Fishery Technology
1995, Vol. 32(2) pp : 102 - 107

Biochemical Composition of *Nemipterus japonicus* and *Nemipterus mesoprion* in Relation to Maturity Cycle

T. Sophy John* and M. Shahul Hameed
Department of Industrial Fisheries
Cochin University of Science and Technology
Cochin - 682 016, India

The biochemical compositon of *Nemipterus japonicus* and *N. mesoprion* was studied in different maturity stages. In both the species, the muscle had more fat and soluble protein during the immature phase. Early stages of maturation, hence offer greater food value in these species. With the advancement of maturity a drop in the fat and soluble protein was observed, whereas a linear relationship with moisture was noted from immature to mature stage. The composition of muscle always demonstrated an inverse relationship with hepatic and gonadal composition.

Key words : **Biochemical composition, maturity cycles, *Nemipterus japonicus*, *Nemipterus mesoprion*.**

It is well established that most of the biochemical constituents of fishes are subject to marked seasonal change, which have been attributed to factors such as maturation, spawning, age, growth and feeding. Information is available regarding the chemical composition and nutritive value of many estuarine and marine fishes but the data on the biochemical composition of nemipterid fishes are meagre. Nemipterids constitute a major fishery rsource in India. The present investigation was undertaken to study the biochemical constituents in different body tissues like muscle, liver and gonad and their variation in relation to sex and maturity cycle in *Nemipterus japonicus* and *N. mesoprion*.

Materials and Methods

Fresh specimens of *Nemipterus japonicus* and *N. mesoprion* were collected from the various fish landing centres in Cochin. The fishes after collection were packed in ice and immediately brought to the laboratory. In the laboratory they were washed thoroughly and the surface moisture was removed by blotting. 8-10 fishes of each sex and maturity stage were used for the present study. The biochemical changes in relation to maturity cycles were studied after classifying the five maturity stages based on the microscopic appearance of the gonads and changes in the colour of the gonads during maturation. The five maturity stages were stage I (immature), Stage II (maturing and recovering spent), Stage III (mature), Stage IV (ripe), and Stage V (spent).

The muscular, hepatic and gonadal tissues were dissected, weighed to the nearest mg, placed in separate vials and dried to constant weight in a hot air oven at 80°C. Dried samples were powdered and stored in a dessicator for further analyses. The water content in the tissues were expressed as percentage of wet weight while the other constituents were expressed as percentage of dry weight. The weight difference between wet and dried tissues expressed as percentage of wet

* Present address : School of Marine Sciences, Cochin University of Science and Technology, Cochin - 682 16, India

weight, denoted the moisture percentage levels. The methods of Barnes and Blackstock (1973) was used to estimate the total lipid levels. Alkali (1% NaOH) soluble protein in the tissues were determined by the method of Lowry *et al.* (1951) using bovine serum albumin as the standard. The method proposed by Kemp and Kitz (1954) was used for the estimation of total carbohydrates from the dried tissues. The ash content was determined from the weight of dried sample ignited at 600°C for 24 h.

Results and Discussion

The maturation of gonads of *N. japonicus* and *N. mesoprion* under study was accompanied by considerable changes in the moisture content of various tissues. The moisture percentage of the muscle was minimum in immature (Stage I) and high in ripe (Stage IV), but decreased in the spent stage (Stage V). The flesh moisture content gradually increased from immature to the ripe fishes. Dambergs (1964) reported that the water level of the muscle tissue increases with maturation. In the liver, the highest water content was recorded in immature fishes, which decreased as fish reached maturity and increased in the spent stage. The gonadal water content also showed similar behaviour. The advancement towards maturity was associated with a very rapid fall of moisture in the ovaries and the lowest values coincided with peak ripeness as observed by Craig (1977) in perches. It was also found that in *N. japonicus*, the water content in the gonad generally showed a slightly higher value for the males whereas in the muscle the females had higher values (Fig. 1a & 2a).

Maturation resulted in an extensive depletion of lipid reserves in the flesh. In both the nemipterids, irrespective of the sex, the maximum level of muscle fat in immature fishes declined to a minimum level on the attainment of maturity (Fig. 1b; 2b). Depletion of fat from the immature to the ripe stage in the body muscle was observed by Lovern and Wood (1937) and Sathyashree (1981). The hepatic fat content gradually increased from immature to mature fishes (Stage III). But then, it showed a decline during ripe and spent stages in both the species. Highest values of liver fat preceded peak ripeness of gonads and with the onset of spawning, a drain in the liver fat seemed to occur. The advancement of maturation was accompanied by increase in gonadal fat, reaching maximum values during ripe stage (Stage IV).

Utilization of the stored lipids for the growth of sexual cells and energy metabolism had been reported by several authors (Bull, 1928; Schehepkin, 1972; Mc Day 1978). Similar observations on *N. japonicus* has been reported by Krishnaveni (1986). The decline in muscle fat from immature to ripe fishes indicates that the build up of fat occurs first in the muscle and was perhaps subsequently diverted to gonads. The depletion of liver fat from mature to spent fishes suggests that the utilization of muscle fat alone did not fulfil the demands of gonadal maturation and hence liver fat was also utilized at final stages of maturation.

The changes in fat of in all the three tissues showed an inverse relationship with the moisture content in the nemipterids. This relationship has been noted in various other fishes and also in nemipterids itself by Krishnaveni (1986).

Alkali soluble protein (ASP) percentage in all the three tissues of both *N. japonicus* and *N. mesoprion* male and female followed a similar trend as that of fat, during the maturity cycle. The ASP in

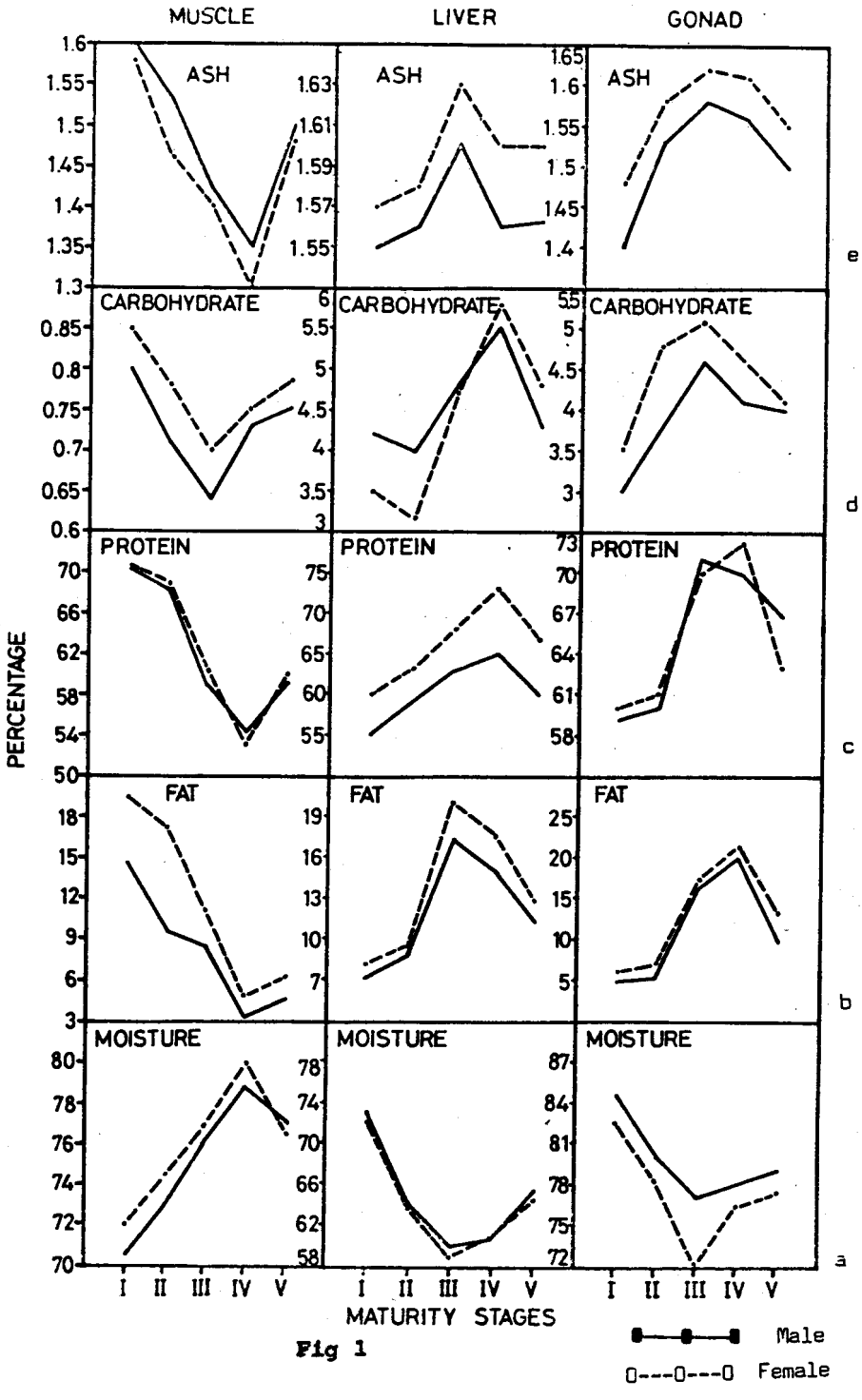

Fig 1

Fig. 1. Moisture (% wet weight) protein, fat, carbohydrate and ash (% dry weight) content in muscle, liver and gonad of *Nemipterus japonicus* in relation to maturity stages.

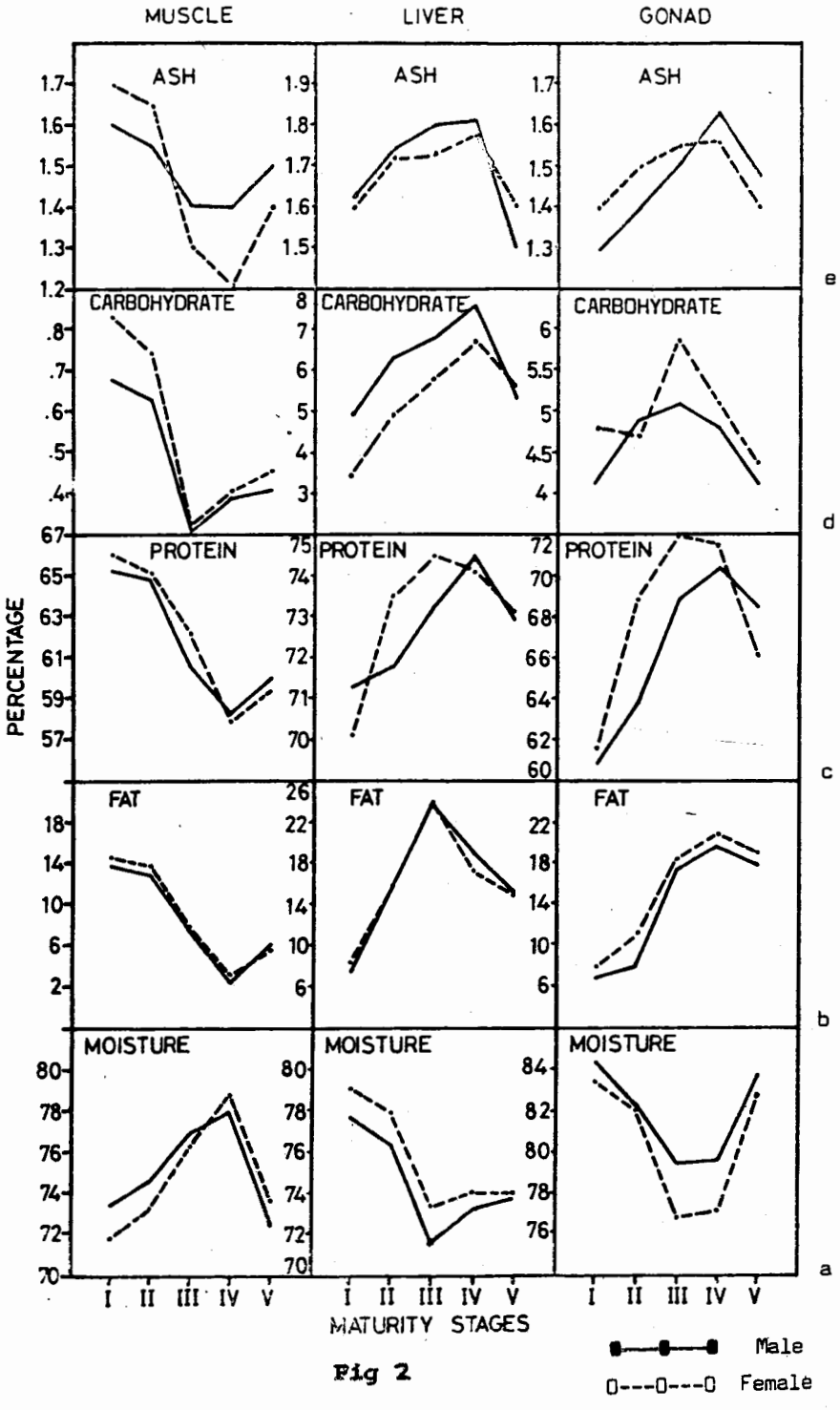

Fig. 2. Moisture (% wet weight) protein, fat, carbohydrate and ash (% dry weight) content in muscle, liver and gonad of *Nemipterus mesoprion* in relation to maturity stages.

muscle gradually declined from immature to ripe fishes and increased again when the fishes reached spent stage (Fig. 1c; 2c).

The ASP in liver increased from immature to ripe fishes. The increase in the ASP of liver and gonads toward ripeness in nemipterids could possibly be due to the increased feeding during maturation of these fishes. The decline in soluble liver protein from mature/ripe to spent stage was evident in both sexes. Expenditure of soluble liver protein for the purpose of germ building at later stages of maturation has been observed by Sorvachev and Shakunovski (1968).

In both the sexes the highest ASP level in gonads was recorded in mature/ripe fishes. Its steep rise in the gonads of maturing/mature fishes indicated a peak period of synthesis and mobilisation of soluble proteins as gonad build up advances. An inverse relationship was discernible also between moisture and ASP in all the tissues.

Physical exhaustion can be studied by means of carbohydrate analysis in mammals, but not in fish. This was evident from the low value of carbohydrate in the flesh of nemipterids (Fig. 1d; 2d). The muscle carbohydrate declined from immature to mature fishes, reaching as low as 0.30% (*N. mesoprion* male). This may be possibly due to the conversion of muscle fat into carbohydrate through glyconeogenesis to maintain an adequate glucose level, necessitated both by the greater muscular activity and maturation of the gonads, as evidenced by the decrease of muscular fat during the ripe stage.

In nemipterid liver the carbohydrate percentage increased from immature to ripe stage and declined during spent stage. In the early stages of maturation of *N. japonicus* the carbohydrate content of males were 50-100% greater than in the females, but the picture was reversed immediately before spawning. Bogoyablenskya and Vel'tischcheva (1972) concluded that, though much of the energy for fishes comes from glyconeogenesis, a greater vigour for this mechanism has been found in the males, and the onset of spawning causes expenditure of lipid from the body of females and glycogen from the males.

The gonadal carbohydrate content which increased from immature to mature fishes decreased during ripe and spent stages. A possible explanation at this juncture would be that when fat and protein have accumulated in the gonad, the role of carbohydrate becomes negligible. However, Greene (1921) and Yanni (1961) report that glycogen and glucose both have been found to accumulate in the ovary during maturation. But the changes in the carbohydrate reserves of the fish seem mostly to reflect the requirements of the developing ovaries. The carbohydrate percentage did not exhibit any distinct relation to the moisture content in general, but a slightly inverse relationship in gonads could be observed.

The inorganic ions in relation to maturation show changes of a random nature (Love, 1970). In the nemipterids studied, ash content of the flesh decreased from immature to mature/ripe stage but increased in the liver and gonad. The decrease from ripe to spent gonads indicates the withdrawl and utilization of minerals for egg build up. Another probable reason could be that the nemipterids feed maximum during mature and ripe stages. The ash content showed inverse relationship with the moisture percentage in the present study. Maturation was accompanied by an increase in the water content of the muscle. The water

content in the muscle, liver and gonad showed an inverse relationship with the ash content in male nemipterids.

Certain conclusions can be arrived for better understanding of the nutritive value of nemipterid fishes and their dietary significance. The moisture and fat content showed an inverse relationship in all the tissues. The soluble muscle protein and fat were at the maximum level in the early stages of maturation. The ash content was at the peak in the early stages of maturation. Hence, large sized fish during the early stages of maturation which have high fat and protein content in the muscle, are at the optimum stage for use as food.

References

Barnes, H. & Blackstock, J. (1973) *J. Exp. Mar. Biol. Ecol.* **12**, 103

Bogoyablenskaya, M.P. & Vel'tischcheva, I.F. (1972) *Fish. Res. Bd. Can. Transl. Ser.* **1**, 27

Bull, H.O. (1928) *J. Mar. Biol. Assoc. U.K.* **15**, 207

Criag, J.O. (1977) *J. Anim. Ecol.* **46**, 617

Dambergs, N. (1964) *J. Fish. Res. Bd. Can.* **21**, 207

Greene, C.W. (1921) *J. Biol. Chem.* **48**, 59

Kemp, A. & Kitz, V., H. (1954) *Biochem. J.* **56**, 646

Krishnaveni, N. (1986) *Biology, Biochemical Composition and Population Identification of the Threadfin bream Nemipterus japonicus* Ph.D. Thesis, Annamalai University, Chidambaram, India

Love, R.M. (1970) *The Chemical Biology of Fishes*, Vol. 1 Academic Press, London, UK

Lovern, T.A. & Wood, H. (1937) *J. Mar. Biol. Assoc. U.K.* **22**, 281

Lowry, O.H., Roseberg, N.J., Farr. A.L. & Randall, R.J. (1951) *J. Biol. Chem.* **193**, 265

Medford, B.A. & Mc Kay, W.C. (1978) *J. Fish. Res. Bd Can.* **35**, 213

Sathyashree, P.K. (1981) *Biological and Biochemical Studies in Grey Mullets of Port Novo, South India* Ph.D. Thesis, Annamalai University, Chidambaram, India

Schehepkin V.Y. (1972) *Vop. Ikthy.* **11**, 697

Sorvachev, K.F. & Shakunovski, M.I. (1968) *Ekol. Freski. Servernoi Atlantiki*, **24**, 133

Yanni, M. (1961) *Vergl. Physiol.* **49**, 130