

SEAFOOD SERVICES AUSTRALIA

**The Development of a Chilled Pasteurised
Prawn Loaf
Range in Retail Packs**

Jason Hancock, Janette McDonald, Christine Gore

FINAL REPORT

Project Number 97/411

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Aquatic Food Marketing Pty Ltd
1616 Redden Street
PORTSMITH QLD 4870



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PRINCIPAL INVESTIGATOR: Mrs J.K.McDonald
ADDRESS: Centre for Food Technology
19 Hercules Street,
Hamilton Qld 4007
Telephone: 07 340 68643
Fax: 07 340 68660

NON TECHNICAL SUMMARY

The aim of this project was to develop a value added seafood product which utilised the soft and broken green prawns from Aquatic Food Marketing (AFM), a prawn trawler company in Cairns, North Queensland. Most of these soft and broken green prawns can only be processed into prawn meat as the abundance of peeled green and cooked prawn meat products entering the country from overseas, means the local product is stockpiled awaiting shortages in the market. It was felt that the local soft and broken green prawns could be utilised to produce a value added product that could enter the market at a different level to that of its current imported competitors. Demand for this value added product might reduce the recurring stockpile of this raw material.

Initial product concept studies with potential consumer markets revealed that there may be a demand for a convenient "ready to use" no mess prawn meat product similar to that of a chicken loaf or roll. With the initial success of the first product prototypes and the overall acceptance of the product concept in the consumer market, it was felt that further market research and product development be undertaken to successfully produce a product which will utilise this raw material.

It is proposed that this project build on the results of the earlier study and bring a product to the point where it can be launched onto the retail market.

Consumer research was used to identify whether the overall concept appealed to the consumer and what the average consumer was looking for in a prawn loaf product.

The requirements and queries from the consumer panels were as follows:

The concept of a prawn loaf received a favourable reception with consumers, however, the following concerns were raised:

- A. What percentage prawn content would be used?
 - B. The quality of the prawn meat being used
 - C. What other "additives" would be in the product?
1. The majority of consumers imagined they would replace existing sliced meats for the prawn loaf on their sandwiches.
 2. Consumers want to be able to buy the product in two forms – a roll, to be sliced to a desired thickness and also in pre-sliced packs.
 3. A chunky prawn texture was desirable.
 4. It must have a natural prawn flavour with no added flavours such as lemon pepper.

The aim of this project was then to take these recommendations and develop them into a product that could be launched successfully and safely onto the retail market.

Formulation development involved optimising the texture of the prawn loaf, which was integral to the usage criteria, outlined by the consumer. The loaf needed to be firm enough for thin slices to be made for sandwich preparation. This was achieved through the trialing of many binder and vegetable gum combinations to produce the appropriate texture.

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Ingredients trialed included soy protein, potato fibre, carrageenan gum, modified maize starch, whey protein concentrate, sodium casienate, tapioca starch, and locust bean gum.

Up to 14 trials and reformulations were manufactured in approximately 3 kilogram bench scale batches before the final result was achieved. The final formulation is outlined below.

Ingredient	(%)
Prawns	55.0
Fish (Nile Perch)	16.0
Salt	1.8
Sodium Tripolyphosphate	0.3
Sugar	1.5
Firmtex	2.0
Gelcarin ME9111	0.8
Locust Bean Gum	0.3
Water	16.2
Alacen 132	4.0
Canola oil	2.0
Sodium Erythorbate	0.10
Total	100

At the conclusion of the development component of the project the shelf life of the prawn loaf was determined by producing a pilot plant scale 6kg batch, produced using the formulation outlined above. The samples of product were stored at 4°C and 10°C for a period of 4 months. The prawn loaf was deemed acceptable both microbiologically and by sensory assessment when stored at 4°C or below for 4 months or less.

The conclusion of this project prior to the completion of stages 6,7 and 8 was due to the delay in the establishment of production facilities by the industry partner. Despite encouragement over the past 12 months as to the benefits of such facilities to this project, scale up and production trials including final shelf life assessment of the prawn loaf were unable to be conducted. The lack of availability of critical production facilities has meant the continuation of the project at this point is untenable.

BACKGROUND

In 1996, Mr Marshall Betzel of Aquatic Food Marketing approached the Centre for Food Technology's Product Development group to investigate the feasibility of developing a chilled product using the meat from soft and broken green prawns. At present this lower grade meat is under utilised. The results of that work indicated that technically a product could be produced with a shelf life of approximately 3 months at 4°C after cooking to an internal temperature of not less than 85°C. However, it became apparent that more extensive development work was required (to optimise the sensory characteristics and confirm the shelf life in association with further consumer testing) before a product of commercial quality could be produced.

Early development work carried out showed that such a product could be produced however further work would be required to refine the flavour, texture and aroma of the prawn roll and also to fully investigate the shelf life of this product whilst optimising product quality.

Consumer sampling of the prototypes developed showed that there was acceptance of the concept provided that taste and presentation could be refined.

NEED

As previously stated the surplus of raw material (soft and broken green prawns - particularly endeavour prawns (*meta penaeus* endeavour) prompted the initial inquiry to find an alternative use for this product. While some of this material is utilised in the smaller size, the soft and broken endeavour prawn lends itself to only be processed into prawn meat. As there is already an abundance of peeled green and cooked prawn meat products entering the country from third world countries at a low price, the local product tends to stockpile awaiting shortages in the market to find a niche.

It was felt that if this product could be value-added to produce an item able to enter the market at a different level to that of its current imported competitors, a demand might be created to reduce the recurring stockpile of this raw material.

Initial product concept studies with potential consumer markets reveal that their indeed may be a demand for a convenient "ready to use" no mess prawn meat product similar to that of a chicken loaf or roll product in the already diverse chicken consumer market.

With the initial success of the first product prototypes and the overall acceptance of the product concept in the consumer market, it is felt that further market research and product development be undertaken so as to successfully produce a product which on mass will receive consumer acceptance hence demand, hence the opportunity to utilise this abundant raw material.

The recommendations made in the Product Development report to Aquatic Food Marketing were:

- > further work to optimise texture
- > further work to optimise the flavour profile
- > extensive shelf life trials to determine the end point for product quality and safety.

It is proposed that the project work outlined in this current proposal build on the results of that earlier study to bring a range of products to the point where they can be launched into the retail market.

OBJECTIVES

1. To identify ideas for further product improvement and innovation and develop up to three prawn knobs, in a variety of shapes, flavours and packaging options
2. *Product definition from market analysis*
Research of the target market to identify specifically what the consumer would want from such a product conceptually.
3. *Development of product which meets market criteria*
The production of a prototype that meets the criteria of the consumer market research.
4. *Confirmation of market acceptance of final product*
Test marketing of product on the consumer to confirm that it meets initial criteria.
5. *Development of commercial scale manufacturing process of product*
Definition of commercial production equipment and processing with creation of pilot production so as to access production costs, quality, control etc. at commercial level.

METHODS

The aim of new product development is to make a profit by producing a safe quality food product that meets market expectations and leads to repeat sales. The product development procedure described here is intended to maximise the chance of success and reduce the risk of failure, by breaking the process into a series of stages. Each stage consists of a set of prescribed and concurrent activities and each stage is multi-functional to include technical and marketing input. Each stage is preceded by a "Gate" which is a decision point designed as a quality check points in the process. At the completion of each stage the Product Development group will confer with the industry partner to evaluate results before proceeding to the next step in the development process.

The product development will be accomplished by following the steps outlined below:

- Stage 1** Idea generation and screening
(Brainstorming sessions and product concept development)
- Stage 2** Product concept testing
(study of market consumer, product and process)
- Stage 3** Development of the product brief
(including technical and marketing and economic constraints)
- Stage 4** Development of prototypes
- Stage 5** Testing of prototypes
(focus groups, consumer acceptance panels)
- Stage 6** Development of the process
(including pilot plant and production trials)
- Stage 7** Shelf life studies
- Stage 8** Test marketing
- Stage 9** Critical analysis of product and process
- Stage 10** Final planning of production and marketing
- Stage 11** Final economic evaluation
- Stage 12** Organisation of final launch
- Stage 13** Launching of the product on the market

Stages 10 – 13 to be undertaken by the industry partner.

RESULTS AND DISCUSSION

STAGE 1

Brainstorming sessions and product concept development.

During the middle of 1997 a brainstorming session was held with a number of CFT employees to consider possible textures, processing methods and potential flavours for a prawn loaf.

Some examples of current retail smallgoods were brought in as prompts to initiate discussion on textures and flavour profiles. Some of the discussion points from the session are listed below:

Texture:

1. Use of injection curing and vacuum tumbling with STP
2. Cutting using bread slicers and vacuum tumbling with STP
3. Coarse mincing/bowl chopping
4. Use of fish or surimi as partial substitute/filler
5. Filling by hand/sausage filler
6. Casing colour best black
7. Cooking in smokehouse, water bath, steamer
8. Pre cooked/blanched prawns, incorporated into loaf immediately prior to filling casing

Texture types:

1. Coarse minced
2. Fine minced
3. Medium minced
4. Fine matrix holding whole pieces
5. Bologna style – Emulsified
6. Loaf style
7. Jellied meat style
8. Pressed ham style (4 x 4)

Flavours:

1. Garlic and onion
2. Lemon and fine pepper
3. Sugar
4. Seafood (prawn)
5. Seasoned salt blend
6. Ginger
7. Dill
8. Parsley
9. Celery
10. Honey
11. Capers
12. Onion and red/green peppers

Further examination of the retail deli market was conducted by Marshal Betzel.

At the conclusion of this concept investigation it was decided more accurate consumer research or focus groups would be required to fine tune the large number of product concepts canvassed.

STAGE 2**Product Concept testing**

In October 1998 Aquatic Food Marketing commissioned the Centre for Food Technology to conduct focus group research on a prawn loaf product. The research consisted of six focus groups of seven to eight people. The executive summary and the key findings of this report are outlined below.

1. The overwhelming response by all consumers was that they enjoy eating seafood and would like to eat more of it.
2. The major factor inhibiting greater consumption is price and the perception quality seafood is difficult to find.
3. The concept of a prawn loaf received a favourable reception with consumers, however, the following concerns were raised:
 - A. What percentage prawn content would be used?
 - B. The quality of the prawn meat being used
 - C. What other “additives” would be in the product?
4. The majority of consumers imagined they would replace existing sliced meats for the prawn loaf on their sandwiches.
5. Consumers want to be able to buy the product in two forms – a roll, to be sliced to a desired thickness and also in pre-sliced packs.
6. A chunky prawn texture was desirable.
7. It must have a natural prawn flavour with no added flavours such as lemon pepper.
8. The retail asking price for the prawn loaf is expected to be around \$15/kg.

STAGE 3**Development of the product brief**

As a consequence of this consumer research a new technical brief for the optimisation of the product concept, based on the conclusions drawn from the focus groups was drafted. It was based on the latest relevant consumer, technical and marketing information at the time.

1. **Product description:** Pasteurised chilled sliceable prawn roll, with a fresh cooked prawn flavour and a high prawn meat content. No added flavours. Appearance of the cut roll or slices must be white with visible pieces of prawn meat (some pink particles) to enhance the perception of a fresh cooked prawn product. Texture must reflect the sensory attributes of fresh cooked prawns.
2. **Presentation:** Pre sliced and pre packaged for entertaining and as a whole roll for sandwiches and for use in pasta and salads.
3. **Target market:** Double income households. (Mixed gender aged 35-50 years). Potential market for females aged 18 -35 years without children at home.
4. **Labelling claims:** Ingredient list must contain prawn meat as major ingredient.
5. **Target retail price:** \$15 to \$20 per kg. The retail price should be quoted on a 250g basis. (Final formulation cost will depend on final prawn content)
6. **Competition:** Up market sliced meat eg turkey roll and ham.
7. **Shelf life:** Approximately 3 months at 4°C storage.
8. **Packaging:** Plastic casings to allow pasteurisation to 80°C internal temperature and easy slicing.

9. **Pack size:** Pre sliced packs and whole rolls.

10. **Processing requirements:** Produce a prawn meat/ binder mix (vacuum mixing may be necessary) to be filled into plastic casings and then steam pasteurised to an internal temperature of 80°C and stored and distributed at 4°C.

11. **Follow up evaluation:** Focus groups to evaluate the proposed final product in proposed packaging and consumer acceptance panels to evaluate the sensory characteristics of the proposed final formulation.

STAGE 4 Prototype Development

From previous development work conducted during 1997 the following formulation and processing methods were established.

Ingredients	50% Prawn meat - no flavour
	%
minced prawns	50.00
soy isolate	5.00
salt	0.80
Frigex	5.00
sugar	0.30
lemon juice	0.20
vegetable oil	4.00
egg white	1.00
iced water	33.70
TOTAL	100.00%

Method:

- Head and tail frozen prawns
- De-vein prawns when partially defrosted
- After de-veining place prawns in chiller
- Mince prawns in Kenwood mincer using plate with 7 mm diameter holes
- Chill prawns
- Weigh out ingredients
- Add minced prawns to bowl chopper along with iced water and salt
- Mix for total 3 minutes
- Add all other ingredients
- Mix for total 5 minutes
- Scrape down bowl to ensure thorough mixing of ingredients
- Transfer mix to filler
- Fill mix into casing
- Transfer filled casings to steamer
- Steam cook until an internal temperature of 85°C is reached (probe in centre of log)

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- Hold 85°C for 5 minutes
- Rapidly chill the product by placing in iced water
- Store at 4°C

After the recommendations of the focus groups the following areas of improvement over this previous development work were required:

1. An expectation by the consumer that an up market prawn loaf must have high prawn content with a visually attractive chunky prawn texture
2. Improve the sliceability of the prawn loaf to allow easy use for both the consumer and deli personnel so slices of varying thicknesses can be produced.
3. The prawn loaf must have a distinct prawn flavour with no added flavourings such as lemon pepper.

Texture Improvement

To assess the suitability of several binding systems at once, a standard bench scale method was developed to eliminate the production of multiple batches of prawn loaf in the early stages of the project. The aim of this exercise was to examine the gelling strength of several binder systems and then to apply these findings to further production trials.

Table 1: Trial of Gel Systems

Trial No.	ME9111	ME2263	Alacen 132	LBG	Firmtex	Egg White Powder	W&W WG2000	W&W PT200
1	2.0 (1%)	-	4.0g (2%)	-	4.0g (2%)	-	-	
2	-	2.0g (1%)	4.0g (2%)	-	4.0g (2%)	-	-	
3	1.0g (0.5%)	1.0g (0.5%)	4.0g (2%)	-	4.0g (2%)	-	-	
4	1.0g (0.5%)		4.0g (2%)	0.6g (0.3%)	4.0g (2%)	-	-	
5	2.0g (1%)	-	-	-	8.0g (4%)	-	-	
6	2.0g (1%)		8.0g (4%)	-	-	-	-	
7	2.0g (1%)	-	-	-	4.0g (2%)	4.0g (2%)	-	
8			4.0g (2%)	-	4.0g (2%)		2.0g (1%)	
9			4.0g (2%)	-	4.0g (2%)			2.0g (1%)+ 0.3g KCL
10			4.0g (2%)	0.6g (0.3%)	4.0g (2%)		2.0g (1%)	
11			4.0g (2%)	0.6g (0.3%)	4.0g (0.3%)			2.0g (1%)

NB: 4g (2%) of salt and 3g (1.5%) of sugar are added to each trial to disperse gums.

Gelcarin ME9111: Kappa Carrageenan;

Firmtex: Modified Maize Starch

Gelcarin ME2263: Iota Carrageenan;

WG2000: Pure kappa carrageenan

Alacen 132: Milk Protein;

PT200: Unrefined kappa carrageenan

LBG: Locust Bean Gum;

Method:

1. Weigh all dry ingredients into a beaker. Mix dry ingredients thoroughly.
2. Add cold water to 200ml mark and stir ingredients off the bottom of the beaker.
3. Make sure there is no gum still on the bottom.
4. Heat to 85°C under constant agitation.
5. Store in chiller overnight.

The results of this trial are outlined below:

Table 2: Comparison of Gel Systems

Trial Number	Texture (mushy/firm/rubbery)	Sliceable (yes/no)	Other comments
1	Firm	Yes	Gel squashes easily under pressure.
2	Mush	No	No real gel formed.
3	Fairly mushy	No	Slight gel.
4	Firm	Yes	As per 1
5	Firm	Yes	As per 1. Opaque.
6	Very Firm	Yes	Very white. Strong gel but brittle and snaps easily.
7	Fairly firm	Yes	Particulate in gel not dissolved.
8	Very firm	Yes	Strong gel.
9	Firm	Yes	Same as 1.
10	Very Firm	Yes	Very strong gel with more flexibility than 8.
11	Firm	Yes	Same as 1.

The conclusions gained from this trial were:

1. Trial number 10 was the best as it produced a strong flexible gel with good sliceability.
2. The addition of Locust bean gum over trial 8 improved the strength and flexibility of the gel system.
3. It was also significant to note the firmness and whiteness of trial number 6 with 4% Alacen 132.

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The results of these preliminary trials gave a good indication to which gelling systems had the potential to create the texture required in the prawn loaf.

To begin to improve the texture of the prawn loaf a series of trials was conducted using a range of fillers and binders. A list of the trials is shown below:

Table 3: Texture Improvement Trials

Ingredient	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7
Prawn	50.0	50.0	50.0	50.0	50.0	50.0	56.6
Fish (Hoki)	0.0	0.0	0.0	20.0	20.0	20.0	22.6
Surimi	20.0	20.0	20.0	0.0	0.0	0.0	0.0
Salt	2.0	2.0	2.0	2.0	2.0	2.0	2.2
STPP	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Sugar	1.5	1.5	1.5	1.5	1.5	1.5	1.7
Sodium erythorbate	.005	.005	.005	.005	0.05	0.05	0.05
MSG	0.3	0.3	0.3	0.3	0.3	0.3	1.1
Canola oil	1.0	1.0	1.0	1.0	1.0	1.0	1.1
Water	18.0	18.0	18.0	18.0	18.0	18.0	11.2
Firmtex	3.0	3.0	3.0	3.0	3.0	6.0	0.0
ME 9111	0.7	0.7	0.7	0.7	0.7	0.7	0.8
Sodium caseinate	3.0						
Soy isolate		3.0					
Surimi plus				3.0			
Alacen 895			3.0				
Protex					3.0		

Firmtex: Modified maize starch
 Gelcarin ME 9111: Carrageenan
 Sodium caseinate: Milk protein
 Soy isolate: Soy bean protein
 Surimi Plus: Milk protein
 Alacen 895: Whey protein concentrate
 Protex: Potato Fibre

The method used for the production of these trials is listed below:

1. Chop half the prawns into 1 cm cubes
2. Dissolve STPP into tap water (5%) when dissolved then add salt and dissolve
3. Emulsify fish and the remainder of the prawns until paste
4. Mix fish, prawns (diced and paste), salt and STPP in Kenwood mixer on minimum setting for 5 minutes using K beater
5. Dissolve sugar and starch into the remaining chilled water (6%)
6. Add to mix
7. Dry blend carrageenan (ME9111), and surimi plus
8. Add slowly to mix and mix for 5 minutes
9. Refrigerate for 30 minutes
10. Fill into 110mm diameter PVC casing using water pressure sausage filler.
11. Sit overnight in fridge.
12. Steam cook for 60 minutes. Probe temperature of product must reach a min. 80°C
13. Place in ice water
14. Refrigerate 48 hours prior to inspection.

The results of these trials are listed below:

Table 4: Texture Comparisons

Sample Number	Evaluation Comments
1	Product too dark due to surimi. Unattractive appearance.
2	Soy isolate gave the loaf a grey appearance.
3	Loaf lighter in colour from Alacen 895, but not bound that well.
4	Good colour and appearance, good sliceability. Well bound.
5	Firm structure, colour too dark due to potato fibre.
6	Loaf quite firm but tacky and moist to touch.
7	Unacceptable appearance. Some pockets of gum within loaf. Texture OK.

A photo of the outcome of these trials is shown in Appendix 3.

Conclusions from these trials showed a combination of kappa carrageenan, Firmtex and surimi plus produced the best textural and appearance characteristics for a prawn loaf. (see Trial 7, Sample 4 in appendix 3)

The significance of carrageenan in the overall textural improvement of the prawn loaf meant a series of trials was conducted to determine the relationship between kappa and iota carrageenan.

Table 5: Carrageenan Comparison trials

Ingredient	Trial A (%)	Trial B (%)	Trial C (%)
Prawn	60.0	60.0	60.0
Fish (Hoki)	14.0	14.0	14.0
Surimi (retail)	1.0	1.0	1.0
Salt	2.0	2.0	2.0
STPP	0.3	0.3	0.3
Sugar	1.5	1.5	1.5
Firmtex	2.0	2.0	2.0
ME 2263 (Iota)	0.0	0.1	0.2
ME 9111 (Kappa)	0.6	0.5	0.4
Water	14.5	14.5	14.5
Surimi plus	2.0	2.0	2.0
Canola oil	2.0	2.0	2.0
Sodium erythorbate	0.05	0.005	0.005
Total	100.0	99.9	99.9

The results of the trials are tabled below:

Table 6: Evaluation of Carrageenan Comparisons

Trial Number	% kappa	% iota	Evaluation Comments
A	100%	0%	Texture quite firm, average sliceability.
B	83%	17%	Texture soft, poor sliceability.
C	67%	33%	Texture soft and mushy, Poor sliceability

The negative impact on the texture of the prawn loaf using iota carrageenan indicated that any further trials would use kappa carrageenan exclusively.

The next series of trials continued to aim to improve the texture and sliceability of the prawn loaf. It was also determined that a more simplified production method should be investigated to allow easier production when full scale up trials are undertaken.

The formulations and method for this trial are shown below:

Table 7: Sliceability Trials

Ingredient	Trial 13A (%)	Trial 13B (%)	Trial 13C (%)
Prawn	60.0	60.0	58.9
Fish (Nile Perch)	14.5	14.5	14.4
Salt	2.0	2.0	2.0
STPP	0.3	0.3	0.3
Sugar	1.5	1.5	1.5
Firmtex	2.0	2.0	2.0
Gelcarin ME9111	0.8	0.8	0.8
Locust Bean Gum	0.3	0.3	0.3
Water	14.3	14.3	14.1
Alacen 132	2.0	2.0	3.9
Canola oil	2.0	2.0	2.0
Sodium erythorbate	0.05	0.05	0.05
Total	100	100	100

1. Dry mix Gelcarin ME9111 and Locust bean gum with salt, sugar, firmtex, alacen 132, erythorbate and STPP.
2. Add water and oil and mix well.

Trial 13A

3. Mince finely 50% of the fish in a small kitchen blender (“oscar”).
4. Dice 100% of the prawns and the remainder of the fish into chunks or pieces using a commercial size dicer (“robot coupe”)
5. Add diced prawns and minced fish to vacuum tumbler.

Note; keep ice water in tumbler prior to mixing product to keep cool.

6. Slowly add gum and water mix. (steps 1 & 2)
7. Mix for 15min at 45kpa
8. Reverse tumbler and mix for a further 15 minutes.
9. Fill into 110mm SC moisture proof casing.
10. Cook to 80°C internal.

Trial 13B & C

1. Mince all the fish (100%) and 360g prawns (20%) in small oscar.
2. Dice remainder of prawns (80%) into chunks or pieces. (robot coupe)
3. Add diced prawns and chopped fish and prawns to vacuum tumbler.
Note; keep ice water in tumbler prior to mixing product to keep cool.
4. Slowly add gum and water mix. (steps 1 & 2)
5. Mix for 15min at 45kpa
6. Reverse tumbler and mix for a further 15 min.
7. Fill into 110mm SC moisture proof casing.
9. Cook to 80°C internal.

The results of this trial are outlined below;

Table 8: Sliceability Comparisons

Trial Number	Texture	Appearance
A	Firm texture, reasonable sliceability, Some breakdown on the edges of the loaf.	Pieces of fish appear greyish in colour. Chunky appearance.
B	Firm texture, good sliceability.	More uniform appearance.
C	Very firm texture, excellent sliceability	More uniform appearance

Photos of the results of this trial are shown in Appendix 4.

Trial production

The manufacturing process was constantly being refined throughout the many formulations trialed. The development of the following process achieved the best results and was successful in producing the most acceptable prawn loaf:

1. Premix the gums, salt, firmtex, alacen 132, STPP, sugar, and erythorbate.
2. Add water and oil to dry blend and mix well.
3. Mince 100% of the fish and 20% of the prawns. (thawed to approx. 0°C.)
4. Dice the remainder of the prawns (80%). (which have been thawed to approx. 0°C)
5. Add all ingredients to the vacuum tumbler and mix for 30min at 45kpa.
6. Fill into a moisture proof casing.
7. Steam cook to a minimum 80°C internal temperature.

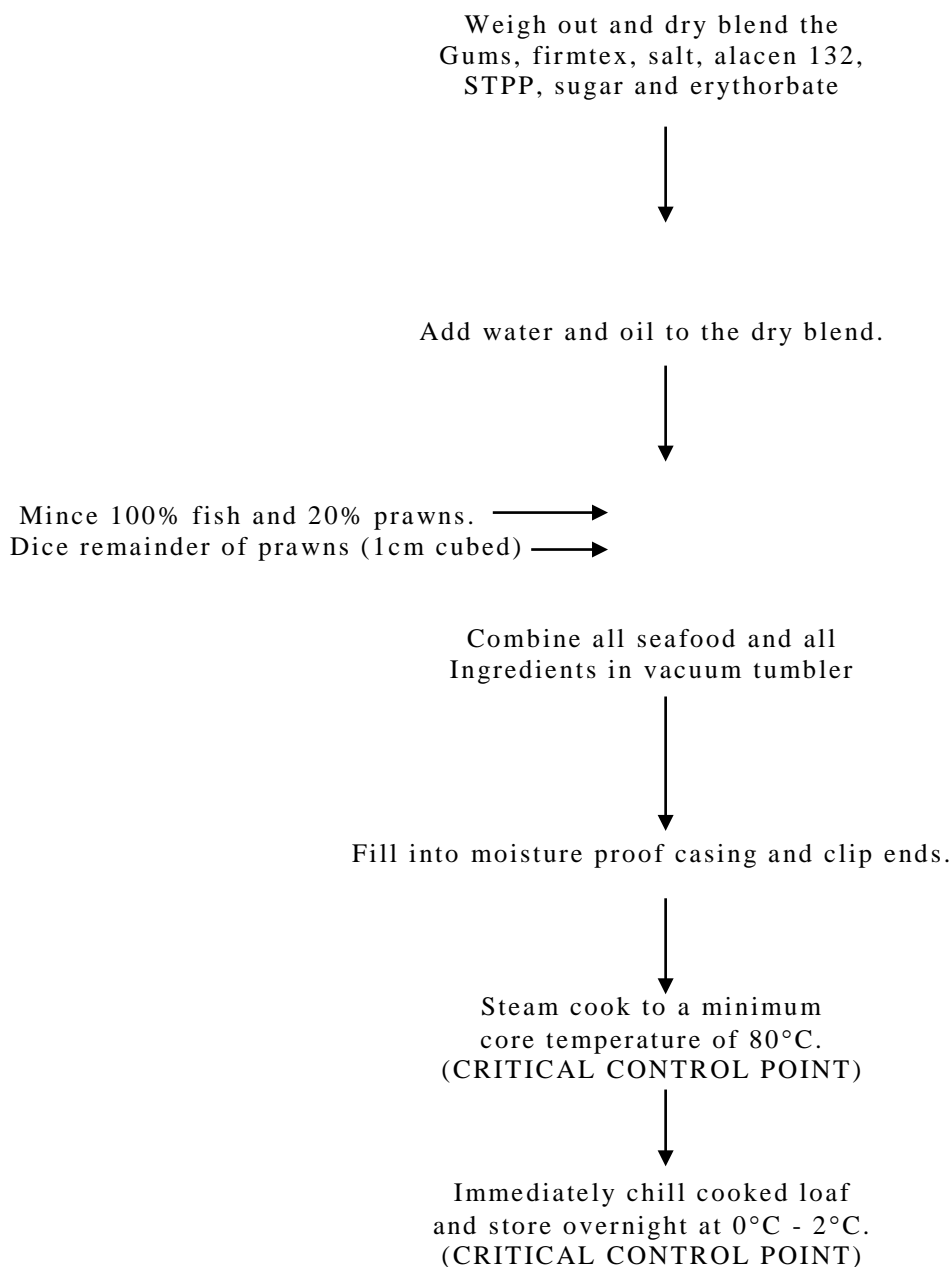
A description of the bench scale equipment used for these trials is as follows

Sunbeam Oscar Blender Model AC-LC
 Robot Coupe Slicer – SA CL.50A 92/05352
 Vacuum Tumbler – Lindgren 20L Vacuum Paddle Blender

A flow diagram of the production process for the prawn log is shown over the page. The major critical control points for the safe manufacture of the prawn loaf are

1. The monitoring of the internal temperature of the loaf during cooking in each batch produced using a temperature probe. Ensuring the loaf has reached a minimum of 80°C core temperature will reduce potential microbiological hazards from occurring and enable a four month shelf life at refrigeration temperatures.
2. The monitoring of the internal temperature after cooking is also critical. Rapid cooling immediately after cooking and chilling overnight at 0°C will ensure the prawn loaf has minimal potential to become microbiologically unsafe.

PROPOSED PROCESS FLOW
BENCH SCALE PRODUCTION OF THE PRAWN LOAF



Packaging Specifications:

The consumer research outlined that initially the prawn loaf should be available in a chub format to be purchased whole or sliced from the supermarket deli. The focus groups also suggested at the future potential of the prawn loaf to be presented as a pre packed sliced product that could be launched at a later date. The trial product was developed in 110mm (lay-flat diameter) stable calibre moisture proof casing from Micris Packaging. (see appendix 7 for the specification of this casing). This packaging method can be simply altered by changing the diameter of the casing to produce different diameters for different meal occasions. (e g; sandwiches or appetisers).

Ingredient List

The ingredient list to be shown on the side of the packaging is as follows:

Prawns, Fish, Whey Protein Concentrate, Canola Oil, Modified Starch (1422),
Salt, Sugar, Vegetable Gums (407, 410), Mineral salt (451),
Antioxidant (316), Water Added.

Raw Material Costs

Appendix 5 outlines the raw material costs and suppliers of the raw materials for the final trial formulation.

Raw Material Specifications

Appendix 7 contains specifications of the critical raw materials used in the formulation.

Finished Product Specifications

Moisture Content	74% - 76%
Salt Content	1.8% - 1.9%
Use by date	120days (4°C or below)
Product Diameter	Approx. 75mm
Colour Characteristics	Whitish, cream colour with pink flecks throughout.
Flavour Characteristics	Clean, natural prawn/seafood flavour.
Texture characteristics	Tender, juicy, not too rubbery to bite. Some larger pieces of prawns visible.
Sliceability	Ability to be sliced thinly. (approx. 2mm)
Marketing Attributes	No artificial colours or flavours.

Preliminary Shelf Life Evaluation

To examine the expected shelf life of the prawn loaf a replica of the most successful previous trial (13C) was manufactured in a 6 kilo batch. The samples produced were stored at 4°C and 10°C for a period of 4 months with microbiological and sensory testing conducted at 1 month intervals. Reference samples were also kept during this period and stored at -18°C. The results of the shelf life trials are shown below:

As shown from the results of the shelf life trials the prawn loaf could safely be stored for a period of 4 months or 120 days at or below 4°C. Some degradation of the prawn flavour and texture occurred at the 4 month period particularly at the abuse temperature of 10°C. At no stage during the 4 month trial was the prawn loaf found to be microbiologically unsafe.

Table 9 Chemical and Microbiological results

Sample point	Storage Temperature	Salt per 100gram	Moisture per 100gram	Standard Plate Count per gram	Lactic Acid Bacteria per gram	Psychrotrophic Bacteria per gram	Anaerobic bacteria per gram
Initial	Fresh	1.85%	75.2%	<100	<100	<100	<100
1 month	4°C	Not tested	Not tested	<100	<100	<100	<100
	10°C	Not tested	Not tested	<100	<100	<100	<100
2 months	4°C	Not tested	75.6%	<100	<100	Not tested	Not tested
	10°C	Not tested	75.7%	200	<100	Not tested	Not tested
3 months	4°C	Not tested	Not tested	<100	<100	<100	<100
	10°C	Not tested	Not tested	<100	<100	<100	<100
4 months	4°C	Not tested	Not tested	<100	<100	<100	<100
	10°C	Not tested	Not tested	<100	<100	<100	<100

Development of a chilled pasteurised prawn loaf range in retail packs

Table 10: Results of Sensory Assessment of Prawn Log

Sample Point	Storage temperature	Visible Mould/ Colour changes	Aroma	Texture	Flavour
Initial	Fresh	No mould; good whitish colour with slight specks of pink and some evidence of prawn/fish pieces	Strong seafood aroma; very pleasant	Good; firm; moist; slices easily	Good prawn flavour; quite strong and pleasant
1 month	4°C	No mould; colour good; unchanged from control	Mild seafood aroma	Firm, sliceable; good	Delicate prawn/ fish flavour
	10°C	No mould; colour good; unchanged from control	Mild seafood aroma	As above	Stronger fish flavour
2 months	4°C	No mould; colour unchanged; good	Good; medium prawn aroma	Good; moist and soft	Good prawn flavour; quite strong
	10°C	No mould; colour unchanged; good	Good; slightly less prawn aroma than 4°C	Drier; firmer than 4°C Slices thinner	OK, but not as fresh prawn flavour; STILL ACCEPTABLE
3 months	4°C	No mould; colour unchanged; good	Mild prawn aroma	Good, firm, easy slicing	Good flavour; not as strong
	10°C	No mould, unchanged colour	Stronger seafood aroma; fishy	Still firm but not as firm as 4°C STILL ACCEPTABLE	Not as pleasant as 4°C but JUST ACCEPTABLE
4 months	4°C	No mould; no changes apparent	Very faint prawn odour	Good; easy slicing; firm but slightly dry	Odd tasteless type flavour, not at all prawn like- JUST ACCEPTABLE
	10°C	No mould,; no changes apparent	Slightly stronger odour but not as strong as original	Good; easy slicing; firm	Very bland; undesirable odd aftertaste; NOT ACCEPTABLE

BENEFITS

The advantages of this work are that

1. a currently under utilised resource is turned into a value added product with wide market acceptance and,
2. a new product concept is introduced into the market that satisfies the market for convenience, flavour, value and nutritional benefits.

FURTHER DEVELOPMENT

To fully implement a chilled pasteurised prawn loaf into the retail market further work is required in conjunction with the industry partner. The steps remaining to achieve successful implementation include:

1. Scale up to full size production batches utilising equipment and facilities supplied by Aquatic Food Marketing. This would be required to optimise both the formulation and manufacturing processes.
2. Final shelf life evaluation.
3. Test Marketing (see appendix 6 for the **Proposal for consumer acceptance evaluation of a prawn loaf**)
4. Final planning of production and marketing
5. Final economic evaluation
6. Organisation of final launch
7. Launching of the product on the market.

As outlined earlier in this report the lack of production facilities has impeded the progression of these final steps and consequently prevented the final implementation of the prawn loaf to the retail market.

The project has completed three of the five objectives and has successfully produced a trial formulation and production methodology for a prawn loaf. The further dissemination of this work now lies in the hands of the industry partner who holds a 12 month sunset clause at the release of this report. This allows the exploitation of the data contained in this report for commercial purposes.

It has also been recommended that contract manufacture of the product by an established smallgoods producer be considered rather than initial investment in new plant and equipment.

If at the end of this 12 month period no activities toward commercialisation have been made by the industry partner, the releasing of this information to other processors or manufacturers is recommended.

CONCLUSION

The product development of a chilled pasteurised prawn loaf consisted of up to 9 stages from idea generation to test marketing and production trials. Despite the willingness of the Centre for Food Technology to see all stages through to completion, further work was impeded due to reasons that have been detailed previously. The stages of the project successfully completed include:

1. Idea generation and screening
2. Product concept testing
3. Development of the product brief
4. Development of prototype

The ultimate outcome of this project is the successful development of a prawn loaf prototype utilising the soft and broken green prawns from Aquatic Food Marketing. The value adding of an under utilised resource to produce a high quality, innovative seafood product has been successfully achieved.

The final trial formulation of the prototype prawn loaf as shown below was achieved through significant development work investigating up to 20 different binders to product the optimum texture and bite in the final product. This extensive trial work produced a product with a distinctive prawn flavour and aroma, and excellent sliceability. The benefits integrated into the product include taste, convenience, no artificial colours or flavours, and ease of slicing. The preliminary shelf life trials also proved a more than acceptable shelf life of 4 months at 4 °c or below was attainable without compromise to texture and flavour.

The project to this point has succeeded to value add to an under utilised resource and produce a product with a high degree of potential for success in the retail market.

Trial formulation of the prototype Prawn Loaf

Ingredient	(%)
Prawns	55.00
Fish (Nile Perch)	16.00
Salt	1.80
Sodium tripolyphosphate	0.30
Sugar	1.50
Firmtex	2.00
Gelcarin ME9111	0.80
Locust Bean Gum	0.30
Water	16.20
Alacen 132	4.00
Canola oil	2.00
Sodium erythorbate	0.100
Total	100%

APPENDIX 1

The FRDC's proportion of ownership of the project intellectual property, based on this application or unless otherwise justified, will be 55.2%.

Aquatic Food Marketing have an assured 12 months at the release of this report to commercialise the findings of this research.

APPENDIX 2

The principal investigator of this report would like to thank the following people for their help in completing this project.

Marshal Betzel

Managing Director
Aquatic Food Marketing

Jason Hancock

Senior Food Technologist
Centre for Food Technology

Chris Gore

Assistant Senior Laboratory Technician
Centre for Food Technology

APPENDIX 3

Trial 7: Comparison of fillers



Trial 7 Sample 4
Surimi Plus/Firmtex/ Kappa carageenan



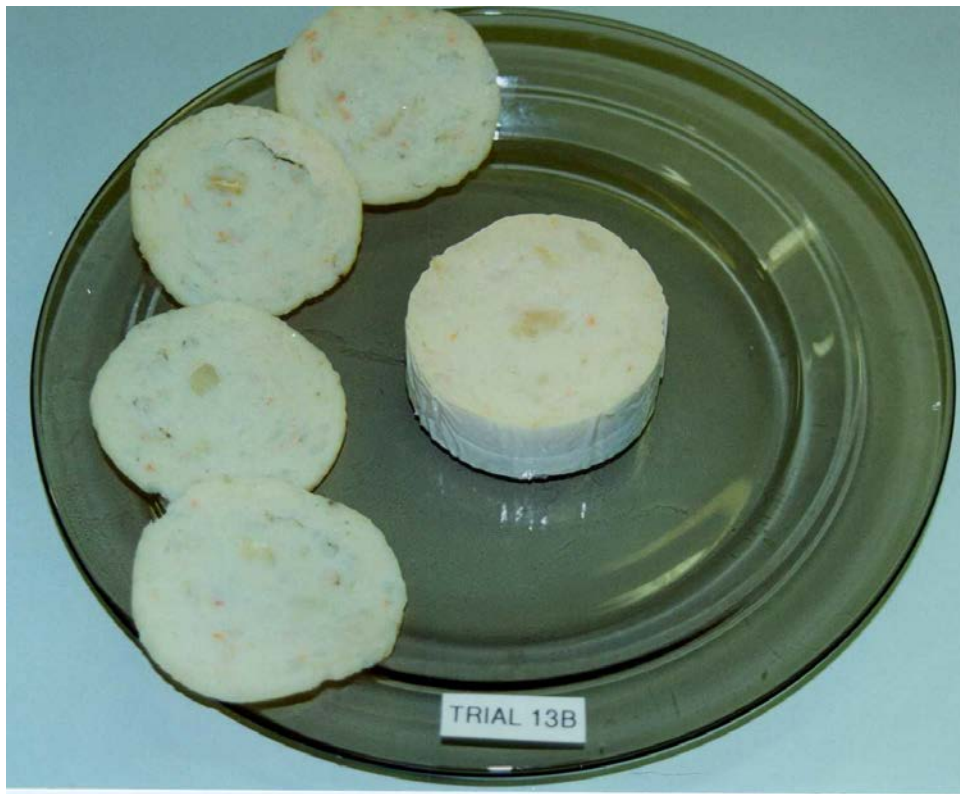
**Trial 7
Sample 4
Surimi Plus/ Firmtex / Cappa carrageenan**

APPENDIX 4

Trial 13 A



Trial 13 B



APPENDIX 4 (CONTINUED)

Trial 13 C



APPENDIX 5**Raw Material Costing as at October 1999.**

Ingredient	Raw material cost per kg (\$)	%	Cost per Kg of finished product (\$)
Prawns	13.80	55.0	7.59
Fish (Nile Perch)	6.20	16.0	0.99
Salt (fine)	0.36	1.8	0.006
STPP	1.92	0.3	0.006
Sugar	1.17	1.5	0.018
Firmtex	2.40	2.0	0.048
Gelcarin ME 9111	23.50	0.8	0.188
Locust Bean Gum	15.00	0.3	0.045
Water	-	16.2	-
Alacen 132	6.92	4.0	0.277
Canola oil	3.14	2.0	0.063
Sodium erythorbate	9.75	0.10	0.010
TOTAL		100	\$9.24/Kg

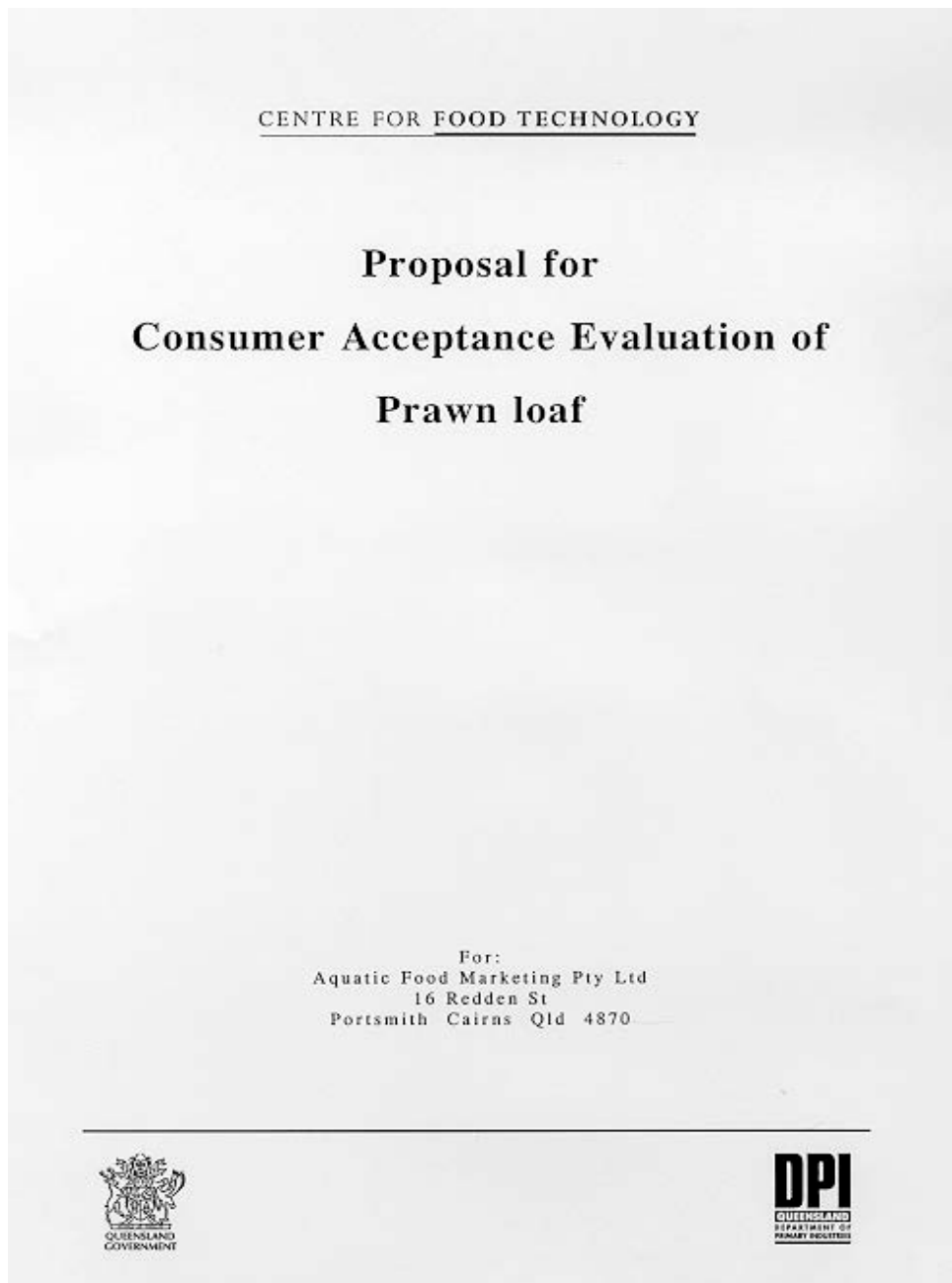
Raw Material Suppliers

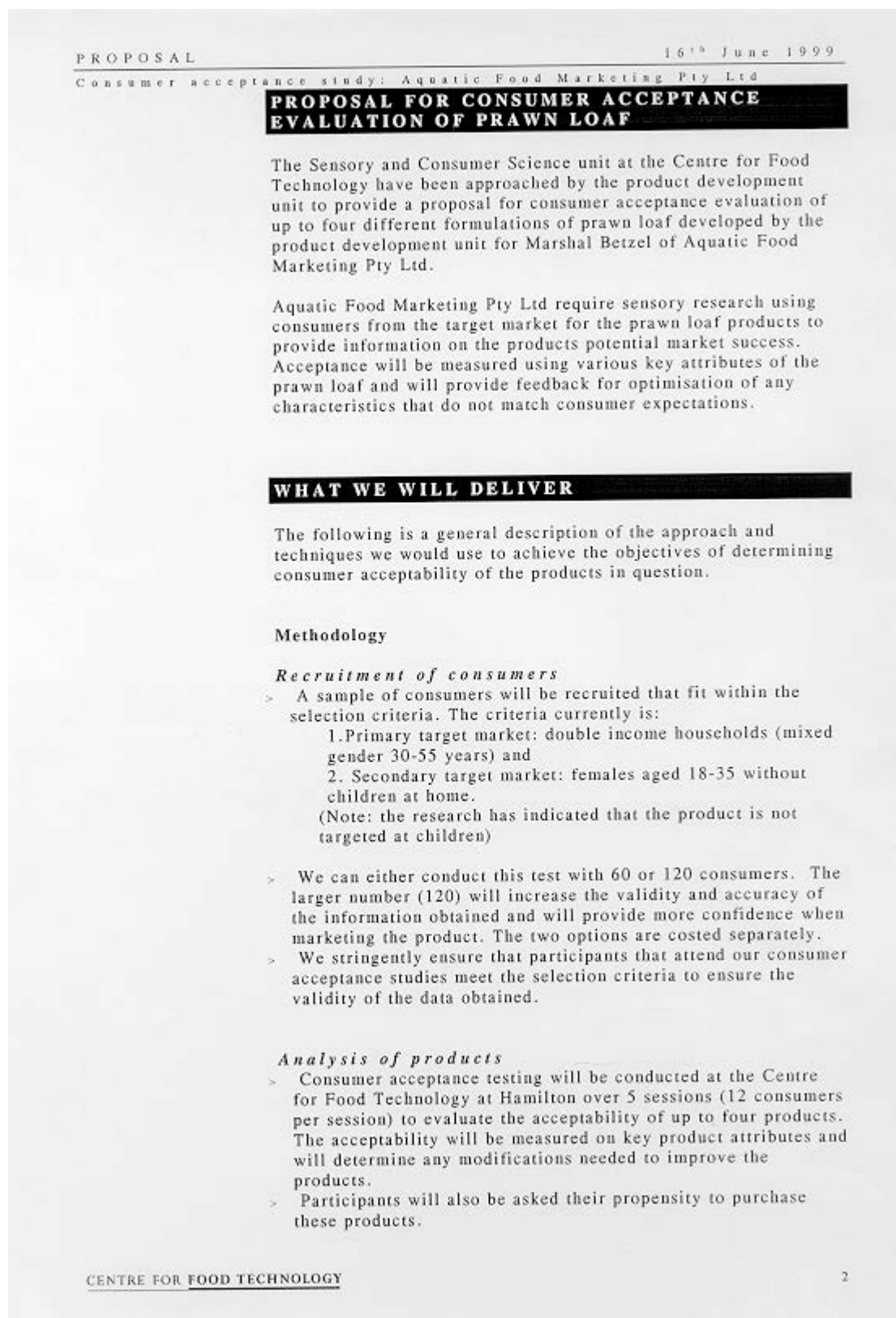
Raw Material	Company	Contact
Firmtex	National Starch & Chemical	Melanie Spaggiari Ph: 02-9838 6026
Alacen 132	New Zealand Milk Products	Tony Kirby-Lewis Ph: 03-9755 5033
Locust Bean Gum	Woods and Woods	Richard Moore Ph: 07-5547 5233
Gelcarin ME 9111	Swift & Co	Jacqui Helkin Ph: 07-3267 6700

NB: The specifications for these raw materials are shown in Appendix 7.

APPENDIX 6

Proposal for consumer acceptance evaluation of a prawn loaf.





PROPOSAL16th June 1999

Consumer acceptance study: Aquatic Food Marketing Pty Ltd

- > Participants can be asked any demographic information deemed relevant by the previous market research, the product development unit and the experienced Sensory and Consumer Science professionals at the Centre for Food Technology. Examples of useful demographic information may include where they shop, frequency of purchase of deli products from the supermarket etc.
- > Tasters will be seated in individual booths illuminated with white light (daylight equivalent). Data will be collected directly into computers using an integrated software package, Compusense Five version 3.1 (Compusense Inc, Canada). Tasters register their opinion of the products using a mouse or light pen to mark horizontal line scales on the computer screen.

Product presentation

Information obtained from the focus groups and discussion with the interested parties will determine the presentation methods for this consumer acceptance study.

Some preliminary concepts include:

- > Feedback on product presentation and packaging and
- > Presentation of product to consumers :
 - > in a salad
 - > on biscuits or
 - > with pasta.

Reporting

- > Within 48 hours of the final test, summaries of the data obtained with statistical differences noted will be faxed to the client.
- > A full report with discussion and recommendations will be sent within three weeks of the final testing day.
- > The results will be presented on request at Hamilton to Marshal Betzel Aquatic Food Marketing Pty Ltd.

PROPOSAL	16 th June 1999
Consumer acceptance study: Aquatic Food Marketing Pty Ltd	
COST	
A preliminary estimate of costs follows.	
<u>Option one: Consumer acceptance study of up to four products for 60 consumers</u>	
> Consumer acceptance studies including recruiting costs, analysis and reporting	\$7150
Payments to 60 consumers (\$30 per person) (for approximately 1 ½ hours attendance)	\$1800
Total	\$8950
Increasing the number of consumers tested from 60 to 120 will increase the validity and accuracy of the information obtained and will provide more confidence when marketing the product. Costs for this are detailed below.	
<u>Option 2: Consumer acceptance study of up to four products for 120 consumers</u>	
> Consumer acceptance studies including recruiting costs, analysis and reporting	\$10150
Payments to 120 consumers (\$30 per person) (for approximately 1 ½ hours attendance)	\$3600
Total	\$13750
Costs above include:	> All design work, execution and reporting of all projects.
Costs currently do <u>not</u> include:	
> Any products purchased for the acceptance studies.	
> Any microbiological testing conducted at Centre for Food Technology.	
Tasting will be undertaken on the understanding that all products supplied for tasting meet all requirements of relevant health acts and regulations for the purposes of human consumption.	
CENTRE FOR FOOD TECHNOLOGY	4

PROPOSAL

16th June 1999

Consumer acceptance study: Aquatic Food Marketing Pty Ltd

EXPERIENCE & EXPERTISE

The Centre's purpose-built Sensory and Consumer Science Unit is one of Australia's most advanced food testing facilities, designed to International Standard ISO 8589-1988.

The sensory evaluation team of professionals specialise in:

- > consumer acceptance testing
- > product profiling
- > quality monitoring
- > assessing ingredient consistency and
- > assessing the shelf-life of food products.

The Sensory and Consumer Science Unit houses custom-made isolation tasting booths allowing complete taster confidentiality and a market research facility for small group discussions with a client viewing facility.

The Centre for Food Technology is one of Australia's leading food research and technology organisations.

In addition to the Centre's strong capability in sensory evaluation and consumer acceptance testing, other services include:

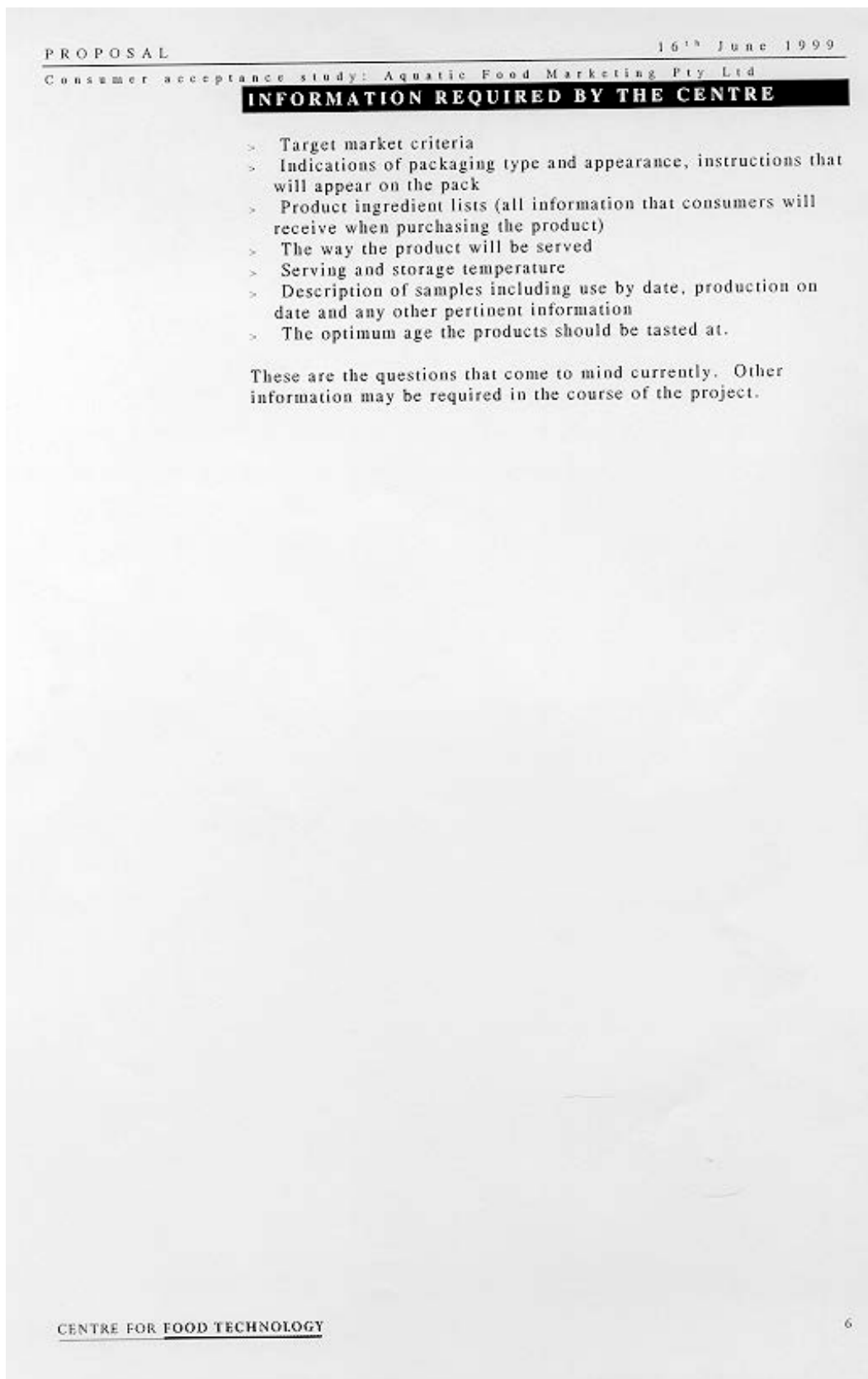
- > chemical and microbiological analysis of food products
- > training, implementation and auditing of quality assurance systems and HACCP-based food safety plans
- > export certification of food products
- > confidential product development
- > pilot plant investigations and process development
- > strategic applied research and development in post-harvest seafood technology, food quality and functional ingredients
- > development of waste minimisation and utilisation strategies and development and auditing of environmental management plans and systems
- > marketing planning and market research and
- > technical, research and marketing information for business development.

Located at Hamilton in Brisbane, the Centre has a staff of 95 skilled food technologists, scientists, engineers, technicians and support staff with modern laboratory facilities and a 220 square metre pilot plant.

The Centre for Food Technology is a commercial unit of the Queensland Department of Primary Industries.

CENTRE FOR FOOD TECHNOLOGY

5



PROPOSAL

PROJECT TEAM

- > Project Leader: Ellen Buckle
Food Technologist
Sensory Specialist
Centre for Food Technology

Ellen is a key member of the Centre's Sensory and Consumer Science Unit in Brisbane. She is very experienced in providing consulting services in consumer preference studies, sensory profiling and training to the food industry in Australia and the Middle East.

Ellen holds a Bachelor of Science (food technology - honours), from University of Queensland, Gatton College. She also is currently studying a MBA (marketing) at the Queensland University of Technology, Brisbane. She has worked as an associate lecturer at the University of Queensland, Gatton College.

- > Team Member: Rob Roberts
Senior Technical Officer,
Centre for Food Technology

Rob is the unit's most senior technical officer and has a long history of experience in recruiting for and running consumer acceptance studies. He is an integral part of all projects conducted by the Sensory and Consumer Science Unit.




- > For further information please contact:
Ellen Buckle
Centre for Food Technology
19 Hercules Street
HAMILTON QLD 4007



Telephone (07) 3406 8616
Fax (07) 3406 8665

APPENDIX 7

Following are the company specifications of the raw materials used in the final formulation of the prawn loaf:

1. National Starch - Firm-tex,
2. New Zealand Milk Products - Alacen 132,
3. Swift & Company Ltd - Gelcarin ME9111
4. Woods and Woods - Food Grade Locust Bean Gum
5. Micris Packaging – SC Moisture Proof Casing

FIRM-TEX[®]		 National Starch & Chemical Pty Ltd A.C.N. 000 351 806 7 Stanton Road Seven Hills 2147 Private Bag 18, Seven Hills 1730 Phone 02-9624-6022 Fax 02-9624-8498	
Label Designation		Food Starch-Modified	
Source		Waxy Maize	
Physical and Chemical Characteristics:			
Color		White to Off-white	
Form		Fine Powder	
Taste		Bland	
Viscosity (CML-Brabender-151)			
Peak		1150 - 1700 BU	
Viscosity Drop		250 - 550 BU	
Moisture		13% maximum	
pH (20% Slurry)		4.5 - 7.0	
Granulation			
Thru USSS #100		>95%	
Thru USSS #200		>85%	
Microbiological Specifications:			
Total Plate Count		10,000/g maximum	
Yeast		200/g maximum	
Mold		200/g maximum	
E. Coli		negative	
Salmonella		negative	
Meets NFPA specifications for thermophilic bacteria.			
Packaging and Storage:			
<p>FIRM-TEX is packaged in four-ply, Kraft paper bags with a net weight of 100 lbs. We recommend that FIRM-TEX be stored in a clean, dry, area at ambient temperature and away from heavily aromatic material. The shelf life for FIRM-TEX is 12 months from the date of receipt.</p>			
<small>Data may become outdated, update yearly.</small>		083193	
			

National Starch & Chemical Pty Ltd
A.C.N. 000 351 806
7 Stanton Road Seven Hills 2147
Private Bag 18, Seven Hills 1730
Phone 02-9624-8498
Fax 02-9624-8498


DATA

FIRM-TEX®


Calories	4 KCal./gram
Calories from Fat	0.01 KCal./gram
Total Fat	<0.15%
Saturated Fat	<0.08%
Cholesterol	None Detected
Sodium	≤200 mg/100g
Total Carbohydrates	87 %
Dietary Fiber	<0.4%
Sugars	None Detected
Protein	<0.5%
Vitamin A	None Detected
Vitamin C	None Detected
Calcium	5 mg/100 g
Iron	0.2 mg/100 g
Moisture*	approximately 12 %
Ash	<0.5%


Note: Please note that while the above information is typical of FIRM-TEX, it should not be considered a specification, since the values may vary slightly between samples.

***Moisture:** The moisture content of all starches will vary, depending on environmental conditions during storage and manufacture. However, FIRM-TEX will generally have a moisture content of around 12%.



New Zealand Milk Products – Alacen 132 Page 1





ALACEN™ 132

WHEY PROTEIN CONCENTRATE - GELLING

ALACEN 132 is a soluble, 80% milk protein which forms a firm, elastic gel when heated.

Product Characteristics

- Firm heat-set gelling
- Yield and texture improver
- Soluble over a wide pH range
- Low viscosity before heating
- Viscosity control
- Excellent nutritional qualities (PER = 3.0)

Suggested Uses

ALACEN 132 is particularly useful for yield extension and texture modification in:

- Reformed meat/poultry/fish
- Ham
- Pasta
- Cultured foods
- Custards

Typical Composition

Energy	1650 kJ/100g	
Protein (N x 6.38)	as is	79.4%
	dry basis	82.9%
Fat	5.9%	
Moisture	4.3%	
Ash	4.4%	

Lactose (by difference) 6.0%

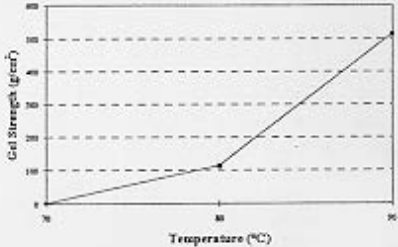
pH (5% at 20°) 7.1

Typical Chemical Analyses

Typical Physical Properties

Colour	Cream
Flavour	Clean
Sediment	Disc A

Gel Strength Profile (10% total solids)



The gel strength may be adjusted by varying the amount of ALACEN 132 used, the time/temperature / pH conditions of processing and the other ingredients used in the food process.


Typical Microbiological Estimates

Aerobic Plate Count (1g)	< 30,000
Coliforms (1g)	Negative
Yeasts and moulds (1g)	< 10
Coagulase Positive Staphylococci (1g)	Negative
Salmonella (750g)	Negative

PG00.05.0599

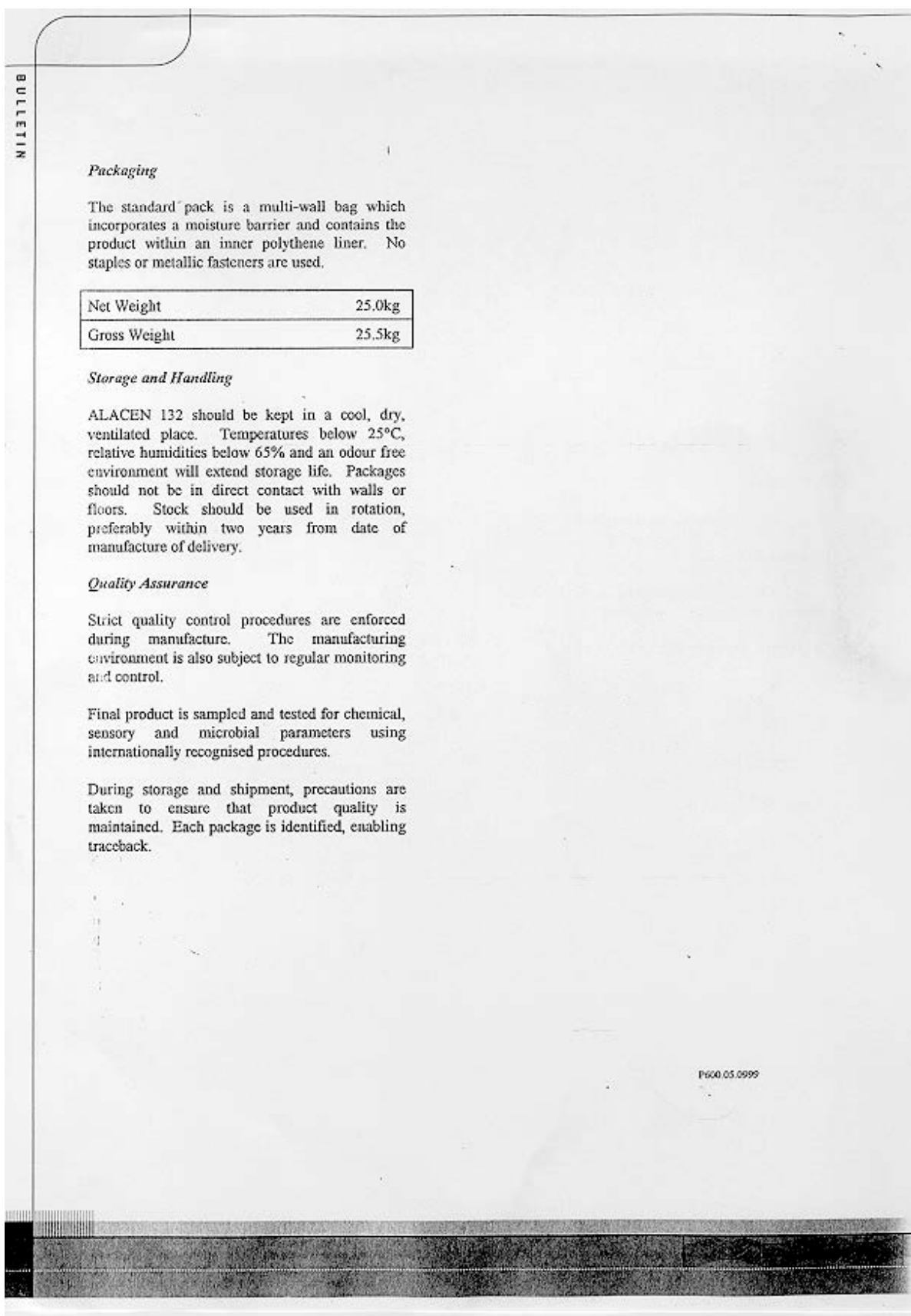
FOR FURTHER INFORMATION PLEASE CONTACT:

NZM-IP(A) Pty Ltd
 830 Wellington Road, Rowville, 3178, Victoria, Australia
 Phone: (03) 9755 5033 Fax: (03) 9764 3954
 Web Site: www.nzmp.com.au



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Swift & Co Gelcarin ME 9111



Swift and Company Limited
 ACN 000865 578
 64 Trenerry Crescent, Abbotsford, Victoria, 3067
 P O Box 700, Abbotsford, Victoria, 3067

Mar-99

Product No: 4900704
 Supplier No: 0008654 (Oct 97)

SPECIFICATION SHEET

GELCARIN ME9111

1. Description and Applications:

Gelcarin ME9111 is light tan to tan in appearance. It has high gel potential carrageenan, retains good gel strength even at high salt levels. It is highly synergistic with locust bean gum and has excellent clarity of water gels.

Gelcarin ME9111 is typically used in meat systems. Suggested use level: 0.20% to 2.00% based on weight of final product.

2. Chemical and physical characteristics:

Tentative Specification	Values	Test method
Water Gel	600 to 900 grams Breakforce	QCP 20001
Brine Test	Passes	QCP 46501
Particle Size	More than 95.0% through a U.S. Standard Sieve, 63µm (Series #230)	QCP 10207
Moisture	Less than 12.0%	QCP 10001
pH, 1.5%	7.5 to 10.5	QCP 10102
Bacteriological		
Aerobic Plate Count	Not More Than 2500/gram	QCP 40001
Mould And Yeast	Not More Than 100/gram	QCP 40203
Salmonella	Not Detected by Test	QCP 40101
E. Coli	Not Detected By Test	QCP 40302
Staphylococci	Not Detected By Test	QCP 40401
Coliform	Not Detected by Test	QCP 40301
Listeria Monocytogenes	Not Detected by Test	QCP 41001
Nitrate Nitrogen	Not More Than 40 ppm	QCP 51602
Nitrite Nitrogen	Not More Than 4 ppm	QCP 51601

3. Storage Recommendations:

Refer MSDS for further details.

Disclaimer

Information in this specification is accurate and reliable to the best of our knowledge and belief, but it is the user's responsibility to determine for themselves in their own applications conditions, the suitability of any material for a specific purpose and to adopt any precautions as may be necessary.

Woods & Woods Locust Bean Gum

WOODS		<i>Established 1933</i> WOODS
SPECIFICATION		
FOOD GRADE LOCUST BEAN GUM HIGH VISCOSITY 3000FM		
Woods & Woods Pty Ltd ANZ001092066 Sydney Office 129-131 Carrington Street PO Box 380 Auburn NSW 2144 Australia Telephone 0219758 2836 Facsimile 0219648 3861 Telex 25182 Woods Melbourne Office 228 Clarendon Street PO Box 2811 East Melbourne Victoria 3002 Australia Telephone 0319116 1311 Facsimile 0319117 1790 Telex 36776 Felusa Brisbane Office PO Box 570 Runaway Bay Qld 4216 Australia Mobile 018 721 020 Facsimile 071 5537 4736		
Chemical & Physical Data		
Gum content		Min 80%
Moisture		Max 12%
Ash		Max 1.0%
Fat		Max 1.5%
Protein (Nx6.25)		Max 6.5%
Colour	White to off-white	
pH in solution		5.0 - 7.0
Mesh (ASTM)		
Through 100 mesh		Min 98%
Through 200 mesh		Min 30%
Viscosity		
1% Solution at 25°C		2800-3100 cps
Microbiological Data		
Total plate count		Max 5000 / gram
Yeast and mould		Max 300 / gram
Coliforms		Negative in 0.1 g
Salmonella		Negative in 25 g
E. Coli		Negative
Arsenic		Max 3 ppm
Heavy metals		Max 20 ppm
Packaging		
Multi wall paper bag with polythene liner	Net weight 25 kgs	

Micris Packaging



SPECIFICATION SHEET

Prepared for:
Date: 4 June, 1998



SPECIFICATION SHEET		INFORMATION	
PRODUCT NAME	HIPAK SC SHRINK CASING		
THICKNESS	45µ (Avg)		
LAYFLAT	110mm (+/- 2.5mm)		
COMPOSITION	SHRINK NYLON // POLYETHYLENE		
SHRINKAGE;	MD	TD	
	@ 90°C	12%	18%
	@ 95°C	13%	21%
TENSILE STRENGTH	MD	TD	
		1000kg/cm ²	1000kg/cm ²
OXYGEN TRANSMISSION AT 23°C-65%RH	55 cc/m ² /24hr/atm		
MOISTURE VAPOR TRANSMISSION AT 40°C-90%RH	13 g/m ² /24hr		

Above values are typical measurements. The data and information contained in this sheet is correct to the best of our knowledge at the time of preparation, but is subject to change at any time without notice. No warranties or guarantees are expressed or implied, and you should test all products according to your own needs and conditions before use.