

# **Quantitative analysis of macronutrients and mineral composition in Larvae and adult stage of *Hydrophilus olivaceus* (Coleoptera: Hydrophilidae), an aquatic insect, consumed in Assam, India**

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**ABSTRACT:** Insects are good source of macronutrients such as protein, lipid and carbohydrate and micronutrients of which calcium, iron, magnesium and zinc are most important. On chemical analysis, it is observed that *H. olivaceus* varies in macronutrient content and mineral composition in terms of different stages of the insect. The protein content larvae and adult is 20.6 g/100g and 24.6 g/100g fresh wet weight respectively and lipid content of adult stage and larvae ranges from 6.2 g/100g to 7.3g/100g. Also a considerable amount of carbohydrate content was found in larvae and adult insect *Hydrophilus olivaceus*. This aquatic edible insect contains high level of iron ranging from 13.682 mg/100g to 15.862mg/100g in larvae and adult stage respectively and larvae level of calcium ranges from 18.349 mg/100g to 22.570mg/100g in larvae and adult insect respectively. Level of zinc in *H. olivaceus* is 01.697mg/100g in adult and 3.986 mg/100g in and level of magnesium is 13.531mg/100g in adult insect and 15.764 mg/100 in larvae.

**KEYWORDS:** Aquatic, Edible, Larvae, Macronutrient, Mineral

## **I. INTRODUCTION**

*Hydrophilus olivaceus* (water scavenger) is a genus of beetles in the family of Hydrophilidae. There are about 48 species in three subgenera in the genus: *Hydrophilus*, *Dibolocolus*, and *Temnopterus* (Fikacek *et al.*, 2008). The water scavenger beetle differs from most water insects in that it hangs suspended from the water surface by its head rather than by its abdomen. They are found in swampy areas such as ditches, pond, beels, stream etc. This insect and its larvae are popular food items among the ethnic tribes in Assam. Amongst all tribes in Assam, the Bodo tribe is the highest consumer of aquatic insects. Hydrophilidae species have good market value and they are commonly sold in different local markets in Assam, India. These predacious aquatic insects are the top predators in fishless water habitats. Larvae and adults of some species of diving beetles (Dytiscidae) are regarded as effective predators of mosquito larvae (Berman *et al.*, 2000; Lundkvist *et al.*, 2003), other insect larvae, amphibian larvae and fish fry (Johansson & Nilsson, 1992; Inoda & Kamimura, 2004; Inoda *et al.*, 2009). Most of aquatic insects are important as fish food, bioindicators, and biocontrol agents (Das and Gupta, 2010). *Hydrophilus* species are endangered taxa in many parts of the world, including, e.g., Great Britain (Beebee, 2007) and Japan (Kondo, 2015). The larvae of *Hydrophilus* are carnivores, the adults are mainly herbivores or omnivores; thus, they need diverse ecosystems for their development. Decrease in the numbers of suitable aquatic habitats due to the abandonment of rice paddies, water pollution, pesticide use and invasion by non-native species is causing great concern in Japan (Kondo, 2015; Nishihara *et al.*, 2006). The habitats of freshwater species, including insects and other invertebrates, are increasingly threatened worldwide (Allan & Flecker, 1993). Proteins are the most important organic constituents of animal and play an important role in energy production. Lipids are used in as energy source, hormone precursors and structural component of cell. These nutrients

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are stored in different parts in the insect body. Also lipids located in the egg play an important role in meeting the energy needs for developing embryo (Boz and Gülel, 2012).

Minerals are indispensable inorganic elements because the body is not able to synthesize them. Talwar *et al.*, 1989 reported that minerals are known to play important metabolic and physiologic roles in the living system. Iron, zinc, copper and manganese strengthen the immune system as antioxidant enzyme cofactors. Calcium is essential element that helps in development of bones and teeth. The high amount of calcium content in insects is used as a supplement for children and adolescents. The aim and objective of the present study is to evaluate the protein, lipid, carbohydrate and mineral contents of adult species and larvae of *Hydrophilus olivaceus* (water scavenger) commonly consumed as food by ethnic tribal people in Assam.

## II. MATERIAL AND METHODS

**Biochemical Analysis:** For chemical analysis, adult and healthy insects were selected. 10% tissue homogenate was prepared by mixing 1 gram of insect in 10 ml of phosphate buffered saline (PBS, pH 7.4) using a tissue homogenizer. The homogenate was centrifuged at 6,000 rpm for 10 min using a centrifuge machine. The supernatant was collected and used as tissue source for biochemical analysis.

The protein content of the edible insects were estimated following the method of Lowry *et al.*, (1951) method using bovine serum albumin as a standard protein. The estimation of carbohydrate was done by following anthrone method (Sadasivam and Manickam, 2008). The total lipid was estimated using chloroform methanol method described by Folch *et al.*, (1957). The mineral elements such as Mg, Zn, Fe, Cu, Ni, Cd, Cr, Pb and Mn were determined by atomic absorption spectroscopy (AAS). The soluble protein, lipid and carbohydrate contents present in edible insects is expressed in mg per gm in fresh weight. All the value of the micronutrients of the sample was recorded in ppm (parts per million) and calculated. The calculated values in AAS were converted into mg/100 gm (i.e. 1 ppm = 0.001 mg/g)

## III. PROPOSED METHODOLOGY AND DISCUSSION

The proposed methodology presented here are biochemical estimation of *H. olivaceus*, an aquatic insect, in fresh weight condition. The biochemical analysis shows that aquatic insect "*H. olivaceus*" is rich in terms of macro-nutrient content as well as mineral elements. This insect is rich in protein and lipid with reasonable amount of carbohydrate and with high in mineral contents. On chemical analysis, it is also observed that *H. olivaceus* varies in macronutrient content and mineral composition in terms of different stages of the insect. The protein content larvae and adult is 20.6 g/100g and 24.6 g/100g fresh wt. respectively and lipid content of adult stage and larvae ranges from 6.2 g/100g to 7.3g/100g. Also a considerable amount of carbohydrate content was found in larvae and adult insect of *H. olivaceus* as shown in the table-1. Thus, the present study reveals a little variations in the protein, lipid and carbohydrate content between the larval stage and adult stage of edible *H. olivaceus*. A study on edible insects by Payne *et al.*, (2016) revealed that the value of protein content exposed with insects containing median values of between 9.96 g and 35.2 g of protein per 100 g, compared with 16.8–20.6 g for meat. The present bio-chemical study of edible insect shows that the edible insect like *Hydrophilus olivaceus*, an aquatic insect, has maximum amount of protein. This present result has similarity with the findings of Chen *et al.*, (2009) who referred that edible insects are rich in protein and fat but not so rich in carbohydrate. From another study it is observed that nutritional values can vary considerably even within a group of insects depending on the stage of metamorphosis, origin of the insect and its diet (Finke M.D *et al.*, 2014). This study also clearly indicates variations of nutritional status of *H. olivaceus* in adult as well as larvae stage. Minerals have a remarkable varieties of metabolic functions as they build, activate, regulate and control many chemicals e.g. iron in haemoglobin, zinc in insulin. Many edible insects in China were found high in calcium, zinc and iron (Chen & Feng 1999). The current study shows that all the chemically analysed species of *Hydrophilus olivaceus* contain high level of iron ranging from 13.682 mg/100g to 15.862mg/100g in larvae and adult stage respectively and a very high level of calcium ranges from 18.349 mg/100g to 22.570mg/100g in larvae and adult insect respectively. Level of zinc in *H. olivaceus* is 01.697mg/100g in adult and 3.986 mg/100g in and level of magnesium is 13.531mg/100g in adult insect and 15.764 mg/100 in larvae. Calcium plays a vital role in several fundamental physiological processes in living organisms including the maintenance of appropriate cellular and tissue permeability,

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stability of intracellular matrices, and neurological and muscular activity (Clark, 1958). The amount of calcium in aquatic insects (24.3–96 mg/100 g) was found to be much higher than in different terrestrial insects (0.0012–0.126 mg/100 g) (Adeduntan 2005). The present biochemical analysis of mineral content in *Hydrophilus olivaceus* also shows the highest amount of Calcium compared to other elemental composition.

## IV. EXPERIMENTAL RESULTS

The aquatic edible species *Hydrophilus olivaceus* (Arthropoda:Insecta: Coleoptera:Hydrophilidae) have good market value and they are sold in different local markets in the study area. These insects are sold at the rate of Rs.160-Rs.200/kg in various local markets in Assam.

### Habit and Habitat:

They are scavengers and predators. The water scavenger beetle differs from most water insects in that it hangs suspended from the water surface by its head rather than by its abdomen. They are found in swampy areas such as ditches, pond, beels, stream, preferring fairly shallow water etc. A few hydrophilids live on land, but most are aquatic. The adults can fly and they are also attracted to lights at night.

### Food:

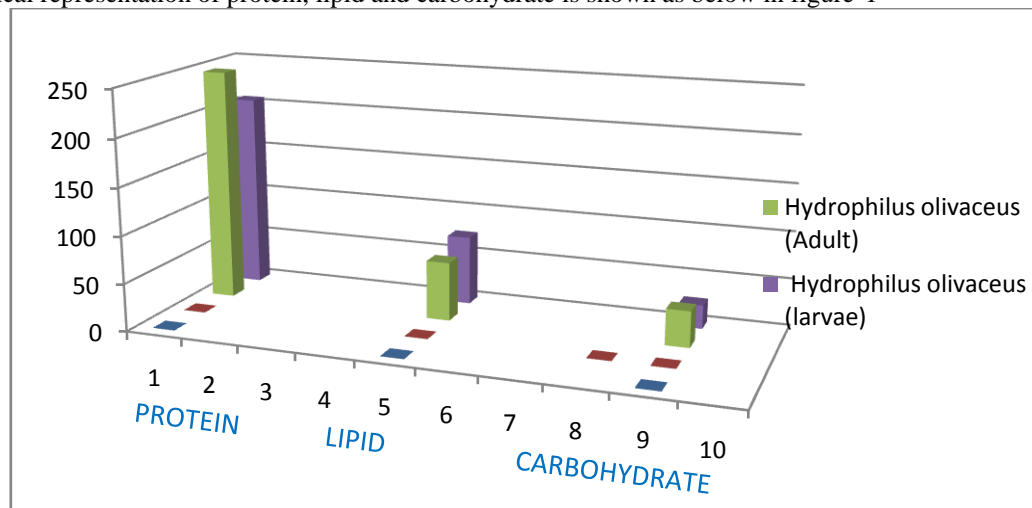
The larvae of water scavenger beetles are predatory, using strong, pincher-like mouthparts to capture and devour a variety of aquatic invertebrates such as mosquito larvae and snails. The adults can be predatory or can be scavengers, eating algae or dead or decaying plants or animal materials.

**Distribution:** These beetles are found swimming in marshy freshwater ponds and swampy area throughout the world in fresh water habitats.

**Table-1: Macronutrient contents (protein, lipid and carbohydrate) of *Hydrophilus olivaceus* (Adult & Larvae)**

Scientific name of the sample	Protein content (mg)		Lipid content (mg)		Carbohydrate content (mg)	
	Mean	SD	Mean	SD	Mean	SD
<i>Hydrophilus olivaceus</i> (Adult)	246.00 <sup>j</sup>	± 8.72	62.00 <sup>d</sup>	± 3.61	38.00 <sup>de</sup>	± 2.65
<i>Hydrophilus olivaceus</i> (larvae)	206.00 <sup>gh</sup>	± 6.19	73.00 <sup>e</sup>	± 3.65	25.00 <sup>cde</sup>	± 4.51

The graphical representation of protein, lipid and carbohydrate is shown as below in figure-1



**Figure-1 Comparison of macronutrients between larvae and adult *H. olivaceus***

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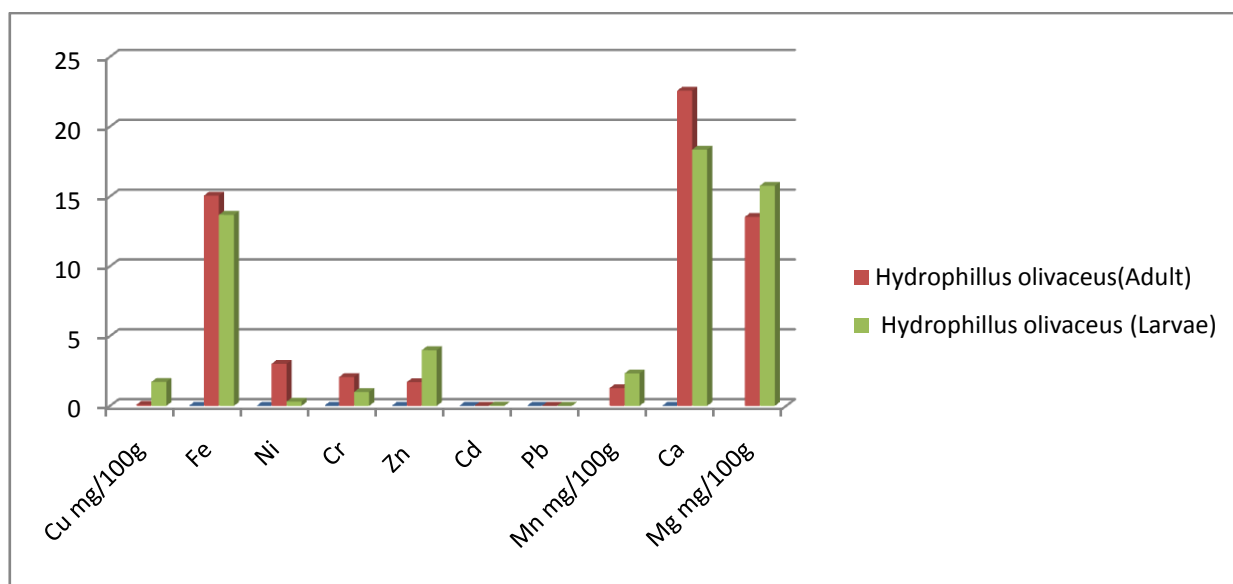
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**Table-2: Micronutrient contents (mineral composition) of *Hydrophilus olivaceus* (Adult & Larvae)**

Name of insects	Cu mg/100g	Fe mg/100g	Ni mg/100g	Cr mg/100g	Zn mg/100g	Cd mg/100g	Pb mg/100g	Mn mg/100g	Ca mg/100g	Mg mg/100g
<i>Hydrophilus olivaceus</i> (Adult)	0.078	15.060	3.0100	2.0680	1.6970	0.000	0.000	1.2710	22.570	13.531
<i>Hydrophilus olivaceus</i> (Larvae)	01.711	13.682	0.305	0.998	3.986	0.032	0.000	2.325	18.349	15.764

Figure -2 shows the mineral contents with highest amount of sodium in larvae as well as adult insect of *Hydrophilus olivaceus*



**Figure-2: Graphical representation of elemental composition of *Hydrophilus olivaceus* (Adult & Larvae)**

### V. CONCLUSION

The tribal people in Assam, North east India, think that the insect eating is their identity of their culture. The current biochemical study also confirms that insects are indeed a good source of protein, lipid and minerals. Thus, aquatic insects are significant group of organisms in terms of numbers and nutritional composition. Therefore, eating insects is not only exciting, healthy and tasty, but almost expected.

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