Proximate Composition of Five Species of Flat Fishes

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Five species of flat fishes, namely, *Cynoglossus semifaciatus, C. lida, C. bilineatus, C. macrolepidotus* and *Psettodes erumei* caught in trawlers off Mangalore were analysed for proximate composition of different body parts. These data are discussed in terms of their variability and applications. In whole body of *C. lida* and *C. semifaciatus* mean values for moisture, protein, fat and ash content on dry basis respectively were 75.9%, 75.3%. 7.1%, 16.1% and 78.9%, 75.6%. 7.9% and 16.6%. Mean values of these constituents of edible parts in the same order for *C. semifaciatus* and *Psettodes erumei* were 77.3%, 80.7%, 7.8%, 10.8% and 77.4%, 86.2%, 3.5% and 11.1% respectively.

Data on proximate composition of fishes are not only useful to the nutritionist, but also to the fishery technologist. Such data are not available for many species of Indian fishes and when they are, usually do not give the essential details regarding taxonomic status, size of the specimen, sample lot, season, degree of freshness, method of sampling and body part analysed. These details are essential for defining the variability of the constituents of proximate composition in different species as available at different landing centres according to maturity and seasons.

Flat fishes (flounders, soles and halibuts) are highly priced white fish in developed nations (Dassow, 1963) where their landings averaged between 3 to 12% during the period 1971–1975. In India, for the same period they constituted only 0.63% of total marine landings (FAO, 1971–1975). In recent years, demersal fishery has been expanding: 50–70% of catch on shrimp trawlers are "by catch" (Ayyappan *et al.* 1976) of which flat fishes figure prominently. Regular fishery has been extant for the Malabar sole (Seshappa, 1973) and this fish is valued for table use in the fresh state and as dried or salted-dried products. The four-lined tongue-sole and Indian halibut are acknowledged as important fish varities (CSIR, 1962). Proximate composition of the Malabar sole and Indian halibut are published elsewhere also (CSIR, 1962; Ayyappan *et al.* 1973).

This paper reports the proximate composition of different body parts of five species of flat fishes, namely, Malabar sole *(Cynoglossus semifaciatus,* Day), four-lined tongue-sole *(C. bilineatus,* Lacopede), large-scaled tongue-sole *(C. macrolepidotus,* Gunther, Catal), shoulder-spot tongue-sole *(C. lida,* Bleeker) and Indian halibut *(Psettodes erumei,* Gunther).

Materials and Methods

Fresh fishes were procured from shrimp trawlers immediately after landing. They were washed in ice water to remove extraneous matter and held under ice until all sampling for analyses were completed which was generally within an hour and never more than a couple of hours. After measurement of the body length (distance between the tip of snout to the end of tail) of individual fish, the body was wiped dry and weighed. Roughly one-third of the sample lot was retained for analysis of whole body, one-third for the edible parts and the rest for flesh. When whole fish was not analysed, the lot was divided equally for analysis of flesh and edible parts. Edible parts were prepared from the body of fish by removal of head enclosing mouth, operculum and pectoral fin, lateral and caudal fins and viscera with or without skin. Flesh was prepared from washed skinless fillets after wiping them dry. Inedible parts remaning after dressing the fish constituted the offal which includes head, fins and viscera

Table 1. *Physical characteristics of flat fishes*

Sl. no.	Month of analysis	Name of fish: Generic (Common)	no. of fish analysed	Total length of body (mm) Range	Average	Total body wt (g) Range	Average		Edible % as dressed	pH
A1	Nov.	*Cynoglossus lida* Bleeker (Shoulder-spot tongue-sole)	18	147–182	166	16–31	21		—	—
A2	Mar.	–do–	10	107–143	125	6–14	11		Whole	7.0
B1	Nov.	*Cynoglossus bilineatus,* Lacopede (four-lined tongue-sole)	11	232–347	284	84–195	118		—	—
B2	Jan.	–do–	7	296–368	331	141–292	202	77.8	Flesh Edible Offal	6.5 6.5 7.0
C1	Jan.	*Cynoglossus macrolepidotus,* Gunther, Catal (large-scaled tongue-sole)	4	256–259	266	75–87	79	79.7	Edible	7.0
D1	Mar.	*Cynoglossus semifaciatus,* (Malabar sole)	100	—	—	—	10		47 Flesh Edible Offal Whole	 6.7 6.8 7.0 7.0
D2	Mar.	–do–	150	66–121	90	1.0–9.5	3.9		53.3 Flesh Edible Offal Whole	 6.8 6.8 7.0 7.0
D3	Apr.	–do–	100	99–119	111	4.5–8.5	6.7		57.0 Flesh Edible Offal Whole	 6.7 6.7 6.9 6.8

(*Table Contd.*)

E1	Apr.	*Psettodes erumei* Gunther (Indian halibut)	6	268–312	290	235–280	296	66.9 Nil
E2	Jan.	–do–	4	282–304	268	258–331	296	66.7 Flesh 6.1 Edible 6.4 Offal 6.8
E3	Feb.	–do–	1	—	380	—	820	70.1 Edible 6.5
E4	Feb.	–do–	5	267–340	302	216–481	342	65.1 Flesh 6.4 Edible 6.5 Offal 6.9
E5	Feb.	–do–	15	153–183	170	54–87	65	61.6 Flesh 6.7 Edible 6.8 Offal 7.0

with or without skin. Skin samples were obtained from the lot used for preparation of flesh samples. When scales were removed skin was peeled after washing in water and wiping the surface dry.

The analysis for proximate composition was done as per standard procedures prescribed by the ISI and modified as reported earlier (Sen & Keshava, 1971). All determinations were carried out in duplicate and reported as average values. 10 g of flesh was mixed with 90 ml distilled water (neutralised adequately) and pH was measured after allowing to equilibrate for 5 minutes.

Results and Discussion

The results of the present investigation on proximate composition may be considered in relation to different methods of preparation in domestic and industrial utilization. Small soles are consumed with or without removal of skin after dressing, that is removal of head, fins, scales and viscera. Larger soles and halibuts are used without skin. Industrially, tiny soles, mostly of juveniles, are important raw materials for sun-drying or salt-drying and fish meal. For large scale utilization in frozen fish industries it is advisable to hold the fish in ice after dressing. Different processed forms are available: fillets are sold as breaded fish or frozen into blocks and converted into fish portions or fish fingers. Mince is utilized in frozen raw product or utilized in fish-sticks, fish balls and sausage. Discarded skins from raw materials for manufacture of gelatin; scales are used for manufacture of fish glue. Offals are a frequent source of pollution in the fish industry. This material can be utilized profitably for the manufacture of fish meal.

It can be seen from the data that flat fishes yield well in terms of edible portions. Edible content as dressed parts was nearly 50% in smaller soles; in halibut it was 60 to 70% depending on size, whereas in larger soles about 80%. Filleting yield was 28% (Thurston, 1961) and yield of mince 38.8% (Revankar *et al.*, unpublished data)

pH of the tissue macerate is used as a criterion of freshness to corroborate observation of sensory evaluation. From fresh specimens, edible parts and flesh had pH of less than 6.8. Smaller soles had higher pH 6.7 to 6.8. In larger soles, pH of edibles ranged 6.5 to 6.7; in halibuts, pH of edibles ranged 6.1 to 6.8, higher values being common for smaller fish. Offal invariably

Table 2. *Proximate composition of flat fishes (Serial nos. are same as used in Table 1)*

Sl. no.	Part analysed	Moisture %	Protein (N x 6.25) %	Fat %	Ash %	Insoluble ash %
A1	Whole body	77.3	17.7	0.8	4.1	0.1
A2	Whole body	74.6	18.6	2.7	3.6	0.3
B1	Whole body	79.9	17.2	0.7	2.8	0.02
B2	Flesh	78.3	18.6	1.3	1.1	—
	Edible with skin	77.8	19.6	1.3	1.7	—
	Offal	74.7	16.3	3.5	5.7	—
C1	Edible with skin	76.1	18.9	1.6	2.3	—
D1	Flesh	78.8	18.6	0.8	1.9	0.01
	Edible without skin	77.7	18.0	1.2	2.9	0.01
	Offal	72.9	18.8	2.0	6.7	0.1
	Whole body	76.5	17.6	1.4	5.1	0.1
	Skin (without scales)	69.6	26.1	1.1	3.2	Nil
D2	Flesh	78.3	19.5	1.2	1.4	0.1
	Edible without skin	76.9	18.9	2.1	2.2	0.02
	Offal	71.6	20.6	2.5	5.9	0.5
	Whole body	75.5	18.5	2.2	3.3	0.2
	Skin (with scales)	57.7	31.9	1.1	10.5	0.4
D3	Flesh	76.8	20.4	1.5	1.7	0.01
	Edible with skin	77.3	18.1	2.0	2.2	0.1
	Offal	74.4	18.2	2.7	4.6	0.2
	Whole body	74.8	19.2	2.2	3.7	0.1
	Skin (with scales)	47.0	41.5	1.8	11.6	0.2
E1	Flesh	80.0	18.9	0.1	2.5	—
	Edible with skin	78.8	18.2	0.6	2.5	—
	Offal	74.5	15.9	2.1	7.4	—
E2	Flesh	79.0	19.1	0.1	1.4	—
	Edible with skin	76.5	20.0	0.6	3.0	—
	Offal	72.8	17.7	1.6	7.1	—
E3	Edible	76.1	21.2	1.9	2.1	—
E4	Flesh	78.6	19.5	0.2	1.3	—
	Edible with skin	76.6	20.0	0.8	2.3	—
	Offal	71.1	16.9	2.4	9.7	—
E5	Flesh	79.8	20.0	0.1	1.5	—
	Edible with skin	78.8	18.2	0.2	2.6	—
	Offal	75.2	15.2	0.5	7.3	—
	Skin	—	20.7	—	—	—

showed higher pH of 6.8 to 7.0 and was responsible for higher ranges of pH at 6.8 to 7.0 of whole fish macerate which read in the range of pH 6.8 to 7.0. In larger specimens, flesh had the lowest pH of 6.4.

The proximate composition of the flat fishes reveal in general high moisture, moderately high protein, low ash and fairly low fat. Highest fat content for whole body of sole is shown at 2.7% (7.3% on dry basis). In edibles of halibut, highest value recorded was 1.9%. These data compare well with those elsewhere (Thurston, 1961); however, higher figure for whole body of Malabar sole of 4.02% and 4.7% is also reported (C.S.I.R., 1962; Ayyappan *et al.* 1976). On dry basis average fat content of whole body in Malabar sole works out to 9.0%; in shoulder-spot tongue-sole to 7.3% and in four-lined sole and large-scaled-tongue-sole, fat content (dry basis) of edibles was 5.9% and 6.7% respectively, but, in Malabar sole it was 7.8% and in

halibut only 3.6%. Skin contributed less fat since the content on dry basis was 3.6% without scales and 3.0% with scales. Fat content of the offal was also of the same order. 8.9% in sole and 6.2% in halibut (dry basis). Flesh had the least fat content (dry basis): 6.0% in four-lined sole; 5.6% in Malabar sole and 0.6% in halibut. Lower fat content probably is an important criterion in favourably determining the shelf-life of this class of fish favouring its utilization for a large range of products.

Among soles, larger amount of protein (N x 6.25) is present in edible portions of larger specimens than smaller ones. This may be related to higher yield of flesh. Thus, on dry basis, protein content in edibles with skin of 3 species of soles was proportionate to decrease in body weight; four-lined sole 88.3%, large-scaled sole 79.0% and Malabar sole 71.1%. In halibut of small (average weight 65 g) and medium (average weight 311 g) size respectively, protein content of edible parts with skin was 85.9% and 85.5% (mean of 3 lots) whereas in larger ones it was 88.7%. On dry basis, flesh had higher protein content of over 90% (mean (92.2%) in halibut and nearly so (mean 87.6%) in soles. Skin with or without scales contained 76.9% and 85.9% of protein (dry basis) respectively. A correction factor of 5.55–6.25 may be admissible to these values since skin comprises mostly of connective tissue proteins containing gelatin.

Ash content of flesh is negligible in four-lined sole, Malabar sole and halibut on dry lines being 5.1%, 7.6% and 6.7% respectively. 13.9%, 16.1% and 16.3% on dry basis were the mean ash content in whole basis of four-lined sole, shoulder-spot sole and Malabar sole respectively. Earlier figures reported for Malabar sole was 10.97% (CSIR, 1962). Mean proximate composition of offals in Malabar sole and halibut respectively (on dry basis) for protein, lipids and ash: are 69.0%, 8.9%, 21.1%, and 61.8%, 6.1% and 29.5%. The figure for protein is not corrected for non-protein nitrogen as stipulated (IS: 4307, 1967). Offals which pose disposal problem are a source of pollution in fishery industries. Their proximate composition promises their utilization for manufacture of poultry feed. In four-lined sole, large-scaled sole, Malabar sole and Indian halibut, ash content of edible parts on dry basis respectively was 5.9%, 6.7%, 10.6% and 11.7%. In skin with or without scaling, it was 10.5% and 23.4% respectively.

Ash is rich in nutrient minerals: Na and K respectively were 137 ± 15 mg% and 263 ± 15 mg% in sole and 80–100 mg% and 800–1000 mg% respectively in halibut (Thurston, 1961), Ca, P and Fe content respectively in sole are 1100 mg%, 519.6 mg% and 10.14 mg% (CSIR, 1962).

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