J. Fish. Sci. Tech. 4(4), 265~267, 2001

JOURNAL OF
FISHERIES SCIENCE
AND TECHNOLOGY

〈NOTE〉

Fatty Acids Composition in Viscera and Muscle of the Philippines Pinkgray Goby, *Amblychaeturichthys hexanema*

Byeong-Dae Choi*, Seok-Joong Kang, Bo-Young Jeong and Lonarda S. Mendoza[1]

Division of Marine Bioscience/Institute of Marine Industry, Gyeongsang National University, Tongyeong 650-160, Korea
[1]Institute of Fish Processing Technology, University of Philippines in the Visayas, Miago-ao, Iloilo 5023, Republic of Philippines

(Received September 2001, Accepted December 2001)

In this study, lipid classes and fatty acids composition in viscera and muscle of the Philippines Pinkgray goby, *Amblychaeturichtys hexanema* were determined. The viscera contained high levels of total lipid (TL, 4.8%), while the muscle contained less TL (0.5%). TL in the viscera consisted of triacylglycerol (83.9%), diacylglycerol (7.9%), polar lipid (7.4%), and cholesterol (0.8%). However, the muscle contained a small amount of TG (3.0%) and much more PL (73.8%). Principal fatty acids composition of PL and NL in the viscera and muscle were 16:0, 16:1n-7, 18:0, 18:1n-9, 18:1n-7, 18:3n-3, 20:5n-3, 22:5n-3, and 22:6n-3.

Key words: *Amblychaeturichthys hexanema*, Fatty acids composition, Lipid classes

Fish have higher levels of n-3 highly unsaturated fatty acids such as eicosapentaenoic acid (20:5n-3, EPA) and docosahexaenoic acid (22:6n-3, DHA) in muscle, liver, brain and retina compared to other vertebrates (Bell and Tocher, 1989). These long chain n-3 highly unsaturated fatty acids are essential for optimal growth many of marine fish. Also these acids are the predominant structural fatty acids in the human brain (Martinez et al., 1974; Sastry, 1985) and retina (Fliesler and Anderson, 1983). These acids accumulate rapidly in fetal and infant neural tissue during the periods of most rapid growth and development, that is during last months of gestation and the first months of postnatal life (Clandinin et al., 1980; Makrides et al., 1994). Therefore, the consumer usually would like to know the lipid contents and n-3 fatty acids composition of the target fish. Recently, Jeong et al. (1998) reported the detailed fatty acids composition of 72 species of Korean fish. This work demonstrates the lipid classes and fatty acids composition of the goby at Kalibo in north area of Iioilo island of the Philippines.

Twenty live specimens of goby (about 10 g in body weight) were obtained from a Kalibo local supplier in the Philippines on Feburary 2001 and dissected to obtain the muscle and viscera. Extraction of lipids from fish was carried out with a mixture of chloroform and methanol (2:1, v/v; Bligh and Dyer, 1959). Polar (PL) and neutral lipids (NL) were separated with silica cartridges (Sep-pak; Millipore Co., Bedford, MA, USA) as described by Juaneda and Rocquelin (1985). Mixtures of fatty acids were prepared by saponification with potassium hydrate. Fatty acid methyl esters were prepared by transesterification with borontrifluoride in methanol (AOCS, 1990). The fatty acid methyl esters were analyzed with gas chromatograph (GC 14A; Shimadzu Co, Tokyo, Japan) equipped with an FID and Omegawax-320 fused silica capillary column (30 m ×0.32 mm i.d.; Supelco Co., Bellefonte, PA, USA). The column temperature programmed with the following conditions: initially 185℃ for 8 min, then an increase in temperature of 3℃ per min to 230℃, and a final hold for 13 min. The carrier gas was helium and the pressure was 100 kPa. Methyl esters

*Corresponding author: bdchoi@nongae.gsnu.ac.kr

of individual fatty acids were quantified with an integrator (C-R5A; Shimadzu Co., Tokyo, Japan). Lipid classes composition were determined as described by Kang et al. (1997). The Chromarods were scanned in an Iatroscan MK-5 (Iatron Lab., Tokyo, Japan) at a scan speed of 40 s, a hydrogen flow of 150 mL/min, and an air flow of 2,000 mL/min. Data were acquired with an Iatrocorder TC-II integrator (Iatron Lab., Tokyo, Japan).

Among lipid classes, over 83% of the TL in viscera (4.8%, wet tissues) consisted of triacylglycerol (TG), while cholesterol and free fatty acids contained less than 1.0% of TL. However, muscle lipids (0.5%, wet tissues) were characterized (Table 1) by a high percentage of PL (73.8%) and small amounts of FFA (3.0%), diacylglycerol (1.1%), and TG (4.9%). PL may be a minor or major part of the total tissue lipids: 0.5% in the liver of the ratfish *Hydrolagus novoaezealandiae* (Hayashi and Takagi, 1980) and 90% in the sperm of the barnacle *Balanus balanus* (Dawson and Barnes, 1966). PL concentrations in different organs of the same animals and sampling period may vary considerably.

Table 1. Lipid classes in total lipids of goby tissues (% total lipid)

Lipid classes	Viscera	Muscle
FFA	tr[1)]	3.0
TG	83.9	4.9
CHOL	0.8	17.2
DG	7.9	1.1
PL	7.4	73.8

Abbreviation: FFA, free fatty acids; TG, triacylglycerols; CHOL, cholesterol; DG, diacylglycerol; PL, polar lipids.
[1)] tr, trace; Less than 0.1%.

Principal fatty acids composition of PL and NL extracted from viscera and muscle are shown in Table 2. The data showed that hexadecanoic acid (C16:0) and octadecanoic acid (C18:0) were the predominant saturated fatty acids. Ackman and Eaton (1966) pointed out that C16:0 was a key metabolite in fish and that its level was not influenced by diet. In the Lake Superior fish (8 species) of tissue, the level of C16:0 was higher than that goby, averaging 68~79% of saturated fatty acids (Wang et al., 1990). The C18:0 was higher than that of the Lake Superior fish (1.8~3.8%) and

Table 2. Fatty acids composition (%) of viscera and muscle lipids in goby tissues

Fatty acids	Viscera		Muscle	
	PL	NL	PL	NL
14:0	1.25	2.70	0.85	2.32
15:0 anteiso	0.18	tr[1)]	0.22	tr
15:0	1.09	2.06	1.04	1.76
16:0	25.43	27.35	18.43	24.57
16:1n-7	3.05	10.40	3.76	7.77
16:0 7Me	0.09	0.13	0.11	0.13
16:1n-5	0.08	0.10	0.08	0.13
16:2n-7	0.47	0.36	0.71	0.24
17:0 iso	tr	0.10	tr	0.11
16:2n-4	0.54	0.95	0.19	0.74
17:0	1.34	1.28	1.24	1.19
16:3n-4	1.78	3.95	2.50	2.99
16:4n-3	1.21	0.46	1.76	0.18
16:4n-1	0.33	0.64	0.49	0.53
18:0	13.73	6.89	10.78	7.70
18:1n-9	4.70	7.94	7.42	5.58
18:1n-7	2.77	5.05	3.15	3.53
18:2 Δ5,11	0.51	1.80	0.62	0.77
18:2n-6	1.72	1.27	1.61	1.55
18:2n-4	0.27	0.41	0.22	0.31
18:3n-6	0.63	0.72	0.29	0.69
18:3n-4	0.16	0.25	0.20	0.21
18:3n-3	3.28	4.99	2.89	3.88
18:4n-3	2.49	4.21	1.24	3.34
18:4n-1	0.14	0.12	0.17	0.13
20:0	0.32	0.20	0.28	0.24
20:1n-7	0.99	0.58	1.62	1.41
20:3n-9	0.19	0.11	0.25	0.17
20:3n-6	0.33	0.12	0.31	0.19
20:4n-6	1.63	0.41	2.32	1.73
20:3n-3	0.20	0.29	0.19	0.19
20:4n-3	1.41	1.48	1.39	1.28
20:5n-3	9.07	4.81	11.39	11.26
22:0	0.16	tr	0.21	0.16
22:1n-7	0.29	0.12	0.51	0.20
22:1n-5	0.36	0.31	tr	0.36
22:2n-6	0.29	tr	tr	0.24
21:5n-3	0.11	0.17	0.17	0.19
22:4n-6	0.35	0.12	0.32	0.19
22:5n-6	0.66	0.12	0.83	0.37
22:4n-3	0.11	0.12	0.13	tr
22:5n-3	5.14	3.87	5.42	4.58
24:0	0.15	tr	0.85	tr
22:6n-3	9.20	2.28	9.58	5.92
ΣSaturates	45.52	40.85	37.29	38.65
ΣMonoenes	12.26	24.89	17.52	19.49
ΣPolyenes	42.22	34.26	45.19	41.86
Σn-6	5.61	2.84	5.68	4.96
Σn-3 HUFA[2)]	25.24	13.02	28.14	23.42
n-3/n-6	5.74	7.98	5.99	6.21
DHA/EPA	1.01	0.47	0.84	0.53

[1)] tr: trace.
[2)] HUFA: highly unsaturated fatty acids (C20 or more carbon).

common brackish goby (7.0%) in Korea (Jeong et al., 1998). Marine oils usually contain detectable (≤ 0.2%) amounts of eicosanoic acid (C20:0) and sometimes recognizable tetracosanoic acid (C24:0), but very little docosaenoic acid (C22:0). The total is normally 0.5% or less for these three chain lengths in marine (Ackman, 1989) and fresh water fish (Jeong et al., 1998). But these acids contained more than 0.5% in the viscera and muscle. These saturated fatty acids showed very specific results in the Philippines goby.

Octadecenoic acid (C18:1) was the major monoenoic fatty acid in the chub, lean lake trout, sea eel, harvest fish, and siscowet lake trout contained more than 30% (Wang et al., 1990; Jeong et al., 1998). But in present study, C18:1 was similar amount (7.5~13.0%) of common brackish goby (Jeong et al., 1998).

The principal acids in the polyunsaturated group were eicosapentaenoic acid (C20:5n-3, EPA), docosapentaenoic acid (C22:5n-3, DPA), and docosahexaenoic acid (C22:6n-3, DHA). The concentrations of EPA, DPA, and DHA were also generally lower than those reported by Ackman and McLeod (1988) for marine groundfish and comparable to their figures for pelagic and mid-surface dwelling in polar lipids. For reasons not entirely clear, long-chain length n-6 fatty acids can be important in specific fish lipids, such as eicosatetraenoic acid (C 20:4n-6) in phosphoinositol lipids of fish salt-secreting epithelia. But in the goby, this long-chain acid contained very small amount.

The ratio of n-3/n-6 fatty acids ranged from 5.74 (PL, viscera) to 7.98 (NL, viscera) and did not show as much species variation as was reported by Hearn et al. (1987). The ratio of n-3/n-6 fatty acids in total lipids of freshwater fish was typically in the range 0.5~3.8 compared to 4.7~14.4 in marine fish. According to Christie (1982) total PL from tissues of fish were characteristically richer in PUFA than that of NL. But PL and NL in the muscle are showed very similar amount of saturated, monoenoic and polyenoic fatty acids.

References

Ackman, R.G. and C.A. Eaton. 1966. Some commercial Atlantic herring oils: fatty acid composition. J. Fish Res. Bd. Can., 22, 907~911.

Ackman, R.G. and C. McLeod. 1988. Total lipids and nutritionally important fatty acids of some Nova Scotia fish and shellfish products. Can. Inst. Foos Sci. Tech. J., 21, 390~394.

Ackman, R.G. 1989. Fatty acids. In *Marine Biogenic Lipids, fats, and Oils.* Vol. I, R.G. Ackman, ed. CRC Press Inc., Boca Raton, pp. 103~137.

A.O.C.S. 1990. AOCS official method Ce 1b-89. In *Official Methods and Recommended Practice of the AOCS,* 4th ed. AOCS, Champaign.

Bell, M.V. and D.R. Tocher. 1989. Molecular species composition of the major phospholipids in brain and retina from rainbow trout (*Salmo gairdneri*). Biochem. J., 224, 909~915.

Bligh, E.G. and W.J. Dyer. 1959. A rapid method of lipid extraction and purification. Can. J. Biochem. Physiol., 37, 911~917.

Clandinin, M.T., J.E. Chappell, S. Leong, T. Heim, P.R. Swyer and G.W. Chance. 1980. Interauterine fatty acid accretion rates in human brain: implications for fatty acid requirements. Early Human Devel., 4, 121~129.

Christie, W.W. 1982. Isolation, separation, identification and structural analysis of lipids. In *Lipid Analysis,* W.W. Christie, ed. Pergamon Press Ltd., Oxford, pp. 11~46.

Dawson, R.M.C. and H. Barnes. 1966. Studies in the biochemistry of cirripede eggs. II. Changes in lipid composition during development of *Balanus balanoides* and *B. balanus.* J. Mar. Biol. Assoc. U.K., 46, 249~253.

Fliesler, S.J. and R.E. Anderson. 1983. Chemistry and metabolism of lipids in the vertebrate retina. Pro. Lipid Res., 22, 79~131.

Hayashi, K. and T. Takagi. 1980. Composition of diacyl glyceryl ethers in the lipids of ratfish, *Hydrolagus novaezealandiae.* Bull. Jpn. Soc. Sci. Fish., 46, 855~861.

Hearn, T.L., S.A. Sgoutas, J.A. Haren and D.E. Sgoutas. 1987. Polyunsaturated fatty acids and fat in fish flesh for selecting species for health benefits. J. Food Sci., 52, 1209~1211.

Jeong, B.Y., B.D. Choi, S.K. Moon and J.S. Lee. 1998. Fatty acid composition of 72 species of Korean fish. J. Fish. Sci. Tech., 1, 129~146.

Juaneda, P. and G. Rocquelin. 1985. Rapid and convenient separation of phospholipids and non phosphorus lipids from heart using silica cartridges. Lipids, 20, 40~41.

Kang, S.J., S.P. Lall and R.G. Ackman. 1997. Digestion of the 1-*O*-alkyl diacylglycerols ethers of Atlantic dogfish liver oils by Atlantic salmon Lipids, 32, 19~30.

Makrides, M., M.A. Neumann, R.W. Simmer and R.A. Gibson. 1994. Fatty acid composition of brain, retina, and erythrocytes in breast- and formula-fed infants. Am. J. Clin. Nutr., 60, 189~194.

Martinez, M., C. Conde and A. Ballabriga. 1974. Some chemical aspects of human brain development. II. Phosphoglyceride fatty acids. Pediat. Res., 8, 93~102.

Sastry, P.S. 1985. Lipids of nervous tissue: composition and metabolism. Prog. Lipid Res., 24, 69~176.

Wang, Y.J., L.A. Miller, M. Perren and P.B. Addis. 1990. Omega-3 fatty acids in lake superior fish. J. Food Sci., 71~76.