

Capri Salad: Validation of nutrient content and development of post harvest protocols

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**Capri Salad: Validation of nutrient content and post harvest protocols
Horticulture Australia Ltd R&D project VG09189**

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Project Purpose: Capri salad is a new type of legume derived salad leaf that has a high yield, short cropping cycle, and high phytonutrient properties. This purpose of this project was to commercialise the product for the Australian pre-packaged salad market. The key activities undertaken included developing and documenting commercial agronomic, postharvest, supply chain, and brand usage protocols. An important aspect of the project was to test and validate nutritional data to support general and high-level health claims. The key outcome is a commercial ready product that can be licensed to any grower in Australia and internationally.

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Media Summary

Due to the increased demand from consumers for pre packaged mixed salad products there is increased focus from salad producers to commercialise new salad ingredients that have superior taste, longevity, taste, and health benefits. The Capri Salad project focused on the validation of nutritional content and development of agronomic and postharvest protocols necessary to commercialise a new category of legume derived fresh cut green salad leaf suitable for pre-packaged salad products. The project then further considered the commercial outcomes for the product based on consumer response testing and commercial trials.

The use of legume sprouts as salad ingredients is currently not widespread and there is limited awareness in the industry as to the nutritional value, taste, and longevity of these products. This project aimed to demonstrate the favourable product characteristics in this context using our prescribed growing method and by developing an appropriate post harvest protocol, brand user manual, nutritional data, and commercial production.

The result of the project was the ranging of Capri salad punnets in a number of independent fruit shops in Sydney and a clear set of documents that outline the growing, post harvest, branding, and health claims of the product. This will allow growers and wholesalers to more easily grow and market the product with predictable returns. We are in active discussions to grow and wholesale the product in Queensland and Victoria with a future intention to launch the product in America in 2012.

In addition to the returns from the sale of the product, there are additional benefits for growers that have been identified, including increased nitrogen content in the soil and use of margin land to grow a high yielding product. Further work is being carried out with individual growers to measure increased total yield from areas of land where Capri is used as a rotational crop in between their normal crop cycles.

Technical summary

The specific problem this project addressed was to take a new category of product with unproven commercial success and achieve a commercial outcome. This was achieved by conducting a wide range of research and development activities that supported the product documentation that was prepared.

Specifically, the research and development actions carried out included:

1. Agronomic trials in a variety of locations to measure and document growth patterns in various environments specifically with reference to temperature, soil type, and water.
2. Measurement of nutritional content of the salad leaves on average five days after harvest.
3. Development of health claims associated with the nutritional content.
4. Development of agronomic and post harvest protocols through trial and error testing of shelf life, taste, and appearance.
5. Consumer response testing.

6. Commercial trials.
7. Desktop study of opportunities in the international market.

The major research highlights include:

- Documented Agronomic and Post Harvest protocols including recommended growing conditions and quality assurance protocols.
- Nutritional content analysis and health claims for marketing.
- Development of a brand user manual.
- Consumer response survey results including shopping habits, sensory preferences, and price expectations relating to our product and the salad punnet category.
- Desktop study of international market opportunities.

One of the key outcomes for the bean industry is the increased awareness of the properties of some bean sprouts and the acceptance of their new use with growers, wholesalers, and consumers. This will have a positive impact on demand for beans and will benefit bean growers. Our recommendation is that further research and development work be carried out to explore other uses for bean products and how they can be presented to consumers. For example, with prepackaged salad dressing sachets to consumers, extracts, and as a feedstock for pasture. The continued work in this area is of great benefit to bean producers as well as the growers who grow the salad leaves.

Introduction

The Capri Salad project was undertaken to further understand, develop, and promote the commercial potential of a legume based salad product for the pre packaged market. It was undertaken for the purpose of having a new type of product to offer growers and wholesalers that offered significant financial benefits to those stakeholders and also a tasty and nutritious product for consumers.

The product came to the attention of Bennelong Holdings due to its novel high density growing method and the high nutritional content, yield, and sensory properties. The commercialisation process was designed by Bennelong Holdings and drew upon team experience on other past projects. The report *'High Health' salad shelf life storage trial* by B Bycroft and P Wilson (July 2007, New Zealand Institute for Crop & Food Research Limited) was reviewed and provided guidance on addressing specific challenges experienced in achieving consistent shelf life quality and informed aspects of the post harvest protocol.

The implications for the prepackaged salad market is the introduction of a new commercial ready 'high health' salad product that can be marketed alone or as part of a salad mix. The impact for growers of the seed and the leaves will be an increased demand for this type of product. From our discussions with wholesalers and consumers this product is not likely to cannibalise sales from the category but rather complement and grow already increasing demand by adding value and differentiating using the health properties and unique taste of the product.

Materials & Methods

The method used to structure the commercialisation process contained the following:

1. On farm agronomic and postharvest trials across various locations to test variables including yield, cropping cycle, taste, shelf life, nutritional content, and return on investment for growers. Post harvest variables included washing, sanitizing, drying, and packing methods with consideration to factors such as pH, temperature, humidity that affected product quality and shelf life.
2. IP documentation and protection strategy including preparation of license agreements and commercial documentation for key stakeholders including a brand user manual for the licensed grower and wholesalers.
3. Nutritional testing to generate, compare, and validate data used for product marketing including health claims. The method used was to take samples from the crop at harvest and deliver by courier to the National Measurement Institute in Victoria for testing of nutritional content including antioxidants, folate, and trace minerals. The average time between harvest and testing was approximately five days, which reflects the realistic average time the product would remain packaged before consumption.
4. Trial marketing of the product into smaller independent retailers to monitor the effectiveness of the protocols developed and to stress test the integrity of the product performance in a commercial supply chain. This method was also used to explore price sensitivities and to facilitate consumer response testing. The product was supplied into store free of charge by Bennelong Holdings in return for space to conduct the consumer response research.
5. Market research was conducted in the form of in store consumer survey for consumer response on product taste, appearance, price, shelf life expectations, buying habits, and price. These surveys were then collated and the results were statistically analysed and conclusions drawn from median and average data points.

The method used broadly reflects the Bennelong Holdings' commercialisation methodology. The virtuous cycle Exploration, Planning, Development, Documentation, Trialing, and Execution guides the specific activities used in this project, and is also the justification for the methods used.

Results

Specifically, the research and development actions carried out included:

1. Agronomic trials in a variety of locations to measure and document growth patterns in various environments specifically with reference to temperature, soil type, and water.
Major research findings: For maximum product yield and quality we found

that the product grows best in loose degraded soil with a cooler temperature. The level and intensity of sunlight affected the length of the crop cycle but otherwise had no effect on yield or taste, unless a very low amount was provided (indoor), in which case the product was discoloured to a pale green. Where the product is grown in dense, rich or humid soil we experienced disease on the leaves and poor taste due. The level of water did not affect the results unless there was an extremely low amount applied to the crop, in which case the growth was very slow.

2. Measurement of nutritional content of the salad leaves on average five days after harvest.

Major research findings: The nutritional content in the two samples are included in the table below. Both samples were analysed five days after harvest, but taken from different locations in Sydney at different times. The variation seen is likely due to location, seasonality and other variables such as maturity. For this reason the minimum values across these results have been used. Further analysis will be undertaken prior to the finalisation of the nutritional panel on the product packaging to verify these figures, and as part of the ongoing quality assurance procedures.

Serving size= 100g	Sample 1	Sample 2
Moisture	90.0g	93.6g
Energy	170 KJ	80 KJ
Protein	5.6 g	3.9g
Fat Total	0.2 g	<0.02g
Total Solids	10.0g	6.4g
Saturated	< 0.1 g	<0.01g
Trans	< 0.1 g	<0.01g
Polyunsaturated	< 0.1 g	<0.01g
Monounsaturated	< 0.1 g	<0.01g
Carbohydrates	4 g	<1 g
Sugars	< 1 g	<1 g
Sodium	5.8 mg	11mg
Calcium	18mg	16mg
Folate	220ug	160ug
Iron	0.9mg	1.6mg
Magnesium	23mg	23mg
Potassium	230mg	210mg
Zinc	0.47mg	0.49mg
Antioxidants	2580umol	13664umol
Vitamin A	1700ug	1500
Vitamin B2	0.06mg	0.2mg
Vitamin B3	<1mg	<1mg
Vitamin B6	<0.02mg	<0.02mg
Vitamin C	16mg	14mg

3. Development of health claims associated with the nutritional content.
Major research findings: The two categories of health claims other than the information contained in the nutritional panel are as follows:

General Level Health Claims

- I. Antioxidants: with a Trolox Equivalent ('TE') of 2,580 per serving (100g), Capri salad is 50% of your RDI of antioxidants. The claim that can be made here is: 'The highest source of antioxidants amongst standard varieties of vegetables,' and 'Antioxidants are essential as part of a balanced diet.'
- II. Low Joule claim: the limit for this claim is that the product is no more than 170kJ per 100g. Eg 'A healthy low calorie treat that taste great.' The test results show the product is right on this limit so this claim may be made.
- III. Lactose Free.
- IV. Very low in Sodium.
- V. Fat Free.
- VI. A leading source of protein from the fresh produce category.
- VII. Contains a high level of Zinc to boost your immune system.

High Level Health Claims

1. The product is very high in folate, pre approved claims around this for primary products are:
 - (a) that increased maternal folate consumption in at least the month before and 3 months following conception may reduce the risk of fetal neural tube defects; and
 - (b) the recommendation that women consume a minimum of 400 micrograms folate per day in at least the month before and at least the first 3 months following conception.
2. Consumption of Fruit and Vegetables may reduce your risk of Coronary Heart Disease.
3. Further work needs to be done to gain approval for an antioxidant (or photochemical) related high health claim as specific evidence needs to be obtained in human trials.

It is likely that following further testing and consumer research we will uncover different claims that can be made and prioritise which claims are more desirable to market than others. It is also noted that some press articles are commenting that whilst the 'high in antioxidants' claim is understood by consumers, scientists are showing that a diet high in antioxidants can be harmful. It would seem that an analysis to determine what phytochemicals are present would be beneficial in allowing us to develop a more focused, and higher level, health claim.

4. Development of agronomic and post harvest protocols through trial and error testing of shelf life, taste, and appearance.
Major research findings: Both agronomic and post harvest protocols have been developed through frequent trials with growers and wholesalers. We have demonstrated the ability to replicate consistent quality and yield. Further, the post harvest problem associated with the washing and drying process has been addressed by carefully setting out the post harvest guidelines developed through experimentation with different methods.
5. Consumer response testing.

Major research findings: Through surveying consumers in a retail environment we were able to confirm consumer shopping habits, taste preferences, price expectation, and product feedback relating to pre packaged salad punnets and specifically our product.

6. Commercial trials.

Major research findings: The commercial environment for new products in the fresh produce industry is not tolerant for underperforming products, however, we were surprised by the willingness and interest shown by some grower wholesalers to grow and market the products for evaluation. The product has been in commercial trials throughout the life of the project and we are working with a number of wholesalers to find a permanent place for the product in their offering.

7. Desktop study of opportunities in the international market.

Major research findings: There are significant opportunities available for the product overseas due to its high yield, fast crop cycle, and health benefits. These options are currently being explored subject to further demonstration of the product in Australia.

Discussion

The research outcomes of the project are as follows:

1. Validation of the methods required to achieve 150% yield of salad leaf with seed inputs of 3kg per square meter.

Discussion: The outcome was achieved and the high yield was demonstrated in a variety of conditions and the protocols developed have been found to be both practical and easy to use by growers.

2. High nutritional content product developed and confirmation of an oxygen radical absorbance capacity ('ORAC') content not less than 2,580 TE per 100grams.

Discussion: The outcome was achieved with surprising success; the testing revealed ORAC levels of up to 13,664 TE per 100 grams which surpassed our expectations and is higher than other products that are marketed for their high antioxidant content such as pomegranates and blueberries. However, to be conservative we have used the lowest number achieved in the series of testing when making reference to the ORAC content.

3. Demonstration of the undemanding characteristics of the crop with reference to soil, nutrients, and water. Further demonstration of the bioremediation properties of the crop.

Discussion: The outcome was achieved and we trialed the product under many growing conditions to test the variables. The product was not substantially affected by the quality of the soil or nutrients applied, however the growing cycle did slow by a week if the crop was left without any water at all which is unlikely as even a small amount of water from rainfall was enough for the

crop to accelerate in growth rapidly. The bioremedial qualities of the crop were well received by the growers and the outcome was achieved with several before and after plots clearly showing evidence of healthier soil including a higher nitrogen content.

4. Demonstrated potential to capture market share in the prepackaged punnet market.

Discussion: The outcome was achieved with the commercial trials resulting in strong interest grower/wholesalers to market the product. With several interested parties we are currently in negotiations to license the appropriate party to continue ongoing the production that has been achieved to date.

5. Documented agronomic and post harvest protocols to enable reliable product quality and shelf life in a commercial environment, up to 14 days.

Discussion: This was one of the most difficult outcomes to achieve, and has ultimately been achieved through ongoing trial and error with different packing equipment provided by a range of grower/wholesalers. The method that worked the best was to use a quick chill before and after the washing stage, and to use a breathable seal for the punnet during the cooler months, and to use modified atmosphere packaging during the warmer months with a reliable temperature controlled supply chain where possible.

6. Potential for commercial success of the product in Australia and opportunities to grow the product in overseas markets.

Discussion: The outcome was achieved through a desktop study of opportunities to grow and market the product under license in international markets. The main markets considered were the US, Europe, Asia, and the Middle East. We are currently in discussions with a large grower/wholesaler on the West Coast of the US to launch the product there in 2012.

Technology transfer

The relevant technology transfer and adoption activities were specifically aimed at commercial growers and wholesalers of salad and related fresh cut products. The transfer was facilitated by thorough and easy to use documentation and licensing that enables any party to grow and market the product in a commercial ready form. The timeframe for adoption has been met and several interested parties are producing the product under license. The technology has been widely promoted and the license is freely available to any grower or wholesaler who would like to grow and market the product or test its use as a rotation crop to remediate the soil.

The next stage of industry adoption and technology transfer will include a wider conversation with industry partners at the Produce Marketing Association conference in June 2011. At this event we will offer the technology for use to a wider range of industry stakeholders that will include scientists working in the high health or functional food sector. By the end of 2011 we hope to have widely increased the awareness of the technology and have new trials underway for other uses for the product such as for extracts.

Recommendations

There are several further key research and commercial activities that will be carried out at Bennelong Holding's own cost:

1. Ensure further industry adoption and technology transfer throughout the industry to commercial growers and wholesalers in Australia.
2. Conduct further research and development activities to commercialise other uses for the technology including for extracts, as feedstock for cows, and as a rotation crop.
3. Pursue international licensing opportunities and export markets for Australian growers.
4. Design and execute a formalised national marketing strategy for the product to support grower and wholesaler sales.
5. Revisit other types of legume derived salad products and diversify the product range using similar intellectual property gained from this project.
6. Conduct support activities for bean growers to ensure security of seed supply to the right specification as volumes increase.

Acknowledgments

Bennelong Holdings Pty Ltd acknowledges Horticulture Australia Ltd for providing matched voluntary contribution funding to carry out this project.

Bibliography

B Bycroft and P Wilson, *'High Health' salad shelf life storage trial*, New Zealand Institute for Crop & Food Research Limited, July 2007.

Appendices

Copies of the following documents can be obtained by contacting Bennelong Holdings:

1. Agronomic Protocol
2. Post Harvest Protocol
3. Brand User Manual
4. Consumer response survey form