Report to ASCRC on Seafood Session at the AIFST Annual Convention Monday 15 July 2013

Allan Bremner

AUSTRALIAN SEAFOOD COOPERATIVE RESEARCH CENTRE

Project No. 2013/702

This project was conducted by

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NON-TECHNICAL SUMMARY

PROJECT NO: 2013/702 Publicity for ASCRC at the 2013 AIFST Annual Convention

PRINCIPAL INVESTIGATOR: Allan Bremner (A fellow of AIFST and member of Convention technical committee)

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(PROJECT) OBJECTIVES OF RESEARCH TRAVEL GRANT/ INDUSTRY BURSARY

To provide support to three emerging ASCRC scientists and to publicise their work and hence, the activities of ASCRC to their peers in a wide audience of food scientists, technologists and food manufacturers.

NON TECHNICAL SUMMARY:

Three budding scientists in ASCRC projects presented their work to a wide audience on 15 July in Brisbane at the 2013 Annual Convention of the Australian Institute of Food Science and Technology Inc., the peak body for food scientists in Australia.

The session, titled 'Value adding seafood through food science', was organised through the Technical Committee, and was chaired by Allan Bremner and 4 speakers covered the allotted time from 1110 until 1245 hrs. The audience ranged from 45-55 persons throughout of whom 33 were asked to answer a questionnaire.

The speakers were:-

- **Graham Fletcher** of NZ Institute for Plant & Food Research who delivered the keynote address "Seafood technology: Where have we been and where are we going' had his travel supported by ASCRC.

  He started with statements that at 125 billion $USD aquaculture in fresh-, brackish- and marine-waters has now exceeded the wild catch. NZ is increasing its tonnage of exports and more mechanised methods of harvesting are being employed. Special emphasis is given to techniques of 'rested harvest' in which a fish with superior flesh qualities is produced by harvesting in ways that minimise the stresses on the fish to provide material for more discriminating markets. Sea transport is limited mainly to frozen product because of the inability to restrict autolytic changes in the flesh whereas bacteria can be inhibited by additives and gas packing. Research into foam boxes made from polylactic acid is promising in delivering packages with as good properties as Styrofoam but which are biodegradable in compost.

In keeping with better handling, flow ice and salt water ice systems to reduce fish temperatures to minus 0.6^0C reduce deterioration substantially. Quality Index schemes are available for many species and automated NIR/Vis instruments are being investigated for online and at-line rapid assessments. Automatic mussel openers are replacing humans as 28 of these machines can open 90,000 per hour compared with 36 workers who can only open 28,000 per hour. To date automation has mainly been used on high-price species but greater adaptability in softwares and robotics in which operational heads can be exchanged on a prime machine base will provide the diversity to handle different tasks.

Better design of process plants with better fittings, materials, drains (stainless steel pipes) and surfaces allows for far greater sanitary compliance and new factories have nil Listeria counts thus relieving them of an average of 10,000 environmental, product and raw material tests. A complete new factory was cheaper than a patch up, plus the cost of tests!

Combinations of antimicrobial packaging and use of carbon dioxide conveniently generated within the pack can prolong shelf-life in new-style consumer packs.

Studies are underway on by-products from total utilisation of the harvest by biological methods to provide enzymes and extracts that can be used in production of other foods e.g., enzymes to aid cheese processing, or in neutraceutical applications e.g., ACE enzymes to reduce hypertension.

- **Carl Paulo** of Innovative Food Sciences and Technology, DAFF QLD spoke on the ASACRC/APFA funded work on stability of colour in frozen prawns 'Assuring techniques to minimise deterioration in frozen cooked aquacultured prawns.'

  He demonstrated that (i) they had developed a superior method for analysing the fractions of Astaxanthin (the pigment responsible for crustacean colour) (ii) that the most sensitive area to monitor the colour was the legs, not the body or head regions (iii) that a thicker glaze preserved the colour for longer (iv) that the free form of trans-astaxanthin was more stable than the cis form or the bound forms (v) that with natural compounds included in the glaze greater colour stability resulted than with commercial glazes (vi) that storage at -30^0C results in greater colour stability, grade 10, than at either -20^0C grade 7,or on cycling between the two temperatures. At the APFA conference one farmer said that the difference between prawns of colour grade 7 and colour grade 10 would mean a loss of about $4 per kg.

- **Tom Madigan** of SARDI spoke on his work 'Microbial spoilage of Australian oysters'. The main growing areas are near the Gulf regions of SA, East and North coast of Tasmania and the SE coast from near the NSW/Vic border north to near the NSW/QLD border and both marine and estuarine culture systems are employed. The main market form is in the half shell and this work had the main aims of (i) evaluating the spoilage profile(ii) identifying the main

spoilage organisms and (iii) seeking suitable indicators by which to evaluate spoilage and was done on both commercial species. Pacific oysters (Coffin Bay SA) and Sydney Rock oysters (Camden Haven, NSW) were stored in the half shell and although Pacifics started at a lower pH (6.28 compared to 6.43 for Sydney Rock) increases followed a similar pattern up to 6 days. Increases in bacterial types were similar during storage and thus were not suitable indicators to differentiate the species or to act as indicator organisms.

Consequently genetic techniques were employed using a well-known 16S RNA gene probe amplified by PCR techniques to uncover presence of cryptic species that do not necessarily grow well using the common plate techniques and hence which grow insufficiently to be purified and identified. The results of sequencing identified 10 families with *Mycoplasmataceae, Vibrionaceae and Alphaprotobacteria* as main components of the microflora of Pacifics and this changed during storage to *Vibrionaceae* (increased), *Pseudoalteromonadaceae* and *Campylobacteriaceae* at 7 days storage.

Similarly the microflora on Sydney Rocks at the start was comprised of a mostly different set of 11 families mainly of *Psychromonadaceae* and *Spirochetaceae*, but after 7 days the main families were *Vibrionaceae and Pseudoalteromonadaceae.* The differences in the initial flora would be due to the marine environments of harvest but clearly the Vibrios and Pseudoalteromonas becaome the dominant types during storage which out-compete the environmental flora from harvest. Both Vibrio and Pseudoalteromonads are well known spoilage organisms and the species at day 7 were identified as *Vibrio gigantis* (99%) and *Pseudoalteromonas agarivorans (100%)* in both species of oysters!

Scaling plots indicated clear differentiation between oyster species and between storage periods and if these organisms are proven to be the main Specific Spoilage Organisms there is scope for development of gene probes as rapid molecular methods to determine spoilage condition.

- **Rachel Tonkin of Curtin University** presented work titled ‘Fish to Dish: Issues and opportunities for the Saddletail Snapper supply chain’ and the presentation was true to label. They adopted an approach of ‘whole of chain’ starting at the boats, through landing and transport, effects of gutting, processing to fillets and then storage in retail display. Temperatures were monitored with logging devices throughout, samples were taken for bacterial total plate counts and for specific microbes and changes were monitored by Quality Index (QI). Both trap and trawl methods of catching were sampled from the early catch and from catches late in the trip.

  The temperatures on board boat were well controlled according to the loggers placed in the gill cavity and the catch was soon chilled to 0^0C and kept near this temperature until unloaded when it increased for a short period but not over 4^0C – indicating expedition and good practice. During the 1200 km trip to Perth the temperature remained slightly below 0^0C again indicating good practice. However, retail temperature control was nowhere near as good with temperature cycling from about 2^0C to as high as 8^0C and a mean

temperature of 5^0C! At this temperature changes occur more than twice as fast as at 0^0C and shelf-life is more than halved!

Fish caught by trapping had higher microbial counts on the whole fish than those caught by trawl and this was reflected in faster spoilage. In general those caught early in the trip were not much different in bacterial count from those caught later (NB. good chilling) but they had changed more according to the Quality Index. Gutting did not reduce bacterial numbers present on the whole fish.

However, in retail display, fillets had, after 3 days unacceptable counts of 10^7 organisms/g, caused no doubt by high temperatures. Any delays through the chain e.g., storage of whole fish at the processors also increased the bacterial counts and the fish had higher QI scores – poorer product. The drip loss increased throughout display during retail storage being up to 20% of the original weight after 4 days representing an economic loss as well as a loss of water soluble flavours and nutrients.

The main bacterial flora were *Shewanella* and *Pseudomonas*; both well known as potent spoilage organisms. The use of sanitisers decreased the overall bacterial load on whole fish but on fillets, if the bacterial load was high, they were less effective.

In the main, these results were predictable in that delays in the chain and high temperatures result in more rapid spoilage as indicated by bacterial counts, increased drip loss and by evaluation with the Quality Index. Better temperature control and a lower temperature in retail display could more than double the display shelf-life of fillets, prevent markdowns, and improve the average standard of material for sale. Delays in getting the product to market should be minimised; better handling looks to be needed in the trap fishery. Sanitisers have limited use in mitigating previous errors but have their place if used at the right point.

OUTCOMES ACHIEVED TO DATE: The outcomes from these presentations are a greater general awareness of ASCRC as funder of research that can be taken up by industry and that ASCRC is fostering emerging scientists to meet future problems.

(PROJECT) OUTPUTS DEVELOPED:

The first output is this report. The second is the DVD of the sessions and the photographs which ASCRC may use for publicity or training.

ABOUT THE PROJECT/ACTIVITY

BACKGROUND AND NEED

Need

There is a need to bring the outputs, implications and conclusions of some of the technical research in Program 2 to the attention of scientists, technologists and managers in the food industry, in addition to the existing approaches within the fishing industry.

The Annual Conventions of the Australian Institute of Food Science & Technology (AIFST) are a perfect opportunity to display research highlights to companies and technologists that produce seafood products for domestic and export sales. AIFST Conventions have long provided this type of opportunity (2013 will be number 46) and invariably have always included seafood research and often dedicated blocks of the program. The technical committee have allotted a prime 90 min block of the program to achieve this, but needs to support this initiative to sponsor the session, defray travel costs for speakers, or potentially to subsidise travel of a keynote speaker from oversea.

Planned Outcomes and Benefits

The main outputs are in the publicity gained for the Seafood CRC work that is directly related to the food industry. Further benefits lie in the opportunities for younger, developing researchers to display their talents and to gain experience and to meet a broader range of contacts in the food industry. Food technologies and test techniques are often common across different commodities.

RESULTS

The session at AIFST Convention was planned and held to an average audience of around 50 persons 24 of which replied to a question sheet for their opinions on the session. The session was presented in the Plenary Auditorium (capacity about 600) to facilitate video recording.

1. Why did you come to this session?

(a) It's my field of expertise 6

(b) I was attracted by the topics and the speakers 11

(c) I wanted to learn new things 6

(d) General interest 6

(e) All of the above 4

(f) Other: To update myself in new technologies; to learn applications in oyster industry

2.How satisfied were you with?

	Overall experience	Organisation of the session	Quality of the presenters	Quality of the topics
Very satisfied	6	10	6	6
Satisfied	18	14	17	17
Neutral			1	1

Unsatisfied				

3. **Did you learn something new that you can apply to your job/career?**

   Yes 20

   No 4

   Other comments: Interesting topics but not related to my work

4.What could we do to improve this session next year?

- Great room but too large for the number of delegates, though good quality of AV presentations on the large screen
- More of the same!
- Tasting would be good (of fresh oysters).
- Maybe an international speaker? Less technical details?
- Emphasis on learning to further industry competitiveness.

Comments on the results of the question sheet

About 35 question sheets were distributed and 24 replies were obtained – a good proportion.

All were either satisfied or very satisfied with content and presentation

20 out of 24 learnt something new to apply to their job/career

INDUSTRY IMPACT

NOTE: results of question sheets

A post- convention comment from an industry member who was present

"I think your research combined with Rachel's closes the gap a little more for us, we are not a big operation (yet) so we don't have the resources to do all the testing. I am very grateful for your work it is invaluable to the industry, hopefully industry will use the information wisely. We have such a wonderful and unique resource that has so much potential we just need to get smarter about how we bring it to market." (forwarded from Tom Madigan).

PROJECT OUTCOMES (THAT INITIATED CHANGE IN INDUSTRY)

Not a direct, but an indirect, outcome of this project: refer to ASCRC researchers and their organisations

SUMMARY OF CHANGE IN INDUSTRY

(What immediate changes might be expected for business/industry?)

Not a direct, but an indirect, outcome of this project: refer to ASCRC researchers and their organisations

WHAT FUTURE AND ONGOING CHANGES ARE EXPECTED?
(What will be the impact?)

Not a direct, but an indirect, outcome of this project: refer to ASCRC researchers and their organisations

WHAT BARRIERS ARE THERE FOR CHANGES TO OCCUR?

Not a direct, but an indirect, outcome of this project: refer to ASCRC researchers and their organisations

IF NOT ALREADY HAPPENING, WHEN WILL THE CHANGES OCCUR?
(e.g. 2 businesses will adopt project findings and two more are expected to adopt findings within 12 months)

Not a direct, but an indirect, outcome of this project: refer to ASCRC researchers and their organisations

WHAT IS THE LIKELIHOOD THAT THESE CHANGES WILL OCCUR?
(e.g. 50% chance that four businesses will adopt project findings)?

Not a direct, but an indirect, outcome of this project: refer to ASCRC researchers and their organisations

WHAT BARRIERS ARE THERE TO ADOPTION OF THESE CHANGES AND WHAT ACTION COULD BE TAKEN TO OVERCOME THESE?

Not a direct, but an indirect, outcome of this project: refer to ASCRC researchers and their organisations

COMMUNICATION OF PROJECT/EXTENSION ACTIVITIES

WHAT IS THE OUTPUT THAT NEEDS TO BE COMMUNICATED?

The information in this report and the photos of the session are in the hands of ASCRC for any future communication and the DVD of the session is being sent under separate cover from the media company:-

Ray Hawkins
Director
Mediavisionz

Ph: 0434 140 464
ray@mediavisionz.com.au

WHO IS/ARE THE TARGET AUDIENCE/S?

ASCRC to decide how they proceed

WHAT ARE THE KEY MESSAGES?
ASCRC to decide how they proceed

WHAT IS THE CALL TO ACTION?

(What is it you want people to do once you communicate the key message to them – i.e. what change of behaviour or action do you want them to take?)

ASCRC to decide how they proceed

COMMUNICATION CHANNELS

ASCRC to decide but DVD could be copied to be shown to relevant industry meetings

LESSONS LEARNED AND RECOMMENDED IMPROVEMENTS

WHAT IS YOUR FEEDBACK?

No difficulties in arranging for good speakers, or in convincing AIFST of the value of holding a seafood session in the Convention.

FURTHER ACTION REQUIRED IN REGARDS TO COMMERCIALISATION?
(e.g. IP protection, licensing, sales, revenues etc)

Outside the scope of this project

ACKNOWLEDGEMENTS

APPENDIX Speaker Bios and Abstracts

1.Seafood technology: Where have we been and where are we going?

Graham Fletcher BSc B.Comm Team Leader Seafood Technologies, Plant & Food Research, Auckland NZ
A microbiologist by training Graham has about 30 years extensive experience in many aspects of seafood science, technologies and processing and collaborates with other Institutes across the globe. With main interests in safety, spoilage, shelf-life, processing and packaging of chilled seafood and other foods some current projects include:

Seafood safety. Focused on understanding factors contributing to risk and on developing controls for Listeria and Vibrio organisms.

Seafood packaging. Evaluating novel antimicrobial films and thermally efficient packaging.

Optimisation chilled fish. Developing quality index assessment (QIM) scoresheets for whole fish, applying modified atmosphere packaging and soluble gas stabilisation to fillets and evaluating options for thawed fillets.

Ultra high pressure processing (HPP) of seafood and horticultural products. Determining and modelling the effect of HPP parameters on unique food characteristics, safety, quality and texture.
Graham.fletcher@plantandfood.co.nz

Graham Fletcher

Seafood technology: Where have we been and where are we going?
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Although in some ways the business of catching and marketing seafood has not changed much over the last 50 years, in other ways there have been major changes. This presentation will draw from 30 years of research experience in the New Zealand seafood industry as well as provide an overview of innovations from around the world. Recent changes will be highlighted, as well as changes appearing on the near and distant horizons. Changes in harvesting and transport methods, processing plant design, increased mechanisation, new packaging technologies, novel means of preventing microbial spoilage and assuring quality, changing responses to food safety challenges, new by-products and new convenience product forms for today's consumer lifestyle will all be considered.

2. Name: Carl Paulo

Email: carl.paulo@daff.qld.gov.au

Phone: (07) 3276 6027

Assuring techniques to minimise deterioration in frozen cooked aquaculture prawns.

Bio: Carl Paulo is a food researcher who specialises in post-harvest value-adding within the seafood industry. Graduating with a Master of Biotechnology from the University of Queensland, Carl took up a position within the Queensland Department of Agriculture, Fisheries and Forestry. In the role for over 6 years, he has been applying his expertise to projects aimed at assisting various seafood sectors. Notable projects include identifying practices to maximise survivability of mud crabs through the supply chain, methods to mitigate muddy flavours in barramundi, developing a rapid detection method for ciguatera toxins in fish and identifying factors that contribute to toughness in cooked saddletail snapper. His current research focus is on natural methods to improve the quality of chilled and frozen farmed prawns.

Assuring techniques to minimise deterioration in frozen cooked aquaculture prawns.

Abstract:

In 2010-11 the national production of aquaculture prawns was 3,970 tonnes with Black Tiger prawn (*Penaeus monodon*) the most cultivated. Of total production roughly 40% are sold chilled and 60% frozen. The higher proportion of frozen prawns is a factor of a short production season, dictated by warm climates, and the continuous year-round demand from consumers. When purchasing, the main decision drivers for consumers are appearance with a prawn of red / orange colouration highly desirable. Unfortunately, during extended frozen storage prawn colour will progressively fade towards a paler / yellow hue. This poses a significant

challenge to the industry as supermarkets require a minimum colour grade with any loss of colour directly translating to a loss in consumer acceptability and ultimately price discounts and profit losses. This study investigates the rate of colour loss during frozen storage as well as methods to mitigate colour degradation. Over a period of 18 months the L*a*b* colour space of frozen prawns was mapped. The carotenoid primarily associated with crustacean colour, astaxanthin, was also quantified by way of HPLC-MS. It was found that temperature, coating prawns in ice (glazing) and inclusion of natural plant extracts within the glaze were effective in limiting colour degradation. Based on findings industry is presented with several options available to improve the colour and quality of frozen prawns during extended storage periods.

3. Tom Madigan
"Using culture-based and culture-independent techniques to assess microbial spoilage of Australian oysters"

Short Bio
Tom has worked with the South Australian Research and Development Institute undertaking seafood research in the areas of food safety and product development for nearly 10 years. He has worked on projects in a wide variety of areas including evaluating the prevalence of marine pathogens, analysis of supply chains, modified atmosphere packaging and analysis of seafood spoilage.
Tom.Madigan@sa.gov.au

Microbial spoilage of Australian oysters
Thomas Madigan [1,2], Nathan Bott [2], Valeria Torok [2], Nigel Percy [2], John Carragher [3], Miguel de Barros Lopes [1], Andreas Kiermeier [2]

[1] University of South Australia
[2] South Australian Research and Development Institute
[3] Logifish Consulting

Spoilage of fresh oysters is complex and includes the metabolic activities of microbial organisms and other biochemical reactions. The aim of this study was to assess microbial spoilage profiles of half shell Pacific and Sydney rock oysters using both a culture-dependent and a culture-independent approach. Odour and pH of oyster meats were also recorded to provide context to microbial profiles. Estimation of microbiological counts by traditional plating of oyster homogenates highlighted the growth of psychrotrophic bacteria with increases in standard plate counts and counts of presumptive *Vibrio* and *Shewanella*. The pH profiles fluctuated with an overall increase at Day 7 in both oyster species. This pattern differs to results reported elsewhere and may be associated with low prevalence of lactobacilli and yeasts. The culture-independent analysis revealed that the majority of bacteria in fresh (Day 0) oysters represented taxa that have not been cultured and systematically described. During storage, an increasing domination of Proteobacteria was noted in both oyster species and sequence analysis indicated that the dominant sequences at Day 7 related to *Arcobacter, Colwellia, Pseudoalteromonas* and *Vibrio.* *Pseudoalteromonas* and *Vibrio* were dominant in both oyster species at end of storage and gene targets from these bacteria may make ideal molecular targets to objectively measure oyster freshness.

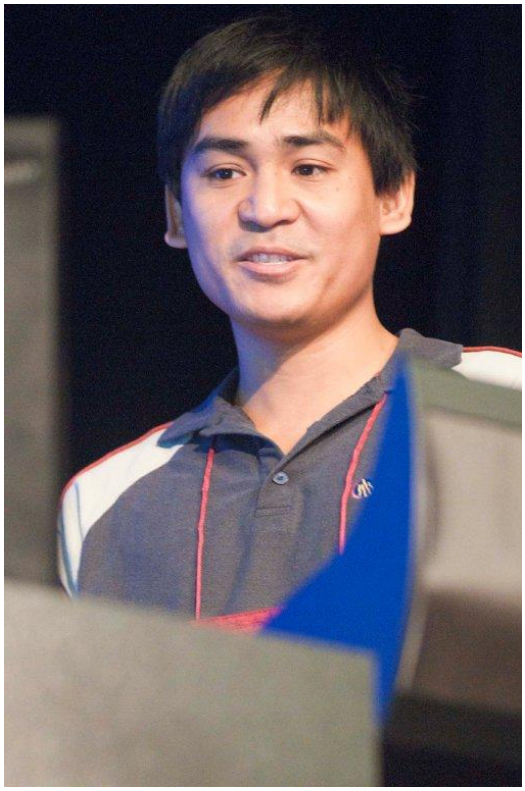
4.Rachel Tonkin

Rachel graduated from the University of Western Australia in 2005 completing a Bachelor of Science with honours. She has since been involved in a number of fishery related projects, investigating the microbiological aspects of different seafood. She was very keen to continue in this line of work and decided to complete a PhD focussing on food microbiology and ways to improve the quality of fresh fish. Rachel is now working at the Centre of Science, Seafood and Health at Curtin University with experiments to improve the practices of the Australian seafood industry and the standard of the product.

Fish to Dish: issues and opportunities for the saddletail snapper supply chain
R. Tonkin[1] J. Howieson[1], F. Denham[1], L. Fuentes[1],
Centre of Excellence for Science, Seafood and Health, Curtin University, Australia[1].

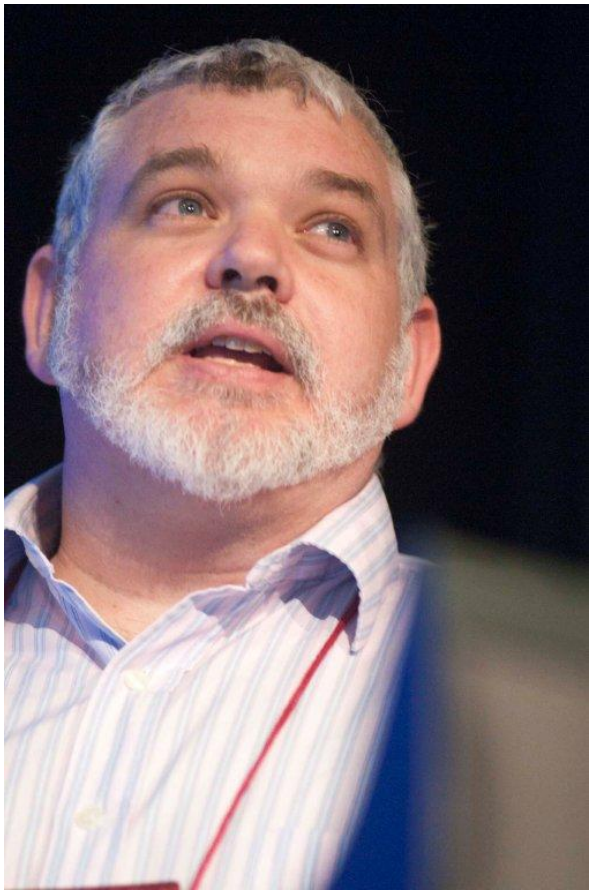
Through chain monitoring from harvest to retail was completed for saddletail snapper trawl harvested in Exmouth, delivered to Perth, processed into fillets and sold at retail. The quality monitoring of saddletail snapper involved continuous temperature logging, sensory analyses, microbiological testing (total plate count (TPC) and spoilage organisms) and measuring drip loss. Temperature monitoring highlighted spikes experienced during unload and throughout various points of storage in retail outlets. The sensory and microbiological analyses paired with previous research performed on whole saddletail snapper indicated that the composition and enumeration of the bacterial populations present on the fillets vary through storage with time and such variation can be shown to affect shelf life. How the fish were stored also has an impact. Interestingly, shelf life did not appear to vary between fish harvested early and late in the 14 day trawl journey. Changes to the supply chain based on the results have included adjustments to post harvest handling, better temperature control, and use of the Quality Index (QI) through chain to monitor quality. The result has been a better quality product which has a longer shelf life. By analysing the results from the fishing industry of today we hope to promote a higher quality of fish into the future.

Graham Fletcher of Plant & Food Research NZ sets the scene with an overview



Carl Paulo of QDAFF explains the techniques for maintaining colour in cooked frozen prawns.

The panel from left Rachel, Tom, Carl & Allan



Tom Madigan of SARDI explains the tricks in identifying the spoilage bacteria in oysters

Rachel Tonkin of Curtin University stresses the critical need for temperature control throughout the chain

Chairman Allan Bremner questions Carl Paulo on how long shelf-life of frozen prawns can actually be.