Characteristics of muscles from shrimp scad (*Alepes djedaba*) and oxeye scad (*Selar boops*)

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Abstract

Proximate composition, nitrogenous compound, myoglobin content and pH of dark and ordinary muscles from shrimp scad (*Alepes djedaba*) and oxeye scad (*Selar boops*) were characterized. Moisture was the most predominant component found in both muscle types of both fish species. Among fish muscle examined, the dark muscle of oxeye scad showed the highest content of protein, lipid and myoglobin ($p < 0.05$) whereas the dark muscle of shrimp scad had the highest ash content ($p < 0.05$). The pH of shrimp scad muscles was higher than that of oxeye scad muscles ($p < 0.05$). SDS-PAGE revealed that myofibrillar protein was a major protein found in both muscle types of both species. Myosin heavy chain (MHC) and actin were major proteins in myofibrillar fraction and MHC was generally higher in ordinary muscle than in dark muscle. Sarcoplasmic protein was found to be higher in ordinary muscle compared to that in dark muscle ($p < 0.05$) and a significant higher content was found in oxeye scad muscle ($p < 0.05$). The highest alkali-soluble protein was noticeable in dark muscle of oxeye scad ($p < 0.05$). Dark muscles from both species composed of stroma with a higher content than ordinary muscle ($p < 0.05$). Generally, dark and ordinary muscles of oxeye scad contained a higher content of non-protein nitrogenous compounds than those of shrimp scad ($p < 0.05$).

Keywords: shrimp scad, oxeye scad, nitrogenous compound, characteristics, muscle

Introduction

Oxeye scad and shrimp scad are abundant dark-fleshed fish species commonly caught in Southern Thailand, especially in the Thasala coast of Nakhon Si Thammarat. Generally, dark-fleshed fish contained a high content of dark muscle associated with a high content of lipid and myoglobin (Chen 2002). As in most animal species, ordinary muscle is anaerobic, whose function is to provide energy quickly and intensively. Ordinary muscle tires easily and primarily uses glycogen as energy source but dark muscle on the other hand is designed for long-term exercise and is used by migrating species that travel great distances using oxidative metabolism of lipids as its principal source of energy (Hultin and Kelleher 2000). The chemical composition of fish flesh varies not only between species, but also between individuals depending on sex, age, feed, stage of maturity, environment, season and muscle location (Sikorski and others 1990). However, no information regarding the proximate and chemical compositions of shrimp scad and oxeye scad caught in Thailand has been reported. Thus, this study aimed to determine the chemical composition and characteristics of muscles from both species.

Materials and Methods

Preparation and chemical analysis of refrigerated mackerel fillet

Oxeye scad with an average weight of 110-120 g and shrimp scad with an average weight of 125-140 g obtained from the fishing port in Thasala along the coast of the Gulf of Thailand were used for this study. The whole muscles were manually excised into dark and ordinary muscles. Protein, ash, lipid and moisture contents of both ordinary and dark muscles were determined according to the methods of AOAC (2000). The pH and myoglobin content was determined by the method of Benjakul and others (1997) and Chaijan and others (2004), respectively. The muscles were subjected to fractionation according to the method of Hashimoto and others (1979). Each fraction was subjected to nitrogen analysis according to the methods of AOAC (2000) and applied on the SDS-PAGE according to the method of Leammli (1970) under reducing and non-reducing conditions.

Results and discussion

Proximate composition of shrimp scad and oxeye scad muscles is presented in Table 1. Dark and ordinary muscles from both species exhibited the different

compositions. Moisture was a major constituent in dark and ordinary muscles from both species. Protein and fat contents were generally higher in dark muscle and a greater content was obtained in oxeye scad muscle, compared to that in shrimp scad muscle (p<0.05). The dark muscle is designed for long-term exercise using oxidative metabolism of lipids as its principal source of energy (Hultin and Kelleher 2000). This resulted in a high content of lipid in the dark muscle. Different myoglobin content was observed between different muscle types and species (Table 1). Oxeye scad muscle contained a larger amount of myoglobin, especially in dark muscle, when compared to shrimp scad muscle (p<0.05). The results were in agreement with Chaijan and others (2004) who reported that myoglobin and lipid were dominant in dark muscle. Shrimp scad muscles showed significant higher pH values than oxeye scad muscles (Table 1; p<0.05). This indicated that the pH of fish muscle was governed by fish species.

Table 1 Proximate compositions, myoglobin content and pH of shrimp scad and oxeye scad muscles

Compositions (%wet wt.)[1]	Shrimp Scad		Oxeye Scad	
	Dark	Ordinary	Dark	Ordinary
Protein	21.30±0.35^{a}	21.19±0.81^{a}	23.08±0.91^{b}	20.91±0.31^{a}
Lipid	0.37±0.03^{a}	0.25±0.03^{a}	0.80±0.08^{b}	0.28±0.07^{a}
Moisture	80.15±0.36^{c}	80.51±0.09^{c}	74.65±0.07^{a}	75.89±0.40^{b}
Ash	1.53±0.05^{c}	1.38±0.01^{b}	1.30±0.05^{a}	1.34±0.03^{ab}
Myoglobin[2]	6.73±0.36^{b}	3.50±0.16^{a}	17.56±1.27^{c}	3.79±0.13^{a}
pH	6.55±0.03^{c}	6.50±0.02^{b}	6.06±0.02^{a}	6.03±0.02^{a}

[1] Values are given as means ± SD from triplicate determinations.
[2] mg/g sample.
Different letters in the same row indicate significant differences (p < 0.05).

Table 2 Nitrogenous constituents in shrimp scad and oxeye scad muscles

Compositions (mg N/g muscle)[1]	Shrimp scad		Oxeye scad	
	Dark	Ordinary	Dark	Ordinary
Non-protein nitrogen	6.96±0.41^{a}	6.22±0.15^{a}	16.06±1.46^{b}	21.47±1.00^{c}
Sarcoplasmic protein	4.64±0.03^{a} (19.4)[2]	5.62±0.19^{b} (22.7)	7.99±0.32^{c} (16.0)	9.90±0.33^{d} (17.3)
Myofibrillar protein	13.65±1.09^{a} (57.2)	14.95±0.82^{a} (60.3)	22.85±0.54^{b} (45.8)	39.23±1.65^{c} (68.4)
Alkali soluble protein	4.08±0.16^{a} (17.1)	3.55±0.22^{a} (14.3)	17.93±0.70^{c} (36.0)	7.73±0.67^{b} (13.5)
Stroma protein	1.50±0.07^{c} (6.3)	0.66±0.04^{b} (2.7)	1.10±0.08^{c} (2.2)	0.50±0.02^{a} (0.9)

[1] Values are given as means ± SD from triplicate determinations.
[2] Numbers in parentheses represent percentage distribution.
Different letters in the same row indicate significant differences (p < 0.05).

Fish muscle was fractionated into different 5 fractions, based on solubility (Table 2). Myofibrillar protein was found as a major protein component for both muscle types and species (45.8-68.4%). Electrophoretic patterns indicated that myofibrillar fraction consisted of several protein bands corresponding to myosin heavy chain, actin,

troponin and tropomyosin (Figure 1-2). Muscle of both species contained a different amount of sarcoplasmic proteins. Ordinary muscle had a larger number of sarcoplasmic proteins than dark muscle. The result was in agreement with Hashimoto and others (1979) who reported that sarcoplasmic protein was dominant in ordinary muscle. In addition, dark muscles contained a higher amount of alkali soluble protein and stroma than ordinary muscles of both species. Greater stroma content in dark muscle could be related to the high mechanical strength of this muscle (Hultin and Kelleher 2000). Oxeye scad muscle was composed of a higher content of non-protein nitrogenous compounds than shrimp scad muscle. This could be related to a higher content of amino acid, dipeptide, nucleotide, trimethylamine and urea in this species.

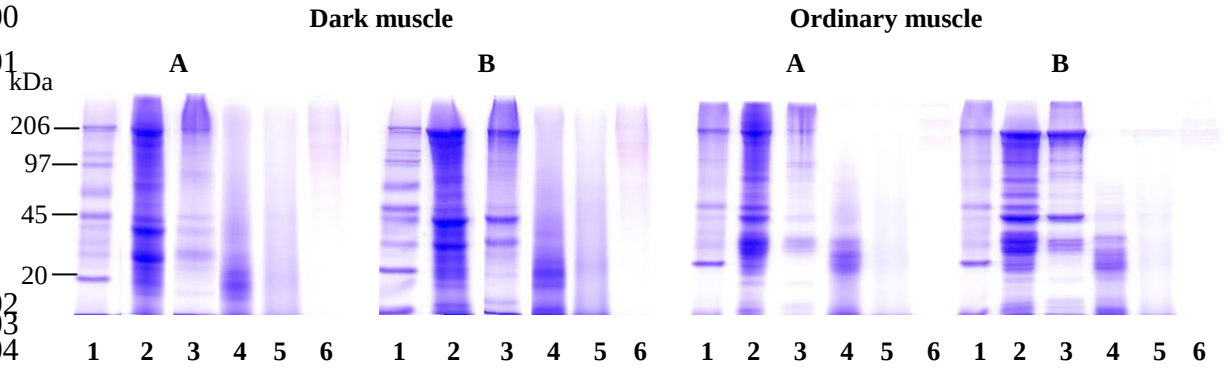

Figure 1 Electrophoretic pattern of various protein fractions from oxeye scad under non-reducing (A) reducing (B) conditions: lane 1 = standard marker, lane 2 = original muscle, lane 3 = myofibrillar protein, lane 4 = sarcoplasmic protein, lane 5 = alkali-soluble protein and lane 6 = stroma

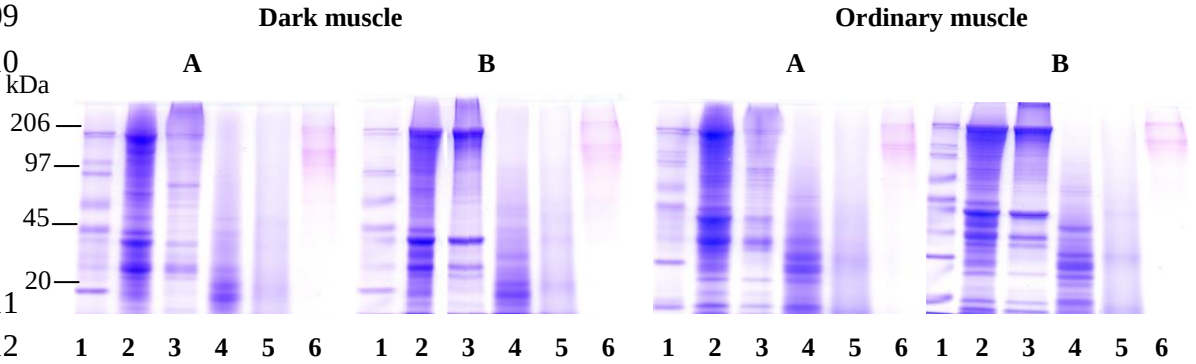

Figure 2 Electrophoretic pattern of various protein fractions from shrimp scad under non-reducing (A) reducing (B) conditions: lane 1 = standard marker, lane 2 = original muscle, lane 3 = myofibrillar protein, lane 4 = sarcoplasmic protein, lane 5 = alkali-soluble protein and lane 6 = stroma

Conclusion

The compositions of dark and ordinary muscles from shrimp scad and oxeye scad were different. Myoglobin was higher in dark muscle from both species. Muscle of both species contained a different amount of nitrogenous constituents. Myofibrillar protein was found as a major protein component for both muscle types and species.

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