J. mar. biol. Ass. India, 1979, **21** (1 & 2) : 86–90

BIOCHEMICAL COMPOSITION OF FROZEN AND DRIED CARANGID FISHES

V. K. VENKATARAMANI* AND GEORGE JOHN

Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamil Nadu.

ABSTRACT

Fresh, frozen and sundried tissues of twelve carangid species were analysed for protein, fat and moisture contents. Comparing all the species, fat content was found to be more in *Selaroides leptolepis* and protein was found to be more in *Atule mate*. Level of protein and fat contents in fresh, frozen and sundried specimens have been studied and their nutritive values are compared.

INTRODUCTION

CARANGID fishes form an important fishery in Porto Novo Coast and most of the landings are salted and sundried, the traditional method of preservation. Carangids, considered as lean, are protenicious and a knowledge of their biochemical composition and the amount of protein denaturation under different preservative methods will be helpful in assessing the merits of the method followed and for their improvement. Earlier works of Basu and De (1938), Chari (1948), Chari and Pai (1948), Sekharan (1949, 1950), Kamasastri (1961), Kamasastri and Rao (1965), Kamasastri *et al.* (1965), Nair (1965), Antony Raja (1969), Ramaiyan and Pandian (1976) and Solanki *et al.* (1976) deal with the proximate composition of several teleostean fishes, but no work has so far been carried out in carangids from our coast, regarding their nutritive values and on the effects of preservation. Presently moisture, protein and fat levels in 12 species of carangid fishes were estimated in fresh, frozen and sundried specimens for comparison.

The authors wish to acknowledge their grateful thanks to Dr. R. Natarajan, Director, CAS in Marine Biology, Parangipettai for the valuable suggestions and for critically going through the manuscript. The authors are indebted to the UGC, New Delhi for providing financial assistance.

* Present Address: Fisheries College, Tuticorin - 628 003, India.

MATERIAL AND METHODS

Specimens of *Alepes kalla* (Cuvier & Valenciennes), *Alepes macrurus* Bleeker, *Atule mate* (Cuvier & Valenciennes), *Alectis indicus* (Ruppell), *Atropus atropus* (Bleeker & Schneider), *Carangoides ciliarius* (Ruppell), *Carangoides chrysophrys* (Cuvier & Valenciennes), *Carangoides malabaricus* (Bleeker & Schneider), *Carangoides talamparoides* Bleeker, *Caranx sexfasciatus* Quoy & Gaimard, *Caranx williamsi* Smith and *Selaroides leptolepis* Valenciennes were collected from the shore seines catches at Parangipettai. All the specimens selected were between 95 and 144 mm (SL) and were females with maturing ovary. The muscle tissue below dorsal fin and above lateral line was used for biochemical analysis. Biochemical estimations were carried out after drying the tissue in an electric oven at 60°C.

Preservative methods

Freezing: To study the effects of freezing, specimens were stored at -6°C for a month, after removing the intestine and gills.

Sundrying: Fresh specimens were collected and were dried in the beach sand for four days at the atmospheric temperature between 26–30°C on all the four days. The moisture content was below 20% thus preventing the growth of moulds (Connell, 1975).

Protein was analysed colorimetrically by Biuret method (Raymont *et al.*, 1964). For the extraction of lipids, chloroform-methanol mixture (3:1) was used (Floch *et al.*, 1956). Preliminary analyses carried out in fresh tissue, showed that chloroform-methanol mixture extracted, not only the lipids but also considerable amount of salts (Giese, 1967). To avoid this a known amount of wet tissue was dried in an oven at 60°C and then lipids were extracted with chloroform-methanol mixture. Powdered oven dried tissue from fresh, frozen and sundried fish was used for lipid and protein estimations as oven drying to a constant dry weight minimises the water content whereby giving a uniformity. The moisture content of fresh, frozen and sundried tissues was estimated gravimetrically. Two grams of muscle was dried in an oven at 60°C till a constant dry weight was reached. The difference in the weight was taken and percentage of moisture level calculated.

Results

The protein and fat contents of fresh, frozen and sundried specimens were shown in Table 1. The results were given on dry weight basis. The moisture retention during various preservation methods was given in Table 2. The results were treated statistically and the ranges were expressed at 95% confidence level.

TABLE 1. *Protein and fat content under various preservative methods (Values in mg/100 mg dry weight; the ranges are expressed at 95% confidence level) N* - 100

Species		Fresh tissue	Frozen tissue	Sundried tissue
Alepes kalla	P :	86.04 ± 3.54	84.03 ± 3.52	65.62 ± 4.06
	F :	10.12 ± 0.94	10.05 ± 1.02	9.23 ± 1.81
Alepes macrurus	P :	83.06 ± 7.22	76.18 ± 6.13	70.62 ± 4.89
	F :	7.84 ± 1.13	7.85 ± 2.95	8.55 ± 1.68
Atule mate	P :	86.83 ± 8.94	76.64 ± 6.92	63.12 ± 5.86
	F :	7.66 ± 1.11	7.74 ± 3.42	7.80 ± 2.95
Alectis indicus	P :	78.85 ± 11.32	72.63 ± 6.05	55.83 ± 6.12
	F :	11.06 ± 4.21	10.02 ± 5.41	9.16 ± 1.06
Atropus atropus	P :	85.24 ± 8.02	82.16 ± 7.09	77.07 ± 6.52
	F :	8.52 ± 1.54	8.02 ± 1.11	8.13 ± 1.05
Carangoides chrysophrys	P :	83.65 ± 5.98	75.81 ± 5.91	64.79 ± 5.10
	F :	10.97 ± 0.94	8.18 ± 2.04	8.67 ± 1.61
Carangoides ciliarius	P :	81.79 ± 6.92	76.20 ± 5.29	69.46 ± 4.16
	F :	8.71 ± 1.62	8.05 ± 0.92	8.55 ± 1.31
Carangoides malabaricus	P :	82.63 ± 6.02	80.12 ± 6.92	54.62 ± 9.23
	F :	9.82 ± 1.62	8.62 ± 1.60	8.63 ± 2.13
Carangoides talamparoides	P :	79.98 ± 5.95	69.00 ± 4.19	65.49 ± 2.59
	F :	10.85 ± 2.75	8.47 ± 0.97	9.50 ± 3.06
Caranx sexfasciatus	P :	84.67 ± 5.17	77.42 ± 3.97	67.51 ± 6.87
	F :	9.08 ± 2.39	7.96 ± 2.95	7.70 ± 0.60
Caranx williamsi	P :	84.46 ± 4.81	78.13 ± 7.14	66.12 ± 12.65
	F :	8.68 ± 5.33	8.05 ± 2.37	9.07 ± 2.49
Selaroides leptolepis	P :	76.80 ± 8.02	60.78 ± 9.26	52.25 ± 7.25
	F :	11.34 ± 6.70	10.16 ± 6.21	10.92 ± 3.26

N = Number of specimens

Fresh tissue

The moisture content in all the twelve carangid species examined varied from 70.52–77.94% of wet weight. The minimum was noted in *S. leptolepis* and the maximum in *A. macrurus*. The protein content ranged from 76.80 to 86.83 mg/100 mg. The minimum was observed in *S. leptolepis* and the maximum in *A. mate*. The minimum fat content was observed in *A. mate* (7.66 mg/100 mg) and maximum in *S. leptolepis* (11.34 mg/100 mg).

The protein content in *S. leptolepis* (52.25 mg/100 mg) was minimum and maximum in *A. atropus* (77.07 mg/100 mg). The fat content ranged from 7.70 to 10.92 mg/100 mg in twelve carangid species (minimum in *C. sexfasciatus* and maximum in *S. leptolepis*).

Discussion

Of all the twelve carangid species studied presently, the apparent inverse relationship between oil and moisture and oil and protein content was obvious in the fresh tissues of *S. leptolepis*

Table 2. *Moisture retention under various preservative methods (Moisture value in percentage of wet weight) N*= 100

Species	Fresh tissue	Frozen tissue	Sundried tissue
Alepes kalla	75.19	53.16	8.05
Alepes macrurus	77.94	79.50	10.71
Atule mate	75.61	76.21	5.63
Alectis indicus	71.70	76.80	6.78
Atropus atropus	74.11	76.21	5.63
Carangoides chrysophrys	73.75	75.91	4.12
Carangoides ciliarius	74.72	75.78	5.15
Carangoides malabaricus	73.41	75.02	6.89
Carangoides talamparoides	71.21	73.56	6.46
Caranx sexfasciatus	73.62	76.72	10.15
Caranx williamsi	75.70	76.49	5.74
Selaroides leptolepis	70.52	73.46	7.34

N = Number of specimens

Frozen tissue

The moisture content in the frozen tissue ranged from 53.16 to 79.50% in twelve carangid species examined with the minimum in *A. kalla* and maximum in *A. macrurus*. The minimum protein content was observed in *S. leptolepis* (60.78 mg/100 mg) and maximum in *A. kalla* (84.03 mg/100 mg). The fat content ranged from 7.74 to 10.16 mg/100 mg in twelve carangid species (minimum in *A. mate* and maximum in *S. leptolepis*).

Sun-dried tissue

The moisture content in the sundried tissue ranged from 4.12 to 10.71% in twelve carangid species. The minimum was observed in *C. chrysophrys* and the maximum in *A. macrurus*. and *A. mate*. In *S. leptolepis* the protein and moisture values were lowest and of fat highest. In *A. mate* the fat content was lowest where as protein content was highest. In *A. macrurus* moisture level was highest and fat value was found to be lowest. This inverse relationship of fat to protein and moisture was because of the fact that the fat replaces some moisture and protein (Braekkan, 1956; Mannan *et al.*, 1961). The higher amount of fat and lesser amount of moisture and protein shows that *S. leptolepis* was more fattier compared to all the carangids examined.

On the basis of protein and oil contents of fresh tissue, Stansby (1962) has classified the proximate composition of fish in to five categories. According to his classification, the carangid fishes investigated belong to the category

B with medium oil content (5 to 15% dry weight basis). The protein content being high (17 to 23% in wet weight basis) are grouped under the category B and D (Stansby, 1962).

The protein content was high in fresh tissue compared to other states of preservation, probably due to lesser denaturation of proteins. High values in frozen condition compared to sundried tissue may be due to enzymes reduced or arrested at temperature below-1°C (Connell, 1975). In - 4°C stored cod muscles, Nowlan *et al.* (1975) found that those substances responsible for protein spoilage like trimethylamine and hypoxanthine and also the bacterial action, were arrested or highly reduced. Spencer and Baines (1964) observed that spoilage due to bacteria was arrested at –4°C. Dyer (1968) found that three quarters of the water is frozen at –4°C. According to Anderson *et al.* (1965) the temperature at which denaturation rate was maximum in freeze storage need not be the same for all the species nor for the same species in all conditions. In the frozen tissue loss or gain of moisture is slight and the only variation may be due to thawing (Bramsnaes, 1962).

The low protein value in sundried tissue, less than what was obtained under frozen conditions, may be due more to denaturation and break down of protein and to changes occurring in fatty substances (van Klaveren and Legendre, 1965). van Klaveren and Legendre (1965) showed in cods that endo and exopeptides are affected during drying. Connell (1975) has shown that loss of protein during drying may be due to denaturation of structural protein complex of muscle actomyosin. According to Cutting (1962) the effect of traditional sun drying on the nutritive value was probably very slight.

The lipid values in frozen and sundried condition did not show appreciable variations. Generally, however the lipid content was found to be somewhat high in fresh tissues than in the other status of preservation.

References

ANDERSON, M. L., M. A. STEINBERG AND F. J. KING 1965. Some physical effects of freezing fish muscle and their relation to protein fatty acid interaction. In: R. Kreuzer (Ed.) *The Technology of fish utilization*, Published by Fishing News (Books) Ltd., London. pp. 105-110.

ANTONY RAJA, B. T. 1969. *The Indian oil sardine Bull. cent. mar. Fish. Res. Inst.*, **16** : 128.

BASU, K. P. AND H. N. DE 1938. Nutritional investigation of some species of Bengal fish. Biological value of the proteins of ruhee (*Labeo rohita*) and *Hilsa* (*Clupea*) *ilisha* by the nitrogen balance and growth methods and supplementary effect of fish on pulse proteins. *Indian J. med. Res.*, **26**: 177-189.

BRAEKKAN, O. R. 1956. Function of red muscle in fish. *Nature*, **178**: 747-748.

BRAMSNAES, F. 1962. The influence of refrigeration and canning on the nutritive value of fish. In: Heen & R. Krenzer (Eds.) *Fish in Nutrition*. Published by Fishing News (Books) Ltd., London. pp. 153-160.

CHARI, S. T. 1948. Nutritive value of some of the west coast marine food fishes of the Madras Province. *Indian J. med. Res.*, **36**: 253-259.

———— AND P. A. PAI 1948. Fish meal from shoaling fishes of the Madras Presidency and their role in animal nutrition. *Indian Farming*, **9**: 358-363.

CONNELL, J. J. 1975. *Control of fish quality*. Published by Fishing News (Books) Ltd., London.

CUTTING, C. L. 1962. The influence of drying, salting and smoking on the nutritive value of fish. In: E. Heen & R. Krenzer (Eds.) *Fish in Nutrition*. Published by Fishing News (Books) Ltd., London. pp. 161-179.

DYER, W. J. 1968. Deterioration and storage life of frozen fish. In: J. Hawthorn (Ed.) *Low temperature biology of food stuffs*. Pergamon Press, New York, N. Y. pp. 429-447.

FLOCH, J., M. LEES AND G. H. SLOANE STANLE 1956. A simple method for the isolation and purification of total lipids from animal tissues. *J. Biol. Chem.*, **226**: 497-502.

GIESE, C. A. 1967. Some methods for study of the biochemical constitution of marine invertebrates. *Oceanogr. Mar. Biol. Ann. Rev.*, **5**: 159-186.

KAMASASTRI, P. U. 1961. Studies on Indian sardine oil. *Indian J. Fish.*, **7**: 443-447.

———— AND D. R. RAO 1965. Studies on Indian fish meal Part I. Chemical composition and storage characteristics of fish meals prepared from different types of fishes. *Ibid.*, **9**: 108-117.

————, P. U. PRABHU AND D. R. RAO 1965. Further studies on the Indian sardine oil. *Ibid.*, **9**: 84-90.

MANNAN, A., D. I. FRASER AND W. J. DYER 1961. Proximate composition of canadian Atlantic fish I. Variation in composition of different section of the flesh of Atlantic halibut *H. hippsoglossus*. *J. Fish. Res. Bd. Canada*, **18**: 93-96.

NAIR, M. R. 1965. A preliminary study of the changes associated with lipid breakdown in oil sardine *(S. longiceps)* stored at refrigerated temperature. *Indian J. Fish.*, **9**: 126-132.

NOWLAN, S. S., W. J. DYER AND R. A. KEITH 1975. Temperature and deteriorative changes in post-rigor cod muscle stored upto 14 days in the Super chill Range, –1 to – 4°C. *J. Fish. Res. Bd. Canada*, **32** (9): 1595-1605.

RAMAIYAN, V. AND AL. PAUL PANDIAN 1976. Biochemical studies on the fishes of the order Clupeiformes. *J. mar. biol. Ass. India*, **18** (3): 516-524.

RAYMONT, J. E. G., J. AUSTIN AND E. LINFORD 1964 Biochemical studies on marine zooplankton. The Biochemical composition of *Neomysis integer*. *J. Com. perm. int. Explor. mer.*, **28**: 354-363.

SEKHARAN, K. V. 1949. Feeding and maturity in relation to fats in the musculature of the rainbow sardine *Dussumieria acuta* (Cuv. & Val.). *J. Madras Univ.*, **18**: 38-48.

———— 1950. Fat contents of the muscles of the Indian herring *Pellona hoevenii* (Blkr.). *Ibid.*, **20** (3): 49-65.

SOLANKI, K. K., M. K. KANDORA AND R. VENKATARAMAN 1976. Seasonal variation in the chemical composition of pomfret *(Pampus argenteus)*. *Fish. Technol.*, **13** (1): 49-53.

SPENCER R. AND C. R. BAINES 1964. The effect of temperature on the spoilage of wet white fish. *Ibid.*, **18**: 175-179.

STANSBY, 1962. Amino acid composition of fresh fish and influence of storage and processing. In: E. Heen and R. Krenzer (Eds.) *Fish in Nutrition*. Fishing news (Books) Ltd., London. pp. 6-67.

VAN KLAVEREN, F. W. AND R. LEGENDRE 1965. Salted cod. In: George Borgstrom (Ed.) *Fish as Food*. Academic Press, New York and London, **3**: 133-160.