REPORT

TO NATIONAL SEAFOOD CENTRE

NEW PRODUCT DEVELOPMENT

REFORMED FISH PRODUCTS FROM FISH PROCESSING WASTE

PROJECT NUMBER 97/404

FISHERIES
RESEARCH &
DEVELOPMENT
CORPORATION

CONTENTS

1.0 EXECUTIVE SUMMARY

- At present, large amounts of fish waste occur in the industry due to either waste material such as fish frames or low commercial value species, and 'incidental' by-catch material.There is a need for the industry to maximise its yields and commercial returns for the limited industry resource. Industry profitability and sustainability depends upon key issues such as maximising commercial yields, value-adding and product development especially for new product markets.

- The objectives of the project are:
  i. To evaluate the feasibility of developing reformed fish products from Australian processed fish waste.
  ii. To develop new products for the fish waste material in association with Australian industry and researchers.

- A review of markets and products shows that in international markets, reformed fish products appear to be well-established and are under-going further development as a result of the market focus upon 'convenience food' main meals and snack foods in the retail and food service markets.

Summary of Categories or Opportunities for Reformed Fish Products

	Category or Opportunity	Example Products
1.	Snack and Finger Food	Pate's, terrines, tournedos, co-extruded/filled/seasoned products
2.	Main Meals and Home Meal Replacements (HMR's)	Sausages, pies, kievs, 'wet' dishes Packaged long shelf-life/MAP whole meals
3.	Gourmet food products	Smoked products, lasagne, ravioli

- These opportunities have been identified as of higher priority due to the following strategic issues:

  - Higher value, low volume specialty market products.
  - Able to be differentiated from 'commodity' products such as fish fingers and fish bites.
  - Less susceptible to competition from cheaper imported fish products.
  - Beneficial to the Australian fishing industry profile in that these opportunities potentially position the industry's products as high quality, gourmet products.

- Industry feedback has confirmed that fish waste includes at least 10 different types of wastes for the Australian fish processing industry:

  i. Head and fish flesh
  ii. Backbone and fish frame flesh

iii. Filleting waste 'pieces'
iv. Processing/frozen block 'sawdust'
v. Skin
vi. Eye
vii. Gut
viii. Bladder
ix. Wings
x. Oil

- Based upon industry discussions, it is estimated that a potential quantity of almost 9,000 tonnes of fish flesh waste material occurred in the Australian industry in 1996/97.

  - This is considered to be a significant resource when it is compared against the following imports during 1996/97:
    - Imported fresh, chilled, frozen whole fish - 10,577 tonnes
    - Imported frozen fillets - 30,047 tonnes
    - Imported other fresh, chilled or frozen fish - 5,006 tonnes

- Fish flesh recovery and product development trials have been conducted with fish processing wastes including:
  - Processing waste such as wings
  - Fish frames from fillet processing
  - Whole fish

- Specifically, wings from Snapper, Snapper carcass frames and whole Trevally were successfully processed for fish flesh recovery. The trials showed that the recovered fish flesh was both high yielding and functional for the further development of food products.

- Trial product development of 'gourmet' higher value food products from the recovered fish flesh have been evaluated by industry as successful. These food products were targeted not to compete in the 'commodity' markets associated with products such as fish fingers, fish bites or fish burgers. Rather these food products were aimed at the main meal and Home Meal Replacement sectors of the market.

- The trial food products including fish lasagne, fish ravioli, fish pie and fish rissoles were assessed by industry for their commercial market potential.

RECOMMENDATIONS

Recommendation 1

Support the further development of reformed fish products from other species of fish which target the strategic specialty food service markets.

Food segment opportunities include:

- Snack and finger foods
- Main meals and Home Meal Replacements (HMR's)
- Gourmet food products

These market segments provide the Australian seafood industry with:

- Higher value, low volume specialty market products.
- Ability to be differentiated from 'commodity' products such as fish fingers and fish bites.
- Less susceptibility to competition from cheaper imported fish products.
- An industry profile that potentially positions the industry's products as high quality, gourmet food products.

Recommendation 2

Support research which strategically utilise the broad range of waste products from fish processing.

This research has principally targeted the utilisation of fish flesh waste, however in total there are some 10 waste materials which may potentially be considered as a source of 'food' material.

Recommendation 3

Support the development of technical product development resources with an emphasis upon the commercialisation of new products and food safety (risk) management.

The commercialisation of new products is a critical stage for new product development. Recent developments in food regulation in Australia highlights the need for the Australian fish processing industry to be pro-active with their management plans for new product development and food safety.

2.0 BACKGROUND

A previous study co-funded by the Fisheries Research and Development Corporation (FRDC) and the Rural Industries Research & Development Corporation (RIRDC) confirmed that seaweed has a wide range of applications ranging from dietary foods, food manufacturing ingredients, textile additives, horticultural biostimulants and fertilisers through to pharmaceutical, health care and medical products.

During this study a major food ingredients company expressed interest in the product development applications of carageenan - a seaweed food ingredient product. Specifically, the company was interested in product development for reformed fish products using fish processing waste material and carageenan as a food binder.

Further discussions with industry identified broad support for the concept especially as it offered the opportunity for the value-adding of downgraded material/waste and could potentially improve industry returns.

This project aims to build on the previous FRDC/RIRDC study and follow-up on a major recommendation of the study which was to undertake '...new product development projects in response to opportunities identified in the market research feasibility studies'

3.0 NEED

Australian fisheries production has been declining in recent years, and there appears to be little potential to significantly increase this production in the medium term. Most of Australia's commercial fisheries are operating at their maximum (available) capacity, and the commercial imperative is for these groups to maximise the value of production from the limited and in some cases, declining fisheries resources. The future of the industry shall be largely related to how well the industry is able to adjust to new market conditions under these environmental and resource constraints.

At present, large amounts of fish waste occur in the industry due to either waste material such as fish frames or low commercial value species, and 'incidental' by-catch material.There is a need for the industry to maximise its yields and commercial returns for the limited industry resource. Industry profitability and sustainability depends upon key issues such as maximising commercial yields, value-adding and product development especially for new product markets.

Recent industry reports (eg, BIS Shrapnel 1998) have confirmed the emergence of the Australian food service market as a major growth area for value-added, 'reformed' food products. This has been shown by groups such as McDonalds with both their (meat) hamburger patties and fish (fillet) patties.

This 'product development' study provides the opportunity for the fish processing industry to collaborate with the Australian food industry. Moreover, it also provides a demonstration or 'lead-case' example for product development which other companies in the Australian market may follow with other commercial fishing/food industry groups.

4.0 OBJECTIVES

1. To evaluate the feasibility of developing reformed fish products from Australian processed fish waste.
2. To develop new products for the fish waste material in association with Australian industry and researchers.

5.0 METHODS

The project was conducted using the following milestone program:

Milestone 1 Australian and International Market Assessment

- Liaison and collaboration with key industry and research groups.
- Establishment of an Australian and international market profile for reformed fish products.
- Definition of key market factors and industry development issues.

Milestone 2 Feasibility Study and Supply Assessment

- Assessment of the availability of 'fish waste' resource.
- Liaison and collaboration with fish cutting/food supply organisations.
- Development of supply and production strategies.

Milestone 3 Reformed Fish Product Development

- Development of reformed fish products in collaboration with Australian food manufacturing and research organisations.
- Commercial assessment of market trials in Australia.
- Assistance with commercial business/development plans.

6.0 RESULTS

6.1 Australian And International Market Profile For Reformed Fish Products.

6.1.1 International Market Trends

Desk market research has been undertaken to review reports on recent international consumer trends for foods generally, and seafood/reformed fish products specifically.

In addition, feedback has been sourced from:

- International trade shows including HOFEX, 1997; Beijing Seafood Conference, 1997; ESE Brussels, 1997.
- Discussions with major retail groups in Indonesia and Singapore.
- Discussions with multi-national food corporations in Australia.

Overall, it would appear that the international industry is currently focussed on the following consumer demands:

- Convenience for the handling, preparation and use of food products.
- Innovation and variety in food products.
- Availability of foods across the total socio-economic range rather than just the upper socio-economic groups.

These broad trends have resulted in the development of many new food products such as:

- Portion-controlled or retail-ready packs for different household sizes.
- Semi-prepared products in portion-controlled packs.
- Heat and serve products in fresh or frozen packs.
- Long-shelf life/modified atmosphere packaged foods.

Table 1 provides selected examples of seafood products (reformed and non-reformed) recently released at the international food shows.

International research on reformed meat products conducted by the University of Western Sydney (UWS) (1995) confirms that reformed foods are not a new food product. Indeed, UWS indicates that there are a number of existing systems available in Europe and America for the production of a range of extruded products including:

- Fish/meat balls
- Patties and terrines
- Sausages
- Pate products
- Bread rolls with minced fish fillings
- Reformed fish/meat logs/fillets/fingers with/without stuffings.

The UWS research and our recent discussions with major food ingredient suppliers confirm that reformed products are well-suited for specialty high value/lower volume niche markets in both the retail and food service industries.

Table 1
Examples of Recent International Releases of New Seafood Products

Item	Target Market	Company/ Location	Product Description	Consumer Benefits
1	Retail	Pieters Holland	Modified atmosphere packs of seafood kebabs, sausages and fillets	Convenience Ready to Eat (RTE) Pre-cooked 4 weeks shelf life
2	Retail	Best Salmon - Chile	Frozen salmon burgers reformed with sodium glutamate	Convenience Potion controlled
3	Food service	P Baarssen - Holland	Frozen breaded fillets formed with salmon and seafood fillings	Minimal preparation time Portion controlled
4	Food service	Islenskt - Iceland Rog - Holland	- Terrines Salmon tournedos and stuffed fish roll logs	Long shelf-life (9 months) Pre-cooked, RTE
5	Food service	Canadian Clearwater - Canada	Scallop burgers	Portion controlled IQF and RTE 99% fat free
6	Retail	Lannen Tehtaat Oy - Finland	Fish sausages	Convenience
7	Food service	Abacus Seafoods - Scotland	Fish bites with a layer of sauce between two layers of fish meat	Portion controlled Frozen and fresh Breaded/unbreaded
8	Retail	Abacus Seafoods - Scotland	Fish floss, dried snack food	Snack food Convenience

In international markets, reformed fish products appear to be well-established and under-going further development as a result of the market focus upon 'convenience' main meals and 'snack' foods in the retail and food service markets.

6.1.2 Australian Market Trends

The Australian market continues to grow driven by factors such as the rise in dual income families and increased disposable income, convenience and to some extent, a decrease in consumer cooking skills.

This is evident by the emergence of the following trends in consumerism for food in Australia:

- Consumers are now and will continue to become more demanding.
- A decline in the traditional family structure, and related changes in style and size of meals.
- A trend away from 'family meals' to staggered meal times, catering for differences in working hours with a consequent emphasis upon convenience and pre-prepared foods.
- Growing popularity of 'cuisine' foods and increasing demand for variety and novelty.
- Increasing use of take-away and convenience foods for casual eating.
- Growth in the supermarket Home Meal Replacement (HMR) trade.
- Food safety has developed to be a key issue for many consumers.

As shown in Table 2 the retail and food service markets for seafood in 1996 was $360 million and $500 million respectively.

Table 2
Australian Retail and Food Service Markets for Seafood

Item	Value ($A)
Retail market - Frozen - Canned	$358.8 mill (94.2 million) (264.6 million)
Food service - Commercial - Institutional	$500 million ($480 mill) ($20 mill)

(Sources: BIS Shrapnel, 1996; Retail World, 1996)

Overall, the Australian market is similar to international markets and their developments. However, one point of difference is the relatively strong influence of Asian consumers and cuisine in the Australian market.

In a recent report by Connectica International (1997) for the Rural Industries Research and Development Corporation, it was noted that over $1.4 billion of Asian foods are imported into Australia per year. Table 3 provides an overview of selected retail and food service products which demonstrate the market response to Asian consumers in the Australian market.

Table 3
Selected Current Australian Retail and Food Service Products

Product Category	Market Segment		
	Australian Foods	Asian Foods	Australian & Asian Foods
1.Main meals	- 'Fillet' products - Crumbed products - Tempura products - Fish burgers/cakes - Kievs/caravelles	- Fish cakes - Fish ball - Fish pastes - Fish sausages - Boiled fish cake	- Tempura products - Thai fish cakes
2. Snack products	- Cocktails/nuggets - Fingers/sticks - Crumbed shapes - Reformed squid	- Yum cha dumplings - Japanese specialities	- Yum cha dumplings
3.Gourmet products	- Smoked products - Pates/Terrines - Sausages - Pies & Burgers	- Fish Sushi -Seaweed or nori rolls	- Fish Sushi -Seaweed or nori rolls
4. New concept products	- Pre-prepared meals - 'Vegetarian' meals	- Sashimi	- Pre-prepared meals - Surimi type products

6.1.3 Market Summary

Overall, based on the review of the above markets and products, the market opportunities may be classified into three groups as shown in Table 4.

Table 4
Summary of Categories or Opportunities for Reformed Fish Products

	Category or Opportunity	Example Products
1.	Snack and Finger Food	Pate's, terrines, tournedos, co-extruded/filled/seasoned products
2.	Main Meals and Home Meal Replacements (HMR's)	Sausages, pies, kievs, 'wet' dishes Packaged long shelf-life/MAP whole meals
3.	Gourmet food products	Smoked products, lasagne, ravioli

These opportunities have been identified as of higher priority due to the following issues:

- Higher value, low volume specialty market products.
- Able to be differentiated from 'commodity' products such as fish fingers and fish bites.
- Less susceptible to competition from cheaper imported fish products.
- Beneficial to the Australian fishing industry profile in that these opportunities potentially position the industry's products as high quality, gourmet products.
- Reformed products have the opportunity to be developed under all three of these categories.

6.2 Industry Development Issues

6.2.1 General

Discussions with Australian industry and the literature review, has confirmed that in Australia the production of mechanically recovered (minced) fish flesh has been traditionally low. To date, it would appear that there are only one or two companies in Australia producing minced fish on a contract basis, and this is predominantly for the Australian manufacture of products such as fish fingers.

The quantities of imported fish blocks are difficult to determine as import statistics do not differentiate between fish fillet and fish mince blocks. Based upon industry discussions, it is estimated that up to 30% of the imported fish mince blocks are minced fish flesh due to product specification and quality requirements.

Major users of fish mince product are the major manufacturers of fish fingers and fish 'bite' products.The reasons for the low production of fish mince is cited as:

- In global terms the Australian fishing industry is small with a total Gross Value of Production (GVP) of $1.63 billion in 1996.
- Almost 60% of the GVP is as a result of the export/sale of low volume, high priced species such as lobsters, prawns, abalone, scallops and oysters.
- There has been little strategic industry focus upon high volumes of low priced fish. This is partly due to the relatively cheap price of other competitive proteins such as red meat that benefit from larger scale industry promotion and development strategies.
- Cheap imports of minced fish blocks for the manufacture of products such as fish fingers.

6.2.2 Issues

- **Market Trends to Convenience Foods**

There is a significant market trend towards pre-prepared or convenience foods. In the retail sector these foods are often known as Home Meal Replacements (HMR) and actively compete with restaurants (meals) in the food service industry.

- **Competition**

Competition may occur from either other competitive foods (meats) and other seafood products, eg fish fingers/bites. It is considered that it would be commercially undesirable to encourage more competition into an existing competitive market such as fish fingers. Rather it is more desirable to expand the size of the market through new product developments and innovation.

Accordingly, industry recommended that this study should focus upon strategic higher value/lower volume specialty food products.

- **Quality, Consistency and Continuity of Supply**

While there is a potential availability of fish flesh waste, there is a need to organise the logistics of homogeneity of species, quality and consistency of the supply.

- **Lack of Industry Awareness of the Waste Resource**

There appears to be a difference in attitude to waste utilisation between the wild and the fish farming sectors of the industry. The latter (eg, Tasmanian Salmon growers) appear to be very conscious of yield and waste utilisation.

- **Why Value-add When Other Opportunity Costs with Other Products may be Higher?**

Similarly, the wild fishing industry may often have little incentive to value-add or further process waste material when the returns or opportunity costs for whole fish products may be relatively high.

- **Waste Management Environmental Issues**

While much of the waste product may be utilised as pet food or fertiliser, there are periods of time when the material is simply dumped as landfill. Industry sources have indicated that this is an undesirable activity, and that Government legislation in the future may curtail or prohibit such dumping.

However, as indicated previously recent market developments have resulted in:
- ***New market opportunities for product development in Australia.***
- ***The opportunity to increase the domestic supply of fish products to replace imports.***
- ***Increased pressure on industry utilisation of waste material.***

6.3 Estimate of Quantities of Fish Flesh Waste

6.3.1 The Issue of Ten Fish Wastes

Previous industry feedback to NSC and subsequent discussions with industry in this project have identified that there is a significant need to identify product opportunities for fish waste product.

Industry feedback has confirmed that fish waste includes at least 10 different types of wastes for the Australian fish processing industry:

1. Head and fish flesh
2. Backbone and fish frame flesh
3. Filleting waste 'pieces'

4. Processing/frozen block 'sawdust'
5. Skin
6. Eye
7. Gut
8. Bladder
9. Wings
10. Oil

To date, the above fish wastes are principally used for the manufacture of fertiliser, pet foods, soup stocks and baits. Industry considers that at present the returns for these products are relatively low (less than $2 per kg) and the prospect for increased returns are limited.

Further, it is reported that these current market opportunities are subject to fluctuation, and when the market demand is low, the industry is forced into the environmentally sensitive option of dumping the waste as landfill. This option is arguably at a cost to both the industry, the community and the environment.

From an industry perspective, any waste utilisation strategy should ideally utilise all the wastes if possible; and maximise the returns for each of the individual wastes.

However, it is emphasised that this is the 'ideal' approach, and this project first and foremost must be 'market driven and not waste-product driven'.

6.3.2 Estimated Quantities of Australian Fish Flesh Waste Material

The quantities of the fish flesh waste material which occurs in the Australian industry is difficult to determine accurately. However, based upon industry discussions and the literature review, Table 5 estimates that a potential quantity of almost 9,000 tonnes of fish flesh waste material occurred in the Australian industry in 1996.

This is considered to be a significant resource when it is compared against the following imports during 1995/96:

- Imported fresh, chilled, frozen whole fish - 10,577 tonnes
- Imported frozen fillets - 30,047 tonnes
- Imported other fresh, chilled or frozen fish - 5,006 tonnes

Table 5
Estimated Potential Quantities of Fish Flesh Waste in 1996

Source of Processing Waste	Quantity (Tonnes)	Estimated Fish Heads & Backbones (Tonnes)	Estimated Potential of Fish Flesh Waste (Tonnes)
Australian catch filleted for export market	4,300	2,669	1,500
Australian catch filleted for domestic market	9,000	5,850	2,100
Imported whole fish filleted for the domestic market	10,600	5,512	1,900
Imported fillets	30,357	N/A	3,100
TOTAL			**8,600**

(Sources: ABARE, Sydney and Melbourne Fish Markets)

These estimates are based upon industry feedback that (subject to species) indicate:

- Total waste from filleting may amount to 40 - 70% of the whole fish.
- Fish heads and backbones only may account for up to 65% of the fish.
- Fish flesh accounts for at least 35% of the fish heads and backbones. (Marfoni, 1989; Infofish, 1991)
- 'Piece' trimmings from processing of imported fillets may amount up to 10% of the product.
- Domestic market filleting: 35,827 tonnes (1995/96) of fin fish (excluding. tuna) less 50% exported is 17,900 tonnes. Assume 50% for filleting is approximately 9,000 tonnes.
- 80% of imported whole fish would be filleted.
- By-catch is not included in these estimates.

6.4 Assessment of Availability Of 'Fish Waste' Resource

6.4.1 General

Surveys were conducted with industry organisations for the feasibility of waste supply. The surveys sought information in terms of:

i. Current waste species.
ii. Current usage of waste and price returns.
iii. Which months/seasons is waste available.
iv. Quantity of waste per month.

v. 'Form' of the waste (whole or carcass) by species.
vi. Any alternative available waste species.
vii. Any quality issues for the waste.
viii. Availability and amount of waste from other sources.

6.4.2 Assessment Results

Company A

Company A confirmed that waste carcass material from Schnapper, Dory and Shark was available all year round and was equivalent to some 500 tonnes per year.

It was indicated that further waste material could be sourced from other groups to enable 'consolidation' of waste supply sources if larger volumes of material was required.

At present, Company A's waste material is removed as rendering waste for animal feed and costs $15 per 1.5 cubic metre for removal.

Summary:

Company A's consistency, volume and 'quality' of waste material indicates their potential to supply waste material for technical and commercial assessment.

Company B

In comparison to Company A, Company B have a major issue of seasonality of supply of Australian Salmon. The Salmon run occurs during the period March to August but can be highly variable. During March/April the supply of Salmon was reported as being low with only 10-15 tonnes per month. Waste material was estimated to be as low as 4 tonnes per month.

It was further advised that the small volumes of Australian Salmon frames would require consolidation with other suppliers and would have to involve the freezing of frames to gain some consistency of supply.

Summary

It would appear that the seasonality, inconsistency of supply and the small volumes of waste material would limit the feasibility of waste supply. However, while they are unable to supply Australian Salmon material for this project, Company B indicated their interest to continue as an observer in this study.

Company C

Company C process some 5 tonnes of Patagonian Toothfish per day, and as a result yields wastes of:

- 2 tonnes of carcass consisting of head, gut, tail and frame.

- 500 litres of fish oil containing omega-3/5 oils.
- Bone in the waste flesh which is 'soft and cartilage-like'.

These wastes are significant factors as the oil is not only a potentially valuable waste product material, but must also be recovered from the fish flesh as it is anticipated that the high oil concentration shall cause the fish waste material to become too 'fluid', and therefore non-functional for further processing. In addition, any recovered fish flesh needs to be separated from the soft cartilage bone material.

As these issues were considered to be critical factors for the progress of the project, Company C conducted preliminary flesh recovery trials with a Baader flesh recovery machine.

The results of these trials at Company C were not successful. The recovered fish flesh material was 'soft and mushy' due to the high oil content in the flesh and the quality of the material was further degraded by the inability to separate the bone/cartilage from the recovered flesh material.

Summary

The on-site technical trials for the recovery of flesh from Patagonian frames was not successful. Company C is continuing to develop techniques for the (cold press) extraction of fish oil from the waste material prior to the processing of the fish flesh. Accordingly, Company C have indicated their interest to continue as an observer in this project.

6.5 Development of Supply and Production Strategies

6.5.1 General

As a result of the above review of supply and seasonality issues for the supply of waste material, on-site product trials were conducted at Company A's premises. Company A was a preferred site due to:

- The initial availability of some 500 tonnes of waste material of specific types of fish (Schnapper and Dory).
- The ability to source and consolidate waste material from other suppliers.
- Commercial links with a large Australian retail group.

6.5.2 Product Development Strategies

The overall approach was to provide Company A with support and resources to develop ownership for the development of products from the waste material.

Accordingly, this part of the project was designed to 'network' equipment and food ingredient companies with Company A. These equipment and food ingredient companies are shown in Table 6.

Table 6
Organisations for Support with Equipment and Reforming Materials

Organisations	Contacts	Products
Food Processing Equipment	Mr Brian Carey - Managing Director Mr Craig Lindsell - Technical Specialist	Beehive, Baader flesh recovery equipment
Interfood/Max Notley	Mr Gary Moulton - Manager Mr Max Notley - Director	Baader flesh recovery equipment Food forming equipment
Michael Nunn & Assoc	Mr Michael Nunn	Mecalyn Steak log machine
FMC Food Ingredients	Mr Stewart Campbell - Regional Manager Mr Khamfa Phonhareon - Technical Specialist	Binders and gels for Reformed product formulations
Swift Australia	Mr Pisquale Piscopo	Binders and gels for Reformed product formulations
Hercules/Copenhagen Pectin	Mr Torben Henriksen Mr David Spaul	Binders and pectin for Reformed product formulations
Venturetech Pty Ltd	Dr Denis Roberts	Consulting scientist for binding materials and food products

Company A subsequently invited the potential involvement of these organisations in the reformed fish product trials.

It was strongly recommended that industry be given the opportunity to invest and own this part of the project, as the success of new product developments shall be largely influenced by the commercial imperatives for the company.

6.6 Reformed Fish Product Development

6.6.1 Pilot Trials for Development of Reformed Fish Products

Table 7

Overview of the Product Development Trials

Date & Location

August 1998, Perth

Purpose

1. To test the effectiveness of machinery for the recovery of fish flesh from a range of fish waste materials.
2. To test the development of 'meal products' from the recovered fish flesh.

Equipment

1. Beehive RSTC-02RA
2. Baader 694 meat separator

Fish Waste Materials/Products

1. Snapper frames
2. Snapper Wings
3. Shark waste (fresh frames and offcuts)
4. Shark fillets (frozen)
5. Whole Trevally

Process

1. Calibrate Beehive and Baader for set up and testing
2. Snapper frames were headed and gutted and cooled
3. Snapper wings were collected and washed
4. Shark frozen fillets were defrosted
5. Shark waste collected
6. Travelly whole fish were headed and gutted
7. Each waste material was individually tested for its ability to separate 'flesh' from the waste material.
8. Resulting mince was collected and bagged in plastic bags and cooled

6.6.2 Key Results of the Trials

Equipment

- The separation using the Baader equipment was relatively unsuccessful. While the literature review had shown that previous overseas trials with the equipment had been successful, these trials in Perth (and previous trials in Albany) were unable to effectively separate fish flesh from the waste materials.

- By comparison, the separation of fish flesh from the waste material using the Beehive was successful and the results are summarised in Table 8 below:

Table 8
Results for Mechanical Separation of Fish Flesh from Fish Waste using Beehive Equipment

Species	Yield	Colour	Texture	Naturally Binding
Snapper frames	70%	Dark (due to blood line)	Good	Good
Snapper wings - with scales	80-85%	Pale pink	Good	Good
Shark fresh waste	60-65%	White	Some cartilage	Good
Shark frozen/defrosted fillets	10%	White/ pale pink	Good but moist	No
Trevally Whole	60%	Dark grey. Some skin flake	Good	Good
Trevally Whole	40%	Improved colour pinkish/ grey. no skin flake	Good	Good
Dory (Frozen/defrosted) frames. Headed / gutted	40%	Pink/grey	Very moist due to oil and water	No

6.6.3 Waste Materials

The following waste materials produced relatively high yielding and functional fish flesh from the waste material:

- **Snapper Wings**

The wings were able to be processed with scales, and produced a fish flesh yield of some 80-85%. The flesh was very functional and was used in 'meal' products including fish lasagne and pies.

- **Snapper Frames**

The frames yielded approximately 70% recovered flesh, and while the flesh was highly functional, there was some discolouration from blood in the flesh. However, further trials confirmed that this discolouration could be 'washed out' of the recovered flesh.

- **Whole Trevally**

Whole Trevally was processed at two speed/pressure settings through the machinery. At a lower pressure setting, the trials with the Trevally produced higher yields of approximately 60%, and this recovered fish flesh was functional in a range of meal products.

6.6.4 Commercial Assessment of Pilot Market Trials

Pilot meal products were prepared from the various types of recovered fish flesh. Table 9 shows that the initial commercial and market assessments of the fish flesh was acceptable in a range of reformed meal products.

Table 9
Initial Commercial Assessment of Reformed Pilot Meal Products

Pilot Meal Products	Source of Fish Flesh	Assessment
Lasagna	Snapper wings	Excellent result. Some tasters could not identify it was fish mince.
Ravioli	Trevally	Excellent bite and taste. Cooked mince was greyish in colour but could be aerated and 'whitened'.
Pie	Snapper wings	Mixed with mash potato powder, peas and carrots. Good taste, some 'fish' odour
Rissoles	Trevally	Crumbed and fried. Excellent taste
Fish cakes	Snapper wings	Parmesan cheese, egg and battered and deep-fried. Excellent taste
Shark mince	Shark mince	Cooked in microwave. Colour white and good bite.

6.7 Commercial Development Plans

Further commercial product development trials have been undertaken by the commercial industry collaborator. These trials have been conducted in-house to capitalise upon new factory premises and the planned acquisition of new capital equipment.

Commercial development plans are progressing on a commercial-in-confidence basis and the commercial collaborator shall advise NSC of the commercialisation and launch of the reformed fish products.(Refer letter under separate cover from the commercial collaborator).

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7.0 SUMMARY AND BENEFITS

7.1 Summary

- Fish flesh recovery and product development trials have been conducted with fish processing wastes including:
  - Processing waste such as wings
  - Fish frames from fillet processing
  - Whole fish

- Specifically wings from Snapper, Snapper carcass frames and whole Trevally were successfully processed for fish flesh recovery. Flesh recovery from other waste products of shark and Patagonian Toothfish were not successful.

- The trials showed that the recovered fish flesh was both high yielding and functional for the further development of food products.

- Trial product development of 'gourmet' higher value food products from the recovered fish flesh have been evaluated as being successful. These food products were targeted not to compete in the 'commodity' markets associated with products such as fish fingers, fish bites or fish burgers. Rather these food products were aimed at the main meal and Home Meal Replacement sectors of the market.

- Food products including fish lasagne, fish ravioli, fish pie and fish rissoles were noted for their commercial market potential.

- The commercial industry collaborator in this project has continued with the in-house management and development of the products for its customers. A major customer of the commercial collaborator has implemented a proprietary food product safety management plan for the further development of the products.

7.2 Benefits

- The major industry sectors to benefit from this work are the fish processing and food manufacturing sectors. Benefits are gained from the increased utilisation of waste material from fish processing. These potential benefits occur in two areas:
  - A potential increased commercial return of up to $5 per kg on a waste product of low commercial value (eg, less than $2 per kg if used for pet food or fertiliser manufacture).

  - A cost saving through the elimination of removal costs associated with the waste where it is of no commercial value. During the study, costs of $10 per cubic metre were cited for the removal of fish carcass waste material.

- The commercial utilisation of the waste material also provides a potential community benefit as at times the waste material has had to be dumped as a landfill.

8.0 INTELLECTUAL PROPERTY

No intellectual property was developed during this study.

9.0 RECOMMENDATIONS AND FURTHER DEVELOPMENT

Recommendation 1

Support the further development of reformed fish products from other species of fish which target the strategic specialty food service markets.

Food segment opportunities include:
- Snack and finger foods
- Main meals and Home Meal Replacements (HMR's)
- Gourmet food products

These market segments provide the Australian seafood industry with:
- Higher value, low volume specialty market products.
- Ability to be differentiated from 'commodity' products such as fish fingers and fish bites.
- Less susceptibility to competition from cheaper imported fish products.
- An industry profile that potentially positions the industry's products as high quality, gourmet food products.

Recommendation 2

Support research which strategically utilise the broad range of waste products from fish processing.

This research has principally targeted the utilisation of fish flesh waste, however in total there are some ten waste materials which may potentially be considered as a ten 'food' resource materials.

Wastes from fish processing may include:
1. Head and fish flesh
2. Backbone and fish frame flesh
3. Filleting waste 'pieces'
4. Processing/frozen block 'sawdust'
5. Skin
6. Eye
7. Gut
8. Bladder
9. Wings
10. Oil

Recommendation 3

Support the development of technical product development resources with an emphasis upon the commercialisation of new products and food safety (risk) management.

The commercialisation of new products is a critical stage of product development. However, recent developments in food regulation in Australia highlights the need for the Australian industry to be pro-active with their management plans for new product development and food safety.

10.0 STAFF

10.1 Consultant Staff

Table 10
Project Staff

Name	Organisation	Interest
Mr Barry Lee	Connectica International	Principal Consultant
Mr Karnig Momdjian	Connectica International	Consultant

10.2 Participating Industry and Researchers for Product Development Trials

Table 11
Industry and Research Staff

Name	Organisation	Interest
Paul and Nick Catalano	Catalano's Seafood market	Proprietors
Fan Chung	Catalano's Seafood market	Quality control manager/ Food technologist
Craig Lindsell	Food Processing Equipment	Supplier of The Beehive
Ken Taylor	Swift and Company	Supplier of carrageenan
Abraham Kotlyar	Natural Sea Foods	Product development consultant to Catalano
Denis Roberts	Venturetech Pty Ltd Murdoch University	Technical consultant will experiment on binding of fish mince
Bean Hai Goh	Ozan International	Consultant to Catalano
Mark Benson	Princess Royal Seafood	Supplier of Baader and interested in testing Beehive on Patagonian Toothfish

10.3 Equipment and Food Ingredient Companies

Table 12
Organisations for Support with Equipment and Reforming Materials

Organisation	Contacts	Products
Food Processing Equipment	Mr Brian Carey - Managing Director Mr Craig Lindsell - Technical Specialist	Beehive, Baader flesh recovery equipment
Interfood/Max Notley	Mr Gary Moulton - Manager Mr Max Notley - Director	Baader flesh recovery equipment Food forming equipment
Michael Nunn & Assoc	Mr Michael Nunn	Mecalyn Steak log machine
FMC Food Ingredients	Mr Stewart Campbell - Regional Manager Mr Khamfa Phonhareon - Technical Specialist	Binders and gels for Reformed product formulations
Swift Australia	Mr Pisquale Piscopo	Binders and gels for Reformed product formulations
Hercules/Copenhagen Pectin	Mr Torben Henriksen Mr David Spaul	Binders and pectin for Reformed product formulations
CSIRO Divn of Food Science and Technology	Dr Jay Sellahewa	Extrusion technology

11.0 PROJECT BUDGET SUMMARY

Table 13
Income Statement

Item	Item	Income Funds	Outstanding Funds
1	NSC 1st contract payment - Project contract executed	15,000	
2	NSC 2nd contract payment - Completion stage 1	13,200	
3	NSC 3rd contract payment - Completion stage 2	5,000	
4	NSC 4th and final payment - Outstanding		(5,000)
	Total Funds Received	**33,200**	
	Total Funds Outstanding		**(5,000)**

Table 14
Project Source of Funds Statement

Item	Activity	NSC (As per Budget)	Industry Funds	Total
			In-Kind (Refer Table 15)	
1	Milestone 1	15,000	-	15,000
2	Milestone 2	13,200	4,500	17,700
3	Milestone 3	5,000	9,600	14,600
4	Milestone 4	(5,000)	27,400	32,400
	Totals	**38,200**	**41,500**	**79,700**

Table 15
Notes for In-Kind Funding Details

Task	Resource	Costing			Other Costs/ Justification	Total
		Rate/ day	No. Days	Total		
1	-					-
2	Pasquale Piscopo	500	8	4,000	500	4,500
3	Mark Benson	500	5	1,500	500 (Baader trials & Fish flesh)	9,600
	Fan Chung	500	3	1,500		
	Bean Hai Goh	500	8	4,000		
	K Momdjian	700	3	2,100		
4	Nick Catalano	500	2	1,000	4,000 (Beehive trials & fish flesh)	27,400
	Paul Catalano	500	2	1,000		
	Fan Chung	500	5	2,500		
	Bean Hai Goh	500	1	500		
	Denis Roberts	500	2	1,000	200	
	Abraham Kotlyar	500	5	2,500	800	
	Swift/FMC	500	10	5,000	2,000 (Carageenan)	
	FPE	300	8	2,400	1,000 (Beehive use)	
	B Lee	700	5	3,500		
	Totals			**32,500**	**9,000**	**41,500**

12.0 REFERENCES

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