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Comparison on fatty acid profile in the different body parts of freshwater crab (*Paratelphusha lamellifrons*)

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Abstract

Different body parts of freshwater crab *Paratelphusha lamellifrons* from Padma river were screened for profiling their fatty acid composition. Gas chromatographic studies revealed the presence 12 varieties of fatty acids of which three are SFA, 9 are UFA of which 5 were monounsaturated fatty acids (MUFA) constitute on average 35.70% of the total lipid and 4 were highly unsaturated fatty acids (PUFA). Amount of SFA, MUFA and PUFA and their concentrations in cephalothorax, cheliped and legs ranges between (24.45-26.77)%, (35.50-36.31)% and (16.90-17.76) % respectively. MUFAs were observed as the dominated one among the investigated fatty acids in all the body parts of *P. lamellifrons*. Except SFAs both cheliped and legs contained maximum amount of MUFAs (36.30% and 36.31%) and PUFAs (17.76% and 17.67%) compared to cephalothorax (34.50% and 16.90%). Palmitic (18.87-19.91) %, oleic (20.87-21.97)% and linoleic (13.62-14.87)% was observed predominant fatty acids among the recorded SFAs, MUFAs and PUFAs in the present study. Omega-3 fatty acids were found maximum in cephalothorax (3.28%) compared to cheliped (2.89%) and legs (2.85)% whereas omega-6 fatty acids in cheliped (14.87%) and legs (14.82%) of *P. lamellifrons* than that of cephalothorax (13.62%). The present study findings indicate that all the body parts of freshwater crab (*P. lamellifrons)* are rich in essential fatty acids omega-3 and omega-6.

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Introduction

Freshwater crab not only plays an important role in the food chain of aquatic ecosystem but also provide a nutrient rich food sources for various communities of the world. More than 6,700 known species of brachyuran crabs and a total of 1,476 species in 14 families are currently known from all zoogeographical regions (except Antarctica), including 1,306 species in eight exclusively freshwater families (Yeo *et al.*, 2008). Bangladesh is a land of river endowed with rich freshwater resources of which many freshwater shellfishes (marine crabs, shrimps and lobsters) are commercially important (Banglapedia). Crustaceans have long been playing a major role in the diet and nutrition of Bangladeshi people and a key contributor in country's export earnings. There are 64 prawns and shrimp, nearly 50 crabs, 6 lobsters, a number of mantis shrimps, king crabs, hermit crabs and an array of crustacean zooplanktons reported in Bangladesh. More than 10 million tons of crustaceans are produced by fishery or farming for human consumption, the majority of it being shrimp, prawns and crabs (Red list). *Paratelphusa lamellifrons*, commonly known as panti kakra is among the four species of freshwater crab so far reported in Bangladesh which is only consumed as food (Shafi and Quddus, 2001).

Fat which is a source of energy, essential fatty acids, carrier for fat soluble vitamin (A,D,E,K) attracted attention of many researcher around the world (Moghal *et al.*, 2017; Moghal *et al.*, 2015; Ayas *et al.*, 2011; Abol-Munafi *et al.*, 2016 and Sreelakshmi *et al.*, 2016) as they have beneficial impact on human health (Dai, 1999). Fatty acids, especially omega-3 and omega-6 EPA and DHA are also essential for crustaceans (Sargent *et al.*, 2002) as they play significant role during gonadial growth, maturation and development. The crab *P. lamellifrons* is not only a source of beneficial protein, fat and minerals but it also contains omega-3 and omega-6 PUFAs (Poly-Unsaturated Fatty Acids) (Mia *et al.*, 2016, Islam *et al.*, 2016 and Islam *et al.*, 2017). Although much research has focused on fatty acid profiling of marine and freshwater crustaceans considering their unique fatty acids composition and degree of unsaturation (Moghal *et al.*, 2017; Moghal *et al.*, 2015; Ayas *et al.*, 2011; Abol-Munafi *et al.*, 2016; Sreelakshmi *et al.*, 2016; Bragagnolo and Rodriguez-Amaya, 2001) but little (Islam *et al.*, 2017) or no information were known on the comparative fatty acid profile of different body parts of freshwater crab *P. lamellifrons*. So, the present attempt has been undertaken to investigate the fatty acid profile of fat extracted from different body parts of freshwater crab *P. lamellifrons*.

Materials and methods

Sample collection and preparation

The freshwater crabs *Paratelphusa lamellifrons* were collected from the Padma River near Rajshahi district which has been observed to have a good range of biological diversity including crustaceans. The crab were collected by using net which is locally known as Kholsoon, Thusi, Duayr and sometimes through hand from the river Padma during the month of May, 2015. Collected crab were then washed with running tap water to remove any adhering materials and then cephalothorax, cheliped and legs were separated (including shell) from whole crab. The separated parts were dried in an electric oven at 60°C for about 24 hours. The dried crab sample were removed from oven and crushed into powder form with motor and pestle and kept in refrigerator until extraction of fat.

Fatty acids analysis

Fat from different dried sample of crab was extracted using the chloroform: methanol (2:1, v/v; containing BHT 0.1mg/100g) method (Folch *et al.*, 1957). The fat thus obtained by extraction was analyzed for fatty acid profiling by converting them to methyl esters (FAMEs) according to the method of Metcalfe *et al.* (1966). FAMEs were finally extracted using methanol. FAMEs, were analyzed by gas chromatography using a Shimadzu gas chromatograph (GC-2010) equipped with polar capillary column (SPTM-2560, 75m length, 0.18mm I.D., 0.14 micron film thickness). The oven temperature was programmed from an initial temperature of 180°C (45 min hold), rising to 240°C at 4°C/min, and held isothermal (240°C) for 15min. Nitrogen was used as a carrier gas at a flow rate of 1ml/min.

The injection port and the flame ionization detector were maintained at 250°C. Identification was made by comparison of retention times to those of authentic standards.

Results and discussion

Fat from different body parts of freshwater crab *P. lamellifrons* were investigated for their fatty acid content and the results thus obtained were listed in Table 1 and their graphical presentation is shown in Fig. 1-7. In the present study total 12 types of fatty acid were recorded in all the body parts of P. *lamellifrons*. Saturated as well as unsaturated fatty acid was observed in all the body parts of crab *P. lamellifrons*. Among the investigated 12 fatty acids as shown in Table 1, three are SFA, 9 are UFA of which 5 were monounsaturated fatty acids (MUFA) constitute on average 35.70% of the total lipid and 4 were highly unsaturated fatty acids (PUFA). Amount of total saturated fatty acids (SFA) were found to ranges between (24.45-26.77)% whereas total MUFA, PUFA, Omega-3, Omega-6 and their ratio (34.50-36.31)%, (16.90-17.76)%, (2.85-3.28)%, (13.62-14.82)% and (0.192-0.241)% respectively. From Table 1 it is evident that all the body parts of examined crab contained highest amount of MUFA compared to SFA and PUFA. The main saturated fatty acids were myristic (14:0), palmitic (16:0) and stearic (18:0) and their amount ranges between (0.44-1.47) %, (18.87-19.91)% and (5.09-5.39)% respectively, while palmitic acid was the dominant among saturated fatty acid and stearic acid is the lowest. Total amount of saturated fatty acids were observed maximum in cephalothorax (26.77%) whereas lowest and almost same amount were found in cheliped (24.45%) and legs (24.46%). Among the different body parts of *P. lamellifrons* cephalothorax contained highest amount of myristic (1.47%), palmitic (19.91%) and stearic (5.39%) acid compared to cheliped (0.49%) and legs (0.44%). Presence of saturated fatty acids (myristic, palmitic and stearic) were observed almost same in amount in both cheliped and legs. King *et al*. (1990) reported 13.4% palmitic and 4.46% stearic contents in the total lipids of Dungeness crab (*Cancer magister*) whereas Ramamoorthy *et al*. (2016) reported 4.98%, 1.11%, and 2.04% palmitic, *in P. pelagicus, P. gladiator and C. lucifera* and 10.86%, 1.03% and 2.94 % stearic acid in *P. pelagicus, P. gladiator and C. lucifera* which, is lower than that our results (18.87-19.91)% except stearic acid in *P. pelagicus* (10.86%). Except stearic acid (3.89%) both myristic and palmitic acid were observed lower compared to our previous study on fatty acid profile of *P. lamellifrons* (Islam *et al*., 2017).

Table 1. Comparative fatty acid profile of crab lipid (% of total fatty acid).

Type of fatty acid	Name of fatty acid	C:D	% Fatty acid		
			CTF	ChF	LF
Saturated fatty acid (SFA)	Myristic acid	(C14:0)	1.47	0.49	0.44
	Palmitic acid	(C16:0)	19.91	18.87	18.88
	Stearic acid	(C18:0)	5.39	5.09	5.14
Mono Unsaturated fatty acid (MUFA)	Myristoteic acid	(C14:1) n-5	0.84	1.26	1.22
	Palmitoleic acid	(C16:1) n-7	10.21	10.15	10.19
	Cis-10-Heptadecenoic acid	(C17:1) n-7	0.56	1.03	0.97
	Oleic acid	(C18:1) n-9	20.87	21.95	21.97
	Erucic acid	(C22:1) n-9	2.02	1.91	1.96
Poly Unsaturated fatty acid (PUFA)	Linoleic acid	(C18:2) n-6	13.62	14.87	14.82
	Linolenic acid	(C18:3) n-3	2.48	2.24	2.29
	Eicosapentaenoic acid (EPA)	(C20:5) n-3	0.51	0.47	0.41
	Docosahexaenoic acid (DHA)	(C22:6) n-3	0.29	0.18	0.15
Saturated fatty acid (SFA)	Total		26.77	24.45	24.46
Mono Unsaturated fatty acid (MUFA)	Total		34.5	36.30	36.31
Poly Unsaturated fatty acid (PUFA)	Total		16.90	17.76	17.67
Omega-3	Total		3.28	2.89	2.85
Omega-6	Total		13.62	14.87	14.82
∑PUFA n-3/∑PUFA n-6	Ratio		0.241	0.194	0.192

Fig 1. Fatty acid profile of cephalothorax (CTF).

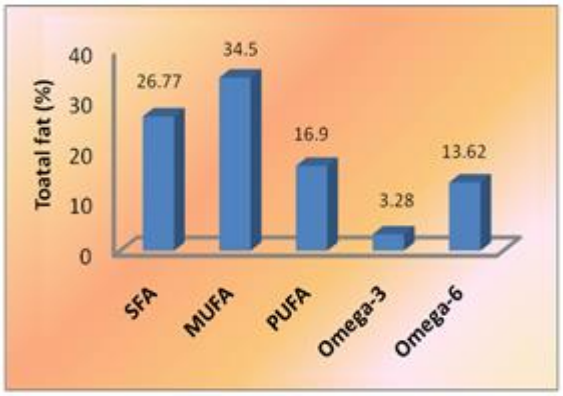

Fig 2. Fatty acid types and their amount in cephalothorax (CTF).

Fig 3. Fatty acid profile of cheliped (ChF).

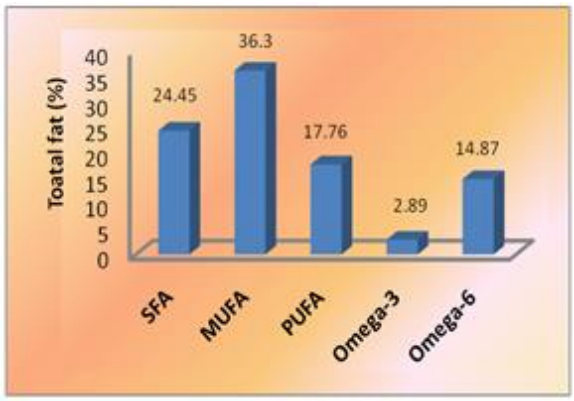

Fig 4. Fatty acid types and their amounts in cheliped.

Fig 5. Fatty acid composition of leg fat (LF).

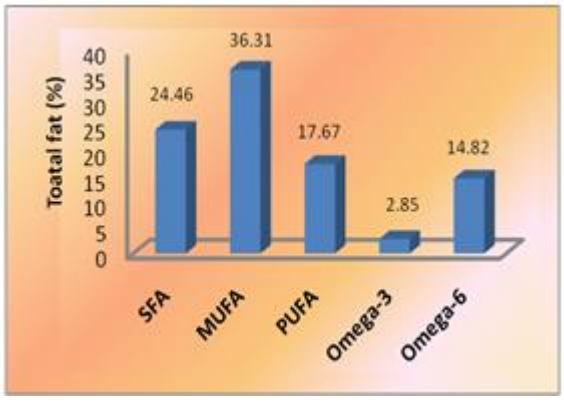

Fig 6. Fatty types and their amounts in leg (LF).

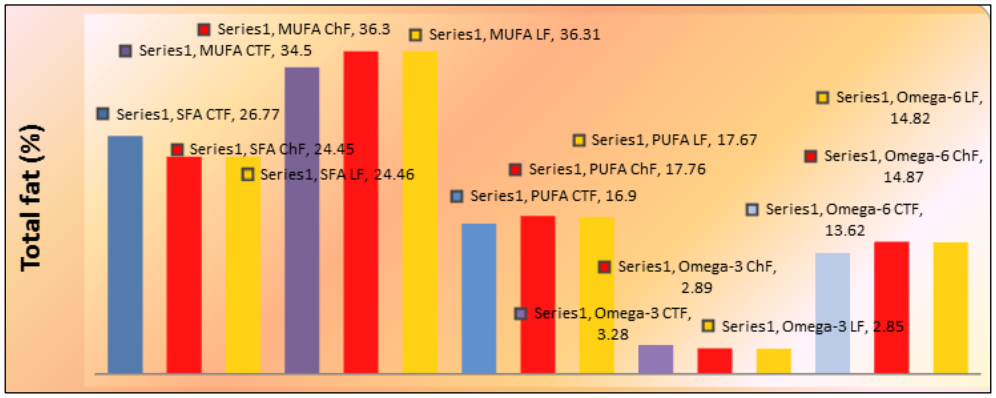

Fig 7. Comparative fatty acid composition of different body parts of *Paratelphusa lamelifrons*.

Monounsaturated fats (MUFA) which can help reduce bad cholesterol in blood lower the risk of heart diseases and stroke (Wolk and Alicia) were observed predominant components among the investigated fatty acid SFA, MUFA and PUFA and their amount was noticed in the following order oleic (20.87-21.97)%> palmitoleic (10.15-10.21)%> erucic(1.91-2.02)%> myristoteic (0.84-1.26)% > cis-10-heptadecenoic acid (0.56-1.03)% which, means MUFA is dominated by oleic acid. Oleic acid is a monounsaturated omega-9 fatty acid with many health benefits like supercharging of muscles and brain by making myelin (Cunnane *et al.*, 2012). Eating a diet high in oleic acid for 4 weeks reduced blood pressure while increasing good HDL cholesterol in women (Ruiz-Gutierrez *et al.* 1996). An animal study reported by Ochoa *et al.* (2011) indicates that a diet high in monounsaturated fats (including oleic acid) reduces age-related changes in the brain's mitochondria.

Cheliped and legs contained almost same amount MUFA (36.30% and 36.31%) whereas cephalothorax contained total 34.50% MUFA which is lower than in cheliped and legs. In the present study palmitoleic and erucic acid were noticed maximum (10.21% and 2.02%) in cephalothorax while cheliped and legs contained highest amount of myristoteic (1.22-1.26)%, cis-10-heptadecenoic (0.97-1.03)% and oleic (21.95-21.97)% in comparison with cephalothorax which is 0.85%, 0.56% and 20.87% respectively. Ramamoorthy *et al.* (2016) reported 12.89%, 0.40% and 1.09% oleic acid in *P. pelagicus, P. gladiator and C. lucifera* respectively which is lower than our results (20.87-21.97) %. Cherif *et. al.* (2008) reported total 23.21% (on average from four sites) MUFA in green crab (*C. mediterraneus*) from the Tunisian mediterranean coasts which is also lower than the total MUFA (34.50-36.31)% of the present study. On the other hands amount of total MUFA (34.50-36.31) % in this study somehow lower compared to our published data (Islam *et al.*, 2017) on whole crab fat of *P. lamellifrons* (42.85%).

PUFA is a prominent source of most biologically significant fatty acids omega-3 and omega-6 which synthesized from the essential FAs (EFAs) alpha-linolenic acid (ALA) and linoleic acid, respectively are beneficial on brain growth, immune system, and preventing of heart attack (Saber, 2016). PUFA particularly omega-3 PUFAs also play a crucial role in determining the nutritive value of crab (Latyshev *et al.*, 2009) and all fish and shellfishes which, are observed throughout the aquatic food chain, are sources of omega-3 fatty acids (www.seafoodhealthfacts.org).

Total amount of PUFA in the different body parts (cephalothorax, cheliped and legs) of freshwater crab *P. lamellifrons* ranged between (16.90-17.76)% and comprises 17.44% on average of the total lipid which is higher compared to PUFA in whole *P. lamellifrons* fat 15.02% (Islam *et al.*, 2017). Total PUFA were found maximum in cheliped (17.76%) and legs (17.67%) than that's of cephalothorax (16.90%). The total omega-3 fatty acids in cephalothorax, cheliped, and legs accounted for (2.85-3.28)% both of which is lower than those reported for green crab *C. mediterraneus* and *C. maenas* and freshwater crab *P. lamellifrons* whereas, omega-6 acids were (13.62-14.87)% and 82.78% of all PUFA which is higher than them (Saber, 2016; Naczk *et al.*, 2004 and Islam *et al.*, 2017). The major n-3 and n-6 PUFA was linolenic acid (C18:3n-3) and linoleic (C18:2n-6) and their amount ranged between (2.85-3.28) % and (13.62-14.87) % in cephalothorax, (CTF), cheliped (ChF) and legs (LF) of *P. lamellifrons* respectively. Cephalothorax contained maximum quantity of total omega-3 (3.28)% and lowest omega-6 (13.62)% fatty acid compared to cheliped (2.89% and 14.47%) and legs (2.85% and 14.82%). Table 1 data demonstrated that eephalothorax was richer in both EPA and DHA in contrast to cheliped and legs. The largest fraction of n-3 PUFA constituted DHA, EPA and ALA, while DHA was generally higher in comparison to EPA (Table 1). The ratio of EPA and DHA between 1:1 and 5:1 is supposedly beneficial to health as stated by FAO/WHO (1994) and some authors (Simopoulos, 2002; Simopoulos, 2008 and Gebauer, 2006). The ratio of EPA to DHA was found to be ranged between (0.192-0.241) % and found maximum in cephalothorax (0.241%) and lowest in legs (0.192%) which is lower

than those reported by Islam *et al.* (2017) and King *et al.* (1990) but higher (in cephalothorax) and within (in cheliped and legs) the recommended desire minimum and maximum dietary ratio of n-3/n-6 (0.1-0.2) by FAO/WHO (1994).

Conclusion

The present study clearly demonstrated that all the body parts (cephalothorax, cheliped and legs) of investigated freshwater crab *P. lamellifrons* are rich with valuable fatty acid MUFA and PUFA specially EPA and DHA. Thus, this freshwater species of crab can be serving as an alternative omega-3 sources for the community especially those living in the bank of the river Padma. Beside this, the information obtained from the present and previous study on this same species can be used by various nutrition, health and medicinal practitioner in prescribing them as major sources of protein, mineral, EPA and DHA.

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