Journal of
Fisheries and Aquatic Science

ISSN 1816-4927

Academic
Journals Inc.

www.academicjournals.com

Journal of Fisheries and Aquatic Science 3 (1): 82-86, 2008
ISSN 1816-4927

Effect of Unilateral Eyestalk Ablation on the Biochemical Changes of Edible Portunid Crab *Charybdis lucifera* (Fabricius)

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Abstract: In the present study was aimed to know the effect of eyestalk ablation on the biochemical composition of the crab, *Charybdis lucifera*. After 3 days of experimental period, proximate composition was estimated both control and eyestalk ablated crabs. The protein content of unilaterally eyestalk ablated (68.97%) crabs was higher than that of control crabs (41.64%). Carbohydrate content of eyestalk-ablated crabs (1.45%) was relatively higher when compared to intact control crabs (1.42%). The lipid content of the present study was also higher in eyestalk-ablated crabs (1.85%) rather than intact control crabs (1.65%). In the present study the values of saturated fatty acids for eyestalk ablated and intact control crabs were 26.32 and 25.89%, respectively. The mono saturated fatty acids in eyestalk-ablated crabs were 0.76% and control crabs were 0.48%. However, the polyunsaturated fatty acids were 11.63% in eyestalk ablated and 5.8% in intact control crabs. From the present study, it could be confirmed that eyestalk ablation influenced protein, carbohydrate and lipid content of the crab, *C. lucifera*. It also effectively influenced saturated and unsaturated fatty acids as evidenced by higher values in eyestalk ablated crabs rather than control crabs.

Key words: Eyestalk ablation, *Charybdis lucifera*, biochemical composition, portunid crabs, intact control, palmitoleic acid

INTRODUCTION

Crabs are diverse group of crustaceans characterized by colorful, hard, flattened carapace and sexual dimorphism. In India, a total of 12 species, belonging to 6 genera of 4 families, viz., *Scylla*, *Portunus*, *Charybdis*, *Matuta*, *Varuna* and *Sartoriana* are of commercial value. The commercially important Portunid crabs found along Parangipettai coast are *Scylla serrata*, *S. tranquebarica*, *Portunus sanguinolentus*, *P. pelagicus*, *Podophthalamus vigil*, *Charybdis. feriata*, *C. lucifera*, *C. natator*, *C. granulata* and *C. truncata* (John Samuel *et al*., 2004). They have very good demand in both Indian and foreign markets. In general eyestalk ablation is performed in hatcheries and research experiments to induce gonad development and moulting in commercial crustaceans. Earlier studies have emphasized more on the influence of eyestalk ablation on the gonad induction and growth by using different feeds. But nobody studied the impact of unilateral eyestalk ablation on the biochemical composition in edible crabs in general and *C. lucifera* in particular. Since biochemical studies are more important in nutritional perspective, an attempt has been made to know the effect of unilateral eyestalk ablation on the biochemical composition (protein, carbohydrate, lipid and fatty acids) of the crab, *C. lucifera*.

MATERIALS AND METHODS

Crabs (weight of 80-120 g and carapace width of 65-84 cm) were procured from Parangipettai (Lat. 11°29'N and Long. 79°46'E) coastal waters and they were acclimatized to the Laboratory

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conditions (Salinity 30-34 ppt; dissolved oxygen, 5.0-6.0 ppm; temperature 28-30°C; pH 7.5-8.5). The experimental animals were divided into two groups. One group was used for eyestalk ablation experiment and the other was kept as intact control. The unilateral eyestalk ablation was performed in the experimental crabs by cutting the right eye at its base with a fine and clean scissors and the wound was cauterized immediately with a hot blunt needle in order to prevent the loss of haemolymph and mortality (Caillouet, 1973).

Both eyestalks ablated and intact control crabs were introduced into synthetic tanks of rectangular shape, having dimensions of 0.5×0.35×0.35 m of length, width and height, respectively. Water exchange was done regularly in the morning. Clam meat was given twice in a day as a feed for both experimental and intact control crabs at 10% of their body weight. Excess feed and other debris were removed while water exchange. Optimum environmental parameters were maintained during the experimental period (Salinity 30-34; dissolved oxygen, 5.0-6.0 ppm; temperature 28-30°C; pH 7.5-8.5). Triplicate was maintained for both control and experimental groups.

After 3 days of experimental period, both control and eyestalk ablated crabs were dried at 60°C in an oven and used for biochemical analysis. The protein, carbohydrate and lipid contents were estimated by adopting the standard methods of Raymont *et al*. (1964), Dubois *et al*. (1956) and Folch *et al*. (1956), respectively.

The fatty acid methyl esters of the samples were injected in to the gas chromatograph (HP 5890) capillary column coated with 5% phenyl silicane at a temperature from 170°C to 310°C for 23.33 min. Flame ionization Detector was used for the analysis. Based on the retention time the different fatty acids of the samples were identified.

RESULTS

A remarkable increase in the level of biochemical constituents was observed in the eyestalk ablated crabs than in intact control crabs. The protein content was found to be higher in eyestalk ablated crabs (68.97%) than that of control crabs (41.64%). Carbohydrate content of eyestalk ablated crabs (1.45%) was relatively higher when compared to intact control crabs (1.42%).The lipid content of the present study was also higher in eyestalk ablated crabs (1.85%) rather than intact control crabs (1.65%) (Table 1).

The total values of saturated fatty acids in eyestalk ablated *C. lucifera* were 26.32%. Whereas in the intact control it was 25.89%. The saturated fatty acids like capric acid, lauric acid, tridecanoic acid, pentadecanoic acid, heptadeeanoic acid and behenic acid was higher than intact control crabs. However, myristic acid and palmitic acid was higher in intact control crabs (Table 2).

Table 1: Biochemical constituents of eyestalk ablated and intact control crabs of *C. lucifera*

Crabs	Protein (%)	Carbohydrate (%)	Lipid (%)
Intact control	41.64±1.55	1.42±0.01	1.65±0.05
Eyestalk ablated	68.97±2.64	1.45±0.02	1.85±0.08

Table 2: Saturated fatty acids in eyestalk ablated and intact control crabs of *C.lucifera*

Fatty acids	Position of the carbon atom	Control (%)	Eyestalk ablated (%)
Capric acid	C 10:0	0.13	0.57
Lauric acid	C 12:0	0.80	1.39
Tridecanoic acid	C 13:0	0.02	0.51
Myristic acid	C 14:0	1.57	1.36
Pentadecanoic acid	C 15:0	0.76	0.90
Palmitic acid	C 16:0	20.09	18.26
Heptadeeanoic acid	C 17:0	2.44	2.97
Heneicosanoic acid	C 21:0	0.08	0.07
Behenic acid	C 22:0	-	0.29
Total		25.89	26.32

Table 3: Monounsaturated fatty acids in eyestalk ablated and intact control crabs of *C.lucifera*

Fatty acids	Position of the carbon atom	Control (%)	Eyestalk ablated (%)
Myristoleic acid	C 14:1	0.04	0.07
Palmitoleic acid	C 16:1	0.13	0.14
Eicosenoic acid	C 20:1	0.07	0.06
Nervonic acid	C 20:1n-9	0.24	0.43
Total		0.48	0.70

Table 4: Polyunsaturated fatty acids in eyestalk ablated and intact control crabs of *C.lucifera*

Fatty acids	Position of the carbon atom	Control (%)	Eyestalk ablated (%)
Elaidic acid	C18:2	0.36	0.11
Linolelaidic acid	C18:2	3.20	0.31
Linoleum acid	C 18:2; 9,12	0.35	2.87
Linolenic acid	C 18: 3;9,12,15	0.61	0.47
Arachidonic acid	C 20:4; 5,8,11,14	1.18	6.46
Eicosapentaenoic acid	C 24: 1; 15	0.09	1.41
Total		5.79	11.63

The total values of monosatrurated fatty acids was found to be higher in eyestalk ablated crabs (0.70%) than that in intact control crabs (0.48%). The myristoleic acid, palmitoleic acid and nervonic acid values are higher in eyestalk-ablated crabs and only eicosenoic acid shows higher value in intact control crabs (Table 3).

The polyunsaturated fatty acids are also showed higher values in eyestalk ablated crabs (11.63%) than control (5.79%). Among 6 polysaturated fatty acids studied in the present study only 3 fatty acids (linoleum acid, arachidonic acid and eicosapentaenoic acid) reported to be higher in eyestalk-ablated crabs (Table 4).

DISCUSSION

Biochemical studies are very important from the nutritional point of view. The biochemical constituents in animals are known to vary with season, size of the animal, stage of maturity, temperature and availability of food etc. The eyestalk hormones have influence on carbohydrate, nitrogen and lipid metabolism in crustaceans (Hignam and Hill, 1979) which were found vary with times and species (Vernberg and Vernberg, 1974; Madhyasthan and Rengnekhar, 1979; Soundarapandian, 1996). In the present study, the levels of protein, lipid and carbohydrate content of the crab, *C. lucifera* were altered by unilateral ablation. Koshio *et al.* (1992) reported that neither unilateral eyestalk ablation nor feeding frequency affected the contents of the protein, lipid or the composition of the lipid class fatty acids of *M. rosenbergii*. Surendranath *et al.* (1992) reported eyestalk ablation caused marked changes in haemolyph glucose, glycogen, proteins, free amino acids, total lipids, free fatty acids and glycerol in the tissues of *Metapenaeus monoceros*.

In the present study, protein content was higher in eyestalk-ablated animals (68.97%) than those in intact control ones (41.64%). Values of protein in the present study agree with other studies (Sheen and D'Aramo, 1991; Thirunavukkarasu, 2005). Balasubramanian and Suseelan (2001) assessed the protein values in *C. smithii* was 59.8 to 71% in dry matter basis. Radhakrishnan and Natarajan (1979) estimated the protein values in *Podophthalmus vigil* by 15.75 to 20.16%. The protein value in *C. affinins* was 17.8% (Vasconcelos and Braz, 2001). In *S. serrata*, the protein content of the body meat and claw meat was 20.11% and 18.54%, respectively (Prasad and Neelakantan, 1989). Anonymous (1999) reported that the protein value in blue crab was 17.17%. George and Gopakumar (1987) observed the protein content in *S. serrata* with egg (19.16%), without egg (20.92%), body meat (16.8%) and claw meat (16.28%). George *et al.* (1990) noticed the protein values in cooked crab of *S. serrata* ranged from 14.43 to 18.96%. The protein content of *P. pelagicus* and *P. sanquinolentus* was

0.47 to 15.91% and 12.81 to 13.6% respectively (Radhakrishnan, 1979). Thirunavukkarasu (2005) recorded the protein values in *S. tranquebarica* from different parts viz., body meat (65.48 to 72.24%), claw meat (69.5 to 80.29%) and leg meat (69.47 to 74.7%).

Carbohydrates constitute only a minor percentage of total biochemical composition. Carbohydrates in fishery products contain no dietary fibre but only glucides, the majority of which consist of the polysaccharide glycogen. They also contain traces of glucose, fructose, sucrose and other mono and disaccharides (Okuzumi and Fujii, 2000). In the present study, carbohydrate content was higher in eyestalk ablated crabs (1.45%) rather than intact control crabs (1.42%). The previous studies were suggested that the carbohydrate in the muscle varied from 0.3 to 0.63% in *P. vigil* (Radhakrishnan and Natarajan, 1979), 2.4 to 3.4% in *C. smithii* (Balasubramanian and Suseelan, 2001), 0.17% in body meat, 0.24% in claw meat of *S. serrata* (Prasad and Neelakantan, 1989), 0.16 to 0.55% in *P. pelagicus* and 0.44 to 0.73% in *P. sanquinolentus* (Radhakrishnan, 1979). In *S. tranquebarica*, the carbohydrate values of body meat, claw meat and the legs meat was 0.59 to 2.23%, 0.68 to 2.87% and 0.76 to 2.76%, respectively (Thirunavukkarasu, 2005).

Lipids are highly efficient as sources of energy, in that they contain more than twice the energy of carbohydrates and proteins (Okuzumi and Fujii, 2000). In the present study, lipid content of the unilaterally eyestalk ablated crabs (1.85%) was higher than that of intact control crabs (1.65%). In *P. vigil* the lipid values assessed from 5.13 to 9.73% by Radhakrishnan and Natarajan (1979). Balasubramanian and Suseelan (2001) recorded the lipid values from 6.2 to 7.6% in *C. smithii*. In *Chaceon affinis* the lipid values were 0.7% (Vasconcelos and Braz, 2001) and in blue crab it was 1.5% (Anonymous, 1999). Prasad and Neelakantan (1989) noticed the lipid content in *S. serrata* from body meat (1.65%) and claw meat (2.01%). George and Gopakumar (1987) assessed the lipid values in *S. serrata* with egg (0.43%), without egg (0.7%), body meat (1.07%) and claw meat (1.0%). In *P. pelagicus* the lipid value was 3.3 to 5.6% and *P. sanguinolentus* it was 3.8 to 5.5% (Radhakrishnan, 1979). The lipid content of the body meat (1.6 to 0.9%), claw meat (1.83 to 2.06%) and leg meat (1.58 to 2.08% was estimated by Thirunavukkarasu (2005). Koshio *et al.* (1992) reported that the unilateral eyestalk ablation did not change the composition of lipid class and fatty acid in *M. rosenbergii*. This suggests that remaining factors and/or hormones in the unilateral eyestalk which was not removed continue to control lipid metabolism to a certain extend.

Besides being a good and cheap source of nutrition, the fatty acids like Omega 3 fatty acids, particularly Eicosapentanoic Acid (EPA) and Decosahexanoic Acid (DHA) are the principle biologically active components of the fish lipids and the EPA and DHA were 2-7 times higher in the roe and hepatopancreas of crabs as compared to the mussel (Tan-Low Laikim, 1998). In the present study the values of saturated fatty acids for eyestalk ablated and intact control crabs were 26.32 and 25.89%, respectively. The mono saturated fatty acids in eyestalk-ablated crabs were 0.70% and in control crabs were 0.48%. However, the polyunsaturated fatty acids were 11.63% in eyestalk ablated and 5.79% in intact control crabs. In the blue crab meat and body parts, the levels of saturated, monosaturated and polyunsaturated fatty acids contributed 19.20, 23.56 and 57.22%, respectively (Anonymous, 1999). Whereas in *S. tranquebarica* the total SFA, MUFA and PUFA are 49.84, 40.34 and 9.81%, respectively (Thirunavukkarasu, 2005).

From the present study it could be confirm that eyestalk ablation influenced protein, carbohydrate and lipid contents of the crab, *C. lucifera*. It also influenced saturated and unsaturated fatty acids as evidenced by higher values in eyestalk ablated crabs rather than control crabs.

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