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# Lipid Profile and Fatty Acid Composition in Eggs of Indian Featherback Fish Pholui (*Notopterus notopterus* Pallas) in Comparison with Body-Tissue Lipid

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**Abstract**: The lipid class and fatty acid composition in eggs of Indian fresh water common featherback fish Pholui (*Notopterus notopterus* Pallas) has been studied in comparison with body tissue lipid. The mean wet weight of matured eggs are 16.3% of total weight of fish, of which 11.5% (on dry basis) is lipid. The eggs contain 6.8 times higher lipid content than that of body tissue. The major portion of the egg lipid is composed of triacylglycerol (TAG) of about 53.8% followed by the amount of phospholipid (PL, 37.0%). Among the PLs, phosphatidylcholine (PC) is predominant (about 57.1%), followed by phosphatidylethanolamine (PE, 25.7%) and phosphatidylinositol (PI, 17.4%). In body tissue lipid, the major fraction is phospholipid (72.5%) which is significantly higher than in the egg lipid (37.0%). The predominant PL fraction in body tissue is PC (51.6%) followed by PE (28.1%) and PI (20.2%). In body tissue, TAG is about 18.0% which is lower than egg TAG (53.8%). Cholesterol (CHL) contents in egg and body tissue are about 4.4% and 0.7% respectively. Total Polyunsaturated fatty acids (PUFAs) are 37.9% and 36.0% in egg and body tissue PL fractions respectively. The arachidonic acid (20:4 n-6, AA) and the eicosapentaenoic acid (20:5 n-3, EPA) in body PL are about 16.5% and 10.6% where as in egg PL fraction, AA and EPA are about 10.7% and 10.6% respectively. The findings and results of the study indicate that *Notopterus notopterus* body tissue and eggs both are rich in PUFAs along with high PL content in body tissue which are very much essential for human health and membrane development.

**Key words**: *Notopterus notopterus*, egg, body tissue, lipid, fatty acid

## 1 Introduction

*Notopterus notopterus* Pallas is a silvery white featherback fish commonly known as "Pholui" in west Bengal, India. This species belonging to the family notopteridae, mainly inhabits freshwater and brackish water of Pakistan, India, Nepal, Bangladesh, Burma, Thailand, Malaysia and Indonesia. *N. notopterus* appears to thrive well in lentic waters. It is common in tanks throughout the greater parts of India. Owing to its carnivorous nature, this fish can only be cultivated in wild waters or in fattening ponds in which large fishes are present. It breeds in stagnant waters or running waters in the rainy season. A ripe female bears relatively fewer eggs, they are laid in small clumps on submerged vegetation. This fish is relished both in fresh and dried state. Soup made from it is reported to be given in measles. Though several workers have investigated bionomics and breeding of *N. notopterus*, no worth while attempt towards its culture in India has been made (1). The

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research work on Indian fresh water or brackish water fish egg lipids and their biochemical and nutritional significance of essential fatty acids are scares, taking into consideration the impact of the fish brood on the quality of the eggs. A great deal of work has already been done on the lipid composition of fish eggs of marine and fresh water species and their probables correlation with the fertilization and embryonic development in fish (2-5). The egg quality of fresh water fishes are measured as hatchability and other parameters and are related to the content of fatty acids in eggs (6). For marine fish, high content of n-3 PUFAs in eggs and larvae are required for successful development of larvae (7).

The lipid nutrition in fish suggests that certain larval stages require PL in their diets (8,9). The essentiality of PL from carp larvae (*Cyprinus carpio* L.) have also been studied (10,11). Carp larvae can be fed exclusively on semipurified diet and strongly react to PL supplementation (10).

In our continuous research programme we have already studied lipid profile and fatty acid composition in eggs of *Cyprinus carpio* L. (12). In the present study, investigation has been made on the lipid profile of *N. notopterus* eggs of Indian origin to find out whether egg lipids contain any important fatty acids in significant proportions, their nutritional significance in fish and also in human beings on the basis of essential fatty acids present in both neutral and PL fractions.

## 2 Experimental

### 2·1 Sample Collection and Lipid Extraction

Fresh matured unfertilized eggs of *N. notopterus* of six different living gravid females weighing about 75.3 g. were collected during rainy season (spawning season) from fisherman in the time of netting at Sodepur, Kolkata, West Bengal, India. The eggs and body tissue sample from different body parts of the respective six fishes were collected and stored separately in glass vials containing chloroform/ methanol (2:1, v/v) and 0.01% (w/w) butylated hydroxy toluene (BHT) at −20℃ prior to extraction.

The total lipid was extracted from body tissues and eggs individually by the extraction method of Folch *et al*.(13). After extraction, chloroform was removed under the stream of nitrogen and finally the lipid was dried under vacuum and stored separately at −20℃ for analysis.

### 2·2 Lipid Analysis

The isolated lipids were mainly a mixture of PL, cholesterol (CHL) and triacylglycerol (TAG) with a trace amount of diacylglycerol (DG), monoacylglycerol (MG) and hydrocarbon as identified distinctly on thin layer chromatographic (TLC) plate (Silicagel G; solvent system hexane /diethyl ether, 70:30 v/v) with phosphate stain, standard cholesterol, TAG, DG, MG and hydrocarbon.

The major lipid class components of PL and TAG were separated on a preparative TLC plate (20 cm × 20 cm) with the above solvent system, and the individual fractions were extracted with diethyl ether.

The total cholesterol was estimated according to the standard method of Zlatkis *et al*. (14).

The total fatty acid composition of the lipid and of the isolated TAG and PL were determined by Gas-liquid chromatography (GLC) method after derivatization into methyl esters as mentioned in our previous publication (12).

## 3 Results and Discussion

Six different body tissues and eggs of the respective individual fish of *N. notopterus* were analysed separately and total lipid content and their lipid class compositions are shown in **Table 1**. Mean wet weight of matured eggs are 16.3% of the total weight of fish. The lipid content of egg is about 11.5% (on dry basis) which is higher in comparison with body tissue lipid content (about 1.70%). The major portion of both the egg and body tissue lipid is composed of mainly PL (about 37.0 % in egg and 72.5% in body tissue), TAG (about 53.8% in egg and only 18.0% in body tissue) and CHL (about 4.4% in egg and only about 0.7% in body tissue lipid) as shown in **Fig. 1**. Besides these components trace amount of monoacylglycerol (MG), diacylglycerol (DG), fatty acids and hydrocarbons are observed in the thin layer chromatographic plate.

PLs present in the total lipid of both egg and body tissue are fractionated to determine the individual components (**Table 2**). Among the PLs most abundant is phosphatidylcholine (PC) about 57.1% and 51.6% respectively in egg and body tissue. Phosphatidylethanolamine (PE) is about 25.7% and 28.1% in egg and body tissue respectively (**Fig. 2**). The other

**Table 1** Lipid Content and Lipid Class Composition in Eggs and Body Tissue of Pholui (*Notopterus notopterus*)*.

| | | |
|---|---|---|
| Total weight of fish (wet weight in g.) | | 75.3 ± 1.39 |
| Weight of fish eggs (wet weight in g.) | | 12.3 ± 1.38 |
| Moisture content in fish eggs (%) | | 59.3 ± 1.16 |
| Moisture content in body tissue (%) | | 54.5 ± 1.00 |
| Lipid content (%dry weight) in eggs | | 11.5 ± 0.43 |
| Lipid content (% dry weight) in tissue | | 1.70 ± 0.10 |
| Lipid class composition (% of total lipid) | Eggs | Body tissue |
| Phospholipid (%) | 37.0 ± 0.85 | 72.5 ± 1.48 |
| Cholesterol (%) | 4.4 ± 0.25 | 0.7 ± 0.10 |
| Triacylglycerol (%) | 53.8 ± 0.73 | 18.0 ± 0.71 |

* Values are mean ± SE, n = 6

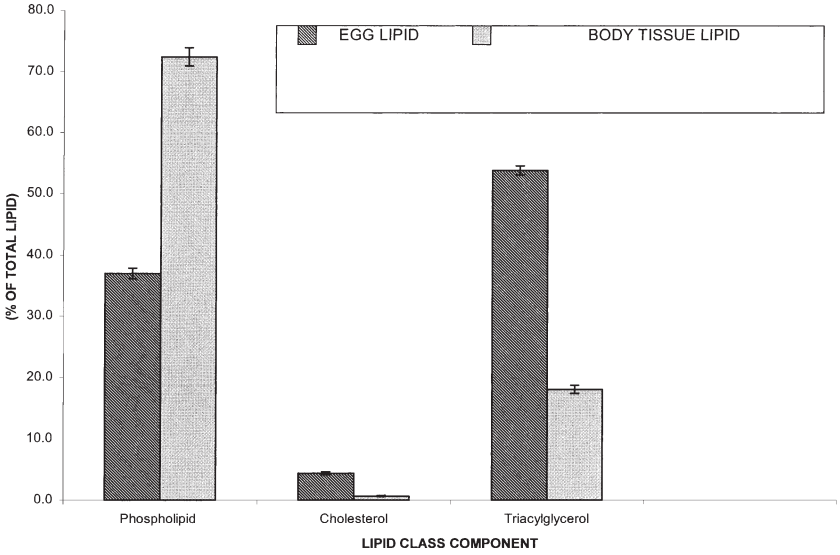


**Fig. 1** Comparative Study on Lipid Class Composition (% of Total Lipid) in Egg and Body Tissue of *N. notopterus.*

**Table 2** Major Phospholipid Fractions (% of Total Phospholipid) in the Eggs and Body Tissue of Pholui (*Notopterus notopterus*)*.

| PL fractions | Egg | Body tissue |
|---|---|---|
| Phosphatidyl choline (PC) (%) | 57.1 ± 1.86 | 51.6 ± 0.72 |
| Phosphatidyl inositol (PI) (%) | 17.4 ± 1.25 | 20.2 ± 1.03 |
| Phosphatidyl ethanolamine (PE) (%) | 25.7 ± 1.34 | 28.1 ± 0.55 |

* Values are mean ± SE, n = 6

PL fraction, phosphatidylinositol (PI) is about 17.4% in egg and 20.2% in body tissue.

PL is the major lipid fraction in the body tissue of *N. notopterus* where as TAG is the predominant fraction in egg lipid. Both in egg and body tissue phospholipid, PC is the predominant fraction. PC is long been known for its structural role in eggs. PC is also implicated as a very important metabolic precursor in eggs and larvae of many marine fishes. PC is catabolised in halibut plaice (*Pleuronectes platessa*) and turbot during embryogenesis, prior to first feeding (15). Fresher *et al.* (8) also showed that PC was a source of metabolic energy and a source of essential fatty acid (EFA), organic phosphorous in eggs and larvae of Cod (*Gadus morhua*). Evans *et al*. (4) showed that PC was playing an important role after fertilization for Atlantic halibut (*Hippoglossus hippoglossus*). High amount of PC in eggs of *N. notopterus* will definitely play a significant role during embryogenesis.

Fatty acid composition of total lipid, TAG and PL fractions both in eggs and body tissues are shown in **Table 3**. Among the saturated fatty acids most abundant is palmitic acid (16:0), about 33.7%, 34.3% and 22.5% in body tissue total lipid, TAG and PL fractions respectively where as in egg, palmitic acid is about 37.9%, 48.3% and 22.1% in total lipid, TAG and PL fractions respectively. The monoenoic fatty acids are represented by two major components palmitoleic (16:1) and oleic acids (18:1). Both in egg and body tissue oleic acid (18:1) is significantly higher than palmitoleic acid. Arachidonic acid (20:4 n-6 AA) and docosahexaenoic acid (22:6 n-3 DHA) in the PL fraction of egg lipid are about 10.7% and 11.2% whereas in body tissue lipid AA and DHA are 16.5% and 4.2% in PL fraction. Eicosapetaenoic acid (20:5 n-3 EPA) is the major HUFA component. EPA is about 11.3%, 7.8% and 10.6% in body tissue total lipid, TAG and PL respectively in comparison with about 5.9%, 3.0% and 10.6% in egg total lipid, TAG and PL fraction respectively. So, it is clear that polyunsaturated fatty acids are accumulated mainly in the PL fraction than in TAG both in egg and body tissue.

Fresh water fish species is mainly characterised by high proportion of n-6 PUFA. About 20.3 % and 15.6% n-6 and n-3 PUFAs are accumulated in the body tissue PL where as 23.7% and 14.1% n-3 and n-6 PUFAs are accumulated in egg PL fraction. Therefore, the ratio of total n-3 to n-6 fatty acid is ranging from 0.8 to 1.7 which is very much significant for fresh water fishes.

The nutritional significance of n-3 fatty acids like EPA and DHA have been extensively investigated due to low incidence of coronary heart disease among populations who consume large amount of fish (16). Marine fishes are rich in n-3 PUFAs. Compared with marine fish, fresh water fishes contain high amount of $C_{18}$ PUFAs and also substantial amount of EPA and DHA (17). A significant amount of EPA both in body tissue and egg along with remarkable amount of DHA in egg PL also supports the previous findings observed by others. Fresh water fish species are also able to desaturate and elongate larger quantities of $C_{18}$ n-6 and n-3 PUF A to $C_{20}$ and $C_{22}$ desaturates (2,18,19). Soup made from

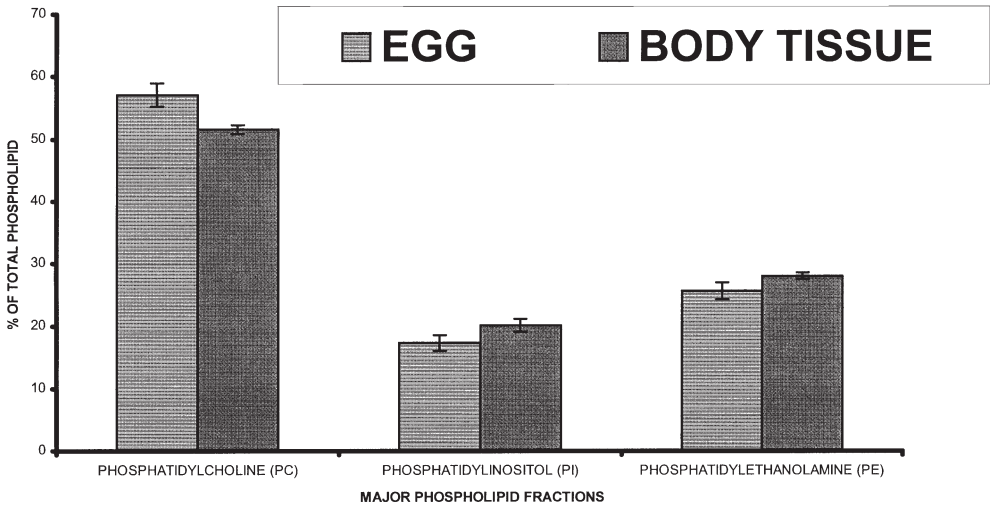


**Fig. 2** Distribution of Major Phospholipid Fractions in Eggs and Body Tissue of *N. notopterus*.

**Table 3** Fatty Acid Composition of Egg Lipid and Body Tissue Lipid of Pholui (*Notopterus notopterus*)*.

| | Fatty acid composition (% w/w) in | | | | | |
|---|---|---|---|---|---|---|
| | Body tissue lipid | | | Egg lipid | | |
| Fatty acid | TOTAL | TAG | PL | TOTAL | TAG | PL |
| 14 : 0 | 3.5 ± 0.18 | 6.1 ± 0.02 | 0.1 ± 0.0 | 1.6 ± 0.14 | 2.1 ± 0.34 | 0.2 ± 0.03 |
| 16 : 0 | 33.7 ± 0.33 | 34.3 ± 0.11 | 22.5 ± 0.16 | 37.9 ± 1.77 | 48.3 ± 0.74 | 22.1 ± 1.52 |
| 18 : 0 | 4.1 ± 0.14 | 7.1 ± 0.04 | 2.4 ± 0.13 | 8.1 ± 0.25 | 4.3 ± 0.12 | 10.6 ± 0.22 |
| 20 : 0 | 1.4 ± 0.02 | 0.8 ± 0.01 | 0.3 ± 0.01 | 0.8 ± 0.09 | 1.6 ± 0.11 | 1.0 ± 0.11 |
| 22 : 0 | 1.1 ± 0.10 | 0.9 ± 0.02 | 0.5 ± 0.0 | 0.5 ± 0.05 | 0.4 ± 0.04 | 0.7 ± 0.03 |
| 24 : 0 | 0.8 ± 0.04 | 0.8 ± 0.0 | 0.6 ± 0.0 | 1.8 ± 0.06 | 0.4 ± 0.04 | 1.8 ± 0.06 |
| TOTAL SATURATES | 44.6 ± 0.25 | 50.1 ± 0.08 | 26.4 ± 0.21 | 50.7 ± 1.66 | 57.0 ± 0.91 | 36.1 ± 1.29 |
| 14 : 1 | 0.9 ± 0.0 | 0.5 ± 0.0 | 0.3 ± 0.03 | 0.7 ± 0.04 | 0.8 ± 0.07 | 0.0 |
| 16 : 1 | 8.1 ± 0.16 | 12.5 ± 0.07 | 0.7 ± 0.02 | 3.3 ± 0.24 | 4.6 ± 0.21 | 3.6 ± 0.47 |
| 18 : 1 | 19.4 ± 0.14 | 19.5 ± 0.14 | 36.7 ± 0.09 | 23.9 ± 0.39 | 20.8 ± 0.38 | 22.2 ± 0.25 |
| TOTAL MONO UNSATURATES | 28.3 ± 0.28 | 32.5 ± 0.09 | 37.8 ± 0.09 | 29.8 ± 1.79 | 26.2 ± 0.34 | 25.8 ± 0.56 |
| 18 : 2 (n-6) | 5.5 ± 0.09 | 4.4 ± 0.04 | 3.9 ± 0.14 | 5.2 ± 0.43 | 5.4 ± 0.26 | 3.4 ± 1.51 |
| 20 : 4 (n-6) | 7.7 ± 0.12 | 3.1 ± 0.02 | 16.5 ± 0.12 | 4.9 ± 0.68 | 3.4 ± 0.09 | 10.7 ± 0.29 |
| 20 : 5 (n-3) | 11.3 ± 0.10 | 7.8 ± 0.03 | 10.6 ± 0.14 | 5.9 ± 0.17 | 3.0 ± 0.55 | 10.6 ± 0.74 |
| 22 : 5 (n-3) | 0.5 ± 0.06 | 0.4 ± 0.02 | 0.6 ± 0.02 | 0.8 ± 0.06 | 0.7 ± 0.08 | 1.9 ± 0.17 |
| 22 : 6 (n-3) | 1.9 ± 0.04 | 1.6 ± 0.02 | 4.2 ± 0.28 | 4.6 ± 0.68 | 4.2 ± 0.20 | 11.2 ± 0.17 |
| TOTAL PUFA | 26.9 ± 0.21 | 17.4 ± 0.07 | 36.0 ± 0.26 | 21.4 ± 1.75 | 16.8 ± 0.96 | 37.9 ± 0.85 |
| (n-3) total | 13.6 ± 0.05 | 9.8 ± 0.02 | 15.6 ± 0.07 | 11.4 ± 0.05 | 8.3 ± 0.03 | 23.7 ± 0.23 |
| (n-6) total | 13.0 ± 0.11 | 7.5 ± 0.03 | 20.3 ± 0.27 | 10.0 ± 0.06 | 8.9 ± 0.05 | 14.1 ± 0.08 |
| (n-3) / (n-6) | 1.05 ± 0.01 | 1.3 ± 0.03 | 0.8 ± 0.01 | 1.1 ± 0.03 | 0.9 ± 0.02 | 1.7 ± 0.05 |

* Values are mean ± SE, n = 6

*N. notopterus*, is being reported to be helpful during measles in different states of India (1). Most probably the soup containing high amount of phospholipid and low cholesterol along with substantial amount of essential fatty acids is very much beneficial for damaged membrane development. The dried fish is also very important in fishery for brood stock diet specially for high PL, essential fatty acid and low cholesterol value.

## 4 Conclusion

The results show that *N. notopterus* fish as a whole along with its eggs are very rich in phospholipids and PUFAs. A major portion of PUFAs are distributed in the respective PL fractions. This information should help in aquaculture of *N. notopterus* and also may be helpful to evaluate the nutritional significance of the fish along with its eggs.

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