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FINAL REPORT

NEW PRODUCT DEVELOPMENT FROM LOW VALUE SPECIES

F R D C PROJECT 95/142

MARCH 1996

FISHERIES RESEARCH & DEVELOPMENT CORPORATION

"Representing the WA Commercial Fishing Industry"
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EXECUTIVE SUMMARY

1. Three fish species were chosen for trials: Australian Salmon, Australian Herring and Australian Sardine.

2. New products were developed from salmon and herring.

3. Sardine shelf life trials were successfully conducted.

4. Two smoked products from salmon were trialed at the Fremantle Sardine Festival, with outstanding success.

5. Results from the trials have been extended to the industry via:

   a) Direct contact
   b) Articles in Prowest
   c) Presentations at industry meetings in Albany, Esperance and Bremer Bay

6. Changes to post harvest handling for sardines have been instituted.

7. One company has increased it's output of smoked salmon and herring.

8. Two overseas companies have expressed interest in buying salmon and herring roe.

9. Further work will be conducted to:

   a) Determine the shelf like, packaging and branding and marketing strategy for smoked salmon and herring.
   b) Determine the market and optimum handling procedures for salmon and herring roe
   c) Incorporate salmon by-product into a dry rock lobster bait.
   d) Extend the concept of "iki-jimi" technique (spike and ice-slurry) to salmon and herring fishermen, and
   e) Extend the concept of icing sardines at sea to those fishermen that have not yet converted to the idea.

10. An analysis of the oil content of herring will be carried out when herring supplies become available, and will be submitted as an appendix to this report.

11. Results of the test-marketing of salmon and herring roe will be submitted as an appendix to this report.

INCREASING THE VALUE OF THE WESTERN AUSTRALIAN SALMON AND HERRING INDUSTRY

– A SCOPING STUDY –

- A Market Research Report on Opportunities for Developing Value Added Salmon and Herring Products -

Prepared for

THE WESTERN AUSTRALIAN FISHING INDUSTRY COUNCIL

By

MARKET EQUITY

November 1995

Winners of the Australian Marketing Institute Awards for Excellence in:

- *Market Research*
- *Small Business Marketing*

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EXECUTIVE SUMMARY

The Western Australian salmon and herring industries are undervalued. Salmon is used for canning (human consumption) and lobster bait and herring almost exclusively for lobster bait. That proportion of salmon used for human consumption commands only a low price and is marketed at a significant discount to other imported brands of salmon. As a result of this situation, the value of these industries is presently very low. In an effort to increase the value of both industries, the Western Australian Fishing Industry Council (WAFIC) commissioned this project to identify markets for value-added salmon and herring products. The objective of this project was not to provide definitive outcomes in terms of how to market the products, but rather to identify those that appear to have the most potential.

The project identified that smoked products and roe represent the greatest potential. The product concepts examined included:

- Rollmops.
- Smoked salmon and herring products.
- Salmon and herring roe.
- Herring fillets.
- Canned salmon.
- Semi-prepared/convenience meals.
- Fish meal.

SMOKED PRODUCTS

From Australian Bureau of Statistics information for the imports of smoked fish and through discussions with industry participants, it was found that the value of the Western Australian market for smoked fish products is about $1 - $1.3 million. While this is relatively small and is therefore unlikely to increase the value of the industry dramatically, if smoked salmon and herring products can compete effectively then the development of a *'boutique'* market may be possible. This may increase the value of the industry, perhaps in the prices fishermen receive for their catch, but more likely in the form of boutique smoked fish businesses being developed by fishermen to supplement their incomes.

Focus groups, including taste trials, were conducted with prospective purchasers of various salmon and herring value-added products. It was found that consumers of fish have several negative associations with salmon and herring, including:

- Strong odour.
- Strong taste.
- Grey colour.
- Poor quality connotations.

However, when these products were smoked, these negatives were disguised. Furthermore, it was found that on the basis of taste alone, there were no connotations of poor quality evidenced. In fact, these products were viewed as elegant, sophisticated and ideal for entertaining. Respondents anticipated that these products would be vacuum sealed, reinforcing the impression of high quality.

Over and above these positive impressions, as most smoked fish products are highly priced, there may be real potential for the introduction of a product at a mid-price point. For example, smoked Atlantic salmon retails for around $40-45 per kilo. If a smoked Australian salmon product could be introduced at a significantly lower price, perhaps half this level or lower, then this may result in significant demand from consumers who could not otherwise afford smoked products and others who only purchase smoked salmon for special occasions. This could result in not only a significant market being developed for Australian salmon, but also growth in the overall smoked fish category as well an improvement in the perception of the fish's overall eating quality.

Recommendations

1) Market research found that smoked salmon and herring products have a very high level of consumer appeal and may represent an opportunity to increase the value of the industry. However, the research only provided an indication of market acceptance. It is recommended that the commercialisation of these product concepts be taken to pilot stage. This would involve conducting a large scale consumer survey to further examine the potential of these products. The Fremantle Sardine Festival would provide a good opportunity to conduct further taste trials and to quantify the products potential.

2) If, after conducting this survey, it is evident that the products do have significant potential, then it is recommended that a marketing plan be developed to achieve their successful commercialisation. The marketing plan would address issues such as:

   - Target market selection.
   - Production (ie., catching, handling, processing).
   - Branding.
   - Packaging.
   - Distribution.
   - Promotions.

SALMON AND HERRING ROE

The research found that there may be significant potential for salmon and herring roe in the Japanese market. This conclusion is supported by the following findings:

- The Japanese roe market is extremely large (approximately 69,500 tonnes in 1992).
- The prices received for some types and forms of roe are relatively high.
- Anecdotal evidence suggests that some fisherman and European immigrants do occasionally eat the roe from these fish and it is, reportedly, quite attractive.
- Some industry participants, who have knowledge of the Japanese market, believe that demand is likely to exist.

Given the actual size of the roe, the size of the resource and the ease of processing, the greatest potential is likely to be with salmon roe.

Early in the project Austrade were contacted to gain information on the Japanese roe market and to identify prospective distributors to work with. It was planned that working with a prospective distributor would provide the basis for how roe would be marketed. While a written brief was provided to Austrade, at the time of writing this report their reply had not been received. A relationship was developed with Canfisco, a large Canadian fishing processing company, who expressed an interest in helping to evaluate the suitability of the roe and in perhaps ultimately marketing the product. They are waiting until the next spawning season when product will be available, at which time a technician will either visit Western Australia or product samples be sent to Canada.

The information gathered on the Japanese roe market suggests that there may be significant potential for salmon and herring roe, particularly salmon roe. However, there are still many uncertainties that need to be addressed to evaluate if the product does have potential and if so, what is necessary for it to be marketed effectively. These issues range from the size of the resource and how the fish is presently 'handled', through to how the final roe product should be packaged and distributed. This is likely to involve working with a prospective distributor.

Recommendations

1) It is recommended that a further study be conducted to focus solely on roe. The objectives of this study should be to conduct more detailed market research into the Japanese roe market and if the product does have potential, to produce a marketing plan identifying how a significant and sustainable market can be developed. It is recommended that this project be completed by forming a project team involving stakeholders such as WAFIC, the Department of Commerce and Trade, fishermen, prospective distributors for the Japanese market and marketing consultants.

THE 'HANDLIING' OF SALMON

The research found that one of the major barriers inhibiting the success of any salmon product is the way the fish is presently caught, processed, handled and distributed. The early stages of this process include beach seining and then transporting the fish on the back of open trucks often over long distances (ie., up to 3-4 hours) to the processing plant. This method, along with other aspects of how the fish is handled, significantly diminishes its quality - particularly for any form of human consumption, but also for bait. This has the effect of limiting the potential uses of the product and therefore the prices fishermen receive. There appears to be a *'catch 22'* situation at play where, until they receive more, or believe it possible to receive more, fishermen are unlikely to change their current practices.

Recommendations

1) It is recommended that a study be conducted into the ways in which the present 'handling' process impacts upon quality, and consequently market potential, and to make recommendations as to how this might most effectively be addressed. This would include the development of strategies for how the product should be handled to meet the quality requirements of its markets.

BACKGROUND AND BRIEF

In Western Australia about 2,000 metric tonnes of salmon and 1,000 metric tonnes of herring are caught annually. Salmon is used for canning (human consumption) and lobster bait and herring almost exclusively for lobster bait. That proportion of the salmon catch used for human consumption commands a relatively low price in the marketplace and is marketed at a significant discount to other imported brands of salmon. As a result of this situation, the value of these industries is presently very low. On the basis of the average price paid to fishermen for these products being $500 per metric tonne, the total value of both industries is only $1.5 million per annum.

Little attention has been focused on establishing markets for value added products associated with these species. However, new product development conducted by some fishermen has shown that attractive value-added products (eg., smoked salmon, rollmops, etc) are possible. While these fishermen have not developed large markets for these products, their relative success indicates that both salmon and herring do have potential to be developed into higher value products.

In an effort to increase the value of both industries, WAFIC commissioned this market research project to identify market opportunities for value-added salmon and herring products.

As stated in the Executive Summary, it is envisaged that further research may be conducted to capitalise on the findings thus far, to provide a clearer definition of the market opportunities that may exist and the actions necessary for these products to be marketed effectively.

APPROACH

The approach taken in conducting this project was to break the market research process into a series of stages.

Stage One: Literature Review/Desk Research

This stage involved gathering and analysing all forms of available written information (domestically and internationally) and gaining input (in-depth interviews) from industry participants. The primary objective of this stage was to identify those markets for value-added salmon and herring products and therefore required researching in further stages of the project.

The products that were examined included:

- Rollmops.
- Smoked salmon and herring products.
- Salmon and herring roe.
- Herring fillets.
- Canned salmon.
- Semi-prepared/convenience meals.
- Fish meal/lobster bait.

Stage Two: New Product Development (the Food Centre)

This stage involved the physical development of the new products, including:

- Salmon and herring fillets.
- Crumbed salmon and herring.
- Salmon and herring in tomato sauce.
- Salmon and apple mornay.
- Indian-style herring.
- Smoked and peppered salmon.
- Smoked herring.

Stage Three: Qualitative Concept Testing (focus groups) with Prospective Consumers

The third stage involved conducting two focus groups with prospective purchasers of the new product concepts.

The focus groups were conducted with consumers who eat fish on a regular basis, who are purchasers of convenience foods and who are responsible for making the purchasing decisions for their households.

Stage Four: Preliminary Analysis of the Japanese Roe Market

At the completion of Stage One it was decided that determining the potential for Australian salmon and herring roe should be one of the major components of the project.

The research was conducted by sourcing information from agencies such as JETRO, the Food and Agricultural Organisation (United Nations) as well as discussions with industry participants in the United States, Canada and the United Kingdom.

A written brief was also provided to Austrade to gain detailed information on the Japanese market and to identify a number of interested Japanese companies to determine if Australian salmon and herring roe was acceptable in the Japanese market. At the time of writing this report this component of the project had not been completed and the project team was still waiting to receive more detailed market information and the list of prospective partners.

Stage One:

DESK RESEARCH - OPPORTUNITY IDENTIFICATION

KEY RESEARCH FINDINGS

Following are the key research findings and market overviews as they relate to each product possibility.

ROLLMOPS:

Rollmops were identified as one of the product possibilities that could be produced from herring. Some initial product development work, conducted by the Food Centre, established that a reasonably acceptable rollmop could be developed.

While it is possible to purchase rollmops in Western Australian made from herring (Western Australian), and even sardines (Western Australian), it is estimated that the vast majority of rollmops sold are of European origin (ie., imported). These products, in particular the Holland House and Yzermans brands, are imported from Holland.

By compiling Australian Bureau of Statistics (ABS) data on imported fish products it was possible to derive an estimate of the total size of the rollmop market, both in Western Australia and Australia. ABS data indicates that approximately $4.7 million worth of herring products (prepared, preserved, smoked, salted, frozen, fresh) were imported into Australian in 1994/95, and of this amount Western Australia represents 5% or $235,000. While these figures do not reflect movements of product between states, it is considered that the total market for Western Australian herring products is unlikely to be greater than $400,000 - $500,000. Of this amount, it was estimated that rollmops are unlikely to represent more than 5-10% of this market - thus relating to a market value of approximately $40,000 - $50,000 per annum.

In addition to the very small size of the rollmop market, it was established that many consumers of rollmops are relatively recent European immigrants and/or their descendants. These people appear to value the ethnicity of European herring products, including rollmops. Importantly, they have a loyalty to the style of the imported product and the associated brands.

Given the relatively small size of the market and the difficulty in competing with imports it was decided that this product possibility would not be pursued in the further stages of the project.

SMOKED HERRING AND SALMON PRODUCTS:

It was identified that it may be possible to produce an attractive smoked salmon and/or herring product. It was found that traditionally a small amount of smoked product, in particular salmon, has been produced in Western Australia; reportedly by some salmon fishermen and a fish processor in Albany.

Approximately $12.2 million worth of smoked fish was imported into Australian in 1994/95. Of this amount Western Australia constitutes approximately 7% or $900,000. Once again these figures do not include imports from the Eastern States, in particular Tasmania from where a significant amount of smoked product is sourced. It is estimated that the smoked fish market in Western Australia is unlikely to be greater than $1.3 million. This market is still relatively small, though more than twice the size of the rollmop market.

On the basis of the size of this market, the anticipated ability to produce an acceptable product and the high price of competing products, it was decided that smoked product possibilities should be pursued in the further stages of the project.

SALMON AND HERRING ROE:

Three factors in particular indicated that roe be considered at the desk research stage:

1) The knowledge that roe from both salmon and herring is presently not being utilised, even though anecdotal evidence from some fishermen and European immigrants suggest that it may be quite attractive to eat.

2) Salmon in particular have a large roe.

3) Export markets being successfully established recently for Western Australian mullet roe.

The Japanese market consumed 69,500t of roe in 1992 (FAO). It was found that Japan accounts for approximately 95% of the world's roe production and that high prices are paid for many different forms and types of roe products.

On the basis of the under-utilised nature of both salmon and herring roe, the size of the market, the apparent potential for many different types of roe and the view held by some industry participants that demand is likely to exist for these types of roe, it was decided that this product possibility should be pursued in the further stages of the project.

HERRING FILLETS:

Historically, virtually the entire herring catch has been used for bait - only a very small proportion has been used for human consumption. This is despite the fact that herring is known to enjoy quite a loyal following by many fish consumers who often eat the fish in fillet form.

As herring is presently under-utilised as a product for human consumption, even though its eating quality is recognised by some, and given the successful development in recent years of a market for mullet fillets, it was decided that this product possibility should be pursued in the further stages of the project. It was also thought that if a market was established for herring roe, then the potential for herring fillets would be significantly greater, ie., due to offsetting some of the harvesting and processing costs.

CANNED SALMON PRODUCTS:

Traditionally, the market for Australian salmon products, in particular canned products, was quite large. However, over the last 10-15 years, due to change in consumer eating habits, the influx of cheaper and higher quality imports, Australia's relatively high processing costs, the increasing popularity of tuna and the poor perception of the quality of Australia salmon, the demand for canned Australian salmon has significantly declined.

Today the canned fish market in Australia is estimated to be in the vicinity of $218.6 million or 23,499 tonne. Of this amount, Australian salmon is estimated to only constitute 1%-3% of this market and thought to be further diminishing.

Due primarily to the product's weak competitive position compared to imported to products, particularly imports of "true" salmon, it was decided that the product possibility would not be a priority area for the further stages of the project. While not being a priority area, it was decided that this possibility should not be completely overlooked and that it may be revisited at some later stage.

SEMI-PREPARED/CONVENIENCE MEALS:

The desk research identified and examined the growing market for semi-prepared, convenience type meals. These include products consisting of a wide range of meats, including fish. These meals, which are semi-prepared and then frozen, are designed so it is only a matter of re-heating (oven or microwave) and perhaps garnishing and/or saucing, to be ready to be eaten. Some of the fish based products already in this category ***(see Figure 1a opposite)*** by form of processing, include product types known as ovenable (33.7%), fish fingers (32.4%) and crumbed (9.5%). In terms of brands in this market ***(see Figure 1b opposite)*** Birdseye (36.5%) and I&J (25.0%) are the major players.

Some of the features of these products include:

- Dory crumbed fillet.
- Crumbed hake.
- Hoki fillets.
- Vegetable hake.

On the basis of the current size and growth of this market, and the anticipated ability to be able to produce an acceptable product, it was decided that this product possibility should also be pursued in the further stages of the project.

FISH MEAL:

The concept of utilising salmon and herring for the production of fish meal was also identified. Research found that a large proportion of the fish meal consumed in Australia is imported. ABS data shows that 97% of Australian fish meal imports in 1994/95 came from Peru and the cost per kilogram for this product was 48c. In addition to the import replacement potential of fish meal produced from salmon and herring, there is also the potential arising from the possibility of producing an aquaculture feed or lobster/crab bait. The potential of all these concepts would be enhanced if processing operations were developed locally for salmon and herring - as a result of demand for roe and/or smoked products. The by-product from this operations, ie., the viscera and frames, could be used as a cost effective base material. An examination of the market potential of these products will be the subject of a further research project, aside from the one conducted by Market Equity.

Stage Three:

QUALITATIVE CONCEPT TESTING

SUMMARY

The objective of the research was to evaluate the acceptability of a number of Australian salmon and herring products. It is anticipated that the products which appear to have the most consumer appeal may be commercialised with a view to helping raise the value of the industry. The products evaluated were:

- Salmon and herring fillets.
- Crumbed salmon and herring.
- Salmon and herring in tomato sauce.
- Salmon and apple mornay.
- Indian style herring.
- Smoked and peppered salmon.
- Smoked herring.

The research was conducted via two qualitative group discussions, amongst consumers who eat fish on a regular basis, are purchasers of convenience foods and are responsible for making purchasing decisions for the household.

The main findings of the research are detailed below.

THE PURCHASE OF FISH

The main reasons for eating fish centred around the natural and healthy nature of the product. Furthermore, in comparison to meat, fish was considered to be reasonable in price. Respondents in the groups also found fish easy to prepare and felt that it provided a tasty meal for the whole family.

The research indicated that consumers expect certain qualities in a fish before it is purchased. In fact, fish consumers appeared to be discerning. The features used to judge the acceptability of fish are as follows:

- Quality and consistency of quality.
- Taste – not too strong.
- Texture – firm.
- Appearance – white meat.
- Number of bones.
- The ability to be "dressed up".

Factors deterring consumers from purchasing certain fish are as follows:

- Strong, over-powering taste.
- Strong odour.
- Grey meat.
- A large number of bones.
- The inconvenience of having to search for a fish which satisfies all the necessary qualities.

PACKAGING

The way a fish is packaged determines to some extent the way consumers perceive the fish in terms of quality and freshness as well as price.

Fresh fish was considered to be the best quality as it was perceived to be more natural and healthy. Nevertheless, at the same time, fresh fish was considered to be more expensive, but worth the extra expense. In other words, fresh fish was associated with value for money.

Frozen fish on the other hand, was perceived to be a cheaper form of fish, and lower quality, but convenient as it can be purchased from supermarkets. Therefore, this form of packaging was perceived to be particularly good for families with time and budget constraints.

Tinned fish, also being available at supermarkets, were considered to be a convenient form of purchasing fish, but of lower quality than any other form. Whilst it was perceived to be acceptable to serve to the family as a light meal, it was not perceived to be an acceptable form for serving to guests.

Vacuum sealed packaging carried connotations of expense and any fish packaged in this way was perceived to be of high quality and suitable for special occasions.

EVALUATION OF THE PRODUCT ALTERNATIVES

Bearing in mind consumers' criteria for acceptability of a fish, it is clear that Australian salmon and herring have problems which need to be overcome before success can be enjoyed. These problems relate to the following issues:

- Strong odour.
- Strong taste.
- Grey colour.
- Poor quality connotations.

It is clear therefore, that any process which overcomes the above concerns is likely to be most successful. It was therefore not surprising that the smoked salmon and herring products were regarded in the most favourable light. The smoked and peppered salmon and the smoked herring were able to:

- Disguise the odour effectively.
- Disguise the strong taste effectively.
- Disguise the grey colour effectively.

Furthermore, on the basis of taste alone, no connotations of poor quality (typical of impressions of Australian salmon and herring) were evidenced and in fact, these products were viewed as superior and were described as elegant, sophisticated and ideal for entertaining. To further support this, respondents anticipated that these products would be vacuum sealed, reinforcing impressions of high quality.

Not only were the smoked salmon and herring products able to overcome inherent problems with these two fish, but they offer additional benefits. At present, the smoked fish market is accessible to only a small percentage of consumers, predominantly as a result of the price of products in this category (for example, smoked Atlantic salmon at $45/kg). By placing the smoked Australian salmon and herring product on the market at a much lower price, the product category is likely to be enjoyed by a much larger percentage of the market, thereby providing an opportunity for long-term growth of the smoked fish market. Furthermore, it is feasible to expect that by pricing these products at a middle-of-the-range price, impressions of salmon and herring may be raised and over the long-term and consumers may not simply assume that they are low quality, bottom end of the market fish.

The research has shown that the smoked herring and salmon products tasted have high consumer appeal and may represent a significant opportunity to increase the value of the industry. Nevertheless, this research offered only a cursory glance at acceptability and prior to simply launching these products, it is suggested that further research is conducted. A greater understanding of the smoked product market is essential, as is the evaluation of smoked salmon and herring alternatives, to ensure that the ideal product concept is adopted. It is anticipated that further research will examine alternative products amongst both current smoked product consumers and potential smoked product consumers to gauge whether the former will be attracted by the products and whether the latter will be encouraged to try smoked products through the products offered.

It is anticipated that quantification of impressions emerging during the group discussions will be conducted at the Fremantle Sardine Festival. This will offer both an ideal occasion and a cost-effective method of conducting quantitative research.

APPROACH

the Western Australian Fishing Industry Council, in conjunction with the Food Centre developed a number of potential salmon and herring products. It was considered necessary to ascertain their market acceptance amongst consumers. The products developed were:

- Salmon and herring fillets.
- Crumbed salmon and herring.
- Salmon and herring in tomato sauce.
- Salmon and apple mornay.
- Indian style herring.
- Smoked and peppered salmon.
- Smoked herring.

Qualitative research (focus groups) was conducted. Two group discussions were carried out. Participants in the focus group discussions were:

- Fish consumers.
- Purchasers of convenience foods.
- Consumers responsible for making the purchasing decision for the household.

Clearly, it was necessary to approach consumers who eat fish on a regular basis, to avoid rejection of the product concepts simply due to a dislike of fish in general. Furthermore, as the products are intended to be quick and easy to prepare, it was important to gauge the impressions of consumers who subscribe to the concept of convenience foods. A further rationale behind the sample design involved the inclusion of those consumers responsible for making the purchasing decisions for the household, so that consumers at whom the product is likely to be aimed were approached.

KEY RESEARCH FINDINGS

BEHAVIOUR SURROUNDING THE PURCHASE OF FISH

The research indicates that consumers of fish are discerning, and search for a number of features in the fish that they intend to purchase. It also highlights a number of characteristics that deter consumers from certain types of fish. Both the attracting and detracting features have important implications for Australian salmon and herring.

Reasons for Purchasing Fish

Respondents said that they purchased fish predominantly because it is a natural and healthy product which can be enjoyed by the whole family. It was compared to meat in this regard and in respect of price. Not only was fish considered to be healthier than meat, but also more reasonable in price. Furthermore, respondents described fish as a tasty product which is easy to prepare. This latter comment referring to the ease of preparing fish may seem to be in contrast to previous research results, but it should be remembered that these respondents were all regular fish consumers enjoying it once a week or more, and are therefore likely to be more familiar with preparation techniques.

Favourite Fish

Before fish is purchased, consumers indicated that they consider a number of criteria. A fish needs to satisfy these criteria before it is considered for purchase. These criteria include:

- Quality and consistency of quality.
- Taste.
- Texture - firm.
- Appearance - it should be white in colour.
- The number of bones - the fewer the better.
- The ability to be "dressed up" with sauces and other accompaniments.

Consumers mentioned that their favourite fish, eaten on a more regular basis than others were John Dory, Barramundi, Red Emperor, Cobbler, Atlantic Salmon, Hake and most other large fish which do not have small bones.

Deterring Factors

In the same way that people seek certain qualities from a fish, there are also certain factors which detract from fish and cause consumers to reject them. These factors are:

- Strong, over-powering taste.
- Strong smell.
- Grey colour.
- Many and small bones.
- The inconvenience of having to satisfy all of the aforementioned criteria when choosing fish.

As a result, a number of consumers rejected Kippers, Mullet, John Dory, Herring and any other small fish with many small bones. The fact that John Dory is mentioned as both a favourite and a rejected fish may well relate to simply personal taste or fish substitution.

Preferred Place of Purchase

The place of purchase was largely dependent on the form of fish required. In this regard, fresh fish was usually purchased from fish markets or fish shops. Fresh fish and the outlets where fresh fish is available were associated with both perceptions of quality and higher price. Nevertheless, although perceived to be of a higher price, fresh fish was also associated with a perception of value for money.

It was considered appropriate to purchase only frozen, tinned and vacuumed sealed fish from supermarkets. Whilst the supermarket was considered the appropriate place to purchase these forms of fish, it was not trusted for fresh fish:

> *"The fish arrives frozen, it defrosts during handling and gets re-frozen for sale as frozen fish or does not get re-frozen and gets sold as fresh fish."*

Price Threshold

The price respondents were prepared to pay for fish depended on the occasion for which the fish was being used. For special occasions, respondents indicated a willingness to spend up to $20/kg, whilst for the family, up to $11.99/kg was considered more appropriate.

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PACKAGING

The way in which a fish is packaged, or the form in which it is presented determines to some extent the way consumers view that fish.

Fresh Fish

Amongst all respondents in both groups, fresh fish was the preferred form. It was perceived to be good quality and a trustworthy way of buying fish. It was associated with the added benefit of being able to be filleted, thereby overcoming the problem of bones, particularly amongst those consumers with families and young children. Fresh fish was usually perceived to be a more expensive form of purchasing fish and, as supermarkets are not considered to be a trustworthy outlet for purchasing fresh fish, respondents often found it an inconvenient choice.

Based simply on the fact that the fish is fresh, there was a perception that the product is better quality, and more natural and healthy. Although considered more expensive, a value for money perception prevailed.

Frozen Fish

Frozen fish was considered to be a convenient form of purchasing fish as it can be obtained at supermarkets during a regular shopping outing. Respondents perceived it to be cheaper and found it easy to prepare. A further benefit of frozen fish is that it is usually filleted. Nevertheless, there is a perception that taste is lost through freezing. Furthermore it was not the most trustworthy of presentations and respondents felt that frozen fish often defrosts during handling and is simply re-frozen for sale. There was also a concern that frozen fish can be stored for too long at supermarkets.

On an overall basis, the low cost and the convenience of frozen fish, and therefore the appropriateness for families with time and budget constraints, emerged strongly.

Tinned Fish

This form of purchasing fish was, like frozen fish, considered to be convenient as it can be purchased at supermarkets during regular shopping outings. Furthermore, it was perceived to be easy to prepare and, although not always the case, was thought to be always filleted. A disadvantage attached to tinned fish was that consumers are currently limited in choice to tuna, salmon and sardines.

Convenience was perceived to be an advantage of tinned fish.. Nevertheless, tinned fish is not considered to be the best quality fish and respondents felt that it would be appropriate to serve to the family as a small, light meal, but not to guests for entertaining purposes.

Vacuum Sealed Fish

Smoked Atlantic Salmon immediately came to mind amongst respondents upon discussion of vacuum sealed fish. Therefore, respondents felt that fish packaged in this form were good for entertaining and were not everyday family type of fish. Overall, fish presented in this way were associated strongly with expense and special occasions.

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EVALUATION OF THE PRODUCT CONCEPTS

The smoked salmon and herring products were received in a far more positive light than any of the other product concepts. This was predominantly due to the fact that they successfully disguised the strong smell, the strong taste and the grey colour that is typical of Australian salmon and herring. The other products were not able to achieve this successfully and therefore the criteria which consumers have set for acceptability of a fish, were not met. As a result, likelihood of purchase for these was low.

Salmon and Herring Fillets

Both salmon and herring fillets were regarded negatively and, although not at any level of statistical significance (ie., given the qualitative nature of the research), were rated 3.7 ad 3.8 out of 10 respectively. The complaints related mainly to the strong taste and smell of both fish. Furthermore, both were perceived to be too oily and the grey appearance of the meat was not enjoyed. Respondents also felt that the texture of both was too tough, rubbery and chewy.

Aspects enjoyed were limited, particularly for the salmon fillets. Herring fillets were regarded in a slightly more favourable light than salmon fillets (although not favourable on an overall basis) and was described by some as moist/juicy/succulent and as having a better appearance and lighter taste.

Suggestions for improvement were also limited, indicating lack of interest in the product and overall rejection. For salmon fillets, suggestions related to any method which disguised the strong taste. Therefore, respondents mentioned the addition of butter, lemon or sauce, as well as different methods of cooking, such as grilling or wrapping the fish in foil. With herring fillets, suggestions included the addition of seasoning and again, anything which reduced the strong, fishy flavour.

Respondents expected both fish to be presented in a frozen form. This provides a reinforcement of the overall impression of a poor quality, low priced fish. Some respondents suggested freezing these fillets in the hope that this process may reduce the strength of taste.

Likelihood of purchase for both salmon and herring fillets was particularly low, although opposition to the herring fillets were slightly less than to salmon fillets. Nevertheless, both fish in this form were perceived to be low quality, low priced fish, positioned at the bottom end of the market, costing no more than between $3 and $6/kg.

Clearly, overall negativity towards the fillets prevailed, indicating that neither salmon nor herring fillets offer a product option for increasing the value of the salmon and herring markets. Furthermore, in this form, these fish will simply reinforce the poor impressions that consumers have of Australian salmon and herring.

Crumbed Salmon and Herring

Both crumbed salmon and herring were perceived in a more favourable light than the plain fillets. Respondents rated crumbed salmon at 3.8 out of 10 and crumbed herring at 5.7 out of 10. Whilst crumbed salmon is still viewed in a negative light, on an overall basis, crumbed herring is perceived positively. Nevertheless, despite a positive evaluation of the latter, it remains a fish which carries connotations of poor quality and low price, and again, will only serve to reinforce the poor impressions that consumers have of Australian herring.

Dislikes of both crumbed fillets referred predominantly to their blandness, and respondents described them as plain, dull and boring. Dislikes were more extensive for crumbed salmon and also included comments regarding the grey meat and the rubbery texture. For crumbed herring, criticisms were less extensive, and over and above blandness, respondents mentioned that the fillets were too thin and it was therefore difficult to taste the fish.

For both salmon and herring, the crumbs were perceived to improve the taste by adding a nice texture and reducing the oiliness, the strong taste and smell. Respondents perceived crumbed herring in particular to be ideal as a snack for children and convenient as it can be taken directly from the freezer to the frying pan.

The only improvements suggested for both crumbed salmon and herring were the addition of accompaniments such as herbs, butter and lemon.

For both fish, the expectations from a packaging perspective were that they would be presented in frozen form, which reinforces the impressions that both crumbed salmon and herring were perceived to be low quality, low priced fish. Therefore, despite the fact that likelihood of purchase for crumbed herring was high, it was placed in the same category as fish fingers, at the bottom end of the market. It would therefore simply reinforce the existing impressions of low quality that consumers have of Australian herring. For crumbed salmon, likelihood of purchase was low and there was strong resistance to the product irrespective of price.

Smoked Salmon and Herring

Both peppered and smoked salmon and smoked herring were perceived in a positive light and present the greatest opportunity for a product option. The peppered and smoked salmon was given a rating of 5.9 out of 10 and the smoked herring 6.5 out of 10. In each case, responses were polarised, with respondents either reacting very favourably or very unfavourably towards it. Those reacting unfavourably were opposed to smoked products in general rather than specifically to these products. Therefore, any dislikes mentioned emerged amongst these respondents alone, and were criticisms of smoked products in general.

Although smoked herring received a greater extent of positivity than peppered and smoked salmon, there was some resistance to the whole fish presentation, and some respondents were not comfortable seeing the head and eyes of the fish. There was also some negativity to the small bones.

Nevertheless, despite the above concerns, in general the positive features far outweighed the negative features and reaction to both smoked fish was enthusiastic. They were both described as attractive in appearance, moist/succulent/tender, with a beautifully strong, smoked, full flavour. Both products were perceived to be appropriate for entertaining, rather than a family meal. Ideas and serving suggestions were extensive and respondents mentioned presenting both products as an entree or with a salad. In each case, these products were perceived to be appropriate for "impressing your friends". In particular, the smoked herring was considered to have a gourmet appearance and was described as a superior product.

Both fish were expected to be presented in a vacuum sealed pack. This reinforces impressions of expense and quality. Further suggestions included the sale of these products at fish shops or fish counters, again reinforcing impressions of quality and freshness. Those respondents objecting to the whole fish presentation of the smoked herring suggested filleting these fish and placing them in sardine-type tins.

The likelihood of purchase for both smoked salmon and smoked herring was high and only those resistant to smoked products were opposed. Pricing expectations were also high, up to $12.99/kg.

The peppered and smoked salmon and smoked herring products appeared to offer opportunities for both the salmon and herring markets and the smoked product market in general. No connotations of poor quality were evident on discussion of these products and they therefore overcome the traditional impressions associated with these fish. In fact, as demonstrated clearly above, these products are considered to be superior. It is certainly feasible to expect that through these products, the impressions of salmon and herring may be improved over time. Furthermore, being priced at a lower level than Atlantic smoked salmon ($45/kg), these products are likely to open the smoked product market to consumers unable to enjoy such products due to their expense. These products may therefore increase the value of the smoked product market as well as that of the salmon and herring markets.

Salmon and Herring in Various Sauces

Various sauce-based salmon and herring products were also developed. These included:

- Salmon and herring in tomato sauce.
- Salmon and apple mornay.
- Herring in Indian style sauce.

No single one of these products was viewed in a particularly positive light. Across respondents in both groups, there was general resistance to pre-made sauces. This was mainly due to the fact that sauces are considered to be too individualised and personal. For this reason, most respondents preferred to make their own.

Only the herrings in Indian sauce were attributed some positive features. The other sauces were regarded extremely negatively, particularly the salmon and apple mornay. The sauces were perceived to be too bland, not complimenting the fish, and being unattractive in appearance. The fish itself was also criticised as being too strong, too rubbery and too grey in colour. Although improvements were suggested, respondents indicated that little would entice them to buy the product, even at a low price. Packaging expectations reinforced the negativity and the outright rejection, with respondents suggesting a tinned product with no label as *"no-one would buy if they knew what it looked like."*

Although the herrings in Indian sauce were not rated as badly as the other three sauce-based products and although the taste was enjoyed, likelihood of purchase remained low, predominantly due to the general resistance to pre-made sauces. Furthermore, this particular product concept was described as a little too spicy and strong, particularly for children.

Product Preference

Product preferences reinforce the opinions expressed above. The smoked products were respondents' first choice more often than any other and offer the greatest opportunity for growth of both the Australian salmon and herring markets as well as the smoked product market. Although crumbed herring fillets were also perceived favourably and herrings in Indian sauce were perceived neutrally, both of these products were perceived to be low quality, low priced products and are therefore unlikely to offer good returns and therefore growth of the herring market. A comparative analysis may be referenced in ***Figure 2*** opposite.

★

IMPRESSIONS OF AUSTRALIAN HERRING AND SALMON

Throughout the taste tests, no respondent identified any fish based on the taste or appearance alone. Once informed that they had tasted Australian salmon and herring, mixed responses were evident. On one hand, some respondents felt that taste was more of an issue than the type of fish. Amongst these respondents, most were unaware of the difference between Atlantic and Australian salmon. This impression was in fact true for most respondents. On the other hand however, some respondents felt that knowing that the products they had just tasted were Australian herring and salmon, simply reinforced their poor impressions of these fish:

"I knew it was a low quality fish and now knowing the type, I can see I was right."

"I can't believe I just ate herring."

Amongst these respondents, Australian herring and salmon were regarded as poor quality fish:

"The Australian salmon is just not a good fish."

"I don't think the salmon is good at all compared to the North Atlantic salmon. It's not good in colour, not in texture, not in flavour. It is a very poor quality salmon."

"John West would have rejected this salmon."

"The only way Australian salmon tastes good or is edible is if it's peppered or it's smoked, otherwise the fish taste is too strong."

"I really don't like Australian herring. I was made to eat it as a child and I haven't enjoyed it since."

"I would never normally consider eating herring because it is just poor quality fish."

The impressions of poor quality were more pronounced for herring than for salmon. In fact, amongst the majority of respondents, there was a general lack of awareness of the difference between Atlantic and Australian salmon. This indicates a need to consider the possibility of alternative names, particularly for herring. This is important in order to avoid rejection by some on the basis of type alone.

Stage Four:

PRELIMINARY ANALYSIS OF THE JAPANESE ROE MARKET

SUMMARY

Of the market research conducted into the Japanese roe market so far, it is clearly evident that this market may represent a significant opportunity to increase the value of the Western Australian salmon and herring industry. There are two critical determinants as to the level of opportunity this market represents.

a) Will the product features of roe from salmon and herring meet the requirements of the Japanese market?
b) Can this product be marketed effectively?

These are the two major unknowns that will need to be addressed through working with a prospective distributor.

Some of the specific areas of uncertainty that need to be addressed include:

- Is the quality of salmon and herring roe suitable to any segment of the Japanese market and what price can be expected?

- Will the small size of the overall resource impact upon the ability to develop a sustainable market?

- What yield can be expected from the amount of fish presently being caught. Some of the factors that will impact upon yield may include the amount of roe per fish (after processing), the timing of capture in relation to time to spawning, the amount of contamination or disease in the roe sample (eg., nematodes in herring roe), etc.

- Will fishermen be able to *'manage'* the product effectively (ie., catching, processing, distribution, etc) and will the cost-benefit be sufficient to justify this effort?

- How will the product be marketed, particularly in relation to distribution. This component of the project can be best completed through developing a close working relationship with a prospective distributor. While the project team has been largely reliant on Austrade to identify a selection of prospective distributors to work with, the project teams own efforts have resulted in a relationship with a large Canadian fish processing company. This company, Canfisco - the Canadian Fishing Company Ltd, has expressed an interest in helping to evaluate the suitability of the roe and in perhaps ultimately marketing the product. They are waiting until next spawning season when product will be available. At this time a technician will either visit Western Australia or product samples be sent to Canada. Similarly, when a suitable Japanese company has been identified, it is envisaged that the same scenario is likely.

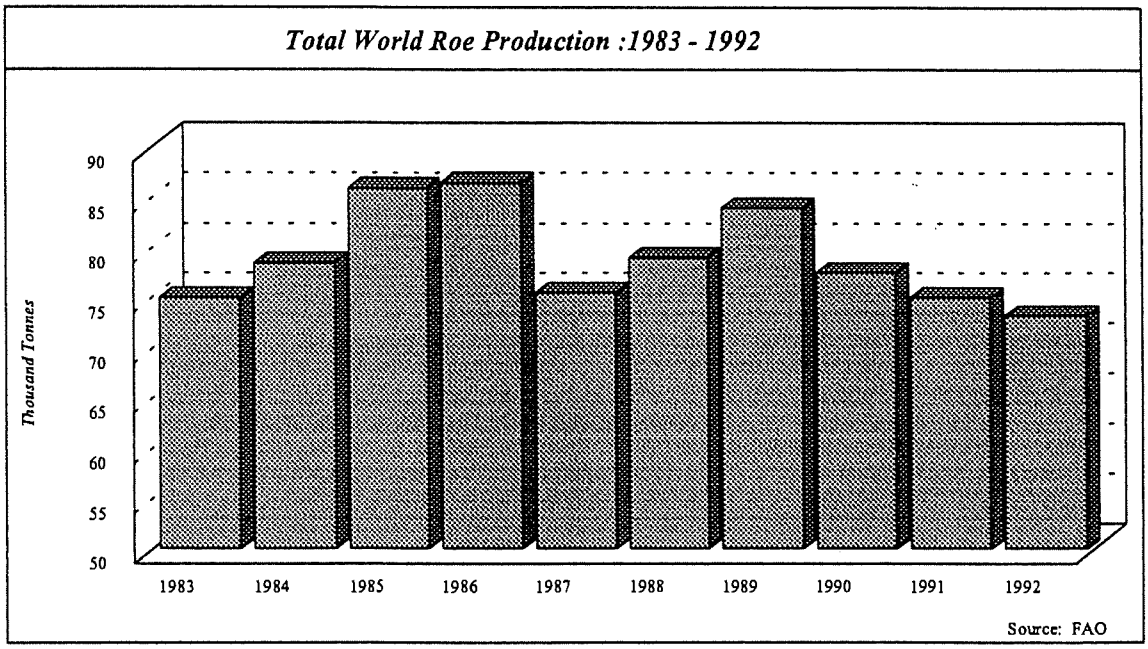
The resulting report on the Japanese roe market provides an insight into the possible potential of this market. However, the purpose of this report is meant only as an overview of the marketplace. It is envisaged that more detailed, up-to-date and more accurate information will be gathered once a firm working relationship has been developed with a company involved in importing roe into this market.

KEY RESEARCH FINDINGS

THE WORLD ROE MARKET

In 1992 the world production of roe, as measured by the Food and Agricultural Organisation - United Nations (FAO) totalled 73,162t. This represented a 3,179 t decrease on the previous year. Over the past 10 years total production has been reasonably constant, but what the total figures mask is the volatile nature of the production of individual species and their different varieties.

Figure 3a:



The cause of the volatile nature of production levels is the substantial variation in global catches of wild stocks of different fish species. As with any demand/supply equation, price is the variable most impacted by these fluctuations. Prices have varied up to 400% on a year to year basis depending on the level of wild catches.

THE JAPANESE MARKET

Japan is the biggest market for roe, with 95% of the total world production entering this market. Roe is marketed as both a luxury product and a staple good, dependent on the grade, fish variety and use. As part of the traditional Japanese diet, roe lacks an atypical customer group(s) in that it is consumed by all segments of society.

Roe is considered a luxury product in the personal gift market and is used in certain ceremonial occasions. The Japanese have a widely practised tradition of gift giving which takes place twice a year. Attractively packaged seafood products including roe are popular gifts and retail prices have reached as high as $300/kg for herring roe in gift packs. This roe is of the highest quality and is sold through retail outlets in 150g jars. Corporations also include roe in their gift giving programmes to employees and business associates. This segment accounts for approximately 20% of the roe gift market.

Herring roe has a tradition of being included in the meals served at weddings and at the often extravagant and lavish New Year dinners. As a result, a large proportion of the total demand for herring roe is during the December and January period.

The restaurant market accounts for approximately 15% of the total market. Typically restaurants demand the higher quality roe for use in the preparation of sushi.

At the lower value end of the market, roe is typically sold in pre-packed containers or packed daily by the supermarkets into small containers for the customer to utilise in the preparation of the daily meal. The quality of this roe is not as critical and prices are held in check by strong supply levels. The take home market accounts for the largest proportion of roe sales.

It appears that one of the main purposes of roe is for presentation. For this reason, colour plays an important role in grading.

In the luxury market, in which roe is used as a gift, demand is directly influenced by the prosperity of the Japanese economy, as well as supply conditions. For some time the luxury market for roe was considered price inelastic but a significant drop in 1990/91 would indicate that this is not so. The 1990 harvest was considered one of the very best in terms of roe suitable for the gift market, and initially prices remained high under the expectation that the market would bare almost any price. By the end of the year large stocks remained unsold and prices had dropped by approximately 30%. In recent years, the luxury market has become quite volatile and has been subject to speculative buying by some importers, thus only exacerbating the levels of price variation.

Market Composition

The three fish species that dominate the roe market are pollack, herring and salmon. Their combined level of production in 1992 made up 94% of world total. The roe of each species is considered unique and the taste, presentation and use peculiar to each type.

From ***Figure 3b and 3c opposite***, the most substantial change in the composition of production over the past five years has been the decrease in pollack roe. Overfishing of pollack resources throughout the world has resulted in catch levels falling significantly and in the last five years, total production has decreased by 11,733t . This represents a 16% decline in market share. Filling this void, but not as a direct substitute, have been herring and salmon roe.

Herring roe has been consumed in Japan for over 100 years but in the past 10 years has enjoyed significant growth in demand - approximately 10% per annum. In 1982 seasoned herring roe was developed and quickly became a very *"fashionable"* product, appealing to younger Japanese because of its convenience and due to its low salt characteristics. Even though production doubled in the 1986 - 1991 period, demand increased at a greater speed and higher prices resulted. Whilst still very popular, the novelty of herring roe has since declined and with demand plateauing, the cheaper sources of herring roe have gained market share as customers have become more price sensitive.

The salmon roe market is characterised by several different varieties and the prices achieved per variety vary significantly.

Chum roe is the most sought after of the salmon varieties with prices as high as US$15/kg, compared to the roe sourced from salmon farms which is as low as US$2/kg. Roe from salmon farms is of a softer consistency and is considered a lower grade.

Oversupply is a negative factor in the salmon roe market currently, with high levels of production from the Alaskan and Russian fisheries and salmon farmers from Chile and Norway flooding the market.

Origin of Japanese Imports

Approximately 90% of all roe is imported into Japan, with chum salmon roe being the only species caught in any great quantities by the Japanese fisheries.

Pollack

Pollack roe is the dominate variety of roe in Japan. In simple terms the reason for this is that there is a very large supply of pollack from which the roe can be extracted and the roe itself is very suitable to Japanese tastes.

Reduced access for the Japanese fishing industry to international waters has resulted in Japanese catches of pollack roe falling significantly in recent years *(see Figure 3d opposite)*.

Herring

Imports of herring roe totalled $276m in 1992, with the main source of imports being Canada.

Canada supplies a large proportion of herring roe imported into Japan, but the herring from which the roe is extracted is not necessarily caught in Canadian waters. Canadian law prevents the exporting of whole unprocessed herring. In response to this, a very sophisticated processing industry has developed over time to the extent that herring from other countries is exported to Canada for processing prior to export to Japan *(see Figure 3e opposite)*.

Salmon

Imported salmon roe totalled $188m in 1992, with USA being the main source.

A recent trend in the supply of salmon roe to Japan, that is not reflected in the below chart, is the high level of supply of roe from salmon farms, in particular from operations in Chile and Norway. This has created oversupply conditions in the lower grades of some varieties of roe *(see Figure 3f opposite)*.

Processing Type

The three main forms of processing are to either cure, salt or pickle the roe. Each type of fish is traditionally processed in a certain way. Pollack roe has traditionally been pickled and it is for this reason that pickling accounts for the largest share of the market *(see **Figure 3g opposite**)*.

Salting involves the packaging of the roe in dry salt. Most fish types will have a proportion of their roe processed in this manner, but this amount is relatively small.

In extracting roe from salmon or herring, the roe can be processed in two ways - the quality of the roe being a determinant of which processing method to be applied. The sujiko method involves extracting the roe still inside the skein (egg sac), washing, curing in a salted brine solution, packaging and then freezing. A flavouring can also be added (eg., soya).

The ikura method involves rubbing the roe from the egg sac, washing the eggs loose, curing in a salted brine solution, packaging and then freezing. Again a flavouring may be added.

Herring and salmon roe are cured in the same manner, however herring is cured for up to 7 days as opposed to approximately 3 days for the salmon roe.

Fish variety and the quality of the roe determine which form of processing is more appropriate. Of the two processes, ikura provides the better returns but the processing costs are higher

Processing in the above methods requires the presence of Japanese technicians. They conduct all grading of product and supervise the processing and packing of the roe. Product processed without Japanese assistance is considered of a lower quality and the returns reduced. If an operation is considered uneconomical for the Japanese to send technicians, an alternative is to pack and freeze the whole fish unprocessed (with roe intact within the fish) and transport to Japan for further processing.

Product Characteristics

It is understood that there are 15 quality classifications (grades) for roe. While there are written industry standards for grading, these are difficult to obtain. However, the discussion below outlines the key factors that are typically evaluated when grading roe.

Freshness

One of the most critical factors is the freshness of the roe. To achieve a Grade 1 rating the roe must be extracted and processed within 24 hours of the fish being caught. Roe extracted after 48 hour of being caught is considered of very poor quality.

Size

Whilst roe of any size is useable, the size does determine which processing style is chosen. Only the larger sized roe can be used in the production of ikura.

Hardness

As with size, the level of hardness determines which form of processing is most appropriate. Roe that is too soft is utilised for sujiko.

Colour

For salmon, the Japanese prefer the roe to be red in colour, and the darker the red higher the perceived quality. Alternatively for herring, yellow is the preferred colour, with the brighter the yellow the higher the perceived quality. However, colouring can be modified through the addition of colourings in the final stages of processing.

Maturity of Roe

The closer the fish is to spawning the better the quality of the roe. It tends to be that roe extracted early in the season is used for sujiko and later in the season for ikura.

Distribution Chain

The importation of roe is conducted by both larger trading houses and independent specialist fish product importers.

Traditionally roe has endured a complicated distribution chain, though there is some evidence today that the chain is being simplified. ***Figure 3h opposite*** outlines the stages involved.

The major trading companies establish a link between Japanese and foreign companies associated with exporting products into Japan.

Secondary processors complete the processing stages to enable the release of roe into the marketplace. This could involved simply packing of roe or extraction of roe from fish, dependent upon the state of the imported product. Secondary processors may also market product under their own label.

Auction companies provide a large scale transaction service between industry groups.

Supply chains for all products in Japan are currently in a state of change, characterised by the reduction in the number of intermediaries between importation and the retailer. Some product is even being imported by trading companies in a shelf-ready state for sale directly to supermarkets.

However, as most forms of roe still require some form of processing, be it just packaging, the traditional distribution chain is expected to remain the most prevalent form of distribution for many years.

Prices

Two of the main factors effecting the prices received by importers are the level of supply from wild stock catches and the carry over stockholdings from the previous year.

Prior to each season of harvesting wild stocks, a stocktake is taken of the stocks of roe remaining in the distribution chain . This factor is an important determinant for price negotiations in the coming year.

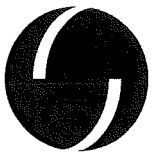
As indicated, the current prices for some varieties of salmon or roe have slumped to $5-7/kg as a result of high Russian and Alaskan catches and large quantities being supplied from the Chile and Norwegian salmon farms.

Alternatively, the returns for chum salmon are a lot more attractive with prices as high as $15/kg, due to less production than other varieties.

The outlook is for the prices of Atlantic and Red salmon to remained depressed. Varieties with a more balanced supply and demand equation should continue to receive similar prices.

In the past, the prices for herring roe have been more volatile that those for salmon roe due to more extreme variations in supply and recovery rates of grade 1 product. The present price for herring roe is approximately $15/kg for grade 1 product and $10/kg for other grades. The outlook is for the current price levels to be maintained over the next 12 months.

THE FOOD CENTRE
of Western Australia (Inc)



NEW PRODUCT DEVELOPMENT FROM LOW VALUE SPECIES

REPORT
FEBRUARY 1996

FOR

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ACKNOWLEDGEMENTS

The Food Centre of WA (Inc) would like to acknowledge the assistance given by the WA Fishing Industry Council during this investigation.

We would also like to acknowledge the assistance given by the CSIRO, Division of Fisheries, Hobart, Tasmania for their contribution in the lipid analysis of the Australian salmon.
(Project FRDC 95/122 "Nutritional Value of Australian Fishes")

1.0 BACKGROUND

Australian salmon and herring, and Australian sardines, are low value products generally caught seasonally, in reasonable volumes, off the South and South-West coasts of Western Australia.

Approximately 2000 MT of salmon, 1000 MT of herring and 5000 MT of sardines are caught annually. The average price paid to fishermen for the three products is $500 per MT, largely unchanged for at least ten years. Salmon is used for canning and lobster bait, herring almost exclusively for lobster bait, and sardines for angler bait, tuna feed and pet food. A tiny proportion of the sardine catch is used for human consumption.

2.0 NEED

There is a pressing need to increase the value of each of these products.

1. The salmon fishery is in a classic "catch 22" situation. It needs research into new products, but the return from the current fishers is too low to warrant the research. Individual fishermen have conducted trials of new products but typically they were unstructured, and not followed by proper marketing.

2. The herring fishery supplements the salmon fishery, but as bait it must compete with imported products which impose a ceiling on its value.

3. Sardines have been shown to be acceptable in higher value products, but the volume of these has been restricted due to poor on-board handling techniques. In order to increase the volume of high value products, on-board handling must be improved.

3.0 OBJECTIVES

To improve the value of the fishery by:

1. Using more of the product caught;

2. Value adding the product;

3. Producing a dry lobster bait, or at least a fishmeal, from the resultant by-product.

4.0 CONCLUSIONS

4.1 PRODUCT DEVELOPMENT

The objective to value-add the low value salmon and herring currently caught off the South and South-West coasts of Western Australia, was clearly achieved with some encouraging results. The greatest potential appears to be in the development of the smoked fish market, and to a lesser extent, a crumbed herring product.

The potential for the smoked market should therefore be investigated further, with a view to developing larger scale pilot plant production facilities. The products should also be evaluated for their market acceptance by means of a large scale organoleptic assessment, for example at a "Food Fest" or "Sardine Festival" event.

Based on these findings, it would be quite feasible to increase the value of these fish and in turn increase the price paid to the fishermen. There would, however, need to be a significant effort made to encourage better handling of the fish once caught, to ensure that the fish is of the best quality when it arrives to be processed. Training and handling videos may be appropriate to achieve this goal.

4.1.1 PICKLING

A fairly extensive development process revealed that the West Australian herring (*Arripis georgianis*) does not lend itself to pickling. The skin texture and mouth feel remained "tough" even after 3 months in the pickling mix. This also applied to the rollmops.

Muscle only (ie skinless) fillets again did not have an acceptable texture after pickling.

A successful pickled product using herring was therefore not achieved. For this reason, other alternative herring products were consequently developed.

4.1.2 SMOKING

The two salmon products, (smoked and peppered smoked), appeared to have potential. Both products were acceptable visually and organoleptically.

A smoked herring was also produced, which again exhibited good potential as a value-added product.

The initial microbiological examination obtained a high total plate count result, and an absence of *Listeria* species in 25 grams. However, this was an isolated test and further developmental work should be carried out to determine the shelf life in vacuum packs, both microbiologically and organoleptically.

The smoking technique should also be fine tuned to include an investigation into using sawdust from locally sourced woods in the South-West area.

4.1.3 OTHER PRODUCTS

The initial evaluation indicated a potential for other salmon and herring value-added products. The highest performers were the crumbed herring and herring in curry sauce. However, it was decided that a few of the other products would be submitted for the focus groups.

As the crumbed herring was perceived as having some potential, approximately 11kg of frozen fish has been delivered to the Fremantle Sardine Company. The potential of using their existing sardine crumbing facility, to produce crumbed herring, will be examined in the near future.

4.1.4 SALMON ROE

Only one of the salmon used to date was in roe. For this reason, development of salmon roe products could not be carried out at this stage.

Development work in this area will therefore be carried out once the salmon are in season again.

4.2 SARDINE SHELF LIFE STUDY

Sardines were "off season" at the time of the trial. Anchovies were therefore substituted, using the same treatment groups as prescribed for the sardines. Anchovies are a similar species, and are similar in size and characteristics to sardines, therefore allowing their substitution. It should be noted that the shelf life study was a comparison between treatment groups, the results being relevant for sardines as well as anchovies.

All treatment groups showed a decline in the freshness of the fish (indicated by increases in the TVB calculations and increases in the plate count). The visual interpretation also clearly indicated this decline.

It can therefore be concluded, that the best method for handling fish once it has been caught, would be to ice slurry at sea, or as soon as possible after the catch has been sorted. The inclusion of a bactericide in the ice slurry also appeared to have a favourable effect in maintaining the quality of the fish.

The tests were repeated on samples that had been blast frozen and stored for one month. The pattern of results replicated those obtained with the fresh samples, although the TVB's and microbial counts were lower. This effect could be attributed to a reduction in the active enzymes that contribute to the protein degradation of the flesh and a reduction in surviving micro-organisms, post-frozen storage.

It may also be appropriate to repeat the study once the sardine season has started, as there will be environmental temperature differences at different times of the year that may also have an effect on the shelf life.

4.3 LOBSTER BAIT

A dry lobster bait was produced using the resultant by-product from the product development section of the project, therefore clearly meeting the initial objective.

The final bait product was in the form of a "bait biscuit" approximately 100g in weight, which was trialed at sea in lobster pots. The results obtained from this trial were not statistically valid, but it is clear that there is a huge potential for optimisation of this product, in terms of attractant properties and sea/current stability. The use of dry bait blocks could significantly impact upon reducing the introduction of pathogens into our fishery stocks. For these reasons, a long term development project has been proposed.

4.4 FISH OIL ANALYSIS

A literature review carried out by Market Equity revealed an increasing awareness of the health benefits of Omega-3 fish oils.

The potential for using an Omega-3 claim for the salmon and herring products was therefore considered. A fatty acid profile was carried out, with poor results. The results could not be relied upon as being representative, as only one fish per species was analysed. This obviously would not account for any fish to fish variations, and consequently a further investigation into the fish oil content will be necessary.

An initial essential long chain Omega-3 Polyunsaturated Fatty Acids (PUFA) analysis was carried out by the CSIRO Division of Fisheries in Hobart, Tasmania, as part of an FRDC funded project FRDC 95/122 "Nutritional Value of Australian Fishes".

The results indicated that the Omega-3 PUFA's EPA (eiscosapentaenoic acid) and DHA (docosahexaenoic acid) were present in Australian Salmon (*Arripis trutta*).

An initial analysis of Australian Herring (*Arripis georgianis*), will be carried out as soon as the season commences.

5.0 RECOMMENDATIONS

1. Preparation of pilot samples using freshly caught, or at least correctly handled, frozen herring and salmon.

2. Repeat of focus groups and/or larger scale product evaluations using the above mentioned pilot samples, to produce statistically valid results.

3. Microbiological and organoleptic shelf life study of smoked salmon, peppered smoked salmon and smoked herring in vacuum packs.

4. Further investigation into the Omega-3 content of the Australian salmon and herring.

5. Investigation into packaging alternatives.

6. Feasibility of producing canned salmon and canned salmon/tuna combinations.

7. Feasibility of producing crumbed herring fillets using a sardine crumbing operation.

8. Repeat of shelf life study using sardines in season.

9. Further investigation into the potential of dry lobster bait by:

    a) determining feasibility of large scale production;

    b) optimisation of product by attractant characteristics and sea stability;

    c) Extensive feeding trials (to include rock lobster pots in the ocean).

6.0 METHODS

6.1 PRODUCT DEVELOPMENT

6.1.1 PICKLED HERRING

The herrings were filleted before being placed into a solution containing a 10 - 15% salt brine, vinegar, spice, vegetable oil and onion. All fillets were completely submerged in the solution to ensure that the pickling process would proceed through the entire fillet, allowing solubilization of the proteins to occur. The time expected for this to occur will vary depending on the size of the fish, but 2-7 days is usually sufficient. After appropriate analysis of the free fatty acids (see Appendix 1B), the fillets were packaged into sanitised jars or vacuum packed with fresh pickling solution, and refrigerated. Free fatty acid analysis was carried out to determine the most suitable end point, which ideally should be between 0.5 - 2%.

6.1.2 ROLLMOPS

The herrings were butterflied before being placed into a solution containing a 10 - 15% salt brine, vinegar, spice, vegetable oil and onion. Again, all butterfly fillets were submerged in the solution completely. Once the free fatty acids had reached a minimum of 0.5% (see Appendix 1B), the butterflies were rolled with onions and/or gherkins before being secured with a toothpick or skewer. All of the rollmops were then packaged into sanitised jars with fresh pickling solution , and refrigerated.

6.1.3 SMOKED SALMON

The salmon was cleaned, gutted and filleted before being pumped with a 5.5% brine solution across the whole length of the fish. They were then refrigerated for approximately 18-24 hours to allow the brine to disperse throughout flesh. The desired salt content of the salmon fillets was 1.5% which was determined by analysis of the salt content of the flesh (see Appendix 1E). The fillet was then hot smoked at 70-90°C for 2-3 hours using an appropriate saw dust mix (30% Jarrah: 70% Pine). After smoking, the fillet was then left to cool to allow the muscle to become firm. It was then carefully vacuum packed in bags and stored below 5°C.

An initial microbiological analysis (total plate count and presence/absence of *Listeria* species) was carried out by Microserve Laboratories on samples of vacuum packed smoked salmon after approximately 3 weeks chilled storage.

6.1.4 SMOKED HERRING

The herrings were cleaned and gutted before being pumped with a 5.5% brine solution across the whole length of the fish. It was then refrigerated for approximately 5-6 hours to allow brine to disperse throughout the flesh. The herring was then hot smoked at 70-90°C for 1-1.5 hours using the same saw dust mix as 6.1.3. After smoking, the fish was left to cool and then carefully vacuum packed in bags and stored below 5°C.

6.1.5 HERRING / SALMON IN BREADCRUMBS

Herring and salmon fillets were dusted with seasoned flour consisting of salt and black pepper, dipped in egg and coated with breadcrumbs prior to pan frying.

6.1.6 HERRING IN OATMEAL

Herring fillets were dusted with seasoned flour consisting of mustard, salt and black pepper. They were then dipped into egg and coated with oats prior to pan frying.

6.1.7 HERRING / SALMON IN TOMATO SAUCE

Onion and garlic were gently cooked in olive oil until softened. Tomatoes and the remainder of the dry ingredients were then added and brought to the boil. The mixture was blended until smooth.

6.1.8 HERRING / SALMON IN MARSALA SAUCE

Herring and salmon were marinated in the marsala sauce prepared and supplied by Ticket Prepared Foods. Both of the fish were pan fried with the sauce.

6.1.9 HERRING IN CURRY SAUCE

The herring fillets were marinated in curry sauce prepared and supplied by Ticket Prepared Foods. The fish was then pan fried with the sauce.

6.1.10 SALMON IN APPLE MORNAY

Dry ingredients were mixed well added to water, and brought to boiling point. The sauce was then heated until thick and cooled before being placed in foil containers containing the salmon. Paprika and parsley were added as garnish.

6.2 LOBSTER BAIT

6.2.1 LOBSTER BAIT PELLETS

Fish by-product obtained from the filleting process was minced twice. Dry ingredients were weighed according to the formulations below, then thoroughly mixed along with the fish by-product and put through a mixer to form extruded pellets. This process was repeated three times to ensure all ingredients were thoroughly mixed. The extruded pellets were then dried in a domestic food drier. The final moisture content of the product was then determined (Appendix 1F).

FORMULATION 1

100g lupin finely ground	20%
250g pollard	50%
150g fish dry matter (500g wet fish)	30%

FORMULATION 2

100g lupin finely ground	20%
200g pollard	40%
200g fish dry matter (666g wet fish)	40%

FORMULATION 3

100g lupin finely ground	20%
200g oats	40%
200g fish dry matter (666g wet fish)	40%

6.2.2 LOBSTER BAIT BISCUITS

The fish by-product and dry ingredients were treated in the same way as for the lobster pellets (see 6.2.1). The mix was then formed using a hamburger press to produce "biscuits". The biscuits were then dried, in short bursts in a microwave, to a constant weight. The final moisture content was again determined. A final moisture below 10% was the target for shelf stability.

For each formulation, biscuits were produced from the mix. The amount of wet fish equivalent contained in each biscuit was therefore as follows:

FORMULATION 1

125g of wet fish equivalent / biscuit

FORMULATIONS 2 & 3

166.5g of wet fish equivalent / biscuit

6.3 SARDINE SHELF LIFE STUDY

Due to the unavailability of sardines, anchovies were used for this study.

All anchovies caught were separated into four groups. Each group then underwent a different treatment. The treatments are as follows:

1. Control - caught and not iced;
2. Ice slurried on shore;
3. Ice slurried at sea;
4. Ice slurried at sea with bactericide.

Once on shore, the fish were drained and stored at 0°C for the duration of the tests.

Samples of each treatment group were blast frozen and kept in frozen storage (-20°C). They were then evaluated after one months storage, using the same tests as those used for the freshly caught samples.

6.3.1 VISUAL TEST

The anchovies were visually evaluated 10.5 hours post catch and 14 hours post catch on Wednesday 22 November, 30 hours post catch on Thursday 23 November and 54 hours post catch on Friday 24 November 1995. The visual test involved looking at the fishes eyes, skin and gills and evaluating them based on guidelines provided by WAFIC.

The visual test was repeated on the blast frozen anchovies approximately one month later, at time intervals of 10.5 hours, 14 hours, 30 hours and 54 hours post thawing.

6.3.2 TOTAL VOLATILE BASES (TVB's)

TVB analyses were carried out on the anchovies 10.5 hours post catch and 14 hours post catch on Wednesday 22 November, 30 hours post catch on Thursday 23 November and 54 hours post catch on Friday 24 November 1995. The TVB analysis involved detecting the level of ammonium that was accumulating on the

fish as it was becoming stale (see Appendix 1H). At a level greater than 300 mg/kg, the fish was considered to be "off".

Total Volatile Bases analyses were also carried out on the blast frozen samples after one months frozen storage, at time intervals of 10.5 hours, 14 hours, 30 hours and 54 hours post thawing.

6.3.3 MICROBIOLOGY

Microbial analyses were carried out on the anchovies to determine the spoilage rate by bacteria over the same period of time. All microbiological analyses were carried out by Microserve Laboratory, at 10.5 hours post catch and 14 hours post catch on Wednesday 22 November, 30 hours post catch on Thursday 23 November and 54 hours post catch on Friday 24 November 1995.

The microbial analyses were carried out on the blast frozen samples after one months frozen storage at time intervals of 10.5 hours, 14 hours, 30 hours and 54 hours post thawing.

6.4 FISH OIL ANALYSIS

A lipid analysis of Australian salmon (*Arripis trutta*) was carried out by the CSIRO Division of Fisheries, Hobart Tasmania, as part of an FRDC funded project entitled "Nutritional value of Australian fishes", project reference number FRDC 95/122.

7.0 RESULTS

7.1 PRODUCT DEVELOPMENT

7.1.1 PICKLED HERRING

The vinegar that was used during the pickling process was diluted accordingly, after a titratable acidity level confirmed the acetic content to be 4.41%. The vinegar was diluted to approximately 2.2% and used for all subsequent pickling solutions.

Free fatty acids were performed on the pickled herring to determine the length of the pickling process. Due to the size of the herrings, the pickling process was relatively short, the optimum time being between 5-8 hours.

After pickling, all pickled herring fillets were packed in sanitised glass jars.

All samples of the pickled herring were evaluated in-house. The evaluation revealed that the skin and muscle texture were tough, and that the flavour was very acetic and strong.

7.1.2 ROLLMOPS

Results were very similar to those found from the pickled herring fillets.

7.1.3 SMOKED SALMON

Salt analysis of the smoked salmon was carried out to ensure that the brine solution used, was of a high enough concentration to produce a residual muscle salt level of 1.5%. After the first analysis it was found that the brine needed to be increased, the second analysis with a 5.5% brine solution achieved a residual salt content of 1.6%.

During the smoking process, various sawdust types were used to smoke the product. When jarrah alone was used, the resulting end product was very dark in colour with not much flavour development. When pine was used exclusively, the resulting end product was light in colour but did however produce a good smoked flavour. A few jarrah : pine combinations were trialed. It was decided that a 30:70 combination of jarrah and pine gave the best results, and was used for all subsequent smoking processes.

As a variation to the original smoked salmon, cracked pepper was added to the salmon prior to smoking. The smoked peppered salmon, when evaluated in-house, was very popular and appeared to have a glaze which was not present on the normal smoked salmon.

All prepared smoked salmon were vacuum packed and refrigerated below 5°C.

An initial microbiological examination of 3 week old chilled samples produced a rather high total plate count of 19×10^6 CFU (colony forming units) per gram. An acceptable level would not be greater than 1×10^6 CFU per gram, for this type of product.

Listeria species were not detected in 25 grams.

7.1.4 SMOKED HERRING

Results for the smoked herring were similar to those obtained from the smoked salmon. The herring was smoked whole and was an attractive gold colour. The herring were also vacuum packed.

7.1.5 HERRING / SALMON IN BREADCRUMBS

Samples were shallow fried resulting in a golden brown coloured product. The taste, when the products were evaluated in-house, was described to be similar to chicken (salmon), and fish fingers. Colour comparison was made between the herring and the salmon, but the general consensus was that the products were quite acceptable.

Samples should be crumbed prior to frying, but if they needed to be stored overnight with crumbs, they were flashed fried to prevent the crumbs from becoming "soggy". The crumbed samples were packed in black foam trays with a polyethylene overwrap.

7.1.6 HERRING IN OATMEAL

The herring was coated in oats and shallow fried prior to eating, resulting in a light golden colour. Due to the oats and the size of the fish, the taste was very bland and "porridge like". Little fish flavour was evident. For these reasons the product was not produced for the focus groups.

7.1.7 HERRING / SALMON IN TOMATO SAUCE

The tomato sauce was initially made according to a recipe, but as there was a need to produce a freeze/thaw stable sauce with a good viscosity, various thickeners and stabilisers were trialed.

A modified starch was trialed. Initially, the resulting sauce was very thick, and a predominant "floury" flavour was present. The sauce made with Satiaxine cx 393 at 0.05% was stable when frozen and thawed, but due to the cost a cheaper alternative product was trialed. Carrageenan (aquagel) was added to the sauce at 0.5%. This produced a sauce with a good viscosity after freezing and thawing, and the cost was kept to a minimum. All subsequent tomato sauces were made with the carrageenan (aquagel) at 0.5%.

After preparation of the sauce it was poured into foil containers containing the salmon or the herring, for reheating in the oven or pan cooking. Results from in-house evaluation revealed the sauce to be quite acceptable and a good masking agent for the colour of the salmon.

7.1.8 HERRING / SALMON IN MARSALA SAUCE

The sauce when heated in a fry pan, thickened and coated the fish, producing a yellow coloured product. It was very strong and thus overpowered the fish. The products were therefore not produced for the focus groups.

7.1.9 HERRING IN CURRY SAUCE

The fish was marinated with the curry in a foil container. The curry was very strong in flavour and was popular amongst those that ate curry, when evaluated in-house. The sauce was made with onions, was fairly runny and was brown in colour.

7.1.10 SALMON IN APPLE MORNAY

The mornay was very thick and yellow in colour, pieces of apple were present in the sauce, and there was a very strong smell when the product was cooked in the oven. The product was packaged in foil containers.

7.1.11 PRODUCTS USED FOR FOCUS GROUP EVALUATIONS

All samples that were prepared were evaluated organoleptically to determine suitability for use in the focus group. The products that were used included the smoked herring and salmon, herring and salmon in tomato sauce, herring and salmon in breadcrumbs, salmon in apple mornay, and herring in curry sauce. Plain raw fillets were also provided for the focus groups, as requested by Market Equity.

7.2 LOBSTER BAIT

7.2.1 LOBSTER BAIT PELLETS

The pellets were extruded from a mixer and left to dry. The moisture content of the pellets was between 6-11%, depending on the percentage of fish by product used in the product. Due to the higher moisture content the pellets were not very stable and went mouldy quite quickly. Those that were stable were fed to lobster at the Aquaculture Centre with very encouraging results. The lobster detected the pellets that had been dropped into the tanks, moved towards them and promptly consumed them.

7.2.2 LOBSTER BAIT BISCUITS

The dimensions of the lobster biscuits were approximately 8.5 diameter x 2.0 cm thick and weighed approximately 100g. They were brown in colour and were stable for at least 2 days in sea water.

Trials were undertaken by professional rock lobstermen, but the results were not statistically valid with only 4 lobsters being caught from nine pots (44.4%) compared to 59 lobsters (83.1%) from 70 pots being caught when whole pilchards and hides were used as bait. However, it should be noted that only 1kg of dry bait was used to catch the 4 lobsters, compared with 140kg of wet bait used to catch 59 lobsters. There was some evidence that the three pots containing the bait biscuits placed close to the shore, had been pilfered. As such, the results were not statistically valid.

7.3 SARDINE SHELF LIFE STUDY

Three different analyses were completed on the anchovies. The results from the visual, total volatile bases and microbial analyses can be seen in the table and graphs below. There was a decline in the freshness of the fish as time lapsed in all analyses.

7.3.1 VISUAL TEST

DATES AND TIMES	EYES	GILL APPEARANCE	SKIN	FLESH
22/11/95 10.5 hrs post catch	Convex and clear	Red, bleeding from the gills	Yellowish tinge, loss of some skin	Firm
22/11/95 14 hrs post catch	Clear, slight bleeding	Red brown colour	Dull, breakages in the skin	Stomach, softer distended, sticky
23/11/95 30 hrs post catch	Slightly cloudy, sunken	Lighter colour	Quite dull, no skin near stomach	Soft, very sticky
24/11/95 54 hrs post catch	Sunken, cloudy	Lighter red brown	Quite dull	Soft

TABLE 1 CONTROL - NO ICE SLURRY

DATES AND TIMES	EYES	GILL APPEARANCE	SKIN	FLESH
22 / 11/ 95 10.5 hrs post catch	Convex and clear	Red	Silvery colour, shiny, some breakage in skin	Firm
22 / 11/ 95 14 hrs post catch	Clear and convex	Red brown, little mucus, slight bleeding	Silvery colour, little duller	Firm
23 / 11/ 95 30 hrs post catch	Clear, sunken	Bleeding, red brown colour	Less bright	Firm, stomach starting to distend
24/ 11/ 95 54 hours post catch	Sunken	Lighter colour	Dull, breakage in skin	Stomach distended, soft

TABLE 2 ICE SLURRY ON SHORE

DATES AND TIMES	EYES	GILL APPEARANCE	SKIN	FLESH
22 / 11/ 95 10.5 hrs post catch	Clear, convex	Dark red	Very shiny	Firm
22 / 11/ 95 14 hrs post catch	Clear, convex	Slight bleeding, red	Very shiny	Firm
23 / 11/ 95 30 hrs post catch	Clear, convex	Red	Little duller but still quite shiny	Firm
24/ 11/ 95 54 hours post catch	Sunken little cloudy	Red brown	Duller, breakage in skin increased	Stomach distending, little soft.

TABLE 3 ICE SLURRY AT SEA

DATES AND TIMES	EYES	GILL APPEARANCE	SKIN	FLESH
22 / 11/ 95 10.5 hrs post catch	Clear, convex	Dark red	Silvery, very bright, shiny	Firm
22 / 11/ 95 14 hrs post catch	Clear, convex	Red	Silvery, very bright	Firm
23 / 11/ 95 30 hrs post catch	Clear, slightly sunken	A little brown on the edge of the gills	Duller, some breakage in the skin	Firm
24/ 11/ 95 54 hours post catch	Sunken, cloudy	Red brown colour	Breakage of skin near stomach	Stomach distended, softer

TABLE 4 ICE SLURRY AT SEA WITH BACTERICIDE

7.3.1.1 VISUAL TEST AFTER 1 MONTHS FROZEN STORAGE

DATES AND TIMES	EYES	GILL APPEARANCE	SKIN	FLESH
20 /12 / 95 10.5 hrs post thawing	Sunken	Red, bleeding	Shiny	Quite firm, distended stomach
20 / 12/ 95 14 hrs post thawing	Sunken, slightly cloudy	Bleeding	Less shiny	Distended stomach, firm
21/ 12 / 95 30 hrs post thawing	Sunken, cloudy	Lighter red-brown	Less shiny, breakage of skin near stomach	Slight soft, stomach distended
22/ 12 / 95 54hrs post thawing	Sunken, cloudy	Red-brown	Quite dull, loss of skin near stomach	Soft, stomach distended

TABLE 5 CONTROL - NO ICE SLURRY

DATES AND TIMES	EYES	GILL APPEARANCE	SKIN	FLESH
20 /12 / 95 10.5 hrs post thawing	Sunken	Red, bleeding	Shiny, lots of breakage in the skin	Firm
20 / 12/ 95 14 hrs post thawing	Sunken, slightly cloudy	Red, bleeding	Quite shiny, breakages	Firm
21/ 12 / 95 30 hrs post thawing	Sunken, cloudy	Bleeding, red-brown	Less shiny	Stomach distended Slightly soft
22/ 12 / 95 54hrs post thawing	Sunken	Red-brown, mucus	Dull	Slightly soft, stomach distended

TABLE 6 ICE SLURRY ON SHORE

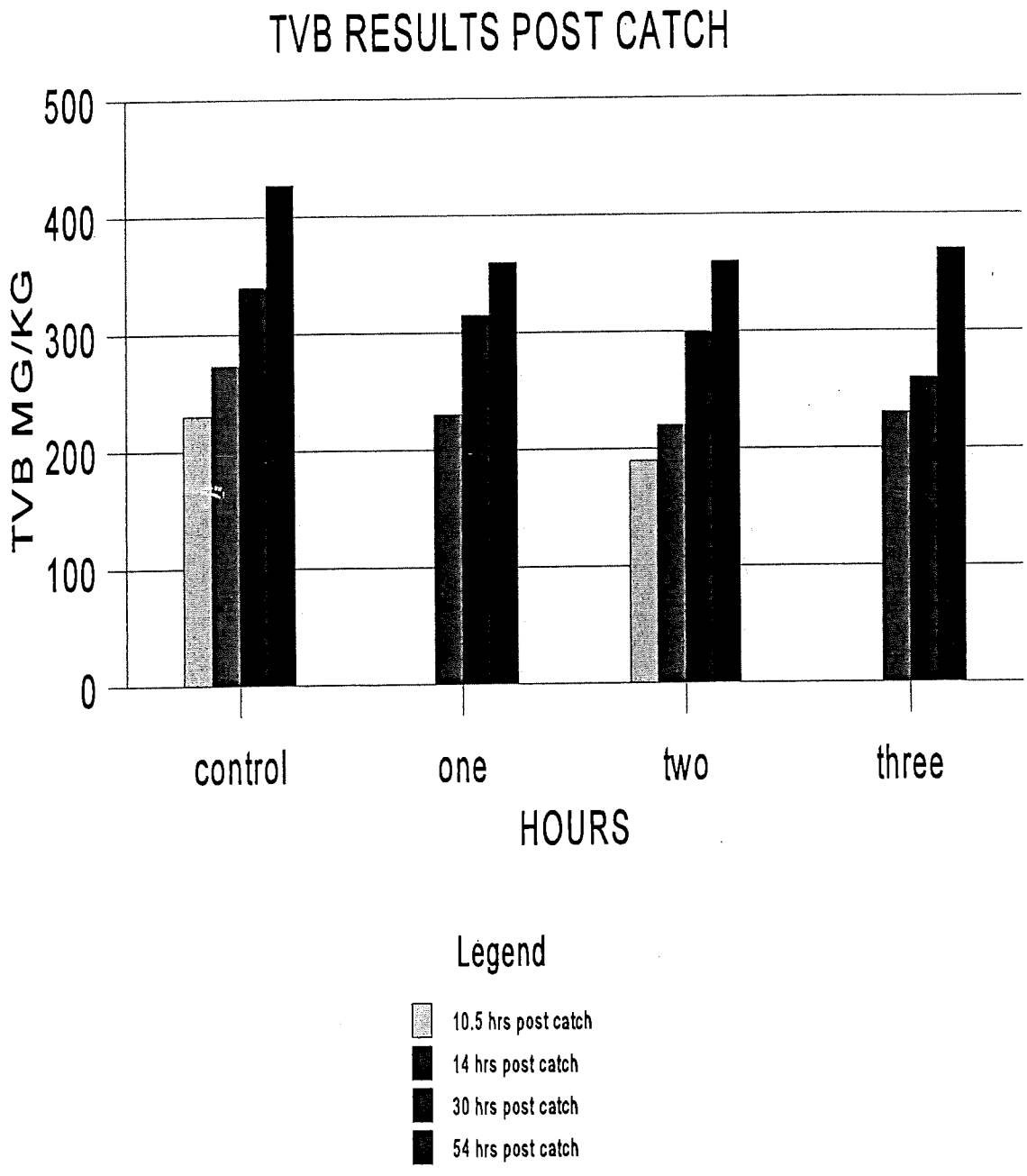
DATES AND TIMES	EYES	GILL APPEARANCE	SKIN	FLESH
20 /12 / 95 10.5 hrs post thawing	Sunken, slightly cloudy	Dark red, bleeding	Shiny, smooth	Firm
20 / 12/ 95 14 hrs post thawing	Sunken, slightly cloudy	Dark red, bleeding	Shiny, smooth	Firm
21/ 12 / 95 30 hrs post thawing	Sunken, cloudy	Red-brown, bleeding	Less shiny, breakage near stomach	Slightly soft
22/ 12 / 95 54hrs post thawing	Sunken, cloudy	Red-brown, bleeding	Less shiny, Breaks near stomach	Slightly soft, stomach distended

TABLE 7 ICE SLURRY AT SEA

DATES AND TIMES	EYES	GILL APPEARANCE	SKIN	FLESH
20 /12 / 95 10.5 hrs post thawing	Sunken	Very little bleeding, dark red	Shiny, breakages in the skin	Firm
20 / 12/ 95 14 hrs post thawing	Sunken, slightly cloudy	Red, little bleeding	Shiny, breakage in the skin	Firm
21/ 12 / 95 30 hrs post thawing	Sunken, cloudy	Red-brown, bleeding	Less shiny	Slightly soft, stomach distending
22/ 12 / 95 54hrs post thawing	Sunken, cloudy	Red- brown	Less shiny, breakage of skin near stomach	Slightly soft, stomach distended

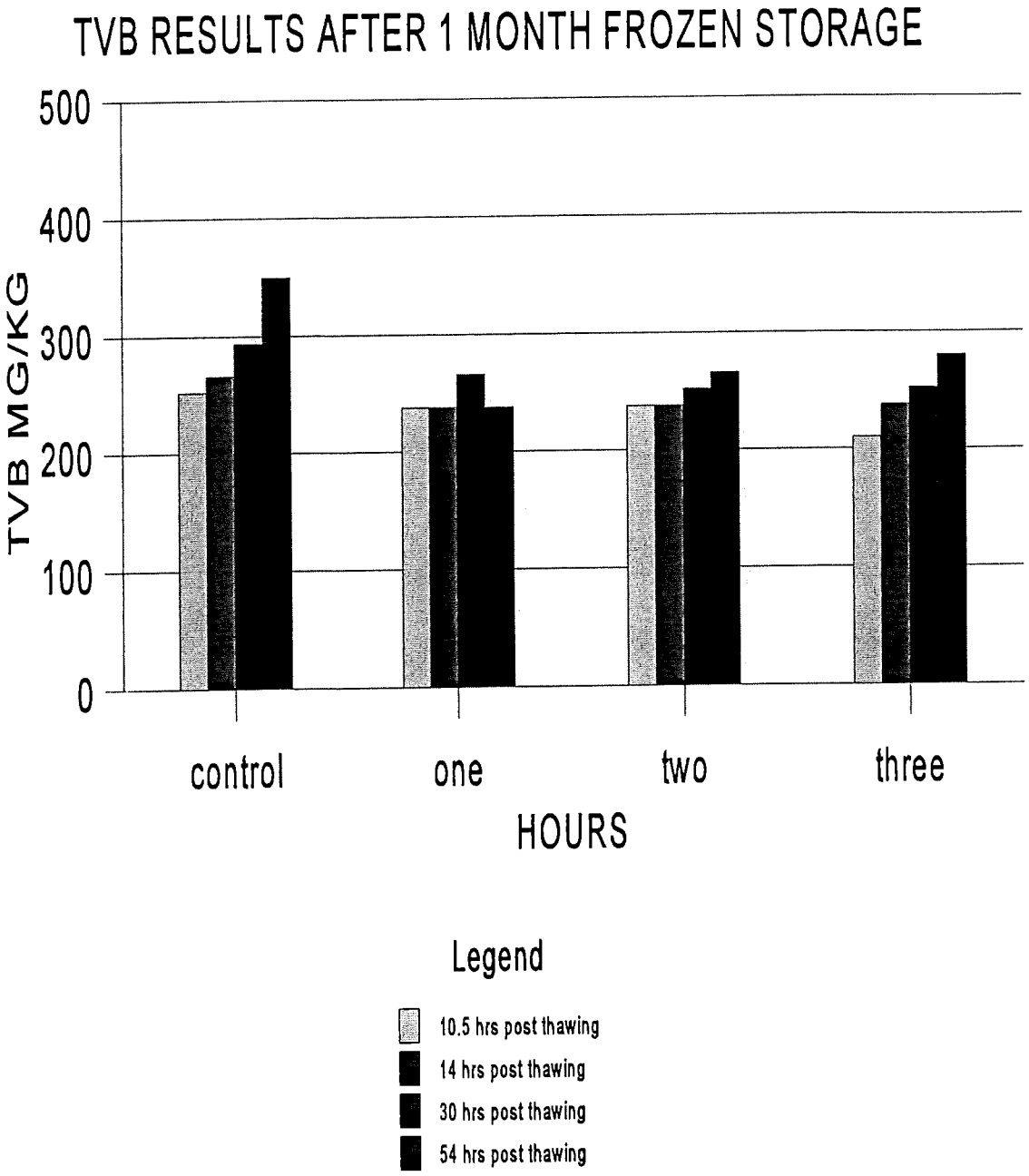
TABLE 8 ICE SLURRY AT SEA BACTERICIDE

7.3.2 TVBs



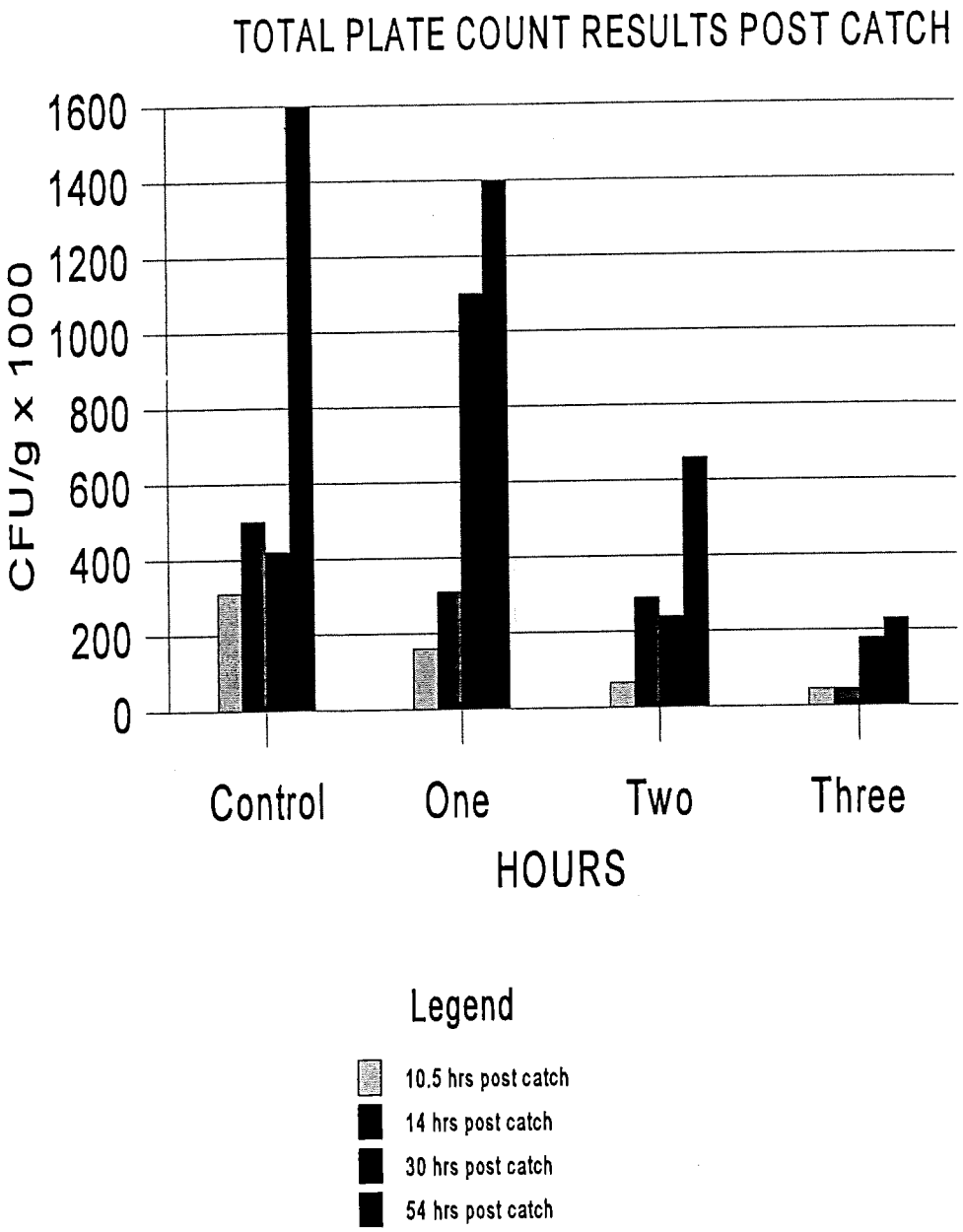
Control - No ice slurry
One - Ice slurry on shore
Two - Ice slurry at sea
Three - Ice slurry at sea with bactericide

7.3.2.1 TVBs



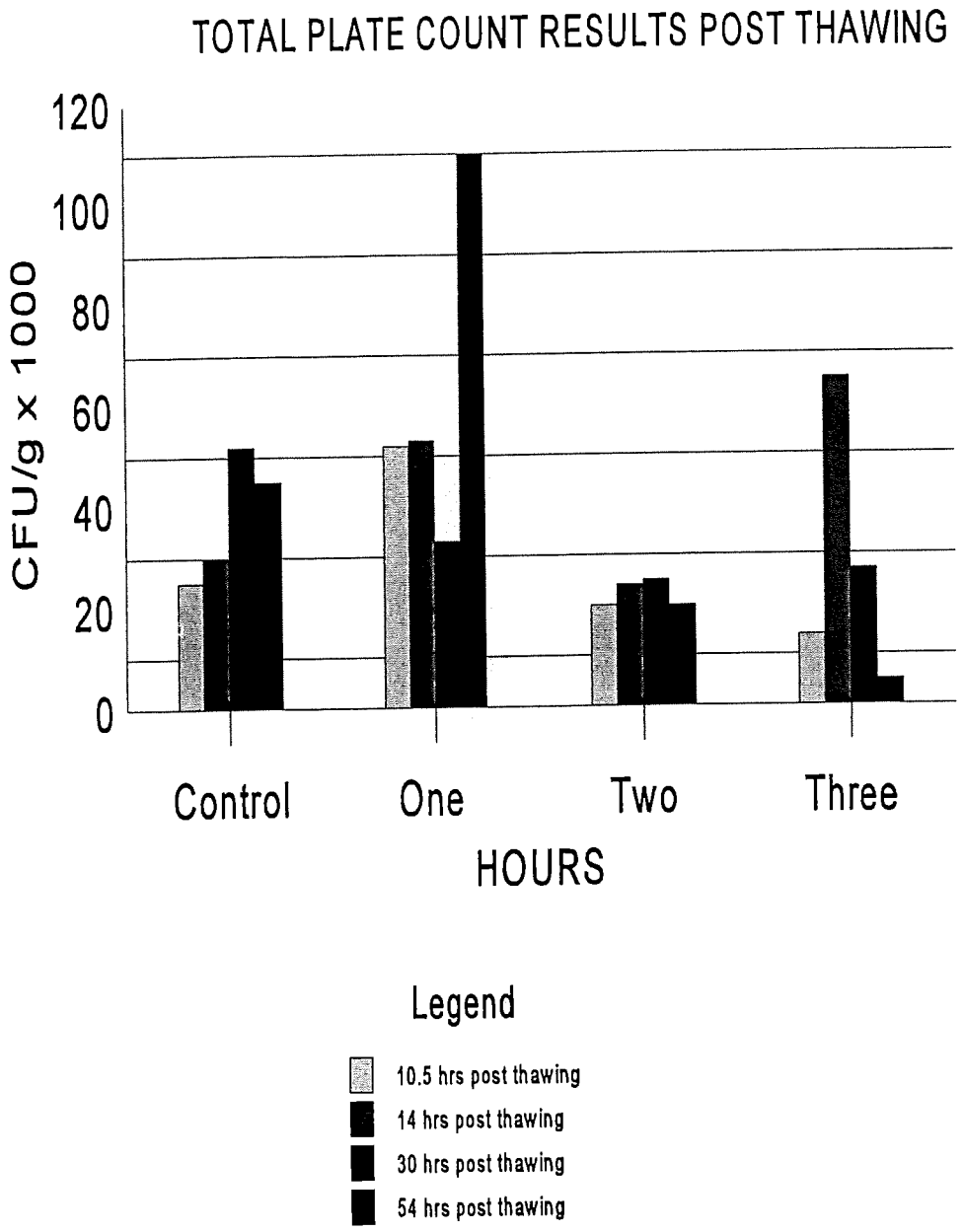
Control - No ice slurry
One - Ice slurry on shore
Two - Ice slurry at sea
Three - Ice slurry at sea with bactericide

7.3.3 MICROBIOLOGY



Control - No ice slurry
One - Ice slurry on shore
Two - Ice slurry at sea
Three - Ice slurry at sea with bactericide

7.3.3.1 MICROBIOLOGY



Control - No ice slurry
One - Ice slurry on shore
Two - Ice slurry at sea
Three - Ice slurry at sea with bactericide

7.4 FISH OIL ANALYSIS

The results listed below were provided by the CSIRO Division of Fisheries, Hobart, Tasmania. It should be noted that these results are draft only, the final figures will become available as the project FRDC 95/122 progresses.

LIPID CLASS DISTRIBUTION

Polar lipid	54%
Triacylglycerol	42%
Sterol	2%
Free Fatty Acids	1%

CHOLESTEROL

193μg/g
1% total lipid (10.8 mg/g)

ESSENTIAL LONG CHAIN OMEGA-3 POLYUNSATURATED FATTY ACIDS

EPA (eicosapentaenoic acid)	6%	0.5mg/g
DHA (docosahexaenoic acid)	31%	2.8mg/g

8.0 LITERATURE REVIEW

8.1 LOBSTER BAIT

Lobster diet consists mainly of fish (dead and alive), shellfish and other lobsters. Bones of fish are swallowed and are necessary for the building of the lobster's shell.

Lobstermen prefer oily fish as bait, for example herring or mackerel, as the oil appears to be an attractant to lobsters. Fish heads also make good bait. (Pruden, 1962).

Lobster bait is usually the offal remaining after fillets have been removed from edible fish. It is for this reason that all manufactured lobster bait will be odorous.

8.2 SMOKING

8.2.1 CHARACTERISTICS OF SMOKE

The characteristic of the smoke flavour depends essentially on the source of the smoke. Oak is generally regarded as being able to produce the best flavour. Generally the softwoods colour the fish quickly, whilst hardwood tends to produce a milder flavour. Wood that has been treated with preservatives must not be used for smoking. Differences in the flavour of the smoked fish arise according to the manner in which the smoke is deposited. Wood smoke comprises of two parts, termed the visible tarry droplets and invisible vapours. All chemical compounds present in the smoke are present in both parts, but not in the same proportion. The vapours contain a higher proportion of volatile compounds than the droplets, thus allowing them to be rapidly dissolved in the moisture on the surface of the fish. The smoke compounds in the vapours dissolved in the moisture on the surface of the fish, and the faster the flow of smoke, the more rapidly these compounds are absorbed. Thus pre-dried fish which has little free moisture at the surface picks up smoke much less readily (Aitken, Mackie, Merritt, Windsor, 1982)

8.2.2 SMOKE CHEMISTRY

The preservative effect of smoke, increase in shelf life, flavour and colour, are due largely to compounds known as phenols. Phenols are active against the naturally occurring fish spoilage bacteria present on all fish. In a well smoked product over 90% of the bacteria originally present are killed by smoke (Aitken & et al, 1982).

A small amount of formaldehyde is present in wood smoke and this may also be responsible for some of the preservative effect associated with smoking.

Phenols contribute predominately to the smoke flavour, whilst carbonyls and phenols are involved in the formation of the colour of undyed smoked products. TABLE 9 shows some of the major components identified in smoke vapours.

TABLE 9 - SOME OF THE MAJOR COMPONENTS IN SMOKE VAPOURS

ACIDS	PHENOLS	CARBONYLS	ALCOHOLS	HYDROCARBONS
Formic	Syringols	Formaldehydes	Ethanol	Benzpyrene
Acetic	Guaiacols	Propionaldehyde	Methanol	Benzanthracene
Butyric	Cresols	Furfuraldehydes		Indene
Caprylic	Xylenols	Octyl aldehyde		Napthalene
Oxalic		Acrolein		Stilbene
Vanillic		Methyl ethyl ketone		Fluorene
Syringic		Methyl glyoxal		Phenanthrene
Phthalic				

8.2.3 SMOKING TIME & TEMPERATURE

Cold smoking temperatures should not be above 30°C, and is favoured for fish that are to be preserved for a long time. This method of smoking results in the fish remaining uncooked.

Hot smoking is in effect a cooking process as the temperatures are raised to 70°C and above. Hot smoked fish are usually intended to be eaten immediately or at most 72 hours post smoking if refrigerated (Aitken & et al, 1982).

8.2.4 STORAGE OF SMOKED FISH

A general rule for the storage of smoked fish is that the drier it is the longer it will keep. However the degree of salting, smoking and the conditions of storage after smoking, play a significant part in the storage life.

Most smoked fish should not be frozen. Whilst freezing prevents decay, on thawing the fish may have lost much of its flavour and acquired an unpleasant texture (Sleight and Hull, 1973).

8.3 HOT SMOKED HERRING

The herring is cut along the belly, carefully gutted, washed with diluted brine and cured in 10-15% brine for 40 -90 minutes. The fish is then drained, dried and smoked. Smoking time is usually 4-6 hours and the initial temperature is about 20°C, it is then increased gradually to reach 85°C in the final stage (Burt, 1988).

8.4 ROLLMOPS

Rollmops are herrings that are boned, halved and rolled tightly around peppercorns and onions and fastened with skewers, before being put into jars to which is added hot spiced white vinegar. They can also be wrapped around pickles or gherkins.

Rollmops originated in Europe and are particularly popular in Scandinavian countries. In Australia the best substitute is the garfish, although the flesh is a little softer than the European herring (Rogers, 1990).

8.5 PICKLING HERRING

Herring for pickling should be very fresh. The fish needs to be carefully cleaned and its head removed. After removal of the head, the strip of thin belly flesh from each side of the opening and the dark streak next to the backbone should be removed. The fillet is then carefully washed and drained (Barbour, 1978).

The fillets are loosely arranged in a large container with a solution of water, vinegar and pickling salt. The fish is left for 3 to 7 days (according to the size of the fish). However if the skin starts to wrinkle or lose colour it is time to remove the fish from the brine (Barbour, 1978).

The cured herring is drained and repacked into a fresh pickling solution consisting of spices, water, vinegar, salt, and slices of onion.

The pickled herring should be stored in a cool place.

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APPENDIX 1 - CHEMICAL METHODS

A TITRATABLE ACIDITY OF VINEGAR

METHOD

2ml of vinegar was placed into 250ml of neutralised water with a pH of 7. Phenolpthalein indicator was added to the solution before being titrated with 0.01N NaOH.

B FREE FATTY ACID ANALYSIS (FFA ANALYSIS)

METHOD

A sample of the fish was blended with water in a ratio of 1: 1. 40g of the resulting homogenate (which contained 20g of fish) was then weighed into extraction thimbles and dried overnight at a temperature of 105°C. A round bottom flask (250 ml) was also placed into the oven to be dried. After drying overnight, the extraction thimbles were removed and placed into a desiccator, while the round bottom flask was weighed. Equipment for the soxhlet extraction was obtained and set up before 200 ml hexane was added. It was then left for 12 hours to allow the fat to be extracted from the sample. After 12 hours the round bottom flask containing both oil and hexane was placed into a rotary evaporator which removed the hexane. The resulting flask containing the remaining oil was then dried in an oven for 30 mins, at a temperature of 105°C, to remove any moisture. After cooling, the round bottom flask was weighed and 20 ml of neutral solvent was added. The dissolved oil was then carefully titrated with 0.1N NaOH.

C ANALYSIS OF FREE FATTY ACID - ACETONE EXTRACTION

METHOD

A sample of the fish was homogenised with distilled water in a ratio of 1:1. 40g of the homogenate was then weighed into an extraction thimble and soxhlet extracted with 200 ml of acetone for 16 hours. After 16 hours the acetone was distilled to a volume of approximately 10-15 ml. A beaker was weighed and any remaining acetone was removed via evaporation. The beaker and the resulting oil were then dried for 1 hour. After 1 hour the beaker was weighed again and the extracted meal residue from the thimble was transferred into the beaker. The beaker was then placed onto a hot plate to remove any remaining solvents before 4N of HCl was added. The meal residue and the HCl were then digested on the hot plate for one hour, after which it was filtered and dried for one hour in an oven. The dried filter was then transferred into a thimble, and once again soxhlet extracted with acetone for 16 hours. After 16 hours the remaining solvent was removed as above and weighed to calculate the total fat in the sample.

D ANALYSIS OF SALT - DIRECT TITRATION METHOD

METHOD

A sample of fish was homogenised 1:1 with distilled water. 20g of the resulting homogenate (10g fish) and 80ml of distilled water was then added to a beaker containing boiling chips. The contents of the beaker were boiled for 5-10 min to ensure all the salt present in the sample would be in solution. After boiling and cooling, 1 ml of potassium chromate solution (10% K_2CrO_4) was added. It was then titrated with 0.01M (0.1N) silver nitrate [0.01M $AgNO_3$= 16.99g ⇨1L]

E ANALYSIS OF SALT - AOAC METHOD 937.09

METHOD

A sample of fish was homogenised 1:1 with distilled water. 20g of the homogenate (10g fish)was then weighed into conical flask, to which 30ml of 0.1 $AgNO_3$ solution and 20 ml of concentrated HNO_3 was added. The mixture was then gently boiled. After cooling, 50 ml of distilled water and 5ml of a ferric indicator was added. This mixture was then titrated with 0.1N NH_4 until a permanent light brown colour was evident.

F MOISTURE CONTENT OF FISH PRODUCTS

METHOD

The fish was homogenised 1:1 with distilled water before 10g of the homogenate was weighed into a metal crucible. The metal crucible was then transferred to an oven (105°C) and left to be dried overnight. After drying, the sample and crucible were weighed to determine moisture loss. Where the moisture content of a dry product, such as the lobster bait, was to be determined, the dry substrate was homogenised with a 1:2.5 ratio of distilled water.

G TOTAL FREE FATTY ACID PROFILE OF SALMON AND HERRING

METHOD

A sample of the relevant fish was homogenised 1:1 with distilled water. It was then transferred into a glass jar before being freeze dried. After freeze drying a sample was placed into a thimble and soxhlet extracted for 12 hours. The extracted sample was then analysed through Gas Chromatography (GC) to determine the fatty acid present in the fish.

H TOTAL VOLATILE BASES - SARDINE SHELF LIFE

METHOD

Anchovies were roughly chopped up into little pieces. 10g of the fish was then weighed into a kjeldahl flask to which more than 2 grams of magnesium oxide was then added. 2-3 drops of anti foam A and 300 ml of distilled water was also added to the flask. 25ml of 2% boric acid, distilled water and a few drops of screened methyl red indicator were measured into a beaker. After connecting the distillation system, the flask was heated to allow the contents to boil in exactly 10 minutes. Using the same heating rate the contents of the flask were distilled for 25 minutes. After 25 minutes the condenser was washed down with distilled water before being titrated with H_2SO_4.

APPENDIX 2 - RESULTS OF CHEMICAL METHODS

A TITRATABLE ACIDITY OF VINEGAR

The titratable acidity of vinegar (see Appendix 1A) was analysed to establish the content of the vinegar that was to be used for pickling. The results for the vinegar were as follows:

RESULTS

Final vol (ml) 17.2
Initial vol (ml) 2.50
Titre (ml) 14.70

Titratable acidity = Titre for 10ml of sample x acetic acid/100ml
= 73.5ml x 0.060
= 4.41% (4.41ml acetic acid /100ml)

Acetic acid content needs to be approximately 2% to be used for the pickling process. Vinegar was diluted accordingly.

B FREE FATTY ACID ANALYSIS (FFA ANALYSIS)

Free fatty analysis (see Appendix B) was carried out for the pickled herring and roll mops to determine the pickling end point. The desired target was between 0.5-2%. The results of the analysis are as follows:

RESULT 1

EXPERIMENT 1

SAMPLE : PICKLED SWAN RIVER HERRING 2.2% ACETIC ACID

	FRESH FISH	PICKLED FISH
Wt FLASK & OIL	111.3792g	118.6698g
Wt FLASK	111.3460g	118.6496g
Wt OIL	0.0332g	0.0202g

TITRATION RESULTS:

	FRESH FISH	PICKLED FISH
Final Vol (ml)	1.42	1.52
Initial Vol (ml)	1.30	1.45
Titre (ml)	0.12	0.07

Conclusion: insufficient oil to analyse correctly. Fish has very low oil content.

RESULT 2

EXPERIMENT 2

SAMPLE: PICKLED ALBANY BULL HERRING IN 1.15% AND 2.25% ACETIC ACID

	FRESH	PICKLED 1.1%	PICKLED 2.2%
FLASK Wt	75.5480g	110.2980g	86.2138g
FLASK AND OIL	78.5276g	110.8889g	86.2795g
OIL	2.9796g	0.5909g	0.0657g

TITRATION RESULTS:

	FRESH	PICKLED 1.1% BRINE	PICKLED 2.2% BRINE
Initial Vol (ml)	8.1	6.4	5.0
Final Vol (ml)	10.5	7.1	5.3
Titre (ml)	2.4	0.7	0.3

$$\text{Acid Value} = \frac{\text{Titration (ml 0.1N)} \times 5.61}{\text{Wt of sample used}}$$

$$\text{FFA} = \frac{\text{acid volume}}{2}$$

$$\text{\% FFA as oleic acid} = \frac{\text{Titre} \times \text{Oleic Acid Factor} \times 100}{\text{Sample wt (g)}}$$

	FRESH	PICKLED 1.1% BRINE	PICKLED 2.2% BRINE
ACID VALUE	4.5187	6.6458	25.62
FFA% (Expressed as oleic acid)	2.26%	3.32%	12.81

C ANALYSIS OF FREE FATTY ACID - ACETONE EXTRACTION

Hexane soxhlet extraction (See Appendix 1B) also extracted proteinaceous lipids from the raw herring. The gave a false high oil content result, therefore a method involving acid hydrolysis and a mild organic solvent was required for fat extraction from pickled herring. AOAC method 948.16 [Fat (crude) in fish meal] (See Appendix 1C) will be used throughout the project for all subsequent analyses.

RESULTS

No samples were analysed using this method due to the unacceptable nature of the pickled products.

D ANALYSIS OF SALT - DIRECT TITRATION METHOD

The analysis of salt (see Appendix 1D) was used to determine the salt content of the smoked salmon. The desired salt content of the salmon should be above 1.5%.

RESULTS

Not a very successful method. The end point was very hard to distinguish, therefore an alternative method was necessary.

E ANALYSIS OF SALT - AOAC METHOD 937.09

This was the new method to analyse the salt content of the smoked salmon (see Appendix 1 E)

RESULT 1

Salt content of smoked salmon
Date: 17-8-95

	SAMPLE 1	SAMPLE 2
Final vol (ml)	12.55	12.40
Initial vol (ml)	0	0
Titre (ml)	12.55	12.40

Subtract ml of 0.1N NH_4SCN (Titre) from ml of $AgNO_3$ added and calculate difference as NaCl.
With 10g sample each ml 0.1N $AgNO_3$ = 0.0058% NaCl.

%NaCl 1.01%

Conclusion - brine solution needs to be increased.

RESULT 2

Salt content of smoked salmon in 5.5% brine

Date: 15-9-95

	SAMPLE 1	SAMPLE 2	SAMPLE 3
Final vol (ml)	0.00	3.00	7.3
Initial vol (ml)	3.00	6.30	10.2
Titre (ml)	3.00	3.30	2.9

Average titre - 3.1ml

%NaCl 1.6%

Conclusion - brine solution yielded the desired salt level.

F MOISTURE CONTENT OF FISH BY-PRODUCT

Analysis of moisture (see Appendix 1F) was completed on fish by product to determine the moisture level for the purpose of formulating baits. The by product comprised all inedible portions of the salmon and herring. This includes head, tail, bones and internal organs and was obtained as a by-product from the filleting process.

RESULTS

	SAMPLE 1	SAMPLE 2
Crucible weight (g)	14.6758	14.3876
Homogenate (g)	11.0243	11.2496
Wt crucible and homogenate (g)	25.7001	25.6372
Wt fish (g)	5.5121	5.6248
Wt crucible and dried sample (g)	16.3532	16.0472
Wt dried sample (g)	1.6774	1.6596
Wt moisture in fish (g)	3.8347	3.9652
Moisture (%)	69.6	70.05

MOISTURE CONTENT OF SMOKED SALMON

Analysis of moisture (see Appendix 1F) was completed on smoked salmon to determine the end points of smoking. This also provided an indication of the amount of moisture lost due to an increase in smoking times.

RESULTS

	SAMPLE 1	SAMPLE 2
Crucible weight (g)	13.8163	13.3587
Homogenate (g)	10.06	10.15
Wt crucible and homogenate (g)	23.8763	23.5087
Wt fish (g)	5.03	5.075
Wt crucible and dried sample (g)	15.4589	15.0235
Wt dried sample (g)	1.6426	1.6648
Wt moisture in fish (g)	3.3874	3.4102
Moisture (%)	67.3	67.2

MOISTURE CONTENT OF LOBSTER BAIT

Moisture analysis (see Appendix 1F) was applied to lobster bait to determine shelf stability. The higher the moisture level, the more likely the bait was to decompose.

RESULTS - extruded pellets

	30% Fish	40% Fish
Crucible weight (g)	15.1338	13.8027
Homogenate (g)	17.05	15.88
Wt crucible and homogenate (g)	32.1838	29.6827
Wt fish (g)	6.089	6.352
Wt crucible and dried sample (g)	20.8531	19.393
Wt dried sample (g)	5.7193	5.5903
Wt moisture in fish (g)	0.3697	0.7617
Moisture (%)	6.07	11.99

RESULTS - BISCUITS

	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5
Crucible wt (g)	23.0420	23.7846	17.4996	17.9296	23.3409
Sample wt (g)	5.4018	4.3373	6.4523	5.3004	6.2355
Wt crucible & sample (g)	28.4438	28.1219	23.9519	23.2300	29.5764
Wt crucible & dried sample (g)	28.0188	27.8112	23.4762	22.7632	29.1298
Wt dried sample (g)	4.9768	4.0266	5.9771	4.8336	5.7889
Wt moisture in sample (g)	0.425	0.3107	0.4752	0.4668	0.4466
Moisture (%)	7.86	7.16	7.36	8.80	7.16

G TOTAL FREE FATTY ACID PROFILE OF SALMON AND HERRING

A total free fatty acid profile (see Appendix G) was completed on both herring and salmon to determine if omega 3 fatty acids were present in the fish.

RESULTS

SAMPLE	OMEGA 3	OMEGA 6
Bull Herring	29.8%*	3.2%*
Herring	6.4%*	3.5%*
Salmon	1.0%*	0.7%*

* Presented as a percentage of the total fatty acid present in the fish.

The results are not representative of the amount of omega 3 and 6 fatty acids present in both herring and salmon, as only one fish was used in the analysis.

H SHELF LIFE TESTING OF SARDINES

TOTAL VOLATILE BASES

Calculations - (titre vol (ml) - blank) x 140 = TVB mg/Kg
NB - Blank in this study is 0.05

10.5 HOURS POST CATCH

	CONTROL	ONE	TWO	THREE
Initial vol (ml)	0.00		1.80	
End vol (ml)	1.70		3.20	
Titre vol (ml)	1.70		1.40	
TVB mg/kg	230		190	

14 HOURS POST CATCH

	CONTROL	ONE	TWO	THREE
Initial vol (ml)	14.0	16.0	17.7	20.1
End vol (ml)	16.0	17.7	19.3	21.8
Titre vol (ml)	2.0	1.7	1.6	1.7
TVB mg/kg	273	231	217	231

30 HOURS POST CATCH

	CONTROL	ONE	TWO	THREE
Initial vol (ml)	23.5	26.0	28.3	31.0
End vol (ml)	26.0	28.3	30.5	32.9
Titre vol (ml)	2.5	2.3	2.2	1.9
TVB mg/kg	343	315	301	259

54 HOURS POST CATCH

	CONTROL	ONE	TWO	THREE
Initial vol (ml)	33.0	36.1	38.7	41.3
End vol (ml)	36.1	38.7	41.3	44.0
Titre vol (ml)	3.1	2.6	2.6	2.7
TVB mg/kg	427	357	357	371

TOTAL VOLATILE BASES FOR THAWED ANCHOVIES

10.5 HOURS POST THAWING

	CONTROL	ONE	TWO	THREE
Initial vol (ml)	7.9	2.1	4.1	6.1
End vol (ml)	10.0	4.1	6.1	7.9
Titre vol (ml)	2.1	2.0	2.0	1.8
TVB mg/kg	252	238	238	210

14 HOURS POST THAWING

	CONTROL	ONE	TWO	THREE
Initial vol (ml)	10.1	12.3	14.3	16.3
End vol (ml)	12.3	14.3	16.3	18.3
Titre vol (ml)	2.2	2.0	2.0	2.0
TVB mg/kg	266	238	238	238

30 HOURS POST THAWING

	CONTROL	ONE	TWO	THREE
Initial vol (ml)	0.1	2.5	4.7	6.8
End vol (ml)	2.5	4.7	6.8	8.9
Titre vol (ml)	2.4	2.2	2.1	2.1
TVB mg/kg	294	266	252	252

54 HOURS POST THAWING

	CONTROL	ONE	TWO	THREE
Initial vol (ml)	16.0	18.8	20.8	15.4
End vol (ml)	18.8	20.8	23.0	17.7
Titre vol (ml)	2.8	2.0	2.2	2.3
TVB mg/kg	350	238	266	280

APPENDIX 3 - MICROBIOLOGICAL RESULTS

FRESH ANCHOVIES

MICROSERVE
MICROSERVE LABORATORY PTY LTD
ACN 066 016 199
Environmental & Industrial Microbiology
NATA Registration No. 10642

Suite 6 771 Beaufort Street Mt Lawley WA 6050
Telephone: 09 271 4675 Facsimile: 09 271 1325
Mobile: 015 446 937

MICROBIOLOGICAL REPORT

Client Details The Food Centre of WA (Inc)
140 Royal Street
East Perth 6004

Order No

Attention Cheryl Hughes

Sample Details Anchovies - Frozen
Shelf Life Test No. 1

Date Collected 22/11/1995
Date Received 19/12/1995
Date Tested 20/12/1995 9.00am

Lab No	Sample	Standard Plate Count cfu per gram
952170F	1. Control	25 000
952171F	2. Ice slurry on shore	52 000
952172F	3. Ice slurry at sea	20 000
952173F	4. Ice slurry at sea with bacteriocide	14 000

Laboratory Comments:
The test results relate specifically to the samples as received in the laboratory.
cfu = colony forming units

Microbiologist
Date Reported 23/12/1995

MFM 6/2

MICROSERVE

MICROSERVE LABORATORY PTY LTD
ACN 066 016 199
Environmental & Industrial Microbiology
NATA Registration No. 10642

Suite 6 771 Beaufort Street Mt Lawley WA 6050
Telephone: 09 271 4675 Facsimile: 09 271 1325
Mobile: 015 446 937

MICROBIOLOGICAL REPORT

Client Details The Food Centre of WA (Inc)
140 Royal Street
East Perth 6004

Order No

Attention Cheryl Hughes

Sample Details Anchovies - Frozen
Shelf Life Test No. 2

Date Collected 22/11/1995

Date Received 19/12/1995

Date Tested 20/12/1995 4.00pm

Lab No	Sample	Standard Plate Count cfu per gram
952185F	1. Control	30 000
952186F	2. Ice slurry on shore	53 000
952187F	3. Ice slurry at sea	24 000
952188F	4. Ice slurry at sea with bacteriocide	65 000

Laboratory Comments:
The test results relate specifically to the samples as received in the laboratory.
cfu = colony forming units

Microbiologist

Date Reported 23/12/1995

MFM 6/2

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Telephone: 09 271 4675 Facsimile: 09 271 1325
Mobile: 015 446 937

MICROBIOLOGICAL REPORT

Client Details The Food Centre of WA (Inc)
140 Royal Street
East Perth 6004

Order No

Attention Cheryl Hughes

Sample Details Anchovies - Frozen
Shelf Life Test No. 3

Date Collected 22/11/1995
Date Received 19/12/1995
Date Tested 21/12/1995 9.00am

Lab No	Sample	Standard Plate Count cfu per gram
952189F	1. Control	52 000
952190F	2. Ice slurry on shore	33 000
952191F	3. Ice slurry at sea	25 000
952192F	4. Ice slurry at sea with bacteriocide	27 000

Laboratory Comments:
The test results relate specifically to the samples as received in the laboratory.
cfu = colony forming units

Microbiologist
Date Reported 24/12/1995

MFM 6/2

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Mobile: 015 446 937

MICROBIOLOGICAL REPORT

Client Details The Food Centre of WA (Inc)
140 Royal Street
East Perth 6004

Order No

Attention Cheryl Hughes

Sample Details Anchovies - Frozen
Shelf Life Test No. 4

Date Collected 22/11/1995

Date Received 19/12/1995

Date Tested 22/12/1995 9.00am

Lab No	Sample	Standard Plate Count cfu per gram
952224F	1. Control	45 000
952225F	2. Ice slurry on shore	110 000
952226F	3. Ice slurry at sea	20 000
952227F	4. Ice slurry at sea with bacteriocide	5 000

Laboratory Comments:
The test results relate specifically to the samples as received in the laboratory.
cfu = colony forming units

Microbiologist

Date Reported 25/12/1995

MFM 6/2

APPENDIX 3 - MICROBIOLOGICAL RESULTS

ANCHOVIES AFTER 1 MONTH FROZEN STORAGE

MICROSERVE
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Mobile: 015 446 937

MICROBIOLOGICAL REPORT

Client Details The Food Centre of WA (Inc)
140 Royal Street
East Perth 6004

Order No

Attention Cheryl Hughes

Sample Details Anchovies - Frozen
Shelf Life Test No. 1

Date Collected 22/11/1995

Date Received 19/12/1995

Date Tested 20/12/1995 9.00am

Lab No	Sample	Standard Plate Count cfu per gram
952170F	1. Control	25 000
952171F	2. Ice slurry on shore	52 000
952172F	3. Ice slurry at sea	20 000
952173F	4. Ice slurry at sea with bacteriocide	14 000

Laboratory Comments:
The test results relate specifically to the samples as received in the laboratory.
cfu = colony forming units

Microbiologist

Date Reported 23/12/1995

MFM 6/2

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MICROBIOLOGICAL REPORT

Client Details The Food Centre of WA (Inc)
140 Royal Street
East Perth 6004

Order No

Attention Cheryl Hughes

Sample Details Anchovies - Frozen
Shelf Life Test No. 2

Date Collected 22/11/1995

Date Received 19/12/1995

Date Tested 20/12/1995 4.00pm

Lab No	Sample	Standard Plate Count cfu per gram
952185F	1. Control	30 000
952186F	2. Ice slurry on shore	53 000
952187F	3. Ice slurry at sea	24 000
952188F	4. Ice slurry at sea with bacteriocide	65 000

Laboratory Comments:
The test results relate specifically to the samples as received in the laboratory.
cfu = colony forming units

Microbiologist

Date Reported 23/12/1995

MFM 6/2

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Mobile: 015 446 937

MICROBIOLOGICAL REPORT

Client Details The Food Centre of WA (Inc)
140 Royal Street
East Perth 6004

Order No

Attention Cheryl Hughes

Sample Details Anchovies - Frozen
Shelf Life Test No. 3

Date Collected 22/11/1995
Date Received 19/12/1995
Date Tested 21/12/1995 9.00am

Lab No	Sample	Standard Plate Count cfu per gram
952189F	1. Control	52 000
952190F	2. Ice slurry on shore	33 000
952191F	3. Ice slurry at sea	25 000
952192F	4. Ice slurry at sea with bacteriocide	27 000

Laboratory Comments:
The test results relate specifically to the samples as received in the laboratory.
cfu = colony forming units

Microbiologist
Date Reported 24/12/1995

MFM 6/2

MICROSERVE

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Telephone: 09 271 4675 Facsimile: 09 271 1325
Mobile: 015 446 937

MICROBIOLOGICAL REPORT

Client Details	The Food Centre of WA (Inc) 140 Royal Street East Perth 6004	**Sample Details**	Anchovies - Frozen Shelf Life Test No. 4
		Date Collected	22/11/1995
Order No		**Date Received**	19/12/1995
Attention	Cheryl Hughes	**Date Tested**	22/12/1995 9.00am

Lab No	Sample	Standard Plate Count cfu per gram
952224F	1. Control	45 000
952225F	2. Ice slurry on shore	110 000
952226F	3. Ice slurry at sea	20 000
952227F	4. Ice slurry at sea with bacteriocide	5 000

Laboratory Comments:
The test results relate specifically to the samples as received in the laboratory.
cfu = colony forming units

Microbiologist [signature]
Date Reported 25/12/1995

MFM 6/2

APPENDIX 3 - MICROBIOLOGICAL RESULTS

AUSTRALIAN SMOKED SALMON (VACUUM PACKED)

MICROSERVE

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ACN 066 016 199
Environmental & Industrial Microbiology
NATA Registration No. 10642

Suite 6 771 Beaufort Street Mt Lawley WA 6050
Telephone: 09 271 4675 Facsimile: 09 271 1325
Mobile: 015 446 937

FOOD REPORT

Client Details	The Food Centre of WA (Inc) 140 Royal Street East Perth 6004	**Sample Details**	Australian Smoked Salmon. Vacuum packed.
		Date of Production	December 1995
Order No.		**Date Collected**	
		Date Received	8/1/1996
Attention	Cheryl Hughes	**Date Tested**	8/1/1996
		Laboratory No.	960041F

Routine Monitoring (x)		**Shelf Life ( )**	**Food-Borne Illness ( )**
Meat ( )	**Dairy ( )**	**Meal ( )**	**Raw (x)**
Poultry ( )	**Seafood (x)**	**Other ( )**	**Cooked ( )**

TEST	RESULT		METHOD
Standard Plate Count	19 000 000	CFU per gram	MMM 2.1F
Listeria species	Not detected	in 25 grams	MMM 2.11F

Laboratory Comments:
The test results relate specifically to the sample as received in the laboratory.
CFU = Colony forming units

Microbiologist
Date Reported 12/1/1996

MFM 4/3

FREMANTLE SARDINE FESTIVAL

14 JANUARY 1995

1. Four hundred kilograms of smoked peppered salmon and smoked salmon were prepared in 250g vacuum sealed plastic pouches packed by two commercial operators, "seatech" of Albany and WA Fish Processors, of Perth.

2. The project was advertised in the West Australian on 10th January 1996 (attached).

3. Twelve "helpers" were recruited to assist on the day.

4. Display equipment was "procured" at no charge to the project from Master Butchers Ltd, The Food Centre, Curtin University, Freedom Marine, and R N Stevens.

5. Market equity conducted a consumer survey at the festival, the results of which are attached.

6. On the day, approximately 11,000 samples were distributed, and 300 questionaires completed.

   Queues to the WAFIC marquee were up to 180 metres long, with a one and a half hour waiting time.

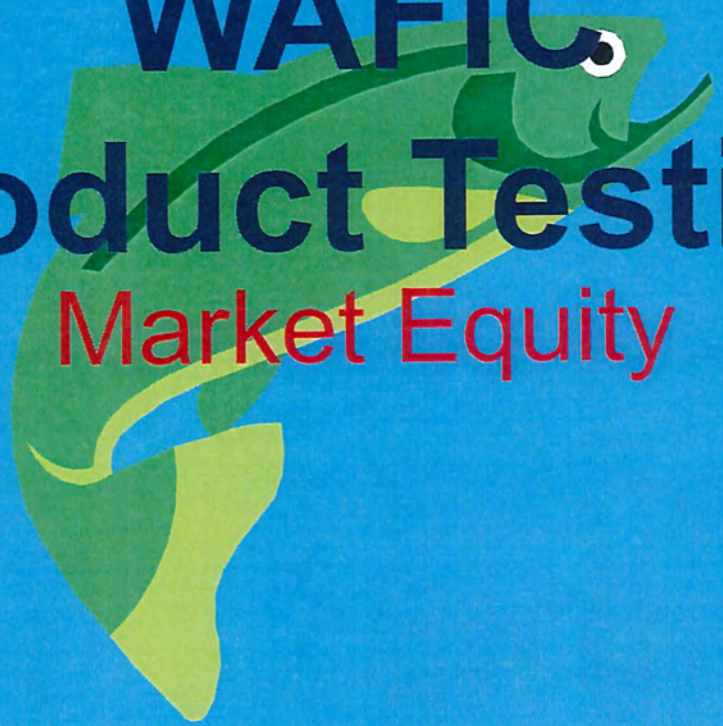
   All samples were consumed two hours before the Festival ended, when the remaining people, in a 50 metre queue, were disappointed (vociferously so!).

7. The essential result of the survey was that smoked salmon, properly presented, could command a retail price of $25.00 per kilo ($6.75 per pack).

   The cost of production was $8.70 per kilo based on a beach price of $0.50. On a beach price of $1.00 per kilo (treble the current price) the 'finished' cost would be $9.00 per kilo. The margin between the retail price and the ex-factory wholesale price, at $16.00 per kilo was considered sufficiently adequate to move to full commercial production.

8. Additional product testing for shelf life, packaging, branding and marketing will now be carried out.

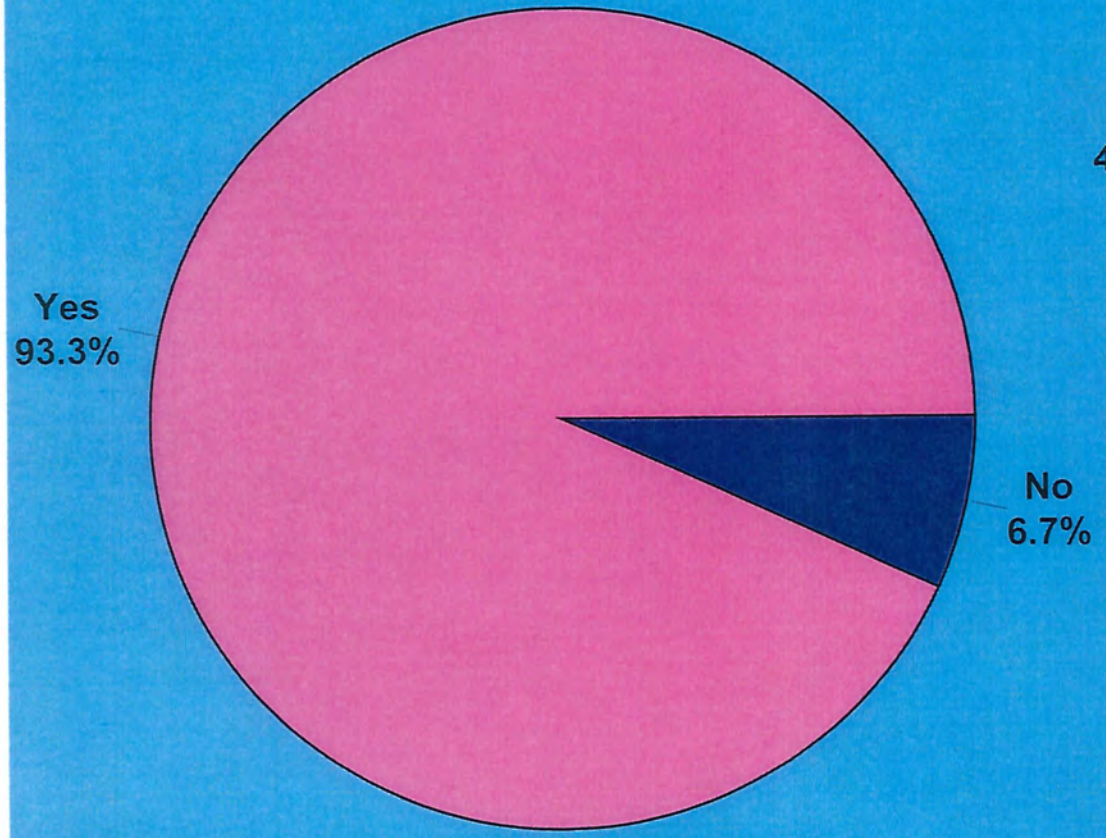
WAFIC
Product Testing
Market Equity



1995 Sardine Festival
Fremantle
Western Australia

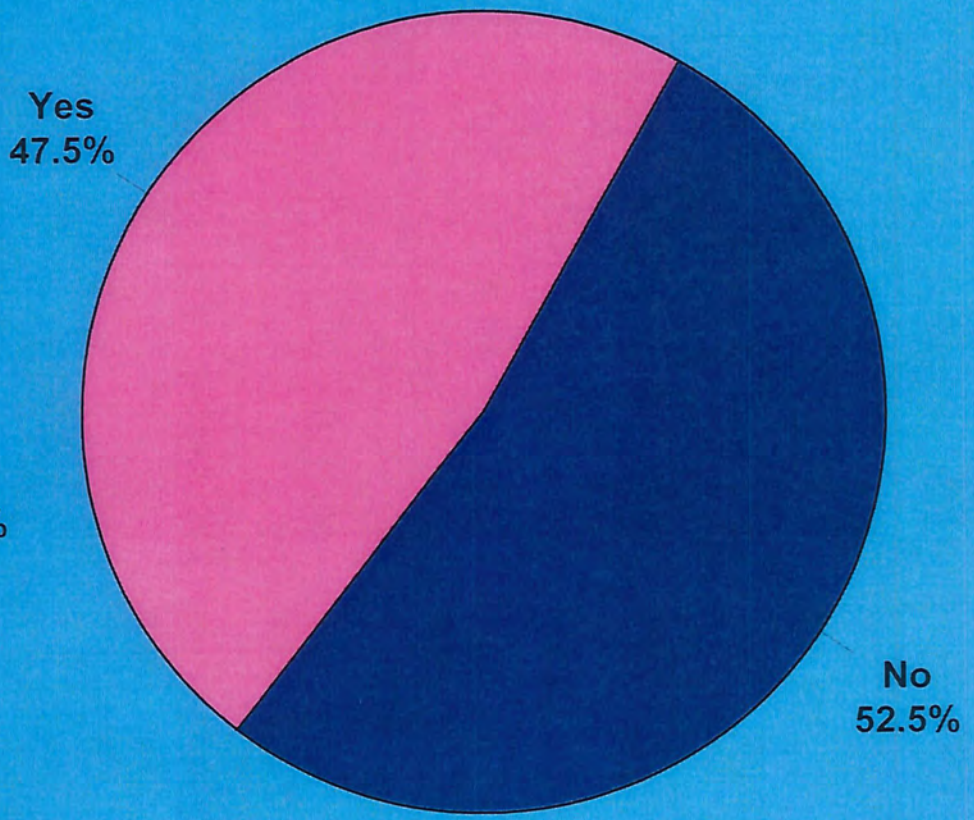
Profile of Respondents

Eat Fish on a Regular Basis



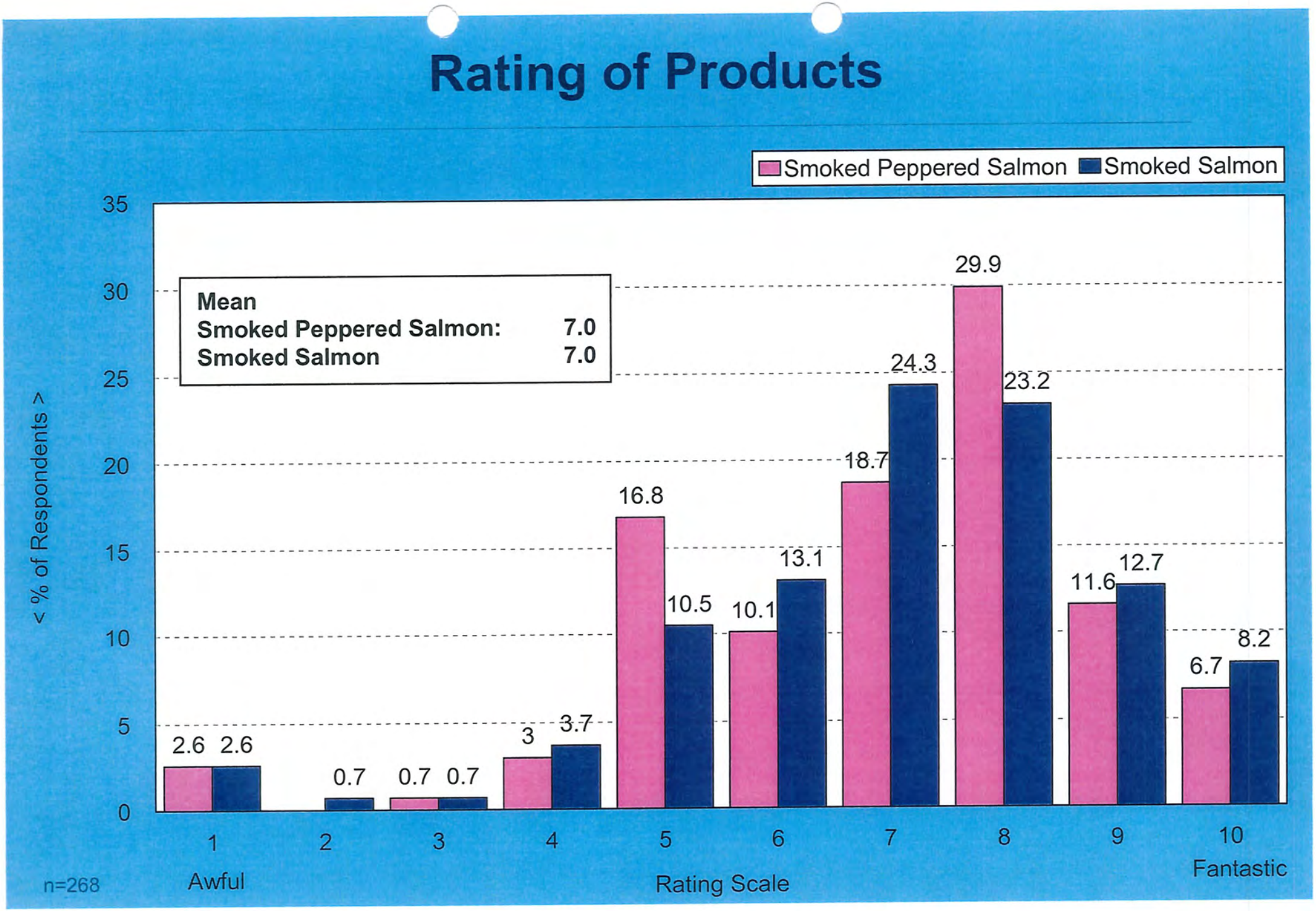
n=267

Eat Smoked Products

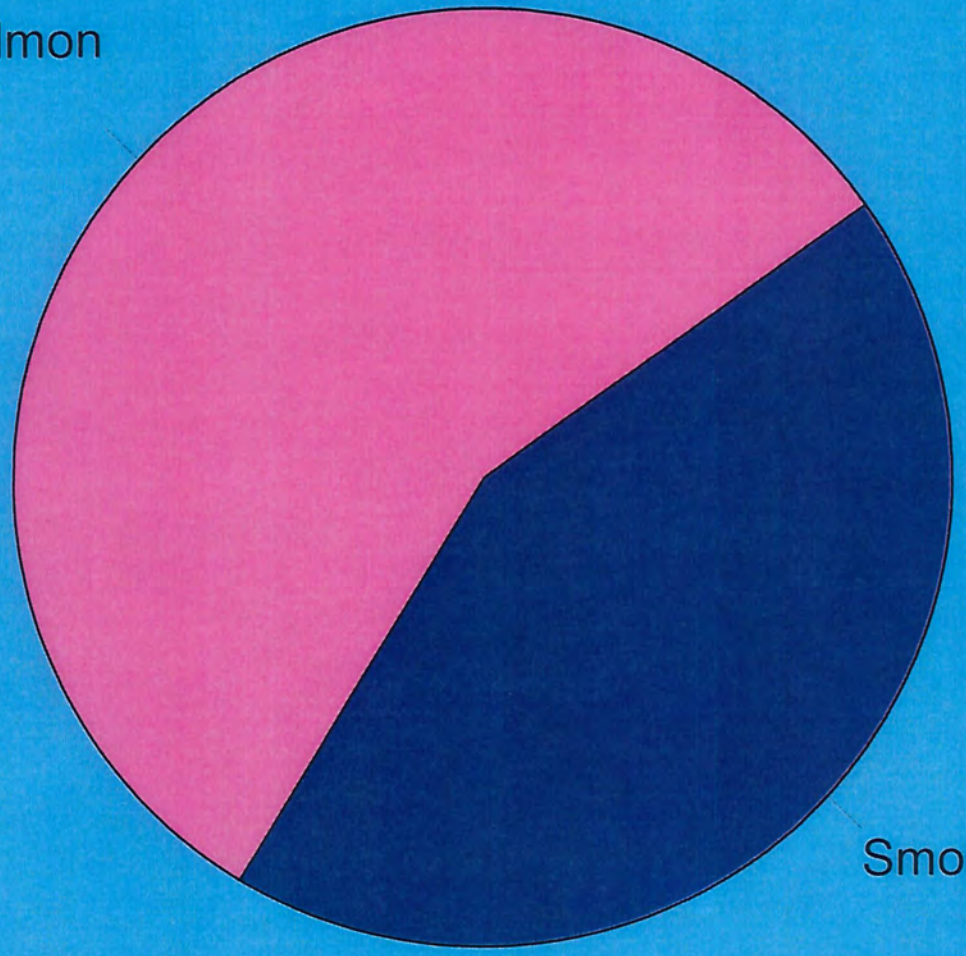


n=263

Rating of Products

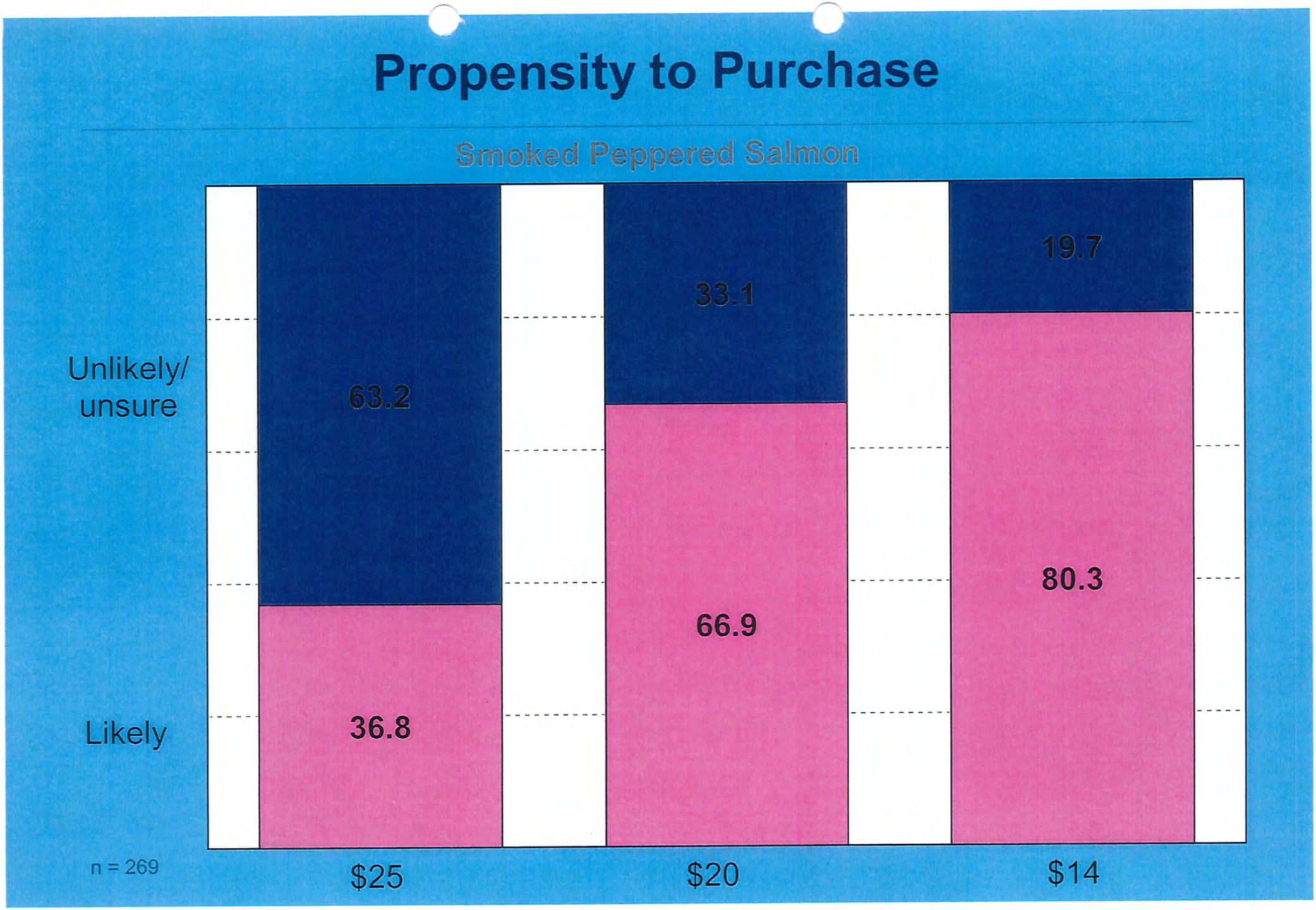


Preference

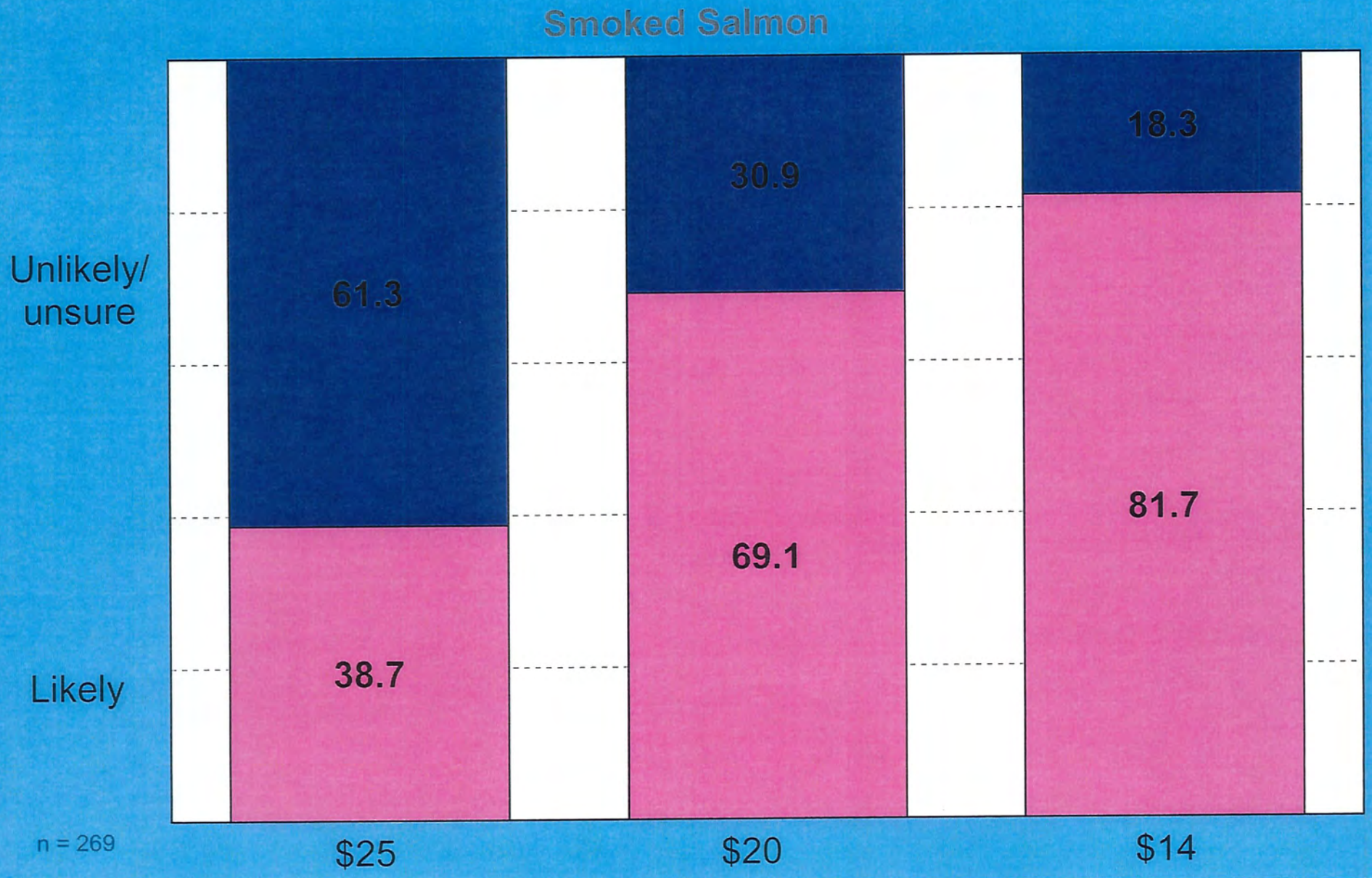


n=267

Propensity to Purchase

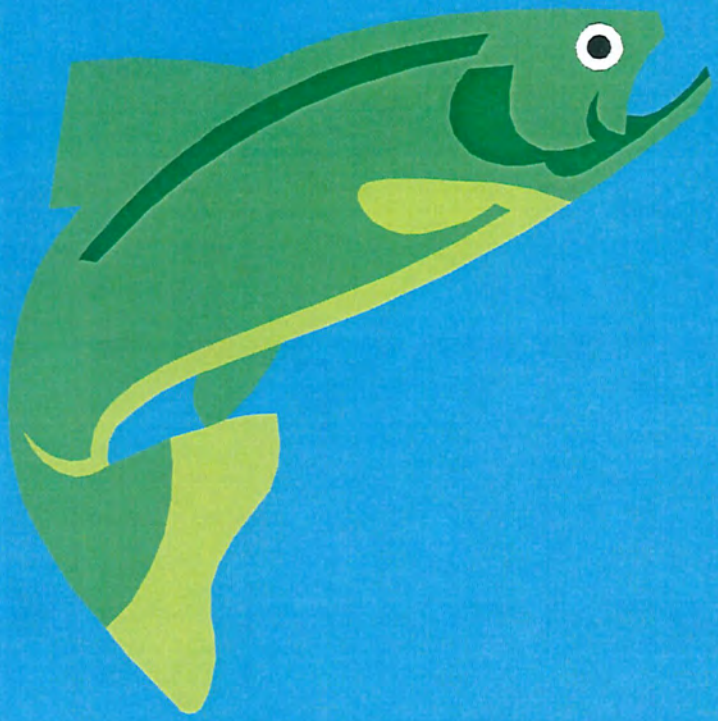


Propensity to Purchase



Market Potential

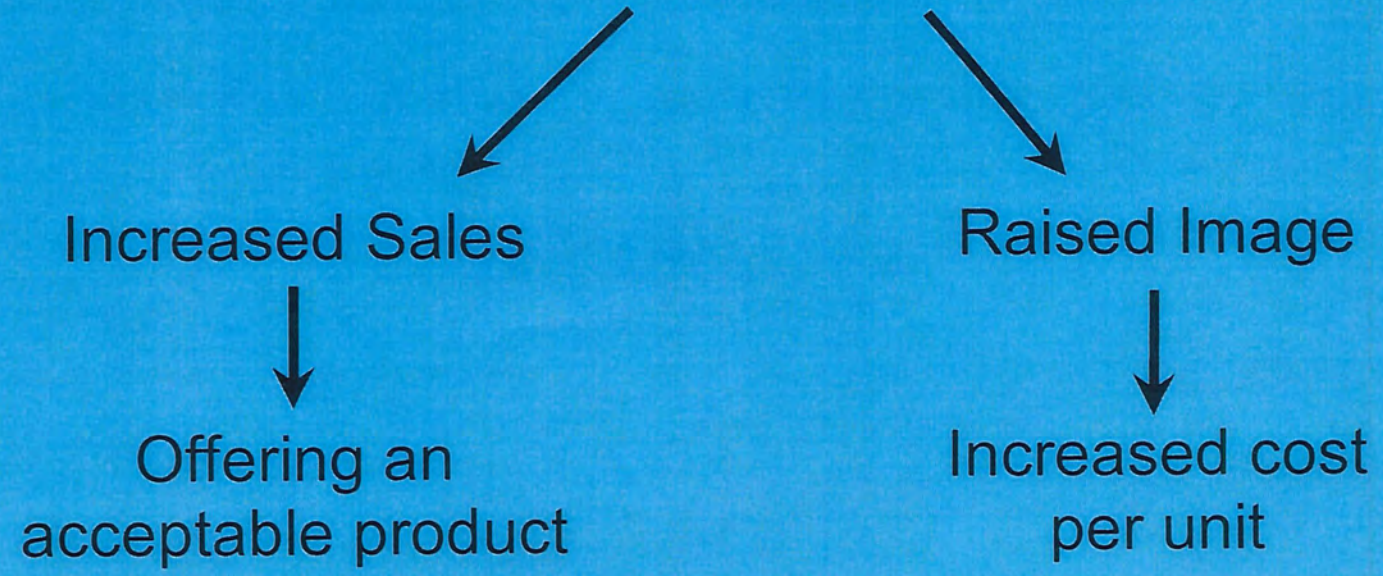
- Smoked Peppered Salmon
  - $25 - 25.0%
  - $20 - 40.8%
  - $14 - 57.3%
- Smoked Salmon
  - $25 - 26.2%
  - $20 - 42.7%
  - $14 - 58.4%



n = 269

Strategic Recommendations

- Both acceptable for launch - favourably received
- Both offer similar market share potential at all price levels
- Need to consider the bigger picture: increasing the value of the market



S with the progression of the humble sardine fillet from fish to gourmet food, beer too has e of age and is now recognised beverage that can be integrated fine dining to complement and nce the flavours of many foods.

e Swan Brewery's Marketing ctor, David Metherell, says that variety of styles of beer now able make it important that umers treat each brew idually and savour its particular ties.

ıe tastes of Western Australian drinkers are evolving. Nowadays like wine, is enjoyed in a myriad fferent situations and for each tion there is an appropriate

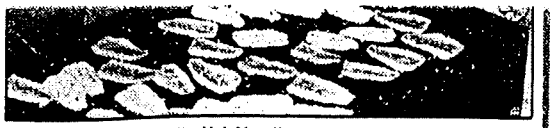
hen dining, the decision in the has often been 'red or white'. it is likely to be Hahn Gold, Bitter or 1857," Mr Metherell

The Swan Brewery Company has always put considerable effort into researching the needs and tastes of Western Australian beer drinkers. An understanding of community preferences has resulted in the development of a variety of brews with very different physical characteristics.

Along with the range of gourmet foods on offer at the Fremantle Sardine Festival will be a few of the many brews available from the Swan Brewery.

Beer tastings will give visitors the opportunity to experience different Swan beers in conjunction with the other fine dining delights.

In addition, Swan Brewery has specially brewed 20 kegs of ginger beer for sale at the Festival. All sale proceeds from the ginger beer will be donated to the Variety Club of Western Australia.



A variety of "nibblies" will be available at the Festival.

Mouthwatering recipes vailable for first time

VELOPING new seafood roducts is not easy (ask y Mendolia!)

when the WA Fishing Industry l was asked to look for new of presenting fish from our rn seas it called on the sionals.

Food Centre of WA, in East produced some mouthwatering s and Market Equity Ltd ted extensive consumer trials n.

best of these products will be le to the public for the first time at the Sardine Festival with FREE tastings.

Curtin University Seafood Science students will be conducting a survey to get public reaction to the fish, and samples will be for sale at special 'Festival Prices.' So what are these products?

For the moment that is our secret! To find out come to stands 44 and 45, near the railway line, at the Fremantle Sardine Festival.

Who knows you could be at the launch of the best thing since fish and chips.

lance to win photo session

DIO Classique is rofessional pho- hic studio that lise in glamour raphy.

t only $95 you can from a range of ncluding Formal, Fantasy or Linge-

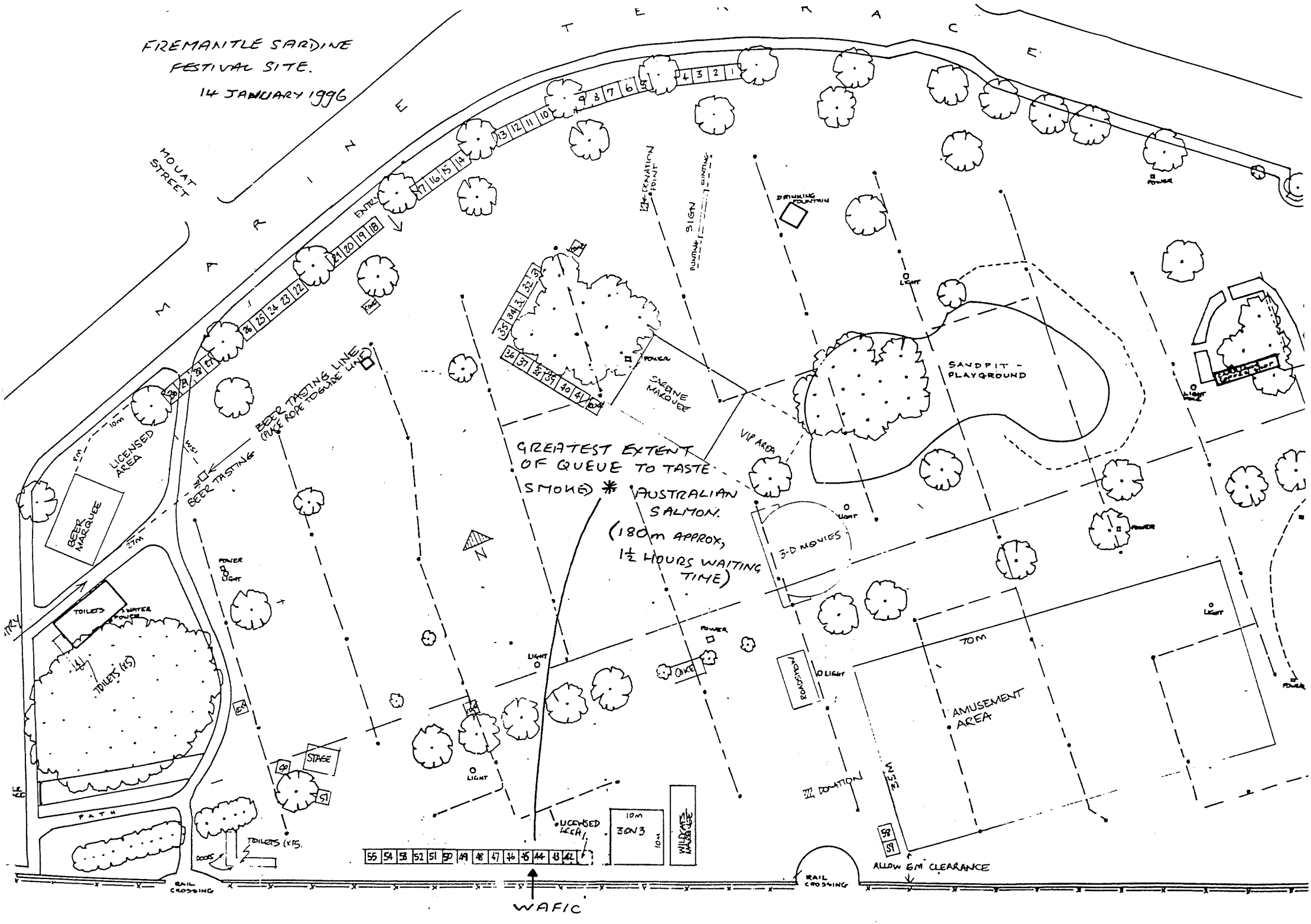
price also allows option to do your together with rtner.

led in the price is ke-up artist and list, who will help create that beautiful look and assist you throughout your session.

Studio Classique accept all major credit cards and can provide gift vouchers.

On Sunday, January 14, one lucky person will have the chance to win a glamour photographic session, to the value of $875, just by filling in a coupon at the Fremantle Sardine Festival.

All entries will need to be filled out and placed in the entry box at the Studio Classique stand on the day.


FREMANTLE SARDINE FESTIVAL SITE.
14 JANUARY 1996
MARINE TERRACE
MOUAT STREET
ENTRY
DONATION POINT
SIGN
DRINKING FOUNTAIN
POWER
LIGHT
SARDINE MARQUEE
SANDPIT - PLAYGROUND
BEER TASTING LINE (RUBBER ROPE TO GUIDE LINE)
BEER TASTING
LICENSED AREA
BEER MARQUEE
GREATEST EXTENT OF QUEUE TO TASTE SMOKED * AUSTRALIAN SALMON.
(180m APPROX, 1½ HOURS WAITING TIME)
VIP AREA
3-D MOVIES
TOILETS
WATER
TOILETS (x5)
STAGE
TOILETS (x15)
DOORS
PATH
OAKS
ROADSHOW
AMUSEMENT AREA
LICENSED AREA
3ON3
WILLIAMS BRIDGE
RAIL CROSSING
ALLOW 6M CLEARANCE
WAFIC