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2002 Conference Proceedings

Peter J. Bechtel, Editor

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Remarks and Acknowledgments

For us in Alaska, we have seen many changes in our fishing industry since the first International Conference on Fish By-Products held in 1990. Our white fish industry is fully developed and Alaska has emerged as one of the world’s leaders in producing surimi and fillets. The fish meal technology presented during the first conference was adopted by our industry. However, our industry has made modifications. For example, most shoreside processors are using a screening system between the drying and milling steps to remove some of the bone fragments to maintain a protein content of at least 65% in the fish meal. Thus, we would like to share with you what we have accomplished as well as learn from you what you have experienced. This sharing of information and needs is good because we all share the same concerns as we strive to increase the utilization of our fishery resources.

It is important to make some acknowledgments. Planning for this conference began in November 2001. Those individuals who served on the organizing committee were:

- Jerry Babbitt (conference chair), National Marine Fisheries Service, Kodiak, Alaska
- Brenda Baxter (conference coordinator), University of Alaska Fairbanks, Alaska Sea Grant College Program, Fairbanks, Alaska
- Peter J. Bechtel, U.S. Department of Agriculture, Agricultural Research Service, Fairbanks, Alaska
- Robin Cababa, The Oceanic Institute, Waimanalo, Hawaii
- Ian Forster, The Oceanic Institute, Waimanalo, Hawaii
- Ronald W. Hardy, University of Idaho, Hagerman Fish Culture Experiment Station, Hagerman, Idaho
- Marc Jones (conference financial manager), Alaska Fisheries Development Foundation, Anchorage, Alaska
- Donald Kramer, University of Alaska Fairbanks, Marine Advisory Program, Anchorage, Alaska
- Scott Smiley, University of Alaska Fairbanks, Fishery Industrial Technology Center, Kodiak, Alaska
Remarks

Additional members on the program committee included:

- Anthony Bimbo, Technical Consultant, Kilmarnock, Virginia
- John Kilpatrick, Marine Protein and Oil Consultant, West Vancouver, British Columbia

In addition, we have been blessed with the generosity of many groups who willingly sponsored this conference. These sponsors contributed speakers’ travel and meeting expenses, and gave us cash for unrestricted use in supporting the conference.

- Alaska Fisheries Development Foundation
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- U.S. Department of Agriculture, Agricultural Research Service
- University of Alaska Fairbanks
  - Marine Advisory Program
  - Alaska Sea Grant College Program
  - Fishery Industrial Technology Center
  - School of Fisheries and Ocean Sciences
- World Aquaculture Society
- Pacific Seafood Processors Association

Welcoming remarks were made by Dr. Charles Hocutt, University of Alaska, Fairbanks, Alaska, for Dr. Craig Dorman, vice president for research, University of Alaska Statewide System and Dr. Robert Matteri, USDA, Agriculture Research Service, Pacific West Area, Albany, California.

Session chairs were Ronald Hardy, Robbin Cababa, John Kilpatrick, Scott Smiley, Peter Bechtel, Anthony Bimbo, Marc Jones, Donald Kramer, Ian Forster, and Chris Mitchell. Donald Kramer coordinated the poster session.

Conference coordinator was Brenda Baxter who received assistance from Beverly Bradley, Tim Sullivan, and Charles Crapo.

Sue Keller copy-edited and arranged production of this proceedings, Kathy Kurtenbach formatted the text pages, and Tatiana Piatanova designed the cover, all of the Alaska Sea Grant College program.

At the conclusion of the conference I think that all were in agreement that the 2nd International Seafood Byproduct Conference was a great success. The interactions among the international and national seafood industry and the Alaskan processing sector has been exciting and meaningful.
Indeed, this was truly an international conference. For the record, there were 125 participants from 17 countries.

Significant advances have been made in our Alaskan processing sector since the first International Conference on Fish By-Products that was held in 1990. Alaska now makes high quality meals which are highly accepted in international markets. However, we realize that we have a long way to go to more fully utilize our harvested marine resources, and we are thankful to the speakers and participants for sharing with us their knowledge and experiences as we continue to develop economically viable options to utilize our resources.

The true test of the success of this conference will be seen in the coming years as we employ the ideas that were discussed during this conference to increase the utilization of our marine resources. One thing that I am sure of is that, like the proceedings from the first conference, the published proceedings from this conference will serve as the reference book in this field for many years to come.

Jerry Babbitt, Conference Chair
National Marine Fisheries Service, Utilization Research Laboratory, Kodiak, Alaska
Fish Processing Waste: Opportunity or Liability

Keynote Address

John S. Kilpatrick
West Vancouver, British Columbia, Canada

The first International Seafood Byproducts Conference was held in Anchorage from April 25 to 27, 1990, over 12 years ago. Many predictions made then have proved accurate, but many problems identified then still await solutions. Problems were opportunities then and that is even more true today. New concerns have arisen, or old ones have returned. New key words that were little used in 1990 are now commonplace.

The world seafood industry is still producing large quantities of “waste,” which I prefer to call secondary process streams, and which can take many forms. Except for whole frozen round fish, which is mainly produced by very large freezer trawlers, all fish processing operations produce “waste” or offal, as secondary process streams. The highest proportion of fish “waste” consists of heads, tails, viscera, and backbones from filleting operations. As the industry moves toward more “value-added” products, which require skinless, boneless fillets, additional waste is produced. When these two streams separate, they are of equal quality—that is, they are at the level of freshness suitable for human consumption. Some “waste” products can have a very high value if they can be separated economically. Many people have tried halibut cheeks or—the Newfoundland delicacy—cod tongues. White fish “v” cuts can be made into high quality minced fish with deboning equipment. Some consumer studies have shown that children tend to prefer fish sticks (fish fingers, as the Europeans call them) made from mince, to those from whole fillets.

The great bulk of fish processing waste, which can amount to over 60% of landed weight, leaves the human consumption stream at equivalent freshness, and is ideal raw material for the highest quality fish meal and fish oil, if the economics and logistics are right. If they are not, there are other profitable approaches.

One of the new key words I referred to is “organic”; another is “sustainable.” There are many different definitions of “organic,” but the Soil
Association in the United Kingdom, one of the bodies approved by the U.K. government to certify food as “organic,” defines “organic” fish meal as only that made from offal and trimmings from processing for human consumption of fish from sustainable fisheries. So, people wanting to produce “organic” farmed fish have to use fish meal and fish oil certified as “organic” in their fish feeds. The largest U.K. fish meal producer has this certification, and the discussion now is how large the premium shall be.

Let us now consider further how things have changed since 1990. Figure 1 shows world fish landings from 1990 to 1999 (FAO figures). For 2000 the estimate is 95 million metric tons, and for 2001 only 90 million t. In 1993, landings reached 105 million t and were as low as 87 million t in 1998. There has been a downtrend from 1990, and no significant growth is foreseen. In contrast, world aquaculture production has doubled since 1990. In 2000, 27.4% of world seafood supplies were from aquaculture and 72.7% were from the capture fisheries. This year the ratio may be close to $\frac{1}{3}:\frac{2}{3}$.

Figure 2 shows world fish meal production, which includes fish by-product meals, since 1990. The 12-year average is 6.53 million t, so it has been remarkably stable, except for the El Niño year 1998, when production fell to 5.21 million t, and Peru produced only 815,000 t compared with 1.74 million t the year before.

Figure 3 shows world fish body oil production. This is much more variable than that of fish meal, because oil yields can vary so much. The average yield in Peru for 2002 as of November was only 2.6%; in 2001 it was 4.3%. As with fish meal, there is no prospect of any significant increase in production, and as the 12-year average from 1990 is only 1.24 million t, this is of tremendous significance to the world seafood byproducts industry.

Figure 4 shows world fish meal plus world fish body oil production. You will note the maximum was in 1994 with 9 million t and the minimum in 1998, the El Niño year, with just over six million t.

Figure 5 shows world population growth since 1990. The total increase since 1990 is 850 million people. The annual rate of increase has been declining—from 1.36% in 1998 to 1.25% (estimated) in 2002. This still means 77 million more people to feed in one year. If those 77 million people took a one-gram fish oil capsule each day, that amounts to 28,105 t. And if half the world’s population took a capsule a day, that is 1.13 million t of fish oil!

The point is that production of fish meal and fish oil, and other fish byproducts in general, has very limited potential for increase, and replacements for some of their unique properties are very hard to find and tend to be very expensive. On the other hand, production of vegetable proteins and oils continues to increase. It is fortunate that it does, as this trend must exceed population growth to feed the world.

Figure 6 shows world consumption of 12 major protein meals in
Figure 1. World fish landings from 1990 to 1999 (FAO figures).

Figure 2. World fish meal production, including fish byproduct meals, 1990-2001.
Figure 3. World fish body oil production, 1990-2001.

Figure 4. World fish meal plus body oil production, 1990-2001.
Figure 5. World population, 1990-2001.

Figure 6. World consumption of twelve major protein meals, 1991-1992 and 2001-2002, showing an increase of 66.2 t (46%) for those years.
1991-1992. The total was 144.5 million t, of which 4.1% was fish meal. The figure also shows world consumption of these same 12 meals in 2001-2002 (forecast). The total is 210.7 million t—or increase of 46%—while fish meal's share of this total has decreased to 3.4%. Note the growing importance of soybean meal-up from 50% in 1991-1992 to 58% in 2001-2002. All the other meals also lost “market share.” Corn gluten meal lost only 0.3% and rapeseed meal only 0.2%. However, total production of these two meals increased by 10.9 million t or by 1.7 times the average total world fish meal production. This is important because these two meals both have considerable importance as protein ingredients for aquaculture feeds.

Figure 7 shows that in 1986 fish meal contributed 7% of total world protein meal supply. Soybean meal’s market share was at the same level as today—so it has recovered all that it had lost in 1991-1992.

Figure 8 shows world fish meal use in 1995 and 2001. In 1995 aquaculture use was 15% and poultry plus pigs 75%. In 2001 aquaculture was up to 40%, and poultry plus pigs down to 53%. The decline in fish meal use for ruminants reflects European Union (E.U.) restrictions on the use of fish meal in ruminant diets—ostensibly because of the fear of adulteration of fish meal with meat and bone meal (prohibited because of BSE [bovine spongiform encephalopathy] concerns).

Another new key word is traceability. Prohibition of the use of fish meal in ruminant diets will be lifted, but only when E.U. bureaucrats can be convinced that fish meal producers can satisfy zero tolerance for any mammalian protein in fish meal.

Chloramphenicol is also a new key word. This is a good example of new emphasis on safety, traceability, and accountability. It is an E.U. example, but as E.U. bureaucracy goes, so goes the rest of the world tomorrow. Safe food is the new motherhood issue. It is good politics, impossible to argue against, and it will not go away—nor should it.

Chloramphenicol is an antibiotic used only as a last resort because of severe side effects. It has been used illegally in shrimp aquaculture in the Far East, and the authorities there have now tightened inspections and penalties for illegal use to an extreme degree. In November 2001 the Dutch authorities detected chloramphenicol in a container of imported frozen shrimp. They ordered the product destroyed but, instead, the shrimp was added to herring offal and sent to a fish meal plant in Cuxhaven. When the Dutch authorities discovered this, they notified the German authorities—unfortunately by mail and over the Christmas period! By the time the German authorities took action it was mid-January and the original 20 t of shrimp had been incorporated into about 1,000 t of fish meal and distributed to customers as far apart as Italy and Russia. When the fish meal lots were recalled and analyzed, chloramphenicol could not be detected but the regulators argued that this was immaterial. Chloramphenicol was detected in the shrimp (which would make about
Figure 7. Major protein meals, 1986.

Figure 8. World fish meal use, 1995 and 2001.
4 t of meal), and thus it must be present in the fish meal, which must be destroyed. I include this cautionary tale to illustrate the new regulatory climate, and to emphasize that, as with any other food processor, manufacturers of fish byproducts of any kind need to have absolute product security and safety.

Figure 9 shows world consumption of 17 major oils and fats in 1990-1991 and 2000-2001. Note that fish oil comprised 1.4% of the total, and soybean oil was 20% in 1990-1991. Ten years later fish oil has fallen to 0.9% of total world oil and fat consumption, and soybean oil has risen to 23.7%. Total consumption of oil and fat rose by 39.9 million t (49%) in the 10-year period. World fish body oil production was 1.26 million t in 1990 and 1.12 million t in 2001.

Figure 10 shows world fish oil use in 1995 and 2001. In 1995 aquaculture used 18% and hydrogenation 70%. By 2001 the proportions were almost exactly reversed. Aquaculture used 70% and hydrogenation 19%. I predict that in the very near future, use of fish oil for hydrogenation will virtually have disappeared and aquaculture and nutraceutical use will have achieved absolute dominance.

It is perhaps ironic that this conference [2nd International Seafood Byproducts Conference] is in Alaska, where aquaculture, apart from salmon ranching, is prohibited by law, and I believe that the most important market for a major fishery byproduct, fish oil, is aquaculture feed. Aquaculture is not going to disappear; it comprised 27% of the world supply of fish in 2000 compared with 73% from capture fisheries. The latest estimate for 2001 is 70:30 (38.25 million t from aquaculture and 90 million t from capture fisheries).

The conventional fish meal and fish oil process is well suited to handle the major industrial fisheries of Peru, Chile, Iceland, Norway, Denmark, and others. And aquaculture and animal feeds need all their production.

Conventional fish meal plants can handle filleting waste very well when there is a steady year-round supply. Excellent examples of this success are the large fish meal plants associated with major Alaskan fish processing operations, and plants such as those at Aberdeen in Scotland.

There are many other ways of handling fish processing waste efficiently. They include (and should include) maximizing human consumption use, as in the example I gave of deboning "v" cuts. Much filleting waste is high in bone content, and thus in ash, so that byproduct fish meals may have over 20% ash compared with a low value of 14% (including salt) in conventional whole fish meals.

The expertise is here in this room to describe these alternatives. They include autolysis and enzymatic hydrolysis, where the bone can be screened out of the liquefied product. Salt can be removed from stickwater by reverse osmosis, concentrating the stickwater at the same time, and reducing ash (salt is recorded as "ash" in proximate analysis).
Figure 9. World consumption of seventeen major oils and fats, 1991-1992 and 2001-2002, showing an increase of 39.9 million t (49%) for those years.

Figure 10. World fish oil use, 1995 and 2001.
In my opinion, co-drying is much neglected as an economical and efficient way of incorporating marine protein into feed for pigs, poultry, and ruminants. In the early 1980s I visited the National Marine Fisheries Service in Seattle and was most impressed by a hands-on researcher who was co-drying fish hydrolysates with various vegetable proteins and cereals. His name was Ron Hardy and he is also presenting at this conference.

Many niche products can provide profitable sidelines when derived from fish byproducts. I have referred to fish oil capsules earlier. The potential is frightening! Fish bones are an obvious source of phosphorus in animal feeds and fertilizers. Poultry can utilize high ash fish meals to advantage. Also, fish bones are softened in the canning process, and are an excellent digestible source of calcium and phosphorus. I enjoy canned salmon skin, bones, oil, and all. I remember a market survey which found that many people used canned salmon by draining off all the liquid, including the oil with its EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid), separating and discarding the skin and bones, mashing the salmon up with lots of mayonnaise and voila—a salmon sandwich. This seems almost criminal to me. What about extra-bone canned salmon (compare “extra pulp” orange juice)?

The conference has provided an excellent overview of the 2002 potential for fish byproducts. In my presentation at the 1990 conference, I acknowledged the help of the International Association of Fish Meal Manufacturers in providing industry statistics. Since then the organization has changed its name, first to IFOMA (the International Fish Meal and Fish Oil Association); then in 2001, it merged with the Fish Meal Exporters Organisation, to form IFFO (the International Fishmeal and Fish Oil Organisation). Its Director General then and now is Dr. Stuart Barlow, and we are fortunate to have him here today. I would like to thank him, Ian Pike, and Jean-François Mittaine for providing excellent statistics. Oil World is also an excellent source of information on all edible oils and vegetable protein meals. I also owe a particular debt of gratitude to Dr. Ulf Wijkström of FAO.