22. Fish as health food

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As far as India is concerned, the successful outcome of green revolution has answered the challenges of food security due to rapid growth in population. But considering the fact that 35% of Indian population falls still below the poverty line emphasizes the need to recognize fisheries as an important sector of the National economy for meeting the food and nutritional security. In the days ahead, "blue revolution" will be the buzzword to meet the challenges of food and nutritional security.

Fish and fishery products form an important food component for a large section of world population. They represent 15.6% of animal protein supply and 5.6% of total protein supply on a worldwide basis. Fish is the primary source of animal protein for over one billion people of developing countries. It is estimated that 60% of people in developing countries obtain 40-100% of the animal protein in their diets from fish [Lowe *et al*., 1998). Protein.lipids and bioactive compounds from seafood's have unique features that differ from those of land animals. The uniqueness of fish protein is due to its excellent nutritive value, high digestibility and presence of all essential amino acids. In general, fish flesh contains 60-84% water, 15-24% protein, 0.1-22% fat and 1-2% minerals. Seafood serves as a rich source of polyunsaturated fatty acids [PUFAs], especially omega-3 PUFAs, minerals and vitamins [Fierens and Corthout *et al*., 2007].

Fish is a health food, with relatively lesser taboos connected to it, unlike meat. World over fish is considered as a delicious item and in nutritional point of view, it is the balanced diet one can easily think of, when consumed along with cereals. A health food should contain all the principal constituents like carbohydrates, proteins, lipids, minerals, vitamins etc. in the right proportion. Detailed biochemical composition of all important Indian food fishes including proximate composition, fatty acid composition of body and liver oils, content of all important minerals, amino acid composition of muscle proteins etc from fresh water, brackish water and marine and deep sea waters have been compiled and reported by the Central Institute of Fisheries Technology (Gopakumar *et al* ., 1997). People are now more health conscious. Diets low in fat and cholesterol with high vitamin and mineral contents are often preferred, especially in the affluent west. For a healthy lifestyle, fish is a good starting point. Importance of fish as a source of high quality, balanced and easily digestible protein is now well understood. For the affluent it is the best health food with curative properties whereas for the less privileged section in developing nations it is the only source of high-quality protein available at affordable cost and in sufficient quantity.

Fish plays a major role in human nutrition. Fish and shellfish form an important part of the human diet, both of the poor and of the wealthy. Good quality fish is an extremely safe food. Meat products are viewed as unsafe after the incidences of diseases like mad cow disease. Fish

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is a versatile, tasty and easy to prepare food. Consumers are increasingly demanding for natural food stuffs, which contain no chemical residues and are not genetically manipulated. Fish is organic and is considered as wild, and for the same reason safer, though of late farmed fish has posed minor problems of harmful residues. For thousands of years, fish has been an important part of the human diet. The ancient Assyrians, Romans and Chinese were famous for their fish farming. During the past decades per capita consumption of fish has gone up globally. Fish is the diet of the poor fishermen, which meets most of their nutritional requirements.

Researchers all over the world have repeatedly emphasized the beneficial effect of eating fish, after conducting systematic research for many years. In recent years, the link between fish oil and heart disease has been the subject of thousands of scientific papers. The whole story began following the discovery that coronary heart disease, while being one of the biggest killers in the world, is practically unknown among the Eskimos. The investigations found that their diet is mostly fish based and is rich in long chain n –3 poly unsaturated fatty acids (Lee and Lip 2003; Von Sehachy and Dyerberg,2001). Eskimos also have a reduced tendency to blood clotting and longer bleeding times compared to other people (Krishnan, *et al.*. 2001). Medical researchers carried out detailed investigations and showed that men who ate fish once or twice per week were protected against coronary heart disease (Ite *et al.* 2004: Eokkila *et al.* 2004). An increase in fish oils in the diet results in a marked reduction in blood cholesterol and triglyceride levels and also thrombosis problem (Bjerregaard *et al.*, 2004).

Lipid content in fish varies between species as also within the species depending on many factors. Fish with fat content as low as 0.5% and as high as 18-20% are common (Table 1). Squalene and wax esters are other components found in unusually high concentrations in certain fish. The fatty acid composition of marine lipids is much more complex than others. Lipids of fish and other aquatic animals contain high proportion of highly unsaturated long chain fatty acids. Fatty acids with carbon chain varying from 10 to 22 and unsaturation varying from 0–6 double bonds are common. Among the saturated acids palmitic and stearic acids are the important ones and in the monounsaturated group, palmitoleic and oleic acids are the major constituents. Among the polyunsaturated acids arachidonic acid, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are the major components. In Central Institute of Fisheries Technology, marine, fresh water and brackish water fishes were screened for evaluating their fatty acid composition and in the flesh (Table 4 a-d). Fish and shellfish from tropical waters were analysed for their cholesterol content, showing higher levels in shellfish compared to fish (Mathew *et al*., 1998).

Fish oils have no effect on the levels of low-density lipoprotein cholesterol (LDL); but they do raise high-density lipoprotein (HDL) by about 10%. HDL is a protective type of lipoprotein since it takes excess cholesterol away from the tissue and returns it to the liver. Diseased heart muscle is susceptible to bouts of irregular electrical activity (arrhythmias), which are potentially lethal and often cause sudden cardiac arrests. There is evidence from animal studies that increasing fish oil in the diet helps to reduce cardiac arrhythmias (Sellmayer *et al.*. 2004; Covington 2004). Fish oils improve the functionality of cell membranes, which helps in proper signal transmission. Fish oil inhibits platelet aggregation, which also reduces the risk of heart

disease (Vanschoonbeek *et al.*. 2004). Raised blood pressure is known to be a major risk factor in coronary heart disease. Most studies on the effects of fish oil given as dietary supplements have shown modest reductions in blood pressure, especially in hypertensed people (Aguilera *et al.* 2004; Wilbuurn *et al.*. 2004; Maano *et al.*. 1995).

As stated earlier, fish oils are rich sources of the essential fatty acids eicosapentaenoic acid (EPA,C20:5 n-3) and docosahexaenoic acid (DHA, C22:6 n-3). Both EPA and DHA fall into a larger category of polyunsaturated fatty acids (PUFAs). Approximately 50% of the fatty acids in lean fish and 25% in fattier fish are polyunsaturated fatty acids. In contrast, the polyunsaturated and saturated fatty acids in beef are 4 – 10 % and 40 – 45 % respectively. EPA and DHA reduce vasoconstriction by competing with arachidonic acid for the enzyme cyclo-oxygenase (Sametz *et al.* 2000). EPA, the main n-3 acid is converted by platelet cyclo-oxygenase to thromboxane A3, which is only a very weak vasoconstrictor, unlike thromboxane A2, which is formed by the action of cyclooxygenase on arachidonic acid, the n-6 acid and is a strong vasoconstrictor (Tapiero *et al.* 2002; Akiba *et al.* 2000). The American Heart Association recommends including fatty fish at least twice a week in the diet (Kris-Etherton *et al.* 2002; Krauss *et al.* 2000). Institute of Human Nutrition in New York also recommends eating plenty of fish. Italian study involving 985 people who survived heart attacks, also proved the beneficial effect of fish oil (Tavani *et al.* 2001). The new slogan in the west is that a tuna sandwich a day keeps heart problems at bay (Mozaffarian *et al.* 2004; O'Neill 2002). It is also stated that if a person wants to reduce the risk of heart attack by more than 20% he has to eat a tuna sandwich just once a month. No wonder they say, "Seafood is heartfood".

Recently the inhibitory role of n-3 PUFAs in the development and progression of a range of human cancers have been established by researchers, world over. Studies have found that the anti-tumor effect of EPA is mainly related to its suppression of cell proliferation (Pham and Ziboh 2002; Yuri *et al.* 2003). The effect of DHA appears to be related to its ability to induce apoptosis or cell death (Baumgartner *et al.* 2004; Chiu *et al.* 2004). The dietary n-3/n-6 fatty acid ratio, rather than the quantity administered, appears to be the principal factor in the anti-tumor effect of n-3 PUFAs.

Apart from heart disease and cancer, fish oil is proved to be effective for preventing wide variety of diseases. In several observational studies, low concentrations of n-3 PUFAs were predictive of impulsive behaviours and severe mental depression (Ruxton 2004; Freeman *et al.* 2004). The importance of PUFAs in the maintenance of insulin in the blood has also been proved in experiments (Holness *et al.* 2004). Clinical and biochemical studies have shown that fish oil, and to a lesser extent fish can be used as a source of n-3 fattyacids in the treatment of rheumatoid arthritis (Ruxton 2004; Remans *et al.* 2004). Supplementations with fish oils can markedly reduce inter leukin – 1 beta production and results in a significant reduction in morning stiffness and the number of painful joints in arthritis patients. Studies have shown fish oil to be effective in the treatment of acute respiratory distress syndrome (Pacht *et al.* 2003), psoriasis (Mayser *et al.* 2002), and multiple sclerosis (Nordvik *et al.* 200) also. Older people who eat fish at least once a week may reduce their risk of Alzheimer's disease by more than half (Yazawa 2004; Morris *et al.* 2002). Other diseases which are reduced due to the

consumption of PUFAs include primary Raynaud's disease (DiGiacomo 1989; Swanson 1986), gastric ulcer (Olafsson *et al.* 2000; Manjari and Das 2000) and Crohn's disease (Geerling *et al.* 2000).

Along with fish oils, proteins in fish are also having positive role in reducing blood cholesterol (Ait Yahia *et al.*, 2004). Recent studies have shown that fish proteins have a clear protective effect in diabetic renal diseases (Mollsten *et al.*, 2001). Fish proteins are having high biological value, as they contain all essential amino acids in the right proportion. Plant proteins, although rich in certain essential amino acids do not always offer all essential amino acids in a single given food. Legumes lack methionine, while grains lack lysine. Fish protein is also an excellent source of lysine as well as the sulphur-containing amino acids, methionine and cysteine. Amino acid scores of fish protein compare well with the FAO reference pattern. In the studies conducted in the Central Institute of Fisheries Technology, Kochi, it was seen that the amino acid composition of the protein is crucial in determining its hypocholesterolemic properties. The alanine/proline ratio in a protein was found to be the significant factor determining its hypocholesterolemic properties (Ammu,K., *et al.*,1994).

Protein content of fish muscle ranges between 16 and 20% depending on the species of the animal, the nutritional condition, and the type of muscle. The crude protein calculated on the basis of the total nitrogen content represents proteins and other nitrogenous compounds, such as nucleic acids, nucleotides, trimethylamine (TMA) and trimethylamine oxide (TMAO), free amino acids, urea, etc**.** Protein from fish is easily digested, with most species showing a protein digestibility greater than 90%. The chemical score or amino acid score compares a food's amino acid pattern to that of whole egg protein. The chemical score of finfish is 70, an indication of its high quality, beef is 69 and cow's milk is 60. The protein efficiency ratio (PER) another measure of protein quality of fish is around 3.5, which is much higher than beef (2.30) and milk proteins (2.5) and close to that of egg (3.92). Fish is a good dietary source of taurine, a non-protein amino acid with multiple functions like neurotransmission in the brain, stabilization of cell membranes and in the transport of ions such as sodium, potassium, calcium and magnesium (Franconi *et al.,* 2004; Birdsall, 1998 ; Del Olmo *et al.*, 2000). Nutritional quality of protein is generally determined by factors like essential amino acid composition, digestibility and biological value. Fish protein is rated high in all the above qualities and is considered as a good dietary protein in all respects (Table1, 2 and 3).

In general, both water soluble and fat-soluble vitamins are present in fish. Fat soluble vitamins A, D, K and E are present in fish in varying amounts-often in higher concentrations than in land animals. The amount of vitamins and minerals is species-specific and can vary with season. The flesh of lean white fish, such as cod, haddock, and pollock, contains from 25 to 50 IU of vitamin A per 100 g, while in the fatty species such as herring, there is from 100 to about 4500 IU of this vitamin in 100 g of meat. The content of vitamin D in sardines and pilchards and in tuna is in the range of 530 to 5400 and 700 to 2000 IU per 100 g, respectively. The contents of vitamin E in the edible parts of fish and marine invertebrates range from about 0.2 to 270 mg/100 g. Fish is a good source of B vitamins. The red meat has higher content of

vitamin B than white meat. Fish liver, eggs, milt and skin are good sources of Thiamine (B_1), riboflavin (B_2), pyridoxine (B_6), folic acid, biotin, and Cyanocobalamine (B_{12}).

Fish also contributes appreciable amounts of dietary calcium, iron and zinc. Fish contains copper and those who relish fish bones get a fair share of calcium and phosphorous. Salt-water fish are rich in iodine. The iodine in marine fish ranges from 300-3000 µg/kg. Fish is a good source of almost all the minerals present in seawater (Nair and Mathew, 2000). The total content of minerals in the raw flesh of fish and aquatic invertebrates is in the range of 0.6 to 1.5% of wet weight. Certain seafoods such as snails and tuna are good source of the macro mineral magnesium. Seafood, especially tuna, is an important source of the essential antioxidant trace element selenium, which provides protection against heavy metal poisonings and a variety of carcinogens. Functioning cooperatively with vitamin E, selenium is also a vital factor in protection of lipids from oxidation as part of the enzyme glutathione peroxidase, which detoxifies products of rancid fat. The carbohydrate content of finfish is insignificant, but certain shellfish store some of their energy reserves as glycogen, which contributes to the characteristic sweet taste of these products.

When we consider the beneficial effects of dietary fish, vegetarianism in dietary habits does not seem to be wise. When one decides to become an obligate vegetarian and cuts out meat/dairy/fish out of diet, he decides to cut out some of the major nutrients body needs on a daily basis for effective functioning. The argument that fish lives in unhygienic habitat and polluted waters is also not valid as pollution is a universal phenomenon, affecting air, land and water Fish is the heart food which gives you both satisfaction and health.

Table 1: Principal constituents of fish and beef muscle (in percentage)

Constituent	Fish fillet			Beef muscle
	Minimum	Normal variation	Maximum	
Protein	6	16-21	28	20
Lipid	0.1	0.2-25	67	3
Carbohydrates		<0.5		1
Ash	0.4	1.2-1.5	10.5	1
Water	28	66-81	96	75

Table 2: Essential amino-acids (percentage) in various proteins

Amino-acid	**Fish**	**Milk**	**Beef**	**Eggs**
Lysine	8.8	8.1	9.3	6.8
Tryptophan	1	1.6	1.1	1.9
Histidine	2	2.6	3.8	2.2

Phenylalanine	3.9	5.3	4.5	5.4
Leucine	8.4	10.2	8.2	8.4
Isoleucine	6	7.2	5.2	7.1
Threonine	4.6	4.4	4.2	5.5
Methionine-cystine	0	4.3	2.9	3.3
Valine	6	7.6	5	8.1

Table 3 – Mineral contents of the muscle of some important speciesv

Table 1 and 2. Source: Lahsen Ababouch, 2000 Fish Utilization and Marketing Service *http://www.oceansatlas.com/world_fisheries_and_aquaculture/html/util/compos/compos/proteins.htm*

Name of fish	Na	K	Ca	Fe	P
Fresh water fish	**(mg /100g)**				
Calbasu (*Labeo calbasu)*	103.2	310.1	318.5	0.9	395.0
Catla (*Catla catla)*	58.0	161.7	495.2	1.0	245.0
Mrigal (*Cirrhinus mrigala)*	69.5	170.5	352.1	1.1	283.2
Murrel *(Channa striatus*)	45.5	270.2	46.8	2.5	139.5
Mussullah Mahser (*Tor mussullah*)	49.4	250.2	97.2	3.8	78.5
Rohu *(Labeo rohita*)	112.2	132.2	86.3	1.4	128.7
Tilapia *(Oreochromis mossambica)*	-	-	585.2	1.5	235.0
Freshwater shark (*Wallago attu*)	130.0	169.3	160.0	0.6	4.9
Brackish water fish					
Grey mullet (*Mugil cephalus*)	136.4	252.8	136.9	4.4	175.0
Milk fish (*Chanos chanos*)	83.5	251.4	9.3	1.3	179.5
Mullet (*Mugil parsia*)	116.2	204.1	31.6	1.3	168.2
Pearl spot (*Etroplus suratensis*)	126.9	296.7	315.3	1.8	251.0
Marine fish					
Mackerel (*Rastrelliger kanagurta*)	100.2	424.5	42.9	4.6	308.0
Oil sardine (*Sardinella longiceps)*	88.1	196.2	68.3	1.2	118.1
Ribbon fish (*Trichiurus savala*)	-	-	214.7	13.9	225.1

Seer fish (*Scomberomorus guttatus*)	100.2	228.6	72.2	1.1	178.2
Shark *(Scoliodon spp.)*	150.3	263.5	70.4	1.3	148.2
Silver belly (*Leognathus splendens)*	-	-	720.1	2.2	735.2
Tuna (*Euthynnus affinis*)	156.8	1290.3	590.0	10.1	349.0
Caranx (*Caranx spp.)*	112.0	180.6	35.0	6.6	158.2
White bait *(Anchoviella spp.)*	-	-	679.0	3.5	475.0
Ray (*Himantura sp.*)	115.2	271.0	63.0	1.2	162.2
Jew fish *(Daysciena albida*)	68.7	146.4	68.3	2.1	78.3
Bombay duck *(Harpodon nehereus*)	-	-	1390.0	19.0	35.0
Shell fish					
Indian White Prawn *(Penaeus indicus*)	209.0	382.0	32.3	5.3	68.0
Freshwater prawn (*Macrobrachium rosenbergiiI*	182.2	298.6	74.0	1.2	79.9
Mussel (*Perna viridis*)	180.1	251.0	64.3	0.9	2.4
Cuttle fish *(Sepia spp)*	146.3	2.6.0	70.1	7.4	88.3
Sand Lobster (*Thenus orientalis*)	726.2	452.0	488.0	8.1	-

Source : Biochemical composition of Indian food fishes. CIFT, 1997

Fatty acid	Silver jewfish (*Johnius argenteus*)	Caranx (*Caranx kalla*)	Sole (*Cynoglossus semi-fasciatus*)	Seer-white meat (*Scomberomorus guttatus*)	Seer-black meat (*Scomberomorus guttatus*)	Tuna white (*Euthynnus affinis*)	Mullet (*Liza corsula*)	Malabar grouper (*Epinephelus spp.*)	Ribbon fish (*Trichiurus sawala*)	Knobby headed flatfish (*Suggrundus tuberculatus*)	Job fish (*Aphareus rutilans*)	Golden anchovy (*Coilia dussumieri*)	Barracuda (*Sphyraena judes*)	Ray (*Rhinobatus djiddensis*)	Bombay duck (*Harpodon nehereus*)	Horse mackerel (*Megalaspis cordyla*)	Manta ray (*Mobula diabolus*)	Bullseye (*Priacanthus sp.*)
Saturated																		
C12:0	1.0	2.0	0.0	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	-	-	0.1	-	0.4	-	2.5
C13:0	0.7	0.6	0.0	0.1	0.0	0.1	0.2	0.9	0.5	1.8	2.3	-	-	0.3	-	-	-	0.9
C14:0	3.2	8.7	9.6	10.4	11.3	2.0	6.9	2.6	4.9	6.4	4.0	4.7	2.2	1.1	2.8	3.1	1.5	7.7
C15:0	1.6	1.1	1.6	1.5	1.0	1.4	1.1	0.0	1.2	2.2	0.3	0.7	-	0.5	0.3	0.6	0.5	0.8
C16:0	20.7	33.8	32.3	26.0	28.0	30.5	28.3	18.0	19.5	22.8	23.7	33.7	22.2	18.6	20.0	26.9	30.2	24.7
C17:0	0.0	1.7	2.8	3.1	2.0	2.1	1.3	1.1	2.0	2.0	1.5	0.8	1.4	1.0	1.1	0.6	0.8	0.4
C18:0	13.6	15.1	14.0	9.3	9.8	16.6	8.5	13.6	12.8	11.9	4.6	7.5	6.8	3.5	6.1	13.6	-	6.5
C19:0	1.7	0.0	0.0	0.0	0.0	0.0	2.9	0.2	0.0	0.6	0.6	1.1	0.7	0.3	-	0.3	0.5	-
Total	42.5	63.0	60.3	50.7	52.1	52.8	49.2	36.4	40.9	47.7	37.0	48.5	33.3	25.5	30.2	45.4	33.4	43.5
Monounsaturated																		
C16:1 n7	12.1	5.7	9.0	11.2	10.7	2.5	10.6	2.0	4.2	2.8	1.9	8.1	-	3.9	6.0	4.5	5.6	8.8
C18:1 n9	12.2	15.5	19.0	15.0	13.6	24.0	8.7	16.6	18.0	15.6	16.3	14.7	12.7	19.5	14.1	12.3	33.5	15.3
C20:1 n9	1.4	0.4	0.0	2.0	1.0	0.9	1.5	9.0	4.6	3.5	0.0	1.0	-	0.7	-	2.2	0.8	0.5
C22:1 n9	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.9	3.0	-	-	1.5	-	1.0	-	-
Others	0.2	1.3	1.3	2.5	2.3	1.9	11.3	1.1	1.6	7.9	1.6							
Total	25.9	22.9	29.3	30.7	27.6	29.3	32.4	28.7	28.4	30.7	22.8	23.8	12.7	25.6	20.0	19.9	39.9	24.6
Polyunsaturated																		
C18:2 n6	2.8	1.4	1.5	2.4	3.6	0.6	0.0	0.6	2.7	3.5	2.9	1.1	-	2.7	1.7	1.0	4.1	-
C18:3 n3	3.3	0.7	0.7	1.5	1.6	0.2	1.6	2.0	1.5	0.7	3.7	-	-	-	0.2	0.7	-	-
C18:4 n3	0.0	1.5	4.7	0.9	0.7	0.7	2.0	1.5	2.2	0.7	0.7	-	-	-	0.6	-	-	-
C20:2 n6	1.3	0.0	0.0	0.4	0.0	0.0	1.0	0.0	0.0	0.0	0.0	-	-	-	1.6	0.4	-	-
C20:4 n6	6.6	0.2	0.0	0.3	0.2	0.9	0.0	1.8	1.0	2.3	1.8	4.3	8.9	6.9	8.1	4.1	6.4	3.7
C20:5 n6	4.0	5.0	1.5	3.5	3.2	10.2	3.0	3.2	5.7	2.9	4.2	6.0	2.7	2.1	11.2	5.1	1.2	4.8
C22:3 n3	1.4	0.0	0.0	0.0	0.0	0.0	0.0	2.6	1.2	0.0	0.0	-	1.3	-	0.2	-	-	-
C22:4 n6	1.9	0.0	0.0	0.0	0.0	1.1	0.3	4.9	1.7	0.9	1.0							
C22:5 n3	2.3	0.9	0.1	0.5	0.1	1.1	1.0	1.6	1.9	0.9	11.0	1.5	-	2.3	-	1.9	2.5	0.7
C22:6 n3	7.6	4.0	2.0	8.2	10.5	3.2	9.5	16.0	12.5	8.7	14.0	14.0	38.8	13.0	23.1	17.2	6.8	18.8
Others	0.6	0.0	0.0	0.4	0.0	0.0	0.0	0.8	0.3	0.3	0.9	0.8	2.4	21.8	3.1	4.3	5.7	3.4
Total	31.8	13.7	10.5	18.1	19.9	18.0	18.4	35.0	30.7	20.9	40.2	26.9	51.6	27.0	46.7	30.4	21.0	27.9

Table 4 b- Fatty Acid Composition (Marine Species Contd..)

Fatty acid	Gizzard shad (*Anodontosoma chacunda*)	Pomfret white (*Stromateus chinensis*)	Madura anchovy (*Thrissocles kammalensis*)	Oil sardine (*Sardinella longiceps*)	One spotted golden snapper (*Lutjanus fulvilamma*)	Progfish (*Batrichthys grunniens*)
Saturated						
C12:0	0.0	0.0	0.0	0.0	-	-
C13:0	0.0	0.0	0.0	0.0	-	-
C14:0	10.0	8.1	8.0	8.1	2.7	2.1
C15:0	0.8	1.0	1.2	0.3	3.6	2.9
C16:0	31.5	20.8	28.8	27.0	18.3	26.2
C17:0	0.8	1.0	0.9	1.0	4.0	4.9
C18:0	17.6	14.1	9.4	3.8	13.3	11.8
C19:0	0.6	1.0	0.6	0.0	0.0	1.7
Others	-	-	-	-	0.1	1.3
Total	61.3	46.0	48.9	40.2	42.0	50.9
Monounsaturated						
C16:1 n7	3.0	1.5	5.3	6.8	6.8	6.7
C17:1 n7	-			-	5.9	3.2
C18:1 n9	7.5	13.5	4.0	15.4	15.3	16.7
C20:1 n9	0.6	4.0	4.0	2.3	0.9	1.0
C22:1 n9	5.5	1.0	1.8	2.9	0.0	0.0
Others	0.6	1.0	1.8	0.8	4.0	0.0
Total	17.2	21.0	16.9	28.2	32.9	27.6
Polyunsaturated						
C18:2 n6	2.6	3.9	3.5	4.3	5.4	2.7

C18:3 n3	0.7	2.5	2.2	0.8	0.0	1.7
C18:4 n3	0.6	4.0	2.0	1.7	2.8	1.1
C20:2 n6	0.7	0.0	0.0	0.0	0.4	0.0
C20:3 n6	-	-	-	-	0.5	0.2
C20:4 n6	4.3	1.0	1.0	2.6	8.1	4.5
C20:5 n3	4.9	8.0	11.8	10.6	1.2	2.4
C22:2 n6	-	-	-	-	0.1	0.3
C22:3 n6	0.7	0.7	0.3	0.0	0.8	1.8
C22:4 n3	0.7	0.9	0.3	1.2	1.2	0.8
C22:5 n3	3.5	1.6	0.3	0.8	1.7	1.7
C22:6 n3	1.9	8.5	12.0	8.8	3.0	4.0
Others	0.9	1.9	0.8	0.8	-	-
Total	21.5	33.0	34.2	31.6	25.2	21.2

Source : Biochemical composition of Indian food fishes. CIFT, 1997

Table 4 c- Fatty Acid Composition (Marine Species Contd..)

Fatty acid	Oil sardine (*Sardinella longiceps*)	Indian scad (*Decapterus russelli*)	Tiger toothed croaker (*Otolithes ruber*)	Shrimp scad (*Alepes djedaba*)	Four finger threadfin (*Eleutheronema tetradactylum*)	Anchovy *Engraulis tri*)	Little tuna (*Euthynnus affinis*)	Needlefish *Hemiramphus huttel*)	Splendid pony fish (*Leiognathus splendens*)	Horse mackerel (*Megalaspis cordyla*)	Great barracuda (*Sphyraena barracuda*)	Hammer head shark (*Zygaena tudes*)	Dorab wolf herring (*Chirocentrus dorab*)	Tongue sole (*Cynoglossus semifasciatus*)	Silver biddy (*Gerres filamentosus*)	Whitefish (*Lactarius lactarius*)	Humpback red snapper (*Lutjanus gibbus*)	Japanese threadfin bream (*Nemipterus japonicus*)	Indian flathead (*Platycephalus indicus*)	Silver whiting (*Sillago sihama*)	Six barred reef cod (*Epinephelus diacanthus*)	Greasy reef cod (*Epinephelus tauvina*)	Emperor bream (*Lethrinus cinereus*)
Saturated																							
C10:0	0.2	0.3	-	-	-	-	-	-	-	0.9	2.8										0.4	0.2	0.4
C12:0	0.1	0.1	0.3	-	0.3	0.1	-	2.5	-	0.5	0.6	0.1	-	2.5	-	0.1	0.2	-	-	-	0.2	0.1	0.2
C14:0	9.1	2.4	3.7	2.8	1.9	4.2	0.6	1.2	3.0	2.0	3.6	0.5	4.3	5.5	3.7	2.6	4.5	3.3	1.2	3.1	2.4	3.0	3.3
C15:0	0.6	0.7	1.1	1.1	0.4	0.9	0.3	0.9	2.1	0.8	0.6	0.2	0.7	-	0.8	0.4	0.5	0.7	1.5	0.6	0.7	0.6	0.8
C16:0	23.5	16.3	26.7	21.4	24.5	25.0	15.4	19.6	25.4	16.7	18.4	19.8	30.3	27.8	22.8	30.4	26.3	21.5	27.2	27.0	17.3	22.6	19.7
C17:0	1.8	2.2	2.0	0.6	0.6	2.1	2.0	-	1.2	2.2	1.6	0.4	2.2	1.4	2.1	1.5	0.5	1.9	4.2	0.4	2.4	2.0	2.2
C18:0	5.6	9.2	10.1	11.9	14.8	9.1	11.5	7.8	9.2	11.5	7.7	9.3	7.6	7.5	8.9	8.8	12.0	8.5	10.4	10.1	7.8	14.2	8.0
C19:0	0.8	-	-	0.3	0.5	1.9	0.5	1.3	0.7	0.9	0.7	-	-	0.5	0.8	0.3	0.6	0.8	0.5	-	0.7	0.9	0.8
C20:0	1.1	0.5	-	-	-	-	0.2	-	-	0.5	0.5	0.1	-	2.0	0.6	0.4	-	0.4	-	2.6	0.6	0.6	0.7
Total	42.9	31.8	43.8	38.1	43.0	43.3	30.4	33.3	41.6	35.9	36.4	30.3	45.0	47.2	39.6	44.3	44.6	37.1	45.1	43.8	32.3	44.1	36.0
Monounsaturated																							
C16:1 n7	11.8	4.6	9.3	3.1	2.9	5.7	1.6	1.5	5.6	3.6	5.4	7.1	7.5	6.5	8.0	6.4	7.6	7.2	3.2	7.3	6.1	4.5	5.2
C18:1 n9	8.1	10.8	19.3	7.7	7.5	10.7	7.0	8.8	10.2	8.3	11.1	23.2	10.8	11.7	14.9	25.7	13.8	16.3	13.8	13.4	13.1	9.8	11.9
C20:1 n9	0.8	1.0	0.2	1.6	1.1	-	0.2	1.9	1.7	0.5	1.0	1.6	0.1	1.2	2.7	0.5	1.8	2.2	0.3	1.1	1.7	1.2	1.5
Total	20.7	16.5	28.8	12.4	11.5	16.4	8.8	12.2	17.5	12.4	17.5	31.9	18.5	19.4	25.6	32.6	23.2	25.7	17.2	21.8	20.9	15.5	18.6
Polyunsaturated																							
C18:2 n6	1.3	1.6	3.0	1.8	0.9	1.1	1.2	1.3	1.7	1.1	1.0	-	1.0	1.2	1.6	0.4	1.8	1.3	1.2	0.6	1.2	0.9	1.1
C18:3 n3	-	0.9	0.9	1.1	-	0.7	0.5	-	0.6	0.9	0.8	0.5	0.4	1.8	1.7	0.4	0.8	0.9	-	0.3	0.8	0.6	0.8
C20:2 n6	0.2	0.5	-	0.5	0.2	-	0.3	-	-	0.4	0.3	0.9	-	0.4	0.8	0.1	0.4	0.7	-	4.5	0.6	0.5	-
C20:4 n6	2.5	3.8	4.0	4.4	7.6	5.7	5.5	3.0	8.1	3.5	3.2	4.1	1.8	4.0	3.7	2.0	3.6	4.6	6.8	3.8	5.5	3.6	4.5
C20:5 n3	11.8	8.1	5.6	5.9	6.8	3.8	7.3	4.1	7.0	0.7	6.6	2.9	5.3	6.0	5.9	3.8	10.8	4.7	3.6	7.5	5.5	4.7	6.8
C22:4 n3	-	2.9	-	-	0.3	-	4.9	0.1	-	3.2	2.0	4.0	-	-	1.7	1.4	-	3.1	-	-	4.4	2.3	3.4
C22:5 n3	-	-	1.4	2.1	2.8	0.7	-	4.7	1.5	-	-	-	0.3	-	-	-	1.1	2.2	1.7	2.4	-	-	-
C22:6 n3	15.5	29.7	8.5	28.5	23.8	25.2	38.1	33.6	15.2	34.0	27.7	20.8	26.4	11.7	14.2	12.9	10.8	15.2	20.1	14.5	24.3	24.6	25.1
Total	31.3	47.5	23.5	44.3	42.4	37.2	57.9	46.8	34.1	43	41.5	33.2	35.0	25.1	29.5	21.0	29.3	32.6	33.4	33.6	42.4	37.1	41.7
Others	5.3	4.2	3.5	5.0	2.8	2.7	2.5	7.3	6.1	8.6	4.0	5.2	1.2	8.7	5.9	2.3	2.5	4.6	3.8	0.6	4.5	3.0	3.7

Source : Biochemical composition of Indian food fishes. CIFT, 1997

Table 4 d - Fatty Acid Composition (Brackish

Fatty acid	Shark (*Scoliodon sorrokowah*)	Whale shark (*Rhiniodon typus*)	Shark (*Carcharinus*	Hammer head shark (*Zygaena tudes*)	Hilsa (*Hilsa toli*)	Reef cod (*Epinephelus sp.*)	Reef cod (*E. diacanthus*)	Dhoma (*Otolithes argenteus*)
Saturated								
C12:0	-	-	-	-	0.1	0.3	0.5	0.4
C14:0	0.5	1.5	0.7	0.1	9.9	2.0	3.1	2.0
C15:0	2.3	-	0.7	0.2	0.3	0.6	0.7	0.6
C16:0	32.3	29.7	28.7	20.1	28.2	25.9	25.3	40.4
C17:0	0.6	0.2	0.6	0.5	0.5	1.3	0.7	0.4
C18:0	17.2	-	-	12.9	-	8.8	10.3	10.1
C19:0	-	0.2	-	-	1.2	-	-	0.5
Total	52.9	31.6	30.6	33.7	40.2	38.9	40.6	54.0
Monounsaturated								
C16:1 n7	2.0	7.1	4.6	2.9	7.7	1.2	3.7	6.8
C18:1 n9	12.9	46.2	52.5	25.6	21.6	17.0	13.3	12.3
C20:1	2.5	10.4	-	-	1.5	1.0	2.0	0.8
C22:1	-	1.6	-	-	0.3	-	1.0	0.1
Total	17.3	65.2	57.1	28.5	31.1	19.2	19.9	20.0
Polyunsaturated								
C18:2 n6	0.6	0.3	0.5	-	1.2	2.0	0.8	0.9
C18:3 n3	-	-	-	-	0.9	0.7	0.6	0.5
C18:4 n3	-	-	-	0.3	-	-	-	-
C20:2	-	-	-	0.2	-	-	-	-
C20:4 n6	6.7	0.5	6.1	8.2	3.0	5.5	5.6	4.1
C20:5 n3	1.7	0.3	-	2.7	7.0	5.0	3.4	3.7
C22:3 n3	-	-	-	0.7	-	-	-	-
C22:4 n3	-	-	-	-	-	-	-	-
C22:5 n3	7.4	0.8	-	0.9	0.6	3.0	4.1	1.4
C22:6 n3	9.3	1.1	3.1	21.5	12.2	21.4	19.3	12.3
Total	25.6	3.0	9.6	34.5	24.8	37.6	33.9	22.9

Fatty acid	Catfish (*Pseudarius spp.*)	Giant catfish (*Netuma*	Grey mullet (*Mugil cephalus*)	Pearlspot (*Etroplus suratensis*)	Milkfish (*Chanos chanos*)
Saturated					
C14:0	4.4	6.9	3.9	1.8	2.9
C15:0	2.2	3.9	5.8	0.7	0.8
C16:0	16.4	22.0	20.3	21.2	22.3
C17:0	5.0	4.3	5.9	0.0	0.0
C18:0	18.4	13.3	5.2	11.7	7.6
C19:0	1.6	1.1	1.7	0.0	0.0
Others	0.2	0.5	0.3	0.6	0.8
Total	48.2	52.0	43.1	36.0	34.4
Monounsaturated					
C16:1 n7	7.6	7.9	10.6	8.0	5.7
C17:1 n7	0.0	1.9	5.7	0.0	0.0
C18:1 n9	18.0	12.3	14.4	22.6	15.0
C20:1 n9	0.5	0.8	5.1	0.0	3.5
C22:1 n9	0.0	0.8	1.1	0.0	1.1
Others	0.0	0.0	0.0	0.0	0.0
Total	26.1	23.7	36.9	30.6	25.3
Polyunsaturated					
C18:2 n6	0.7	3.3	0.0	4.0	3.0
C18:3 n3	5.8	0.0	4.0	5.2	2.2
C18:4 n3	0.5	3.5	0.8	0.0	1.9
C20:2 n6	0.0	1.7	0.0	2.7	0.0
C20:3 n6	0.0	1.6	0.0	2.3	0.0
C20:4 n6	3.3	3.6	2.9	6.0	5.4
C20:5 n3	5.5	4.4	3.3	1.9	4.3
C22:2 n6	0.6	0.0	0.0	0.0	0.0
C22:3 n3	1.5	0.6	0.7	1.4	1.7
C22:4 n3	0.0	2.1	3.1	1.6	2.5
C22:5n3	3.2	2.1	1.8	3.0	5.7
C22:6n3	4.8	1.6	2.8	4.9	15.5

Table 4 e- Fatty Acid Composition (Fresh water species)

Fatty acid	Spiny eel (*Mastacembelus armatus*)	Green snakehead (*Ophicephalus punctatus*)	Filamented barb (*Puntius filamentosus*)	Orange chromicle (*Etroplus maculatus*)	Stinging catfish (*Heteropneustes fossilis*)	Pearlspot (*Etroplus suratensis*)	Milkfish (*Chanos chanos*)	Waigue snapper (*Lutjanus vaigiensis*)	Freshwater shark (*Wallago attu*)
Saturated									
C12:0	2.1	0.0	0.3	0.0	1.2	0.0	0	0	3.4
C13:0	0.7	0.3	2.0	0.2	1.4	1	0	0.2	0.4
C14:0	3.6	0.7	3.4	3.4	3.3	3.8	1.6	2.4	3.2
C15:0	3.0	2.1	1.5	1.1	2.2	2.8	1	1	1.5
C16:0	13.7	24.0	13.4	24.7	17.6	19.9	19.9	17.6	20
C17:0	3.8	3.0	2.3	2.8	2.5	0.4	2.6	2.6	1.4
C18:0	12.6	13.7	16.8	12.0	9.4	15.7	10.4	10.8	9.4
C19:0	1.8	1.3	0.9	0.9	1.6	0	2.5	1.6	0
Total	41.3	45.1	40.6	45.1	39.2	43.6	38	36.2	39.3
Monounsaturated									
C16:1 n7	7.5	5.8	7.9	6.3	16.5	11.1	8.4	7.6	6.9
C17:1 n7	1.1	2.0	1.6	1.2	0.0	0.4	2.4	0	0
C18:1 n9	20.4	14.0	18.6	13.7	15.3	20.3	20.8	32	22.1
C20:1 n9	1.0	0.7	0.0	0.9	0.0	1.6	1.8	0.8	0.6
C22:1 n9	0.5	0.3	1.1	0.7	0.9	1	0	0.9	0.7
Others	3.0	1.8	0.0	0.2	2.5	0.1	1	0.6	3.2
Total	33.5	24.6	29.2	23.0	35.2	34.5	34.4	41.9	33.5
Polyunsaturated									
C18:2 n6	8.2	3.8	10.4	2.1	4.1	7.6	3.5	4.9	6.8
C18:3 n3	1.9	0.5	4.0	0.6	0.9	5.5	3.7	3.6	3.6
C18:4 n3	1.6	1.8	1.2	3.6	1.7	2.4	7	1.6	2.4
C20:2 n6	0.0	0.2	0.6	1.0	1.0	0	0	1.1	1.3
C20:3 n6	1.5	0.2	1.2	0.7	2.1	0	1.2	0.6	0
C20:4 n6	7.1	6.1	6.7	3.0	6.3	3.5	2.4	3.2	4.6
C20:5 n3	1.2	6.0	1.4	2.2	3.8	0.5	2.2	0.9	0.8
C22:4 n6	1.3	2.4	0.8	5.9	0.9	0	1.8	1.4	0
C22:5 n3	0.3	2.2	0.2	5.1	0.5	1	0.5	0.7	0
C22:6 n3	2.2	6.7	2.6	8.0	0.3	1	2.4	1	2.8
Others	0.0	0.0	0.3	0.0	1.3	0.5	2.9	0	3.1
Total	25.3	29.9	29.4	32.2	22.9	22	27.6	19	25.4
Unidentified	-	0.4	0.8	-	2.8	0	0	3	2

Source - *S. Ma/hew et al. Food Chemistry 66 (1999) 455-461*

Table 5 : Content of cholesterol, NSM and fat (a) in fish, (b) in shellfish

S. Mathew et al. Food Chemistry 66 (1999) 455-461

No. family	Species	Common name	Length Weight (average) (cm)	(g)	Month	Cholesterol (mg%)	NSM (g%)	Fat (g%)
(a) Fish								
I Acanthuridae	*Acanthurus xanthopterus* (Valenciennes, 1835)	Yellow fin surgeon fish			October	33.8	0.05	0.99
2 Ariidae	*Arius fella* (Day,1877)	Black fin sea catfish	25	300	July	58.3		1.6
3 Ariidae	*.4rius fella* (Day,1877)	Black fin sea catfish	32	315	March	56.9	0.09	0.72
4 Ariommidae	*Ariomma indicus (Day, 1870)*	Indian drift fish				59.9	0.25	2.4
5 Belonidae	*Strongvlura strongylura* (Van Hasselt, 1823)	Spot tail needle fish	35	145	Februray	55	0.07	0.86
6 Bothidae	*Pseudorhombus* sp	Flounder	15	40	March	64.7	0.13	0.3
7 Bothidae	*Pseudorhombus* sp	Flounder	14	29.5	March	51.9	0.11	0.55
8 Carangidae	*Megalaspis cordyla* (Linnaeus, 1758)	Torpedo scad	21	100	Februray	59.1	0.1 1	1.6
9 Carangidae	*Megalaspis cordyla* (Linnaeus, 1758)	Torpedo scad (with skin)	21	100	Februray	62.3	0.15	1.88
10 Carangidae	*Trachynotus ovatus*	Pompano	19	193		55	0.1	1.04
11 Carangidae	*Caranx carangus* (Bloch, 1793)	Black tailed trevally	14	968	October	52.6	0.28	7.11
12 Carangidae	Scomberoides tol	Needle scaled			March	48.1	0.12	1.02

	(Cuvier, 1832)	queen fish						
13 Carangidae	*Trachynotus ovatus*	Pompano	20	220	October	47.4	0.08	1.94
14 Carangidae	*Megalaspis cordyla* (Linnaeus, 1758)	Torpedo scad	20	120	March	50.9	0.08	0.64
15 Carangidae	*Parastromateus niger* (Bloch, 1975)	Black pomfret	23	250	March	60.2	0.1 1	1.09
16 Carangidae	*Decapterus russelli* (Ruppell, 1830)	Indian scad	18	49	March	67.6	0.12.	1.34
17 Carangidae	*Scomberoides tol* (Cuvier, 1832)	Needle scaled queen fish	36	285	March	55.1	0.09	0.88
18 Carangidae	*Megalaspis cordyla* (Linnaeus, 1758)	Torpedo scad	37	424	March	55.1	0.11	1.01
19 Carangidae	*Carangoides malabaricus* (Bloch & Schneider, 1801)	Malabar trevelly	16	75	March	55.9	0.16	1.61
20 Carangidae	*Carangoides malabaricus* (Bloth & Schneider, 1801)	Malabar trevelly				47.6	0.14	1.16
21 Carangidae	*Caranx carangus* (Bloch. 1793)	Black tailed trevally	20	99	March	67.3	0.13	1.01
22 Carangidae	*Caranx para* (Cuvier, 1832)	Banded scad	15	32	March	73.7	0.13	1.73
23 Carangidae	*Atropus atropus female* (Schneider, 1801)	Cleft belly trevally	23	181	March	64.6	0.15	3.41
24 Carangidae	*Atropus atropus* (Schneider, 1801)	Cleft belly trevally	18	91	March	57.1	0.09	1.52
25 Chanidae	*Chanos chanos* (Forsskal, 1775)	Milk fish	35	300	December	33.6	0.05	0.98

26 Chirocentrida	*Chirocentrus dorab*	Silver bar			October	39.6	0.06	2.42
27 Chirocentrida	*Chirocentrus nudus* (Swainson, 1839)	White fin wolf herring	49	94.32	March	46	0.2	
28 Chirocentrida	*Chirocentrus nudus* (Swainson, 1839)	Wolf herring	45	364	March	39.4	0.1	1.56
29 Cichlidae	*Oreochromis mossambica*	Tilapia female	16	65	December	41.8	0.06	0.51
30 Cichlidae	*Etroplus maculatus* (Bloch, 1785)	Orange chromicle	7	7.5	December	5.12	0.07	0.71
31 Clupeidae	*Opisthoptertus tardoor* (Cuvier, 1829)	Tardoore	15	30	July	68.6	0.11	4.9
32 Clupeidae	*Opisthoptertus tardoor* (Cuvier, 1829)	Tardoore	16	44	October	62.2	0.36	6.3
33 Clupeidae	*Opisthoptertus tardoor* (Cuvier, 1829)	Tardoore	24	110	March	53.7	0.1 1	1.46
34 Clupeidae	*Dussumieria acuta* (Valenciennes, 1847)	Rainbow sardine	17	41	March	50.4	0.13	0.94
35 Clupeidae	*Sardinella melanura* (Cuvier, 1829)	Blacktip sardinella	16	49	March	52.7	0.09	1.8
36 Clupeidae	*Dussumieria hasse/ti*	Oil sardine	16	25	June	86.5	0.25	4.34
37 Cynoglossida	*Cynoglossus dubius*	Carrot tongue sole	33	213	March	39.2	0.07	0.47
38 Cynoglossida	Cynoglossus sp	Flounder	19	38	March	48.3	0.1	0.24

39 Cyprinidae	*Cirrhinal mrigata* (Hamilton & Buchanan, 1802)	Mrigal				36	0.06	
40 Cyprinidae	*Labeo rohita* (Hamilton and Buchanan, 1802)	Rohu	Adult			36.2	0.07	
41 Elopidae	*Flops machnata* (Forsskal, 1775)	Lady fish	52	900	December	32.9	0.05	0.47
42 Engraulidae	*Tryssa dusumeiri* (Valenciennes, 1848)	Dussumier's thryssa	15	30	Februray	54.6	0.26	3.15
43 Ephippidae	*E phippus Orbis* (Bloch, 1787)	Spade fish	11	42	March	82.7	0.26	3.19
44 Gerridae	*Gerres filamentoses* (Cuvier, 1829)	Whipfin silver biddy	15	84		53.8	0.09	2.35
45 Gerridae	*Gerres filamentoses* (Cuvier, 1829)	Whipfin silver biddy	18	84	October	45.9	0.09	2.2
46 Haemulidae	*Pomadasys furcatum*	Grunter	19	100	February	61	0.22	4.63
47 Haemulidae	*Pomadasys kaakan* (Cuvier, 1830)	Javelin grunter			March	53.7	0.13	0.67
48 Haemulidae	*Pomadasys sp*	Grunter	15	63	March	63.8	0.12	0.93
49 Hemiramphid	*Hemiramphus lutkei*	Needle fish			October	52.5	0.12	1.74
50 Lactaridae	*Lactarius lactarius*	False trevally	14	40	• July	97.4	0.38	6

	(Bloch & Schneider, 1801)							
51 Leiognathidae	Leiognathus equulus (Bloch, 1787)	Pugnose ponyfish			May	90.6	0.15	
52 Leiognathidae	*Leiognathus splendens* (Cuvier, 129)	Splendid ponyfish			May	107	0.14	1.1
53 Leiognathidae	*Leiognathus bindus* (Valenciennes, 1835)	Orange fin pony fish	8	7	March	88.2	0.31	1.85
54 Lethrinidae	*Lethrinus cinerius*		44	1200	October	148	0.37	3.26
55 Lutjanidae	*Lutjanus gibbus* (Forsskal, 1775)	Humpback red snapper	31	850	March	95.5	0.24	7.7
56 Lutjannidae	*Pristipomoides filamentoses* (Valenciennes, 1835)	Blue spotted job fish			October	80.6	0.2	5.03
57 Megalopidae	*Megalops cyprinoides* (Broussonet, 1782)	Oxeye tarpon	18-	69	December	46.2	0.07	0.62
58 Mugilidae	*Vaiamugil cunnesius* (Valenciennes, 1835)	Long arm mullet				62.9	0.25	2.24
59 Mullidae	*Upenus vittatus* (Forsskal, 1775)	Striped goatfish	15	50	March	48.7	0.15	1.01
60 Mullidae	*Upenus vittatus* (Forsskal, 1775)	Goat fish				43.1	0.1	0.89
61 Myliobatidae	*Mydiobatis nieuhofli*	Eagle ray	27	1040	March	56	0.09	0.67

62 Nemipteridae	*Nemipterus bleekeri*	Pink perch	22	119	March	63.4	0.12	0.8
63 Nemipteridae	*Nemipterus japonicus* (Bloch, 1791)	Pink perch	21	130	March	56.4	0.09	0.83
64 Nemipteridae	*Parascolopsis eriomma*	Rosy monacle bream	27	375	February	46.5	0.1	1.56
65 Polynemidae	*Eleutheronema tetradactylus*	Four finger thread fin	33	500	Februray	63.7	0.1	0.85
66 Polynemidae	*Polynemus sextarius* (Bloch and Schneider, 1801)	Blackspot threadfin	15	43	March	68.5	0.11	1.08
67 Priacanthidae	*Priacanthus sp*	Bull eye	18	75	March	53.1	0.1	0.52
68 Psettodidae	*Psettodes erumei* (Schneider, 1801)	Indian tiny turbot	33	587	March	41.6	0.07	0.54
68 Psettodidae	*Psettodes erumei* (Schneider, 1801)	Indian tiny turbot	33	587	March	41.6	0.07	0.54
69 Scianidae	*Nibea maculata* (Schneider, 1801)	Blotched croaker	23	150	January	38.8	0.12	1.56
70 Scianidae	*Johnius carutta* (Bloch, 1793)	Karut croaker	18	65	October	74	0.08	1.2
71 Scianidae	*Johniops Sinai* (Cuvier, 1830)	Sin croaker	14	33	May	69.6	0.1	0.6
72 Scianidae	*Johniops sinai* (Cuvier, 1830)	Sin croaker	12	18	May	72.1	0.23	0.8
73 Scianidae	*Johnius elongates*	Spindle croaker	16	74	March	65.6	0.11	0.87

	(Mohan, 1967)							
74 Scianidae	*Otolithus ruber* (Schneider, 1801)	Tiger toothed croaker	34	458	March	41.7	0.05	0.81
75 Scianidae	*Johniops sina* (Cuvier, 1830)	Sin croaker	17	80	March	59.7	0.1	0.85
76 Scombridae	*Rastrelliger kanagurta* (cuvier, 1817)	Mackerel	12	15	May	51.4	0.05	6.84
77 Scombridae	*Rastrelliger kanagurta*	Mackerel female	27	259	September	58.4	0.18	7.65
78 Scombridae	*Rastrelliger kanagurta*	Mackerel male	23	127	June	55.6	0.17	5.09
79 Scombridae	*Rastrelliger kanagurta*	Mackerel immature	18	70	June	64.8	0.09	2.08
80 Scombridae	*Rastrelliger kanagurta*	Mackerel female	21	115	October	*65.4*	0.14	5.17
81 Scombridae	*Elachata nigra*	Kadal varal	*46*	*750*	October	*59.3*	0.1	1.38
82 Scombridae	*Rastrelliger kanagurta*	Mackerel	*21*	119	March	*69.7*	0.15	1.94
83 Scombridae	*Elachata nigra*	Kadal varal	44	514	March	*65.6*	*0.1*	*0.68*
84 Serranidae	*Epinephles latijasciatus* (Temminck and Schlegel, 1842)	Banded grouper	*27*	*283*	March	41.4	*0.08*	*0.42*
85 Sillaginidae	*Sillago sihama (Forsskal, 1775)*	Silver sillago	14	30	March	*112*	*0.12*	*3.39*
86 Sparidae	*Argyrops spinifer* (Forsskal, 1775)	King soldier bream	20	190	March	*37.8*	*0.06*	0.43
87 Sphyraenidae	*Sphyraena forsteri* (Cuvier, 1829)	Big eye barracuda	30	125	March	*58*	0.1	*0.61*
88 Sphyraenidae	*Sphyraena obtusata (Cuvier, 1829)*	Obtuse barracuda	23	80	March	*59.9*	*0.09*	*0.84*

89 Sphyraenidae	*Sphyraena jello (Cuvier, 1829)*	Barracuda	45	510	March	*34.6*	*0.09*	*0.53*
90 Stromateidae	*Pambus argentius (Epiphrases, 1788)*	Silver pomfret	16	150	March	*44*	*0.1*	*1.08*
91 Synodontidae	*Saurida undosquamosis* (Richardson, 1840)	Brush tooth lizard fish	24	*98*	March	*57.6*	0.11	*1.22*
92 Teraponidae	*Theraponjarbua (Forsskal, 1775)*	Jarbua therapon			October	*33.7*	0.1	*1.94*
93 Teraponidae	*Terapon jarbua*	Jarbua therapon				*24.6*	*0.06*	*0.96*
94 Torpedinida	*Narcine sp*	Electric ray	23	1.1	March	*72.7*	*0.1*	*0.78*
95 Trachinidae	*Percis pulchella*	Rosy grub fish	14	*35*	March	*22.2*	0.04	*0.72*
96 Trichiuridae	*Lepturacanthus savala* (Cuvier, 1917)	Savalai hair tail	47	*87*	March	*68*	0.1	*0.88*
97 Uranoscopide	*Chanoscopes* sp	Star gazers	*28*	*399*	March	*37*	0.11	0.87
Fish Egg								
1 Scombridae	*Rastrelliger kanagurta*	Mackerel egg			September	*462*	1.38	*5.71*
Prawn								
(b) Shellfish								
1 Penaeidae	*Penaeus indicus* (H.Milne Edwards, 1837)	Indian white shrimp	13	*14*	February	*129*	0.17	*1.35*
2 Penaeidae	*Penaeus indicus*	Indian white shrimp	17	*22*	February	163	0.18	1.34
3 Penaeidae	*Metapenaeus monoceros* (Fabricius, 1798)	Speckled shrimp	*7*	*2.75*	February	144	0.18	*0.95*
4 Penaeidae	*Metapenaeus monoceros*	Speckled shrimp	*9*	*6.25*	February	123	0.17	1.22
5 Penaeidae	*Penaeus monodon*	Giant tiger prawn	19	*45*	February	118	*0.25*	1.02

	(Fabricius, 1798)							
6 Penaeidae	*Metapenaeus dobsoni* (Miers, 1878)	Kadal shrimp	9	*3.13*	February	120	*0.23*	1.34
7 Penaeidae	*Metapenaeopsis stridulens* (Alcock, 1905)	Fiddler shrimp	8	*2.3*	March	143	*0.23*	0.98
Crab								
1 Scyllaridae	*Scylla seffata* (Forsskal)	Mud crab	10	180	May	*54.8*	0.15	*0.75*
2 Scyllaridae	*Scvlla serrata* claw meat					51.5	*0.09*	0.64
3 Portunidae	*Portunus sanquinolentus* (Herbst)	Red spot crab	13	*110*	May	52.4	*0.1 1*	0.58
4 Portunidae	*Charibdis cruciata ("Herbst)*	Coral crab	10	*156*	May	56.5	*0.11*	0.7
5 Portunidae	*Charibdis cruciata*	Coral crab	11	*190*	March	54.2	*0.09*	0.76
6 Portunidae	*Portunus pelagicus* (Herbst)	Sand Crab	14	*1 11.*	May	66.8	*0.14*	0.68
Antartic krill								
1 Euphausidae	*Euphausia* sp	Antartic krill	Whole			102	0.13	
2 Euphausidae	*Euphausia sp*	Antartic krill	Tailmeat			33.3		
Cuttle fish								
1 Sepiidae	*Sepia aculeate*	Cuttle fish				162	*0.22*	1.3
2 Sepiidae	*Sepia aculeata*	Cuttle fish	10	67	March	130	0.24	*0.92*
Squid								
1 Loliginidae	*Loligo duvauceli* (Orbingy)	Squid	15	*52*	March	198	*0.34*	1.4

2 Loliginidae	*Loligo duvauceli*	Squid		188	*0.23*	1.33

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