

Lipid composition of skin and muscle of the Indo-Pacific sailfish, *Istiophorus platypterus*

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Abstract

The fat contents and fatty acid profiles of the skin, dorsal muscle, ventral muscle and belly flap of the Indo-Pacific sailfish, *Istiophorus platypterus* (Thalapattha) were determined. Three fish samples per month were obtained from Pitipana, Negambo landing site over a period of eight months (August 2007- March 2008). The mean fat content of the edible portion of *I. platypterus*, was lower than 5%. Therefore *I. platypterus* can be considered as a low fat fish (low < 5%, medium 5-10, high > 10%). The percentage content of fat in the skin and muscles were as follows; skin (6.52 ± 0.53), ventral muscle (2.52 ± 0.19), dorsal muscle (1.79 ± 0.27), belly flap (3.91 ± 0.15). The composition of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) were as follows; skin 56%, 39%, 44%; ventral muscle 44%, 46%, 33%; dorsal muscle 39%, 42%, 24%; Belly flap 52%, 34%, 38%. The proportion of eicosapentaenoic acid (EPA, 20:5n-3) and docosahexaenoic acid (DHA, 22:6n-3) in the fat of skin (2.31%, 7.23%) and belly flap (2.06%, 5.36%) were significantly high (P < 0.05) compared to ventral muscle (0.86%, 2.74%) and dorsal muscle (1.78, 2.07%).

Key words: Lipid composition, docosapentaenoic acid, eicosapentaenoic acid, *Istiophorus platypterus*

Introduction

The popularity of fish as a source of food has increased markedly in recent years. Seafood has served as a major source of animal protein and lipid since early civilization (Mazza, 1998). Fish are also an excellent source of minerals and vitamins. Fish protein is highly digestible and is rich in essential amino acids, especially methionine and lysine. (Edirisinghe, 1999).

Fish lipids are becoming increasingly recognized for their high nutritional and pharmaceutical value. Fat is distributed in some parts of the fish body, such as skin, belly flap, dark muscle, light muscle, gonads, liver, intestines, backbone, and head. But this fat is not evenly distributed in all parts of the fish. According to the fat levels in the edible portion, Ackman (1990) categorized fish species into three groups as low fat fish (<5% fat), medium fat fish (5-10% fat) and high fat fish (>10% fat).

The fat contents, fatty acid profiles, protein contents and minerals etc. have been determined for a number of different fish species. But no such extensive literature is available for the Indo-Pacific sailfish. The present study was carried out to determine the fat contents and fatty acid profiles in dorsal muscle, ventral muscle, belly flap and skin of *Istiophorus platypterus*.

Materials and Methods

The study was carried out over a period of eight months (August 2007-March 2008). Three steak samples of Adult Indo-Pacific sailfish per month were purchased from the Pitipana, Negombo landing site. Each fish sample was separated into dorsal muscle, ventral muscle, belly flap and skin after removing the red muscle which was very little in the species. Moisture content was measured by the oven drying method. Total fat content of each sample was determined by Majonnier method (James, 1999). Fat was extracted according to the Bligh and Dyer method (1959), to analyze the fatty acid composition. Fatty acid methyl esters (FAME) were prepared (James, 1999), and the analysis of FAME was carried out in Gas Chromatography (Holman, 1962; Kirk & Sawyer, 1991). The chromatographic peaks were identified by comparing their retention time with the reference standards (cod liver oil and GLC 411). Data was statistically analyzed using one way analysis of variance (ANOVA) at 5% level of significance.

Results & Discussion

According to Ackman, (1990) tropical water fish have lower contents of lipids compared to fish from cold northern (or southern) latitudes. The present results agree with this finding. In the present study, the mean total fat content of edible parts (dorsal muscle, ventral muscle and belly flap) of Indo-Pacific sailfish ranged between 1.79-3.91%. The considerable variation in lipid content reported in many studies on fish in different areas around the world is apparently due to factors such as season, temperature, diet, age, sex, size and reproductive status (Ozogul

et al,2005). Percentage total fat content of the skin (6.52 ± 0.53) was significantly higher than the ventral muscle (2.52 ± 0.19), dorsal muscle (1.79 ± 0.27) and belly flap (3.91 ± 0.15) of the Indo-Pacific sailfish (Fig 1). The present study reported higher amount of fat in the belly flap than in the ventral muscle and dorsal muscle and the fat content of ventral muscle was higher than that of the dorsal muscle.

Monthly statistical differences were not found in the fat content of *I. platypterrus* during the present study. Arrington et al,(2006) report tropical environments experience minimal season variation of temperature and photoperiod.

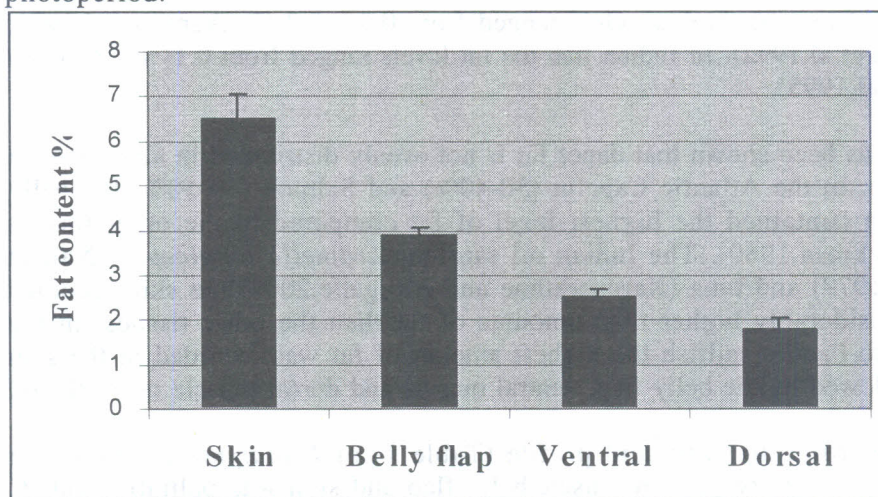


Fig 1: Fat content in the Ventral muscle, dorsal muscle, Skin and Belly flap of the *I.platypterus*

Table 1: Fatty acid profile (As percentage of FAMES) of the ventral muscle, dorsal muscle, skin and belly flap of the *Istiophorus platypterus* (Mean±SD)

Fatty acids	Dorsal	Ventral	Belly flap	Skin
14:0	2.56 ± 0.25	2.46 ± 0.16	3.57 ± 0.12	4.74 ± 0.48
16:0	21.33 ± 0.75	23.07 ± 0.64	24.85 ± 0.38	26.02 ± 0.18
18:0	11.85 ± 0.09	13.81 ± 0.72	18.58 ± 0.74	23.08 ± 0.25
20:0	3.73 ± 0.81	4.76 ± 0.26	5.27 ± 0.52	2.58 ± 0.62
Total SFA	39.47 ± 0.84	44.10 ± 0.47	52.27 ± 0.63	56.42 ± 0.42
18:1	9.03 ± 0.78	10.11 ± 0.81	7.48 ± 0.91	8.29 ± 0.52
20:1	4.54 ± 0.57	5.35 ± 1.03	5.06 ± 0.47	5.73 ± 0.41
22:1	27.36 ± 0.65	29.06 ± 0.93	20.58 ± 0.72	21.37 ± 0.93
Total MUFA	42.67 ± 0.32	46.39 ± 0.75	34.76 ± 0.38	39.72 ± 0.37
18:3n-3	0.45 ± 0.47	0.47 ± 1.13	0.45 ± 0.26	0.46 ± 0.72
18:4n-3	0.11 ± 0.62	0.12 ± 0.27	0.15 ± 0.32	0.16 ± 0.79
20:5n-3	1.78 ± 0.73	0.86 ± 0.63	2.06 ± 0.63	2.31 ± 0.91
22:5n-3	20.36 ± 0.64	28.93 ± 0.58	30.54 ± 0.79	33.75 ± 0.84
22:6n-3	2.07 ± 0.43	2.74 ± 0.62	5.36 ± 0.47	7.23 ± 0.83
Total PUFA	24.91 ± 0.74	33.39 ± 1.14	38.88 ± 0.54	44.24 ± 0.72
Total USFA	67.58 ± 1.12	79.78 ± 0.63	73.64 ± 0.32	83.96 ± 0.37

The mean total fat content of edible parts (dorsal muscle, ventral muscle and belly flap) of Indo-Pacific sailfish ranged between 1.79 - 3.91%. Therefore according to Ackmen's (1995) classification, this fish can be considered as a low fat fish. Jayasinghe et al (1996) also report that the Indo-Pacific sailfish is a low fat fish. It has been reported that generally fish from tropical waters have lower contents of lipid than cold water fish. In a study carried out on some Sri Lankan fish the values ranged from 0.37-4.49% (Gunasekara and Wimalasena,2006) . In another study carried out on five species of tuna from Sri Lankan waters the fat levels ranged from 1.2-1.8% (Karunaratne and Attygalle,2007). Fat levels in fish from the Arabian Gulf ranged from 0.9%-5.2 % (Agren et al,1991; Eid et al,1992). In Indian fish the fat levels ranged from 0.1- 14.7% (Rao et al,1995).

It has been shown that depot fat is not evenly distributed in all parts of a fish. In the Atlantic Capelin (30-40%) and Salmon (30-50%) the belly flap contained the highest level of fat compared to the other tissues (Ackman,1980). The Indian oil sardine *Sardinella longiceps* (Nair et al,1979) and tuna (Karunaratne and Attygalle,2007) the skin recorded considerably higher than amounts of fat than the other tissues. In the Indo-Pacific sailfish the highest amount of fat was recorded in the skin followed by the belly flap, ventral muscle and dorsal muscle respectively.

According to fatty acid profile (Table 1) of *I. platypterus* the major saturated fatty acid in muscle, belly flap and skin was palmitic acid (C 16:0). The major MUFA was C 22:1. According to the present study, Indo-Pacific sailfish generally contained lower amounts of PUFAs than SFAs and MUFAs except in skin and belly flap in which the MUFAs were less. The amount of EPA was $2.31 \pm 0.91\%$ (Skin), $0.86 \pm 0.63\%$ (Ventral muscle), $1.78 \pm 0.73\%$ (Dorsal muscle), and $2.06 \pm 0.63\%$ (belly flap). The amount of DHA was $7.23 \pm 0.83\%$ (Skin), $2.74 \pm 0.62\%$ (Ventral muscle), $2.07 \pm 0.43\%$ (Dorsal muscle) and $5.36 \pm 0.47\%$ (belly flap). But DPA (22:5n-3), an intermediate product between EPA and DHA transformation was found to be relatively high. The amount of DPA was $33.75 \pm 0.84\%$ (skin), $28.93 \pm 0.58\%$ (ventral muscle), $20.36 \pm 0.64\%$ (dorsal muscle) and $30.54 \pm 0.79\%$ (bellflap). The skin, ventral muscle, dorsal muscle and belly flap of the *I. platypterus* contained 64.68%-78.62% moisture. There was an inverse linear relationship between total fat content and moisture content (Pearson's correlation -0.732, $P < 0.05$).

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