ISSN: 2347-5129
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.352
IJFAS 2016; 4(2): 119-125

www.fisheriesjournal.com
Received: 21-01-2016
Accepted: 24-02-2016

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Patterns of variation in the proximate composition of *Maydelliathelphusa masoniana* (Henderson), (a decapod crustacean), found in the local water bodies of Jammu region of J&K state (India)

Priya Manhas, Seema Langer, Irfan A Noorani, Rakesh K Gupta

Abstract
During the course of present study, various nutritional aspects viz. protein, glycogen, lipid, moisture and ash of the body meat of an edible freshwater crab, *Maydelliathelphusa masoniana* (Henderson) has been investigated in both male and female crabs and marked seasonal variations were also taken into consideration during an yearlong investigation. Lipid and water contents were inversely related, maximum lipid levels were being recorded during the pre-spawning months and minimum during post-spawning. Lipid and protein however, showed positive correlation. Pre-spawning period witnessed high energy values and muscle glycogen witnessing a direct correlation with feeding and spawning activity. Nutritive value of *M. masoniana* is well comparable to other edible species of decapod crustaceans like prawns and shrimps thereby ensuring its candidature as an edible and potential culturable species.

Keywords: *Maydelliathelphusa masoniana*, decapod crustacean, J&K

1. Introduction
Crabs, among many other invertebrates, are considered to be important shell fishery products [1]. The crabs rank after shrimps and lobsters for their esteemed seafood delicacy and the value of fishery they support [2]. Crab meat is considered as a delicacy in many parts of the world but the limited utilization of shellfishes (crab) in our state (Jammu and Kashmir) is due to conservative food habits and lack of knowledge about the nutritive value of crabs. Existing literature information on the food value of most crabs is scarce despite the food richness of these crustaceans. Most persons rate the fish higher in preference to the crabs which are considered inferior and food for the low income earners/poor. Studies on *Maydelliathelphusa masoniana*, a local freshwater crab in Jammu water bodies has recently attracted the attention of workers keeping in view the fact that it is readily available, completes its lifecycle in freshwater only and can be maintained in captivity. So far, a very limited number of reports are on record with regard to this species. Whatever little work has been reported pertains to its eco-biology and population structure. Preliminary studies witness the species to be a potential culture candidate as evinced by its high protein content. Further the scope or role of a species in aquaculture practice is primarily determined by its nutritional status, especially the protein value.

2. Materials and methods
Crabs were collected from their natural habitat, at Gho-manhasan stream,***at a distance of about 12 kms from University of Jammu. Only adult crabs (of 5-6 cm carapace width) were selected. Soon after catching, crabs were brought to the laboratory and were segregated sex wise. The crabs were then dissected for body meat, claw meat and trash. The organic constituents of each component were determined by standard methods such as total Proteins [3]; Glycogen [4]; Lipid [5]; Moisture [6]. The results were expressed on dry weight basis. Caloric content was calculated by multiplying the concentration of various components with conversion factors 4.15, 9.4, 5.65 for carbohydrate, lipid and protein respectively [7]. The caloric values were expressed as calories per gram (cal gm^{-1} DWB).

3. Results and discussion

3.1 Seasonal dynamics of protein content

Biochemical analysis of the body meat, claw meat, and trash (Tables: 1, 2) revealed that the protein content fluctuated from 46.05±0.82% to 62.16±0.30% with an annual average of 54.38±4.08% in body meat; from 46.0±0.64% to 57.39±0.35% with annual average 51.97±3.62% in claw meat and from 19.54±0.50% to 29.05±0.66% with an annual average 25.78±3.04% in trash in female crabs. In males, however, it fluctuated from 55.12±0.30 to 64.5±0.11% with an annual average 59.52±0.30% in body meat, 55.40±2.63% in claw meat. In trash, it varied from 20.39±0.35% to 25.06±0.50% with annual average 23.41±1.47%. The values so recorded were found to differ significantly among various months (p<0.05). When compared with males, females had lower annual average protein content being 59.52±2.31% and 54.38±4.08% respectively and this is probably due to the fact that in females, muscle proteins gets mobilized for the gonadal development. The same trend was observed in shrimp, *Penaeus merguiensis* and in fresh water prawn, *M. idea* and in Palaemonid prawn, *M. idella idella*. (Fig. 1)

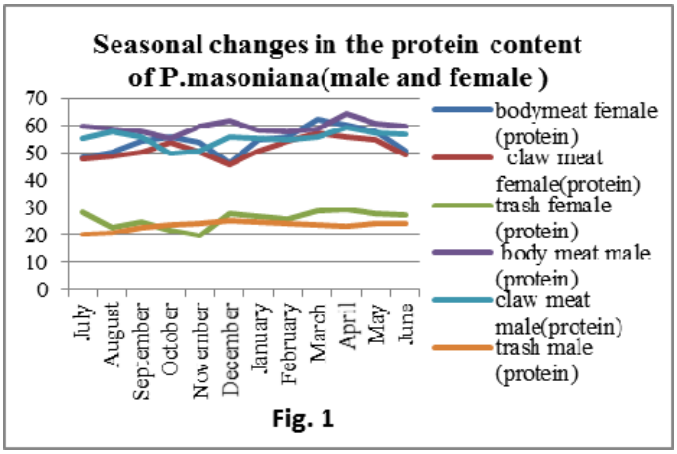

Fig. 1

Protein - water cycle High levels of protein during post-monsoon and spring season can be attributed to plank tonic abundance on one hand and deposition of proteins to meet the protein requirement of next breeding season on the other hand. On the contrary, a decrease in the protein content during winters and monsoon may consequently arise due to spawning function, reduced feeding intensity, and enhanced catabolic process, reduction in the reserve food content and large scale transfer of proteins from muscles to ovaries. Similar observations have been recorded in *M. dayanum* by [8, 9, 10]. The protein cycle thus appears to have a strong correlation with feeding and spawning.

Results drawn after statistical computation of data suggests a significant negative correlation between protein content and moisture i.e., the increase in the moisture content is accompanied by decrease in the protein content and vice versa. Such a negative correlation has also been observed in *Clibanarius longitarsu* [11]; in *Fenneropenaeus indicus* [12]; in *Metapenaeus dobsoni* [13] and in *Scylla serrata* [14].

3.2 Seasonal dynamics in the glycogen content:

The seasonal variations in various biochemical contents in both male and female crabs have been shown in Table 1 and 2 respectively. Mean values of glycogen content furnished a range varying from 0.98±0.13% to 3.62±0.73 with an annual average of 2.20±0.96% in body meat, from 0.76±0.21% to 2.53±0.42% with an annual average of 1.33±0.68% in claw meat and from 0.89±0.33% to 2.78±0.56% with an annual average of 1.67±0.63% in trash of female crab. Similarly, in male specimens, glycogen content varied from 0.97±0.28% to 2.73±0.57% with an annual average of 1.84±0.63% in body meat, from 0.86±0.25% to 2.13±0.25% with an annual average of 1.42±0.51% in claw meat, from 0.68±0.45% to 2.45±0.37% with an annual of 1.29±0.60% in trash.

Glycogen cycle

High values (3.62±0.73; 2.73±0.57%) in both the sexes were recorded in spring and post-monsoon which correspond to non-spawning period and thereafter a decreasing trend with the advancement of spawning season was noticed. Low levels in the glycogen content were observed during winters (December- January) and Monsoon (July- August) with lowest values (0.97±0.28%, 0.98± 0.13%) in the month of December in both male and female crabs respectively (Fig. 2). The diminution in the glycogen content during winters and monsoon thereby exhibit utilization of glycogen as an energy source in addition to fat for the ripening of gonads. It appears that the muscle glycogen is associated with the feeding in addition to the spawning activity. The moderate values of glycogen during post-spawning may be due to high feeding activity during these months as reported by [15].

An inverse relationship between glycogen content and moisture content is another characteristic observation made during present study i.e., an increase in the glycogen content is accompanied by a corresponding decrease in the moisture content and vice-versa.

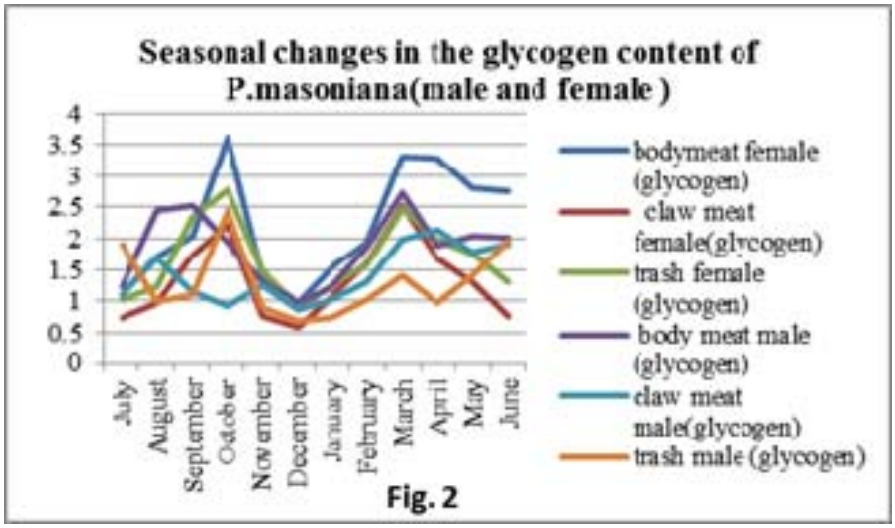

Fig. 2

3.3 Seasonal dynamics in the lipid content:

Perusal of table 1 and 2 reveal that the mean lipid content in female crab varied from 3.99±0.32 to 5.85±0.46% with an annual average of 4.82±0.61% in body meat, from 2.82±0.31 to 4.01±0.53% with an annual average of 3.38±0.36 in claw meat, from 2.51±0.53% to 4.07±0.28% with an annual average of 3.69±0.47% in trash. Similarly in males, it varied from 4.08±0.31% to 6.52±0.41% with an average of 5.15±0.67% in body meat, from 2.22±0.15% to 4.29±0.21% with an annual average 3.39±0.67% in claw meat and from 2.22±0.15% to 4.30±0.51% with annual average of 3.29±0.65% in trash . The lipid content in the present species is comparatively low as against higher values recorded for fin fishes. Higher values of lipid content have been reported in *I. crenata* (5.4 -15.6%) [16]; in *P. vigil* (16.8–31.9%) [17]. Present species therefore, stands in a better quality food list for human beings. When compared to other species of shell fishes, *M. masoniana* has higher lipid content viz., *M. rosenbergii*: 3.37, *Scylla tranquebarica: 1.8-2.7%*, *Scylla serrata*: 0.21% [18].

Lipid- water cycle

In general, the high values for lipid were observed during non-spawning season. The high lipid content observed in spring and post-monsoon could be attributed to active feeding and optimum availability of food, as algal blooms and plankton are reported to acquire maxima during this period [19]. The lipid content however, showed a declining trend towards May to July and November to January and an increase during August to October and February to April. (fig. 3) Decline in lipid content during spawning period was possibly due to mobilization of lipid as energy source to meet the high energy demands, during the act of ovulation and spawning on one hand and due to low feeding intensity and low availability of food items on the other. Similar reports on energy mobilization in fishes during spawning seasons have previously been made by [20, 21, 22, 23, 24, 25, 26, 27, 28] In the present study, it has been observed that male crabs have average higher lipid content than female crabs. Our results are in contradiction with the findings of [29] wherein lipids were found to be the most variable fraction and males of marine invertebrates were found to have a lesser lipid content.

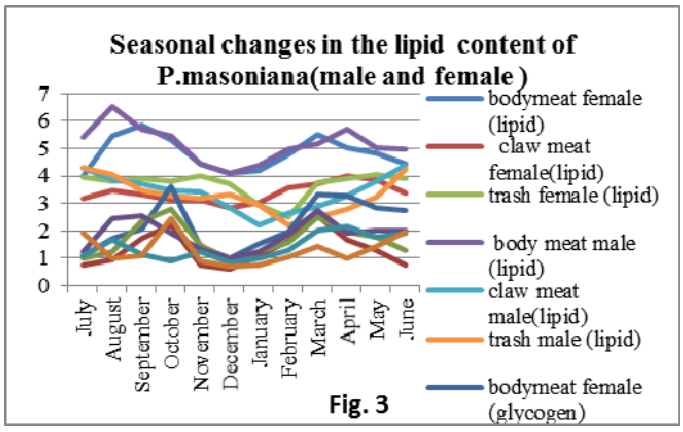

Fig. 3

3.4 Seasonal dynamics in the moisture content

An inquisitive study of table-1 & 2 and fig.4 reveals that females have higher moisture content that the males in all the three body tissues i.e., body meat, claw meat and trash. There is a significant variation in the moisture content of *M. masoniana* (female) throughout the period of investigation. Comparatively high values of water content were recorded during July (monsoon) and December (winters) which may be due to the breeding period of the animal. Similar results showing high water content in breeding season have also been reported by by many workers [30, 31].

It has been recorded that there is an increase in the moisture content which is accompanied by decrease in protein, lipid and glycogen content in all the three body tissues. Moisture content, thus showed significant but inverse relationships with lipid and protein contents. This inverse relation might be due to low temperature, low feeding rate, high energy demands to maintain body temperature and to cope up with food scarcity during winter. Similar results were earlier propounded by many authors [26, 27, 32, 33, 34, 35, 36, 37]

Table 1: Proximate composition of *Maydelliathelphusa masoniana* (female), a local freshwater crab of Jammu region during different months of the year. The results are expressed on dry weight basis (values represent±standard deviation)

Months	Body Tissue	Protein (Mean±SD)	Glycogen (Mean±SD)	Lipid (Mean±SD)	Ash (Mean±SD)	Moisture (Means±SD)	Calorific Value (Cal/g , dry wt)		
							Protein	Glycogen	Lipid
,	BM	48.51±0.12	1.10±0.29	3.99±0.32	6.98±0.41	84.23±1.6	274.08±0.68	4.57±0.96	37.51±3.00
	CM	47.95±0.56	0.76±0.21	3.17±0.36	7.89±0.56	83.58±1.55	270.92±3.17	3.03±0.87	29.80±3.39
	T	28.17±0.35	1.01±0.23	3.95±0.28	28.57±0.46	68.53±1.22	159.16±1.98	4.19±0.96	37.13±2.63
August	BM	50.98±0.71	1.71±0.41	5.45±0.43	6.78±0.52	81.30±1.53	288.03±4.02	7.10±1.73	51.23±4.04
	CM	49.50±0.51	0.96±0.40	3.46±0.54	8.13±0.44	80.8±1.54	279.67±3.15	3.98±1.66	32.52±5.08
	T	22.39±0.28	1.23±0.22	3.81±0.27	30.37±0.37	56.75±1.12	126.50±1.59	5.10±0.92	35.81±2.53
September	BM	54.29±0.32	2.04±0.05	5.85±0.46	9.89±0.73	81.90±1.61	306.73±1.81	8.47±0.21	54.99±4.32
	CM	50.50±0.23	1.73±0.61	3.32±0.54	12.63±0.52	79.20±1.19	285.32±1.29	7.18±2.53	31.21±5.08
	T	24.55±0.46	2.35±0.34	3.92±0.31	33.43±0.33	58.70±1.27	138.70±2.60	9.75±1.41	36.85±2.92
October	BM	55.85±0.48	3.62±0.73	5.33±0.19	7.60±0.24	81.29±1.57	315.55±2.71	15.02±3.08	50.10±1.87
	CM	53.91±0.57	2.22±0.63	3.15±0.59	8.79±0.58	78.78±1.39	304.59±3.22	9.21±2.62	29.61±5.54
	T	21.71±0.50	2.78±0.56	3.79±0.46	37.89±0.94	59.43±1.10	122.66±2.83	11.53±2.33	35.62±4.32
November	BM	53.98±0.47	1.41±0.26	4.41±0.53	8.32±0.63	81.76±1.48	304.98±2.65	5.85±1.08	41.45±4.98
	CM	50.22±0.62	0.76±0.20	3.12±±0.25	11.36±0.53	79.56±1.46	283.74±2.57	3.15±0.83	29.32±2.35
	T	19.54±0.50	1.49±0.30	3.98±0.52	32.91±0.25	60.0±1.15	110.40±2.83	6.18±1.25	42.30±2.45
December	BM	46.05±0.82	0.98±0.13	4.09±0.40	7.75±0.34	82.56±1.40	260.18±4.64	4.06±0.54	38.35±3.76
	CM	46.0±0.64	0.59±0.09	2.82±0.31	9.41±0.43	80.30±1.52	259.90±3.62	2.44±0.37	26.51±2.92
	T	27.91±0.44	0.89±0.33	3.70±0.53	24.75±0.57	66.0±1.28	157.69±3.62	3.69±1.37	34.78±4.99
January	BM	54.75±0.47	1.53±0.26	4.22±0.54	8.54±0.33	82.20±1.65	309.33±2.65	6.34±1.08	39.67±5.08
	CM	50.93±0.44	1.06±0.18	3.02±0.32	8.68±0.52	80.69±1.45.	287.75±2.99	4.40±0.75	28.39±3.01

	T	26.58±0.47	1.25±0.19	2.91±2.91	28.98±0.29	65.19±1.30	150.17±2.65	5.19±0.79	27.35±3.20
February	BM	56.03±0.24	1.95±0.69	4.76±0.87	9.67±0.33	79.61±1.55	316.07±1.35	8.13±2.85	44.74±8.18
	CM	54.35±0.27	1.60±0.25	3.54±0.56	10.49±0.52	78.08±1.36	307.07±1.53	6.64±1.04	33.28±5.27
	T	25.63±0.38	1.58±0.40	2.51±0.53	36.73±0.48	65.23±1.19	144.80±2.15	6.56±1.66	23.59±4.99
March	BM	62.16±0.30	3.32±0.31	5.49±0.38	12.35±0.46	78.13±1.45	351.20±3.46	13.78±1.29	51.61±2.81
	CM	57.39±0.35	2.53±0.42	3.72±0.60	17.31±0.34	77.73±1.44	324.25±3.05	10.50±1.74	34.97±5.64
	T	28.98±0.19	2.46±0.14	3.78±0.53	34.23±0.31	65.15±1.23	163.73±1.07	10.29±0.58	35.53±4.98
4April	BM	60.50±0.50	3.28±0.22	5.03±0.28	8.85±0.23	78.53±1.40	341.82±2.82	13.61±0.92	47.28±2.63
	CM	56.01±0.75	1.69±0.50	4.01±0.53	9.17±0.21	78.35±1.50	316.45±4.24	7.01±2.08	37.69±4.99
	T	29.05±0.66	1.98±0.21	3.91±0.63	35.86±0.64	64.03±1.29	164.13±3.73	8.22±0.87	36.75±5.93
May	BM	57.54±0.42	2.81±0.65	4.84±0.63	7.17±0.31	79.28±1.61	325.10±2.37	11.66±2.70	45.50±5.90
	CM	54.95±0.61	1.30±0.31	3.86±0.34	9.63±0.26	79.04±1.37	310.46±2.24	5.40±1.27	36.28±3.19
	T	27.91±0.52	1.74±0.17	4.07±0.28	32.03±0.30	64.17±1.21	157.69±2.94	7.26±0.71	38.26±2.63
June	BM	50.77±0.41	2.76±0.65	4.44±0.51	6.54±0.35	80.98±1.57	288..04±2.32	11.45±2.70	41.73±4.80
	CM	49.07±0.89	0.76±0.18	3.38±0.35	8.75±0.53	79.76±1.58	277.24±5.02	3.15±0.75	31.77±3.29
	T	26.98±0.56	1.30±0.26	3.89±0.66	29.10±0.43	65.23±1.19	152.43±3.17	5.40±1.21	36.57±6.20
Annual average	BM	54.38±4.08	2.20±0.96	4.82±0.61	8.37±1.66	80.98±1.79	306.8±26.39	9.17±3.80	45.35±5.75
	CM	51.97±3.62	1.33±0.68	3.38±0.35	10.22±2.63	79.66±1.58	293.63±19.86	5.51±2.61	31.78±3.34
	T	25.78±3.04	1.67±0.63	3.69±0.47	32.11±3.86	63.28±3.57	145.65±17.69	6.95±2.52	35.05±4.93

Table 2: Proximate composition of Maydelliathelphusa masoniana (male), a local freshwater crab of Jammu region during different months of the year. The results are expressed on dry weight basis (values represent±standard deviation).

Months	Body Tissue	Protein (Mean±SD)	Glycogen (Mean±SD)	Lipid (Mean±SD)	Ash (Mean±SD)	Moisture (Means±SD)	Calorific Value (Cal/g , dry wt)		
							Protein	Glycogen	Lipid
July	BM	59.98±0.90	1.22±0.21	5.40±0.54	8.47±0.34	79.08±1.98	338.88±5.08	5.06±0.87	50.76±5.08
	CM	55.18±0.30	1.09±0.13	4.29±0.21	9.35±0.46	79.27±1.85	311.77±2.02	4.52±0.54	40.33±1.98
	T	20.39±0.35	1.91±0.20	4.30±0.51	34.21±0.43	65.18±1.38	115.20±1.98	7.93±0.83	40.42±4.79
August	BM	58.75±0.35	2.44±0.51	6.52±0.41	6.78±0.47	78.65±1.69	331.93±1.99	10.13±2.12	61.29±3.86
	CM	57.98±0.90	1.69±0.37	3.86±0.51	8.13±0.36	80.18±1.69	327.58±5.08	7.01±1.54	36.28±4.80
	T	20.73±0.28	0.99±0.99	4.07±0.41	29.49±0.40	64.03±1.41	117.12±1.59	4.11±0.95	38.25±3.86
September	BM	57.56±0.50	2.53±0.50	5.68±0.46	6.60±0.44	79.12±1.78	325.21±2.81	10.49±2.08	53.39±4.33
	CM	55.72±0.36	1.15±0.38	3.72±0.44	6.66±0.28	79.81±1.64	314.82±2.04	4.77±1.58	34.96±4.14
	T	22.60±0.24	1.10±0.55	3.47±0.34	31.44±0.30	66.13±1.60	127.69±1.67	4.56±2.29	32.52±3.20
October	BM	55.12±0.30	1.93±0.66	5.48±0.44	7.27±0.33	78.51±1.80	311.42±1.70	8.00±2.74	51.51±4.14
	CM	49.90±0.45	0.91±0.38	3.45±0.35	8.12±0.25	77.05±1.87	281.93±2.55	3.78±1.58	32.43±3.29
	T	23.89±0.52	2.45±0.37	3.29±0.18	27.32±0.46	61.30±1.18	134.97±2.94	10.17±1.54	30.92±1.70
November	BM	59.92±0.39	1.31±0.21	4.42±0.41	7.65±0.17	77.41±1.59	338.54±2.20	5.43±0.87	41.54±3.86
	CM	50.98±0.92	1.24±0.18	3.42±0.44	7.86±0.63	77.17±1.39	288.03±5.19	5.15±0.75	32.14±4.14
	T	24.30±0.29	0.89±0.28	3.19±0.22	30.43±0.56	63.0±1.29	137.29±1.64	3.69±1.17	29.99±2.07
December	BM	62.0±0.24	0.97±0.28	4.08±0.31	8.65±0.51	80.67±1.76	350.30±1.35	4.02±1.17	38.35±2.91
	CM	55.82±0.31	0.86±0.25	2.82±0.55	8.47±0.34	79.47±1.85	315.38±1.75	3.57±1.04	26.51±5.17
	T	25.06±0.50	0.68±0.45	3.33±0.30	36.51±0.22	70.19±1.61	141.58±2.82	2.82±1.87	31.30±2.82
January	BM	58.5±0.24	1.22±0.25	4.41±0.29	11.26±0.21	79.67±1.69	330.52±1.39	5.06±0.96	41.45±2.72
	CM	55.12±0.60	1.01±0.22	2.22±0.15	12.98±1.22	76.95±1.65	311.42±3.38	4.19±0.91	20.87±1.41
	T	24.71±0.38	0.73±0.45	2.91±0.16	32.71±0.28	61.90±1.01	139.61±2.31	3.02±1.87	27.35±1.50
February	BM	58.0±0.32	1.85±0.31	4.98±0.82	9.84±0.26	78.49±1.77	327.70±1.81	7.68±1.29	46.81±7.71
	CM	54.80±0.79	1.29±0.18	2.63±0.27	7.90±0.52	77.51±1.26	309.62±4.46	5.35±0.75	24.72±2.54
	T	24.03±0.24	1.02±0.13	2.22±0.15	28.51±0.38	60.37±1.11	135.76±1.36	4.23±0.54	20.86±1.40
March	BM	59.0±0.67	2.73±0.57	5.18±0.52	8.97±0.28	77.41±1.43	333.35±3.79	11.32±2.37	48.69±4.89
	CM	56.0±0.39	1.99±0.56	2.90±0.32	9.11±0.32	77.01±1.49	316.40±2.20	8.25±2.33	26.10±3.08
	T	23.85±0.46	1.40±0.28	2.51±0.18	31.87±0.47	62.13±1.31	134.75±2.60	5.81±1.16	23.59±1.70
April	BM	64.5±0.11	1.89±0.27	5.69±0.51	7.11±0.33	75.01±1.58	364.42±0.62	7.84±1.12	53.48±4.80
	CM	59.34±0.30	2.13±0.25	3.26±0.14	8.56±0.35	76.78±1.84	335.27±1.70	8.83±1.04	30.64±1.32
	T	23.08±0.34	0.97±0.28	2.80±0.24	28.01±0.32	58.13±1.10	130.40±1.92	4.02±1.67	26.32±1.99
May	BM	60.89±0.80	2.03±0.16	5.03±0.36	8.68±0.32	76.96±1.63	344.02±3.10	8.42±0.67	47.28±3.39
	CM	57.31±0.72	1.78±0.33	3.81±0.48	8.86±0.32	78.13±.1.64	323.80±4.07	7.38±1.37	35.81±4.51
	T	24.08±0.10	1.41±0.30	3.21±0.24	35.13±0.25	64.08±1.13	136.05±0.57	5.85±1.25	30.17±2.06
June	BM	59.90±0.62	2.01±0.15	4.98±0.73	11.38±0.37	78.26±1.77	338.43±3.50	8.34±0.62	46.81±6.86
	CM	56.68±0.46	1.92±0.39	4.41±0.37	13.21±0.42	79.47±1.98	320.24±2.60	7.96±1.64	41.45±3.48
	T	24.30±0.28	1.97±0.31	4.23±0.22	30.11±0.19	61.48±1.40	137.24±1.58	8.17±1.29	39.76±2.07
Annual average	BM	59.52±2.31	1.84±0.63	5.15±0.67	8.56±1.62	78.27±1.45	336.22±13.28	7.64±2.34	48.44±6.28
	CM	55.40±2.63	1.42±.051	3.39±0.67	9.10±1.99	78.25±1.31	313.01±15.03	5.89±1.88	31.86±6.35
	T	23.41±1.47	1.29±0.60	3.29±0.65	31.31±2.90	63.15±3.10	132.26±8.36	5.37±2.29	30.96±6.14

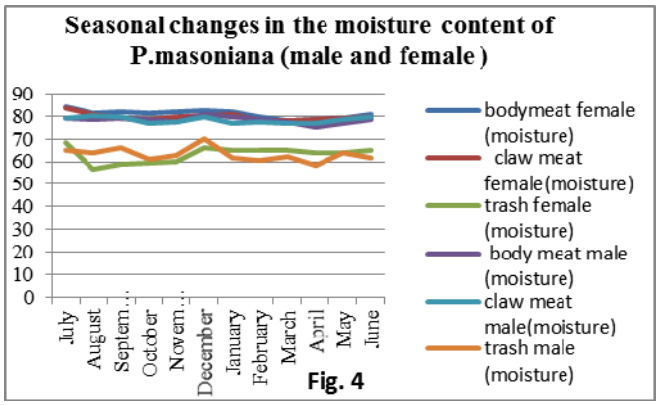

Fig. 4

3.4 Seasonal dynamics in the ash content:

The ash content in female crabs varied from 6.54±0.35% to 12.35±0.46% with an annual average of 8.37±1.66% in body meat, from 7.89±0.56% to 17.31±0.34% with an annual average of 10.19±2.63% in claw meat, from 28.57±0.46% to 37.89±0.94% with annual average of 32.07±3.86% in trash. Similarly, in male crabs, it fluctuated from 6.60±0.44% to 11.38±0.37% with annual average 8.56±1.62% in body meat, from 6.66±0.28% to 13.21±0.42% with an annual average of 9.10±1.99% in claw meat, from 27.32±0.46% to 36.51±0.22% with annual average of 31.31±2.90%. Ash content has been found to be highest in trash in comparison to body meat and claw meat. No regular seasonal trend of the ash content was noticed during the period of study. (Fig. 5)

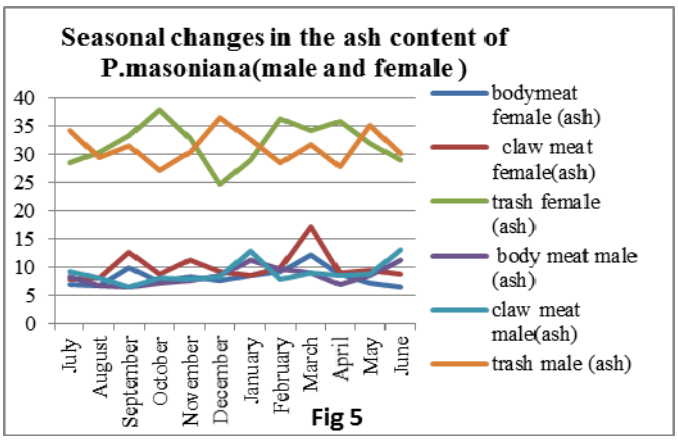

Fig 5

4. Energy value

4.1 Protein

In the body meat of female crabs, it fluctuated from 260.18±4.64 cal/g to 341.83±2.82 cal/g with an annual average of 306.8±26.39 cal/g. In the male crabs, however, it fluctuated from 311.42±1.70 cal/g to 364.43±0.62 cal/g with an annual average of 336.2±13.28 cal/g. The maximum value recorded in the claw meat and trash of female and male crabs are 324.25±3.05, 164.13±3.73; 335.27±1.70, 141.58±2.82 cal/g respectively. The minimum value recorded for claw meat and trash of female crabs are 259.90±3.62 cal/g and 110.40±2.83 cal/g respectively. The minima recorded for the claw meat and trash of male crabs are 281.94±2.55 cal/g and 115.43±1.98 cal/g respectively.

4.2 Lipid

The calorific value in the female crabs fluctuated from 37.5±3.00 to 54.99±4.32 cal/g in body meat, from 26.51±2.91 to 37.69±4.99 cal/g in claw meat and from 23.59±4.99 to 42.30±2.45 cal/g in trash. The annual average recorded for body meat, claw meat and trash of female crabs are 45.35±5.75, 31.87±3.34, 35.05±4.93 cal/g respectively. Similarly, in the male crabs, it fluctuated from 38.35±2.91 to 61.29±3.86 cal/g in body meat, from 20.87±1.41 to 40.33±1.98 cal/g in claw meat and from 20.87±1.41 to 40.42±4.79 cal/g in trash.

4. 3 Glycogen

It has been observed that the calorific value in the female crab fluctuated from 4.07±0.54 to 15.02±3.08 cal/g in body meat, from 3.03±0.87 to10.50±1.74 cal/g in claw meat and from 3.69±1.37 to 11.54±2.33 cal/g in trash. The annual average recorded in female crab is 9.17±3.79, 5.50±2.6, 6.95±2.52 for body meat, claw meat and trash respectively. In male crabs, however, it fluctuated from 4.03±1.17 to 11.33±2.37 cal/g in body meat, from 3.57±1.04 to 8.84±1.04 cal/g, from 2.82±1.87 to 10.17±1.54 cal/g in claw meat and trash respectively.

The caloric values of *M. masoniana* recorded during different months are presented in Fig.4. It has been observed that there is a decline in the energy contents during the monsoon and winters which correspond to the spawning period when the gonads are in advanced stage of maturity. The decline in the energy content may be attributed to following factors:

a) Low metabolic rate during winter months.
b) Divergence of energy from muscles towards gonads for their maturation during spawning.

Our results are in accordance with the results of Monteccchia *et al* (1990) [38] who also have reported a decline in the muscle energy contents with maturation process of gonads in Meluceius hubbsi. Similar decline in lipid contents of muscles with maturation of ovaries has also reported by [39].

5. Conclusion

From the study of the seasonal variation in the biochemical composition of the body meat of *P.masoniana*, it appears that there are two distinct periods of variation i.e.:

• From December to January (winter) and July to August (Monsoon), which correspond to the spawning period decrease in the protein content, may consequently arise due to:

a) Spawning function
b) reduced feeding intensity,
c) Enhanced catabolic process
d) Reduction in the reserve food content and
e) Large scale transfer of proteins from muscles to ovaries.

• From February to April (spring) and August to October (Post-monsoon) which correspond to non-spawning period, the maximum value of protein content could be ascribed to various biological factors viz:

a) Greater accumulation of proteins in the muscles for facilitating the process of vitellogenesis and
b) Enhanced metabolic rate leading to increased feeding intensity to satisfy the greater demands of energy and body building processes.

During this period *M. masoniana* is nutritionally rich as protein, lipid, moisture and ash content in the muscle are high. Thus, these two periods are characterized by a variation in the chemical composition.

6. Acknowledgements

The authors are thankful to the Head of the Department of Zoology and Dr. G.D. Singh, Scientist IIIM, Jammu for providing the necessary laboratory facilities. Third author is

highly thankful to CSIR for financial assistance as Junior Research Fellowship.

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