there will be just 8 minutes spent preparing food by 2010.

Apart from the increase in demand for semi-prepared, convenience foods, another consequence of this reduced time in the kitchen is a decline in cooking skills.

All these factors have a significant influence on meal preparation:

- More single serve meal solutions
- Work takes number one priority
- Younger generation can't and won't cook.
- Ready meals are in demand – ambient, chilled & frozen
- People tend to shop for less, more frequently, rather than plan a regular 'big' shop.
- Those more frequent shops tend to result in more impulsive purchase decisions, with meals being planned in-store.
- Hot snacks at home for eating on the run (e.g. toaster croissants)
- More sophisticated packaging such as self-heating cans (US)
- 'Desk fast' solutions for meals at work, such as cereal bars and smoothies
- Increase in 'snacking on the go' type products aimed at the professionals under 30

It should be noted there are also emerging trends taking hold worldwide in direct contrast to the push for convenient, prepared foods, such as the Slow Food Movement, where traditional production and cooking methods are advocated. The increasing popularity of Farmer's Markets also defies the major food trends.

Even more interesting is the emergence of the contradictory nature of many consumers, who to make up for consuming guilt-ridden semi and fully prepared meals through the busy working week, prefer to spend weekends cooking from scratch, entertaining with more indulgent foods and taking time over the eating experience.

In a similar vein is the dichotomy between the values of 'citizen' and 'consumer', where the one person can claim a passionate dislike of McDonalds due to an impression of their practices being detrimental to the environment, but justify eating there with the family every Friday because it's convenient and the kids love it.

2. Global Food Trends

AC Nielsen has published a report titled '*What's Hot Around the Globe, Insights on Growth in Food & Beverages 2004*'. This study focuses on retail purchases in 59 countries spanning Asia Pacific, the Emerging Markets, Europe, Latin America and North America. The countries included in the study account for over 93% of the world's gross domestic product and over 77% of the world's population. AC Nielsen analyzed data across 89 Food & Beverage categories, comparing year ending July 2004 to

year ago. In the report, four categories that fall in the Fruit & Vegetables product area experienced growth of between +6% and +9%, making them part of the 'what's hot' list. The four product categories included:

- Frozen Fruit, the fastest growing category within the group at +9% in the last year.
- Fresh Ready-to-Eat Salads grew by +8%
- Fresh Vegetables grew by +7%
- Shelf-Stable Fruit & Nuts grew by +6%

The fresh cut salad market, in particular, appeals to the time poor consumer willing to pay for the convenience of a pre-prepared meal solution. The gourmet leaf mix, it could be argued, also appeals to the consumer who appreciates an alternative to the 'everyday' lettuce, perhaps wanting to entertain at home and cut just a few corners.

3. Fresh salads and herbs market in Australia

A report prepared for HAL in late 2002, *Identifying and Assessing Opportunities in the Processed Vegetable Market*⁴, indicated retail sales of fresh cut salads and vegetables in particular had enjoyed enormous growth from \$15 million in 1990 to \$70 million in 2000, but still only accounting for 2.5% of all produce sales by volume.

This report identified four basic fresh cut categories in the Australian marketplace:

- Lettuce/spinach/salad mixes
- Coleslaws
- Stir fry mixes
- Fresh processed herbs

Shelf space dedicated to these fresh-cut products has been increasing in the major supermarkets, reflecting sales growth. Foodland in South Australia has anecdotally confirmed that the cut salad section is its fastest growing category in fresh produce. Growth in sales growth reflects the growing trend of the time-poor, convenience-seeking consumer. The vast majority of these products sold in the two major supermarkets are sold under retailer's own brands.

4. Main players in Australian fresh salad market

The major Supermarkets Coles and Woolworths govern the retail scene in Australia, sharing around 75% of the grocery market between them and 48 – 50% fresh produce sales. In these outlets, the fresh cut category tends to be dominated by the retailers' own brands. Despite their domination, there are some independently branded products in the fresh cut produce section:

One Harvest – One Harvest is the parent company for Harvest FreshCuts and Vegco. It claims to be Australia's largest retail fresh cut business. This company is Australian owned and operates across the country, with its own farming operations, production facilities and a network of contracted suppliers.

In 2004, a representative of The Harvest Group, the umbrella company for all the business' interests, claimed its total annual turnover was more than \$120 million.⁵

Combining both its Brisbane and Bairnsdale plants, Harvest FreshCuts has seven machines to handle its plant bagging needs; maximum output is estimated at 300,000 bags per day. The potato lines handle up to 15,000 bags per day, while the fruit lines can move through 50,000 bags per day. The sandwich/salad bowl output is 25,000 per day. Current demand across all product lines is 204,000 per day.⁶

⁴ David McKinna et al, *Identifying and Assessing Opportunities in the Processed Vegetable Market*, Stage 1 report, October 2002.

⁵ Philip Hopkins, *Catering to demand for ready made food*, The Age, 26/1/04

⁶ Fresh Cut magazine, www.freshcut.com, US. Accessed 3/11/05

Harvest FreshCuts main customers are the 1600 Coles and Woolworths stores across Australia. There is no 'middleman' in the supply chain, with pre-cut products delivered directly to the supermarket chains' distribution centres. This means that 80 percent of all products processed and marketed by Harvest FreshCuts are private label products for their supermarket customers.

Looking at providing "fast, fresh and flavoursome" solutions, Harvest FreshCuts has redefined its category map, offering three ranges of product quality:

Good – entry point products designed to attract new users to the category and entice them to shop more frequently. This retail at everyday low prices, represent good value and, because of their flavour profile (familiar and popular ingredients), they have family appeal.

Better – introduces a wider variety of ingredients, is priced a level above and are typically used to create a meal that would be shared with family members or close friends.

Best – premium priced products that deliver a restaurant quality dining experience in the comfort of the home. Meals that would be shared at home with a partner, instead of going out, or used for entertaining and impressing guests.

Harvest FreshCuts acknowledges that packaging is very important with 80% of all supermarket purchase decisions made at the point-of-sale. The packaging is contemporary, accompanied by recipes and colour coded to assist purchasers make their selection.

The One Harvest Company predicts that in the future, the processing arm, Harvest FreshCuts, will incorporate salads, vegetables and fruit and encompass a range of convenience store healthy alternatives for the C-store market and is developing fruit and vegetable snacks for kids. Major extensions to the iceberg, romaine and baby leaf category are also on the cards.⁷

Mrs Crockets – Claims to be Australia's largest supplier of salads and side dishes, with operations in Brisbane, Sydney and Melbourne. Mrs Crockets claims to have experienced 35 per cent compound growth since 1983. The business employs more than 400 people and sells an average of 5.5 million servings of fresh salads a week. It supplies Woolworths/Safeway, Coles and Bi-Lo as well as fast food outlets including KFC, Red Rooster and Oporto.

This company places a significant emphasis and investment on the growth in demand for quality and convenient fresh meal solutions believing Australia will follow in the footsteps of the UK and US markets where these trends dominate.

Mrs. Crockets' product range has extended to include dressed salads (coleslaw, pasta salads, potato salads), leafy salads (garden salads), prepared "fresh-cut" vegetables, and "cook-chill" products (mashes). In the past 12 months, the company has developed a range of packaged products that are marketed as "Meal Complement Solutions" and recently the company has acquired a "fresh" soup company in its business.

5. Supply Chain Logistics

In Australia the Melbourne and Sydney wholesale markets handle the bulk of fresh cut produce sales. Major buyers, particularly those supplying the two larger supermarkets, source produce from the wholesale markets but can also buy direct from growers. In some parts of Australia growers have formed co-operatives to jointly market lines of produce. Lotus Red is one such grower cluster, with a collective of hydroponic lettuce producers in NSW banding together to meet market requirements.⁸

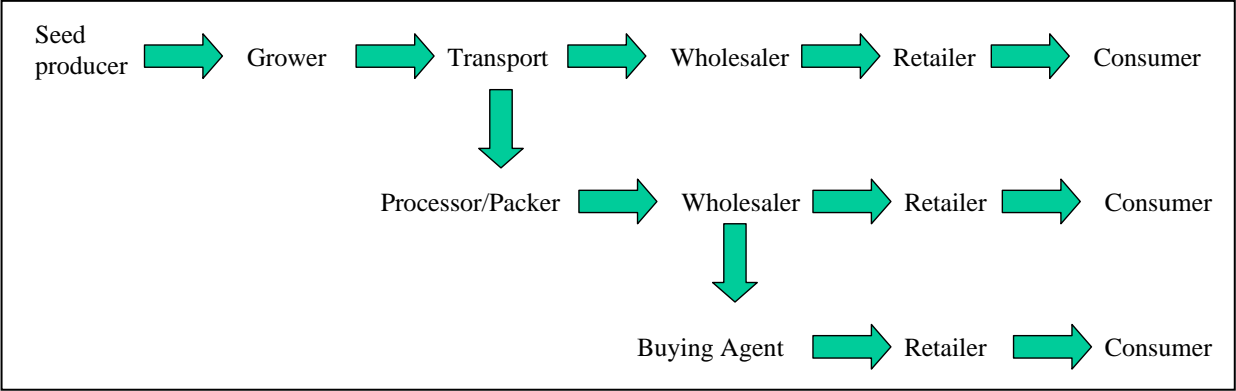
⁷ Fresh Cut magazine, www.freshcut.com, US. Accessed 3/11/05

⁸ See Business Central Coast website, www.businesscc.com.au/iiad/industry_clusters/hydro.html, accessed 16.11.05

Managing the supply chain is a key success factor in the fresh salad market due to the short shelf life of the product. This means it is important to have the processing plant close to production and markets within reach, though innovative packaging may improve shelf life and so increase supply chain flexibility.

The typical fresh cut salad supply chain can be overpopulated and lengthy (Figure 3.)

Figure 3: Fresh cut salad supply chain



One Harvest in 2003 illustrated the change in its supply chain management protocols with the picture below. While it may not be typical, it demonstrates the drive from the major industry players to work from the marketplace backward to ensure the supply chain is satisfying market requirements.

Figure 4: Consumer focused supply chain



Preliminary Consumer Studies of Watercress Acceptance in Australia

Assessment done by New Focus Pty Ltd, Adelaide. www.newfocus.com.au

A. Background and aims of the research

Broadly, the research sought to understand and test the market opportunities for watercress, specifically targeted towards:

- current shopping behaviour and trends as it relates to the purchase of fresh and pre-packaged salads/vegetables
- understand the experience, perceptions and attitudes towards pre-packaged salads/vegetables
- understand the appeal and buyer behaviour of watercress against that of similar products
- identify market opportunities to facilitate purchase including:
 - appeal of watercress as part of a combined salad
 - preferred packaging
- gauge the propensity to purchase and use watercress and identify drivers to increase purchase.

B. Method

New Focus conducted four focus groups with grocery buyers. Two focus groups were conducted in Adelaide and two in Melbourne. The sampling frame is provided below:

Segment	SA	Vic	Total
Grocery buyers All ages	2 groups (19 participants) 24 th January 2006 6.00pm and 7.30pm New Focus offices Marden, SA	2 groups (16 participants) 29 th January 2006 6.00pm and 7.30pm Viewpoint Group Rooms St Kilda, Vic	4 groups

Note: Refer to Appendix #1 for details of each focus group results.

The New Focus in-house field team recruited each focus group participant from a random list generated from the database. We informed participants of the broad issues to be discussed on the night so that they were better prepared for the session. Participants were screened with qualifiers to ensure we were speaking with non-rejectors of green salads. Participants were sent written confirmation of the time/date of the group and were telephoned 24 hours in advance to maximise attendance on the night.

Quantitative information was gathered during the focus groups via a self-completion questionnaire. Participants were asked at various stages of the discussion to record their shopping behaviour and the appeal of the products trialled.

Three products were provided for evaluation - watercress, rocket and combination leaves (watercress, rocket and baby spinach). Products were tasted in the same sequence in all groups, and they were not labelled - ensuring responses were unbiased. The first product trialed was identified only as Product A and was watercress. Product B was rocket and Product C was spinach, rocket and watercress leaves. Product C was not premixed, and participants could select their own combination of the three leaves.

C. Summary of key findings

Quantitative findings are drawn from the self-completion questionnaire provided to focus group participants. Due to the small sample size (n=35) findings are not statistically significant, and should be viewed as indicative, rather than representative of the population as a whole. Figures are indicative of the groups sampled only.

The following provides a 'snap-shot' of key findings in this research:

- Presentation and appearance are important in the choice of fresh vegetables and warrant investment
- The consumer generally expects to consume prepacked salads within 24 hours of purchase. Fast consumption is important for products such as watercress that have short shelf lives
- Product life of fresh vegetables is important and will deter people if it does not meet expectations. A further area for investigation is to understand the UK experience to prolong the freshness of watercress and seek to adapt this to Australian conditions
- The combination of leaves is an appealing concept and should be further developed for launch into the Australian market. The ratio of leaves will be critical to success – a ratio of 1:1:1 (watercress : rocket : spinach) was not considered to be the ideal ratio between the three products
- Both Melbourne and Adelaide participants found the combination of leaves most desirable of the product tested (with consideration given to the combination of leaves). At this stage, we recommend that the SA market (where watercress was slightly more favourably received) be used as a test market for a combination leaf salad. Further investigation may be needed into the packaging and distribution systems to ensure consistent delivery of a high quality product to consumers, before the product is launched nationally
- Taste is key driver for watercress and also the key barrier
- Slightly diluting the strength of the watercress taste (from that trialled) is likely to increase the appeal
- Trial is the necessary precursor to purchase of watercress and needs to be an important part of the marketing plan
- The health benefit of watercress is not leading 'news'. Because it is a vegetable there is the expectation that it's healthy and this is sufficient nutritional motivation for most
- Restaurants represent an opportunity to increase awareness, gain trial and build credibility of watercress.

D. Results

Results and discussion of the findings from the four focus groups.

1. Focus group – behaviour and perceptions

1. a. Shopping and eating behaviour

Consistent with previous research findings, quality is a key purchase driver for fresh fruit and vegetables. Appearance is the main determinant of quality, with texture also evaluated by some.

'Good quality' was associated with bright, fresh colours, although there was a wariness of products that looked "too good". This seemed to indicate over-processing, which was at odds with the concept of fresh produce. Appearance of the store, and what that implies about the quality and care of the fresh produce was also important to consumers. Participants noted they look for a clean store, without "mouldy" produce, or produce that is "not too banged up".

Price played a role, but rather than a specific driver of purchase, it seemed to help people evaluate quality, in the form of a value for money equation. It also provided a differentiator when two or more choices were available.

In discussion of shopping behaviour there was no spontaneous mention of choosing fruit or vegetables based on nutritional value or specific health benefits. It seems bright, firm produce is considered good quality and therefore considered healthy.

Participants considered their shopping behaviour was more 'ad hoc' than it had been in the past, and shopping several times a week for fresh fruit and vegetables was not uncommon. Melbourne participants shopped more frequently than Adelaide participants, with approximately three-quarters of Melbourne participants saying they shopped several times a week, while compared to 58% in Adelaide. For watercress, given its perishable nature, this is encouraging. Existing consumer

behaviour indicates that watercress, once purchased, is likely to be consumed within a few days, and therefore more likely to be an acceptable quality. There is a trend towards the fruit and vegetable grocer as a socially correct place to shop, but this may not reflect actual behaviour - 51% of participants mentioned that the most recent place they purchased fresh vegetables from was a supermarket, although only 43% claimed they normally purchase these products from supermarkets.

The majority of participants were happy to experiment with new vegetables, but only after trial. Examples of trial and introduction were through friends and family, at restaurants, seeing a chef on TV cook it or from recipe cards. Store staff was mentioned in Adelaide as an important source of information about new vegetables, and participants in Melbourne noted restaurants as a source of inspiration to try new vegetables. Interestingly there was no mention of restaurants from Adelaide participants, in regard to trial of new vegetables.

1. b. Prepacked salad - perceptions

Prepacked salads were more top of mind than prepacked vegetables eg stir-fry mixes. This may be because the research was conducted during summer, or it may be that prepacked salads have a larger share of mind than other prepacked vegetables. Prepacked vegetables were considered more expensive and of lesser quality than vegetables with no packaging, or packed in other ways. Indeed, prepacked vegetables seemed to be considered a different product than their fresh/loose/unpackaged counterparts. There was widespread experience in the Adelaide groups of prepacked salads “going off” within 24 hours, although the Melbourne group did not spontaneously mention such experience. Because of this prior experience, participants mentioned only purchasing prepacked salads if they were going to consume them within 24 hours of purchase.

Prepacked vegetables were purchased for a specific purpose. There was no mention of prepacked vegetables being kept ‘on hand’, or ‘for emergencies’ as with other convenience foods. The key benefits of prepacked salads were believed to be the convenience of preparation (rather than convenience of shopping) and access to variety. Participants seemed to feel justified in purchasing prepacked salads for products that were difficult or took some knowledge to prepare independently. An example of Caesar salad was given in one of the Adelaide groups. Participants felt that cos lettuce was difficult to find, so prepacked Caesar salad was helpful. It may also be that to prepare a Caesar salad independently took skill and knowledge, and participants felt they lacked the necessary experience. The convenience for prepacked salads was associated more with laziness, rather than the positive life-enhancing benefit of adding variety.

A number of findings from the previous research conducted by New Focus should be considered within the context of this current research. Applicable sections of the previous research report in relation to shopping behaviour is represented over:

“There was an evident trend in shopping behaviour towards healthy eating and living. The result of this trend of health, wellbeing and fitness translates slightly different behaviour across each segment. In Adelaide, shoppers, whether major shoppers or convenience, communicated that they are tending towards purchasing more fresh food, particularly from specialist stores (eg butcher, baker, greengrocer, etc). In Sydney, however, the trend for convenience shoppers was away from fast food or junk food towards healthier alternatives, such as pre-packed meals. For those who could afford it, there was also a trend towards purchasing more organic foods.

Across the groups, the consistent purchase drivers that impact most on buying intention are quality and value for money. Participants considered that quality encompassed the taste, look and freshness of the food. Sydney participants felt that the ability to gauge the ripeness of the fresh produce through touch, sight and smell assisted to determine the quality of the food. Value for money is considered to refer to the best tasting, freshest and best looking food that can be afforded.”

Three out of four participants noted they ate salads all year round. The quantity consumed in warmer vs. cooler months was not measured.

1. c. Perceptions of watercress

Participants held pre-existing perceptions of watercress. Despite very few being able to name watercress as the product before tasting it, a minority of participants recalled previous experience and perceptions of the product following the taste-test. Of those who had heard of or tasted watercress before, the product tasted in the focus groups was considered to be different from what they experienced previously or imagined. Participants expressed that the product tasted in the focus groups was generally more appealing than their existing perception. Outside of the taste, perceptions around the English heritage of the product were mentioned (generally in a positive light). Current perceptions will be important to consider in the marketing of any watercress product, eg calling the product “cress” is likely to increase appeal.

2. Product testing

The distinctive flavour of watercress was polarising. While some liked the flavour, others did not find it appealing. Overwhelmingly, the combination of leaves was the preferred product among the three tested (watercress, rocket and combination of watercress, rocket and spinach). Participants were less likely to reject the combination leaves, and noted that the spinach leaves “mellowed” both the rocket and the watercress. The appeal and objections of all three products trialled are summarised in Table 5.

Table 5: Consumer Opinions

	Appealing	Objections
Watercress	<ul style="list-style-type: none"> • Taste: <ul style="list-style-type: none"> – zesty – peppery – surprising – sharp taste – spicy – bitter • Green appearance • Crunchy texture • Spontaneously imagined with other leaves 	<ul style="list-style-type: none"> • Taste <ul style="list-style-type: none"> – too strong alone – strong aftertaste – bitter – overpowering taste • Name – watercress didn’t convey the potency of the flavour
Rocket	<ul style="list-style-type: none"> • Taste: <ul style="list-style-type: none"> – bitter – peppery – cleans the palate • Change of flavour as chewed • “Trendy” previously, now much more for everyday use (badge of fashionable) • Wide distribution • Familiarity 	<ul style="list-style-type: none"> • Taste <ul style="list-style-type: none"> – too strong alone – strong after taste • Change of flavour as chewed
Combination	<ul style="list-style-type: none"> • The most appealing product • “Spinach takes the edge off” • Had the widest appeal: those who liked the flavour of watercress, but wouldn’t eat it alone, were enthusiastic about this option • Crunchy • Refreshing • Balanced • Seen as interesting: “To liven up a boring dish” 	<ul style="list-style-type: none"> • Only those who rejected watercress or rocket entirely rejected this concept • Taste still a barrier for some, primarily due to surprising intensity of watercress • Ratio of leaves will be critical • Must have something that indicates the ‘kick’ – nothing about the actual product indicates the interesting flavour

The quantitative findings below support the qualitative discussion.

2. a. Watercress

Overall 40% found the product not at all appealing or not appealing compared to 48% who found the product appealing or very appealing – the product polarised participants.

Adelaide was more positive than Melbourne, where 53% found the product appealing or very appealing, compared to 44% in Melbourne.

2. b. Rocket

Not as polarising as watercress; only 29% of participants rated rocket as not at all appealing or unappealing, compared to 42% who thought it was appealing or very appealing. There was a bigger group (29%) of participants who felt neutral about the rocket.

2. c. Combination

This product was more widely accepted, with only one participant rating it as not at all appealing. Overall, 69% found the mix either appealing or very appealing. Even given the small sample, this result indicates a significantly higher preference for the combination than either the individual watercress or rocket.

3. Combination leaves significantly most appealing concept

From early in the discussion, in all groups, many participants spontaneously mentioned a combination of salad leaves would be preferable to either watercress or rocket individually. This was endorsed when Product C (combination leaves) was tasted. Analysis of the quantitative data further supports the appeal of the combined product, with Product C being clearly the most preferred in both Melbourne and Adelaide. Overall the first choice of product was most likely to be the combination product, then watercress, then rocket. However more people in both Melbourne and Adelaide also chose watercress as least preferred product, indicating its polarising taste. For example; 69% in Melbourne chose watercress as their least preferred product, as did 56% in Adelaide.

Considering future market size, first preference is the key indicator, and with 65% of all participants nominating Product C as the first preference product (compared to 26% for watercress alone, and 9% for rocket alone) the combined product is most definitely the best opportunity to gain watercress sales.

A Melbourne participant summarised the flavours by noting “watercress is the highlight” of the combination, meaning that its taste had the most standout. (This may also be because it was the less familiar flavour). A Melbourne group characterised the combination of flavours as: warmth from rocket, zest from watercress, and coolness from spinach

While the combination of leaves was almost universally preferred over either rocket or watercress alone, participants experience varied greatly, depending on the ratio of leaves. The exact blend will be a critical consideration to take this product to market. A ratio of spinach: watercress: rocket of 3 or 4:1:1 seemed to gain widest acceptance. New Focus recommends experimentation with different ratios of combination.

4. Usage

Participants spontaneously discussed using watercress as an ingredient in a mixed green salad. This was the most frequently mentioned usage.

Other uses for watercress that were mentioned included as an ingredient in a tomato sandwich, as an additional vegetable in stir-fry/Thai style cooking, as a bed of warm greens with fish or steak. Some creative ideas were forthcoming, especially in Adelaide where participants had no trouble imagining ways they could use watercress, eg with watermelon or potato salad.

Participants would add watercress, or the combination salad, to their existing repertoire of vegetables. They were very comfortable with the concept of moving between different types of vegetables and seemed to value variety, as evidenced by the increase in experimental behaviour with Asian cooking. It is unlikely watercress will replace any particular vegetable.

5. Packaging

Participants preferred the combination product to be sold as a prepacked salad. Loose leaves were also popular, as they were perceived to be fresher and there was greater flexibility to create their own ratio within the mix.

For watercress alone, the 'living herb' concept was most desirable. This may reflect participants' imagined uses for watercress, as an ingredient rather than a main component.

Overall participants saw limited benefits of packaging fresh produce: minimal packaging was preferred, with its key purpose being transportation and possibly to help extend the life of the product.

Packaging for watercress must:

- 1) enhance the appearance of the product
- 2) help extend the life

Previous research undertaken by New Focus had similar findings. The relevant findings from the prior enquiry, validated during this current study, are presented below:

“Packaging plays a role as both a motivator and inhibitor to purchasing. Where the packaging is seen to be ‘packaging for packaging sake’, this is an inhibitor to purchase. Participants felt this inhibited purchase as consideration was given to the excess bulk, weight, inability to check the freshness of the food (touch and feel), and to a lesser extent, impact on the environment.

Among fresh food items, in particular fruit and vegetables, packaging is considered to be important only if it serves to increase the length of time that the food stays fresh. This packaging must also present the fresh food well and clearly communicate the benefits of the packaging (eg keeps the lettuce fresher for twice as long).

Packaging that was useful is considered to:

- *do what it says it will do and clearly communicate benefits*
- *be re-useable or easily recycled/disposed of*
- *allow the product to be viewed (clear or transparent)*
- *improve the core benefits of the product (taste, freshness, etc).*

The general perception about packaging for fresh food is that it limits the purchaser's ability to closely examine the quality of the food. That is, packaging for fresh food is seen to be 'hiding' the bad produce, leading to a 'one or two bad ones in every pack' perception, and is seen to contain food of a lower quality.”

6. Pricing

Participants believed the price of watercress would very much depend on the packaging. Packaged as a living herb, it should be priced in line with similar products.

However if packaged as a combination of leaves the price should be similar to other mixed lettuce leaves, eg rocket and spinach. In situations where a premium is commanded for fully prepacked salads, eg Caesar salad that includes dressing and croutons, it is unlikely a mix of just spinach, rocket and watercress would be able to justify a similar premium price.

7. Health benefits

Participants in all groups had very little or no awareness of the individual health benefits of specific fruits or vegetables, despite recent promotion of everything from mushrooms to blueberries. All participants noted positive health benefits associated with fresh produce, but none had any specific, well informed knowledge. It's considered healthy to eat vegetables, but participants did not know the particulars of why. All vegetables were considered healthy, although broccoli did gain specific mention by several participants.

For watercress, no participant was able to articulate a health benefit, although because it is a vegetable it was widely accepted that it was "good for you".

Specific health benefits are unlikely to be a purchase driver. Participants could not name any specific situations or products that they bought because of the health benefit. During discussion of the health benefits of watercress, the conversation shifted back to taste and appeal, or otherwise, of the bitter flavour. Taste is the primary determinant of choice, and therefore trialling will be the key to the successful marketing of watercress. A perceived health benefit is unlikely to motivate over and above trial and taste.

8. Communicating research to the consumer

Some consumers were sceptical about the research, while others accepted it readily and enthusiastically said it would make them purchase. As stated above, although some participants who rejected the taste of watercress said they'd eat it given this information, it is unlikely to be a true indication of their behaviour, given their demonstrated existing behaviour in shopping for fruit and vegetables.

Questions such as "how much do you have to eat", "does the method of preparation change it" were top of mind for several. Being UK research was not an issue for most participants, however, funding of the study by the Watercress Alliance raised questions as to its validity. The credibility of the information could be improved by more studies, longer studies, and independently funded studies. An endorsement by a cancer authority, eg Bowel Cancer Research Centre would also increase the credibility of the information, although some questioned whether this could be 'bought'.

Participants noted several forms of communication were suitable to build awareness of the health benefit. Not unusually, TV was most often put forward, with a mention by a TV chef such as Jamie Oliver, being seen as effective. Other forms of communication suggested can be found in the group write-ups. Interestingly the mediums suggested, eg use by a TV chef, don't lend themselves to providing a depth of information. The mediums mentioned are informative, but primarily focused on usage, rather than providing detailed health information such as would be possible in a magazine article (not mentioned). This may indicate that although participants appreciated knowing the information, they didn't necessarily value the details. At best, the health benefit of watercress is likely to reinforce the purchase decision after it is made, rather than to motivate action.

9. Distribution

The best opportunity for watercress is distribution through supermarkets. It was not considered particularly or exclusively a 'health food shop product'.

In Melbourne, some participants noted that they would expect a product with such health benefits to be available in tablet form. Rural Solutions SA may consider further investigating the feasibility of creating the same health benefits in tablet form as this presents additional competition to watercress producers.

Education of the taste of watercress will be vital, and some participants in Melbourne suggested distribution via healthy salad bars, or juice bars, eg "gives a peppery kick". The example of wheat grass was mentioned by participants to demonstrate how distribution at Boost Juice has increased awareness and usage of this vegetable.

Go to Market Plan – steps in the route to market

	Critical issue	Next step
Distribution	Distribution must ensure high quality (crisp, colourful) product reaches consumer's table	<ul style="list-style-type: none"> • Cool Chain to be investigated • Grower requires fast cooling, quick chilling capabilities. Vacuum cooler possible solution (funding decision) • Chilled zones in distribution centres for supermarkets also required
	Distribution in eastern states supermarkets will be necessary to build a national business, however Coles and Woolworths are reluctant to increase suppliers	<ul style="list-style-type: none"> • It may be necessary to form a strategic alliance with existing supplier to supermarkets, to gain distribution in eastern states. Opportunities and barriers to be identified • Possibility of franchising growing/distribution technology
Product	Product researched was too bitter for maximum appeal	<ul style="list-style-type: none"> • Combination of different ratio of 3 leaves to be investigated, cost to be evaluated • Sensory evaluation possible, perhaps linking with in-store trial? • Profile of watercress to be investigated for opportunities to reduce bitterness; possibly related to sulphates
	Presence of yellow leaves implies product is not fresh and therefore reduces purchase potential	<ul style="list-style-type: none"> • Investigate options and cost to provide product with no yellow leaves, eg cutting higher
	Consumers desire minimal packaging that enhances quality of the product	<ul style="list-style-type: none"> • Ziplock packaging to be investigated, however cost and automation implications may make it unsuitable • UK packaging or technologies which improve freshness and longevity of product to be investigated • Consider packaging design which conveys "surprising zest" to consumer
Marketing	Trial of product is an important precursor to purchase of an unfamiliar vegetable	<p>Methods to stimulate trial to be investigated and budget implications considered:</p> <ul style="list-style-type: none"> • In-store trial • Store staff trial (important source of information for shoppers) • Restaurant/cafe usage program • Recipe cards (build awareness, ability to drive purchase unproven) • TV chef endorsement
	"Watercress" does not convey the appealing aspects of the product, or motivate consumers to try	Consider re-branding, possibility of Zest Cress put forward

Other points of note

- Price: same as existing product in similar packaging, eg rocket
- Health benefit not lead motivator to purchase or continual usage

Health Benefits of Watercress

Watercress is an excellent source of many vitamins and minerals, which are vital to health. It also contains high levels of a range of antioxidants, and PEITC, which has been shown to have powerful anti-cancer properties.

Hippocrates, the father of medicine, is thought to have established his first hospital close to a watercress stream so that he could use fresh stems to treat his patients. Since that time science has identified many of the beneficial compounds contained in the plant.

Nutritional value of watercress

The Watercress Alliance have engaged leading UK dietician, Dr Lyndel Costain, to summarise the nutritional benefits of watercress.

Based on an average portion (80g edible weight), watercress is the better source of vitamins B1 and B6, vitamin E, beta-carotene and vitamin A equivalents, iron, calcium and zinc (very small differences for zinc) compared to raw and boiled broccoli, raw tomato and a raw apple, See Table 4.

For vitamin C, magnesium, watercress is a better source than all of the others listed, except for raw broccoli (but this isn't the way that it's typically consumed in the UK)

All are low in calories and fat.

Table 4. Comparative nutritional analysis (per 80 gram serve)

(Figures in brackets are the % of the Recommended Daily Allowance (RDA) for that nutrient - no figures, means there is no RDA for that nutrient)

	Watercress (raw)	Broccoli (raw)	Broccoli (boiled)	Tomato (raw)	Apple (raw)
Calories (kcal)	18	26	19	14	38
Protein (g)	2.4	3.5	2.5	0.6	0.3
Fat (g)	0.8	0.7	0.6	0.2	0.1
Fibre (g)	1.2	2.1	1.8	0.8	1.4
Beta-carotene (mcg)	2016	460	380	451	14
Vitamin A equivalent (mcg)	336 (42%)	77 (10%)	63 (8%)	75 (9%)	2 (0.3%)
Vitamin B1 (mg)	0.13 (9%)	0.08 (6%)	0.04 (3%)	0.07 (5%)	0.02 (2%)
Vitamin B6 (mg)	0.18 (9%)	0.11 (6%)	0.09 (5%)	0.11 (6%)	0.05 (3%)
Vitamin C (mg)	50 (83%)	70 (117%)	35 (58%)	14 (23%)	5 (8%)
Vitamin E (mg)	1.17 (12%)	1.04 (10%)	0.88 (9%)	0.98 (10%)	0.47 (5%)
Folate (mcg)	36 (18%)	72 (36%)	51 (26%)	18 (9%)	1 (0.5%)
Vitamin K (mcg)*	200	82	113	6.3	1.8
Calcium (mg)	136 (17%)	45 (6%)	32 (4%)	6 (0.8%)	3 (0.4%)
Iodine (mcg)**	16 (11%)	1.6 (1%)	1.6 (1%)	1.6 (1%)	Not known
Iron (mg)	1.8 (13%)	1.4 (10%)	0.8 (6%)	0.4 (3%)	0.1 (0.7%)
Magnesium (mg)	12 (4%)	18 (6%)	10 (3%)	6 (2%)	4 (1%)
Manganese (mg)	0.5	0.2	0.2	0.1	0.1
Phosphorus (mg)	42 (5%)	70 (9%)	46 (6%)	19 (2%)	9 (1%)
Potassium (mg)	184	296	136	200	96
Zinc (mg)	0.6 (4%)	0.5 (3%)	0.3 (2%)	0.1 (0.7%)	0.1 (0.7%)
Lutein and Zeaxanthin (mcg)*	4614	1353	1214	98	23
Quercetin (mg)*	3.2	2.6	0.9	0.5	3.5

Data Sources for Table 4:

- Food Standards Agency (2002) McCance & Widdowson's The Composition of Foods, 6th Summary Edition. Cambridge: Royal Society of Chemistry.
- U.S. Department of Agriculture, Agricultural Research Service (2003). USDA National Nutrient Database for Standard Reference, Release 16.
- VEGA (1999) – for watercress only, otherwise from Food Standards Agency (2002).
- USDA Database for the Flavonoid Content of Selected Foods (2003).

Information from the Watercress Alliance provides the following information:

Gram for gram, watercress contains as much vitamin C as oranges, more calcium than whole milk and more iron than spinach. Watercress has high levels of beta-carotene and vitamin A equivalents associated with healthy skin and eyes. It provides iodine and most B vitamins, including folic acid that is important for healthy pregnancy and is now being associated with cardiovascular health. Watercress also contains a variety of anti-oxidants, such as lutein, quercetin and zeaxanthin, which can help mop up potentially harmful free radicals.

The health associations of this crop are increasingly being exploited in market promotion. Without clinical trials, which are expensive, it has not been possible to make specific health claims. However it is appropriate to promote the nutritional characteristics of the crop, some of which the consumers relate to health attributes i.e. the calcium, iron and vitamin contents. Other promotional comments used include "Eaten for centuries because of its....." or "Tests in America have shown that....."

Watercress and cancer research

Watercress is the richest natural source of a compound called phenylethylisothiocyanate (PEITC), which gives the plant its unique peppery flavour and in a wide number of scientific studies has been shown to have powerful anti cancer properties.

The anti-cancer potential of a number of Brassica crops was highlighted by in the RIRDC Newsletter "Access to Asian Foods" by O'Hare, Wong and Force (2005). This work focused on the glucosinolate content of different Brassica seeds, including watercress.

More than 50 scientific studies have demonstrated that PEITC is not just a potent inhibitor of cancer development, but that it has the ability to kill cancer cells and prevent cancer-causing agents being metabolised into carcinogens (known as 'phase 1 suppression') and to stimulate enzymatic activity involved in detoxification of carcinogens (known as 'phase 2 activation').

In the 1990s, an American scientist Stephen Hecht (1999) continued the research into PEITC with a human dietary trial involving watercress and smokers. He demonstrated that smokers eating 2 oz of watercress with each meal were protected from a key carcinogen (NKK) associated with tobacco and implicated in lung cancer.

In 2000, a study by the Institute of Food Research in Norwich and the John Innes Institute reinforced previous findings (Rose *et al*, 2000). But in this case, the anti cancer response was thought to be more potent than pure PEITC and so further investigations were made. This revealed that watercress also contained another glucosinolate – methylsulphinylalkyl glucosinolate, a precursor of a range of methylsulphinylalkyl isothiocyanates (MEITC) – more usually found in broccoli and Brussels sprouts, and that together these compounds formed a more potent anti cancer weapon.

The latest research project by Ulster University is investigating watercress's anti cancer potential in relation to colorectal cancer. The two-year study, which is being funded by The UK Watercress Alliance, includes a 23-week dietary trial involving 30 men and 30 women aged between 18 and 55.

Colorectal cancer (or large bowel cancer) affects over 33,000 people every year in the UK and is one of the cancers thought to be most influenced by diet. It is a disease that causes nearly 16,000 deaths each year in the UK.

Food Safety Risk Assessment for Watercress

Assessment done by Dr Ian Delaere, Bioactives Risk Assessor, South Australian Research & Development Institute.

Chemical Composition

One hundred grams of fresh watercress has been analysed to contain 43mg of vitamin C, 4700 IU of vitamin A (NIH 1987) and 34mg of α -tocopherol (Hadas, Meir *et al.* 1994).

Watercress is known to contain eight glucosinolates (see Table 6) (Fahey, Zalcmann *et al.* 2001).

Table 6: Chemical and common names of glucosinolates present in watercress

Chemical name	Common name
Benzyl	Glucotropaeolin
4-Hydroxybenzyl	[Gluco]sinalbin
2-Phenylethyl	Gluconasturtiin; phenenthyl
7-(Methylsulfinyl)heptyl	Glucoibarin
8-(Methylsulfinyl)octyl	Glucohirsutin
7-(Methylthio)heptyl	
9-(Methylthio)nonyl	
8-(Methylthio)octyl	

Watercress is the most abundant source of gluconasturtiin, with 5.32g of gluconasturtiin/100g of defatted seed (Daxenbichler, Spencer *et al.* 1991), the precursor to phenenthyl isothiocyanate (PEITC).

Glucosinolate Variation within Accession

Cultural conditional including the quality and quantity of light, day length, temperature, and nutritional balance can dramatically influence crop growth and phytochemical yield.

A study on stage of harvest on PEITC content, found that PEITC concentration did not vary substantially in leaves harvested 40, 50 and 60 days after transplant though the fresh weigh and therefore yield of PEITC was higher in leaves harvest at 60 days when compared to 40 days (Palaniswamy, McAvoy *et al.* 2003).

Hazard Assessment

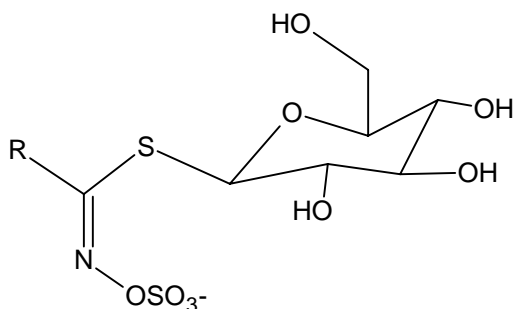
Natural Toxins - Glucosinolates and Isothiocyanates

Glucosinolates (β -thioglucoside-*N*-hydroxysulfates), the precursors of isothiocyanates, are present in sixteen families of dicotyledonous angiosperms including large number of edible species. At least 120 different glucosinolates have been identified in these plants, although closely related taxonomic groups typically contain only a small number of such compounds (Fahey, Zalcmann *et al.* 2001).

Glucosinolate content in plants is about 1% of dry weight in some tissues of the Brassica vegetables, although the content is highly variable, and can approach 10% in the seeds of some plants, where glucosinolates may represent one-half of the sulphur content of the seeds (Fahey, Zalcmann *et al.* 2001).

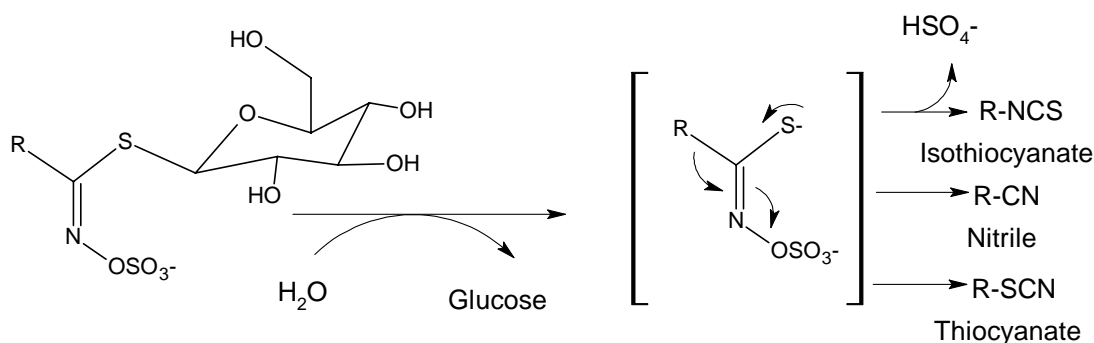
Glucosinolates are water soluble compounds that have no direct biological activity, but produce physiological effects in the body following enzymatic hydrolysis to isothiocyanates (ITC), catalysed by the action of plant myrosinase (thioglucoside glucohydrolase; EC 3.2.3.1) or similar enzyme activity associated with microflora of the gut. An indicative structure of the glucosinolates is presented in Figure 5.

Figure 5: Indicative structure for glucosinolates



After hydrolytic cleavage of the β -glucosyl moiety, the sulfate moiety is released non-enzymatically to form the thiohydroxamate-O-sulfonate from both aliphatic and aromatic glucosinolates. This unstable intermediate then rearranges to form isothiocyanates, or other breakdown products (e.g. thiocyanates, nitriles, epithionitriles, oxazolidine-2-thiones) in a manner that is depends upon the glucosinolate substrate as well as the reaction conditions (e.g. pH, or the presence of Fe^{2+} or epithiospecifier protein) (Fahey, Zalcmann *et al.* 2001). An indicative hydrolytic pathway for glucosinolates is presented in Figure 6.

Figure 6: Indicative hydrolytic pathway of glucosinolates



ITC's are metabolised in mammals by conjugation with glutathione, followed by conversion via the mercapturic acid pathway to N-acetylcysteine conjugates and excretion in the urine. Thus, the presence of ITC-N-acetylcysteine conjugated in the urine is indicative of uptake and metabolism of ITC's by the body (Rose, Faulkner *et al.* 2000).

Toxicity of glucosinolates and isothiocyanates

The major focus of much previous research has been on the negative aspects of these compounds because of the prevalence of certain "antinutritional" or "goitrogenic glucosinolates in the protein-rich defatted meal from widely grown oilseed crops and in some domesticated vegetable crops (Fahey, Zalcmann *et al.* 2001).

There is, however an opposite and positive side of the picture represented by the therapeutic and prophylactic properties of other "nutritional" or "functional" glucosinolates (Fahey, Zalcmann *et al.*

2001). For example, a diet rich in cruciferous vegetables, such as Brussels sprouts, broccoli, cabbage or cauliflower, may reduce the risk of many common cancers (Beecher 1994). This preventative activity is thought related to the presence of the glucosinolates.

Toxicology – Gluconasturtiin and Phenethyl isothiocyanate

Gluconasturtiin

Animal toxicity studies

No animal studies on the toxicity of gluconasturtiin were identified in the literature.

Genetic toxicity studies

Gluconasturtiin has been shown to induce chromosomal aberrations and sister chromatid exchanges in Chinese hamster ovary cells at concentrations of above 2 mg/ml (Musk, Smith *et al.* 1995).

Gluconasturtiin (100 μ M) has been shown to significantly induce point reverse mutation in growing *Saccharomyces cerevisiae* diploid D7 strain yeast cells without myrosinase. In the presence of myrosinase, cytotoxic effects were observed in stationary phase growing cells at 10 μ M (Canistro, Della Croce *et al.* 2004).

Overall conclusion

No animal toxicology data on gluconasturtiin was identified in the literature.

Gluconasturtiin possesses genotoxic activity. The significance of these findings for human health is unknown.

Phenethyl isothiocyanate (PEITC)

Animal toxicity studies

The National Cancer Institute has published a précis of preclinical safety studies associated with the clinical development plan for PEITC (NCI 1996). A summary of results is presented below.

The oral LD50 for PEITC was estimated to be 862 mg/kg (ca. 5.3 mmol/kg bw) for Fisher 344 rats [781 mg/kg bw (4.8 mmol/kg bw) for female rats and 898 mg/kg bw (5.5 mmol/kg bw) for male rats]

PEITC fed to female A/J mice at 0, 1, 3, or 10 μ mol/g diet (ca. 0, 0.1, 0.4 and 1.3 mmol/kg bw/day) for 14 days resulted in decrease food consumption and body weight gain at the highest dose.

PEITC was administered at concentrations of 0, 500, 1500 and 2500 ppm (ca 0, 245, 735 and 1225 $\mu\text{mol/kg bw/day}$) in the NIH-07 diet to Fisher 344 rats for 90 days. At the highest dose, mean body weight was significantly reduced only during the second week of treatment for males and females, although food intake throughout the study was similar in PEITC-treated and control animals. Organ weights were similar in control and treatment groups except for the liver. The mean relative liver weight to final body weight and the mean absolute body weight was significantly greater in male rats from the 1500 and 2500 ppm groups. Hematological and biochemical parameters were similar in all groups except for serum alkaline phosphatase, which significantly reduced in male rats treated with 2500 ppm PEITC. There were no treatment related gross lesions in any rat at necropsy; however, compound-related microscopic changes in the epithelial lining of the forestomach were observed for the 1500 and 2500 ppm PEITC groups; these changes included increased width of the keratin layer and squamous epithelial cell ghosts retained in the keratin layer. The results of this study indicate that the NOEL for PEITC in Fisher 344 rats is 500 ppm in the diet (ca. 245 $\mu\text{mol/kg bw/day}$).

PEITC was administered at concentrations of 0, 2, 4 and 8 mg/kg bw/day (ca 0, 12, 24 and 49 $\mu\text{mol/kg bw/day}$) in the diet to dogs for 90 days. Preliminary results reported gastric irritation in all drug-treated groups, while the severity and frequency of diarrhoea and vomiting were dose related. Treatment-related reactive changes were seen in the bladder at the two highest doses, including inflammation, hyperplasia and haemorrhage. The NOEL was determined to be 2 mg/kg bw/day (12 $\mu\text{mol/kg bw/day}$).

Genetic toxicity studies

PEITC has been shown to induce chromosomal aberrations and sister chromatid exchanges in Chinese hamster ovary cells at concentrations of 0.9-1.2 $\mu\text{g/ml}$ (Musk, Smith *et al.* 1995).

PEITC has been shown to be mildly genotoxic in the absence of metabolic activity in the *Salmonella*/microsome assay with TA98 and TA100 (100 $\mu\text{g/ml}$), weakly genotoxic in the absence of metabolic activity in the differential DNA repair assay with *E. coli* (25 $\mu\text{g/ml}$) (Kassie and Knasmüller 2000). Both tests indicate that genotoxic activity is ameliorated in the presence of metabolic activity.

Overall conclusion

In rats, safety studies established a NOEL of 40 mg/kg bw/day (245 mmol/kg bw/day). In the broadest terms the safe daily dose for a 70 kg human would be in the range of 0.4 –2800 mg (NCI 1996).

Although PEITC have been repeatedly advocated as very promising anticancer agents, the data indicates that PEITC is genotoxic (Kassie and Knasmüller 2000). The significance of these findings for human health is unknown.

Heavy Metal and Environmental Contaminants

Food standards, when used to establish maximum levels (MLs) for contaminants in various foods, operate within a broader risk management structure to reduce public health risks. Other regulations that encourage practices that in turn reduce contamination of food operate at all levels of government in Australia. These include waste management/disposal programs, water quality programs, industrial zoning regulation and environmental safeguards.

In many cases, the potential for contamination of food is self-limiting because of these other regulations and specific regulation may be unnecessary. When a food standard is considered necessary for a particular contaminant as a risk management option, this is achieved by establishing an ML in particular food commodities. MLs are the legal limits enforced through the State and Territory Food Acts and are, in general, used only when other mechanisms of control are considered insufficient or inadequate to safeguard the health of consumers.

FSANZ regulates the presence of contaminants in food through Standard 1.4.2 – Contaminants and Natural Toxicants. This Standard sets out the maximum levels (MLs) of specified metal and non-metal

contaminants and natural toxicants in nominated foods. As a general principle, regardless of whether or not a ML exists, the level of contaminants and natural toxicants in all foods should be kept as low as reasonably achievable (the ALARA principle).

There is no Australian data on the prevalence of heavy metal contaminants in watercress.

A New Zealand study of wild-crafted watercress sampled from 11 streams in the greater Wellington region (urban, semi-urban and rural) found heavy metals were detected in the following ranges (mg/kg wet wt);

Arsenic	0.25-0.27	(detected in 2/55 samples)
Cadmium	0.005-0.05	(detected in 28/55 samples)
Lead	0.01-1.0	(detected in 44/55 samples)
Mercury	Not detected	(LOD = 0.02)

Watercress from urban and semi-urban streams had higher mean metal concentrations of lead (and other heavy metals such as zinc and copper) than the other sites (Edmonds and Hawke 2004).

The NZ data on wild-crafted watercress indicates that there considerable non-compliance with the ML for lead (0.1 mg/kg) in vegetables (except brassicas).

No data was found on the prevalence of other environmental contaminants in watercress.

Chemical Control Agents

Maximum residue limits (MRLs) for agricultural and veterinary chemicals are established in the Australia New Zealand Food Standards Code (the Code). FSANZ evaluates the potential dietary exposure associated with the proposed MRLs and ensures that this exposure does not represent an unacceptable risk to public health and safety. MRLs are listed in Standard 1.4.2 – Maximum Residue Limits of the Code.

The inclusion of the MRLs in the Code allows produce treated according to Good Agricultural Practice (GAP) to be legally sold, provided that the residues in the treated produce do not exceed the MRL. Changes to Australian MRLs reflect the changing patterns of agricultural and veterinary chemicals available to farmers. These changes include both the development of new products and crop uses, and the withdrawal of older products following review.

Standard 1.4.2 lists the maximum permissible limits for agricultural and veterinary chemical residues present in food. Schedule 1 lists all of the agricultural and veterinary chemical limits in specific foods.

Schedule 2 lists all extraneous agricultural chemical limits in specific foods. If a maximum residue limit for an agricultural or veterinary chemical in a food is not listed in the schedules there must be no detectable residues of that agricultural or veterinary chemical in that food. Also, if an agricultural or veterinary chemical is not listed in the schedules, there must be no detectable residue of that chemical or its metabolites in any food.

Schedule 3 groups certain agricultural or veterinary chemicals according to their chemical groups. Commodity and commodity groups which are referred to in this Standard are listed in Schedule 4. Schedule 4 also specifies the part of the commodity to which the maximum or extraneous residue limit refers.

Watercress is defined in Schedule 4 as a Leafy Vegetable. MRL's of agricultural chemicals for Leafy Vegetables are presented in Table 7.

No data was found with regard to the prevalence of use of agricultural chemicals in Australian watercress.

Bacterial Pathogens

Fruits and vegetables carry natural non-pathogenic epiphytic microflora. During growth, harvest, transportation and further processing and handling the produce can, however, be contaminated with pathogens from human or animal sources. Fresh produce has been implicated in a number of documented food borne illnesses.

Surveillance of vegetables has indicated that these foods can be contaminated with various bacterial pathogens, including *Salmonella*, *Shigella*, *E. coli* O157:H7, *Listeria monocytogenes* and *Campylobacter* (SCF 2002).

No Australian data was identified on the prevalence of bacterial pathogens in watercress.

A New Zealand study of wild-crafted watercress sampled from 11 streams in the greater Wellington region (urban, semi-urban and rural) found *E.coli* in watercress from all sites at levels above acceptable food hygiene limits. *Campylobacter* was present in 11% of the watercress samples and was more common in rural and semi-rural catchments (Edmonds and Hawke 2004).

Studies on minimally processed watercress have found high initial bacterial loads (Park, Cho *et al.* 1998) and the reports of *Salmonella* (Martins, Behrens *et al.* 2004).

In most cases, fruits and vegetables or their products are washed after harvesting by producers, processors, packers and/or consumers and potable water is generally used for this purpose. The safe use of chemical decontaminants to reduce microbial load and the implications of residues from this kind of treatment is not well documented (SCF 2002).

Viral Pathogens

Food borne viruses causing human disease originate from human faeces. Many enteric viral infections are mild and of relatively short duration. Most cases are probably not identified because specimens are not commonly examined for viruses and detection methods used routinely only some of the viruses' known to cause infectious intestinal disease.

Hepatitis A and Norwalk-like virus (NLV) (Formerly known as Small Round Structured Viruses [SRSV]) are most commonly documented viral contaminants in food.

An outbreak of SRSV in watercress was reported in the UK (SCF 2002).

Parasitic Pathogens

There are many case reports in the literature of the human fascioliasis (a liver fluke infection) and an association with the consumption of watercress. Over the period 1970-1990, 2594 human cases were reported in 42 countries (Mas-Coma, Esteban *et al.* 1999).

Fascioliasis is a zoonotic disease caused by the trematode *Fasciola hepatica*. It can infect a wide variety of mammalian hosts, particularly sheep, goats and cattle. Humans become infected after eating aquatic plants on which encysted organisms are present or by drinking contaminated water (Saba, Korkmaz *et al.* 2004).

There is no Australian data on the prevalence of liver fluke infections in association with watercress.

No data has been found on the prevalence of liver fluke cysts on watercress in New Zealand (NZFSA 2005).

The lifecycle and vectors of contamination associated with *Fasciola hepatica* in watercress are well known (Dreyfuss, Vignoles *et al.* 2003; Rondelaud, Hourdin *et al.* 2005; Rondelaud, Vignoles *et al.* 2001).

Infection of watercress with *Fasciola hepatica* can largely be controlled in cultivation systems by protecting against from the intrusion of livestock and by being designed in such a way as to eliminate the possibility of the ingress of the liver fluke vectoring snail *Lymnaea truncatula*.

Food Poisoning Events

There is no Australian data on the prevalence of food poisoning events in association with watercress.

New Zealand data indicates that between 1997 and August 2004, seven cases of gastroenteritis have been reported as being possibly linked to the consumption of watercress. Of two cases of campylobacteriosis, one records the watercress as being collected off a farm. Giardiasis was identified in three cases, and salmonellosis in a further two cases. Of these, only two cases (one of each condition) identified a local stream as being the source of the watercress (NZFSA 2005).

Allergens – Mustard Allergy

Mustard is the fourth most important food allergen for children, after eggs, peanuts and cows milk (Rancé, Kanny *et al.* 1999).

Mustard belongs to the Brassicaceae family. It is typically a mixture of *Sinapis alba* (white mustard) and *Brassica juncea* (oriental mustard). The major allergen (Sin a I) of mustard is a thermostable protein that is resistant to digestion by trypsin and degradation by other proteolytic enzymes (Gonzales del la Pena, Monsalve *et al.* 1996; Monsalve, Gonzales del la Pena *et al.* 1993). There are some 3200 species and 375 genera of Brassicaceae. The most common include radish, rutabaga, various types of cabbage (cauliflower, Brussels sprouts, kohlrabi and Chinese cabbage), broccoli, turnip, watercress, horseradish and rapeseed. Cross-reactions involving clinical manifestations between mustard and other *Brassicaceae* family allergens are rare (Rancé 2003).

Dietary Exposure

The most recent data relevant to the Australia New Zealand Food Standards Code is the 1997 New Zealand National Nutrition Survey. Data from this survey are included in DIAMOND, the Food Standards Australia New Zealand dietary exposure assessment program.

In New Zealand, watercress was reported to be consumed by 0.7% of the study respondents, with an average serving size for those consuming of 230g. Overall this equates to a mean daily intake of 1.8g/person/day for the total population. There is no indication of the source of the watercress consumed (NZFSA 2005).

Consumption of watercress at least once per week was reported by 14% of Maori respondents, 13% of Pacific Islander respondents and 1% in other ethnic groups (NZFSA 2005).

Summary and Qualitative Discussion of Risk

Watercress can be a high-risk food if collected from areas contaminated naturally or by human activities.

Watercress can bioaccumulate heavy metals, lead and arsenic in particular and has also been associated with bacterial pathogens, *Campylobacter* in particular.

There is substantial evidence internationally associating the consumption of raw watercress with human fascioliasis (liver fluke).

Food poisoning incidence where watercress is collected from streams indicates that plant material can become contaminated with *Salmonella* or the parasite *Giardia*.

Watercress can become a low risk food when cultivated under conditions that limit hazard prevalence, these conditions include:

- Control of water quality for heavy metal and bacterial contaminants;
- Control site for the introduction of bacterial contaminants (rodents/birds);
- Control site for the introduction of liver fluke (faecal matter from bovine/ovine hosts); and
- Control of hazard prevalence through appropriate washing and cold chain procedures post-harvest.

Though there is mounting evidence on the genotoxic and mutagenic activity of individual glucosinolates and isothiocyanates this data contradicts epidemiological evidence associating consumption of Brassicaceae with lower cancer risk.

The food safety hazards associated with the consumption of glucosinolates and isothiocyanates present in watercress are considered negligible particularly when viewed as making a minor contribution to total dietary glucosinolate consumption from all sources of the diet in the general community.

Table 7: Maximum Residue Limits in Leafy Vegetables (Watercress)

Agricultural chemical	MRL mg/kg
Carbaryl	10
Chlorothalonil	T7
Cypermethrin - Cypermethrin, sum of isomers	T2
Dithiocarbamates - Total dithiocarbamates, determined as carbon disulphide evolved during acid digestion and expressed as milligrams of carbon disulphide per kilogram of food	5
Fenamiphos - Sum of fenamiphos, its sulfoxide and sulfone, expressed as fenamiphos	*0.05
Glyphosate - Sum of Glyphosate and aminomethylphosphonic acid (ampa) metabolite, expressed as glyphosate	*0.1
Metalaxyl	0.3
Methamidophos - <i>see also</i> Acephate	T1
Methomyl - Sum of methomyl and methyl hydroxythioacetimidate ('methomyl oxime'), expressed as methomyl - <i>see also</i> Thiodicarb	1
Parathion-methyl	T1
Pendimethalin	*0.05
Permethrin - Permethrin, sum of isomers	T5
Pirimicarb - sum of pirimicarb, dimethyl-pirimicarb and N-formyl-(methylamino) analogue (dimethylformamidio-pirimicarb), expressed as pirimicarb	T3
Pymetrozine	T0.5
Spinosad - Sum of spinosyn A and spinosyn D	5
Tetrachlorvinphos	2

Interpretation

- An asterix '*' denotes that the maximum residue limit is set at or about the limit of determination.
- A 'T' appearing denotes that the maximum residue limit is a temporary maximum residue limit.

The Cost and Returns of Watercress Production

Appraisal done by Mike Krause, Principal, Applied Economic Solutions
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Watercress can be grown in both outdoor and in hydroponic environments, but with its demand for water, it is best suited to hydroponics in the Australian environment where water is becoming a scarce resource.

In the hydroponic environment it is possible to produce watercress all year round, hence continuity of supply is possible. The life cycle of a crop is about 6 weeks from seedling to harvest, and once harvested then replanting can occur. In a hydroponic environment, rotation is not an issue.

Since watercress is currently a niche market in Australian the price paid to growers is relatively constant throughout the year. It is anticipated the expansion of watercress will occur in the future, which will lead to increased competitiveness and lower prices. Hence, conservative prices and costs have been used in this analysis.

Holla-Fresh P/L of Tantanoola (SA) currently grows watercress and the information provided in the report comes from their experience. They grow watercress hydroponically and freight to retail outlets. They currently have two markets for watercress: selling loose leaves to packers who include watercress in the loose salad packaging market; and bunches of live watercress. They receive different prices from both of these markets.

The Analysis

The gross margins for both the loose salad packaging and the live watercress market have been provided. The difference between the gross margins is largely the prices received for each product, as the costs of production are identical and costs of packaging loose in bags or as live plants in plastic tubes was very similar. The costs have been provided on a 1,000m² hothouse area, both as a gross margin per week and per year. This approach is thought to be the easiest as crops are planted weekly to provide continuity of supply. The gross margins for both markets are provided in Tables 8 and 9 and the prices and production levels are seen to be average from Holla-Fresh's experience.

Table 8: Gross Margin of loose salad packaging (\$/1,000m² hothouse)

Income	per week	per year
production	300.00 kg	15,600 kg
price	\$10.00 /kg	\$10.00 /kg
Total Income	\$3,000.00	\$156,000
Costs		
Seed	\$17.50	\$910
Growool (growing medium)	\$140.00	\$7,280
Fertiliser	\$20.00	\$1,040
Chemical	\$5.00	\$260
Labour	\$1,050.00	\$54,600
Power	\$250.00	\$13,000
Repairs and maintenance	\$20.00	\$1,040
Freight	\$350.00	\$18,200
Total costs	\$1,852.50	\$96,330
Gross Margin	\$1,147.50	\$59,670

Sensitivity (annual gross margin)			
Price (\$/kg) / production (kg)	12,480	15,600	18,720
\$8.00	\$3,510	\$28,470	\$53,430
\$10.00	\$28,470	\$59,670	\$90,870
\$12.00	\$53,430	\$90,870	\$128,310

Table 9: Gross Margin of the live watercress market (\$/1,000m² hothouse)

Income	per week	per year
production	3,500 bunches	182,000 bunches
price	\$1.00 /bunch	\$1.00 /bunch
Total Income	\$3,500.00	\$182,000
Costs		
Seed	\$17.50	\$910
Growool (growing medium)	\$140.00	\$7,280
Fertiliser	\$20.00	\$1,040
Chemical	\$5.00	\$260
Labour	\$1,050.00	\$54,600
Power	\$250.00	\$13,000
Repairs and maintenance	\$20.00	\$1,040
Freight	\$350.00	\$18,200
Total costs	\$1,852.50	\$96,330
Gross Margin	\$1,647.50	\$85,670

Sensitivity (annual gross margin)			
Price (\$/bunch) / production (bunches)	145,600	182,000	218,400
\$0.80	\$20,150	\$49,270	\$78,390
\$1.00	\$49,270	\$85,670	\$122,070
\$1.20	\$78,390	\$122,070	\$165,750

The gross margins indicate that more profitability is available from supplying the live bunch market, but this may change over time as competition grows. The gross margins may appear very positive. However, it should be remembered that significant capital costs are involved in setting up a hydroponics operation. Returns similar to the above gross margins are needed to attract new entrants into this market for it to grow.

Capital costs

The capital cost of developing hothouses for watercress production is significant. The production levels provided above reflect a fully automated hothouse system where the high cost of labour is kept to a minimum. There are other hothouse systems that are cheaper to build and equip with the necessary irrigation systems, but their productivity is lower and cost of labour is higher. Table 10 provides the estimated current capital costs for developing a 1,000m² hothouse with the associated earth works, tank and irrigation systems, blinds and handling equipment. Some of these costs will be sight specific and potential investors will need to research their options. Obviously the more automated, the higher the capital cost.

Table 10: Capital Cost for developing a 1,000m² Hothouse

Hothouse complexity	Capital cost of development
Fully automated	\$300,000 - \$350,000
Manual	\$180,000 - \$200,000
Basic manual	\$100,000 - \$120,000

Summary

Watercress production is in its infancy in Australia and early research and market response would indicate that there is potential for this market to grow. From a production perspective, there appears to be positive margins available, but investment is also needed in the form of marketing and promotions for this product to be developed into an industry. The capital costs required to develop a hothouse is also significant.

Appendix 1 – Focus group responses

4. Combined Group Write-ups

Groups No:	1&2
Criteria:	Grocery Buyers
Location:	New Focus, Marden, SA
Date:	Tuesday 24 th January 2006
No. of participants:	19

Shopping and eating behaviour

When you purchase fresh vegetables what are the most important factors to you?

- Appearance mentioned as first priority when purchasing fresh vegetables:
 - Bright, crisp, fresh looking colour
 - Not having overly processed look
 - Not bruised, poorly handled, “not banged up”, “no grub holes”, produce handled with care
 - “Looks appetising”
- Other important factors mentioned by participants:
 - Variety
 - Brand name eg. Jaffa oranges. “I know it’s been good in the past”
 - Australian produce
 - Price – considering some vegetables “go off the next day”
 - Firm texture
- Store
 - Able pick up and smell, interactive
 - Store looks clean, no flies, no mouldy fruit
- For unfamiliar produce:
 - Research first then purchase
 - Cookbooks, friends, internet, recipe cards all mentioned as research sources – but suspect family and friends are key influences
 - Asking people who work in the shop frequently noted. Can break down the barrier to trial, even after other forms of communication, eg. asking person who worked in Asian shop about Snake Beans
 - Mystic and possibly fear around new vegetables eg. seeing artichoke on TV, seeing it in the market, respondent still “didn’t know what to do with it” and hadn’t bought it, even though she was enthusiastic and had strong motivation
 - Many agreed they’d like to try before they buy, noting samples in-store had positively influenced purchase in the past

What has been your experience with pre-packaged salads and vegetable mixes?

Focus was on salads, experience with prepacked vegetables was less top of mind. Convenience and variety were key drivers, mentioned first. Negatives associated with pre-packed salads and vegetables were spontaneously discussed after the positives, and there was wide experience of prepacked salads going limp quickly.

- Convenience
 - Convenience was immediately mentioned when the concept of prepacked salads and vegetables was introduced. Participants gave examples of using the prepacked salads when they’d been working late, were “in a hurry” and when entertaining. Entertaining included when friends were “coming over”, using the salads as an easy option with a platter of food and taking prepacked salads to BBQs. Other behaviours regarding prepacked salads and vegetables mentioned by individual participants were keeping the

salad bag in the fridge for a work lunch and purchasing stir-fry vegetable mixes for a grandmother who had difficulty cutting up vegetables. Interestingly, pre-packaged salads seemed to be most likely bought for a particular purpose, rather than kept in the fridge for spontaneous situations – probably because of participants’ experiences with pre-packed salads turning bad quickly (within 24 hours).

- Variety
 - Participants purchased pre-packed salads when ingredients were a bit more complicated, and salad harder to make. Tabouli and Caesar salad were given as examples. Participants were happy to trade off the benefits of fresh produce for the advantage of getting 4 or 5 different ingredients in one pack. Participants felt particularly enthusiastic about the advantages of pre-packed Caesar salad. Perhaps seeking out more elaborate salad options was a positive endorsement of providing/nurturing skills, rather than the slight negative connotation of buying prepacked salads because they were convenient
- Participants’ experience of poor quality of prepacked salads was an issue
 - There was widespread experience amongst participants of pre-packed salads “going off within 24 hours”. Many mentioned salads had gone “a bit limp”. Use within 24 hours seemed to be most desirable
- Pre-packed salads were also noted as expensive by a few participants, although certainly not by the majority. Perhaps because of the convenience and variety provided, participants expected to pay a price premium

Product testing

Watercress

- General reactions to the product
 - Wide variety, from dislike, to “so-so” to “yummy”. Reaction seemed to be dependent upon participants’ overall acceptance of unusual vegetables
 - The “surprise” of the flavour was a standout reaction. Participants clearly weren’t expecting such a distinctive taste. The way the flavour developed was also noted. Some participants liked this, while others thought the after-taste was too strong. These participants were generally those who didn’t like the product overall
- Other general spontaneous reactions:
 - “Bitter”
 - “Go well in a mixed salad. It’s cooling”
 - “Nice sharp taste”
 - “Zesty for a salad”
 - “Almost fizzy”
 - “Peppery”
 - “Hot”
 - “Frustrating. Little leaves fall apart in my mouth, there’s no flavour and then a strong flavour. I wish I had some mints”

Responses to specific prompting:

- How would you describe the taste?
 - “Radishy”
 - “It had a bite”
 - “Surprising”
 - “Unexpected”
 - “Bitter” / “Bitter, but I like it”
 - “Sharp”
 - “I like the spicy taste”
 - “Tingling taste”
 - “Strong aftertaste”

- What is it most similar to?
 - “Horseradish”
 - “Turnip”
 - “Rocket”
 - “Sour-sop”
- How appealing is it?
 - Appeal was spilt, some liked it very much, and others did not find it appealing at all. Reactions ranged from “horrible taste”, “I wouldn’t go out of my way to buy it. It’s too strong” through to “Fantastic”. Those that found it appealing would use it in the mixed salad; by itself it had limited appeal.
 - The appearance was appealing, and the texture was generally acceptable. The ratio of stalk to leaf was acceptable, although one participant wanted bigger leaves. The “crunchy” texture was also desirable. It was described as “grittier than lettuce”
- Would you buy it?
 - About half each group would possibility/definitely buy it when prompted in the group
- How would you use it?
 - In a mixed salad was by far the most frequently mentioned use for the product. However, participants had no trouble thinking of other ways in which it could be utilised. Alternatives included:
 - In a tomato sandwich “Dress up a boring tomato sandwich”
 - Stir fry/in Thai type food
 - Mix in a sauce
 - As a garnish
 - With potato salad
 - As a bed of wilted greens, with fish, (there was specific discussion about which fish it would be best with eg. snapper), chop or steak
 - Put into mashed potatoes
 - “Makes a boring dish interesting”, “enhances the experience”
 - Salsa
 - As a “garnish” in sandwich
 - With watermelon, “it would cut through the sweetness”

Perceptions of watercress

- Participants were asked to guess what the product was. Almost no-one guessed correctly, with the majority not being able to identify a single possible alternative, although some people went on to mention later they had prior experience of watercress in their youth. Guesses included coriander, mustard greens/plant, some kind of rocket, some kind of spinach
- When the product was revealed as watercress there was surprise amongst participants in both groups, as the product they tasted exceeding their expectations. A few participants were unaware of watercress, but the majority had heard of it before. The perception of watercress was two-dimensional: taste, and the English heritage of usage were the strongest perceptions.

Current perceptions of watercress

- “I didn’t think it was quite as nice as this”
- “I’d forgotten about that”
- “Posh afternoon tea”
- “Very British”
- “Sandwiches”
- “Quiches”
- “Not as pungent as this”
- “I ate it from creeks when we went rabbiting as kids”
- “Watery tasting vegetable” (from the name)
- “Not so bitsy, more green leafy”
- “I don’t remember it having a green stem, the stem was white”

There was some discussion about the name:

- “Change the name, the name sounds bland”
- “Name is misleading”
- “How about PowerCress, Ultra Cress, Super Cress?”

Rocket

- General reactions to the product
 - “Like it”
 - “Starts out ok, but the last bit is bitter and hangs around”
 - Non descript, I’m ambivalent
 - Very bitter
 - “Bitter, but like it”
 - Starts out alright then hangs around
 - “My husband would like this, it’s like mustard”
 - “Great with tomato”
 - “I’d put it with other vegies, potato salad”
 - “Flavour sits in the back of your nose”
 - “Similar to the other one”
 - “Stronger than the one before”
 - “Didn’t find it as bitter”
 - “Not fussed”
 - “I’d mix it”
 - “I wouldn’t eat it unless it was with other things”

When asked to guess what the product was some participants suspected it was rocket, but few guessed with certainty. Other ideas put forward were endive and oregano.

Responses to specific prompting:

- How would you describe the taste?
 - “Sharp”
 - “Bitter”
 - “Like Endive”
 - “Wouldn’t eat it under any circumstances”
 - Less appeal than watercress
 - Less distinctive
 - Less versatile although same flavours
 - Range of recipe options mentioned for watercress
 - “Lovely”
 - “Nice”
 - “Quite strong”
 - “Peppery”
 - “It changes as it sits on the tongue”
 - “Distinctive”
 - “Creamy or buttery at first and then something else there”
 - “Cleans the palette”
- What is it most similar to?
 - “Endive”
 - “Rocket”
 - “Thistles”
 - “Lingers like an onion”
 - “Mustard”

- How appealing is it?
 - Seems less versatile than watercress with a more limited range of options spontaneously mentioned
 - It is appealing for some, but not on its own
 - Some made unfavourable comparisons to watercress; they found it stronger, particularly in aftertaste. Another interesting comparison was made that watercress was spicy and rocket was bitter.
 - Have eaten some with steak, leafy mixes, “it’s good in a mix”
- Would you buy it/use it?
 - Half group 1 would probably or definitely buy when asked in the discussion
 - Uses included mixed salad (eg. with cucumber and tomato), or warm, wilted with steak or seafood

Perceptions of Rocket

- Unanimously, perceptions were regarding the taste of the product, but there was some debate about whether rocket was usually more or less spicy than the sample they had tried:
 - “It normally has bigger leaves”
 - “Peppery”
 - “Spicy”
 - “Bitter”
 - “Nice in salad”
 - “More spicy than this”
 - “I’d don’t remember it being as spicy”
 - “I know it’s very good for you and I’ve started growing it”
 - “Health”
 - “I thought it had different leaves”
 - “I thought rocket was like normal spinach, but this is nothing like spinach”

Combination leaves

- General reactions to the product
 - More appealing because the spinach “mellows out” the strong flavours of watercress and rocket
 - “Like it”
 - Participants who didn’t like the watercress or rocket at all did not find the combination salad appealing. However, those who found the rocket and watercress even mildly appealing were enthusiastic about the combination product and buying signals were stronger
 - Rejecters of the pre-mixed salad concept tended not to like it
 - Some would add their own ingredients to it, eg tomato, cos lettuce, normal lettuce, cucumber, capsicum, sprouts
 - 80% spinach
 - “Crunchy”
 - “The combination makes a difference”
 - “Great, but you need other lettuce”
 - “Good combination”

Responses to specific prompting:

- How would you describe the taste?
 - “Much more pleasant, spreads flavour”
 - “Subtle bite”
 - “Refreshing”
 - “Peppery”
 - “Fairly balanced”
 - “Leafy balance”

- What is it most similar to?
 - Participants saw Product C as a “mixed lettuce” product. Most had tried pre-packed mixed lettuce and this concept was not unfamiliar
 - “Nice. I’ve used this before, with pear, olive oil and balsamic”
- How appealing is it?
 - “Well balanced – some leaves are more stalky and the spinach is more leafy”
- Would you buy it/use it?
 - Stronger agreement than either of the individual watercress or rocket leaves
 - Most would buy it
 - Some noted they would prefer to purchase the ingredients separately to control the ratio and because of the variable quality of pre-packed salads. However this may not be an indication of actual likely behaviour, based on their existing use of pre-packed salads. Some participants pragmatically suggested they wouldn’t get the ratio “right” if they were to mix it themselves and preferred it to be mixed for them.
 - Good with meat, fish
 - Add to pasta (this was in response to the spinach component)
 - Add to soup
 - “To liven up a boring dish”
 - Add a dressing, “oil & vinegar”

Ratio is going to be very important: 80% to 30% - but too much? Maybe 20% 20% 60%?

Which of the three products did you prefer?

- Mixed salad preferred significantly. Turned ‘maybes’ into ‘definites’
- For example, group 1: 3 people preferred the watercress (including 2 people who grew their own vegetables and rejected GE foods)
- 1 person preferred the rocket
- 5 people preferred the mixed salad

Would you consider purchasing it? What would you expect the price to be (similar to which other products?)?

- Watercress
 - “Same as a fresh herb”
- Mixed product
 - “Same price as loose leaf lettuce”
 - “Same as salad mixes”
 - “Depends on packaging”
 - “I wouldn’t buy it if it was more expensive than normal lettuce”

Would you buy in addition to or in replacement of other vegetables? (which vegetables)

- Most respondents would add it to their existing repertoire of vegetables.

Packaging

How should Watercress (Product A) be packaged?

- Preference was for no packaging, and that leaves would be selected loose from box
- Loose leaves were spontaneously mentioned as the preferred packaging by respondents when discussing pre-packed salads in general and also when trying the various products
- Other packaging concepts mentioned were:
 - “With a rubber band, like a bunch” (Watercress)
 - “Clear bag with clear labelling” (Combination leaves)
 - “Stay fresh bags like the ice lettuce” (Any product)
- Packaging was noted as a method to transport the product and potentially help keep it fresh

Health benefits

What health benefits aware of that watercress provides?

- Zero awareness of any specific health benefits of watercress, although because it's a green vegetable it is automatically perceived positively eg. broccoli is high in iron therefore this product might be high in iron too
- Questionable whether health benefits actively drive purchase. Participants could only give vague examples of when knowing the health benefits of a product had lead to purchase eg. "broccoli, when I remember"
- "Vitamins"
- "Full of Vitamin C because it's green"

General reactions to the health benefits

- Group 1 were sceptical of research, and noted many caveats. Group 2 were more enthusiastic and embraced the information positively. This may have more to do with the group composition than the research. Group 1 contained 2 or 3 people who had clearly identified themselves as "greenies", who avoided processed food and even grew their own vegetables. Their more cautionary attitude may have influenced the rest of the group to be less accepting than had they been operating in isolation.
- Health benefits received very positively by some:
 - "I'm going to buy it now!" (from respondent who did not find Watercress appealing)
- Scepticism around how much was needed for health benefit - "A sack full?"

Respondents questioned if preparation (cooking vs. raw) changed the benefit and questioned funding of research project by the Watercress Alliance. One respondent likened it to tobacco companies producing self-serving research.

More studies, over longer time periods would make the information more credible for some respondents, "does this uni even exist?"

Across both groups, awareness of the health benefits increased the appeal for one or two respondents, but on the whole appeal related to taste, rather than to any perceived health benefit. A specific health benefit is unlikely to determine appeal of watercress, and almost certainly unlikely to influence purchase, "Studies don't make much of a difference to what I eat."

Relevance of UK research

- No issue with UK research per se

Should the health benefits be communicated? How should it be communicated?

- Mass media communication (TV, radio) of health benefits was suggested. Participants mentioned the in-store environment and utilising recipe cards and store staff. Endorsement by the Cancer Foundation, and production of a recipe book sponsored by them was also put forward by a few participants

Group No:	3&4
Criteria:	Grocery Buyers
Location:	Viewpoint Group Rooms, Melbourne
Date:	Thursday 19 th January 2006
No. of participants:	16

Shopping and eating behaviour

When you purchase fresh vegetables what are the most important factors to you?

- Quality
 - How it is presented
 - How it looks
 - Nutritious
- Freshness
 - The look, colour
 - “Not too old and tired looking”
 - “Leaves not wilted”
 - “Not too much water on them” (spraying technique used by supermarkets)
 - “Feels fresh”
 - “Appearance”
 - “Smell”
 - “Ripeness”
- Presentation
 - “It must look good”
 - “Won’t buy mixed lettuce if it looks limp”
 - May go to the grocer if not satisfied with presentation/look
- Convenience
 - Pre-cut stir-fry vegetables

Prompted: impact of previous experience

- Will sometimes ask others for advice on what to use it for (eg shop keeper, check-out, floor staff)
- Majority will purchase only if they know an intended use for the product, otherwise “I’d probably buy it, put it in the fridge and then throw it out in three weeks time”
- Influences on purchasing new products mentioned by the group were:
 - Seen on cooking shows
 - Adaptation of something familiar (eg different kind of lettuce)
 - Trial of product at store (product demonstrations)
 - Trial of product at friends, restaurants
 - If product has recipes on pack or nearby (eg recipe cards in store) – only a few chose this option
- Some participants noted that their shopping behaviour has changed in recent years, with a tendency to purchase vegetables more on an ad hoc basis
- Asian vegetable influence considered to be high at the moment with many participants trying different vegetables in Asian salads and dishes
- However, others were reluctant to try new tastes without having first tasted the products before considering purchasing them
 - “I don’t buy weird vegetables”

What has been your experience with pre-packaged salads and vegetable mixes?

- Considered to be convenient “but only if it looks fresh”
- Group members all indicated having a poor experience or not buying because of “poor quality” look of product (especially lettuce leaves)
- Preference for majority when not time-poor (majority of participants mentioned having sufficient time to purchase individual vegetables and salad ingredients) is to purchase individual ingredients

- Packaged vegetables considered “expensive” and of “lesser quality”
 - “More expensive than loose vegetables”
 - “I’ll only buy if it is close to the price of the loose [product]”
 - “Doesn’t taste as fresh”
 - Asparagus cited as an example – you tend to pay more for a bunch of asparagus than if you purchase the same quantity loose
- When going out to a friend’s house and asked to bring salad, may consider some pre-packaged salads (different types of lettuce) as salad “looks better”, provided that it is fresh
- Some group members mentioned that when pre-packaged salad is sold in the supermarket at a ‘reduced price for quick sale’, they will often consider purchasing provided that it still looks “fresh enough”
- Others consider pre-packaged salads to be an “option of last resort” – if what they want is not available in the stores individually but only in packet
- Participants who enjoyed cooking tended to prefer to make salads from scratch. Those who did not enjoy cooking had a higher tendency toward packaged salads, but not at the expense of quality of food
 - Pre-packaged salads were described as the “lazy option”
 - “I like the personal touch of salads made from scratch”
- Pre-packed has greatest attraction for time-poor shoppers, however others felt that even though they may be time-poor when shopping, they would still spend time choosing the fresh produce and less time on packaged products such as tins and breakfast cereals

Product testing

Watercress

- General reactions to the product
 - “Rabbit food”
 - “Tastes like weeds”
 - “Tastes similar to radish” – “it has a bite like radish”
 - “Peppery”
 - “Nice with roast vegetables”
 - “It’s horrible”
 - “Stronger taste” (than compared with how participant recalled that it tasted)
 - “Intense”
 - “Like cabbage”
 - “Strong”
 - “Intensity”
 - “Terrible”
 - “Would taste nice with other leaves”
- How would you describe the taste?
 - “Dull, but then spicy”
 - “Can be overpowering”
 - “Would be good with mixed salads”
 - “Risotto”
 - “Sandwiches”
 - “On a steak (as a garnish)”
 - Taste is considered to be very strong and concerns were raised that it may be overpowering. Consequently participants felt that they would not use it as a major ingredient, but it could be used as something different.
 - “Peppery”
 - Would eat it in a mixed salad but not by itself
 - “Good in sandwiches or on a roll”
 - “Use as a herb”
 - “May be nice as a dried herb”

- What is it most similar to?
 - Similar to spring onion, a herb
 - Use it like Vietnamese mint
 - Use like coriander on a stir-fry “to finish it off”
 - “Stronger than rocket”
 - Gotu Kola herb used for medicinal purposes
- How appealing is it?
 - Too peppery/overpowering to be considered appealing
 - Would be good as a mix, with tomatoes
 - “Better as a mix”
 - Could use it as a herb and add to cooking, like stir-fry (similar to use of coriander)

Rocket

- General reactions to the product
 - “More bland”
 - “Not as strong (as watercress)”
 - “A type of lettuce”
 - “Droops very quickly”
 - Worse than the other one (watercress)
 - “Not as strong”
 - “Aromatic”
 - “Doesn’t do it for me”
 - “But might eat it for the health benefits” (health benefits unknown)
 - “Tastes like lawn”
 - “Would make a salad with it, but not use it on its own”
- How would you describe the taste?
 - “Bitter”
 - “A hint of bitterness”
 - Most participants had previously tasted rocket before in mixed salads
 - “Awful aftertaste”
 - “Not as heavy, more mild than watercress”
 - “Wouldn’t have either A (Watercress) or B (rocket) on its own”
 - “Tastes warm” (has a warm taste to it)
 - “After taste strong”
 - Use in pasta, salads
 - “Fashionable”
 - “It was cool”
 - “Trendy”
 - Jamie Oliver and celebrity chef promotions (reason given for why became trendy)
 - Has wide distribution – eat it at restaurants, will buy it if I see it served at a restaurant and I like the taste.
 - Chef/restaurants main influence, friends also an influence
- What is it most similar to?
 - “unique”
 - “like a vitamin tablet”

Combination leaves

- General reactions to the product
 - 1:1:1 ratio considered too strong because of watercress
 - 3 or 4:1:1 (spinach : rocket : watercress) considered better combination as it took edge off
 - “Good combination”
 - “Spinach takes the edge off”
 - “Adds sweetness”
 - 2:1:1 ratio considered “too sharp”
 - “Adds coolness to salad”

- “Watercress adds zest” “the highlight”
- “Needs higher proportion to take edge off” (considered still too peppery for most)
- “Tastes better than the others”
- “Mixed is better than the individual leaves”
- “Watercress dominates”
- “Spinach is nice and mellow”
- How appealing is it?
 - “Would not consider it to be appealing seeing it in shop, but it is appealing now that I have had a taste”
 - Taste is barrier, needs to get taste test to lead to purchase

Which of the three products did you prefer?

- Mixed salad preferred

Would you consider purchasing it? What would you expect the price to be (similar to which other products?)

- Would expect salad to cost around \$8/kilo for mixed salad
- Watercress should be priced similar to different types of lettuce (eg Cos lettuce)
- Similar price to bunch of herbs
- Would purchase watercress, mixed salad – price for watercress should be similar to rocket and spinach prices

Would you buy in addition to or in replacement of other vegetables? (which vegetables)

- Few participants would purchase watercress as a replacement for other vegetables without first being educated on why they should eat watercress over other products
- One participant indicated that they would purchase it if a more mild product was available
- One participant indicated that they would purchase watercress as it currently exists to use in salads

Packaging

How should Watercress (Product A) be packaged?

- Preference is for no packaging (loose) or fresh herbs packaging. Packaging is seen to add to the price, making it more expensive but not necessarily providing any benefits to the product
- Minimal packaging considered to be most useful – there is a general distrust of packaging “what is it hiding”
- One benefit of packaging is seen to protect product from being crushed or bruised
- Packaging is not seen to play much of a role or function in mind of consumers. Little thought is given to benefits of improving shelf life. Packaging that is not recyclable in council crates is considered to be a turn-off for some participants
- Loose preferred
- Could be mixed with fruit
- “Have recommended recipes”

What packaging do you consider to be useful? Why?

- “Living herb is good, the plant lasts”
- “Doesn’t go off”
- “Looks aesthetically good”
- Can be problem with smell after time

Health benefits

What health benefits aware of that Watercress provides?

- “It must be good for you, it’s green”
- “No calories”
- “Must have something”
- No participant was able to articulate any health benefits of watercress unprompted
- “If it tastes bad, it must be good for you”

Test general reactions to the health benefits

- “I’d buy it regularly”
- “It’s funded by the Watercress Alliance” (seen as a negative)
- “How much do you need to eat”
- “I’d be more convinced if there were published articles on this”
- Credibility of research would be improved by:
 - More studies done independently
 - Endorsement by independent body, such as anti-cancer council or bowel cancer research centre
- UK research in itself is considered to be relevant and credible
- “I’d buy it”
- “Would use it as another herb like basil or coriander”
- “I’d wait for the tablet form”
- “How much per week is needed to eat it”
- “Still have some value/benefit” – even though not necessarily thought to be credible
- Needs a few studies – review by a herbalist, anti-cancer endorsement

Are you more likely to purchase it?

- “Rocket considered more versatile”
 - “You can eat larger quantities of it”
 - “Preferred taste”

Should the health benefits be communicated? How should it be communicated?

- Anti-cancer endorsement – “but can the endorsement be bought?”
- Put endorsement on packet
- TV advertising to promote benefits
- TV chef endorsement seen as credible and high impact
- “Get a celebrity chef to endorse it and show how to use it”
- Jamie Oliver named as possible celebrity chef

Given health benefits, where would you expect this product to be available? (supermarket, health food shop)?

- Distribution was considered to be best through supermarket
- Group considered if research held true, that there would soon be a PEITC tablet that people could take – may not lead to more watercress consumption
- Sell at produce market – not considered a health food product
- Key is to educate on how to use the product
- Consider using Boost Juice and similar chains to incorporate into drinks – participants indicated that this has worked for them understanding benefits of wheatgrass

If rocket (product B) had same health benefits as watercress, which product would you be more likely to purchase?

- Rocket considered to have a better taste
- “Rocket is fashionable” – served in restaurants, Jamie Oliver, considered to be gourmet
- “If same health benefits, you are back to square one”

Abbreviations

ADAS/MAFF	Agriculture Development & Advisory Service/Ministry of Agriculture, Fisheries & Food (UK)
eC	Electrical conductivity (measure of salinity)
EMS	Environmental Management System
FSANZ	Food Standards Australia New Zealand
HACCP	Hazard Analysis and Critical Control Point
ITC	Isothiocyanate
MEITC	Methyl sulphinylalkyl isothiocyanate
MRL	Maximum Residue Limit
NFU	National Farmers Union (UK)
NKK	A nicotine-derived nitrosamine (carcinogen)
NOEL	No Observable Effect Level
NPK	Nitrogen:Phosphorus:Potassium fertiliser
PEITC	Phenyl ethyl isothiocyanate
PR	Public Relations
RDA	Recommended Daily Allowance
TWC	The Watercress Company
USDA	United States Department of Agriculture

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