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# Lipid Profiles of Turtle (*Aspideretes gangeticus*) Organs

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**Abstract**: Total lipid was extracted from four organs of the turtle *Aspidertes gangeticus* namely liver, muscle, eye and brain. Lipids like phospholipid and cholesterol were estimated in the total lipids. Fatty acid compositions of the total lipids were also determined. *A. gangeticus* liver shows a much higher content of total lipid (11.2%) than in muscle (0.5%). Phospholipid content is more in brain (6.5%) and muscle (7.2%) than in liver (2.4%) and eye (1.5%). Cholesterol occurs in brain (12.6%), eye (7.6%) and muscle (6.1%). The phospholipid and cholesterol ratio is maximum in muscle (1.1), gradually lowering in liver (0.8), brain (0.5) and eye (0.2) in the proportions indicated. In turtle all the organs studied are rich in palmitic ($C_{16:0}$) and stearic ($C_{18:0}$) acids. The amount of saturated fatty acid is more or less in equal proportion in the organs like eye (36.7%) and liver (37.9%). Turtle muscle and liver are more rich in polyunsaturated fatty acids in comparison with the other organs. Liver is enriched in the monoenoic $C_{18:1}$ acid (38.2%) that is relatively much less in brain (16.9%), eye (16.6%) and muscle (15.6%), respectively. Eicosapentaenoic acid ($C_{20:5}$) is especially high in *Aspideretes* eye (12.9%). Arachidonic acid ($C_{20:4}$) is present in all the tissues studied.

**Key words**: *Aspideretes gangeticus*, fatty acid composition, turtle

## 1 Introduction

*Aspideretes gangeticus* is regularly seen in the Hooghly (West Bengal, India) estuarine system during winter when they come for laying eggs. The species inhabits the Ganga, Sind and Mahanadi. The species is highly aquatic inhabiting the deep turbid rivers but it is frequently seen basking on sandy banks. It is omnivorous species and diet comprises of a wide range of aquatic vegetation and animal food like fish, mollusks, frogs and crustaceans. It is very prominent scavengers also. They are mainly herbivorous. Studies on turtle oils are very limited especially organ wise lipid composition study. A current work on this aspect in leather back turtle has been compared with *A. gangeticus* (1). Rowe *et al*. (2) observed that the average total lipid proportions were high in painted turtle than the snapping and blanding turtles in egg yolk, post-embryonic yolk and hatchling whereas the average phospholipid content is just the opposite. Study on the dermal oil of the carnivorous Atlantic leather back turtle shows the noteworthy presence of dodecanoic acid and a high percentage of tetradecanoic acid in comparison to marine oil in general (2). Fat of the green turtle (*Chelone mydas myder* linne) which is primarily herbivorous shows that the amount of tetradecanoic acid (3) which is bit different from the above observation. The $C_{20:0}$ acid and $C_{22:0}$ acids reported (4) for an Indian Ocean turtle (*Erect-*

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*mochelys imbricata* Agassiz) are also comparable although this omnivorous type contain only traces of dodecanoic acid in the fat. The present investigation of the fatty acid composition of *Aspideretes gangeticus* is part of a continuing study of lipids of marine and estuarine animals, their ecological aspects and commercial potentiality.

## 2 Experimental

### 2·1 Collection of Turtles

The turtles *Aspideretes gangeticus* were collected from Hooghly estuarine region of Bay of Bengal during February, 1995 and were studied for lipid composition.

### 2·2 Extraction of Lipid

The animals weighing approximately 4.5-5.2 kg had a carapace length 0.4-0.45 m and breadth 0.28-0.33 m. From each turtle a bit of liver, eyes, brain and 1 $cm^2$ of muscle beneath the carapace were taken and stored at -20℃. The lipids were extracted from each organ accordingly to the process of Bligh and Dyer (5). The isolated lipids were stored under nitrogen atmosphere and stored at -20℃ for further analysis.

### 2·3 Determination of Phospholipid and Cholesterol

Phospholipid content was estimated by measuring phosphorous in the lipid using the standard method of A.O.C.S. (6). Cholesterol was estimated according to the standard method of Zlatkis *et al*. (7).

### 2·4 Fatty Acid Analysis by Gas Liquid Chromatography

The total fatty acid composition of the lipid was determined by Gas-liquid chromatography (GLC) after derivatization into methyl esters (8). The HP-5890A GLC (Hewlett Packard, Palo Alto, CA) was connected with a glass column (183 cm × 0.31 cm i.d.) packed with 10% diethylene glycol succinate (DEGS) supported on Chromosorb-WHP (100/200 mesh) of HP make. The oven, injector and detector block temperatures were maintained at 190, 230, and 240℃, respectively. IOLAR-2 nitrogen (BOC India Ltd, Kolkata, India) was used as the carrier gas (flow rate 45 ml per min). The fatty acid esters peaks were identified and calibrated with standard methyl esters supplied by Sigma Chemical Co. (ST. Louis, MO).

### 2·5 Statitical Analysis

The results are given as the mean ± standard deviation.

## 3 Results and Discussion

### 3·1 Total Lipid and Structural Lipids of Turtle Organs

Turtle liver shows high content of total lipid than muscle. Muscle lipid content is less because turtle is a very slow moving animal and so its energy requirement is less having a low fuel need in muscle. Similar results are also found in leather back turtle (*Dermpchelya coriacea*) where representative samples of liver and pectoral muscle show 43% and 4.9% of total lipid respectively (1). A comparatively high percentage of liver lipid shows an important energy storage function of this organ.

**Table 1** shows that phospholipid content in *Aspideretes gangeticus* is both high in brain and muscle rather than in liver and eye. The ratio of phospholipid and cholesterol is maximum in muscle (1.1), gradually lowering in liver (0.8), brain (0.5) and eye (0.2). Cholesterol is high in brain and eye, followed by next in muscle. Cholesterol content is remarkably low in turtle muscle. The extremely low phospholipid content in eye (1.5%) in comparison with the other organs indicated that turtle has a weak eye sight. However comparative analysis of organs inhabiting different regimes is presently restricted by the limited data available for non mammalian species.

### 3·2 Fatty Acid Composition of the Total Lipid of Turtle Organs

Turtle (*Aspideretes gangeticus*) organs like muscle, liver, eye and brain are all rich in palmitic ($C_{16:0}$) acid and stearic ($C_{18:0}$) acid (**Table 2**). The total amounts of saturated fatty acids are more or less equal in the two organs namely eye and liver. The richest source of very long chain saturated fatty acids in most higher animals is the brain and particularly myelin (9). The total saturated fatty acids of brain is maximum in *A. gangeticus*. The monoenoic fatty acids in brain are *cis* configuratic and contain predominantly two isomeric forms n-7 and n-9 homologous. The relative proportions of the two monoenoic homologous vary quite significantly with carbon chain length. Palmitic acid and stearic acid of turtle *A. gangeticus* of muscle is quite similar to that of

**Table 1** Total Lipid and Structural Lipid Composition (%w/w) of Various Organs of Turtle (*Aspideretes gangeticus*).

| | Organs | | | |
|---|---|---|---|---|
| | Muscle | Liver | Brain | Eye |
| Total Lipid | 0.5±0.02 | 11.3±0.2 | 4.9±0.04 | 1.9±0.04 |
| Phospholipid | 7.2±0.9 | 2.4±0.3 | 6.5±0.1 | 1.5±0.06 |
| Total Cholesterol | 6.1±0.4 | 2.8±0.09 | 12.6±0.5 | 7.6±0.1 |

Values are Mean ± S.D., n=5

**Table 2** Fatty Acid Composition ( %w/w) of the Total Lipid of the Turtle (*Aspideretes gangeticus*) organs.

| Fatty Acids (%w/w) | Name of Organs | | | |
|---|---|---|---|---|
| | Muscle | Brain | Eye | Digestive Track |
| Saturated | | | | |
| 14:0 | 4.6±0.7 | 4.0±3.5 | 1.3±0.3 | 2.5±0.8 |
| 16:0 | 20.5±0.8 | 35.2±13.7 | 26.0±7.1 | 29.5±1.3 |
| 18:0 | 9.2±0.4 | 25.2±5.6 | 8.2±2.7 | 6.5±0.6 |
| 20:0 | - | 0.2±0.0 | 1.6±0.7 | - |
| 24:0 | 9.5±12.1 | 2.9±0.1 | - | - |
| Total | 43.8±10.2 | 48.2±15.6 | 36.7±3.5 | 37.9±2.7 |
| Monoenoic | | | | |
| 14:1 | 0.8±0.4 | 2.1±0.3 | 0.9±1.2 | 0.5±0.2 |
| 16:1 | 6.2±0.4 | 10.9±0.2 | 7.8±2.6 | 9.6±3.7 |
| 18:1 | 15.6±4.8 | 16.9±0.1 | 16.6±7.8 | 38.2±1.5 |
| 24:1 | 3.5±0.3 | - | - | - |
| Total | 26.1±5.2 | 30.1±0.2 | 25.5±11.6 | 48.3±5.1 |
| Polyenoics | | | | |
| 18:2 | 5.6±5.8 | - | 5.9±0.2 | 1.1±0.1 |
| 18:3 | 1.8±1.4 | - | - | 1.1±0.2 |
| 18:4 | 0.8±0.7 | - | 3.4±2.9 | - |
| 20:2 | 0.6±0.1 | - | - | - |
| 20:3 | 9.2±1.1 | 3.3±5.3 | - | 1.9±0.5 |
| 20:4 | 2.9±0.7 | 4.2±1.1 | 5.2±3.6 | 1.2±0.3 |
| 20:5 | 2.5±0.3 | 1.0±0.3 | 12.9±4.6 | 1.6±0.2 |
| 22:3 | - | - | - | 0.6±7.0 |
| 22:4 | - | 8.7±6.5 | 4.5±0.3 | 3.5±2.7 |
| 22:5 | 1.1±0.2 | 2.5±2.9 | - | 0.7±0.3 |
| 22:6 | 1.6±1.1 | 1.2±0.0 | - | 0.2±0.1 |
| 24:2 | 1.3±0.2 | 0.8±0.0 | - | - |
| Others | 3.2±1.7 | 0.1±0.7 | 5.8±4.9 | 1.5±1.7 |
| Total | 30.1±5.1 | 21.8±3.2 | 37.8±14.6 | 13.6±2.3 |

Values are Mean ± S.D., n=5

Indian Sea turtle (*Erectmochelys imbricata-2*). Turtle muscle and liver contain more number of PUFAs (**Table 2**) compared to the other organs. The liver contains quite a high amount of $C_{18:1}$ acid followed by its decline in brain, eye and muscle tissues respectively. The polyunsaturated fatty acids of the series 20:5, 22:5 and 22:6 are represented in muscle, brain and liver as in leatherback (*Dermochelys coriacea*) adipose tissues, muscle and liver (1).

## 4 Conclusions

*Aspideretes* lipids followed a marine lipid like composition such as leather back turtle. Long chain PUFA like 20:5 is especially high in *Aspideretes* eye (12.9%). The presence of arachidonic acid 20:4 in all the tissues points out a terrestrial animal lipid character. This is inconsistent with *Dermochelys coriacea* (1). Thus even the lipid composition of turtle is adjusted for dual life in land and water.

## References


1. D.L. HOLLAND, J.DAVENPORT and J. EAST, The Fatty acid Composition of the Leather Back Turtle *Dermocyelys coriacea* and Jelly Fish Prey, *J. Marine Biol. Assoc*., Vol. **70**, 761-770 (1990).
2. J.W. ROWE, L. HOLY, R.E. BALLINGER and D.S. STANLEY, Lipid Provisioning of Turtle Eggs and Hatchlings Total Lipid, Phospholipid, Triacylglycerol and Triacylglycerol Fatty Acid Composition, *Biochem. Physiol*., Vol. **112**, 323-330 (1995).
3. R.G. ACKMAN and R.D. BURGHER, Cod Liver Oil Fatty Acid as Secondary Standards in the GLC of Polyunsaturated Fatty Acids of Animal Origin: Analysis of a Dermal Oil of the Atlantic Leather Back Turtle, *J. Am. Oil Chem. Soc*., Vol. **42**, 38-42 (1965).
4. T.P. HILLDITCH and P.N. WILLIAMS, *The Chemical Constitution of Natural Fats*, 4th edn., Chapman and Hall, London, pp. 26-75 (1964).
5. E.G. BLIGH and W.J. DYER, A Rapid Method of Total Lipid Extraction and Purification, *Can. J. Biochem. Physiol*., Vol. **37**, 911-917 (1959).
6. Official Methods and Recommended Practice of American Oil Chemists' Society, Method No. Ja 7-86 4th edn. (D. FIRESTONE, ed.), AOCS, Washington DC, (1991).
7. A. ZLATKIS, B. ZAK and A.J. BOYLE, A Method for the Determination of Serum Cholesterol, *J. Lab. Clin. Med*., Vol. **41**, 486 (1953).
8. L.D. METCALFE and A.A. SCHMITZ, The Rapid Preparation of Fatty Acid Esters for Gas Chromatographic Analysis, *Anal. Chem*., Vol. **33**, 363-364 (1961).
9. A. POULOS, Very long Chain Fatty Acids in Higher Animals, *Lipids*, Vol. **30**, 1185-1186 (1995).