1990

Fish in the diet

Aquaculture Department, Southeast Asian Fisheries Development Center

Southeast Asian Fisheries Development Center, Aquaculture Department (1990). Fish in the diet. Aqua Farm News, 8(2), 1-8.

http://hdl.handle.net/10862/2643

FISH IN THE DIET

How our bodies maintain optimal health and how we obtain optimal nutrition seem to be a never-ending story, and new information and new concerns are being described every day.

As health and nutrition progressed in Western industrial nations during the 20th century, ranking of the top three causes of death changed from (a) infection, (b) malignancy, and (c) cardiovascular to the present pattern of (a) cardiovascular, (b) malignancy, and (c) infection. This reversal showed that good nutrition and the use of antibiotics and vaccines could virtually eliminate infection as a cause of death and as the average life span increased, the causes of death gradually shifted to long-term chronic disorders that have complex and subtle causes. Foods then should be chosen on the basis of knowledge and information currently available.

Biomedical researchers have shown in the past 20 years that nearly a dozen very potent autocoids (hormone-like materials) derived from polyunsaturated fatty acids are involved in a wide range of disorders and diseases including heart attack and stroke, heart disease, high blood pressure, asthma, arthritis, and other immune-inflammatory disorders, and tumor proliferation. These diseases represent situations in which our own defensive regulatory autacoids are producing inappropriately strong signals, and the system changes from normal to pathophysiological. Thus, our tissues are "under attack" by inside rather than by outside infectious agents.

Various food marketers responded to the evidence that a diet high in calorie and saturated fat was correlated with high levels of cholesterol in the plasma and with high risk of heart disease and death from cardiovascular disorders. The immediate response was a promotion to encourage greater consumption of polyunsaturated fat and therefore decrease the relative content of saturated fat in the diet.

Providing a steady supply of a variety of finfishes and crustaceans that contain low amounts of saturated fats will complement the present trends in biomedical research. The old reasons for eating fish remain sound.

Source: W.E.M. Lands, "Fish and human health: a story unfolding," **World Aquaculture**, Vol. 20 (1), March 1989.

Item One: Dietetics of Fish

Many people ask about the benefits of eating fish. The following points are from a report by FAO:

Fish better than meat and milk. The nutritional quality of fish is similar to but somewhat higher than that in meat and milk, but less than that in eggs.

High protein content. The protein content of most fish species varies between 15 and 20%; however, the fat content varies more widely than protein, water, or minerals.

Vitamins and minerals. Fish provides most of vitamins (particularly A, B, and D) and a good selection of minerals (especially calcium and phosphorus), trace elements like iron and iodine (in marine species) necessary for good health.

Amino acids. Fish provides a good combination of amino acids well suited to human nutritional requirements. It is particularly high in lysine and sulphur amino acids.

Helps lower blood cholesterol. The high content of polyunsaturated fatty acids also con-

tributes significantly to essential fatty acid requirements important in some cases in lowering blood cholesterol levels.

Source: Elvira Baluyot *in* Food Research Quarterly, cited in **Austasia Aquaculture Magazine**, Vol. IV, No.3, October 1989.

Item Two: Nutritional Consequences of Processing

Handling

How the fish is handled and stored after harvesting has a great deal to do with how well and how long it will retain its quality. Physical abuse, bruising, density of packing, time before cleaning and gutting, washing, and sanitation procedures all affect how much the fish will have deteriorated before it reaches the next stage in processing. Deterioration in quality affects the ultimate nutritional value of the product through losses and chemical changes.

There are three categories of concern in the immediate handling of seafood that are linked to the retention of nutritional value: fish spoilage, primarily relating to bacterial activity; lipid oxidation and autolysis (self-digestion); drip loss from the cut surfaces of fish; and washing procedures.

Bacteria present in the gut and visceral organs are ready to spring into action on the fish muscle once the animal has died. That is one reason why it is especially important to gut and wash fish as soon as possible after harvest. Bacteria also reside on the flesh as a result of cross contamination - the unintentional transfer of microorganisms from storage sites, fish handlers' equipment and other places to the fish. The use of cleaning solutions, rinses, and good sanitation practices will minimize this problem.

Fat breakdown or rancidity or autoxidation refers to the chemical breakdown of fat in the presence of oxygen. Autoxidation, which is a major concern to the fish industry, is difficult to prevent because the chemical process is self-generating. It is particularly prone to occur in poly-unsaturated oils, continues or is enhanced at freezing temperatures, is not particularly deterred by the usual food antioxidants and causes much fish spoilage.

Fish oil is especially vulnerable to rancidity because of the large share of polyunsaturated fatty acids with many double bonds. The double bonds are highly susceptible to taking up oxygen resulting in the development of unpleasant "fishy" odors.

Oxidation is enhanced in the presence of compounds containing iron or copper, so that the red muscle parts of the flesh are much more easily spoiled. This can be a problem for such species as tuna, swordfish, bluefish, mackerel and others. Fish oils also oxidize more quickly when frozen or irradiated rather than when iced and stored. Rancidity is retarded in frozen seafoods that are vacuum packaged.

The main nutritional implication of fat oxidation is that the nutritional value of the fat is decreased because the amount of polyunsaturated fatty acids is reduced. Oxidation also destroys fat-soluble vitamins, especially vitamins E and A.

Once the fish has been cut, the surface of the flesh looses water. This water loss occurs in both fresh and frozen fish (upon thawing) and can be extensive. While the loss is primarily water, the drip also contains water soluble proteins, B vitamins, and minerals. Fish that has been thawed and refrozen exhibits much greater drip loss, fatty acid oxidation and other signs of inferior quality. Measures to reduce drip are related directly to the methods of handling and to the use of polyphosphate dips. Polyphosphate dips increase water pickup. They also increase the amount of sodium and phosphorus in the fish while retaining moisture, protein, and minerals.

Sanitation and handling procedures aboard ship and in the fish processing plant require washing fish sometimes several times before it reaches its final packaged form. In addition to keeping the fish clean, however, washing leaches out protein and minerals, diminishing the nutritive value of the fish.

Freezing

Freezing is one of the best ways to prolong shelf life of seafood and if done under proper conditions, is effective in retaining high quality and flavor. Textural changes are inevitable, but these are not necessarily very noticeable at the consumer level. Freezing of less than top quality product or using slow freezing procedures that are known to damage the fish will reduce the quality of the frozen product. Today's practices of freezing as soon as possible after harvest, treating freshly caught fish with great care, using superior packaging materials, and ensuring transport and storage well below O°C have resulted in very high quality product.

The possible adverse consequences of freezing include the following: texture loss through breakdown of the physical structure of the muscle; denaturation of proteins with the loss of amino acids; breakdown of fats with the accumulation of unpleasant by-products and a loss of fatty acids and vitamins; chemical interactions between proteins and lipids and proteins and carbohydrates; and loss of protein, B vitamins, and minerals through drip. These changes occur as a result of chemical processes, enzyme activity, and microbial action. There are fewer data on nutrient changes with freezing in seafood than there are for many other food categories.

The most important factors in nutrient retention in frozen seafood are:

- top quality product at the outset
- low bacterial counts
- short time between harvest, cleaning and freezing
- rapid chilling
- very low freezing and storage temperatures (below O°F or - 18°C)
- rapid time to reach the frozen state
- fat content of the fish - fattier fish oxidize more readily
- packaging material - resistance to breakage is important
- presence of air (oxygen) - oxygen accelerates oxidation, carbon dioxide retards it.

Rancidity can be kept to a minimum by the following conditions:

Rapid chilling. Spoilage starts immediately after a fish dies and the rate of spoilage is mainly temperature-dependent. The sooner the fish is cooled, the better. Use of small ice flakes gives the ice greater contact with the fish and removes heat faster than large ice chips. Small ice flakes are superior for rapid chilling.

Short time to freezing. The longer the intervals between harvesting, chilling and freezing, the greater the oxidation of fats upon freezing.

Temperature of freezer storage. Studies with various species have shown increased storage time and preservation of quality with storage at -30°C (-22°F) compared with storage at -18°C (0°F). Home freezers usually do not reach temperatures as low as -30°C but are designed to reach temperatures between -15°C (+5°F) and -20°C (-4°F). Many do not reach this range and vary in their holding temperature with defrosting cycles. Retail freezing units also vary widely in their temperature. Fluctuations in holding temperatures - even well below freezing - also increase oxidation as well as texture loss.

Use of additives. There are reports that the appropriate use of tripolyphosphates and ascorbic acid will reduce oxidative rancidity in some species of fish. Most fish have been resistant to the beneficial effects of food antioxidants, although some success with ascorbic acid has been reported.

Species. In general, susceptibility to rancidity increases with the fat content of the fish. That does not mean, however, that low fat fish will not undergo oxidative rancidity.

Spawning. Prior to spawning, fish feed voraciously and increase their body fat content substantially. After spawning, their fat content is very low and the water content of the muscle high. These changes are particularly marked in Pacific salmon species which die after spawning. Such changes in composition make the quality of the flesh inferior. Even though the fat content is reduced, oxidative rancidity still occurs.

Presence of red muscle. Pigmented muscle is rich in iron and copper, two minerals that promote oxidative rancidity. Keeping time is therefore reduced, even under ideal storage conditions in such fish. This applies mainly to tuna, swordfish and bluefish.

Bleeding. Fish that have been bled prior to freezing exhibit superior keeping qualities. This is partly due to the removal of blood with its iron-containing pigments that foster lipid oxidation. Bleeding fish after catch as soon as possible results in a higher quality product all around and is a strongly recommended handling procedure.

In summary, there is no more appropriate recommendation than that of Dr. Donald Kramer: "If I were to pick the two most important points which should be stressed to fishermen, they would be early bleeding and early chilling."

Salting

High concentrations of salt have been used for centuries to preserve fish, meat, and poultry. In many parts of the world, salt cod is still used. In large amounts, salt inhibits bacterial activity and in low concentrations it enhances flavor. In the salt preservation of fish, salt is added in the dry form sprinkled directly on the dressed fish or the fish is soaked in a brine solution.

The result of salting is that water and some water-soluble proteins are drawn out and sodium migrates into the flesh. As the sodium content increases, the proteins become less soluble or are "salted out." Brined fish are usually stored in brine solution until used, while dry salted fish are air-dried and stored in crates or frozen.

Fish proteins are denatured by salt but it is not known whether this affects their digestibility. Nutritive value and essential amino acids are apparently unaffected. It is generally thought that salting has little effect on protein quality.

The effect of salting on vitamin and mineral content is difficult to assess because of the lack of comparative data. It is expected that some of these nutrients would be drawn out of the flesh along with water and dissolved proteins. A reduction of 50% of the B vitamins in heavily salted herring has been reported. Sodium content is of course greatly increased.

Salt increases the oxidation of lipid in fish and the salting of fatty fish must proceed quickly if the degrading effects of rancidity are not to outweigh the preservative effects of salt. Fatty fish are brined immediately after harvest to minimize the chances of oxidation.

Item Three: Surimi

Surimi is a Japanese word rapidly becoming the generic name for deboned, minced, and washed fish. Consumer-ready surimi-based products resemble crab legs, crab salad meat, scallops, shrimps, and fish sausages. The freshness and age of the fish, the parts of the fish used, and the number of washings all affect the quality and amount of fish protein. The whitest product with the most desirable gelling properties comes from fish processed immediately after harvest where the tail, backbone, and belly flaps are not used.

A variety of ingredients is usually added to the surimi to achieve certain product characteristics. In addition to the salt, sugar, and polyphosphate used to extract the protein from the flesh, starch or egg white may be added to improve texture and water-binding properties. Potato or wheat starch increases the gel strength and elasticity of the surimi. Egg white may be added to enhance gel strength and to make the product whiter and glossier. Final products may contain, in addition, vegetables, monosodium glutamate, other fish and shellfish, artificial or natural coloring and flavors, lard, oil, cream, and sorbic acid.

The difficulty with surimi is in demonstrating that it is nutritionally equivalent to the products it resembles. There are several aspects to this challenge. One is the selection of the appropriate basis for comparison. Should surimi be compared in nutritional quality to the fish from which it is

prepared or should it be compared to the seafood whose flavor and shape it assumes (crab meat, for example)? What about the negative attributes of the product it resembles - perhaps its cholesterol content? How many nutrients should the comparison include? What percentage of the content in the original product is considered equivalent? There are more questions but these illustrate the dilemma.

The quality of surimi protein is high, just like most other animal proteins. This means that a little goes a long way and that its nutritional contribution to a meal is probably greater than its analytical value suggests, because it enhances the poorer quality proteins present in other foods. The quality and quantity of protein in surimi-based foods is one of its most important nutritional features.

The fat content of surimi is very low, sometimes even less than that found in the original fish species. Surimi-based products, however, may have fat added to them which substantially changes the nutritional profile of the food. The amount and kind of added fat needs to be evaluated. Lard and vegetable oil have been used in surimi-based products and one is hard pressed to condone the addition of animal fats or highly saturated vegetable ones to our already excessive intake of these substances. Nevertheless, if the total amount of fat is small, and the total calories from fat is less than 20%, for example, the nutritional value of the product may not be compromised.

Certain methods of surimi preparation may increase the amount of cholesterol present and cholesterol could become an issue in foods where it has not been expected previously. One way to handle the situation is to require cholesterol labeling of surimi-based products.

The iron content of surimi is similar to the variation and amount observed in fish and shellfish and suggests that both processing techniques and equipment as well as the source of the fish are important in determining the final iron content. Obviously other foods added to the surimi might affect the total iron content, not only in terms of amount but also by providing substances that might interfere or compete with the iron during digestion and absorption. There is also substantial variation in the amounts of B vitamins. Losses of these and other water-soluble vitamins are not surprising because of the washing procedures used to prepare surimi. Vitamin A levels are low as expected.

Generally surimi-based products are much higher in sodium than unprocessed fish and shellfish. The levels of sodium observed in commercial surimi products bear this out. Such high sodium levels will preclude the use of surimi products by thousands of people with high blood pressure who are trying to restrict their sodium intake and might otherwise enjoy the convenience and appeal of surimi.

Sugar (sucrose) and sorbitol, a sugar alcohol that is less sweet than sucrose but of equivalent caloric content, are added to improve the stability of the surimi to freezing. These increase the calorie content of the product without enhancing its nutritional worth and give it a sweet taste which is objectionable to some. Apart from the contribution of these sugars to the technological processing of surimi, there is nothing to recommend their presence. That they are important to the final stability of the product justifies their presence, but manufacturers should be encouraged to add as little sugar to be consistent with good storage properties.

Item Four: Smoked Fish and Your Health

The development of modern kilns that allow control of temperature, humidity and air flow enables the production of high quality smoked seafood that is both safe and tasty.

Smoking used to be an important form of seafood preservation. It still is in some parts, but it is more important these days as a means of flavoring seafood. For preservation purposes, refrigeration, freezing and sometimes additives give a superior product.

Smoked fish are generally prepared in one of two ways: cold-smoked where the temperature

does not exceed 85°F, and hot-smoked where the temperature reaches 140-150°F. Cold-smoked fish are more moist but need to be cooked before eating, while hot-smoked fish are completely cooked but drier.

The effects of smoking on the nutritional characteristics of seafood have not been thoroughly studied. There is loss of moisture and water-soluble nutrients during the brining prior to smoking, and additional water is lost during the actual smoking process. The gloss that develops on cut surfaces of fish that have been brined is mainly due to the swelling of the protein and the drying of the surface, not to additives.

Smoked fish may be coated with or packed in oil to preserve moisture and texture. The oil used for this purpose is usually soybean or other vegetable oil. While its use may maintain palatability, it also adds calories.

Two concerns about smoked fish are the presence of nitrites and polycyclic aromatic hydrocarbons. Both substances have been associated in some way with cancer. It is common practice to use nitrites in smoked fish to develop flavor and color and to deter the growth of harmful microorganisms. Its use is widespread but not essential for producing a top quality safe product. If nitrite is used, its presence is supposed to be listed on the ingredient statement.

The implications of smoked seafood on health are currently difficult to assess because of the scarcity of data. It seems safe to recommend not eating the charred or outer skin of smoked seafood. Lightly smoked products are probably less risky than heavily smoked ones. Many dietary recommendations advise against frequent consumption of smoked meat and fish. Because the materials and methods used to prepare smoked seafood vary so widely, it is important to obtain more information about the hazards of consuming these foods. Smoked seafood is a gourmet and ethnic item.

Item Five: Health Themes

Heart health. Eating seafood fits well with recommendations for "heart healthy" eating. Promoting seafood consumption by showing the ways in which seafood fits in with dietary recommendations for discouraging heart disease gives seafood a heart healthy image.

Cholesterol intake is believed to be linked with heart disease and most health professionals urge people to reduce their intake of cholesterol. Cholesterol is found only in foods of animal origin. Most finfish are low in cholesterol. Since most of us consume more cholesterol than is thought to be good for us, and since high cholesterol consumption tends to raise blood cholesterol levels which increase the risk of heart attacks, it is wise to consume foods low in cholesterol. Consuming fish frequently, say twice a week, is an easy way to help lower cholesterol intake.

Shellfish vary in their cholesterol content. Clams, mussels, scallops, oysters, American lobster and some varieties of crab are as low in cholesterol as most finfish. Others have substantially more: spiny lobster, blue crab, black abalone, octopus, shrimp, and squid. Fish roe is also very high in cholesterol. Because the varieties with more cholesterol also have very little fat, much less of the cholesterol is absorbed. In some species, the presence of other sterols also reduces the uptake of cholesterol during digestion.

Frequent consumption of most seafood can help a person reduce his intake of cholesterol. The only caution relates to the frequent consumption of large amounts of those few cholesterol-rich varieties of seafood. Unless a person eats on a regular basis great quantities of the few seafood products that are high in cholesterol, seafood will not be an important source of dietary cholesterol. Keeping to the low cholesterol varieties is easy to do as there are relatively few species whose intake should be monitored. Seafood can be enthusiastically promoted as a low-cholesterol food as long as the exceptional varieties are noted and sweeping generalizations are avoided.

Discourage cancer. Seafood consumption is consistent with dietary recommendation to

lower fat intake. High fat is associated with some forms of cancer. The vast majority of seafood items are low in fat, and, as long as they are not deep-fried, will retain their low fat advantage over other animal protein foods.

High blood pressure. The excessive intake of sodium is associated with high blood pressure in many people. Because seafood is naturally low in sodium (except for canned, smoked, pickled, dried and some other prepared seafood), it is especially appropriate for everyone trying to maintain a sensible sodium intake. Make sure that suppliers are not adding unwanted sodium through the use of water-retaining dips.

Reaching the desirable body weight. Because most seafoods are low in fat, they are also low in calories. This feature is ideal for people trying to limit their calorie intake and lose or maintain weight. One can still have a generous portion and stay within suggested calorie range.

Item Six: Developing Recipes

Recipes and cooking techniques are an especially important part of converting non-seafood users into seafood users. There are several aspects to consider when developing or selecting recipes to enhance the promotion of seafood: appeal through words and pictures, suggested flavor outcome, ease of preparation, time required to prepare, availability of ingredients, cooking skill required, legibility, and nutritional merit especially concerning the amount and type of fat required and the amount of ingredients containing salt or sodium.

Many times the worth of a recipe is not in whether the buyer actually follows the preparation, but whether the recipe suggests to the reader that the seafood item can be prepared in an appealing or simple way, or that it will turn out well. Sometimes the recipe is a reminder of another item the buyer has on hand which would complement the seafood. Often, the recipe literally determines whether or not the item will be purchased and prepared.

The appeal of a recipe is suggested first in its title and next in the list of ingredients. Appeal is communicated visually with colored photos. These are expensive and not always necessary, but should be seriously considered where budget permits. As part of a print advertising campaign they can be most communicative.

Ease of preparation is especially important for novice or hesitant cooks. This does not necessarily mean relying on prepackaged or bottled accompaniments, but requires the judicious selection of simple tasty recipes with imaginative variations. Ease of preparation can be verified by checking the number of ingredients required; the number and kind of utensils and the type of preparation involved. Time of preparation is a premium feature for busy households and those where the chief cook has limited skill or culinary interest. Because seafood cooks in just a few minutes, this feature deserves prominence in seafood marketing. Recipes giving the approximate preparation time can be helpful to hurried cooks.

The availability of ingredients is one of the most serious deterrents to trying a recipe. It is not that the ingredients are undesirable, but that preplanning or special trips to the shop may be required for items not normally kept at home. Recipes calling for more than one variety of seafood are particularly liable to be avoided on this account. The basic seafood recipe collection should rely on foods most likely to be on hand. Recipes that include alternatives are also more useful than those with no options. Exotic ingredients can convert the ordinary to the delectable, but have to be used to be appreciated.

It is preferable to have a simple, imaginative line of recipes covering all seafood varieties rather than catering exclusively to the needs of one group. Avoid developing recipes for the gourmet market, unless, of course, this is truly your market. Develop recipe texts as if for the simple-minded and you will not go astray.

Be alert for the amount of fat suggested. One guideline to use for evaluating the total amount of fat used is to keep the fat content of one serving of the recipe no more than thirty percent of the

total calories of the serving. Most recipes will turn out just as well with only one teaspoon of fat per serving and will have fewer calories. Deep-fat frying should not be recommended as a method of cooking seafood; not because it is unflavorful, but because it is unhealthful. No one needs the additional fat taken up by seafood cooked in this way. Promote the leaner, healthier cooking methods instead.

As a guide for salt content, suggest using no more than an eighth of a teaspoon salt per serving; that is half a teaspoon in total for a recipe serving four. Most recipes exceed this amount. Reducing the salt level to this amount is barely detectable by taste and is doing a favor to the blood pressure. Never suggest adding salt to taste. Most people add far too much.

To improve the overall nutritional value of the product, consult a qualified nutritionist or registered dietitian. Encouraging the use of vegetables in seafood recipe is an opportunity to promote good nutrition indirectly through seafood. A line or illustration depicting the nutritional highlights of a recipe tells the reader that nutrition was a consideration in developing the recipe.

Source of Items Two to Seven: **Seafood Nutrition** by Joyce A. Nettleton, New York: Osprey Books, 1985.

MAKING SHRIMP CAKE

Balao or *alamang* (*Acetes indicus* or *Atya* sp.) is usually sold in dried form but spoils easily within six months. In Paracale, Camarines Norte and Cabusao, Camarines Sur, the people have developed an indigenous processing technology to produce shrimp cakes in order to prolong the storage life of *balao*.

Processing of *balao* is a traditional and practical way of extending the shelf life of the shrimps. The process is simple, requires low capital investment, and low technological input. It only involves the use of salt. Salting enhances the flavor of *balao*. The shrimps become more pleasing to the palate. Thus, shrimp cakes have gained wide acceptance for 20-30 years in local and foreign markets.

Dried shrimps

Dried shrimps are easy to prepare but have limited shelf life. However, salting of shrimps into cakes improves the quality and storage life of the processed product. Salting preserves the product by lowering the moisture content up to the point where the food-spoiling agents are destroyed. This results in a product that could last for 1-2 years at ordinary storage conditions. Shrimp cake making, therefore, ensures better and more stable products in the market and provides better income for small fishermen. Shrimp cake could be a potential product not only for small-scale village processing in Bicol but also elsewhere where shrimps abound.

Technology generation

Recently, the Bicol University College of Fisheries, in collaboration with the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, conducted a study on the technology of shrimp cake-making in Bicol which involved the development of a standard procedure for shrimp cake-making, quality assessment, and storage.

The traditional method of processing *balao* was studied and improved for better quality and longer storage life of products.

Results showed that a drying time of 3-5 hours is best for shrimp cake-making. With 39% moisture, the products using the modified process lasted for two years when packed in polyethylene bags at a low density. Shrimp cakes were also highly acceptable and nutritious.