J.Natl.Aquat.Resour.Res.Dev.Agency 36 (2000) 47-53
The National Aquatic Resources Research & Development Agency,
Crow Island, Mattakkuliya, Colombo-15, Sri Lanka.

Nutritional Evaluation of Some Small Coastal Fish in Sri Lanka

E.M.R.K.B. EDIRISINGHE[1], W.M.K. PERERA[2] & A.BAMUNUARACHCHI[3]

1 *Institute of Post Harvest Technology, National Aquatic Resources Research & Development Agency (NARA), Crow Island, Colombo-15, Sri Lanka.*
2 *Department of Nutrition and Community Resources Management, Wayamba Campus, University of Rajarata, Kuliyapitiya, Sri Lanka.*
3 *Department of Chemistry, University of Sri Jayawardenepura, Nugegoda, Sri Lanka.*

Abstract

KEY WORDS: SMALL FISHES; PROTEIN; LIPID

Small pelagic fish play a very important role in human nutrition and health. Lipids of these fish differ remarkably from plant and other animal lipids. The aim of the study was to describe the proximate composition of thirty-three small pelagic fish species commonly available in Sri Lanka. Fish species were collected from Negombo and Chilaw fish landing sites and subjected to analysis for moisture, ash, protein and total lipid content.

Tigertooth croaker (*Otolithus ruber*) was found to have the highest moisture percentage (80.0%) followed by *Clarias.sp* (78.9%), Indian anchovy (*Steloporus indicus*) and Comerson's anchovy (*Stelophorus commersonii*), (78%). The lowest percentage of moisture, 69.4%, was recorded in White sardinella (*Sardinella albella).* Indian ilisha (*Ilisha melastoma*) was found to have the highest amount of ash (10.1%) followed by *Otolithus.sp* (8%) and Big-eye barracuda contained the least amount (2.5%). *Carassius Carassius*, Pickhandle barracuda (*Sphyraena jello*) and Indian mackerel (*Rastrelliger kanagurta*) contained higher amounts of protein, 24.3, 20.6 and 19.2% respectively. The lowest protein content (10.1%) was found in Indian scad (*Decapterus russelli*). The protein content of the fish was in the range of 13 – 15 %. The results revealed that the small fish are moderate protein sources.

The total lipid content varied between 0.6 – 8 %. White sardinella recorded the highest percentage of lipid (8%) where Tigertooth croaker contained the lowest percentage (0.6 %). The study showed high fatty species to contain low amount of moisture and vice versa establishing an inverse relation between fat and moisture quantitatively.

Introduction

Fish and seafood play a significant role in human nutrition and health. They are rich sources of nutrients. They provide a good balance of proteins, lipids, vitamins, minerals and have a relatively low caloric value than other muscle foods. Fish has been a well known source of protein in the human diet for a long time. Fish protein is highly digestible and is rich in essential amino acids (Kinsella, 1988). The amount of protein present in fish varies from 17 to 27% on a wet basis. Many fish species, such as tuna and mullet are rich in protein. `Sea fish contain limited amounts of carbohydrates, less than 1%, but freshwater fish may contain 2-7% (Wimalasena and Jayasooriya, 1996). The most commonly eaten finfish and shellfish have very low fat contents compared to other muscle foods. Generally fish contain 0.5 - 10 % lipids (Ackman, 1988; Jayasinghe *et al.*, 1992; Edirisinghe *et al.*, 1998) and it may increase up to 20% in some fatty species. Fish lipids have become valuable for human health and nutrition as a food material as well as a medicine. The n-3 (omega-3) polyunsaturated fatty acids of fish lipids have the ability to provide considerable protection against cardiovascular diseases and a number of chronic degenerative diseases in humans (Lands, 1985; Simopoulas *et al.*, 1986). Fish also is an excellent source of minerals and vitamins. Fish is rich in Sodium, Potassium, Calcium, Zinc and Iron (Nettleton, 1985). Generally fresh fish contain reasonable amounts of minerals, but processed fish such as dried fish contain higher values (Kinsella, 1986). Fish liver oils are rich in Vitamin A and D (Nettleton, 1985).

There are many varieties of fish around Sri Lanka and most of them are edible. Nearly 50% of fish landings in Sri Lanka accounts for small fish species. Although the small pelagic fish species are reported to have a high nutritional value, documented information regarding the above factors, specially about nutritional value, is not available for fish in Sri Lanka. There is no doubt that these fish could be useful in promoting nutritional status of the population.

Materials and Methods

Materials

Fish species used in this study were purchased from fish landing sites at Chilaw and Negombo on the north-western coast of Sri Lanka. Chemicals (analytical grade) used in all experiments were obtained from Sigma Chemicals (UK) or Merck/BDH (UK).

Methods

Fish samples were packed in polythene bags and stored in ice (0°C) and immediately transported to the laboratory at the National Aquatic Resources Research & Development Agency, Colombo. The total length (cm) and weight (g) of the fish were measured and stored at -18°C until required for further analysis.

A sample of 4 fish was taken for the analysis and the proximate composition of the whole fish was analysed by measuring dry matter (AOAC, 1980), ash (AOAC, 1980), lipid (by modified Bligh & Dyer method, Hanson and Olly, 1963) and protein (by Kejldhal method, AOAC 1980).

Results and Discussion

The proximate composition namely, moisture, ash, lipid and protein contents of thirty-three pelagic fishes studied are given in table -1.

Moisture content

The highest constituent of fish was the moisture content. Tigertooth croaker (*Otolithus ruber*) contained the highest moisture percentage (80.0%) followed by *Clarias.sp* (78.9%), Indian anchovy (*Steloporus indicus*) and Comerson's anchovy (*Stelophorus commersonii*), (78%). The lowest percentage of moisture, 69.4%, was recorded in White sardinella (*Sardinella albella*). Peiris and Grero (1973) reported that the moisture content of Dorab wolf herring, Herring and Toothpony was 72.7%, 71.7% and 78.2% respectively. According to Castrillon *et al.,* (1997) the moisture content of Sardine (*Clupea pilchadus*) was 60.7%. Hatano *et al* (1985) reported that the moisture content of Chum sardine show seasonal variation and it increased during the spawning period.

Wimalasena and Jayasooriya (1996) had reported the moisture content of some fresh water fish of Sri Lanka to be between 66 – 84 % and this indicated that there is not much difference in the moisture content between fresh water fish and sea water fish.

Ash content

In the present study Indian ilisha (*Ilisha melastoma*) contained the highest amounts of ash (10.1%) followed by *Otolithus.sp* (8%) and Big-eye barracuda contained the lowest amount (2.5%). Generally, ash content is about 2 - 4% but in this study 6 fishes out of 33 contained greater than 5% of fish. Peiris and Grero, (1973) has reported the ash content of Herring, Dorab wolf herring and Toothpony to be 4.4%, 2.3% and 1.7% respectively. According to Hatano *et al.,* (1985), the ash content of Chum salmon also shows a decrease due to seasonal effects during spawning migration.

Lipid content

White sardinella recorded the highest percentage of lipid (8%), which had the lowest amount of moisture (69.4%), followed by Blue trevally (*Carangoides ferdue,* 5.5%), Tigertooth croaker contained the lowest percentage of lipid, 0.6%, recorded the highest percentage of moisture, compared to other species. Generally high fatty species contained low amount of moisture indicating an inverse relationship between fat content and moisture content of fish. In the present study, the total lipid content of the studied species varied between 0.6 – 8.0 %. The total lipid content is different to the lipid content of the edible portion of some fish such as Dorab-wolf herring, White sardinella and Spotted sardinella (Jayasinghe *et al.*, 1992). The total lipid content of Indian mackerel (2.2%) in this study is lower than the value reported by Lantz and Gunesekara (1957). The lipid contents obtained in the present study were not in accordance with the results obtained by Peiris and Grero (1972, 1973). These differences may be due to a number of reasons. The lipid content of fish varies with species, season, physiological status, diet, location in body, and age (Ackman, 1982; Kinsella, 1988) The total lipid content of Mackerel (20.6%), Capelin (1.78%), Herring (12%), Smelt (1.2%) and Sturgeon (7.2%) from Nova Scotia sources was reported by Ackman (1988). The fish from colder waters typically store fat as an energy reserve.

Protein Content

Fish is composed of 10 – 25% protein (average 19%) and is well known as a source of high quality protein. Among the species studied *Carassius Carassius*, Pickhandle barracuda (*Sphyraena jello*) and Indian mackerel (*Rastrelliger kanagurta*) was found to contain 24.3, 20.6 and 19.2% of protein, respectively. The lowest protein content (10.1%) was found in Indian scad (*Decapterus russelli*) followed by Giant cat fish (*Arius thalassinus*, 10.8%). The protein content of Dorabwolf herring was 17.6%, which was lower than the amount reported by Peiris and Grero (1973). In 17 out of the 33 species analyzed in the present study the protein content of 17 species ranged between 15 – 20%. In 12 species the range was between 10 - 15% and in 2 species it was over 20%. This data revealed that this set of small fish are moderate protein sources when compared with some high protein sources such as Skip jack tuna, Mackerel tuna, Strate back herring

(Peiris and Grero, 1973). Hatano *et al* (1985) had reported the protein content of chum salmon to vary between 16.8 - 21.8% with the level decreasing to 8% showing a seasonal effect associated with the upstream migration.

Conclusion

The proximate composition data provides valuable information regarding the nutritional value of fish species. The moisture content was found to be the highest constituent of fish studied (69 - 80%), followed by protein (17 - 25%), total fat (0.6 – 8.0 %) and ash content (2.5 – 10.1%). Among the species studied, *Carassius carrasius* records the highest protein content with relatively low moisture. Regarding the lipid content, White sardinella reported the highest among the species studied. Fish is also known to contain a high percentage of omega-3 polyunsaturated fatty acids. Encouragement of consumption of these varieties of fish could be helpful to developing countries like Sri Lanka, where protein, energy malnutrition is existing, together with other vitamins and minerals deficiencies.

Acknowledgement

Financial assistance by the European Economic Community under the project, Improved Utilization of low value fish species (Research Area III - Fish Lipids (STD-3), No TS3-CT93-0207) through NARA is acknowledge.

References

ACKMAN, R.G. (1982). *Nutritional evaluation of long-chain fatty acids in fish*. S.M. Barlow, S.M. and Stansby, M., Eds. 25-88. Academic press, New York.

ACKMAN, R.G. (1988). Concerns for Utilization of Marine Lipids and Oils. *Food Technology, vol.5:pp.151-155.*

AOAC. (1980). *Official methods of Analysis*. 13th edition. Association (of Official Analytical Chemists, Inc., Arlington, USA.

CASTRILLON, A.M., NAVARRO, P. & ALVAREZ-PONTES, E. (1997). Changes in Chemical Composition and Nutritional Quality of Fried Sardine (*Clupea Pilchardus*) produced by Frozen storage and Micoware Reheating. *Journal of Science Food and Agriculture, vol.75,pp. 125-132.*

EDIRISINGHE, E.M.R.K.B., PERERA, W.M.K., JAYASOORIYA, S.P. & BAMUNUARACHCHI, A. (1998). Health related fatty acids in some pelagic fishes in Sri Lanka. – *Sri Lanka Journal of Aquatic Science, No 3, pp.91-101.*

HANSON, S.W.F. and OLLY, J. (1963). Application of the Bligh & Dyer method of lipid extraction to tissue homogenates. *Biochemical Journal, vol. 89, pp.101-102.*

HATANO, M., ANDO, S. & ZAMA, K.(1985). Effective utilization of fatty chum salmon- 11; Nutritional quality of muscle protein during spawning migration of chum salmon. *Bulletin of the Faculty of Fisheries, Hokkaido University, vol.36 (4) pp. 267-280.*

JAYASINGHE, J.A.G., MUBARAK, A.M., WIMALASENA, S. & WIJESUNDARA, R.C. (1992). Fatty acid composition of some edible fish of Sri Lanka. *Chemistry in Sri Lanka, vol. 9(1),9p.*

KINSELLA, J.E. (1986). Food Components with Potential Therapeutic Benefits: The n-3 Polyunsaturated Fatty acids of Fish Oils. *Food Technology,* 40 (2): 89-97.

KINSELLA, J.E. (1988). Fish and Seafoods : Nutritional Implications and Quality Issue. *Food Technology,* 42(5): 146-150.

LANDS, W.E. (1985). *Fish and Human Health* Academic Press, New York.

LANTZ, A.W. & GUNASEKERA, C. (1957). Chemical analysis of some Ceylon Fishes. *Bulletin of the Fisheries Research Station- Ceylon,* 5, 1-34.

NETTLETON, J.A. (1985). "Seafood Nutrition". Osprey Books, Huntington, New York.

PEIRIS, T.S.S. & GRERO, J. (1972). Chemical analysis of some Ceylon Fishes-2. *Bulletin of the Fisheries Research Station- Ceylon,* 23(1 - 2), 1-7.

PERIS, T.S.S. & GRERO, J. (1973). Chemical analysis of some Sri Lankan Fishes-3. *Bulletin of the Fisheries Research Station- Sri Lanka (Ceylon), vol.24(1-2),pp. 1-12.*

SIMOPOULAS, A., KIFER, R. & MARTIN, R. (1986). *Health Effects of Dietary Polyunsaturated Fatty Acids in Seafoods.* Academic Press, New York.

WIMALASENA, S. & JAYASOORIYA, M. N. S. (1996). Nutrient Analysis of Some Fresh Water Fish. *Journal of National Science Council of Sri Lanka, vol.24(1), pp. 21-26.*

Table 1: Proximate Composition of Fish

(mean ± S.D, n = 4)

No	Date	Landing Site	Family	Common name	Scientific name	English name	Moisturee (%)	Ash (%)	Lipid (%)	Protein (%)	Weight (g)	Total length (cm)
1	94/06/29	Chilaw	*Chirocentridae*	Katuwalla	*Chirocentrus dorab*	Dorab-wolf herring	74.4±4.5	3.5±0.2	2.2±0.3	17.6±1.3	58.1±8.9	22.4±5.9
2	94/06/29	Chilaw	*Carangidae*	Suraparawa	*Selaroides leptolepis*	Yellow stripscad	75.7±3.8	3.4±0.3	2.1±0.3	15.7±1.4	17.4±1.2	10.2±0.5
3	94/06/29	Chilaw	*Engraulidae*	Handella	*Stolephorus indicus*	Indian anchovy	78.4±2.5	3.3±0.4	1.3±0.2	15.9±2.5	16.9±2.4	12.7±1.8
4	94/07/07	Chilaw	*Caesionaidae*	Angaya	*Pterocaesio digramma*	Double-lined fusilier	72.2±2.8	2.9±0.1	4.2±0.8	13.3±2.1	53.1±3.7	14.0±2.4
5	94/07/07	Chilaw	*Sphyraenidae*	Theliya	*Sphyraena forster*	Big -eye baracuda	78.3±3.7	2.5±0.4	1.4±0.3	14.832	110.7	24.6
6	94/07/07	Chilaw		Hungu	*Clarias. sp*	--	78.9±2.7	3.3±0.4	2.7±0.3	11.6±1.3	--	--
7	94/07/07	Chilaw	*Trichiuridae*	Sawalaya	*Trichiurus lepturus*	Largehead hairtail ribonfish	71.0±0.8	3.6±0.2	4.4±0.3	15.3±2.2	452	61
8	94/07/07	Chilaw	*Scombroidae*	Makaruwa	*Rastrelliyer. sp*	--	74.1±4.3	3.9±0.3	2.2±0.1	15.4±1.7	--	--
9	94/07/07	Chilaw	*Carangidae*	Parati	*Carangoides ferdau*	Blue trevally	72.1±2.1	3.4±0.1	5.5±0.4	13.7±1.7	16.2±1.8	11.4±1.2
10	94/07/20	Chilaw		Anguluwa	*Arius thalassinus*	Giant cat fish	75.4±1.5	6.5±0.5	3.3±0.3	10.8±1.2	461.0±15.4	29.5±3.5
11	94/07/20	Chilaw	*Carangidae*	Linna	*Decapterus russelli*	Indian scad	72.1±2.3	3.1±0.1	3.3±0.2	10.1±0.9	45.1±3.8	28.9±4.1
12	94/07/20	Chilaw	*Belonidae*	Muralla	*Strongylura strongylura*	Spottail needle fish	75.5±2.6	4.8±0.6	1.4±0.1	14.7	80.2±5.9	22.1±1.2
13	94/07/20	Chilaw		Illatthiya	*Chaetodon atromaculatus*	Butterfly fishes	72.8±3.8	3.4±0.2	4.1	13.9	--	--
14	94/07/20	Chilaw	*Caesionaidae*	Angaya	*Pterocaesio chrysozona*	Gold band fusilier	71.1±5.9	2.7±0.2	4.0±0.2	14.7±0.9	44.9±4.3	13.8±1.5
15	94/07/28	Chilaw		Vekkaya	*Chanos chanos*	Milkfish	75.9±3.9	2.7±0.2	3.0±0.2	16.0±2.4	--	102±10.9
16	94/07/28	Chilaw		Mewatiya	*Carassius carassius*	—	72.1±5.0	5.5±0.6	2.6±0.2	24.3±1.7	--	--
17	94/07/28	Chilaw	*Clupeidae*	Sudaya	*Sardinella albella*	White sardinella	69.4±4.0	4.0±0.4	8.0±1.2	--	17.4±2.2	9.6±1.1
18	94/08/11	Chilaw	*Clupeidae*	Tottawa	*Opisthopterus tardoore*	Long-finned herring	72.4	6.0±0.4	3.5±0.3	14.7±1.6	11.0±0.4	10.1±0.6
19	94/08/11	Chilaw	*Clupeidae*	Wenganawa	*Ilisha melastoma*	Inadian ilisha	74.45	10.2	2.0±0.5	--	--	--
20	94/08/11	Chilaw	*Engraulidae*	Lagga	*Thryssa . sp*	--	72.4±2.8	4.7±0.5	2.9±0.3	15.6±2.4	17.1±1.5	11.1±0.8
21	94/08/11	Chilaw	*Clupeidae*	Salaya	*Sardinella melanura*	Blacktip sardinella	73.3±3.4	4.5±0.3	1.8±0.2	17.5±1.7	21.0±1.9	12.7±0.5
22	94/08/26	Chilaw	*Sphyraenidae*	Theliya	*Sphyraena jello*	Pickhandle barracuda	72.1±5.8	5.7 ±0.3	0.9±0.1	20.6±2.0	66.4±5.9	20.8±3.8
23	94/08/26	Negombo	*Sciaenidae*	Pannawa	*Otolithus ruber*	Tigertooth croaker	80.0±4.1	4.4±0.1	0.6	13.7±1.7	--	40.1±4.9
24	94/08/26	Negombo	*Sciaenidae*	Pannawa	*Otolithus .sp*	--	76.2±3.4	7.9±0.6	1.1	12.5±1.5	--	37.9±3.1
25	94/09/01	Chilaw	*Scombroidae*	Kumbalawa	*Rastrelliger kanagurta*	Indian mackerel	72.9±4.7	4.0±0.7	2.2±0.3	19.2±0.7	72.5±4.8	16.2±1.1
26	94/09/01	Negombo		Pasambia	*Ephippus orbis*	Spade fish	74.5±2.8	4.0±0.3	2.4±0.2	17.9±0.9	--	--
27	94/09/01	Negombo	*Clupeidae*	Thonda Hurulla	*Dussumarria acuta*	Rainbow sardine	76.7±3.4	3.6±0.5	1.8±0.2	16.4±1.1	31.2±2.5	12.9±0.9
28	94/09/10	Chilaw	*Engraulidae*	Halmassa	*Stelophorus commersonii*	Commerson's anchovy	78.4±4.1	3.8	1.2±0.1	15.2±1.4	2.8±0.2	6.1±0.5
29	94/09/10	Chilaw	*Clupeidae*	Gal Hurulla	*Amblygaster clupeoide*	Bleekers smoobelly sardinella	74.3±2.8	2.7±0.2	1.4±0.3	17.4±1.6	114.5±8.5	35.1±6.7
30	94/09/10	Negombo	*Mullidae*	Nagari	*Upeneus taeniopterus*	Finstripe goat fish	74.1	4.3±0.3	1.8±0.2	18.1±0.2	50.1±4.6	21.0±3.4
31	94/09/21	Chilaw		Waligowwa	*Schismatogobius deraniyagalai*	--	76.8±6.0	3.6±0.3	1.8±0.1	15.9±0.7	--	--
32	94/11/07	Chilaw	*Teraponidae*	Keeliya	*Terapon puta*	Small scaled terapon	73.2±1.4	4.2±0.3	1.7±0.2	18.5±3.1	30.8	11.8
33	94/11/07	Chilaw	*Engraulidae*	Raul lagga	*Thryssa setirostris*	Longjaw thryssa	74.7±2.1	5.0±0.3	3.6±0.3	15.9±1.8	15.2±2.4	13.5±3.4