E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2020; 8(4): 385-391

www.fisheriesjournal.com
Received: 25-06-2020
Accepted: 29-07-2020

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Proximate composition of *Salmophasia bacaila* (Hamilton, 1822), a small indigenous freshwater fish of river Tungabhadra, Karnataka, India

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Abstract
The proximate analysis of *Salmophasia bacaila* was carried out to understand the effect of parasitic infection on its nutritive value. Some important constituents like protein, lipid, moisture and ash were estimated for 12 months (March, 2017 to February, 2018) for both infected and non-infected fishes. Protein values were ranged between 14.90% - 18.60% in non-infected fish and 13.60% - 17.58% in infected fish. The lipid values ranged between 1.84% - 3.34% in non-infected fish and 1.52% - 3.26% in infected fish. The moisture values ranged between 72.12% - 74.84% in non-infected fish and 73.10% - 79.40% in infected fish. The ash content ranged between 2.54% - 4.22% in non-infected fish and 2.70% - 4.80% in infected fish. Significant changes in the proximate composition of infected and non-infected fishes were observed.

Keywords: Small indigenous fishes, proximate composition, seasonal variations, Tungabhadra river

Introduction

The indigenous fish diversity of India comprises 2,246 species of both marine and freshwaters, out of which 450 species are categorized as small indigenous fish species [1]. These fishes attain a maximum size of 25 cm at their adult stage [2]. These fishes are preferred by rural people due to their availability throughout the year. Traditional capture fisheries in India mainly focus on the exploitation of large and medium sized fishes of both freshwater and marine waters. The small indigenous fishes of food importance are commonly neglected due to lack of knowledge with respect to their nutritional and medicinal importance.

The role of fish as a rich so[urce of nutrients to meet the nutritional demands of any country is unquestionable. Fish is recommended as a cheapest source of protein with easy digestibility and can meet the protein hunger, livelihood and nutritional security of the people in the coming years [3]. The rich essential nutrients of fishes make them as supplementary food for both infants and adults [4]. The small indigenous fish species are normally treated as miscellaneous species, though they are rich in important nutrients. These fishes serve as an alternative source of dietary proteins of good quality and play a key role in preventing the nutrient deficiencies and related ailments [5].

People from the rural areas with low income cannot afford costly fish species like common carps. This results in a considerable demand for commonly available small indigenous fish species. The genus Salmophasia includes 13 recognized species [6]. A very few species like *Salmophasia bacaila, S. phulo, S. untrachi, S. balookee* and *S boopis* are used as food fishes due to their nutritional quality, preferential choice of the consumers. These fishes received a very little attention with respect to parasitic infection and their affect on the proximate composition. *Salmophasia bacaila* is commonly known as large razor-belly minnow is an important small indigenous food fish of India, Bangladesh, Nepal, Pakistan, Afghanistan [7, 8]. It is a surface -marginal feeder with complex diet composition which includes insects, crustaceans, and zooplanktons with omnivorous feeding habits [9]. *Salmophasia bacaila* is a commonly preferred food fish in the Tungabhadra river basin to meet the nutritional demands of rural folks.

The proximate composition of a fish species is a result of interactions between physical and biological features like temperature, seasonal changes, body size, food complexity, spawning period, etc [10]. Protein, lipid, moisture and ash content of fish is very important for consumers, researchers and other stakeholders for understanding and exploiting their nutritional values and for efficient fish processing [11]. The proximate composition of the whole body of a fish species indicates its quality and its feeding habits [12]. The consumer acceptance of a fish species is chiefly determined by the texture of the flesh and quality of the nutrients [13]. Fish parasites have a great impact on the health status and the nutrient profile of the fishes [14]. Parasites release toxins into the host body and results in alteration of their biochemical composition [15]. Hence, an attempt was made to evaluate the proximate composition of both infected and non-infected *Salmophasia bacaila* and their suitability for consumption.

Materials and Methods

The small indigenous freshwater cyprinid fish, *Salmophasia bacaila* were collected from the two different locations *viz*., Nilogipur and Dhadesugur of Tungabhadra river, Karnataka, India with the help of local fishermen during March, 2017 to February, 2018 on monthly basis. The fishes were brought to the laboratory, cleaned thoroughly and stored in a freezer at 4ºC after the removal of the head and alimentary canal. The proximate composition of muscle of these fishes was carried out by using standard methods [16].

Estimation of Protein

Micro-Kzeldahl method was employed for the estimation of proteins. About 0.5 g of sample was digested in digestion unit for about 45 minutes. The digest was taken in a distillation unit for distillation. Later it was titrated with 0.1N Hcl and crude protein was obtained by multiplying the total nitrogen by a conversion factor of 6.25.

N (%) = [(Titration Reading - Blank Reading) × Strength of acid ×14×100]/Weight of the Sample ×1000
Protein content (%) = N (%) ×6.25

Estimation of Lipid

For the estimation of lipid, ether extract was measured by using Soxtec extraction unit by using petroleum ether at a boiling point of 40-60ºC as a solvent.
% Lipid= (Weight of the Residue/Sample Weight) ×100

Estimation of Moisture

The moisture content of the sample was estimated by drying the sample at 105ºC to a constant weight for about twenty four hours.
Moisture content (%) = (Weight Loses/Weight of Sample taken) × 100

Estimation of Ash

The ash content was determined by weighing sample in a porcelain crucible and placed in a muffle furnace at 600ºC for about six hours.
Ash content (%) = (Weight of the Ash/Sample Weight) ×100

Results and Discussion

The percentages of Proteins, Lipids, Moisture and Ash are represented in the tables (1-8) and figures (1-8). The mean protein content of non-infected *S. bacaila* was recorded as 16.73% in Nilogipur and 16.72% in Dhadesugur, while the mean protein content in the infected fish was recorded as 15.52% in Nilogipur and 15.62% in Dhadesugur (Table-1 & Fig-1). This indicates that parasite infected fish shows less protein content compared to non-infected fish. The highest protein content was recorded in pre-monsoon season as 17.51% and 17.32% for non-infected fishes in Nilogipur and Dhadesugur respectively. Similarly for infected fishes, these values were recorded as 16.32% and 16.71% during the same season. Though these values for infected fishes are highest in pre-monsoon season, but were lower than the non-infected fishes during the same season. The least protein content i.e., 15.60% and 15.71% for non-infected and 14.21% and 14.39% for infected fish was observed during monsoon season at the two study stations respectively (Table-5 & Fig-5).

The mean lipid content of non-infected fish was recorded 2.68% and 2.59% at Nilogipur and Dhadesugur respectively and in infected fish it was observed as 2.28% and 2.45% in both the study areas which show a fairly low lipid content in infected fish (Table-2 & Fig-2). Seasonal analysis of lipid in both infected and non-infected fish show significantly higher values in pre-monsoon season than the monsoon season (Table-6 & Fig-6).

Sultana *et al*., [17] studied the effect of helminth parasites on the protein and lipid content of the cat fish, *Clarias batrachus* and reported that infected fish shows comparatively lesser values of both proteins and lipids than the non-infected fishes. Similar findings were made by Sabina Yesmin and Hamida Khanum [18]. A decrease in the protein and fat content of infected fish is also due to its low consumption of food as well as parasite competition for these foods from the host fishes [19]. The present findings agree with these studies.

Salmophasia bacaila breeds once in a year and its spawning period extends between June - September [20]. In the present investigation, low protein and lipid values were reported in infected fishes during spawning period as the fishes are more susceptible to parasitic infection during this period [21, 22].

The mean moisture content of non-infected fish at Nilogipur was recorded as 73.26% and at Dhadesugur 73.38% with slight variations. The mean moisture content of infected fish at Nilogipur and Dhadesugur was observed as 75.68% and 75.59% respectively (Table-3 & Fig-3). These findings clearly indicate that the moisture content of infected fish is more than the non-infected fish. Seasonal wise analysis of moisture content in both infected and non-infected fish in the two study areas indicate that highest moisture content was observed during monsoon season as a whole but in particular, the highest moisture content was observed in infected fish (Table-7 & Fig-7).

In the present study, the mean ash content of non-infected fish at Nilogipur was observed as 3.24% and at Dhadesugur as 3.32%. In infected fish, it was recorded at Nilogipur as 3.73% and at Dhadesugur as 3.78% (Table-4 & Fig-4). During post-monsoon season, the highest ash content was noticed in both infected and non-infected fish (Table-8 & Fig-8). High moisture and ash contents were observed in the infected fish in the present study. The similar findings were observed by Farzana Abbas *et al*., [23]. The differences in proximate composition of infected and non-infected fishes clearly suggest that parasitic infections cause a decrease in nutrient components [24]

Table 1: Monthly variations in Protein (%) during 2017-18

	Salmophasia bacaila			
Month	**Non-infected fish**		**Infected fish**	
	Nilogipur	**Dhadesugur**	**Nilogipur**	**Dhadesugur**
MAR	18.36	18.22	17.10	17.58
APR	17.62	18.28	16.90	17.06
MAY	18.60	17.30	16.22	16.42
JUN	15.48	15.50	15.06	15.80
JUL	14.92	15.02	14.32	15.06
AUG	14.90	15.02	13.60	14.24
SEP	16.02	16.00	14.10	13.86
OCT	16.58	16.82	14.84	14.40
NOV	16.72	16.60	15.18	14.98
DEC	17.02	17.00	16.20	15.72
JAN	17.22	17.38	16.84	16.36
FEB	17.38	17.58	15.92	16.00
MEAN	16.73	16.72	15.52	15.62
STDEV	1.2212	1.1315	1.1750	1.1482

Table 3: Monthly variations in Moisture (%) during 2017-18

	Salmophasia bacaila			
Month	**Non-infected fish**		**Infected fish**	
	Nilogipur	Dhadesugur	Nilogipur	Dhadesugur
MAR	72.12	72.24	73.40	74.50
APR	72.34	72.54	74.10	73.80
MAY	72.94	72.84	75.90	74.88
JUN	72.90	73.62	78.30	77.10
JUL	73.92	74.10	77.68	76.58
AUG	74.50	74.84	79.40	78.30
SEP	74.34	74.40	76.80	77.26
OCT	73.90	73.86	75.10	76.10
NOV	73.62	73.56	75.92	75.60
DEC	73.20	73.12	74.62	73.90
JAN	72.90	72.84	73.10	74.50
FEB	72.54	72.68	73.90	74.60
MEAN	73.26	73.38	75.68	75.59
STDEV	0.7828	0.8065	2.0235	1.4639

Table 2: Monthly variations in Lipid (%) during 2017-18

	Salmophasia bacaila			
Month	**Non-infected fish**		**Infected fish**	
	Nilogipur	Dhadesugur	Nilogipur	Dhadesugur
MAR	2.96	2.90	2.62	2.88
APR	3.32	3.06	2.96	3.10
MAY	3.30	3.34	2.80	3.26
JUN	2.56	2.54	2.28	2.96
JUL	2.24	2.26	2.06	2.30
AUG	2.06	1.86	1.58	1.86
SEP	2.02	1.84	1.66	1.52
OCT	2.60	1.96	1.80	1.68
NOV	2.46	2.44	2.18	1.88
DEC	2.64	2.66	2.00	2.30
JAN	2.96	3.00	2.50	2.62
FEB	3.06	3.28	2.98	3.12
MEAN	2.68	2.59	2.28	2.45
STDEV	0.4451	0.5355	0.4887	0.6161

Table 4: Monthly variations in Ash (%) during 2017-18

	Salmophasia bacaila			
Month	**Non-infected fish**		**Infected fish**	
	Nilogipur	**Dhadesugur**	**Nilogipur**	**Dhadesugur**
MAR	3.82	3.80	4.30	4.22
APR	3.00	3.48	4.08	3.96
MAY	2.98	3.18	3.92	4.28
JUN	2.80	2.84	3.18	3.80
JUL	2.60	2.58	2.96	3.22
AUG	2.54	2.58	2.70	2.86
SEP	2.62	2.64	3.10	2.98
OCT	3.12	3.16	3.82	3.42
NOV	3.42	3.48	3.66	3.90
DEC	3.84	3.88	4.12	4.18
JAN	4.20	4.22	4.80	4.63
FEB	4.02	4.06	4.18	3.98
MEAN	3.24	3.32	3.73	3.78
STDEV	0.5935	0.5866	0.6287	0.5512

Table 5: Seasonal variations in Protein (%) during 2017-18

	Salmophasia bacaila			
Seasons	**Non-infected fish**		**Infected fish**	
	Nilogipur	Dhadesugur	Nilogipur	Dhadesugur
Pre-Monsoon	17.51	17.32	16.32	16.71
Monsoon	15.60	15.71	14.21	14.39
Post-Monsoon	17.08	17.14	16.03	15.76
Mean	16.73	16.72	15.52	15.62
STDV	1.0019	0.8851	1.1437	1.1663

Table 6: Seasonal variations in Lipid (%) during 2017-18

	Salmophasia bacaila			
Seasons	**Non-infected fish**		**Infected fish**	
	Nilogipur	Dhadesugur	Nilogipur	Dhadesugur
Pre-Monsoon	3.03	2.96	2.66	3.05
Monsoon	2.23	1.98	1.77	1.84
Post-Monsoon	2.78	2.84	2.41	2.48
Mean	2.68	2.59	2.28	2.45
STDV	0.4092	0.5345	0.4590	0.6053

Table 7: Seasonal variations in Moisture (%) during 2017-18

	Salmophasia bacaila			
Seasons	**Non-infected fish**		**Infected fish**	
	Nilogipur	Dhadesugur	Nilogipur	Dhadesugur
Pre-Monsoon	72.57	72.81	75.42	75.07
Monsoon	74.16	74.30	77.24	77.06
Post-Monsoon	73.06	73.05	74.38	74.65

Mean	73.26	73.38	75.68	75.59
STDV	0.8142	0.8000	1.4476	1.2874

Table 8: Seasonal variations in Ash (%) during 2017-18

	Salmophasia bacaila			
Seasons	**Non-infected fish**		**Infected fish**	
	Nilogipur	Dhadesugur	Nilogipur	Dhadesugur
Pre-Monsoon	3.15	3.32	3.87	4.06
Monsoon	2.72	2.74	3.14	3.12
Post-Monsoon	3.87	3.91	4.19	4.17
Mean	3.24	3.32	3.73	3.78
STDV	0.5810	0.5850	0.5381	0.5770

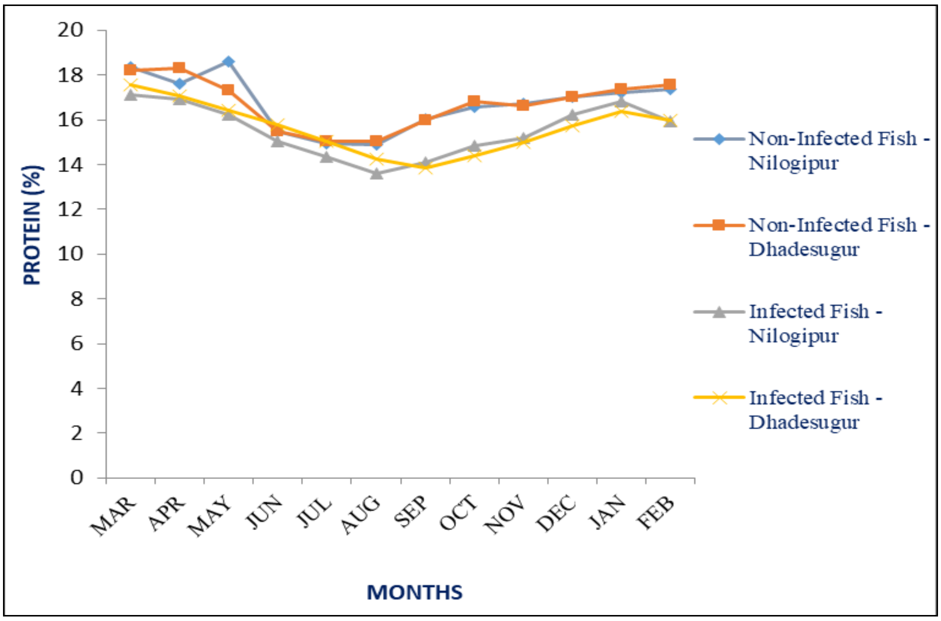

Fig 1: Monthly variations in Protein (%) during 2017-18

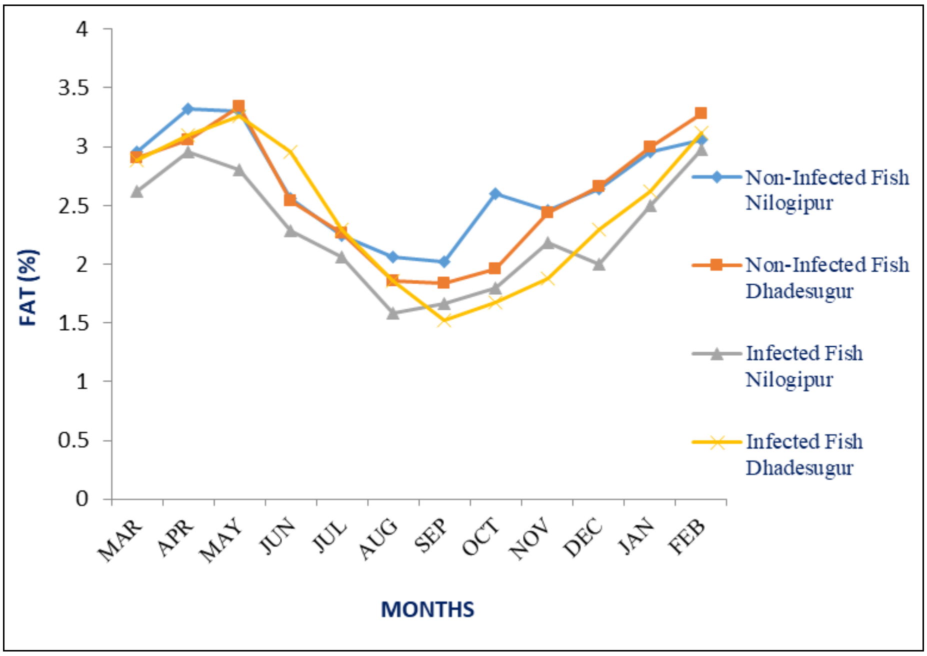

Fig 2: Monthly variations in Lipid (%) during 2017-18

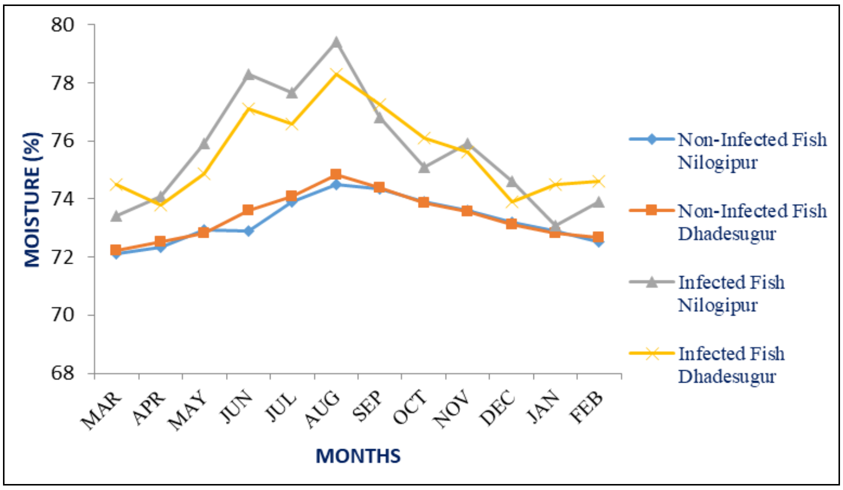

Fig 3: Monthly variations in Moisture (%) during 2017-18

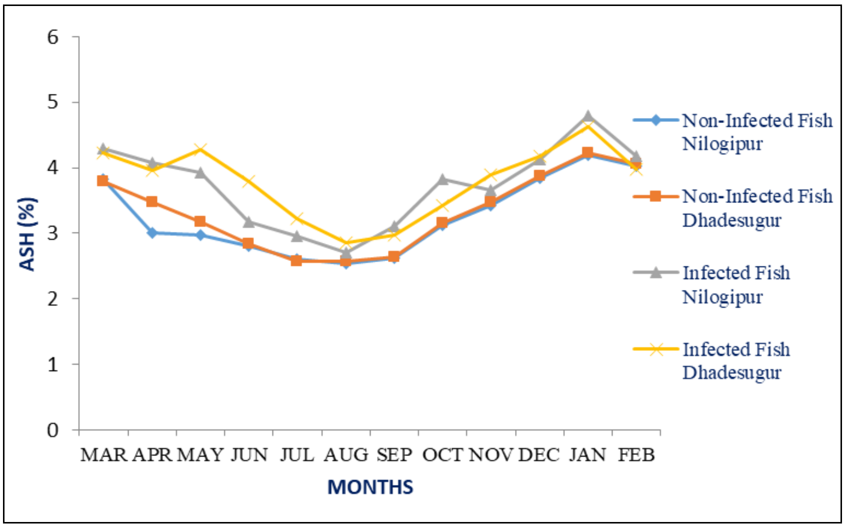

Fig 4: Monthly variations in Ash (%) during 2017-18

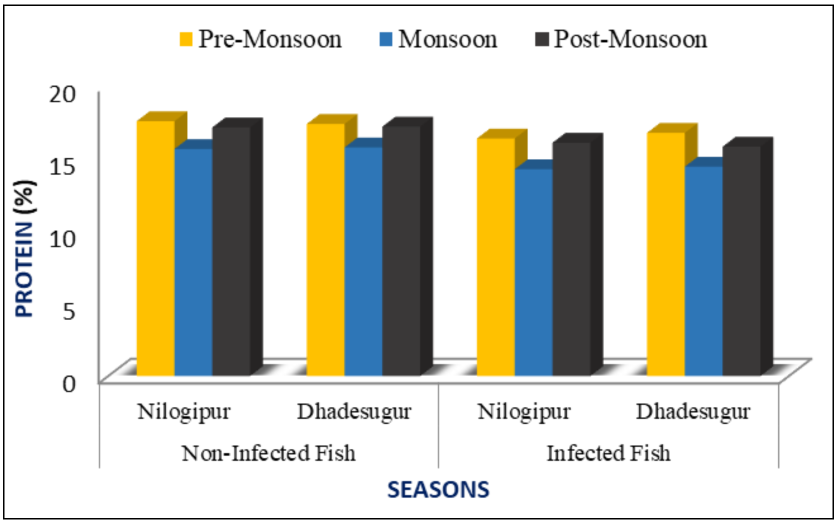

Fig 5: Seasonal variations in Protein (%) during 2017-18

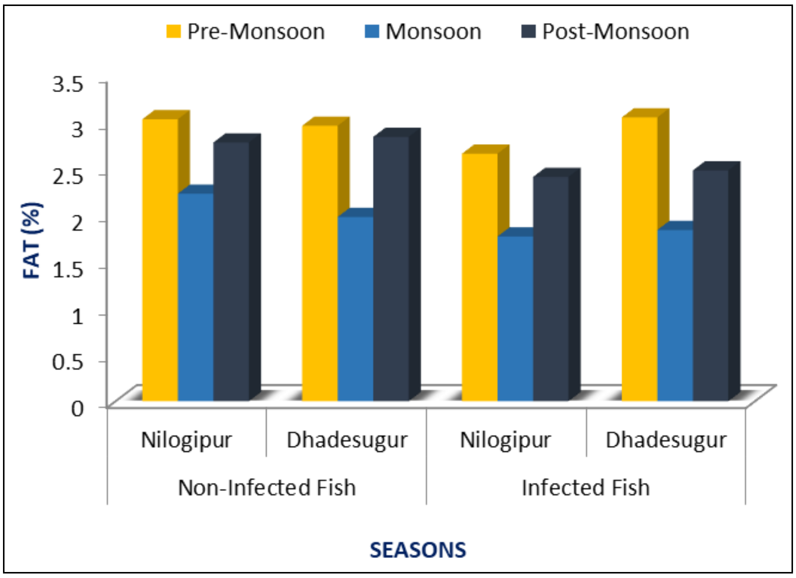

Fig 6: Seasonal variations in Lipid (%) during 2017-18

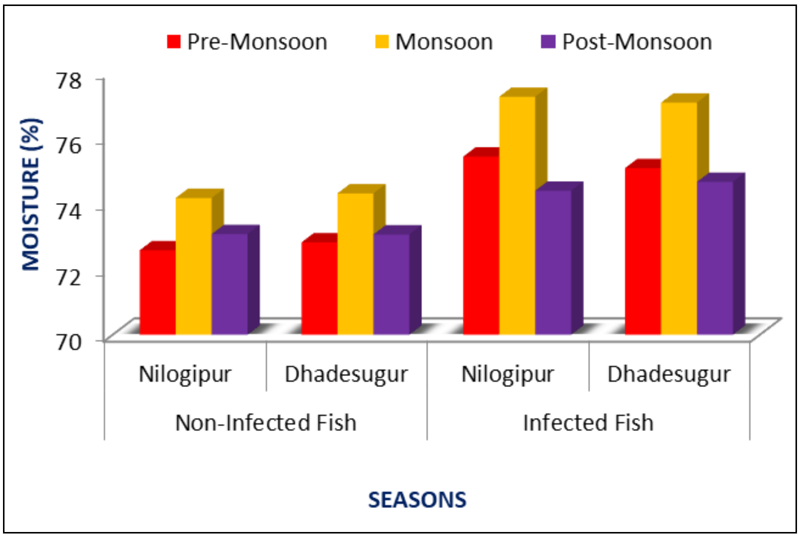

Fig 7: Seasonal variations in Moisture (%) during 2017-18

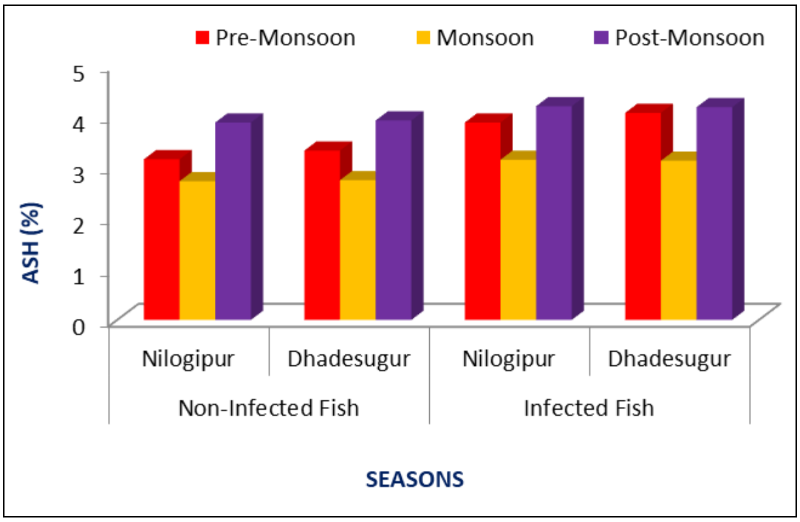

Fig 8: Seasonal variations in Ash (%) during 2017-18

Conclusion

Analysis of the data presented in the above tables and graphs clearly indicates a significant variation in the proximate composition of both infected and non-infected fish in terms of monthly as well as season wise in relation to spawning periodicity. It is evident from the study that parasites have a considerable effect on decreasing the nutritive value of fish but it is not a prime cause. This knowledge helps the fishery sector and other stakeholders to consider the effect of parasites on fishes and take proper measures for better management of fishery resources.

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