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Biochemical and nutritive analysis of invasive aquatic weed *Hydrilla verticillata* (L.F) Royle

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Abstract
Indian population has been increasing at alarming rate day by day. It leads to food crisis and malnutrition in India. This issue can be overcome by the intake of locally available edible invasive weeds. *Hydrilla verticillata* collected from Palakkad district, Kerala. The collected plants were dried and stored in air tight container. The biochemical analysis were carried out by following standard methods in the lab. The results were tabulated and represented in chart and compared with RDA value. Result showed the presence of carbohydrate, starch, protein and amino acid in least amount. Characteristic presence of the vitamins and minerals were also observed and found to be in required amount. On analyzing, the plant showed the potential to act as a source of Vitamin B1, Calcium, Iron and Magnesium. This micronutrients possess the nutritive value greater than the RDA value. Hence *Hydrilla* can be considered to improve the health status of the consumer as a result of the presence of nutrients that are vital for good health.

Keywords: *Hydrilla verticillata* (L.F) Royle, invasive aquatic weed, malnutrition, nutritive value, RDA value

Introduction
India is the second most populous country in the world with 1.3 billion people. Overpopulation in India results pressure on resources such as water, food and energy. Almost one in seven people are chronically hungry, lacking enough food to be healthy and lead active lives. According to RDA with in a healthy balanced diet a Man needs around 2,500kcal a day. As a part of healthy balanced diet a man requires 45g of protein, 230g of carbohydrate, 70g of fat, 20 g of saturates, 24g of fiber, 6g of salt per day. Other than this vitamins and minerals are also important for healthy life. Carbohydrates, fats and proteins are macronutrients, which are needed in large amount, while vitamins and minerals constitute the micronutrients that are required in small quantity. When the body does not get the right amount of the vitamins, minerals, and other nutrients to maintain healthy tissue and organ function leads to malnutrition. It results in reduced immunity, increased susceptibility to disease, impaired physical and mental development and reduced productivity.

Malnutrition remains a critical global problem. Each year, more children die as a result of under nutrition than of AIDS, malaria and tuberculosis. Thus the issue of how we will sustain this situation due to overpopulation is of the utmost importance. One of the simple ways to overcome the food crisis is the intake of locally available edible invasive weeds**.** Invasive weeds are non-native species that can thrive in areas beyond their natural range of dispersal. These plants are characteristically adaptable, aggressive, and have a high reproductive capacity. Their vigor combined with a lack of natural enemies often leads to outbreak populations. There are many invasive weeds with nutritional importance which can be easily available to tribes and poor people those cannot afford to buy the nutrient rich vegetables, fruits and other food products. Due to the lack of information regarding such plants people ignore them. Aim of the study was to explore the Biochemical and nutritive analysis of the invasive aquatic weed *Hydrilla verticillata* (L.F) Royle.

Materials and Methods
Collection of Plant Materials
Mature fresh plants of *Hydrilla verticillata were* collected from Kalpathy river, (Fig 1) Palakkad district, Kerala, India, were brought to the laboratory. Taxonomical identity of the plant was confirmed at the Department of Botany, Nirmala College for Women, Coimbatore, Tamil Nadu. The plant was washed with running tap water and distilled water and spread on newspaper to remove the excess water. Then shade dried at room temperature. Dried plant of *Hydrilla verticillata* were powdered with the aid of an electric blender. The powdered plant was stored in an air tight container for further analysis.

Fig 1: Study Area

Plant Description
Hydrilla verticillata (L.F) Royle (Fig 2)

Fig 2

Kingdom	:	Plantae
Order	:	Alismatales
Family	:	Hydrocharitaceae
Subfamily	:	Hydrilloideae
Genus	:	Hydrilla
Species	:	*H. verticillata*

*Hydrilla verticillata (*L.F) Royle (Fig 2) belongs to the family Hydrocharitaceae. *Hydrilla* is native to central Africa and possibly Australia but now is found in temperate and tropical regions around the world. Sometimes called as "water thyme". It is slender, submerged, perennial, aquatic herb, that can grow on water surface and form dense mats. Stem is much branched rooting at nodes, usually 7.6 m long. Its small leaves are strap-like, pointed and grow in whorls of four to eight around the stem. Tiny white flowers are visible on long stalks, and potato-like tubers form along the roots that are found in the mud.

Biochemical Analysis

The biochemical analysis was analyzed by following standard methods. Carbohydrates-Anthrone Method, Starch-Anthrone Method, Protein-Lowry's Method, Amino Acids-Ninhydrin Method, Vitamins-AACC Method (1976), Minerals-AOAC method (1975).

Review of Literature

Studied regrowth of *Hydrilla* from axillary buds and observed that *Hydrilla* reproduce vegetatively under controlled conditions and under field conditions by development of axillary buds from sub-apical fragments. The fragments with a single node were capable of regrowth under both conditions. Das pal *et al.,* (2015) [2] reviewed Pharmacognostical and physiochemical activity of the aquatic weed *Hydrilla verticillata* (L.f.) Royle known as nutrient power house. The results indicate that where the plant causes substantial economic hardships, interferes with various water uses, displaces native aquatic plant communities, and adversely impacts freshwater habitats. investigated the pharmacological activities of *Hydrilla verticillata*. The pharmacognostical studies identified the antioxidant activity, CNS activity analgesic activity anticonvulsant activity of *Hydrilla.*

Results

The result of biochemical analysis (Table 1, Fig 3, 4, 5, 6) showed the presence of Carbohydrate 6 mg/100g, Starch 5.4mg/100g, Protein 13.4mg/100g, Amino acid 6.4mg/100g, Vitamin A 0.38mg/100g, Vitamin B 11mg/100gm, Calcium 1388 mg/100gm, Iron 14mg/100gm, Magnesium 406mg/100gm, Potassium 1680mg/100gm and Phosphorus 220mg/100gm that are typically hard to obtain from plant food. Among these Carbohydrate, Starch, Protein, Amino acid were in least amount when compared with RDA value (Table 2), where as Vitamin B1, Calcium, Iron, and Magnesium shows higher value than RDA. *Hydrilla* can be suggested for VitaminB1 (11.0mg/100g), Calcium (1388mg/100g), Iron (14mg/100g) and Magnesium (406mg/100g) for infants, childrens, adults, pregnant and lactating mother, since its value is higher than RDA value.

Table 1: Concentration of Nutrients Present in *Hydrilla verticillata*

S. No	Nutrients	Concentration (mg/100g)
1	Carbohydrate	6
2	Starch	5.4
3	Protein	13.4
4	Amino acid	6.4
5	Vitamin – A	0.38
6	Vitamin – B1	11.0
7	Calcium	1388.0
8	Iron	14.0
9	Magnesium	406.0
10	Potassium	1680.0
11	Phosphorus	220.0

Table 2: Comparison of Nutrients Present in *Hydrilla verticillata* With Recommended Dietary Allowance (RDA) value

S. No	Nutrients	Nutrient present in Sample mg/100g	RDA Value			
			(1-3years) Infants and children	Older children	Adult man and women	Pregnant women and lactating mother
1	Carbohydrate	6	95g	130g	130g	210g
2	Protein	13.4	11.0g	19g	46-56g	71g
3	Amino acid	6.4	714mg	214mg	84mg	---
4	Vitamin – A	.38	.300mg	0.600mg	0.900mg	.770mg
5	Vitamin – B	11.0	0.5mg	0.9mg	1.3mg	1.4

6	Calcium	1388.0	500mg	1300mg	1000mg	1000mg
7	Iron	14.0	7mg	8mg	8mg	27mg
8	Magnesium	406.0	80mg	240mg	400mg	360mg
9	Phosphorous	220.0	460mg	1250mg	700mg	700mg
10	Potassium	1680.0	3000mg	4500mg	4700mg	4700mg

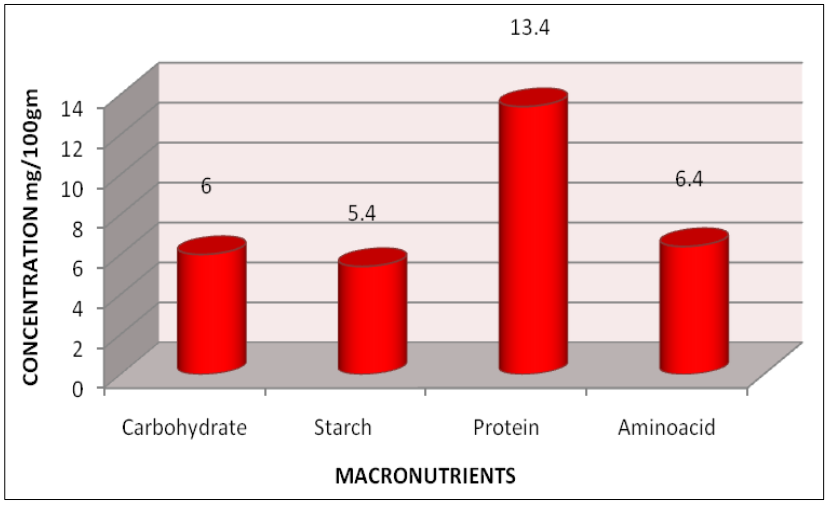

Fig 3: Concentration of Macronutrient Present in *Hydrilla verticillata*

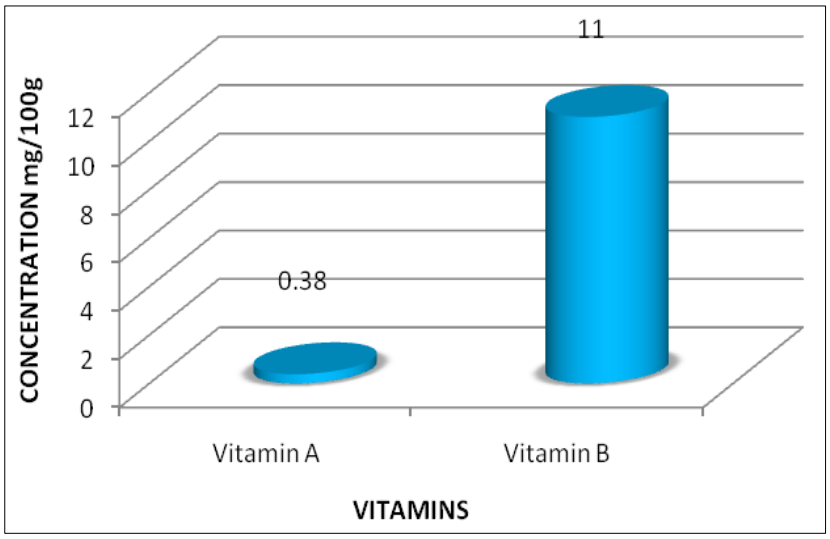

Fig 4: Concentration of Vitamins Present in *Hydrilla verticillata*

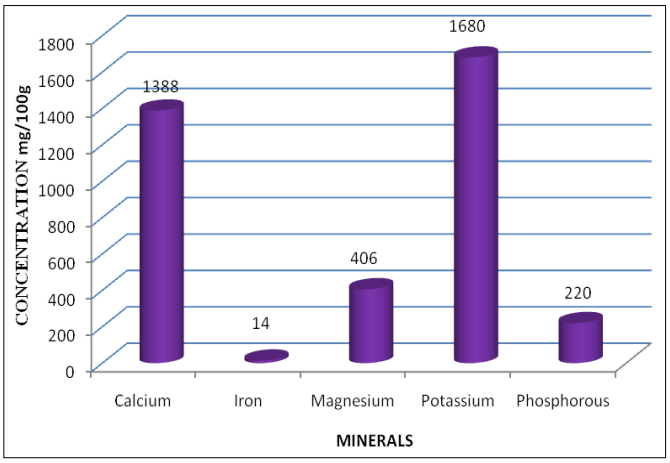

Fig 5: Concentration of Minerals Present in *Hydrilla verticillata*

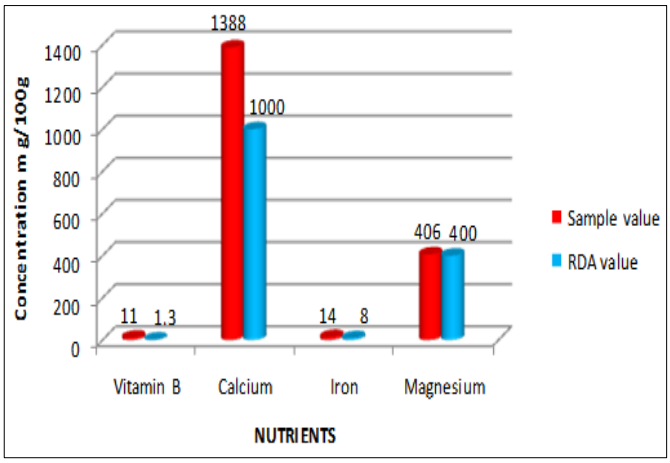

Fig 6: Suggested Nutrients in *Hydrilla verticillata* with Comparison to RDA

Conclusion

On analysis the plant showed the potential to act as a source of Vitamin B1, Calcium, Iron and Magnesium. Vitamin B1, Iron, Calcium are responsible for maintaining mental health, for delivery of oxygen to the cell and for the maintainance of strong bones and resilient connective tissue. Adequate amount of these nutrients are hard to obtain in true vegetarian diet. They are commonly supplied by animal foods like milk, cheese and meat. The presence of these nutrients make *Hydrilla* as a green food of grate value to everyone, especially for vegetarians. Comparing with other nutrients Calcium and Vitamin B1 are present in large amount. So that *Hydrilla* is suggestible for patients with mental depression, tooth decay, back and leg cramps, osteoporosis, brittle bones, caused due to calcium deficiency. Beriberi is a serious malnutrition disorder caused due to vitamin B1 deficiency. Hence the intake of *Hydrilla* also reduces the chance for beriberi. Iron deficiency leads to anemia, it causes some cognitive problem also. So the diet enriched with *Hydrilla* can improve the intellectual performance of children's**.** Magnesium involves hundreds of chemical reaction in our body and helps to maintain good health. High Magnesium foods include dark leafy greens, nuts, fish, avocados, yogurt, dried fruit, seeds etc, these are very costly and very difficult to afford buy poor people. So adding powdered *Hydrilla* in their daily diet keeps the body healthy.

Hydrilla has the potential to improve the health status of the consumer as a result of the presence of various nutrients that are vital for good health. It is a less expensive and readily available invasive aquatic weed that not yet explored and found to be rich in Vitamins and Minerals. The poor people who are not able to buy the costly nutrient rich food items can use *Hydrilla* as a nutrient supplement. It consequently improves the food security and reduce malnutrition among under privileged people. The result of this study offer a platform of using *Hydrilla verticillata* as a herbal alternative for various nutrients.

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