

A Study on Chemical Analysis of Water Hyacinth (*Eichornia crassipes*), Water Lettuce (*Pistia stratiotes*)

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ABSTRACT: In the present study the plant materials of water hyacinth (*Eichornia crassipes*) and water lettuce (*Pistia stratiotes*) were collected from Aranmanai Kulam Dindigul (Dt), Tamilnadu, India, and carefully brought into the laboratory. Then the fresh and dry weight of whole plant, leaves, stems and roots of water hyacinth and water lettuce were analyzed. After that the Carbon, Nitrogen, Cellulose, Hemicellulose, Lignin, Protein, Lipid, Ash and Calorific value were also analyzed. The results indicated that the Carbon, Nitrogen, Cellulose, Hemicellulose, Lignin, Protein, Lipid, Ash and Calorific value were significantly higher in, leaves, stems and roots of water hyacinth than in leaves and roots of water lettuce.

KEYWORDS: Water hyacinth (*Eichornia crassipes*), Water lettuce (*Pistia stratiotes*) and Chemical Composition

I. INTRODUCTION

Recently, a substantial hike in the fossil fuel prices due to the rapid depletion of natural energy sources and human population explosion has kindled immense public cognizance towards global energy security (Hendriks and Zeeman, 2009) [1]. Factors like global warming, environmental considerations and sustainable growth are encouraging scientists to explore low cost, environment friendly alternative energy sources (Merino-Pérez et al., 2015) [2]. In a forage for sustainable replacement of fossil fuels, lignocellulosic biomass derived biofuel can be an alternative renewable energy. Their major advantages are abundant availability, sustainability, recyclability, carbon neutrality and absence of 'food vs. fuel' competition (Ganguly et al., 2013) [3]. However, water hyacinth (*Eichornia crassipes*) and water lettuce (*Pistia stratiotes*) may also be a sustainable resource for biofuel production because of its abundance, low cost and availability. Biofuel production from water hyacinth and water lettuce greatly depends on the disruption of its complex lignocellulosic structure, which is recalcitrant to biodegradation. The organic components of lignocellulosic structure mainly contains of cellulose, hemicelluloses and lignin (Hendriks and Zeeman, 2009) [4]. (Mishima et al., 2006) [5]. In addition to the production of biofuel there are several other advantages to harvesting of aquatic weeds. Removal of plant biomass from the waterways will lead to decreases in the organic carbon load to the anaerobic bottom waters and sediments of the reservoirs and therefore decrease the uncontrolled release of methane from the surface of the water storage (Dalal et al., 2008) [6].

II. METHODOLOGY

Collection of Plant materials:

Plant materials of water hyacinth (*Eichornia crassipes*) and water lettuce (*Pistia stratiotes*) were collected from Aranmanai Kulam Dindigul (Dt), Tamilnadu, India.

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Analysis of different parameters:

Fresh weight and Dry weight of whole plant, leaves, stems and roots of water hyacinth (*Eichornia crassipes*) and water lettuce (*Pistia stratiotes*) were analysed using standard methods.

Analysis of Chemical compositions:

The chemical compositions of dried and pulverized biomass of water hyacinth and water lettuce, which was heated at 105°C for 3 h to get the constant dried weight, were measured (Yang, 1999) [7]. Total organic carbon (%) Potassium dichromate oxidation method Walkley and Black (1947) [8] Total nitrogen (%) Micro-Kjeldhal method Tandon (1993) [9]. The cellulose, hemicelluloses and lignin contents were measured in a Foss Fibertec 2010 hot extractor. The protein content was measured on a Foss Kjeltec 2300 analyzer unit. The lipid content was determined with the ether-extraction method on Socsplus-SCS 04 R. The dried biomass of water hyacinth and water lettuce was heated and burned at 800°C for 2h and residual weight was measured as the ash content. The calorific value of the dried biomass of water hyacinth was determined on bomb calorimeter.

Statistical Analysis:

The following statistical tools were used for the analyses and interpretation of the data. The experimental results are presented in the form of Tables using Microsoft Excel (Version 2003 and 2007). Mean and Standard Deviation were also calculated with the help of the same tool.

III. RESULTS AND DISCUSSION

In the present study the plant materials of water hyacinth (*Eichornia crassipes*) and water lettuce (*Pistia stratiotes*) were collected and the fresh and dry weight of whole plant, leaves, stems and roots of water hyacinth and water lettuce were analyzed. After that the Carbon, Nitrogen, Cellulose, Hemicellulose, Lignin, Protein, Lipid, Ash and Calorific value were also analyzed. The results are given in Tables (1, 2, 3, 4, 5 and 6). Similar kind of works were done by (Cathryn et al., 2010; AO Xia et al., 2013; Abdel-Fattah and Abdel-Naby, 2012; Richen Lin et al., 2015; Das et al., 2015; Fan Xu et al., 2016 and Mishima et al., 2008) [10, 11, 12, 13, 14, 15, 16].

Table 1. Fresh weight of whole plant, leaves, stems and roots of water hyacinth (*Eichornia crassipes*)

S.No	Fresh weight of the whole plant(g)	Fresh weight of the leaves	Fresh weight of the stems	Fresh weight of the roots
1.	33 ±0.15	17 ±0.44	5 ±0.55	11 ±0.99
2.	41 ±0.13	22 ±0.45	6 ±0.52	13 ±0.92
3.	30 ±0.14	14 ±0.43	6 ±0.61	10 ±0.89
4.	31 ±0.20	15 ±0.32	6 ±0.65	10 ±0.72
5.	32 ±0.23	16 ±0.33	5 ±0.43	11 ±0.90
6.	38 ±0.34	21 ±0.21	7 ±0.56	10 ±0.98
7.	35 ±0.33	20 ±0.22	7 ±0.62	8 ±0.88
8.	34 ±0.35	18 ±0.15	7 ±0.57	9 ±0.89
9.	29 ±0.41	15 ±0.32	6 ±0.71	8 ±0.79
10.	30 ±0.25	16 ±0.40	6 ±0.75	8 ±0.72

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Table 2. Dry weight of whole plant, leaves, stems and roots of water hyacinth (*Eichornia crassipes*)

S.No	Dry weight of the whole plant(g)	Dry weight of the leaves	Dry weight of the stems	Dry weight of the roots
1.	3.1 ±0.56	1.7 ±0.88	0.7 ±0.77	1.1 ±0.66
2.	4.0 ±0.55	2.2 ±0.89	0.7 ±0.78	1.3 ±0.69
3.	3.0 ±0.57	1.4 ±0.78	0.6 ±0.69	1.0 ±0.60
4.	3.0 ±0.67	1.6 ±0.76	0.6 ±0.68	1.0 ±0.65
5.	3.1 ±0.69	1.7 ±0.77	0.5 ±0.69	1.1 ±0.61
6.	3.8 ±0.89	2.1 ±0.89	0.7 ±0.64	1.0 ±0.59
7.	3.3 ±0.88	2.0 ±0.59	0.9 ±0.67	0.8 ±0.66
8.	3.2 ±0.45	1.8 ±0.58	0.9 ±0.66	0.9 ±0.71
9.	2.5 ±0.49	1.9 ±0.87	0.6 ±0.61	0.8 ±0.76
10.	3.0 ±0.50	1.6 ±0.80	0.6 ±0.70	0.8 ±0.75

Table 3. Fresh weight of whole plant, leaves, stems and roots of water lettuce (*Pistia stratiotes*)

S.No	Fresh weight of the whole plant(g)	Fresh weight of the leaves	Fresh weight of the roots
1.	30 ±0.55	20 ±0.87	10 ±0.80
2.	31 ±0.33	22 ±0.53	11 ±0.33
3.	30 ±0.31	20 ±0.45	10 ±0.35
4.	31 ±0.29	21 ±0.15	10 ±0.49
5.	32 ±0.19	13 ±0.49	10 ±0.47
6.	37 ±0.20	25 ±0.33	12 ±0.86
7.	35 ±0.35	22 ±0.59	13 ±0.39
8.	33 ±0.48	21 ±0.60	12 ±0.49
9.	28 ±0.54	20 ±0.15	8 ±0.50
10.	30 ±0.49	19 ±0.39	11 ±0.55

Table 4. Dry weight of whole plant, leaves, stems and roots of water lettuce (*Pistia stratiotes*)

S.No	Dry weight of the whole plant(g)	Dry weight of the leaves	Dry weight of the roots
1.	3.0 ±0.19	2.0 ±0.89	1.0 ±0.55
2.	3.1 ±0.30	2.1 ±0.79	1.2 ±0.57
3.	3.0 ±0.77	2.0 ±0.88	1.0 ±0.69
4.	3.1 ±0.99	2.1 ±0.60	1.0 ±0.71
5.	3.2 ±0.95	1.1 ±0.66	1.2 ±0.69
6.	3.7 ±0.47	2.5 ±0.70	1.2 ±0.39
7.	3.5 ±0.80	2.1 ±0.81	1.4 ±0.47
8.	3.3 ±0.55	2.1 ±0.30	1.2 ±0.99
9.	2.8 ±0.59	2.0 ±0.49	0.8 ±0.79
10.	3.0 ±0.77	1.7 ±0.57	1.3 ±0.39

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Table 5. Chemical analysis of the dried biomass of water hyacinth (*Eichornia crassipes*)

S.No	Compositions (%) dried weight)	Leaves	Stems	Roots
1.	Carbon	30.33	29.55	27.22
2.	Nitrogen	0.3	0.2	0.1
3.	Cellulose	29.86	29.33	18.11
4.	Hemicellulose	31.81	28.35	16.23
5.	Lignin	5.49	18.36	15.67
6.	Protein	21.97	7.70	3.33
7.	Lipid	1.93	0.98	0.65
8.	Ash	13.10	21.20	50.11
9.	Calorific value (KJ/g-DW)	15.33	14.55	9.25

Table 6. Chemical analysis of the dried biomass of water lettuce (*Pistia stratiotes*)

S.No	Compositions (%) dried weight)	Leaves	Roots
1.	Carbon	27.35	25.55
2.	Nitrogen	0.28	0.2
3.	Cellulose	27.55	16.11
4.	Hemicellulose	29.71	14.23
5.	Lignin	3.47	13.57
6.	Protein	19.77	1.43
7.	Lipid	0.73	0.35
8.	Ash	11.10	30.11
9.	Calorific value (KJ/g-DW)	13.31	7.23

IV. CONCLUSION

Water hyacinth and water lettuce currently growing in waterways represent a significant waste stream, which is currently either killed with herbicides or biological agents and allowed to degrade within water storages or removed for disposal in land fill at considerable cost. These experiments show that these two macrophytes can be readily degraded under anaerobic condition to yield significant quantities of hydrogen. Anaerobic digestion provides a feasible technology to harness the chemical energy stored in these weeds. Water hyacinth and water lettuce were evaluated in this study as substrates for Biohydrogen production. It can be concluded that aquatic plants are a promising biomass for Biohydrogen production. Biohydrogen will play a major role in future because it can utilize renewable sources of energy.

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