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Comparative nutrient studies of two species of *Chironomus* from Manipur for value added fishery

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Abstract
Manipuri are very fond of fish so rearing fish is one of the profitable agricultural practice and many farms are continuously developed. The huge production from lakes and river farming are much lagging behind the requirements of the state. Shortage of nutrient rich fish diet is one of main cause of shortage of fish production in Manipur. Keeping this aim in mind, the present study was taken up to enrich the fish diet using easily available *Chironomus* species larvae as source of nutrient. Two species of the *Chironomus* species: *C. plumosus* and DSC 1(predominant species foundly in polluted habitats and yet to identify), were compared on basis of nutrient contents like carbohydrate, fats, proteins, omega 3 etc. Larvae of same species were collected from seven aquatic habitats. The larvae were dried in the room temperature in the shade. Then the dried larvae were grinded into powder and outsourced for the nutrient testing. Besides the nutrients study the materials were tested for presence of unwanted/harmful metals that might be accumulated from the environments of the larvae. The results showed that the larvae possessed roughly equal amount of nutrients despite differences in size of the larvae and there were no reports of presence of unwanted/harmful metals that might accumulate from the diet to the fish. So, they are safe as artificial fish diet. Moreover, the larvae contain fair amount of omega 3 which is good for value added fishery. But it is yet to be tested whether the omegas that were present in the larval diet will be transferring to the fish and again reached the general mass. Future studies should focus on the mass production of the larvae including the adults for sustainable generation of different development stages for mass production.

Keywords: Manipur, fish diet, *Chironomus* species, *C. plumosus* and DSC 1, omega 3

1. Introduction

Manipur is land of feasts, every time in every occasion feast is a treat for all and fish is the king of feast. Without fish the feast is tasty curry without salt. Importance of fish is enormous in the society of valley people. But there is always shortage of such demands. The condition might be unavailability of fish and enrich diet.

In order to increase the fish productivity and enhanced growth many farmers used the artificial food as well as many chemicals. Such practices not only reduce the storing durability of fish but also indirectly cause harm to the people due to deterioration in fish. Nowadays the organic farming is the talking and acting point for their beneficial and as well as the environmental friendliness. In fishery the organic farming may include regular supply of grass, oil cakes from market which is costly, the wastes of animals in mixed farming. All above practices are one or other are either costly or troublesome for the regular farmers of Manipur. So, a search for an alternative cost free, sustainable everlasting technological now how for regular farmers on organic farming is much. One such method is used larvae of *Chironomus plumosus* and compare with another species abundantly found ditches and lakes named as DSC 1. DSC 1 is a Yama like species yet proper naming is not included in the present study [1].

The insect as a food for fish is quite an innovative and sustainable idea for the state. The best candidate for the study is *Chironomus plumosus*. *Chironomus plumosus*, also known as the buzzer midge, Is a species of nonbiting midge (Chironomidae) that occurs throughout areas in the Northern Hemisphere? Adults are pale green with brown legs and grow to 12 mm (0.5 in). Males have feathery antennae, while females' antennae are sleek. A dark brown band is seen at the end of each abdominal segment. The larvae are called bloodworms because some larvae are bright red, but they can also be found in brown and almost black. When the larva pupates, they drift towards the surface, making them vulnerable to many types of fish [2].

In the present study the nutrient content and applicability of the insect larvae were tested and analyzed the future prospect of the larvae as the fish diet.

2. Materials and Methods

The present study takes two *Chironomus* species: *C. plumosus* and DSC1. The species were described according to the morphology including anal tubules (Fig. 1. A, B, C, D), mentum and cytology using appropriate keys. The larvae were from two habitats and after determining the species, they were dried in the room temperature in the shade for 5 days. The dried larvae were grinded to powder with the help of mortar and pestle and the powder were send to Sophisticated Industrials materials Analytical Laboratories private Limited, New Delhi. Besides the nutrients content of the two larvae the test of content of metals like lead (Pb), copper (Cu), arsenic (As), tin (Sn), zinc (Zn), cadmium (Cd), mercury (Hg) etc. were done to ascertained fitness of larvae as fish diet.

3. Results and Discussion

Table 1: The nutrient contents of two species of *Chironomus* as given by the testing farm were compared.

S. No.	Nutrients		DSC 1	*Plumosus*
1	Fats % by mass		13.21	14.2
2	Protein % by mass		42.12	38.14
3	Fibre % by mass		5.16	8.24
3	Carbohydrate % by mass		8.28	9.17
4	Calorific value (kcal/100gm)		214	228
5	Mineral % by mass		5.7	4.2
6	Omega 3			
		α Linoleic acid	1.03	1.05
		Eicosapentaenoic acid	0.34	0.27
7	Metals screened	Pb, Cu, As, Sn, Zn, Cd, Hg	Nil	Nil

The major nutrients that constituted the cell were present in the two types of larvae as expected. The content of nutrients in two species of Chironomids was identical despite differences in the size. The size of larvae of *C. plumosus* is twice the size of the DSC 1 (Fig. 1) but nutrient contains is quite similar.

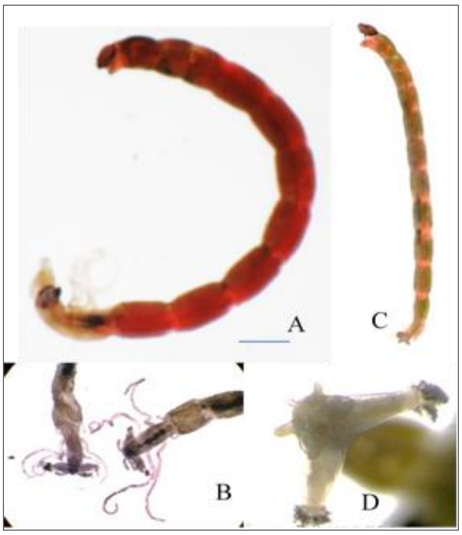

Fig 1: *Chironomus plumosus* (A-larva, B-anal tubule) and DSC 1 (C-larva, D-Anal tubule). Bar represents 1 mm.

Table 2: Chemical composition of *Chironomus plumosus*, expressed as percent's in fresh and dry weight (mean value ± standard deviation, N = 10)

Component	%	
	Fresh weight	**Dry weight**
Water	87.9 ± 0.26	
Crude protein	7.6 ± 0.29	55.7 ± 0.28
Crude fat	1.3 ± 0.18	9.7 ± 0.3
N-free extractive substances	2.1 ± 0.64	26.4 ± 0.48
Ash	1.1 ± 0.25	8.2 ± 0.36

Table 3: Amino acids content in *Chironomus plumosus* larvae (mean value ± standard deviation, expressed as % in fresh and dry weight; N = 10)

Amino acid	*Chironomus plumosus (%)*	
	Fresh weight	**Dry weight**
Arginine	0.29± 0.008	2.12± 0.003
Histidine	0.14 ± 0.005	1.02 ± 0.003
Isoleucine	0.27 ± 0.010	1.98 ± 0.005
Leucine	0.34± 0.005	2.49± 0.005
Valine	0.27± 0.009	1.99± 0.003
Lysine	0.33 ± 0.006	2.48 ± 0.003
Phenylalanine	0.37± 0.008	2.76 ± 0.004
Methionine	0.30 0.007	2.19± 0.004
Threonine	0.27 ± 0.008	2.01 ± 0.003
Tryptophan	0.19± 0.006	1.39± 0.004

Table 4: Fatty acid composition of *Chironomus plumosus* larvae (% of total fat, mean values, N = 10) [3].

Fatty acid group		Fatty acid	%	Total (%)		(0-6 : co-3
Saturated		Myristic. 12:0	1.17	26.12		
		Pahnitic. 16:0	19.43			
		Arachidic. 20:0	0.21			
Monounsaturated		Palmitoleic	7.24	30.42		
		Oleic	21. 21.51			
		Eicosanoic	0.41			
		Neuronic	1.26			
PUFA	op - 6	Linoleic. 18:2	13.76	18.81	34.03	0.81
		Eicosadienic. 20:2	0.88			
		Arachidonic. 24:4	4.17			
	co - 3	Linolenic. 18:3	7.21	15.22		
		Eicosapentaenoic. 20:5	4.36			
		Docosapentaenoic. 22:5	1.16			
		Docosahexaenoic. 22:6	2.49			
Others (unidentified)			9.43	9.43		

The tables from 2 to 4 explain the importance of the insect larvae as the fish food (Bogut *et al*. 2007).

There might be some minor variations in the composition of the elements according to the differences in the habitats but it a fact that the insects could be used as food of the fish. As reported the differences within or between species may be due to intrinsic or environmental factors. Indeed, the proximate composition of larvae depend on the larvae age, composition of earth pond water, food availability and food quality and quantity [3, 4, 5, 6, 7]. In addition, environmental factors such as temperature, photoperiod, pH, oxygen content, and biotic interaction can affect growth and consequently nutritional composition in bloodworms [8, 9].

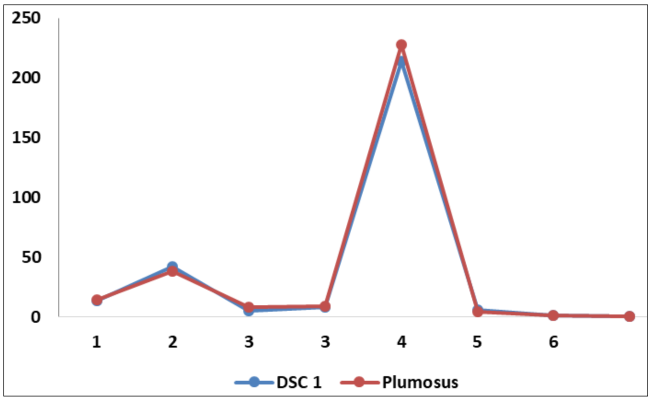

Fig 2: The comparison on the nutrient contents of two species of *Chironomus* species base on the table 1.

The insects are generally the most favourite foods for the fish so as their models are used as the bait for the fish. The insects are the food of the human [10] as the fish [3]. It is obvious that the great quantity of ω-3 fatty acids (15.22%) detected in *Chironomus plumosus* larvae, being significantly higher compared to other animals, represents a rich source of essential fatty acids, not only for fish, but also for humans. For example, the requirements of rainbow trout for highly unsaturated fatty acids (HUFA) are 1% of linolenic or 0.5% of eicosapentaenoic plus 0.5% of docosahexaenoic fatty acid, while carp needs 0.5% HUFA or 1% of linoleic and 1% of linolenic fatty acid [9]. The needs of channel catfish for ω-3 fatty acids are less than 1% [11] while the requirements of other fish sorts are similar (Bogut, 1995). Therefore, we can conclude that *Chironomus plumosus* larvae completely meet the needs of all fish sorts for essential fatty acids. Typically, farmed fish have higher lipid content than their counterparts caught from the wild area. Anyway, there are reports showing a lower ratio of ω-3 to ω-6 fatty acids in cultured than in wild fish [12]. Although the lack of essential fatty acids in these fish is not presumable because of high total lipid content, the addition of natural food (like *Chironomus plumosus* larvae), very rich not only in essential fatty acids but also in most amino acids, can have beneficial effect on fish growth, condition and health. This can also be the way to improve the fish quality and enrich this part of human diet with essential fatty and amino acids. Our final conclusion is that *Chironomus plumosus* larvae represent a potential suitable natural component of farm fish diet.

As the protein, lipids, calorific values are higher in the larvae, so they could be used as fish diet in inland fishery. As reported by Boget[3]. In present study there is no report of heavy metals in the larvae of species (table 1). The report of presence of heavy metals and other metals had been published while feeding the captive amphibian [13] (Fard *et al*., 2014). So there is need of reducing the heavy metals by culturing the larvae and not procured from year round from their wild habitat. The different load of heavy metals in chironomids larvae most probably correlates with content of metals in water and sediments. The synergistic effect of different physical and chemical factors such as temperature and hardness of water, sediment pH, exposure time, chemical form, and availability of metals might promote accumulation of heavy metals into chironomids larvae [14, 15]. To eliminate or reduce the environmental impacts (e.g., heavy metals load), captive rearing of bloodworms in controlled environments is advisable, though there are great difficulties and laborious in keeping cultures going and failures can be occurred be anytime [16]. So future work should focus on the culturing the insect for sustainable and value added fishery.

4. Conclusion

The larvae possessed roughly equal amount of nutrients despite differences in size of the larvae and there were no reports of presence of unwanted/harmful metals that might accumulate from the diet to the fish. So, they are safe as artificial fish diet. Moreover, the larvae contain fair amount of omega 3 which is good for value added fishery. But it is yet to be tested whether the omegas that were present in the larval diet will be transferring to the fish and again reached the general mass. Future studies should focus on the mass production of the larvae including the adults for sustainable generation of different development stages for mass production.

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