Australian Government

Fisheries Research and Development Corporation

What's so healthy about seafood?

SECOND EDITION

A GUIDE FOR SEAFOOD MARKETERS

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IMPORTANT NOTICE

Information in this book has been highly condensed and simplified so that it is suitable for marketers of seafood who have varying levels of knowledge and expertise. It does not purport to provide advice for any form of personal medical intervention. The information, opinions and advice contained in this book may not relate to, or be relevant to, the particular circumstances of any reader.

Any person wanting authoritative advice or information about their personal diet is advised to consult a medical practitioner.

Please refer also to the disclaimer overleaf.

This book is available electronically at www.frdc.com.au/bookshop/free.htm

What's so healthy about seafood? — a guide for seafood marketers
2nd edition

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DISCLAIMER

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Foreword

Seafood's changing place in health

Water and what is found in it to eat have always been an important part of the human experience. Waterways, rivers, lakes, estuaries and oceans have generally provided an abundance of creatures and plants for humans to eat. The edible creatures have been diverse and have included finfish, crustaceans and molluscs — and the mark of ancient human settlements has been the midden, with its remains of aquatic food. It is difficult to imagine our species without such food, except where it is in short supply or where belief systems preclude its use.

However, communities remote from the sea and in which other animal-derived foods are abundant have tended to eat little seafood, especially when storage, transport and safety have been issues. In recent times, seafood has become more accessible and very safe for the majority of the population in Australia and in the countries to which Australia exports. The increased availability of seafood, further enhanced by that most popular of pastimes and sports, fishing, has been matched with an increased interest in its health properties.

It was only a few years ago that the essentiality of certain so-called omega-3 fatty acids in the human diet became clear. In their most beneficial form they are "long-chain" — the not-so-long ones (like alpha-linolenic acid) coming from plants in the sea and, to a lesser extent, on the land, on which sea creatures and some land animals feed and turn them into the "long-chain omega-3 poly-unsaturated fatty acids" (LCn-3PUFA). The best source of these LCn-3-PUFA is seafood, especially finfish (the fatty tissue of finfish) but also crustaceans and shellfish.

Having insufficient omega-3 fatty acids in the diet amounts to a deficiency, and is associated with a wide range of health problems which include cardiovascular disease, diabetes, certain cancers, osteoporosis and disorders of the central nervous system, including depression in some instances, and impaired cognition (leading to dementia).

Photographer Eva Boogaard, Lochman Transparencies

One of the most interesting findings is that, even though some seafood contains a significant amount of cholesterol, its effects on the blood cholesterol (in its various forms) may not be unfavourable — depending on the way in which the fish is prepared and cooked, and what it is eaten with. Moreover, other favourable more direct effects in the arteries and the heart itself actually protect against cardiovascular disease. Studies, especially in Australia, of the effects of finfish on the health of arteries and on the likelihood of fatal abnormal heart rhythms show it to be a protective food.

As major shifts in seafood science and health began to take place, Shawn Somerset and Martin Bowerman, in a project funded by the Fisheries Research and Development Corporation, began to assemble this material for industry and the community. Their thorough analysis and interpretation of current nutritional research is the foundation on which this book is based. Following their work, and as the field of enquiry became more active and clearer, the best current evidence was critiqued and interpreted for the present publication, to assist those responsible for the seafood chain and how it might promote health.

The evidence is now largely unequivocal that, provided a person has no individual sensitivity, some fish each week is an advantage to health and longevity. This is not to say that added health value may not be achieved where it is combined together with a varied plant-based diet. Indeed, variety amongst sea-foods is also likely to confer health benefit.

Above all, if most of the world's population is to benefit from seafood intake, the resource has to be valued and protected and its sustainability ensured. Available evidence indicates that small amounts of fish — up to about three or four servings of about 100 grams of finfish a week — are enough to optimise health. The corollary is that small changes in seafood consumption by most of the world's population will make major changes in health outcomes.

Mark L. Wahlqvist

Professor Mark Wahlqvist AO, BMedSc, MD BS (Adelaide), MD (Uppsala), FRACP, FAIFST, FACN, FAFPHM, FTSE, is an Honorary Professor of Medicine, Monash University, and also in Health and Behavioural Sciences at Deakin University. He is regarded as one of the world's leading nutrition scientists. Professor Wahlqvist took up his first professorial appointment in 1978 as the Foundation Professor of Human Nutrition at Deakin University, Geelong, Victoria. Since then he has held a number of senior academic and clinical appointments including Professor and Head of Medicine at Monash University; Chairman, Division of Medicine and Director of the Professorial General Medical Unit at Prince Henry's Hospital and subsequently the Monash Medical Centre, Melbourne; and Associate Dean, International Health and Development, Faculty of Medicine, Monash University.

Professor Wahlqvist has written and edited numerous publications, both books and papers, on nutritional science and has been a member and Chair of a number of eminent nutritional science and advisory committees. He is currently the President of the International Union of Nutritional Sciences; Chair of the National Nutrition Committee, Australian Academy of Science; Editor-in-Chief, Asia Pacific Journal Clinical Nutrition; the recent Chair of Food Safety Council of Victoria; and has also served as a board member of the Australia New Zealand Food Authority.

In 2000, Professor Wahlqvist was appointed as an Officer of the Order of Australia (AO) for his contributions to the fields of nutritional science and public health.

About this book

Sydney Fish Markets

Much scientific information on the health benefits of eating seafood is accumulating, yet relatively little of this information has been effectively communicated to the general public, largely because of the technical, specialised nature of many research findings. However, a project funded by the Fisheries Research and Development Corporation — in keeping with the Corporation's strategy of developing knowledge of seafood and seafood products among consumers — radically changed that situation. FRDC project 1996/340, *Enhanced usage of contemporary scientific findings on health benefits of seafood to promote fresh seafood consumption*, collated and distilled the results of a broad collection of scientific research and made them more widely available. This book builds on the project's outputs by presenting the findings specifically to people who market seafood.[1]

The project reviewed and analysed a substantial number of scientific papers and found that consumption of seafood has positive health benefits for all age groups and has significantly higher benefits for certain medical conditions. However, the level of evidence to support these benefits varies significantly. The project's final report provides in-depth technical support for the information in this book. The project also establishes a clear path from the original research to the statements made in this document.

1 A hard copy of the full report is available within Australia from the FRDC. The project's non-technical summary is available on the Internet at www.frdc.com.au/pub/reports/files/96-340.htm

Acknowledgements

The FRDC is grateful for the enthusiastic cooperation of many people who gave their expertise and time to help to prepare this book.

The FRDC research and development project from which most of the book is derived — project 1996/340 — was undertaken by Dr Shawn Somerset and Martin Bowerman. This material was synthesised by Matthew Huggan. Extensive comment and advice, especially on presenting complex research findings to general audiences, was subsequently provided by some of Australia's leading nutritionists and medical specialists. The principal contributors and commentators were Professor Peter Howe, Dr Rosemary Stanton, Dr Richard Telford, Dr David Topping, Professor Mark Wahlqvist, Phillip Walsh and Dr Naiyana Tikky Wattanapenpaiboon.

Text and commentary from contributors was selectively edited and further developed by Dr Patrick Hone, Clive Huggan and Michael Parolin. It was then exhaustively examined and subsequently brought up to date by Professor Wahlqvist and Dr Wattanapenpaiboon. Consequently, the final text is not necessarily consistent with all contributed material.

How to use this book

This book provides information on the health benefits of seafood to people who market seafood, meeting a long-felt need to provide a technical basis for telling consumers about the benefits of eating seafood. It is presented in three sections:

- Section 1 provides an overview.
- Section 2 provides more detailed information on seafood and specific conditions, including a question-and-answer section.
- Section 3 covers legislation governing the way you can communicate information about seafood nutrition.

Different sections give different levels of information. For example:

- If you simply want to tell customers in broad terms about the general benefits of eating seafood, you should read the overview and section 3.
- If you want to provide general information on the effects of eating seafood on a certain condition (for example, in response to a customer's inquiry), you should read the summary of benefits in the overview and the notes on their condition in section 2 — and when talking with customers you should advise them to consult their doctor for further advice.
- If you are providing detailed information about seafood to consumers, you should study section 3 to ensure you are complying with the law. Giving information to people about health benefits brings certain obligations!

A glossary, on pages 38–39, provides an explanation of terms used in this book.

What's in a word?

— make sure you understand the key words used in this book

This book describes the results of wide-ranging nutritional research in terms that — as far as possible — are suitable for a general readership. However, in the interests of accuracy it has often been necessary to use technical terms that are not generally well-known. Some of these terms are in the glossary on pages 38–39.

It is important that you become familiar with the following key terms used in this book:

- **Seafood**: In this book, this term describes, collectively, finfish and other aquatic animals such as crustaceans and molluscs.
- **Finfish**: Aquatic vertebrates having gills, fins and typically an elongated body usually covered with scales.

  Note: this more specific term has been used where appropriate to avoid the confusion that could result from the word "fish", which is often taken to include other aquatic animals such as crustaceans or molluscs. (Reference to "fish" has been retained when quoting legislation or research findings; in very general contexts; and in the table on page 31, which is based on material from Food Standards Australia New Zealand.)

Department of Primary Industries, Queensland

- **Crustaceans**: A large family of arthropod animals, characterised by a hard, close-fitting shell that is shed periodically. Includes prawns, crabs, lobsters, shrimps, bugs and freshwater crayfish.
- **Molluscs**: Invertebrates characterised by a calcareous shell (sometimes lacking) of one, two or more pieces that wholly or partly encloses the soft unsegmented body — for example, abalone.
- **Shellfish**: Species of crustaceans and molluscs.

Important: Section 3 — Guidelines for Communication about Seafood Nutrition — includes excerpts from the Australia New Zealand Food Standards Code. In that code "fish" means any of the cold-blooded aquatic vertebrates and aquatic invertebrates, including shellfish, but does not include amphibians and reptiles.

Department of Agriculture, Fisheries and Forestry

Section 1 Overview of the health benefits of eating seafood

Finfish and other foods from oceans, rivers and lakes have long been recognised as nutritious. They are an excellent source of protein and are rich in essential poly-unsaturated fatty acids.

Seafood is the best food source of iodine; salt water seafood contains about twice the iodine found in freshwater varieties. It also provides an excellent source of selenium and fluoride. Other minerals which are provided in moderate amounts are iron, zinc and magnesium. The iron content is about a third to a half that in red meat.

Shellfish is similar in food value to finfish, but crustaceans contain about twice as much cholesterol as other seafoods. Molluscs used to be classified as foods high in cholesterol, but it is now known that most of the sterols in these foods are compounds other than cholesterol. Moreover, cholesterol in food is not the main predictor of blood cholesterol. The issue of cholesterol from seafood and blood cholesterol is discussed on page 18.

From the early days of nutrition science, finfish in particular has been acknowledged for being a high protein, low calorie food. In recent years, the importance of finfish in the diet has extended from its image as a cornerstone of a healthy diet, to more specialised roles in disease prevention. Scientists working on coronary heart disease in Nordic countries during the 1970s observed that Greenland Inuits (Eskimos) had one-tenth to one-third the heart attack rate of Danes. Subsequent studies found that Inuit people have much lower blood cholesterol, triglyceride and 'bad' cholesterol (low-density lipoprotein, LDL) levels, and higher 'good' cholesterol (high-density lipoprotein, HDL) levels, than their Danish counterparts. Similar results have been observed with Japanese people from Kohama Island — where people have the lowest incidence of heart disease in Japan and much higher serum levels of certain fatty acid due to higher intake of fresh finfish.

In recent years, the importance of finfish in the diet has extended from its image as a cornerstone of a healthy diet, to more specialised roles in disease prevention.

In the last decade it has been observed that the consumption of two or more serves of finfish per week is associated with a lower prevalence of heart disease.

Beneficial effects of seafood consumption have also been reported for other diseases or conditions. These benefits have been linked to the long-chain, highly poly-unsaturated omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which are found in seafood. This has further highlighted the possibility of additional health benefits associated with eating finfish. However, the levels of supporting evidence differ.

The physiological conditions which may benefit from optimal finfish consumption and the level of supporting evidence are summarised in table 1. Further details on each condition are provided in section 2.

TABLE 1: HEALTH BENEFITS ASSOCIATED WITH FINFISH CONSUMPTION AND LEVELS OF SUPPORTING EVIDENCE

Disease or health condition	Strong evidence of significant health benefits	Promising preliminary results	Possible health benefits (require more substantiation)
Coronary heart disease	✓		
High blood pressure	✓		
Irregular heart beat (arrhythmia)	✓		
Diabetes	✓		
Cancer			
Bowel cancer		✓	
Laryngeal cancer			✓
Pancreatic cancer			✓
Asthma		✓	
Rheumatoid arthritis	✓		
Crohn's disease		✓	
Central nervous system			
Neural development		✓	
Memory			✓
Depression			✓

SEAFOOD CONSUMPTION IS ASSOCIATED WITH A WIDE RANGE OF HEALTH BENEFITS.

Seafood is high in beneficial fats

Humans can manufacture some types of fatty acids in the body, but must obtain those essential for good health (the poly-unsaturated omega-3 and omega-6) from the diet. Omega-3 fats are best found in seafood and plants such as soybean, canola, flaxseed and purslane. Omega-6 fats are also found in seafood of all kinds: crustaceans, molluscs, shellfish and, to a variable extent, finfish. However, plant foods such as sunflower seed, corn and soybean are usually a better source of omega-6 fats. In recent times, the emphasis in affluent diets has been on poly-unsaturated fatty acids of the omega-6 type, so that the ratio of the omega-3 to omega-6 has been too low. Regular seafood intake plays an important role in allowing a healthy ratio of omega-3 to omega-6 fatty acids.

To prevent essential fatty acid deficiency, nutritionists generally recommend that humans must consume at least 2.4% of total fat intake as omega-6 fats, and 0.5–1.0% of total fat as omega-3 fats.

Plants alone may not provide enough essential fatty acids, especially long-chain omega-3 fats. These are best obtained from seafood.

ESSENTIAL FATTY ACIDS ARE BEST OBTAINED FROM EATING SEAFOOD. SWORDFISH AND ATLANTIC SALMON (PICTURED) ARE TWO SPECIES THAT CONTAIN HIGH LEVELS OF OMEGA-3 FATS.

Department of Primary Industries, Queensland

OMEGA-3 FAT CONTENT OF AUSTRALIAN SEAFOODS

Different types of seafood have different levels of omega-3 fats. As a general rule, plant-eating finfish have less omega-3 fats than omega-6 fats (e.g. 30% omega-3 and 70% omega-6 as a percentage of total fat content), whereas carnivorous finfish have more omega-3 fats than omega-6 fats (e.g. 70% omega-3 and 30% omega-6 as a percentage of total fat content). These omega-3 fat contents are far higher than the amounts found in plants.

The Fisheries Research and Development Corporation has published five detailed books on Australian commercial seafood and its fat content and composition:

- *Seafood the good food: oil content and composition of Australian commercial fishes, shellfishes and crustaceans*
- *Seafood the good food II*
- *Australian Seafood Handbook: an identification guide to domestic species*
- *Australian Seafood Handbook: an identification guide to imported species*

  The above are available from CSIRO Publishing: publishing.sales@csiro.au or 1300 788 000 toll-free in Australia (+61 3 9662 7500 from overseas).

- *Australian Seafood Users Manual — making the most of the world's best*

  Available from Seafood Services Australia: www.seafoodservices.com.au/bookshop or telephone 1300 130 321 toll-free in Australia (+61 7 3633 6777 from overseas).

The contents of omega-3 fats in various species of seafood, derived from the *Australian Seafood Handbook*, is shown in tables 2a and 2b.

TABLE 2A: OMEGA-3 OIL CONTENTS OF VARIOUS AUSTRALIAN SEAFOOD SPECIES

Species	Total oil content Oil (%)	PUFA* (mg/100g)	DHA (mg/100g)
School shark	0.9	300	250
Swordfish	7.7	1350	550
Snapper	0.6	220	150
Barramundi	0.9	110	50
Pink ling	0.5	120	80
Spanish mackerel	1.2	400	275
Atlantic salmon	2.7	650	425
Tiger prawn	0.8	180	75
Blue mussel	1.7	330	170
Pacific oyster	1.0	300	150
Sydney rock oyster	1.3	300	160

* PUFA = omega-3 poly-unsaturated fatty acids

(Nichols et al. 1999, in *Australian Seafood Handbook: Domestic Species*, eds G.K. Yearsley, P.R. Last & R.D. Ward).

TABLE 2B: AMOUNT OF SEAFOOD REQUIRED TO PROVIDE VARIOUS INTAKES OF FISH OILS

Species	Grams of seafood that must be eaten to obtain the following levels of omega-3 fats, fish oil and DHA: 1 gram of omega-3 fats	2.5 grams of fish oil	200 milligrams of DHA
School shark	333	278	80
Swordfish	74	32	36
Snapper	455	417	133
Barramundi	909	278	400
Pink ling	833	500	250
Spanish mackerel	250	208	73
Atlantic salmon	154	93	47
Tiger prawn	556	313	267
Blue mussel	303	147	118
Pacific oyster	333	250	133
Sydney rock oyster	333	192	125

(Nichols et al. 1999, derived from *Australian Seafood Handbook: Domestic Species*, eds G.K. Yearsley, P.R. Last & R.D. Ward).

Seafood is also a good source of other nutrients

SELENIUM

Selenium is now recognised as an essential element for humans; it plays a major role in the enzymes that make up part of the body's antioxidant defence and other systems. It helps to prevent DNA damage caused by various chemicals and radiation. Dietary deficiency of selenium has not been demonstrated in humans — although animals on a deficient diet develop a number of symptoms including retarded growth, muscular dystrophy and necrosis of the heart, kidney and liver. Finfish can be a useful source of dietary selenium. In Australia, low levels of selenium in soils make this an important factor.

CO-ENZYME Q10

Finfish is one of the good sources of co-enzyme Q10. Although more than 40 years ago co-enzyme Q10 was known to function as an anti-oxidant at the sub-cellular level, it has only recently received attention in relation to its food sources. Co-enzyme Q10 concentrations rise under the influence of oxidative stress (e.g. physical exercise) and in degenerative conditions of the brain, such as Alzheimer's disease, whereas it is reported that its concentrations drop in several diseases, including degenerative muscle diseases and liver carcinomas. Although co-enzyme Q10 can be synthesised in the body, additional intake from food is required.

TAURINE

Seafood contains a large amount of taurine. This amino acid is known for its role in the formation and excretion of bile salts, which are the breakdown products of cholesterol. It also plays a role in the function of the neonatal retina and in cognitive function.

Which one is better — finfish or fish oil supplements?

On the basis of omega-3 fatty acid content, fish oil is an attractive commodity, because it has a higher concentration of these than the whole finfish. Fish oil can be a useful option for people who are unable to eat seafood, or who cannot eat it in quantities sufficient for their health needs. For example, to achieve the required effects of omega-3 fatty acids, some people may need to have the equivalent of 2–3 serves (at 100 grams per serve) of finfish a day, or about 6–9 grams of finfish fat per day (an average finfish has about 3 grams fat per 100 grams). Such effects may be to reduce the concentration of blood triglyceride (a blood fat), decrease the risk of an abnormal heart rhythm or perhaps correct a mood disorder (depression).

Fish oil may achieve these effects much more conveniently than eating finfish. However, some health effects of finfish are not seen with fish oil. Reduction of high blood pressure is an example; this is thought to be due to the relatively higher proportion of DHA to EPA in finfish compared with that in fish oils. Again, factors from the flesh (muscle) of finfish, other than fatty acids — such as protein and its amino acid content, micronutrients, or co-enzyme Q10 — may be important to health. In finfish there are also factors that are anti-oxidants, which protect the poly-unsaturated fatty acids from oxidation — whether before or after ingestion. These may not be as well represented in fish oil, although this can be addressed during processing.

There is a natural constraint as to how much finfish we can eat, but less so (unless because of taste or after-taste) for fish oil. To this extent, it is theoretically possible to have an excessive amount of omega-3 fats from fish oil. However, the larger amounts are normally given under medical supervision, where effects can be carefully managed. Such effects can increase bleeding tendency or increase not only the 'good' HDL cholesterol but also the 'bad' LDL cholesterol, especially in diabetes, while lowering the triglyceride (a favourable outcome).

On the whole, it can be said that finfish (and seafood in general) are to be preferred to fish oil, but where larger amounts of omega-3 fatty acids are needed and finfish intake is a problem, fish oil can play a valuable health role.

Fish oil may achieve effects much more conveniently than eating finfish, but some health effects of finfish are not seen with fish oil.

STEAMING IS RECOGNISED AS A PARTICULARLY HEALTHY METHOD OF COOKING SEAFOOD

Department of Primary Industries, Queensland

Healthy ways to cook seafood

There is really no perfect oil for deep frying. Other cooking methods such as grilling or steaming should be encouraged.

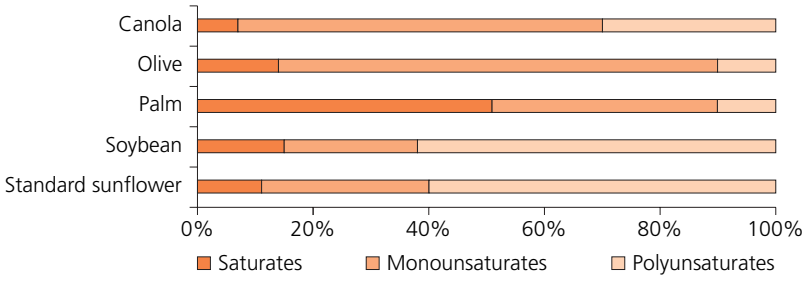
The cooking method could markedly alter the fatty acid content of a seafood meal. The best ways to cook seafood and maintain its health benefits by minimising omega-3 fat losses are steaming, micro-waving, grilling or baking. A recent study of older people showed that eating broiled or baked finfish provided more protection against fatal myocardial infarction and death from coronary heart disease than eating fried fish or fish burgers. It appears pan-frying and deep-frying seafood, with very high temperatures, could destroy some omega-3 fats, although some studies show no effect. Frying also causes more cooking oil to be absorbed into the finished product than with cooking by other methods. It is recommended that if seafood is to be pan-fried or deep-fried, it's preferable to use cooking oil that is high in mono-unsaturated fats, such as olive or canola oils.

If seafood is to be fried, it should be pan-fried in a small amount of oil rather than solid fat, which tends to be more saturated or be hydrogenated with a higher trans fatty acid content. Trans fatty acids are similar in effect to saturated oils, and raise 'bad' cholesterol and decrease 'good' cholesterol levels. There is really no perfect oil for deep frying. Dominantly, mono-unsaturated oils (such as olive oil) or poly-unsaturated oils (such as sunflower oil) are preferable to solid fat. But mono-unsaturated oil is generally too expensive, and poly-unsaturated oil, with essential fatty acids, may undergo unfavourable chemical changes. Most 'fish and chips' shops use saturated or hydrogenated oils because they last longer and are generally cheaper. The important consideration in deep frying is to use oils that are clean and replaced regularly. Other cooking methods such as grilling or steaming should be encouraged.

The cooking temperature of oil is important. For example, with chips that are often served with finfish, if the cooking oil temperature falls below 180–185°C, up to 40% more fat is absorbed into the chip (or about 3 teaspoons of extra fat — amounting to about 100 calories or 420 kilojoules — in a single serve of chips). Table 3 shows the relative contents of saturated, unsaturated and mono-unsaturated oils in various cooking oils.

TABLE 3: RELATIVE PERCENTAGES OF FATS IN COMMON COOKING OILS

	Saturates	Mono-unsaturates	Poly-unsaturates
Canola oil	7	63	30
Olive oil	14	76	10
Palm oil	51	39	10
Soybean oil	15	23	62
Standard sunflower oil	11	29	60



Cooking seafood with various herbs could also be beneficial to health — for example, supplementing seafood with garlic can significantly lower cholesterol and triglyceride levels. Herbs are normally anti-oxidants as well. They can also help to preserve the essential fatty acid value of seafood and reduce the formation of potentially harmful chemicals such as heterocyclic amines (derivates of amino acids in proteins) if seafood is over-cooked.

Finfish do not lose their positive health benefits by being canned. Finfish canned in fish oil have a particular advantage, but are now less available in the market place. Finfish canned in olive or canola oil bring with them the health benefits of these oils; canned in brine or spring water, there are less calories.

Finfish do not lose their positive health benefits by being canned.

Nutritionists increasingly advocate the use of a Mediterranean diet (which contains seafood) as a healthy diet for people at risk or suffering from coronary heart disease. Seafood is important in disease prevention but should not be considered in isolation. It has a premium place in a healthy diet for most people.

WHAT IS THE MEDITERRANEAN DIET?

The Mediterranean diet consists of:

- more bread,
- more vegetables and legumes,
- more seafood,
- less meat (beef, lamb, pork) — replaced by poultry,
- no day without fruit,
- no butter or cream, and
- olive oil or other mono-unsaturated oil source.

Concern about seafoods — heavy metal content

The health hazards associated with the consumption of seafood contaminated with heavy metals (notably mercury) have received world-wide publicity. The levels of heavy metals vary in different seafood species because each has different habitats and feeding patterns. Large predatory species of finfish such as tuna, swordfish and some species of shark eat smaller plant-eating finfish, and therefore they tend to accumulate higher levels of mercury. Further up the food chain, the mercury can become more concentrated in the flesh of the finfish. Where water has been polluted by manufacturing or mining, the amounts can be unacceptable and intolerable from a human health point of view. Problems have only arisen when individuals eat large amounts of finfish that have fed in contaminated waters.

Mercury is a highly reactive heavy metal with no known physiologic activity. Exposure to toxic levels of mercury results in neurologic and renal damage. It has been put forward that a high dietary intake of mercury from seafood consumption increases the risk of coronary heart disease. Therefore, the risk of heart disease in a population may depend on the balance between omega-3 fatty acids and mercury in seafood consumed.

Presently the majority of the population are exposed to mercury at levels that are not associated with harmful effects. In Australia, there have been no reported cases of mercury poisoning as a result of seafood consumption. The Australian Food Standards Code currently prescribes maximum levels for mercury in food. Two separate limits are imposed for seafood:

- 1.0 mg/kg for finfish that are known to contain high levels of mercury (such as swordfish, southern bluefin tuna[2], barramundi, ling, orange roughy, rays and shark/flake), and
- 0.5 mg/kg for all other species of finfish, crustaceans and molluscs.

Some research indicates that human foetuses are more sensitive than adults to the effects of mercury from food consumption, especially to the nervous system. Hence there are concerns about whether pregnant women should reduce their intake of seafood to limit the exposure of the foetus to the toxic effects of mercury. But a recent study in the Republic of Seychelles, an island nation in the Indian Ocean, suggests that mercury exposure from seafood consumption during pregnancy does not have significant cognitive or behavioural effects in later childhood. In the Seychelles, the concentration of organic mercury in seafood is similar to diets consumed during pregnancy in most of the world, but the seafood consumption rate is much higher (average 12 meals per week).

This study indicates that small amounts of mercury are not a problem, although two other studies in the Faeroe Islands and New Zealand found detrimental effects. In these latter studies, whale blubber and shark provided large amounts of mercury in short periods of time, which may be more harmful than lesser amounts when finfish are eaten more frequently and regularly.

Although findings from various studies are inconsistent, there is no reason for pregnant women to avoid or reduce seafood consumption. Moreover, many components of seafood are very important for foetal development — for example, protein and its amino acids, omega-3 fatty acids, iodine and calcium. In addition, low consumption of seafood in early pregnancy could be a risk factor for pre-term delivery and low birth weight. Therefore, given the concerns regarding heavy metal exposure, pregnant women need to avoid large and old predator finfish and take as much care as they can to ensure that seafood comes from areas with pollution controls.

Food Standards Australia New Zealand (www.foodstandards.gov.au) recommends that consumption of some types of finfish by pregnant women, women planning pregnancy and children up to six years of age should be limited, as shown in table 4 on page 31.

2 Canned tuna has lower levels of mercury than fresh southern bluefin tuna because the tuna fish used for canning is a different and smaller species, and is generally caught when less than one year old.

Seafood is important in disease prevention but should not be considered in isolation. It has a premium place in a healthy diet for most people.

Key messages

ONE TO FOUR SERVES A WEEK ARE PROBABLY BEST

Several studies now demonstrate that even a limited finfish intake — say one serve (about 100 g) per week — is better than none, especially in relation to heart disease. Up to four serves a week may be useful in some health respects, such as blood pressure control. The amount recommended will depend not only on benefits but also on risks. For example, heavy-metal toxicity may be avoided with modest intake while the nutritional benefits of finfish are preserved.

With crustaceans, shellfish and molluscs, the concerns felt by some people about cholesterol content are hardly relevant with occasional intake (say weekly), and of even less concern where the cooking technique and food habits avoid the use of saturated animal fat (as with deep frying and fatty spreads).

Message: Have between one and four serves (about 100 grams per serve) of finfish a week, because increasing health benefits may be seen across this range of intake. This amount is considered to be safe in relation to heavy metals (such as mercury) or other contaminants, unless the finfish is harvested from an area without pollution controls. This guideline is relevant to pregnancy, as well as for adults in general; children will generally have somewhat smaller portions.

BENEFIT OF SMALL PORTIONS

When preferred, convenient, more affordable or culturally appropriate, serving sizes smaller than 100 grams of finfish can be used in a cumulative way for health over the day or over a few days. Examples would be sushi, marinated herrings or small tins of finfish such as sardines, salmon or tuna.

Message: Small serves of finfish as a snack or meal adjunct are healthful.

SUSTAINABILITY

As the health evidence for regular seafood intake becomes clearer and more widely known, demand will increase and wild-caught seafood stocks will be under greater pressure. Optimising intake for the greatest majority globally will be important, as will the methods of harvesting and farming seafood. Another consideration will be the maintenance of aquatic biodiversity to which the interest in, and acceptability of, a variety in seafood intake will also contribute. A more contemporary science-based education program about the health benefits of finfish, crustaceans, shellfish and sea plants will promote biodiversity and, with it, sustainability.

Useful sources of information on sustainability factors in the fishing industry are *Investing for tomorrow's fish: the FRDC strategic plan for fisheries research and development, 2005 to 2010* and FRDC annual reports, available from the Fisheries Research and Development Corporation (telephone 02 6285 0400 or visit www.frdc.com.au).

Message: Eat a variety of seafood as part of a varied diet for its health benefits, both direct and indirect, which are achieved by encouraging biodiversity and sustainability.

Concerns about cholesterol content of crustaceans and shellfish are hardly relevant with occasional intake, and of even less concern when saturated animal fat is avoided.

Section 2 More detailed information on seafood and specific conditions

Finfish and heart disease

Coronary heart disease is a major cause of death and disability in Australia. In the early 1970s, evidence emerged that finfish intake had important health implications. Most studies focused on protection by finfish against heart disease and consequent death. While many individual factors are involved in the onset and progression of the disease, including genetics and lifestyle, the positive benefits of finfish in reducing the risk of coronary heart disease have been widely studied and are now well accepted.

Studies have found that decreased risk of death from heart attack is related to increased finfish consumption. In one study, finfish consumers had more than half the survival rate of people who ate no finfish. The highest rates of heart disease have been recorded for men who ate no finfish at all. These studies indicate that one or two serves of finfish per week can substantially lower the risk of coronary heart disease. However, it is important to emphasise that no single food will cause or prevent coronary heart disease.

Studies indicate that one or two serves of finfish per week can substantially lower the risk of coronary heart disease.

SECONDARY PREVENTION OF CORONARY HEART DISEASE

After someone has had a heart attack, it is very important to prevent further damage that may bring about another heart attack. Steps taken to lower this risk are called secondary prevention measures.

It was demonstrated in a clinical controlled trial that, for those who recovered from heart attacks, consuming fatty finfish two or three times a week could reduce overall mortality by nearly one-third after two years. Similarly, in another trial, with supplements of omega-3 seafood fats, total mortality was reduced by 20%, cardiovascular death by 30%, and sudden death by 45%. In one study, a Mediterranean diet that includes 47 grams of finfish per day has also been shown to be more effective than a low-fat diet in protecting against sudden cardiac death. People on the Mediterranean diet consumed less fat, saturated fat, cholesterol and linoleic acid, but significantly more oleic acid and alpha-linolenic acid (a plant omega-3 oil). This resulted in far lower heart attack and death rates in the five-year follow-up period. In fact, only two years into the study the researchers found the results so striking that they stopped the trial and recommended that all the participants follow the Mediterranean diet.

Prevention of heart disease through finfish consumption may rely on a combination of the following mechanisms:

- reducing serum triglycerides,
- optimising blood pressure,
- improving blood flow, and
- minimising irregular heart beat.

DIETARY CHOLESTEROL AND BLOOD CHOLESTEROL

Most studies confirm that increasing dietary cholesterol results in higher blood cholesterol, and is associated with increased heart disease risk. This is particularly so when combined with eating saturated fat. Only 15% of the population experience increases of blood cholesterol greater than 10%. There are a number of factors modulating this effect. Gender, age and distribution of body fat can influence the way the body handles cholesterol from food. Another is the fatty acid composition of the diet. Two classes of dietary fatty acids can raise blood cholesterol: saturated fats (mostly from animal foods, such as meats) and *trans* mono-unsaturated fats (produced by hydrogenation of vegetable oils).

Cholesterol in the body is transported by low-density lipoproteins (LDL) and high-density lipoproteins (HDL). Cholesterol-laden LDL is deposited in part of the wall of blood vessels. The accumulation of LDL can cause tissue damage and, as a result, the artery becomes completely blocked. If this happens to the arteries of the heart (coronary arteries), it leads to a heart attack. For this reason, LDL cholesterol is considered to be 'bad' cholesterol — although it is not *all* bad since the body requires some LDL cholesterol for body metabolism. In contrast, HDL cholesterol is considered to be 'good' cholesterol, as HDL helps to remove LDL cholesterol from the body. High cholesterol, high LDL and low HDL levels are risk factors for heart disease. High triglycerides in combination with these factors multiply this risk further.

Furthermore, LDL can undergo a chemical reaction of *oxidation*, which is enhanced by certain reactive molecules normally produced as part of the defence system, and as the by-products of metabolic processes that utilise oxygen. This 'oxidised' LDL has been implicated in hardening of the arteries and arterial damage. LDL oxidation appears to be influenced by the type of fats we eat and minimised by the intake of various anti-oxidant foods. Whilst replacing saturated fat with omega-6 fats is a healthy strategy, a healthier strategy would be to reduce the amount of dietary saturated fats and omega-6 fats in the diet by replacing some of these with omega-3 fats from seafood, which also contains its own natural anti-oxidants such as vitamin E, carotenoids and co-enzyme Q10.

Department of Primary Industries, Queensland

NUTRITIONISTS INCREASINGLY ADVOCATE THE USE OF A MEDITERRANEAN DIET (WHICH INCLUDES SEAFOOD) FOR PEOPLE AT RISK OR SUFFERING FROM CORONARY HEART DISEASE.

People on a Mediterranean diet in a trial had far lower heart attack and death rates in the five-year follow-up period than people on a low-fat diet. Two years into the study, the results were so striking that the trial was stopped; all participants were recommended to follow the Mediterranean diet.

Anti-oxidants — such as vitamin C, E, beta-carotene and certain compounds found in fruits and vegetables — are crucial in protecting the body against the process of oxidation. The amount of anti-oxidants in the body protects against unwanted oxidation of the fats in seafood. Hence, to maximise the benefits of omega-3 and omega-6 fats, anti-oxidants should be eaten as well. To further enhance the intake of anti-oxidants, seafood intake should be combined with a diet rich in fruit and vegetables.

The general dietary approach for lowering blood cholesterol is to limit cholesterol intake to less than 300 milligrams per day and reduce dietary fat, especially animal saturated fat. Low-fat diets also reduce the protective HDL levels. If the person has high blood cholesterol, intake is restricted further, to less than 200 milligrams per day.

People at risk of developing coronary heart disease are often advised to only rarely eat crustaceans (prawns, crabs, lobsters) because these foods contain high cholesterol. However, it should be noted that oysters, clams, mussels and crab can be found to be suitable for diets that lower blood cholesterol, in combination with a reduced saturated fat intake. Moreover, their omega-3 fat content provides protection against heart disease by means other than the effects on blood cholesterol.

Use of seafood in conjunction with low-fat diets can increase HDL cholesterol and reduce triglycerides; therefore, use of seafood may be more suitable for reducing the risk of coronary heart disease than a low-fat diet on its own. Some of the disadvantages of a low-fat diet are avoided by supplementation with fish oil.

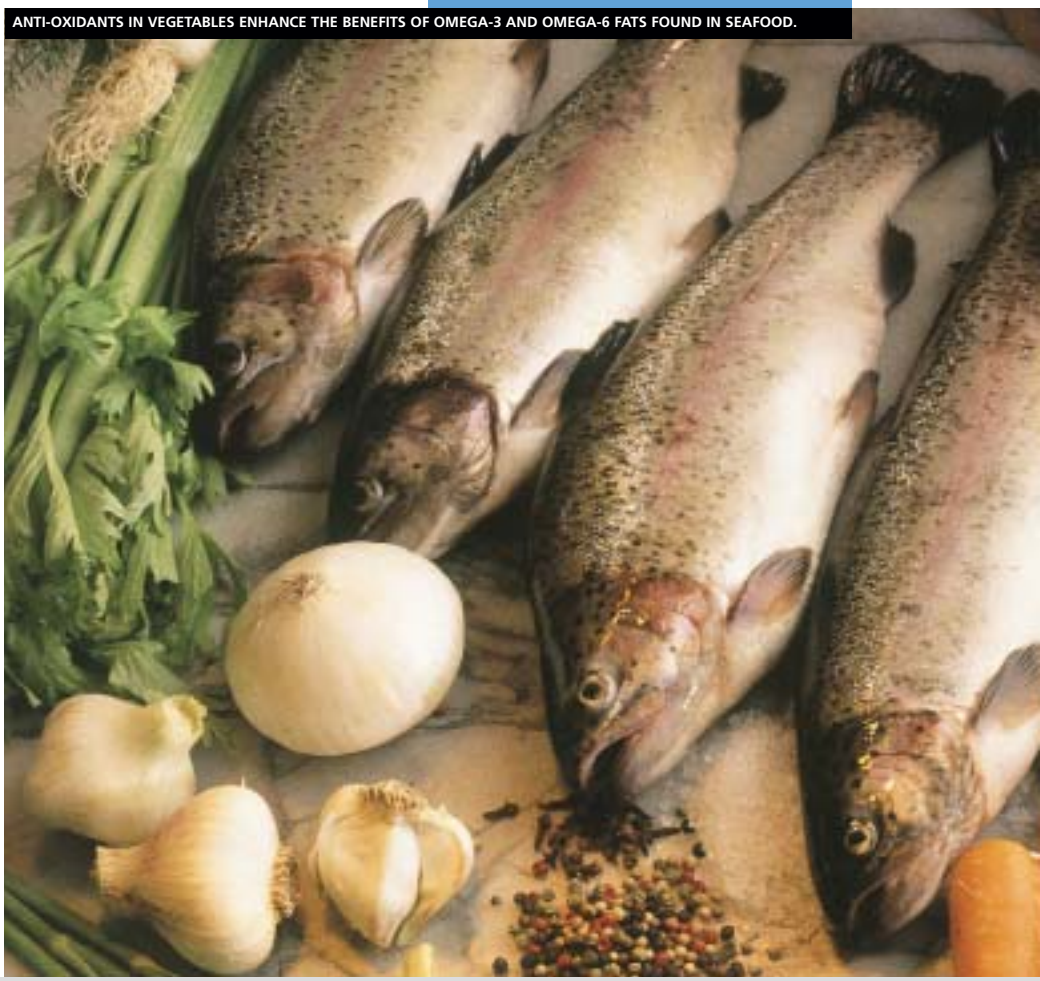
FISH OIL MAY HELP TO IMPROVE BLOOD FLOW

Blood flow in injured arteries is restricted by the hardening of blood vessels caused by the deposition of fatty plaques and calcium in the arterial wall. Nitric oxide, which is a major contributor to dilation of blood vessels, can ease the blood flow. Injured parts of an artery wall produce much less nitric oxide.

Fish oils are thought to increase nitric oxide levels released by blood vessel tissue (especially when it has been injured), and to locally relax blood vessels. Other research shows that omega-3 fish oil helps to dilate the coronary artery in heart transplant patients. In patients with non-insulin dependent diabetes mellitus, the oil also improves blood flow in the forearm — indicating protection against blood vessel constriction and thrombosis.

Seafood should be combined with a diet rich in fruit and vegetables.

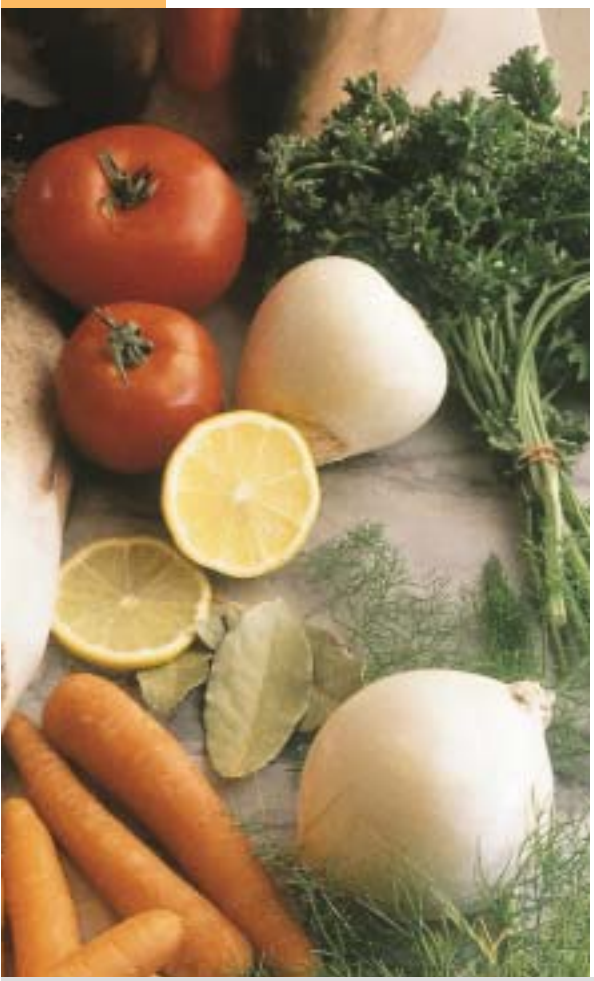
ANTI-OXIDANTS IN VEGETABLES ENHANCE THE BENEFITS OF OMEGA-3 AND OMEGA-6 FATS FOUND IN SEAFOOD.



FINFISH PROTECTS AGAINST HEART ARRHYTHMIA

Many scientists consider that omega-3 fats from finfish may help to prevent disruptions to the rhythm of the heart (heart arrhythmia or ventricular fibrillation). In one study, patients who had recently suffered a heart attack were given 5.2 grams per day of fish oil. Heart rates were examined for variability, since such variability protects against ventricular arrhythmia. It was found that fish oil had the beneficial effect of increasing heart rhythm variations in the patients.

There is considerable evidence that the consumption of omega-3 fat-enriched diets leads to a marked reduction in the susceptibility of the heart muscle to develop heart arrhythmia and subsequent sudden cardiac death.



FINFISH AND HIGH BLOOD PRESSURE

Early studies on the effect of fish oil supplements on high blood pressure showed significant lowering of blood pressure. However, other studies have shown no — or relatively small — effects on blood pressure. It is suggested that in severe and life-threatening situations, fish oil may be useful for rapid exchange of omega-3 fats for omega-6 fats to help normalise blood pressure and a range of other risk factors for myocardial infarction (heart attack).

One study has shown that in overweight people with high blood pressure, incorporating finfish into a weight-reduction diet has additive effects in reducing blood pressure, as well as beneficial effects on heart rate. These effects may be due in part to constituents of finfish other than omega-3 fats, such as finfish protein. It was recently reported in an animal model study that omega-3 fats supplied in the early development period can affect blood pressure later in life.

SEAFOOD AND STROKE

Evidence from populations with very high consumption of finfish, such as Greenland Eskimos, native Alaskans and fishing Japanese, has raised concerns that finfish consumption may increase the risk of haemorrhagic (bleeding) stroke. However, the average food supply per capita among people living in Australia (equivalent to 0.1–0.2 grams per day of omega-3 fatty acids) is much lower than that of Greenland Eskimos (equivalent to 10.5 grams per day of omega-3 fatty acids). Thus, the potential for increased risk for haemorrhagic stroke may be minimal at the average intake of Australians.

[Note: In Australia's 1995 National Nutrition Survey, 8% reported eating fish on the day of the survey (24-hour recall method). For these people, the average amount of marine fish was 96 g, and for high consumers 298 g.]

A large study among male healthcare professionals in the US reported after 12 years of follow-up that consuming seafood, mainly finfish, at least once a month could reduce the risk of ischaemic (deficiency of blood) stroke by 40% in men, and consuming finfish once per month or more did not change the risk of haemorrhagic stroke. This suggests that eating finfish once per month can be protective against stroke, especially ischaemic type, in men. The similar beneficial effect of fish consumption, but to a lesser extent, was also seen in another large study in female nurses after 16 years of follow-up. The risk of total stroke was reduced by 20% among women who ate finfish once per week or more, and again, high consumption of finfish (more than 5 times per week) did not increase the risk of haemorrhagic stroke.

Much evidence points to diets rich in omega-3 leading to a reduction in the development of heart arrhythmia.

Seafood and other diseases or conditions

FINFISH AND RHEUMATOID ARTHRITIS AND OTHER AUTO-IMMUNE DISEASES

Among the fatty acids, it is the omega-3 fats that possess the most potent activities of modulating immune function, and among the omega-3 fats, those from seafood (EPA and DHA) are more potent than those of plant origin. Many clinical studies reveal the benefits of omega-3 fats from seafood in the management of inflammatory and auto-immune diseases, such as arthritis, Crohn's disease, ulcerative colitis and lupus erythematosus.

Recent studies have indicated that increased consumption of finfish may improve symptoms of rheumatoid arthritis. Comparisons between people who live in the Faeroe Islands in the northern Atlantic and mainland Nordic countries show that people from the Faeroe Islands have a much lower prevalence of rheumatoid arthritis. This lower prevalence is associated with higher finfish consumption and much lower meat, dairy and vegetable consumption. The inhabitants of the Faeroe Islands also consume significant amounts of whale meat and fat, further increasing their intake of omega-3 fats.

Supplementing diet with omega-3 fats while patients have continued with their usual medications has improved symptoms. In addition, supplementing diet with EPA and DHA decreases the need for non-steroidal anti-inflammatory drugs. Omega-6 fat content in the patient's diet, and drug therapy, affect how well the medication works. Therefore, omega-3 fats may potentially allow medication dosages to be decreased.

A study of Crohn's disease patients who consumed fish oil (2.7 grams per day of omega-3 fatty acids) showed significantly higher remission. Using fish oils to treat Crohn's disease patients requires substantially more fish oil than can be obtained from eating finfish. Consequently, fish oil capsules are usually required. The need for capsules rather than fresh finfish to treat Crohn's disease patients is evident from findings showing that countries with high finfish consumption also have appreciable incidences of Crohn's disease.

Anyone with Crohn's disease should consult their physician for advice on the amount of fish oil they should consume.

Finfish is a protein source that has low saturated fat content and can contribute usefully to calorie-controlled weight loss diets, particularly when it replaces high-fat sources of protein.

FINFISH AND OBESITY

Obesity in Australia is generally a reflection of changing lifestyles: more Australians than ever before are obese. Being overweight is unhealthy, often leading to serious problems such as diabetes, coronary heart disease and cancer. Diet and physical activity are regarded as the most important factors in obesity.

Total dietary fat is a large contributor to obesity. Hence, low fat diets are popular for reducing weight. However, the type of fat consumed is just as important as the total fat consumed. The popular belief that all fats contribute to weight gain is not accurate — whether the fats are unsaturated or saturated significantly affects their contribution to weight gain. Some studies also show that increased finfish intake may protect against obesity and glucose intolerance.

Important: Capsules of omega-3 oil with dosages between 4 and 10 grams per day may increase blood sugar levels in people with diabetes, although other benefits, such as the reduction in certain risks for coronary heart disease, usually outweigh this consideration. People with diabetes should consult their medical practitioner.

SEAFOOD AND CANCERS

Many foods and nutrients have been studied for good and bad effects on the risk of bowel cancer. These include red meat (especially charred), fruits and vegetables, dietary fibre, fat and alcohol. Although dietary fat is considered to be a risk factor for bowel cancer, indications are that EPA and DHA intakes are associated with a decreased risk of bowel cancer. It is thought that the long-chain poly-unsaturated fatty acids in fish oil suppress the formation of inflammatory metabolites in the gut. Inflammation may decrease the immune surveillance. This immune surveillance reduces the growth of cancer cells. Thus seafood consumption may be protective against this disease.

In recent years, increasing attention has been paid to the intake of specific fatty acids as the dietary risk factors for breast and prostate cancers, and notable among these have been the fatty acids in seafood. EPA and DHA have been shown consistently to inhibit the proliferation of breast and prostate cancer cells in test tube, and to reduce the risk and progression of these tumours in animal studies.

The potential benefits of an increased consumption of seafoods or intake of fatty acids from seafood with respect to cancer prevention have yet to be established.

However, the evidence from population studies has been inconsistent or unclear. Encouraging results come from few studies of populations with a generally high intake of seafood fats. For example, participants in the Health Professional Follow-up Study who ate finfish more than three times a week had a lower risk of prostate cancer (especially for metastatic cancer), compared with those who ate finfish less than twice a month. However, most studies do not show an association between finfish consumption or the intake of seafood fats and the risk of hormone-related cancers. Therefore, the potential benefits of an increased consumption of seafoods or intake of fatty acids from seafood with respect to cancer prevention have yet to be established.

Similarly, research indicates that fish oil may also be associated with a decreased risk of developing laryngeal and pancreatic cancer. However, these findings require more substantiation before strong claims can be made.

SEAFOOD AND DIABETES

People with diabetes have an increased risk of developing heart and other cardiovascular diseases. Consequently, diabetes and heart disease management require a combined strategy. Omega-3 seafood fats have a favourable effect on heart disease risk factors such as platelet aggregation (responsible for stickiness of the blood), high blood pressure and metabolism of plasma lipoproteins (blood fats). However, in people with diabetes, caution needs to be exercised in supplementation with omega-3 fish oil capsules (where 1 gram of fish oil is about 30% omega-3 fatty acids). This is because dosages between 4 and 10 grams per day (equivalent to or more than 1–3 serves of seafood per day) may result in increased levels of blood sugar (glucose). However, lower doses (2.5 grams per day) have been shown not to affect glycaemic control, although they still provide useful effects on heart disease risk factors. Generally, eating seafood does not create a problem and is actually an advantage.

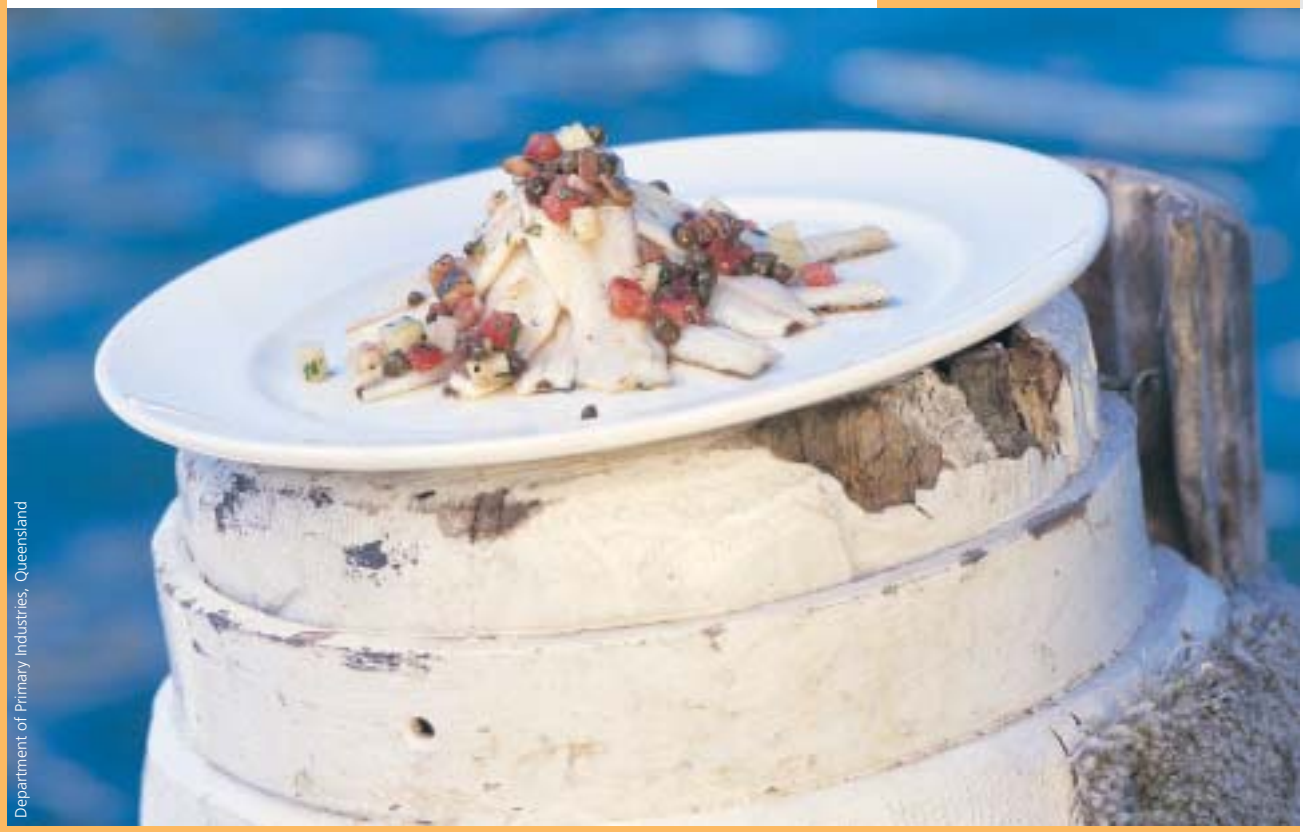
Omega-3 fat intake can reduce insulin resistance in skeletal muscle. A high dietary proportion of omega-6 and omega-3 fats has been implicated in increased insulin resistance; hence, an increase in dietary omega-3 fats from seafood may address this.

FINFISH AND ASTHMA

Dietary factors have been implicated in increasing rates of asthma in children and young adults over the last two decades. The effects of eating finfish on development and prevention of asthma require substantial research to be conducted before strong claims can be made. However, a recent study found that children who consumed fresh (not canned) finfish had a lower risk of developing asthma. The evidence is not clear as to which components of finfish might be important in asthma prevention. Studies into the effect of fish oil on patients who already have asthma have been inconclusive.

SEAFOOD AND NEURAL DEVELOPMENT

Essential fatty acids, particularly DHA, are needed for cell membranes. They are a major factor for early development of nerve and brain cells in infants. It is evident from a number of studies that adequate supply of DHA is needed for brain growth and functional development of infants. Both integrity and function of nerves can be permanently disturbed by deficits of essential fatty acids. Breast-fed infants have a higher DHA level in the brain and red blood cells, and they are likely to have an enhanced neural development compared with formula-fed infants. One study indicates that infants need a continuous supply of DHA, since infants breastfed for a shorter period — that is, less than 16 weeks — show poorer visual acuity scores than those receiving DHA, either from breast milk or fish oil.



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FINFISH AND COGNITIVE DECLINE

Omega-3 fats in finfish are important in the structural components of nerve cells, and play a role in the formation of brain chemicals transmitting information from one nerve cell to the next. They may also have a specific role in brain development and regeneration of nerve cells. Therefore, eating finfish may be favourable for brain function.

Increasing evidence shows the protection of finfish against cognitive impairment. One study in France reports that older people who eat seafood at least once a week are at lower risk of developing dementia, including Alzheimer's disease. Two longitudinal cohort studies in the Netherlands showed that high finfish intake was associated with reduced risk of dementia, particularly Alzheimer's disease (the Rotterdam study) and tended to be associated with reduced risk of cognitive decline (the Zutphen Elderly Study). Long-chain polyunsaturated fatty acid intake may be associated with cognitive function and Alzheimer's disease through prevention of vascular disease and diabetes or more directly through altering the lipid composition of the brain membrane.

FINFISH AND AGE-RELATED MACULOPATHY

Age-related maculopathy (a pathological condition of macula retinae) is a leading cause of irreversible blindness in Australia. The human retina and macula contain a high proportion of omega-3 fatty acids, particularly DHA, which appears to play an important role in the normal functioning of the retina. Thus, it is biologically plausible that omega-3 fatty acids are protective against the development of age-related maculopathy. This suggestion is supported by a research survey which showed that eating finfish more than once per week could reduce by half the chance of developing late age-related maculopathy, compared to consuming less than once a month. (Additional research is needed before definite benefits can be claimed.)

Eating finfish may be favourable for brain function.

FINFISH AND DEPRESSION

A multi-national comparison of depression prevalence shows that Japan — where the finfish consumption averages 67 kg per person per year — has a relatively low prevalence of 0.12%. New Zealand has an average finfish consumption of 18 kg per person per year, and a high prevalence of depression: 5.8%. It is clear that there is an association between finfish consumption and incidence of depression. In addition, the most consistent observations about fatty acids and depression are the low level of both omega-3 and omega-6 fats in the blood. It is likely that the availability of these fatty acids is important in modulating mood. It is further suggested that decreased omega-3 fat intake may affect the central nervous system in early development or adulthood, so increasing vulnerability to depression.

Seafood and women's health

RESEARCH HAS INDICATED THAT SEAFOOD CONSUMPTION MAY HAVE A RANGE OF BENEFITS FOR WOMEN DURING PREGNANCY AND LACTATION.

Much of the research on heart disease has concentrated on men, since they have a higher risk of developing this disease. However, women also develop coronary heart disease. A large survey conducted in a population of over 100,000 registered female nurses in the US (Nurses' Health Study) suggests that, after 16 years of follow-up, fish consumption (at least once per month) could reduce risks of coronary heart disease by 20%, and of stroke by 7%. Another study into the effects of various foods on heart disease risk in women found that eating foods such as meat, salami, butter and coffee was associated with increased coronary heart disease risk. Eating foods such as carrots, fresh fruit, green vegetables, finfish and moderate alcohol reduced risk. In addition, women who ate finfish more than once per week had a 40% lower chance of developing heart disease than those who consumed finfish less than once per week.

SEAFOOD CONSUMPTION DURING PREGNANCY AND LACTATION

Research has indicated that seafood consumption may have a range of benefits during pregnancy and lactation. During pregnancy, the foetus requires large amounts of omega-3 fatty acids and obtains them from the mother. In general, DHA levels get progressively lower as the pregnancy becomes more advanced. Furthermore, maternal DHA levels are higher in women during their first pregnancy compared with levels in subsequent pregnancies. As a result, first-born children have a higher DHA status than that of following children. It appears that the mother's DHA source is not easily replenished in time for subsequent pregnancies and if the mother breastfeeds, this replenishment is likely to take longer.

Observations of high birth weights and long gestations in the seafood eating community of the Faeroe Islands suggest that increasing seafood consumption can increase birth weight by prolonging gestation or by increasing the foetal growth rate. Research in Denmark also shows that low consumption of seafood (less than 15 grams of finfish or 0.15 grams of omega-3 fatty acids per day) in early pregnancy could increase the risk for pre-term delivery and low birth weight. The DHA status in premature infants has been positively related to head circumference, birth weight and birth length. Increasing the foetal DHA status could promote foetal growth, thereby improving the survival chances of premature infants.

Fats from seafood have an important role in development of nerve cells in infants. DHA is found in breast milk and the levels in breast milk can be predicted by how much seafood the mother eats. It is therefore advisable for pregnant or breast-feeding women to increase their seafood consumption. In one study, breast-feeding mothers achieved an average DHA level in breast milk of 0.46% by consuming 0.4 grams per day of DHA (equivalent to 97 grams of Atlantic salmon). A level of 1.13% was achieved by consuming 1.3 grams per day. A number of studies indicate that breast-fed infants have enhanced neural (brain) development compared with formula-fed infants. DHA is thought to contribute to enhanced neural development since breast milk contains this oil but, until recently, artificial formulae did not. In one study, the DHA content of red blood cell membranes in infants who were breast-fed or had their formula supplemented with fish oil remained the same as the levels at birth. However, infants who only consumed un-supplemented formula showed significant decreases in DHA levels.

Seafood and older people

Seafood, because it is high in nutrient density, has an important role to play in diets designed to maintain health and well-being as people get older. Studies from three countries with relatively low intakes of finfish indicate that finfish intake is associated with reduced risk of death from coronary heart disease. Of particular note are the benefits of even small levels of finfish intake. Middle-aged men who ate no finfish were at a much higher risk than those who ate finfish once or twice per week. One study showed that older people who regularly ate 24 grams of finfish per day (127 milligrams of omega-3 fats, or 58 grams of snapper) had about half the chance of dying from coronary heart disease as those who ate no finfish.

Seafood and indigenous Australians

Indigenous Australians are at particular risk of developing type II diabetes, having up to six times the rates of Australians of European descent. Research showed that remarkable improvements to diabetes and coronary heart disease risk factors can result from changing the diet. In the research, ten indigenous Australians with diabetes changed from a modern Western diet (high in fat and low in unrefined carbohydrate) to a more traditional diet (low in fat, low in saturated fat and high in dietary fibre). The group lost an average of 8 kg over the seven-week period, and had significant improvements in glucose tolerance and insulin sensitivity. Of the total energy in the traditional diet, 19% was derived from finfish.

Department of Agriculture, Fisheries and Forestry

Questions and answers

Q1: Is it true that seafood, especially shellfish, is high in cholesterol?

A1: In the past, shellfish were excluded from low-cholesterol diets because they were believed to be high in cholesterol. New measuring techniques indicate that cholesterol levels of many shellfish are much lower than was previously thought. In fact molluscs — such as clams, oysters, scallops and mussels — were found to have a large amount of sterols, which have similar chemical structure to cholesterol. These sterols appear to have a beneficial effect because they inhibit the absorption of cholesterol eaten at the same meal.

Cholesterol levels are not significant in most seafood products. Finfish are generally quite low in cholesterol; shellfish have low to moderate amounts. Cholesterol levels in crab and lobster are similar to that found in the dark meat of chicken. Because shellfish contain very little saturated fat, they are no longer excluded from typical low-cholesterol diets. Saturated fats may increase the ability of dietary cholesterol to increase blood cholesterol.

People with normal blood cholesterol (<5.0 mmol/L) can eat seafood daily if they wish. For people with higher cholesterol levels, seafood can be consumed a few times per week if saturated fat intakes are low.

Q2: Which one is more nutritious — fresh or sea water finfish?

A2: When the essential fat content matters, there is little nutritional difference between fresh water finfish and sea water finfish if they both live in cold, southerly waters. However, given the differences between sea water and fresh water, sea water finfish have richer amounts of iodine, magnesium and sodium, which have multiple functions in the body.

Q3: Which one has more omega-3 fatty acids — tropical or temperate finfish?

A3: Omega-3 fats keep the blood flowing properly in humans, in the same way as they do in finfish when the fish swims in colder water. Therefore, finfish caught from southern locations or in spring season tend to have high omega-3 fatty acids. Tropical fish do not have much omega-3 fats in their fatty tissue, but they are still good sources of omega-3 fatty acids from their muscle tissue.

Q4: Which one is better — farmed or wild caught finfish?

A4: Generally farmed finfish (such as trout and salmon) have more total dietary fat and the amount of omega-3 fat depends on the species and the oils used in fish feeds. For finfish caught in the wild, omega-3 fat levels vary according to species, the time of year, age and size. The best advice is to consume a wide variety of finfish and other seafood — both farmed and wild caught.

Q5: How much seafood do we need to eat to get enough omega-3 fats?

A5: Currently Australia does not have recommendations for omega-3 fat intake. A report from the UK Department of Health recommends that the intake of marine omega-3 fatty acids should be at least 210 milligrams per day. Just 60 grams of canned or smoked fish should achieve this amount.

Q6: Can we get enough dietary omega-3 fats from plant food alone?

A6: Certain plant foods — such as nuts, some vegetables and soy — contain omega-3 fats. But these fats are different from those provided by seafood. Omega-3 fats from plants can be converted, to a limited extent, in the body to EPA and DHA — the type of omega-3 fats present in seafood. Therefore, we need to eat a very large amount of plant food to get health benefits similar to those we get from seafood.

Q7: Which one is better — finfish or fish oil supplements?

A7: Taking fish oil supplement may be much more convenient than eating finfish, but some health effects of finfish are not seen with fish oil. Generally speaking, fish contains more of the 'long-chain' fatty acid DHA. An excessive amount of omega-3 fats from fish oil may be harmful unless given under medical supervision. It can increase bleeding tendency or increase both 'good' and 'bad' cholesterol.

Q8: Is cod liver oil the same as fish oils? Can we get omega-3 fats from cod liver oil instead of fish oils?

A8: No, cod liver oil and fish oils are not the same. Cod liver oil is extracted from cod liver and is an excellent source of vitamins A and D. Fish oils are extracted from the flesh of fatty fish like salmon and herring, and are good sources of EPA and DHA. Fish oils contain very little vitamin A and D, but cod liver oil does contain EPA and DHA. However, if we try to obtain daily recommended intakes of EPA and DHA from cod liver oil, we would probably exceed the recommended daily intake of vitamins A and D.

Q9: Which method is best to cook seafood?

A9: Grilling, steaming, microwaving and baking are the best ways to cook seafood and maintain its health benefits. But if seafood is to be pan fried or deep fried, the cooking oil that is high in mono-unsaturated fats — such as olive or canola oil — is preferred because the oil is incorporated into the food. See pages 12–13.

Q10: How do omega-3 fatty acids protect against heart disease?

A10: Research suggests that omega-3 fatty acids from seafood protect against heart disease in a number of different ways:

- They inhibit the formation of blood clots (thrombi). This is important because most heart attacks result when blood clots get stuck in blood vessels leading to the heart or brain.
- They may prevent heartbeat abnormalities, thereby protecting against sudden cardiac arrest, a major cause of death from heart disease.
- They reduce triglycerides, a type of fat in the blood which, when raised, increases the risk of heart attacks.
- They can reduce blood pressure as a risk factor for heart disease.
- They may retard the growth of plaques that narrow arteries leading to the heart.

Q11: Should pregnant women eat seafood?

A11: For pregnant women, there are many benefits associated with eating seafood. Apart from the benefits supplied to the mother, many components in seafood are important for development of the foetus — such as protein and its amino acids, omega-3 fats, iodine and calcium.

However, as discussed on page 14, all seafood contains mercury, which could have harmful effects if the intake is high. The amount of mercury in most seafood is very low, and since most people eat only moderate amounts of seafood the benefits of eating seafood far outweigh the risk posed by the small amounts of mercury. Regulations are also in place that set a limit on the amount of mercury that can be present in fish that is sold.

The amount of mercury in a fish depends on how long it lives and what it eats — so the big, long-living or predatory finfish tend to accumulate more mercury. Food Standards Australia New Zealand (FSANZ) has therefore recommended the number of serves of seafood that can be eaten safely, taking this factor into account — see table 4.

Q12: Should people with high blood pressure avoid eating seafood?

A12: Although seafood may have a high salt content — and this can be a problem for people with high blood pressure — it is mainly related to the salt water when fish is packed in brine, which can be washed off.

Too much salt in the diet has been linked to high blood pressure. The extent to which sodium restriction lowers blood pressure is generally agreed to depend on age, initial blood pressure and degree of over-weight — it is greater with age, in people who are more overweight, and at higher blood pressures. Also, the beneficial effects of sodium restriction may not be seen for several weeks. Sodium restriction may not lower blood pressure further if blood pressure is within the normal range. The exact mechanism is unclear, but it is thought that the excess salt increases the blood volume, and also the contraction (and resistance to blood flow) of blood vessels.

Q13: What is seafood allergy?

A13: Seafood — particularly crustaceans, scaly finfish and molluscs — can be a cause of food allergy. Seafood allergens in sensitised individuals can cause adverse reactions to recur over a lifetime. Many reactions are mild and limited to localised hives or swelling. The most dangerous symptoms are breathing difficulties or hypotension (drop in blood pressure), either of which can be life-threatening. Anaphylaxis and death have been described in association with seafood allergy. Other symptoms include swelling of the face or throat, dizziness, difficulty in thinking, an intense sense of fear, tightness in the chest, vomiting or diarrhoea.

TABLE 4: FSANZ RECOMMENDATIONS FOR THE NUMBER OF SERVES OF SEAFOOD THAT CAN BE EATEN SAFELY

<table>
<tr><th>Pregnant women and women planning pregnancy</th><th>Children up to 6 years</th><th>Rest of the population</th></tr>
<tr><td>1 adult serve = 150 grams (equivalent to approximately 2 frozen crumbed fish portions)</td><td>1 serve for this age group = 75 grams (equivalent to approximately 3 fish fingers*)</td><td>1 serve = 150 grams (equivalent to approximately 2 frozen crumbed fish portions)</td></tr>
<tr><td colspan="2">2–3 serves per week of any fish and seafood not listed in the column below</td><td>2–3 serves per week of any fish and seafood not listed in the column below</td></tr>
<tr><td colspan="2">OR</td><td>OR</td></tr>
<tr><td colspan="2">1 serve per week of orange roughy or catfish — and no other fish that week</td><td rowspan="3">1 serve per week of shark (flake) or billfish (that is, swordfish and marlin) — and no other fish that week</td></tr>
<tr><td colspan="2">OR</td></tr>
<tr><td colspan="2">1 serve per fortnight of shark (flake) or billfish (that is, swordfish and marlin) — and no other fish that fortnight</td></tr>
</table>

Notes

The FSANZ recommendations are based on knowledge of the Australian population and Australian diets and consumption, and may therefore differ from advice in other countries.

Some of the fish names in the above table have been amended from those in the FSANZ brochure in keeping with recommendations of the Australian Fish Names Committee. Comprehensive information on fish names is available from www.seafoodservices.com.au/fishnames/

* Blue grenadier (= hoki in New Zealand) or hake are the main species in fish fingers consumed locally.

More information is available from FSANZ on 02 6271 2222, e-mail information@foodstandards.gov.au, or from www.foodstandards.gov.au — including a useful brochure, 'Advice on fish consumption: mercury in fish', at www.foodstandards.gov.au/_srcfiles/mercury_in_fish_brochure_lowres.pdf

There are only a few studies which examine the actual allergens or substances involved in triggering reactions. Muscle proteins such as parvalbumin (in scaly fish) and tropomyosin (in crustaceans) appear to be important allergens. Seafood allergy usually involves only one group of foods — finfish, shellfish or crustaceans. People allergic to seafood from one group can usually tolerate those from another. In other words, allergy to one scaly fish often results in allergy to other scaly fish, but not necessarily to crustaceans. For those who are allergic to one or two proteins that may be present in multiple species, there is a risk of "cross-reactive" allergic responses to other animals as well.

Occasionally, intense cooking will partially or completely destroy the triggering allergen. This may explain why some people who are allergic to fresh fish are able to tolerate tinned salmon or tuna.

For seafood allergies, there is no effective prevention other than complete avoidance. Food labels need to be read carefully because highly processed foods may contain hidden fish or shellfish.

Q14: What is ciguatera fish poisoning?

A14: Ciguatera fish poisoning is probably more important than any other form of seafood poisoning. Its epidemiology is complex and it is impossible to predict outbreaks. Higher ocean temperatures may increase the incidence of ciguatera poisoning. This illness results from eating large reef fish that look, taste and smell normal but are affected with ciguatoxins. The toxin is derived from algae colonising coral beds. It first affects the coral-grazing fish and is then passed up through the food chain to the fish-eating fish (i.e., snapper, grouper, amberjack, barracuda) and finally to humans. The toxin is not destroyed by either cooking or freezing. If consumed in sufficient dose, it can cause diarrhoea, vomiting and abdominal pain, then abnormal sensation (such as burning, prickling and formication) and other neurological effects which may persist for weeks, months or years. Unfortunately, there is no way to identify whether the fish is contaminated. Therefore, always know what kind of fish you are eating and, during the hot season, avoid large predatory reef fish such as mackerel.


BREAM FILLETS
$14.99 kg
ATLANTIC SALMON FILLETS
ICE FISH FILLETS
$9.99 kg
WHITING FILLETS
Red Snapper Fillets
$ 19.99 kg
SALES

Section 3 Guidelines for communication about seafood nutrition

This section summarises what can and cannot be said about the health benefits of seafood. If you are involved in marketing seafood, you should read this section carefully.

The two main influences on what seafood marketers can say about their product are:

- what the law specifies they can say; and
- within those constraints, what is in the interests of 'good practice' for their customers, themselves and the seafood industry.

This section of the book provides information under these two headings. The information was updated in mid-2004. It is important for seafood marketers to keep up with developments: they should contact Food Standards Australia New Zealand through its website (www.foodstandards.gov.au) or telephone (02 6271 2222) for the latest information.

Legal restraints on what you can say

The primary source of information on food regulation in Australia and New Zealand is the Australia New Zealand Food Standards Code, which was developed by Food Standards Australia New Zealand (FSANZ), an independent, bi-national statutory authority. It is given legal force via Australian federal, state and territory food legislation and New Zealand food legislation.

The Code came into force in 2002 to harmonise food standards between Australia and New Zealand. It was intended to be less prescriptive than the *Trade Practices Act 1974*, thus allowing greater innovation, but at the same time to require more consumer information on labels. The Code is also the primary source of reference on what can and cannot be said when promoting the health and nutrition benefits of seafood.

The *Food Standards Australia New Zealand Act 1991* (Commonwealth of Australia) lists three objectives of FSANZ in developing or reviewing food regulatory measures and variations of food regulatory measures:

- protection of public health and safety,
- provision of adequate information relating to food to enable consumers to make informed choices, and
- prevention of misleading or deceptive conduct.

This last objective is also the cornerstone of the Trade Practices Act, administered by the Australian Competition and Consumer Commission (ACCC). As this Act has a much wider charter than food, FSANZ generally defers to the Trade Practices Act. For example, the terms 'Product of Australia' or 'Made in Australia' are defined by the Trade Practices Act.

The Food Standards Code, which is continually being amended, is available from www.foodstandards.gov.au/foodstandardscode/

HEALTH CLAIMS

Health claims are the claims on food labels or advertising material that refer to the potential for a food or component of a food to assist in reducing the risk of, or improving, a serious disease or condition. Health claims are currently prohibited in Australia and New Zealand.[3]

Standard 1.1A.2 of the Code includes the requirement that any label on a package containing food, or any advertisement for food, is not to:

- contain a claim or statement that the food is a slimming food or has intrinsic weight-reducing properties;
- include a claim for therapeutic or prophylactic action or a claim described by words of similar import;
- include the word 'health' or any word or words of similar import as a part of or in conjunction with the name of the food;
- contain any word, statement, claim, express or implied, or design that directly or by implication could be interpreted as advice of a medical nature from any person; or
- contain the name of, or a reference to, any disease or physiological condition.

The Standard does not prevent information on the omega-3 content of seafood being made available to the public, or pamphlets containing information on the factual health benefits of omega-3 fats in the diet.

The consumer may make the connection between the health benefit of omega-3 and consuming seafood, but the proprietor cannot make that connection for them.

Recently, the Australia and New Zealand Food Regulation Ministerial Council agreed to a new framework for nutrition, health and related claims. The framework will guide FSANZ in developing a new Standard for inclusion in the Code. The claims classification framework sets out criteria for two levels of claims:

- general-level claims, which do not make reference to a serious disease and will not be subject to pre-market approval by FSANZ; and
- high-level claims, which make reference to a serious disease and which will be pre-approved by FSANZ, with approved claims being listed in the Standard.

NUTRITION CLAIMS

Standard 1.2.8, Nutrition Information Requirements, covers:

- nutrition information that must be provided on food labels, and
- the specific conditions for making certain nutrition claims.

Standard 1.2.8 requires most packaged foods to display a nutrition information panel. Exemptions include unpackaged food, food that is packaged in the presence of the purchaser and foods such as fish that comprise a single ingredient or category of ingredients.

Thus, seafood that is purchased at the deli and subsequently packaged does not need a nutrition information panel. Packaged salmon fillets do not need a nutrition information panel if there are no added ingredients, but packaged smoked salmon and packaged crumbed finfish will need one because they do not comprise a single ingredient.

A nutrition information panel must provide information on energy, protein, fat, carbohydrate sugars and sodium in the format prescribed by the Standard. For detailed requirements, refer to Standard 1.2.8.

Once a 'nutrition claim' is made, the exemptions do not apply. A nutrition claim relates to the function, presence or absence of a nutrient in a food. A statement that 'Atlantic salmon is a good source of omega-3 fatty acids' is considered a nutrition claim. A claim that 'canned sardines are a good source of calcium' or a label declaring 'reduced salt' canned tuna are also nutrition claims.

Some nutrition claims are specifically regulated in Standard 1.2.8. Other claims — for example, 'low fat' — are prescribed in the industry-developed Code of Practice on Nutrient Claims in Food Labels and in Advertisements. Although this Code of Practice is not itself legally enforceable, any false or misleading claims could be subject to action under the Trade Practices Act. Nutrition claims are currently being reviewed during development of the new standard on nutrition, health and related claims.

Standard 1.2.8 and the Code of Practice should be reviewed for details of the nutrition claims that are possible.

3 With one exception that allows for claims linking the consumption of folate with reduced risk of neural tube defects in babies.

OMEGA-3 CLAIMS

Fish or fish products with no added saturated fat

To make an omega-3 fatty acid claim for fish or fish products with no added saturated fat, such as fresh finfish fillets, the food must contain no less than:

- 200 milligrams of alpha-linolenic acid (ALA) per serving, or
- 30 milligrams of total eicosapentaenoic (EPA) and docosahexaenoic (DHA) acid per serving.

To make a 'good source' of omega-3 fatty acids claim for fish or fish products with no added saturated fat, such as fresh finfish fillets, the food must contain no less than 60 milligrams total EPA and DHA per serving. Some consequences of this requirement are as follows:

- Atlantic salmon, for example, has a total EPA and DHA level of more than 500 milligrams per 100 grams and less than 1% of saturated fat. Even one-eighth of a normal serve would therefore contain more than the 60 milligrams or more of EPA and DHA necessary to justify a 'good source' claim.
- If an omega-3 fatty acid claim is made on a packaged product, the label must include a nutrition information panel and the panel must state the source of omega-3 fatty acids, namely alpha-linolenic acid, docosahexaenoic and/or eicosapentaenoic acids.
- If the product is sold unpackaged or is packaged in the presence of the purchaser at the deli counter, with a notice or tag making an omega-3 fatty acid claim, the nutrition information panel must be displayed on — or in connection with — the food or be provided to the purchaser on request. Leaflets containing the information would satisfy this requirement.

Fish or fish products with added saturated fat or other components

To make an omega-3 fatty acid claim for fish or fish products with added saturated fat or other components, the food must contain:

- less than 28% of the total fatty acids as saturated and trans fatty acids; or
- 5 grams or less of saturated and trans fatty acids per 100 grams of food; and
- no less than 200 milligrams of alpha-linolenic acid (ALA) per serving; or
- no less than 30 milligrams of total eicosapentaenoic (EPA) and docosahexaenoic (DHA) acid per serving.

(Sources of information on fatty acid content are *Seafood the good food*, the *Australian Seafood Users Manual* and the *Australian Seafood Handbook* (two separate editions, for domestic and imported species respectively — see page 9). Most seafood has a low total fat content, and generally the EPA and DHA levels far exceed 30 milligrams per serve.)

To make a 'good source' claim for fish or fish products with added saturated fat or other components, the product must contain:

- less than 28% of the total fatty acids as saturated and trans fatty acids; or
- 5 grams or less of saturated and trans fatty acids per 100 grams of food; and
- no less than 60 milligrams total EPA-plus-DHA per serving.

If an 'omega-3' claim is made for fish or fish products with added saturated fat or other components, a nutrition information panel is required on the label, which must indicate the type of omega-3 fatty acid — e.g., ALA, DHA and/or EPA. If the product is not required to bear a label, the nutrition information panel must be displayed on — or in connection with — the food or provided to the purchaser on request.

Omega-3 fatty acid claims must comply strictly with the Food Standards Code.

'Good practice' communication

The seafood industry generally enjoys a good reputation as a reliable source of information about the products it sells. Professionals involved in seafood promotions know they must maintain credibility with the general public and the scientific community. They know only too well that inaccurate claims about food may generate short-term sales, public interest and attention — but in the longer term the distrust generated in the community will take a great deal of time and money to win back. For an industry that is highly focused on its 'clean and green' image and invests heavily in food safety and other quality initiatives, following good practice about nutritional claims is extremely important.

Seafood marketers can enhance credibility, consumer welfare and the reputation of the seafood industry by:

- studying nutritional information very carefully so that they understand it thoroughly;
- not distorting it when passing it on to consumers;
- presenting information in a clear and easily understood way;
- linking nutritional messages to current consumer preferences;
- avoiding alarmist overtones;
- ensuring that staff are well trained to provide information appropriate to their individual roles, and that they refer more complex inquiries to the right person; and
- using the recommended marketing names for seafood in accordance with the *Australian Seafood Handbook*.

The Food Standards Code's constraints on information about the potential health benefits in labelling and direct advertising apply to all types of food, and represent the Australian community's expectations in this area. At the same time, there is an increasing demand for factual nutrition information in the community. By basing information about seafood nutrition on this book and on other reputable sources, seafood marketers will be meeting some of that demand in a responsible way, to the benefit of consumers and the seafood industry.

Further information

For further information on the Food Standards Code, contact:

- the Food Standards Code advice line — 1300 652 166
- e-mail: advice@foodstandards.gov.au

Glossary

Australia New Zealand Food Standards Code	A code that regulates the advertising and promotion of food. Only specific sections relate to seafood.
crustaceans	See *seafood*.
DHA	Docosahexaenoic acid, an omega-3 oil found in seafood.
EPA	Eicosapentaenoic acid, an omega-3 oil found in seafood and in very low concentrations in plants.
essential fatty acids (EFAs)	Fats that play a crucial role in growth and reproduction. As with vitamins, the body cannot synthesise essential fatty acids: they must be ingested. Omega-3 and omega-6 are essential fatty acids. The term "oil" is often used as an alternative to "fat" in this context.
fatty acid	See *essential fatty acids*.
finfish	See *seafood*.
fish	See *seafood*.
fish oils	Fish oils are omega-3 oils that are found in seafood, especially finfish. They can be consumed as concentrated oil capsules or by eating finfish.
Food Standards Australia New Zealand	The bi-national, independent statutory authority that develops food standards for composition, labelling and contaminants, including microbiological limits, that apply to all foods produced or imported for sale in Australia and New Zealand.
Food Standards Code	See *Australia New Zealand Food Standards Code*.
FSANZ	See *Food Standards Australia New Zealand*.
g	grams.
HDLs	High-density lipoproteins: blood particles consisting of thousands of cholesterol molecules and other lipids bound to a protein. HDLs reduce deposition of cholesterol in arterial plaques. Often referred to as 'good' cholesterol.
kg	kilogram or kilograms.
LDLs	Low density lipoproteins, blood particles consisting of thousands of cholesterol molecules and other lipids bound to a protein. LDLs are the most harmful in coronary heart disease.

mg milligram or milligrams.

milligram One thousandth of a gram.

molluscs See *seafood*.

omega-3 fats Poly-unsaturated fats found in seafood and in minor amounts in plants.

omega-6 fats Poly-unsaturated fats found in plants and seafood. Consumption of linoleic acid (an omega-6 oil) should be about 3 to 5% of total dietary fat.

seafood (and related terms) The following related terms have been used in this book:

- *Seafood*: In this book, this term describes, collectively, finfish and other aquatic animals such as crustaceans and molluscs.
- *Finfish*: Aquatic vertebrates having gills, fins and typically an elongated body usually covered with scales. Note: in this book, this more specific term has been used where appropriate to avoid the confusion that could result from the word "fish", which is often taken to include other aquatic animals such as crustaceans or molluscs. (Reference to "fish" has been retained when quoting legislation or research findings; in very general contexts; and in the table on page 31, which is based on material from Food Standards Australia New Zealand.)
- *Crustaceans*: A large family of arthropod animals, characterised by a hard, close-fitting shell that is shed periodically. Includes prawns, crabs, lobsters, shrimps, bugs and freshwater crayfish.
- *Molluscs*: Invertebrates characterised by a calcareous shell (sometimes lacking) of one, two or more pieces that wholly or partly encloses the soft unsegmented body — for example, abalone.
- *Shellfish*: Species of crustaceans and molluscs.

Section 3 — Guidelines for Communication about Seafood Nutrition — includes excerpts from the Australia New Zealand Food Standards Code. In that code "fish" means any of the cold-blooded aquatic vertebrates and aquatic invertebrates, including shellfish, but does not include amphibians and reptiles.

Trade Practices Act 1974 Australian Commonwealth legislation governing all retail sales to protect the public against false or misleading claims, including about food.

Select bibliography

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