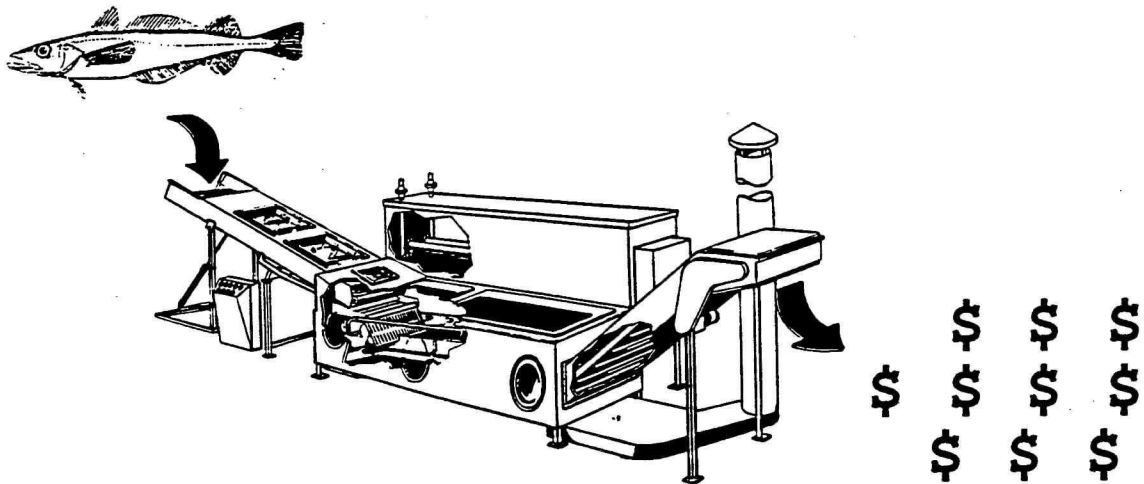


PACIFIC WHITING VALUE-ADDED PRODUCTS



Michael T. Morrissey
OSU Seafood Laboratory

Gilbert Sylvia
Hatfield Marine Science Center

Coastal Oregon Marine Experiment Station
Oregon State University

PACIFIC WHITING VALUE-ADDED PRODUCT REPORT

Spring, 1995

Summary of Product Development Research
1993-1994

Coastal Oregon Marine Experiment Station/Oregon State University Seafood Laboratory

Oregon State University

Principal Investigators

Dr. Michael Morrissey

phone: 503-325-4531

fax: 503-325-2753

email: morrissm@bcc.orst.edu

Dr. Gilbert Sylvia

phone: 503-867-0284

fax: 503-867-0138

email: sylviag@ccmail.orst.edu

FOREWORD

The Pacific Northwest Seafood Association is involved in several activities. Our primary goals are to maintain the greatest long-term, sustainable harvest utilization and value-added benefits from all of our fisheries. The State of Oregon has been substantially involved in the areas of allocation and uses of Pacific whiting. As an outgrowth of that, the State has become a partner with the Department of Agriculture and the Oregon Economic Development Department in trying to establish some goals for the fishing industry. In 1992, the state decided that commercial fisheries should be designated a key Oregon industry. That event combined with several Pacific whiting workshops has led to the development of a Pacific Northwest Seafood Association, which is unique both in its origin and by the effort to include both processors and fishermen. This report provides one of the vehicles necessary to realizing those goals. The Pacific Northwest Seafood Association has fully supported this project and many of its members have given freely of their time, plant operations and product during the past two years. The seafood industry is changing rapidly in Oregon as it is elsewhere in the world. The harvest of Pacific whiting now represents more than 50% of the total harvest of all fish and shellfish in the state. Although this is the first time that a high-volume fisheries has been developed in Oregon, we fully realize that it needs to be market driven and not production driven. To understand the markets, we need to know what value-added products can be produced from Pacific whiting. At present the majority of Pacific whiting is made into surimi, an important value-added product. However we know that the health of the whiting fisheries in Oregon should be based on our ability to produce a number of value-added products. More importantly, we need to know how the end user, the consumer, perceives these products and what they are willing to pay. This project and the results in this report are an important step in understanding value-added processing with Pacific whiting. As this industry grows the health of Oregon's fishing economy will become stronger and will benefit not only the fishermen and the processor, but the consumer as well.

Tom Libby, Co Chairman

Pacific Northwest Seafood Association

TABLE OF CONTENTS

1.	Executive Summary	1
2.	Introduction.....	3
3.	Value-Added Products	4
3.1	Individually Quick Frozen fillets	4
	Product Development	4
	Wholesaler Survey	4
	Wholesaler Evaluation	4
	Marketing and Quality Assurance	5
	Summary	7
	Consumer Survey	8
	1994 Oregon State Fair	8
	Sensory Evaluation 1994 OSF	8
	Marketing Evaluation 1993 OSF	11
	Marketing Evaluation 1994 OSF	12
	Summary	13
	Trained Panel Results	13
	Focus Group Results	14
	Conclusions	15
3.2	Minced Whiting/Shrimp Patty	15
	Wholesaler Survey	16
	Wholesaler Evaluation	16
	Consumer Survey	16
	Sensory Evaluation	16
	Marketing Evaluation	17
	Conclusions	18
3.3	Fresh Surimi Analogs	18
	Conclusions	19
3.4	Stabilized Mince	20
4.	Implications of Value-Added Research	21
5.	Conclusions	21
	Appendix A: References	22
	Appendix B: Wholesalers Interested in IQF Fillets	24
	Appendix C: Wholesalers Interested in Whiting/Shrimp Patties	24
	Appendix D: Processors of Pacific Whiting Value-Added Products	25

This material is based on work supported by the Oregon Economic Development Department (OEDD) Regional Strategies Grant, and a United States Department of Agriculture (USDA) Special Research Grant.

1. EXECUTIVE SUMMARY

This report summarizes research undertaken by the Coastal Oregon Marine Experiment Station for developing value-added products from Pacific whiting. The research was sponsored by the Oregon Economic Development Department as part of their Regional Strategies Program for Lincoln County. Additional funding was provided from a seafood marketing grant from the U.S. Department of Agriculture.

The utilization of Pacific whiting for shore-based surimi production is one of the great success stories of the Oregon fishing industry. It demonstrated that private enterprise, with research and public support, could initiate a new seafood industry. The main objectives of the whiting value-added project were to build on this success and develop opportunities for additional Pacific whiting products.

Three products were investigated in terms of product development, sensory evaluation, and potential market strategies. These products include IQF fillets, minced fish and shrimp breaded patties (Shrim-Bo's), and fresh surimi. Product development research was undertaken at the Oregon State University Seafood Laboratory (OSU-SL) in Astoria, Oregon. Consumer evaluation of the products were tested at the Oregon State Fair in Salem. Evaluations by focus groups and

trained panels were performed at the Oregon State University Sensory Laboratory in the Department of Food Science in Corvallis. Wholesale evaluations of IQF fillets and Shrim-Bo's were conducted using actual products and a combination of mail and telephone surveys. All results are part of the public domain and are intended to be used by the industry for both product development and marketing strategies.

MAJOR FINDINGS

IQF FILLETS

- In consumer surveys, Pacific whiting IQF fillets compared favorably with IQF fillets from Argentina and Chile and were significantly better than IQF fillets from Peru. All of these products have established markets in the United States.
- Pacific whiting is recognized as a soft-textured fish and was rated equal overall to other delicate species such as Dover sole. Frozen fillets maintained desirable sensory attributes for at least one year.
- Analysis of wholesaler demand showed that the product was competitive with most South American hakes. The product's past reputation, inconsistent quality, and soft texture must be addressed. Assuring product consistency is critical for volume production.

SHRIM-BO'S

- The whiting/shrimp mince breaded patties received favorable acceptance in all categories

except moisture content. Patties with 60% whiting/shrimp and 40% mince consistently received the highest scores.

- Shrim-Bo's were well received by consumers and wholesalers. There was strong interest by at least five or six wholesalers (see Appendix C). Flavors of the patty, and flavor and texture of the breading may need to be improved.

FRESH SURIMI

- Results from the survey indicated that consumers prefer fresh surimi based analogs to frozen products, and were willing to pay more for a fresh or never frozen product.
- It is estimated that producers of fresh surimi can produce the same quality product for \$0.05/lb. less than the frozen product.

IMPLICATIONS AND MARKET CONSIDERATIONS

Large volume, relatively low ex-vessel prices, and improved quality of Pacific whiting provide value-added opportunities for processors and marketers. Consumers find whiting products to be comparable in most characteristics to other higher priced seafood. However, product development strategies must address the product's past reputation, inconsistent quality, and soft "delicate" texture. Besides new profit opportunities, value-added strategies also

provide a portfolio of products which reduce the risks associated with the volatile surimi market. Given the growing demand for healthy consumer foods and forecasts for limited growth of global groundfish supplies, quality Pacific whiting products are well positioned for institutional, retail, and food service. Secure and sufficient allocation for shoreside development, coupled with comprehensive market driven management strategies can provide the Pacific whiting industry with the foundation for successful diversification into a variety of value-added products. There are excellent opportunities for the Oregon seafood industry to produce and market value-added products from Pacific whiting.

2. INTRODUCTION

This report is a summary of value-added research focusing on Pacific whiting markets, products, and public policy conducted in 1993-1994. In 1991 research completed by Dr. Gilbert Sylvia and Greg Peters showed that wholesalers, distributors, and secondary seafood processors were confident that a wide variety of product forms could be profitably processed from Pacific whiting. These respondents, however, believed that successful product development was dependent upon improvements and standardization of product quality. Over the last ten years research at the Oregon State University Seafood Laboratory (OSU-SL), and Coastal Oregon Marine Experiment Station (COMES) with cooperation from Oregon processors, fishermen, and several state and federal agencies, have demonstrated that consistent quality products can be produced from Pacific whiting.

Industry has recognized the need to diversify the product forms developed from Pacific whiting to reduce market volatility and increase profits. Secondary and tertiary processing of Pacific whiting could bring additional income to coastal communities and the state economy. Successful shoreside processing of Pacific whiting into value-added products would have a direct impact on 1) the allocation of Pacific whiting harvests, 2) creation of jobs and skills in Oregon's

seafood industry, 3) an increase in coastal and state income, 4) the foundation for value-added processing for other species, and 5) the overall economic health of the fishing industry.

The value-added products being analyzed by the OSU-SL and COMES include individual quick frozen (IQF) fillets, minced whiting/shrimp patty, fresh surimi analogs, and stabilized mince. IQF fillets have been produced by three Oregon processors during the last two years. A minced whiting/shrimp patty or Shrim-Bo have been redeveloped at the OSU-SL. The three Shrim-Bo product blends developed by the OSU-SL include a 80% whiting/20% shrimp, a 60% whiting/40% shrimp, and a 40% whiting/60% shrimp patty. Development of the minced shrimp/whiting seafood patty has been discontinued during the 1994 season due to a poor shrimp harvest. Fresh surimi analog research has been underway at the OSU-SL during the last two years. Development of stabilized minced is still in the preliminary stages.

Over the last two seasons, there has been commercial production runs of IQF fillets at Pacific Coast Seafoods and Inland Quick Freeze. Pacific Coast Seafoods has now installed an IQF fillet processing line at their Warrenton plant. Product development for the minced shrimp/whiting patty took place at the OSU-SL with a commercial run at Gran Pac Seafoods. Fresh surimi analog research

and development was conducted this past year at the OSU-SL in cooperation with Point Adams Packing Company and Kyotaru, Oregon, Inc.

This report summarizes the findings and progress of the Pacific whiting value-added project being funded by the Oregon Economic Development Department and the U.S. Department of Agriculture, a two year project which begun in December, 1992. Laboratory-based research and development, sensory analyses, consumer analyses, and market research will be described and summarized. The report will conclude with a discussion of the implications of the research findings and potential for development of the Pacific whiting industry.

3. VALUE-ADDED PRODUCTS

3.1 IQF FILLETS

Individually quick frozen (IQF) fillets were the most extensively tested product form because, (1) the processing technology is already developed, (2) other whiting or hake species are sold as IQF fillets, and (3) there are established national and international markets for IQF whitefish fillet products.

Product Development

During the 1993 and 1994 seasons, there were commercial production runs of IQF

fillets at Pacific Coast Seafoods (Warrenton, Oregon) and Inland Quick Freeze (Albany, Oregon). Product development of IQF fillets continued in 1994. In addition, Pacific Coast Seafoods installed a new IQF fillet processing line in their Warrenton plant.

Wholesaler Survey

During the 1993 and 1994 seasons, samples of the IQF fillets were sent out to 66 wholesalers involved in the distribution and secondary processing of whiting products. Companies were asked to evaluate the characteristics of the fillets, as well as answer questions to determine attitudes and demand for quality assurance, marketing, and willingness to purchase.

Wholesaler Evaluation

The overall evaluation of the IQF fillets ranged from *fair to good*. Respondents expressed concern about product variation. Although some of the variation could be attributed to improper handling and unfamiliarity with the product, variation could also have resulted from handling at the fishing and processing level or intrinsic (i.e. pre-harvest) variation in product characteristics. Texture was often referred to as "too soft". This characteristic scored the lowest out of the eight characteristics surveyed; conversely, workmanship and appearance defects scored reasonably high. Fat line (dark red muscle tissue) distortion of the fillet color, however, was a common statement, as well as problems with bruising,

blood lines, and blood spots. Several respondents stated that the fat line in the fillets must be removed (deep skinned), and the tail should be squared off. Some of the fillets also had skin present or jagged cuts. The respondents' score for flavor ranged from light, mild flavor to very fishy or bland. Odor ranged from mild and odorless to fishy and gamey. The general appearance of the fillets appeared too small to some after cooking, and the fat line detracted from the overall appearance of the fillet. Figure 1 summarizes the results of the wholesaler evaluation of the IQF fillets.

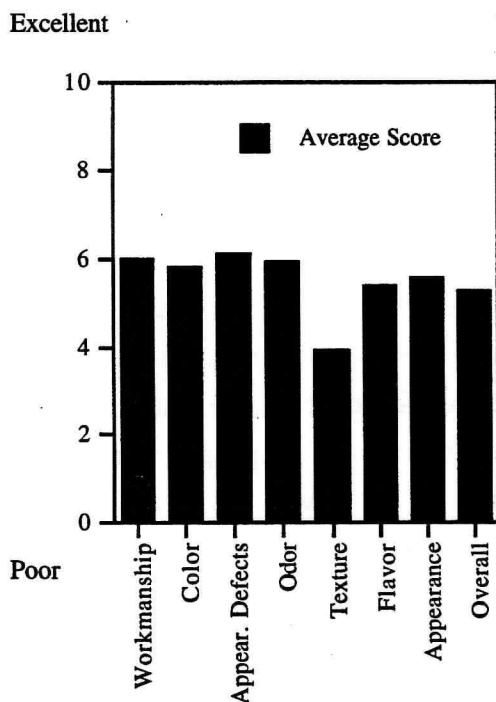


Figure 1. IQF fillets evaluation by national wholesalers and secondary processors of IQF fillets.

Marketing and Quality Assurance

Besides the sensory analysis, respondents were asked to score the relative desirability of different types of labeling information (Figure 2). Results showed that accurate net weight and frozen shelf life were the two most desired labeling characteristics. Country of origin was considered moderately desirable. Wholesalers and secondary processors were indifferent to labels which included quality grade information.

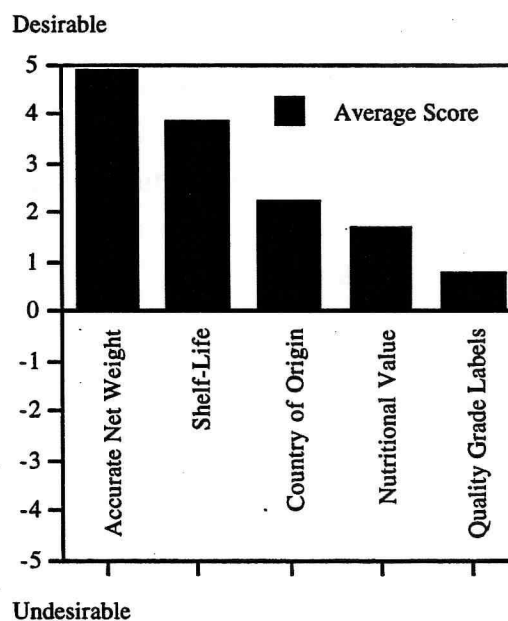


Figure 2. Relative desirability of different types of labeling information by national wholesalers and secondary processors of IQF fillets.

The wholesaler survey also focused on the buyer's and firm's experience with whiting species, importance of product characteristics, and how these characteristics could affect profitability and short-run

demand. The procedures and results are summarized below.

Stage 1: Importance and Acceptability of Product Characteristics

In the first stage of this analysis, respondents were asked to rank the relative importance of maintaining product consistency for eight frozen fillet characteristics. The characteristics included *shelf-life, flesh color, texture defects, appearance defects, workmanship defects, skin/membrane defects, size of fillet, and bone count*. Respondents' felt it was important to maintain product quality consistency for all eight characteristics. Maintaining a low bone count was the most important characteristic; workmanship was the least important. The majority of respondents felt that it would be unacceptable if less than 91% of the packages had more bones than was stated on the package. The respondents also felt it would be unacceptable if net weight varied more than 10% for the stated average. Conversely, the product remained acceptable if only 80% of the packages had the stated level of workmanship. The six other characteristics surveyed had acceptability levels ranging from 81% to 90%.

Stage 2: Respondents Established Grades

In the second stage, respondents were asked to develop grading standards for Pacific whiting frozen fillets. Respondents

were asked to indicate, from two identical listings of nine characteristics, which options would best describe their definition of a Grade A and Grade B Pacific whiting frozen fillet product. Each characteristic had three different levels corresponding to a high, medium, and low level of quality for that characteristic. Each respondent defined two grades (Grade A and Grade B) and were asked to specify the level of nine individual product characteristics (Table 1).

Table 1. Industry designed Grade A and Grade B IQF hake fillets

Characteristic	Grade A Average	Grade B Average
Overall Product Consistency	96%	86%
Shelf-Life	13 months	9 months
Flesh Color	white to off-white	off-white to slightly pink
Texture Defects	firm to moderately firm	moderately firm
Appearance Defects	none to slight (1.8)*	slight to moderate (3.2)*
Workmanship Defects	excellent to good (0.8)*	good to fair (2)*
Skin/Membrane Defects	none to minor (0.29)*	minor (1.2)*
Size of Fillet	none to minor (0.5)+	minor to major (1.3)+
Bone Count	0.5 bones/lb. fish	1.5 bones/lb. fish

* per fish

+ number of fillets below the stated weight range

Stage 3: Market Experiment

In the final stage of the analysis, a market experiment was conducted. Respondents identified the relative importance of frozen fillet characteristics, including product price, in contributing to firm profitability and conditional short-run demand price. This experiment also provided information that identified the importance of firm attributes to firm profitability and short-run demand.

Table 2 summarizes the results for United States wholesalers with gross revenues of less than 15 million dollars. The results show that mark-up between receivers of skinless fillets receive \$0.21 per pound more than a skin-on product. The Grade A product was consistently \$0.45/lb. higher than the Grade B product (Table 2).

Using the results from the third stage of the analysis, calculations were made on the price difference attributed to moving from a Grade B to a Grade A product (Table 3). A reduction in the number of bone count from 1.5 bones per pound on average to .5 bones per pound on average increased the value of a fillet product by \$0.07/lb. Size of the fillet was the least important attribute resulting in only a \$0.04 increase in moving from 1.3 to 0.5 fillets below the stated weight range.

Table 2. Break even prices for IQF whiting fillets for Grade A and Grade B products

Product Form	Buyer	Grade A price	Grade B price
Skin-on	1st receiver	\$0.81	\$0.36
	2nd receiver	\$1.05	\$0.60
Skinless	1st receiver	\$1.02	\$0.57
	2nd receiver	\$1.26	\$0.81

Table 3. Additional value for moving from a Grade B to a Grade A characteristic

Characteristic	Additional Value
Shelf-Life	\$0.06
Flesh Color	\$0.06
Texture Defects	\$0.05
Appearance Defects	\$0.06
Workmanship Defects	\$0.05
Skin/Membrane Defects	\$0.06
Size of Fillet	\$0.04
Bone Count	\$0.07
Total Additional Value	\$0.45

Summary

Results from the analysis demonstrated that there are many product characteristics important to wholesalers. However, reducing the variation of these characteristics may be as important as improving their overall level. This appears to be particularly

true for characteristics such as bone count, texture, and net weight. In addition, although IQF Pacific whiting fillets were rated *fair to good* relative to other hake/whittings, the primary problems were of variation in product quality and soft texture.

This research also suggests that the establishment of a two-tiered grading scheme would impact market price and wholesaler demand. Additionally, firm size, marketing position, and regional location may influence which specific product characteristics are important within a Grade A and Grade B classification scheme. Respondents indicated that it is important for bone count to conform to stated standards, (e.g., a boneless product should be boneless over 90% of the time). Research also suggests that a successful quality assurance program would need to consider both market and cost information, and be a part of promotional efforts directed toward expanding market opportunities.

Consumer Survey

IQF fillets were sampled by consumers at the 1993 and 1994 Oregon State Fair (OSF). Preliminary surveys at the 1993 OSF provided information that was used to improve and standardize the 1994 survey. Only the sensory results for the 1994 OSF are presented in this report.

OREGON STATE FAIR

Sensory Evaluation 1994 OSF

At the 1994 Oregon State Fair, Pacific whiting was compared in blind tests to the following species: Argentinean whiting, Peruvian whiting, Chilean whiting, Alaskan pollock, Dover sole, ling cod, and rockfish. Only skin-off whiting was used and all products were precut and coded. All whiting fillets were 2-4 ounces in size.

Relative Comparison of Pacific,

Peruvian, Argentinean and Chilean whiting

The major emphasis of the consumer taste test was to compare Pacific whiting against the three competitive whiting species in the United States market. There were 334 sets of four samples tested by consumers comparing the Pacific, Peruvian, Argentinean, and Chilean whiting. The results summarized in Figure 3 indicate that Pacific whiting was significantly preferred over Peruvian and comparable to Argentinean. Chilean scored slightly higher than Pacific whiting.

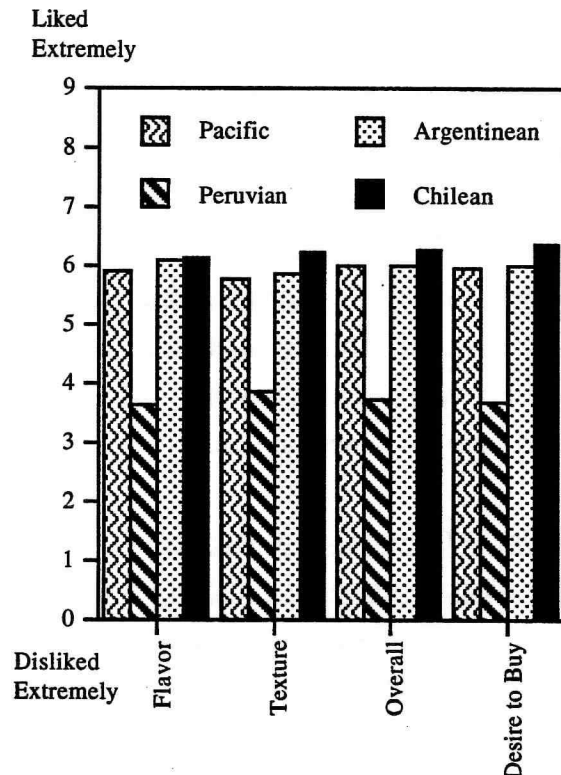


Figure 3. Blind comparisons from 334 consumer taste tests for four species of whiting.

Relative Comparison of one year old
Pacific whiting to new Pacific,
Peruvian, and Argentinean whiting

A sensory comparison was also conducted with one year old Pacific whiting (O-Pacific) relative to recently harvested and frozen Pacific (N-Pacific), Peruvian, and Argentinean whiting. Overall, the one year old Pacific whiting was comparable to new Pacific whiting (Figure 4).

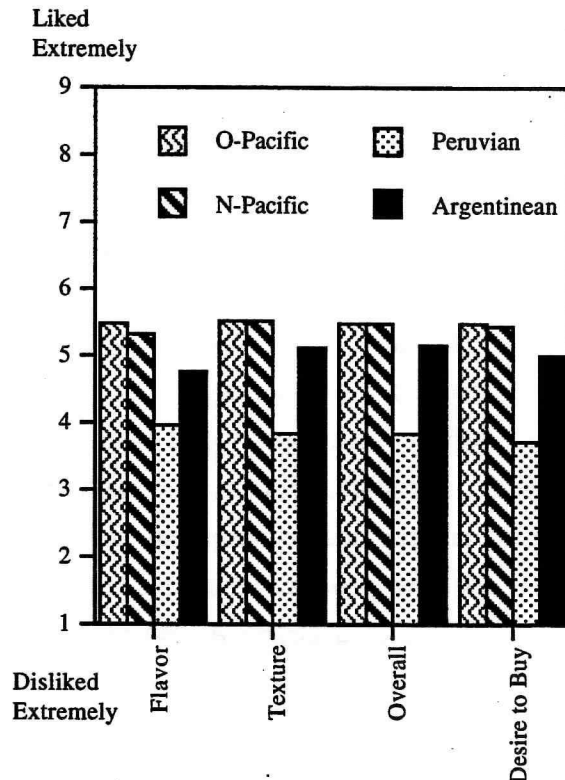


Figure 4. Blind comparisons from 80 consumer taste tests for Pacific whiting (new and 1 year old), Peruvian, and Argentinean whiting.

Relative Comparisons of Pacific whiting,
Peruvian, Argentinean, and Dover sole

Figure 5 summarizes test results comparing three whiting species relative to Dover sole. Argentinean and Pacific whiting scored approximately the same for overall satisfaction (6.0, 6.4, respectively) and Peruvian scored poorly (3.7). Peruvian whiting scored poorly in all categories. Pacific whiting received comparable scores with the more expensive Dover sole in most categories.

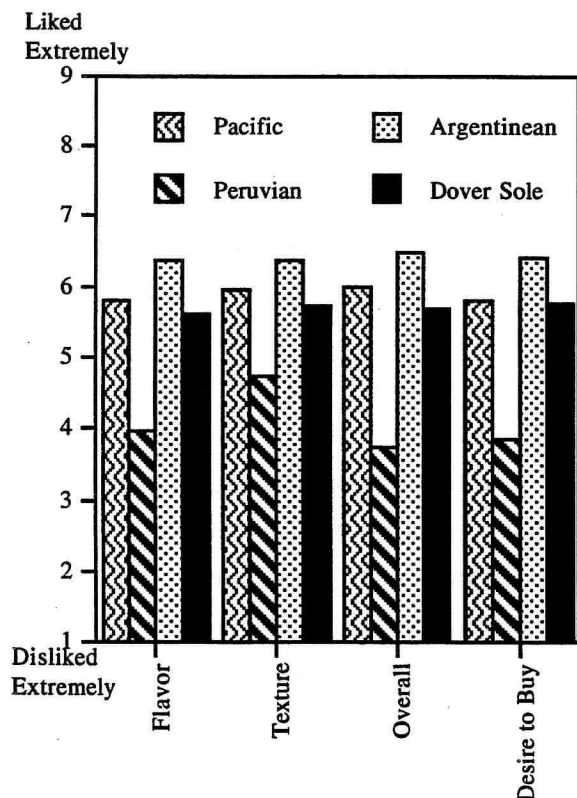


Figure 5. Blind comparisons from 70 consumer taste tests for three species of whiting and Dover sole.

Relative Comparison of Pacific whiting.

Ling Cod, Pollock and Rockfish

Sixty consumers compared Pacific whiting, ling cod, pollock, and rockfish. The purpose was to test how Pacific whiting matched up with other popular fish species. Once again, Pacific whiting scored comparable in all categories except for texture (Figure 6). Pacific whiting showed no difference in flavor intensity, overall flavor, and overall enjoyment relative to the other products. However, respondents indicated that the flesh was somewhat softer in comparison to the other three species.

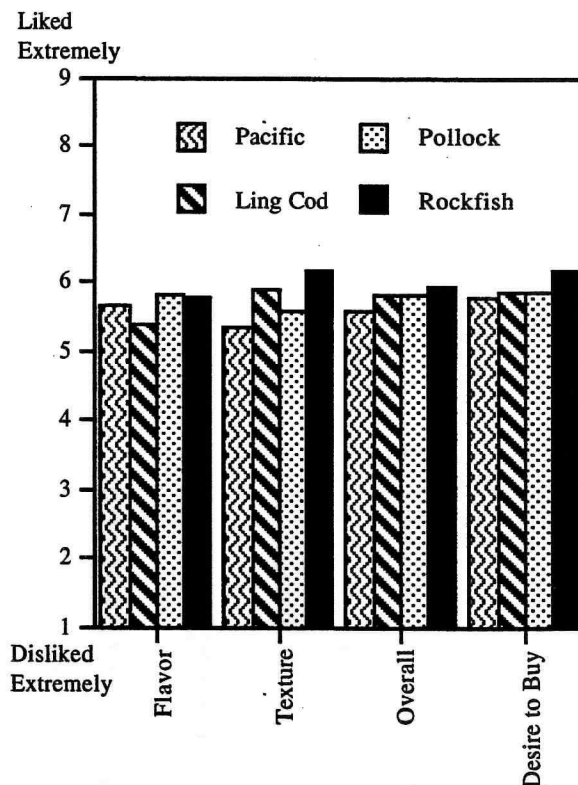


Figure 6. Blind comparisons from 60 consumer taste tests for Pacific whiting, ling cod, pollock, and rockfish.

Pacific whiting Overall

Summary results for all sensory characteristics across all consumer sensory tests for Pacific whiting are presented in Figure 7. Respondents scored thickness, fish flavor intensity, and color as being just right (the scale for thickness, color, flavor intensity and firmness ranged from 1-5 with 3 being just right). Overall, Pacific whiting scored a 5.96 on a nine point scale. This score was comparable not only to South American whittings, but other higher priced west coast species. These findings suggest that Pacific whiting, if captured and processed properly and prepared using fast

cooking techniques (e.g., microwave, quick frying), is a good quality product (although slightly soft and *delicate*) acceptable to consumers.

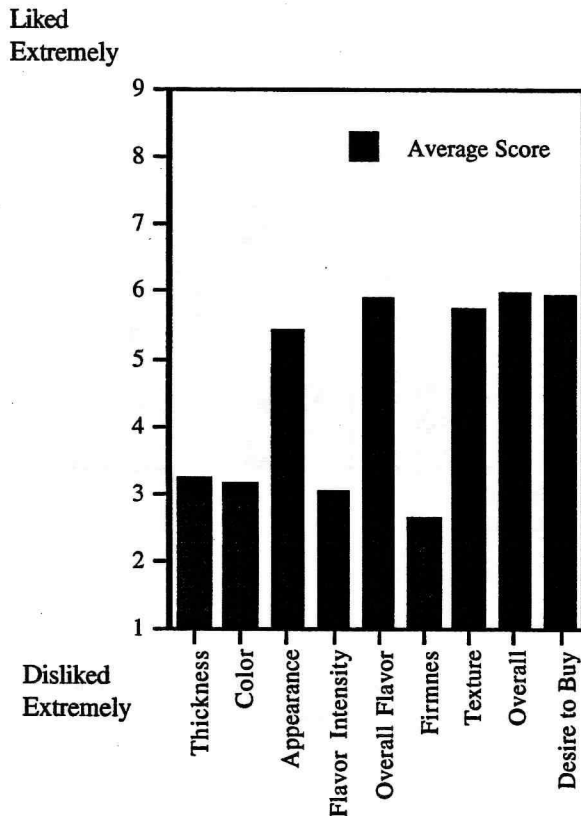


Figure 7. Total Pacific whiting sensory evaluation scores (all tastings). The scale for thickness, color, flavor intensity, and firmness ranged from 1-5 with 3 being just right.

Marketing Evaluation 1993 OSF

Consumers participated in a hypothetical market experiment similar to the one conducted with wholesalers. Consumers were asked to state the desirability of five hypothetical fillet products and indicate potential annual purchases. All the products were assumed to be 2-4 ounces, skinless IQF fillets sold in 2 pound packages. The

products were assumed to have the same sensory characteristics as the product that the respondent enjoyed the most in the sensory evaluation. Each product differed in *price* (\$1.50, \$3.00 or \$4.50/lb.), *country of origin* (United States or Argentina), *product information* (a product contained or did not contain product information on storage, cooking, and how the fish was caught and processed), and *quality inspection level*. A product had three different levels of quality inspection: none, a low level of inspection that does not necessarily guarantee satisfaction, and a high level of inspection that guarantees consumer satisfaction.

Statistical analysis demonstrates the relative importance of a change from a base attribute to a new level attribute (Table 4). For example, a product that originated in the United States would be slightly more important than one from Argentina. Females tended to value products as more important than males and products lacking information decreased in importance. Respondents indicated that an increased level of quality inspection would greatly increase the importance of the product, indicating consumers concerns regarding seafood quality and safety.

Table 4. Importance attributed to changing characteristics of buyer and product

Characteristic	Base Attribute/ New Level Attribute	Importance
Seafood Consumption	42 times/yr/ 52 times/yr	Slightly (+)
Origin of Product	United States/ Argentina	Important (-)
Gender	Male/ Female	Important (+)
Product Information	Yes/ None	Very Important (-)
Medium Quality Inspected	Yes/ None	Very Important (-)
High Quality Inspected	Yes/ None	Very Important (-)
Overall	Unit Score=6/ Unit Score=7	Important (+)

Marketing Evaluation 1994 OSF

Packaging

As part of the market evaluation, respondents were asked to select from a list of 13 different options the five types of information they would most desire to see on seafood packaging. The results are presented in Table 5 from most to least important.

Consumers were most concerned with issues related to shelf-life. Respondents wanted to know when the fish was caught and how long it could be expected to last. This issue is not as important for frozen product as for fresh, but can still have

important ramifications for marketing strategies for Pacific whiting. Handling, cooking, and storage information was also important. Respondents felt that some sort of safety and quality inspection label was important; industry inspections carried slightly more weight than government inspections. How and where the fish was caught scored lower than most of the product information options.

Table 5. The most requested information for seafood packaging by consumer survey respondents

Packaging Information	Number of respondents
Expiration dates	192
Date fish was caught	178
Previously frozen label	122
Handling, cooking, and storage information	117
Industry safety inspected label	103
Industry quality inspected label	90
Government quality inspected label	83
Government safety inspected label	79
Harvest location	70
Fish caught in environmentally sound manner	55
Labeled fresh	52
Labeled grades (A, B, etc.)	43
Ingredients in processed fish	39
Fishery is not threatened or endangered	25
Who has handled fish	24

Safety and Quality

The recent proposal for a government mandated seafood inspection program based on HACCP principles could have important implications for the seafood industry. At the 1994 Oregon State Fair, 260 consumers were asked whether they could differentiate between quality and safety issues. Consumers were given an identical list of 13 statements relating to seafood quality and seafood safety. Consumers were then asked

to select their five most important safety concerns and their five most important quality concerns. The results are shown in Table 6 with the five top answers for quality and safety highlighted in bold.

Table 6. Consumers top five concerns for seafood safety and quality

Attributes	Safety	Quality
Careful handling & processing	195	119
Cleanliness	179	137
Odor	147	171
Date fish was captured	128	110
No diseases or bacteria	124	72
No pollutants	112	41
Buying from a reputable retailer	99	107
Freshness	95	207
Thickness	78	29
Fish displayed on ice	36	42
Taste	35	119
Texture	30	85
Harvest location	30	23

These responses indicate that consumers were not able to completely differentiate between safety and quality issues. For example, respondents ranked odor and the date fish was captured as the third and fourth most important safety concerns, when in fact these attributes are generally associated with product quality. These findings suggest that most consumers' feel safety is a subset of overall quality.

Summary

At the 1994 Oregon State Fair, Pacific whiting scored approximately the same overall as skin-off Pacific whiting from the 1993 State Fair, while Peruvian whiting did much poorer at the 1994 OSF. Pacific whiting was significantly preferred over

Peruvian whiting and was comparable to Argentinean whiting. Chilean whiting scored slightly higher than Pacific whiting in the 1994 OSF. Pacific whiting scored comparable to ling cod, pollock, and rockfish in all categories except for texture. The results showed better than expected consumer enjoyment and acceptance of Pacific whiting.

TRAINED PANEL RESULTS

Nine selected staff and students from the Department of Food Science and from outside the department were recruited to be involved in a trained panel study. The selection of the trained panel was based on their ability to describe and detect sensory characteristics in the seafood product. The judges were asked to rate the characteristics of *appearance*, *aroma*, *flavor*, and *texture* for the following products: Pacific, Chilean, Peruvian, and Argentinean whiting, Dover sole, ling cod, rockfish, and pollock.

The fillets were in individual frozen form. Each fillet from each species was cut into a 0.5" x 0.5" piece. The sample to be judged was randomly selected from several fillets from the same species. A fast heating method (microwave oven) was used to cook the samples.

Results showed that (1) color intensity of cooked Pacific whiting was not significantly different from that of Chilean whiting and rockfish; (2) Dover sole had the lightest color; and (3) flake size of pollock, Chilean,

and Dover sole were not different from that of Pacific whiting.

Fresh fish aroma of Pacific whiting was different than Dover sole and Peruvian whiting, but not the other species (not shown). Dover sole had the lowest score while Peruvian had the highest. Salty aroma of Pacific whiting and Dover sole differed with Dover sole having a lower degree of saltiness. Argentinean whiting's nutty aroma was the highest and pollock's the lowest. Pacific whiting possessed some buttery aroma which was not different from that of Chilean, ling cod, pollock, and rockfish. Dover sole was the highest in buttery aroma.

Figure 8 presents comparisons of flavors. Overall, fish flavor intensity of Pacific whiting did not differ from that of Dover sole and pollock. Pacific whiting's freshness and fishy flavor differed from Dover sole and Peruvian.

Pacific whiting textural properties did not differ significantly from those of Dover sole, except for hardness (not shown). Pacific whiting's hardness was the lowest compared to the other products.

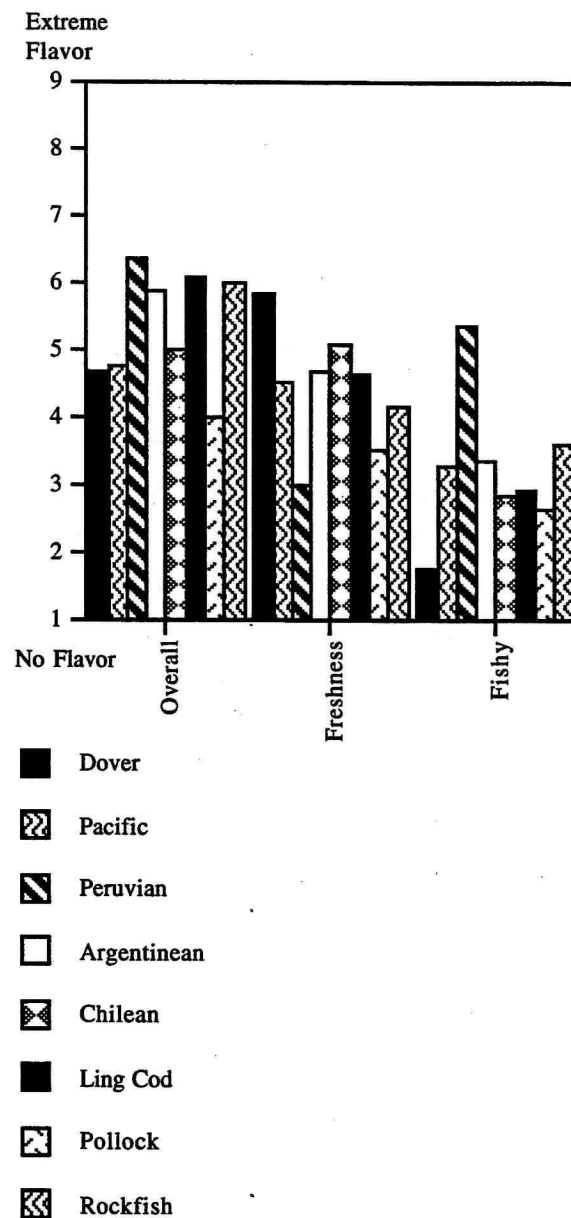


Figure 8. Average flavor scores for eight species from nine trained panel participants.

FOCUS GROUP RESULTS

Nine consumers participated in three discussion sessions to generate information and insights into consumer thinking, reaction, and purchasing behavior of seafood. The purpose of the study was to

reveal consumer feelings and motivations using their own language and descriptions for seafood in general, and Pacific whiting in particular. The study showed that flavor was the most important factor affecting consumers' purchase decision for fish. Flavor must be fresh, mild, and pleasant; unpleasant and strong fishy flavors are undesirable. Appearance, odor, price, and thickness of fillets were the next important factors, respectively. Color consistency, flake size, fresh fish and fishy aroma were meaningful and important characteristics to consumers, while texture was not as important. Consumers prefer clean and fresh looking fish with consistent color. Large flakes on a thick cut is desirable. Ideal texture is firm and flaky with medium moistness.

Consumers cited positive remarks toward Pacific whiting IQF fillets (cooked by a microwave). They felt it was clean, looked good (e.g., color, shape, thickness), and they liked the pleasant odor and flavor. Consumers indicated that the texture was springy and flaky. However there were also negative comments. Consumers indicated that there was a stronger fish smell than when they cooked the fish at home by their own methods (e.g., cooked, baked, deep fried). Overall, however, Pacific whiting was acceptable to many of the consumers.

Conclusions

At the Oregon State Fair Pacific whiting showed that it could compete comparably with Argentinean and Chilean whiting IQF fillets and above Peruvian fillets. Pacific whiting scored high in flavor and overall characteristics. Interestingly, although Pacific whiting had the lowest scores in firmness, in the focus group consumers ranked it high in texture liking its "delicate" texture as a fillet product. This was verified when Pacific whiting was compared to Dover sole as a fillet product. Respondents scored Pacific whiting thickness and fish flavor intensity as just right, but the color of the cooked portion was perceived to be slightly dark and the firmness was "soft". Pacific whiting scored comparable to ling cod, pollock and rockfish in all categories except for firmness. The results showed favorable overall consumer acceptance of Pacific whiting.

3.2 MINCED WHITING/SHRIMP PATTY

Seafood patties made from a blend of minced whiting and shrimp is not a new concept. Shrim-Bos, as they were originally called, were first developed at the OSU-SL in the early 1970's. The product was distributed locally for several years, but the company eventually went out of business.

The OSU-SL decided to redevelop the patties and test wholesaler and consumer response.

Wholesaler Survey

Three different blends of minced whiting and shrimp were tested. The blends were 80% whiting/20% shrimp, 60% whiting/40% shrimp, and 40% whiting/60% shrimp. The patties were sent to 66 companies nationwide.

Wholesaler Evaluation

Overall, the patties were favorably received by wholesalers, with some respondents expressing a very strong interest in handling the product (see Appendix C). Generally, the patties with 60% whiting received the most favorable scores, although in some instances, the 40% whiting patty had comparable or slightly greater scores. In contrast, the 80% whiting patties received the lowest scores, although not by a significant margin (Figure 9). As expected the whiting/shrimp mixture of the three patty types had no effect on the scoring of the breaded characteristics.

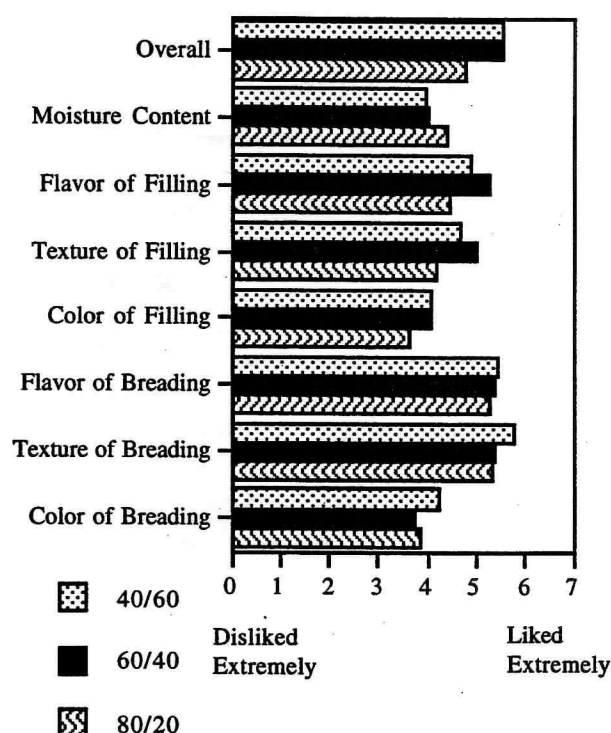


Figure 9. Wholesaler evaluation of minced whiting/shrimp patties

Consumer Survey

Sensory Evaluation

The minced whiting/shrimp patties were received favorably at the 1993 Oregon State Fair. Scores for all three mixtures averaged from 6.5 to 7.2 on a 9 point scale (Figure 10). All product blends scored well, but the 60% whiting/40% shrimp scored slightly higher for all characteristics than the other blends. The moisture content was also perceived to be just right (4.03).

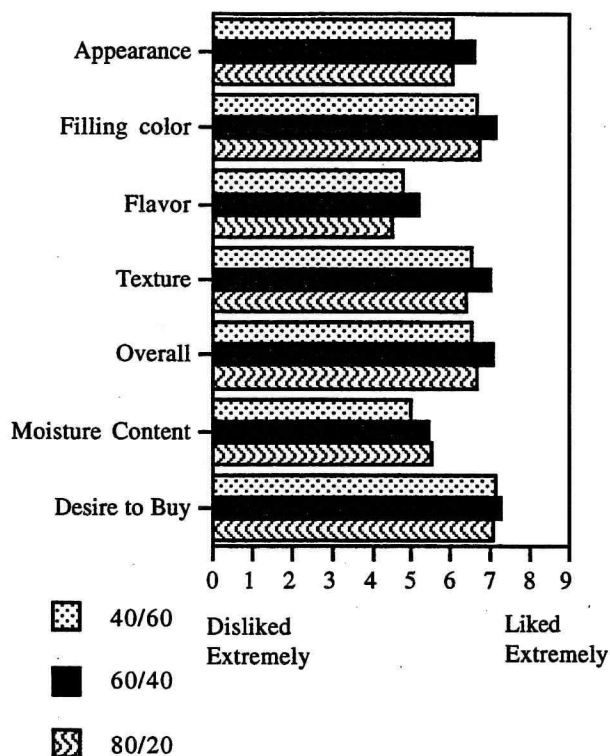


Figure 10. Consumer scores from sensory evaluation of minced whiting/shrimp patties

Similar to the wholesaler evaluation, the 60% whiting/40% shrimp scored slightly higher than the other two blends. However, consumers scored the seafood patties considerably higher than wholesaler representatives. Improper handling and storage may be partly responsible for the lower scores by wholesalers. The frozen patties were shipped using dry ice and in some cases products may have thawed out before being sampled. Also, the patties were shipped out two months after the state fair and three months after the product was produced. Product deterioration could be one explanation for the lower scores.

Marketing Evaluation

Consumer respondents were asked to score desirability and individual demand for five hypothetical minced whiting/shrimp breaded seafood products. Products were assumed to be frozen, sold in 1.5 lb. packages, and have the same blending characteristics which the respondent scored highest in the sensory evaluation. Each product differed in *price* (\$2.00, \$4.50, or \$7.50/package), *product size* (1 oz. nugget or 4 oz. patty), *origin of product* (United States or Oregon), *product information* (product does or does not contain information on cooking, handling, etc.), and *level of quality inspection* (none, moderate level but satisfaction is not guaranteed, or high level that guarantees satisfaction).

Statistical analysis demonstrates the relative importance of a change from a base attribute to a new level attribute (Table 7). The results suggest that individuals with lower incomes had a greater importance than those with higher incomes. Older individuals and males also perceived a greater importance in general than younger, female individuals. Respondents indicated that an increased level of quality inspection would greatly increase the importance of the product.

Table 7. Importance attributed to changing characteristics of buyer and product

Characteristic	Base Attribute/ New Level Attribute	Importance
Gender	Male/ Female	slightly important (+)
Medium Quality Inspection	Yes/ None	very important (-)
High Quality Inspection	Yes/ None	very important (-)
Age	under 50/ over 50	important (-)
Per Capita Income	\$15,877/ \$25,877	important (-)

Conclusions

Consumers scored the seafood patties considerably higher than wholesalers. All product blends scored well, but the 60% whiting/40% shrimp scored slightly higher for all characteristics than the other two products for wholesalers and consumers.

3.3 FRESH SURIMI ANALOGS

With the development of the Oregon Pacific whiting surimi industry (4 surimi plants in Oregon), the possibility of producing fresh surimi analog products is a reality. In their 1991 survey, Sylvia and Peters found that some leading producers of quality analog products believed that a "fresh high quality surimi" was a significant opportunity for shore based plants. The purpose of this

study was to investigate consumers' acceptability of fresh or never frozen surimi crabmeat compared to the commercially available frozen product. We also intended to determine the technical feasibility of producing fresh surimi products and what economic benefits might be generated. We tested the acceptance of 297 consumers at the 1994 Oregon State Fair. However, the fresh crab analog was made with a lower grade surimi than the frozen product. Out of the 297 consumers, 151 were given information that they were tasting fresh surimi against frozen surimi, while 146 received no information about the product.

Among consumers who did not know about the products (blind tasting), the frozen product was preferred due to the higher grade of surimi used in the product. However, when information about the products was given to the consumers, the fresh surimi product scored higher. This suggests that there were strong consumer preferences for a fresh or never frozen product (Figure 11). Survey results showed that consumers overwhelmingly preferred to purchase fresh surimi over frozen surimi. Consumers also stated they were willing to pay approximately \$0.15/lb. more for a fresh surimi product. Likewise, 60% of the respondents would pay \$0.10/lb more for fresh surimi if it contained less sugar and had fewer calories than frozen surimi (Figure 12).

Fresh surimi does not need cryoprotectants (e.g., sorbitol and sucrose) since it is never frozen. This represents considerable savings to a surimi producer, and without these additives fresh surimi could be perceived as a healthier product to the consumer. Technical research at the OSU-SL has demonstrated that surimi loses some of its gel strength when frozen. Therefore, less fresh surimi is needed to make analog of the same gel strength than frozen surimi, producing as much as a 10% savings to an analog processor.

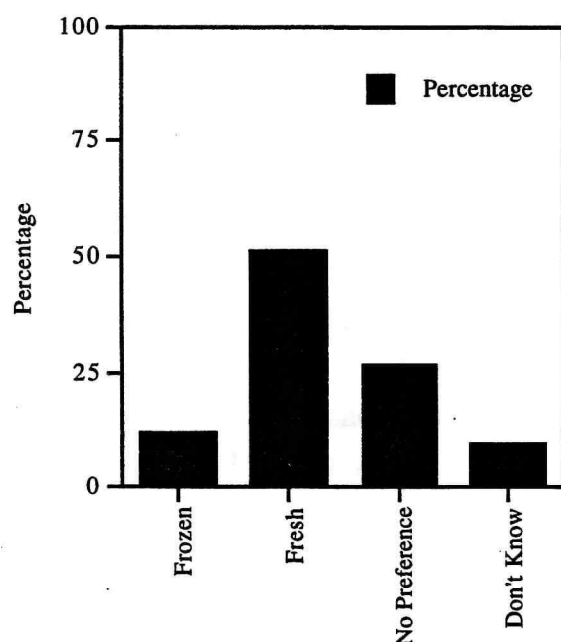


Figure 11. Percentage of consumers selecting fresh or frozen labeled surimi

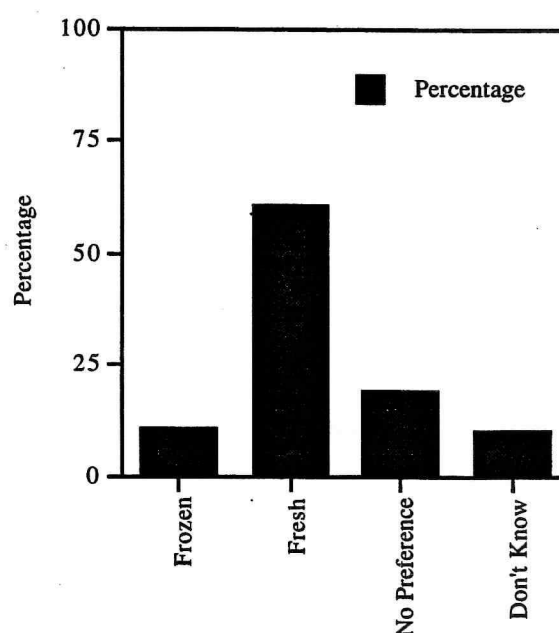


Figure 12. Percentage of consumers selecting fresh relative to frozen product if they knew fresh surimi contained less calories and no sugar, but cost \$.10/lb. more

Conclusions

There are several advantages for developing products from fresh surimi. For both surimi and surimi-based seafood operations, (1) production costs would be lower due to the simple fact that one is not using ingredients such as cryoprotectants (e.g., sorbitol); (2) a higher gel strength for fresh surimi; and, (3) a wider range in use of flavorings. Results from the survey indicate that consumers prefer fresh surimi to frozen surimi and are willing to pay more for a fresh product. Consumers responded favorably to fresh surimi, which could be marketed as a healthier product with fewer ingredients and less calories. The use of fresh surimi appears to be a viable means of expanding the U.S. surimi markets.

3.4 STABILIZED MINCE

The use of cryoprotectants in surimi is well understood. Cryoprotectants protect the functionality of fish proteins during frozen storage. Surimi blocks can be stored up to 18 months and used to produce quality products with good gel-forming characteristics. Research is now investigating the use of low-cost cryoprotectants for fish mince. These compounds can stabilize the proteins during frozen storage and produce a stabilized mince. Normally, fish mince (especially mince made from gadoid species such as whiting) experience a number of problems during frozen storage. Minced blocks become spongy and readily lose water (loss of water holding capacity). The texture characteristics are poor and there are a number of off-odors associated with frozen mince blocks. It was thought that the use of cryoprotectants may prevent these effects, and a high quality mince block could be used to produce quality value-added products.

Ongoing research at the Oregon State University Seafood Laboratory is testing standard sucrose/sorbitol, sucrose/M250 (a maltrin corn syrup solid), polydextrose and drained dried whey as cryoprotectants to produce "stabilized" mince. The corn syrup and whey products are inexpensive while sorbitol and polydextrose are moderately

expensive (costs would be higher than the fish mince they are replacing).

Results show that the quality of the stabilized mince was considerably higher than control samples (no cryoprotectants) in terms of texture characteristics, salt soluble protein (a measure of protein denaturation) and DMA production (a chemical indicator of frozen fish quality). Polydextrose was the most effective of all cryoprotectants studied. The color of mince was only slightly affected by cryoprotectants. Pacific whiting mince will have protease present in the flesh and it is recommended that 1.5% to 2% of food grade inhibitors such as beef plasma protein be added to prevent texture degradation. Consequently, more protease inhibitor needs to be used. Based on OSU-SL results, it is recommended that beef plasma protein, a standard protease inhibitor for surimi, be used at the 2% level. Although value-added products were not produced from stabilized mince the higher quality characteristics especially texture, would indicate that quality products could be manufactured. Fish mince tends to have a poor reputation in the seafood industry and commands a low price. This poor image could be improved with the production of a stabilized mince. The costs of cryoprotectants such as sucrose and drained whey are less than the cost of the mince itself and would off-set minimal additional costs of processing.

4. IMPLICATIONS OF VALUE-ADDED RESEARCH

The results of wholesaler and consumer surveys suggest that if efforts are made to improve and standardize product quality, Pacific whiting has potential for use in a variety of value-added products. Soft texture presents a problem and technologies to improve texture need to be emphasized or developed. Mixing whiting with other products (other species, colloids, fillers, etc. in value-added products) is one example of production strategies which address the soft "delicate" texture. Developing product quality assurance is one strategy to improve acceptance and overcome the product's poor reputation. Standardized grades could meet industry buyer needs, but costs and logistical issues need to be addressed.

Work needs to continue given the high volume and low ex-vessel price of the product. One potential strategy is production of value-added products for institutional use including nursing homes, prisons, and school systems.

The future potential for high volumes of on-shore production of Pacific whiting is significant. Expectations for an increase in global demand for reasonably priced white fish products suggests a promising future for this industry, across a variety of product

forms and market segments including retail and institutional buyers.

5. CONCLUSIONS

Results strongly suggest that if efforts are made to improve and standardize the quality of Pacific whiting that a number of value-added products could be successfully produced. There was notable improvement in the quality of IQF fillets from the 1993 to the 1994 season. This results from a better understanding of the fishery, improving on-board handling, and processing and marketing the product in user friendly packages such as 2 lb. packs. IQF fillets kept in frozen storage for one year showed very little deterioration and were rated favorably in the consumer survey.

There is still concern with softness of the texture and workmanship of the final product. Work with the focus group and the trained panel show that Pacific whiting has an inherently soft texture. It is well known in the industry that the flesh can turn mushy if time and temperature parameters are not carefully monitored. The softness or "delicacy" of the flesh can be perceived in some markets and for some product forms as a positive characteristic. Pacific whiting fillets scored well when compared to Dover sole, another soft fleshed species. Potential markets could include school lunch programs or nursing homes where mild tasting, soft-

textured fish are favorably received. Industry producers are encouraged to include cooking instructions (fast cooking methods such as microwave, frying, etc.) on the packaging so that soft texture is minimized.

Research and processing experience has demonstrated that the enzyme related softening of the flesh can be countered with the use of food-grade protease inhibitors. Although this will not work well in intact tissue such as fillets, it can be incorporated in mince and surimi products. The fish/shrimp minced products called Shrim-Bo's, showed high acceptance from both consumers and wholesalers. Texture was not regarded as a concern in these products. Stabilized mince has potential as a product and shows superior texture characteristics after long-term frozen storage than regular mince. Moreover, the cost of ingredients for stabilizing Pacific whiting mince is less than the mince itself. With four surimi processing plants now in Oregon, the potential for making fresh (never-frozen) surimi-based seafood is excellent. There would be costs savings due to higher gel strength in the fresh product, and consumer perceptions of a higher quality product.

Oregon State University, the Coastal Marine Experiment Station and the Oregon State University Seafood Laboratory plan to continue cooperative research into Pacific whiting in the areas of marketing, food technology, and resource management.

Future research will focus on diversifying industry opportunities, developing value-added products, standardizing and improving product quality, and developing management strategies that improve resource benefits. Research will continue to emphasize close industry ties and interdisciplinary approaches.

APPENDIX A: REFERENCES

The following are articles of interest on Pacific whiting published by the Coastal Oregon Marine Experiment Station since 1992. Contact either Michael Morrissey at the OSU Seafood Laboratory or Gil Sylvia at the Coastal Oregon Marine Experiment Station about obtaining copies.

Journal Articles

An, H., Seymour, T.A., Wu, J.-W. and Morrissey, M.T. 1994. Assay systems and characterization of Pacific whiting (*Merluccius productus*) protease. J. Food Sci. 59(2):277-281.

Chung, Y.C., Richardson, L., and Morrissey, M.T. 1993. Effects of pH and NaCl on gel strength of Pacific whiting surimi. J. of Aquatic Food Product Technol. 2(3):19-35.

Hsu, C.K., Kolbe, E., Morrissey, M.T., and Chung, Y.C. 1993. Protein denaturation of frozen Pacific whiting (*Merluccius productus*) fillets. J. of Food Sci. 58:1055-56, 1075.

Lin, T.M., Park, J.W. and Morrissey, M.T. 1995. Recovered protein and recondition of water from surimi processing waste. J. Food Sci. 60(1):4-9

Morrissey, M.T., Wu, J.-W., Lin, D. and An, H. 1993. Protease inhibitor effects on torsion measurements and autolysis of Pacific whiting surimi. *J. Food Sci.* 58(5):1050-1054.

Park, J.W. 1994. Functional protein additives in surimi gels. *J. Food Sci.* 59(3):525-527.

Seymour, T.A., Morrissey, M.T., Peters, M.Y., and An, H. 1994. Purification and characterization of Pacific whiting protease. *J. Agric. Food Chem.* 42:2421-2427.

Simpson, R., Kolbe, E., MacDonald, G., Lanier, T.C. and Morrissey, M.T. 1994. Surimi production from partially processed and frozen Pacific whiting (*Merluccius productus*). *J. Food Sci.* 59(2):272-276.

Sylvia, G. and Peters, G. 1991. Market opportunities for Pacific whiting. A report prepared for Oregon Economic Development Department and the Oregon Department of Agriculture. Published by Oregon Coastal Zone Management Association, Newport.

Sylvia, G., Larkin, S., and Morrissey, M.T. In press. Optimizing product quality of marine resources: a bioeconomic analysis of the Pacific whiting fishery. Report to the Conference on International Institute of Fisheries Economics and Trade, Taipei, Taiwan, Republic of China, July 18-21, 1994.

Sylvia, G., M. Murphy and S. Larkin. In press. Designing quality assurance standards for seafood products: a marketing management analysis. Report to the Conference on International Institute of Fisheries Economics and Trade, Taipei, Taiwan, Republic of China, July 18-21, 1994.

Sylvia, G. and R. Enriquez. In press. A multiobjective analysis of the Pacific whiting fishery. *Journal of Marine Resource Economics*.

Sylvia, G. and R. Enriquez. In press. The geographic distribution of fishing effort: an analysis of alternative policy objectives in the Pacific whiting fishery. *Natural Resource Modeling and Management*.

Sylvia, G., S. Larkin and G. Peters. In press. Short run firm-level demand for Pacific whiting products: a multiattribute, multisector analysis. In second review - *Canadian Journal of Agricultural Economics*.

Books

Sylvia, G. and Morrissey, M.T. (ed.). 1992. *Pacific Whiting: Harvesting, Processing, Marketing and Quality Assurance*. Oregon Sea Grant, Corvallis, OR. Cost \$10

Sylvia, G., Shriver, A. and Morrissey, M.T. (ed.). 1994. *Quality Control and Quality Assurance for Seafood*. Oregon Sea Grant, Corvallis, OR. Cost \$10

Alheit, J. and Pitcher, T. (eds.). *Hake: Fisheries, Ecology and Markets*. Chapman and Hall, New York. Cost \$50

The following chapters refer to Pacific whiting in the book edited by Alheit and Pitcher:

Sylvia, G. Global markets and products of hake. Chapter 15: 415-435.

Peters, G., Sylvia, G., and Morrissey, M.T. Determination of quality parameters for Pacific whiting (*M. productus*). Chapter 16: 437-449.

Sylvia, G., Bertullo, E., and Werner, J. Recommendations of the workshop group on quality assurance for hake. Chapter 17: 451-457.

APPENDIX B: WHOLESALE INTERESTED IN IQF PACIFIC WHITING FILLETS

Contact: Robert Walker
Phone: (504) 834-9393
428 Jefferson Highway
Jefferson, LA 70121

Contact: Ed Wrege
Phone: (517) 753-8980
Wreg's Fish Company
226 Millard Street
Saginaw, MI 48605

Contact: Douglas Baker
Phone: (612) 926-9181
Baker Sales
3600 W. Lake Street
Minneapolis, MN 55416

Contact: Carl Dekker
Phone: (717) 761-2600
Iceland Seafood Corp.
1250 Slate Hill Road
Camp Hill, PA 17011

Contact: Blaine Vord
Phone: (414) 729-5865
Aqua, Inc.
1032 Pilgrim Road
Neenah, WI 54956

Contact: Garrett Browner
Phone: (315) 699-5993
C. Browner Company
6342 Lakeshore Road
Cicero, NY 13039

Contact: James Vogt
Phone: (315) 789-5322
Geneva Seafood & Fish Company
69 N. Exchange Street
Geneva, NY 14456

APPENDIX C: WHOLESALE INTERESTED IN WHITING-SHRIMP PATTIES

* Strong interest in product

**Strong interest; willing to assist in product
promotion and marketing

**Contact:* Michael Casey
Phone: (818) 705-6511
B.R. Sales Company, Inc.
6924 Canby Avenue, Suite #109
Reseda, CA 91335

Contact: Beatrice Pace
Phone: (305) 741-4361
Pace Marketing Company
9474 N.W. 48th Street
Sunrise, FL 33351

Contact: John Robinson
Phone: (213) 832-4249
L.A. Fish & Oyster Company
2212 Signal Place
San Mateo, CA 90731

**Contact:* Junre Desporte
Phone: (601) 432-1018
Desporte & Sons, Inc.
444 Caillavet Street
Biloxi, MS 39530

**Contact:* Bob McErlean
Phone: (914) 426-1000
Ramapo Seafood Corp.
One Alpine Court
Chestnut Ridge, NY 10977

Contact: Tim Berg
Phone: (212) 867-3160
Hanwa Seafood Corp.
750 3rd Avenue
New York, NY 10017

Contact: Andrew Herman
Phone: (814) 695-6427
Shelco Seafood
721 N. Junaita Street
Hollidaysburg, PA 16648

Contact: Blaine Vord
Phone: (414) 729-5865
Aqua, Inc.
1032 Pilgrim Road
Neenah, WI 54956

****Contact:** Michael Kater
Phone: (603) 893-3368
Interstate Seafoods, Inc.
1315 Delaware Drive, Unit 1
Salem, NH 03070

APPENDIX D: PROCESSORS OF PACIFIC WHITING VALUE-ADDED PRODUCTS

Contact: Russ Farmer (Ops. Manager)
Products: Fish feed processed from waste
Phone: (503) 861-2256
Bioproducts, Inc.
1935 N.W. Warrenton Dr.
Warrenton, OR 97146

Contact: Terry Rosaaen
Products: H&G
Phone: (707) 464-3106
Castle Rock Seafoods
P.O. Box 1074
Crescent City, CA 95531

Contact: Jerry Bates
Products: Surimi, Fish meal, H&G
Phone: (503) 265-8834
Depoe Bay Fish Co.
P.O. Box 1650
Newport, OR 97365

Contact: Jerry Thomas
Products: H&G
Phone: (707) 443-1673
Eureka Fisheries
P.O. Box 217
Fields Landing, CA 95537

Contact: Scott Adams
Products: Fillets
Phone: (503) 888-3253
Hallmark Fisheries
P.O. Box 5390
Charleston, OR 97420

Contact: Pierre Marchand
Products: Fillets, H&G
Phone: (360) 642-3773
Jessie's Ilwaco Fish Co.
P.O. Box 800
Ilwaco, WA 98624

Contact: Steve Joner
Products: Proposed processing plant -
multiple products
Phone: (360) 645-2201
Makah Fisheries Management
P.O. Box 115
Neah Bay, WA 98357

Contact: Pete Edison
Products: Surimi, Fillets, H&G
Phone: (503) 265-4215
Newport Shrimp Co.
P.O. Box 1301
Newport, OR 97365

Contact: Grant Larson
Products: Fillets
Phone: (503) 325-2421
Ocean Beauty - Astoria
P.O. Box 626
Astoria, OR 97103

Contact: Whitey Forsman
Products: Surimi, H&G, Fillets
Phone: (503) 861-2201
Pacific Coast Seafoods
P.O. Box 70
Warrenton, OR 97146

Contact: Tom Libby
Products: Surimi
Phone: (503) 861-2226
Point Adams Packing Co.
P.O. Box 162
Hammond, OR 97121

Contact: Paul Krabbe (Manager)
Products: H&G
Phone: (503) 265-5365
Point Adams Packing Co.
P.O. Box 1025
Newport, OR 97365

Contact: Frank Ormonde (Manager)
Products: H&G
Phone: (707) 464-6177
Sea Products
270 Hwy. 101 South
Crescent City, CA 95531

Contact: Mike Brown (Manager)
Products: Fillets, H&G
Phone: (360) 268-9161
Washington Crab Processors
P.O. Box 1488
Westport, WA 98595

Contact: Alan Morasch
Products: Seafood wrap-ups, a line of
precooked heat-n-serve whiting entrees
Phone: (360) 256-6651
Splash 'n Sea
3606 SE 151 ST Court
Vancouver, WA 98684

This Page Intentionally Left Blank

ACKNOWLEDGEMENTS

We wish to thank the many private companies, public agencies, and individuals who contributed to this project. We thank the Oregon Department of Economic Development and the Regional Strategies Program for providing the basic funding for the project. We also thank the U.S. Department of Agriculture for the Seafood Marketing Grant. A number of Oregon companies gave freely of their time, plant operations, and product. These companies include Pacific Coast Seafoods, Pt Adams Packing Company, Arctic Alaska/Depoe Bay, Kyotaru Oregon, Newport Shrimp/Inland Quick Freeze, Granpac Foods, and Splash and Sea. Their cooperation with researchers in the Pacific whiting industry has created a can-do attitude helping the industry gather a tremendous amount of information within a short period of time. A number of staff and graduate students have worked on this project and have been very helpful throughout. Michael Murphy and Weeraporn Akomsri were instrumental in carrying out surveys and consumer testing. Yildiz Karaibrahimoglu, Edda Magnusdottir, and Siriporn Pipatsattayanuwong worked on product development. A number of other students contributed their time and effort in administering taste tests and analyzing data throughout the project. A special thanks goes to Deana Grobe for compiling the information and undertaking the editing of the report.