
QUALITY
ASSURANCE
OF
SEAFOOD

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Dedication

To the members of the U.S. seafood industry, one of our nation's oldest and most important industries, and especially to:

- The fishermen who often expose themselves to high degrees of physical risk and are faced with varying types of economic handicaps, especially in their struggle to compete against more heavily subsidized foreign fishermen;
- The spirited, pioneering seafood processors and retailers who have begun to take the necessary steps to ensure the quality of their seafood products to the consumer;
- The restaurateurs who, by their ability to assure the quality of the seafood that they serve, have lifted the image of the entire class of seafood from the lowest to the highest eating experiences;
- The dedicated and resourceful scientists, epitomized by the late Dr. John T.R. Nickerson of M.I.T., whose efforts will eventually enable more consumers to obtain high-quality seafood at retail outlets.

Preface

This book is based on a U.S. government research project that studied the quality assurance of seafood and its impact on the economics of processing.

Quality assurance, which is determined at the point of consumption, serves a twofold function: it increases consumer demand and eliminates losses due to spoilage. This book outlines a plan that will increase the domestic supply of seafood. We include recommendations for some administrative revisions and a description of four target areas for improvement in fisheries production in the United States.

- Accelerated growth in aquaculture
- Development of fisheries
- Preservation of temporary oversupplies
- Improvements in processing efficiency

Seafood is a vital and growing source of protein in the U.S. food supply, and is potentially a multibillion-dollar industry. For these reasons, it is in the best interests of the United States to develop its seafood productivity.

Added costs to assure quality should not be construed as a deterrent to achieving that goal. On the contrary, we subscribe to a paradox proposed in the *Harvard Business Review* of July/August 1986 by Pro-

fessor Wickham Skinner, professor of business administration at the Harvard Business School: "When low cost is the goal, quality often gets lost. But when quality is the goal, lower costs do usually follow."

The resolution to this paradox is that when quality is assured, the substantial losses due to product spoilage and the adverse effect on demand caused by customer dissatisfaction are greatly lessened. When fixed costs are distributed over a large production base, the cost per unit will be lower than for those costs distributed over a small production base. Finally, less effort is required to sell a product that has a positive image in the mind of the consumer.

It will be noted that the text places emphasis on fish and fish fillets and virtually omits reference to shellfish and processed fish products (canned, cured, pickled, or otherwise treated). The reason is that fresh and frozen fish products, and especially fish fillets, have most often been cited for lack of good quality by investigative teams that have surveyed them at the marketplace, particularly in retail supermarkets; these are the products that have given negative connotations to the word *fish*. However, the quality of shellfish products at the retail level is usually high, partly because some of the shellfish are marketed in the live state (such as lobsters, oysters, clams, and crabs), and partly because their high value motivates handlers to avoid spoilage losses. There seem to be no indications of lack of quality in canned and other processed seafood products. Still, the observations and recommendations made in the text are applicable to the handling of all seafood.

This book is directed at a broad audience: the seafood industry; government agencies (federal, state, and local); the academic community; the general public; politicians; nutritionists; dietitians; food editors; and students of food science, nutrition, and dietetics. For this reason, we have attempted to present the material in nontechnical language. At the same time appropriate scientific discourse has been included to give interested scientists the technical rationale behind some of the statements and conclusions reached. Parts of the text that may be less relevant to the general audience but useful to scientifically trained readers are set apart in appendices, although even these are not in the strictest technical style, because not all readers are equally trained in all fields of food science.

In the interest of time, and because some of the discussions may not be of immediate interest to everyone, the text has been so organized that individual members of the seafood industry do not have to read the entire book to obtain the information they need. Still, the text contains much information that is of at least ancillary interest to all, and we recommend that the book be read in its entirety. It provides insight into the reasons why there is a seemingly more rapid spoilage of seafood

than there is of meats; why frozen seafood products are apparently of poorer quality than unfrozen ones; why seafood bought in the supermarkets often is not of as good quality as that bought in specialty stores; why the U.S. seafood industry is much more important than is generally perceived; and why seafood is so much more important than other protein sources.

Finally, our lengthy and broad experience has brought us to the conclusion that the study of seafood provides a variety of scientific challenges worthy of sophisticated academic and research efforts. These efforts, for which there is a reasonably high probability of success, should produce gratifying rewards to those who seek the opportunity to make important scientific and technological contributions to the literature. At the same time these researchers would help the United States attain the high economic and health benefits that can be derived from one of its most valued, natural, renewable resources.

Acknowledgments

Although we cannot name each of the innumerable contributors to this book, we would like to express our sincerest thanks to all concerned, especially James Bordinaro, Sr., founder of the Empire Fish Company, Inc.; Charles Shackleford, plant manager of the Great Atlantic and Pacific Tea Co., Inc.; Ronald H. Carignan of the DeMoulas Super Markets, Inc.; Gus Aslanis, president of the Aslanis Fisheries; Anthony Amoriggi, Jr., plant manager of Amoriggi Brothers Seafoods; the late Salvatore J. Favazza, executive secretary of the Gloucester Fisheries Commission; Jake Dykstra of the New England Fisheries Steering Committee; John D. Kaylor, Joseph H. Carver, Joseph M. Mendelsohn, and Burton L. Tinker of the Gloucester Laboratory of NMFS; and finally, Thomas J. Moreau, Philip J. McKay, and Vernon Rix of the NMFS Northeast Inspection Office.

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PART

1

ASSURANCE OF SEAFOOD SUPPLY

CHAPTER

1

The Need to Assure the Seafood Supply

FOOD IN HISTORY

It is universally accepted that man's basic needs are food, clothing, and shelter. This short list does not include such items as water, oxygen, and sun—perhaps because, although vital, in their natural state ordinarily they are not marketable commodities; nor does the list include innumerable social and cultural needs. Of man's three basic needs, food is not only the most important, it is the only vital one. People cannot survive for long without food, but they can without clothing and shelter.

In the beginning of his existence, man was forced to spend most of his time and effort simply obtaining the food required for his sustenance. He derived his food from edible plants, animals, fish, birds, amphibians, reptiles, and insects. He was nomadic, following herds and moving on from areas where the supply of edible plants had been spent. Thus he had little or no time to engage in other activities and it is surmised that, for all practical purposes, it took all of the efforts of one person to supply the food required by one person.

If we look at this relationship as an indication of food-supplying efficiency, we obtain a value that will be useful later: a ratio of 1:1. To determine food-supplying efficiency, we will use a simple fraction in which the numerator represents the total number of people to be fed,

and the denominator represents the number of people engaged in the activity that supplies the food. Namely, $FSE = N/W$ where *FSE* stands for food supply efficiency, *N* the number of people to be fed, and *W* the number of workers engaged in supplying the food.

But man was not a loner. It is speculated that the groups to which early man belonged were relatively small, numbering about twenty members in all. Division of labor began with the formation of these groups, allowing everyone to participate in one of the several activities that were aimed at food procurement. The most able-bodied were the hunters of animals; the others gathered plant foods and perhaps prepared the hunting tools for the hunters. Thus, in essence, it took the output of the entire group to supply the food required by the group.

Man's food-gathering activities in the earliest days resembled those of animals, but his superior intelligence eventually permitted him to outstrip animals. According to evolutionary theory, man's full-time mobility on two limbs was largely influenced by his ability to use his forelimbs to wield a club or to throw rocks and, later, spears in order to enable him to capture animals that were faster and/or stronger than he. His ordinary animal abilities enabled him to learn to avoid poisonous or otherwise harmful foods, but it was his superior intelligence that eventually enabled him to surmise the role of seeds in plant reproduction.

This latter development enabled man to grow plants, making them available without having to search for them. Once man recognized the benefits of assuring survival and quality of life by purposefully planting seeds, he made a quantum leap to the tactics that assured his food supply. This activity eventually marked the beginning of non-nomadic, sedentary civilization.

The Impact of Agriculture on Man

The development of agriculture affected man's entire life. The convenience of permanent shelters became evident, and this led to the establishment of hamlets, which in turn developed into villages. Soon there emerged the concept of boundaries to protect the planted fields, and many battles must have been fought over these. No doubt the outcome of many of these battles depended on the food supplies of the armies involved. The art of war itself may have gotten its beginnings from man's food-gathering activities, for what else would have been used in combat except the weapons—such as clubs, rocks, spears, and slings—that had already been devised to hunt the larger animals?

The same ingenuity that man had applied to devise hunting weapons was eventually devoted to the development of tools and equipment to operate farms, to cut trees, and to build houses. At a much later

stage, when farming reached the point that one farmer could produce enough food for two people, one person was freed to engage in activities other than those concerned with the procurement of food. Those demonstrating special skills or interests would gradually become engaged in producing tools or other goods and providing services, such as grain milling, storage, transportation of the crops, and even trade. Products reached ever-expanding markets, and goods produced in one area became available to people who, living in other areas, might have never seen those items before. Trade also permitted man to expand the variety of foods in his diet and to use ever-increasing amounts of spices and condiments. Indeed, these very activities motivated explorations, land acquisitions, and the building of empires.

As development followed upon development, farming efficiency increased, and the food produced by one farmer could feed more people than it had in the past. Ever more people were freed to undertake other pursuits, causing mushrooming developments in every area of human endeavor. As a result, the human race was permitted time for leisure, recreation, and the pursuit of a large variety of other "nonproductive" activities.

The practice of agriculture and trade has taught us the value and wise use of water to irrigate the land and to provide navigation and energy. Unfortunately, it has also brought us to activities that have resulted in the extinction of many species of animals and in the pollution of the environment.

From a nutritional point of view, an important aspect of the development of agriculture is that it converted man from dependence on a predominantly meat diet to dependence on a predominantly grain and vegetable diet.

THE NUTRITIONAL COMPOSITION OF FOODS

Of the major nutritional elements in foods, two are of special importance in seafood: proteins and lipids. Although there are also other components (see figure 1.1), they are not of great relevance for the purposes of the present discussion, and by concentrating our attention on proteins and lipids, we can better show the dietary superiority and possible therapeutic value of seafood. These characteristics are outlined in figure 1.2 and discussed in some detail below.

Proteins

Proteins play a unique and varied role in our diet. They are required for the building and rebuilding of body tissues, the conduct of body

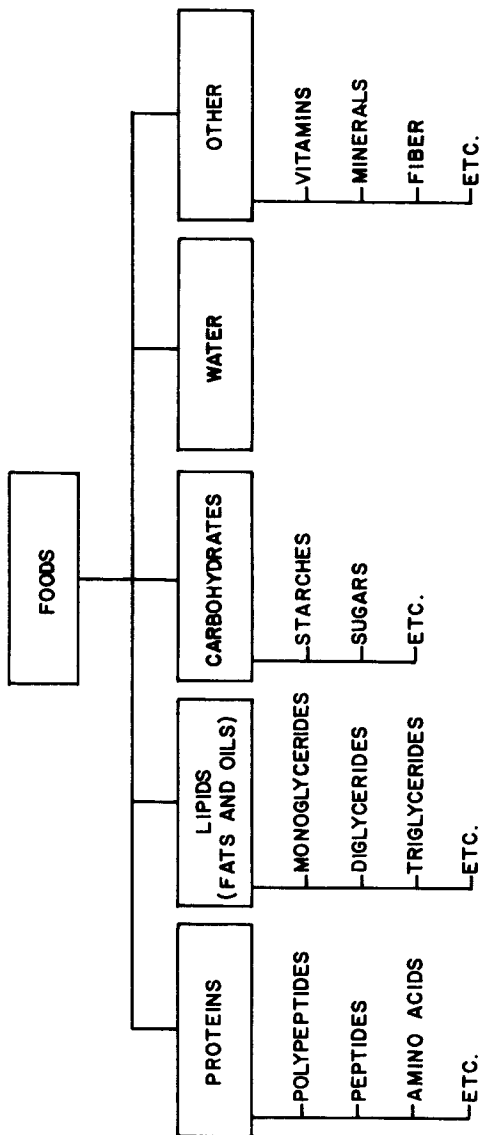


Figure 1.1. Nutritional Components of Foods.

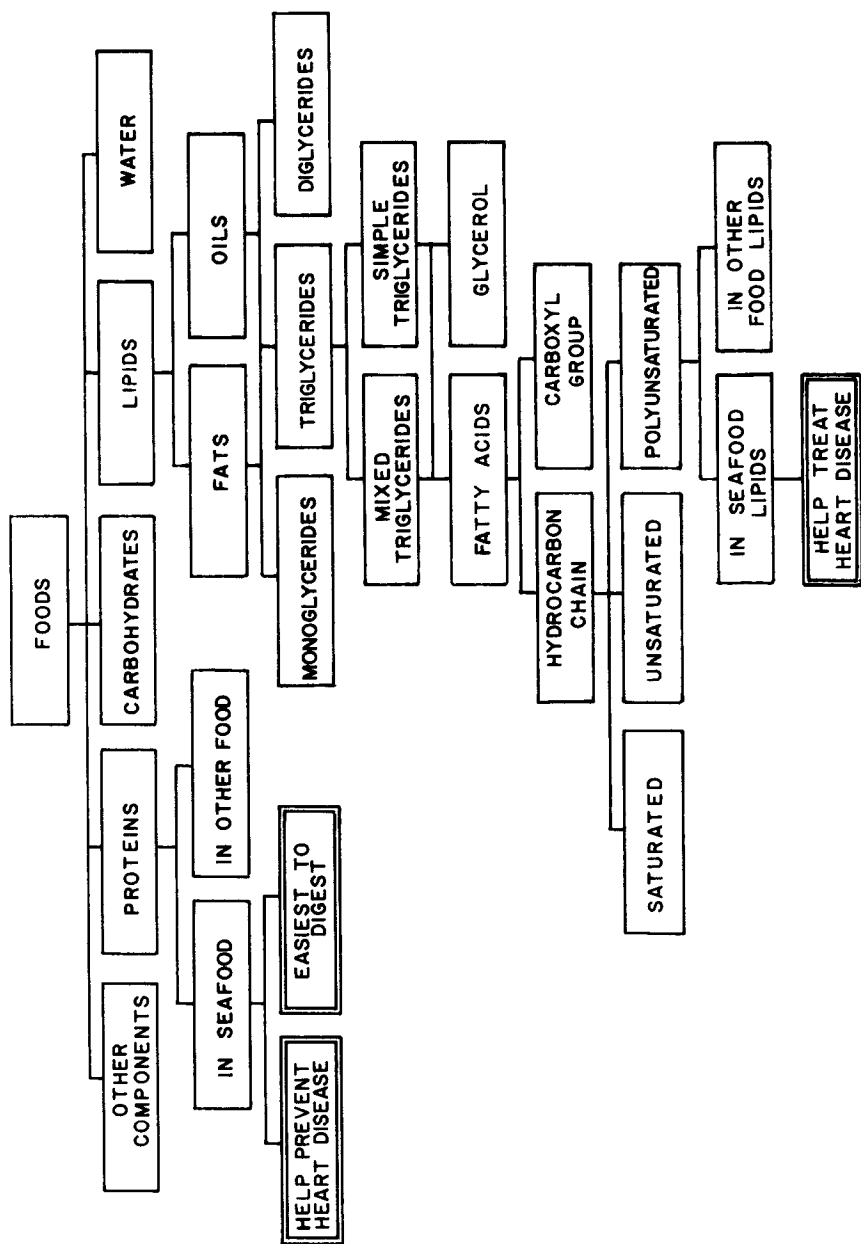


Figure 1.2. An Overview of the Dietary Superiority of Seafood.