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Elemental content present in waste salvinia *molesta* D. S. Mitch. And its utilization in soil for soil quality improvement

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Abstract
S*alvinia molesta* D. S. Mitch. Is an invasive aquatic fern. It is considered one of the world`s worst weeds because of its high mobility, tolerance to environmental stress, exponential growth rate and level of difficulty to control. After plant death, the residues are go to the soil as waste. As much more amount of *Salvinia* wastes have been intermixing with soil every day and changing the soil quality. So, an attempt has been taken to analyses the impact of waste *Salvinia* on alteration of both physico chemical and elemental content of soil. An attempts were taken to use the waste *Salvinia* as a bio-fertilizer. The novelty of this work is the utilization of waste as wealth in an environment friendly way. This research address the research gap by analyzing the elemental content present in *Salvinia molesta* D. S. Mitch. In the present study it was found that the waste which causes environmental pollution containts different useful elements which is major and minor element for plant nutrition. It was observed that the soil which were treated with *Salvinia* waste contained more nutrient than the normal garden soil. So, *Salvinia molesta* D. S. Mitch. Waste can be recommended as the organic fertilizer which can fulfill the nutrient level of soil and enhance the soil fertility.

Keywords: *Salvinia molesta*, soil, physico-chemical parameters, Bio-fertilizer, Elemental content

Introduction
Pollution of the environment are mostly influenced by consumption pattern and waste management habits of an individual (Vaccariet at al., 2019). To reach the circular economy, waste statistics should be managed (Ana *et al*., 2019). The amount of waste generated globally are estimated 7 to 10 billion tons per years (Wilson *et al*., 2015) [19]. Among which 70% is not reused or recycled (Tisserant *et al*., 2017). *Salvinia molesta* waste is one of the most important solid waste which are produced in large quantities in all the environment due to its high multiplication rate. The organic residue produced from any plants or animal origin has play importantt role in changing soil quality. The organic materials affect the soil physically (Hullugalle *et al*., 1996), soil nutrient content and faunal diversity of soil (Wade and Sanchez, 1983) [18]. As we know that bio-fertilizer are the major source to enhance the growth and development of plants. So in this study elemental content in *Salvinia molesta* waste was analyzed and physico-chemical parameters of both garden soil and garden soil treated with *Salvinia* waste were compared for knowing the waste composition either that is beneficial or harmful for environment.

Materials and Methodology
In this study, soil samples were collected from Garden of Centurion University of Technology and Management, BBSR, Odisha, at depths of 15 cm using soil auger. The samples were collected in a polyethylene bags and properly labelled. Then the collected samples were taken to the laboratory and treatment was done for the preservation of soil and further analysis has been done as per standard procedure (Saeed and Rafiq, 1980) [20]. The collected samples were air dried in sun light for about twenty four hour. Then the samples were dried in an oven 105 degree centigrade till complete dehydration. Then the sample was ground in a mortar pestle then passed through 0.5mm nylon mesh sieve. These soil samples were again packed with the airtight polythene. The physico-chemical parameters like pH, E.C., soil moisture percent (%), water holding capacity of soil and elemental content of both soil and *Salvinia* waste were analyzed using standard methods.

Statistical analysis and presentation of data
All the experiments were done in triplicates and the data presented in the figure are the means of three independent experiments. The data were analyzed statistically and standard errors of mean (SEM) were given wherever required.

Results and discussion
1. Physico-chemical parameters of elemental analysis of soil
The physico-chemical parameters like pH, Electical conductivity (E.C.), soil moisture content (%), water holding capacity (W.H.C.), and different elements/ compound contents present in the garden soil treated with *Salvinia molesta* were analysed.

Table 1: Comparison between garden soil and garden soil treated with dry waste matter of *Salvinia molesta*

Parameters	Unit	Garden soil	Garden soil treated with fruit waste
pH		7.646 ± 0.042	7.454 ± 0.012
Electrical conductivity	mho/cm	0.838 ± 0.022	0.856 ± 0.026
Water holding capacity	ml/kg	142.536 ± 0.988	149.242 ± 0.864
Moisture Content	%	10.882 ± 0.212	11.024 ± 0.045

Values of four replicates ± SEM

pH: The pH values of the soil samples collected from our collage garden area was found within 7.5 to 7.7.So the soil sample was considered to be basic. After addition of *Salvinia molesta* waste it was found to be 7.3 to 7.5 which indicates that the *Salvinia* waste neutralizes the alkaline soil. Then after addition of *Salvinia molesta* waste it was found to be decreases.

Electrical conductivity (E.C.): The conductivity values in the soil samples of the area under study were found to range from 0.830mho/cm to 0.845 mho/cm. After addition of *Salvinia* waste it was found to be 0.852 mho/cm to 0.860 mho/cm which shows the decreasing trend in Electrical conductivity value.

Soil moisture content: At pre-monsoon period moisture content were found in the range of 9.1% to 11.2% whereas at post-monsoon period it was ranged from 10.4% to 12.6%, which indicated that the moisture content present in soil of the area is suitable for crop production. After addition of *Salvinia molesta* waste it was found to be increases.

Water holding capacity (W.H.C): Soil water holding capacity is a term that all farms should know to optimize crop production. When there is a difficult in the amount water in the soil, the soil profile needs to be replenished by precipitation or irrigation. In the study the soil had range between 136.42 to 156.44. After addition of *Salvinia molesta* waste it was found to be 140.10 to 161.11. After addition of *Salvinia molesta* waste it was found to be increases.

2. **Elements/compound content:** In this study, elemental analysis of soil had been done in the basis of XRF (X-ray fluorescence).The soil was found to be contained many elements/compounds i.e given in table.

Table 2: Comparison between the elemental content present in garden soil, *Salvinia molesta* waste and garden soil mixed with *Salvinia molesta* waste

Elements/ Compounds	Unit	Garden Soil	Dry waste of Salvinia molesta	Garden soil + waste
Al_2O_3	%	11.674 ± 0.543	00±00	10.886±0.044
SiO_2	%	69.754 ± 1.875	3.246±0.026	62.986±0.136
P_2O_5	%	3.457 ± 0.008	4.6265±0.014	3.596±0.008
SO_3	%	1.008 ± 0.044	3.721±0.008	1.848±0.012
Cl	%	0.682 ± 0.008	31.182±0.242	3.982±0.014
K_2O	%	1.056 ± 0.004	28.215±0.138	2.908±0.006
CaO	%	5.348 ± 0.064	26.833±0.462	6.942±0.014
TiO_2	%	0.268 ± 0.012	0.167±0.002	0.232±0.004
MnO	%	0.428 ± 0.006	00±00	0.348±0.006
ZrO_2	%	0.088 ± 0.008	00±00	0.062±0.001
Fe_2O_3	%	4.086 ± 0.056	00±00	3.988±0.008
V_2O_5	Ppm	238.567± 0.268	00±00	214.884±1.026
Cr_2O_3	Ppm	196.563 ± 0.164	188.352±1.648	192.422±0.884
NiO	Ppm	76.192 ± 0.916	158.206±1.422	83.080±0.068
ZnO	Ppm	164.424 ± 0.647	491.802±2.864	198.204±0.088
Ga_2O_3	Ppm	28.246 ± 0.426	00±00	25.006±0.022
Rb_2O	Ppm	148.737 ± 0.646	160.154±2.244	149.896±0.0046
As_2O_3	Ppm	10.824 ± 0.075	00±00	9.004±0.006
SrO	Ppm	144.746 ± 0.098	121.554±0.988	141.888±0.126
Y_2O_3	Ppm	38.374 ± 0.738	00±00	34.044±0.064
Nb_2O_5	Ppm	42.748 ± 0.896	00±00	38.224±0.122
SnO_2	Ppm	92.749 ± 1.008	00±00	84.006±0.228
Eu_2O_3	Ppm	546.836 ± 1.748	00±00	493.882±1.824
Yb_2O_3	Ppm	46.734 ± 0.964	19.244±0.062	45.024±0.284
ThO_2	Ppm	48.385 ± 0.647	00±00	43.274±0.098
CuO	Ppm	94.584 ± 0.476	214.052±1.221	101.098±0.214

Values of four replicates ± SEM

There are several elements and compounds were found to be present in *Salvinia molesta* waste which enhanced the nutrient level of garden soil. After addition of waste, concentration of different valuable elements like P_2O_5, SO_3, Cl, CaO, and Rb_2O were found to be increased which enhanced the soil nutrient level. In a study it was reported that the application of egg shell waste enhance the soil fertility (Biswal *et. al*., 2019) [2]. In another study, it was reported the application of compost act as fertilizer on growth of onion (Brechin and Mc. Donald, 1994), on barley (Hountin *et al*., 1995). From another experiment, it was found that, the *Salvinia molesta* waste compost are highly desirable for plant growth (Oladapo *et al*., 2015) [11]. The presence of some metals like copper, zinc, iron, manganese, molybdenum and nickel are essential micronutrient for plant growth (Arzoo and Saatapathy, 2017). Similarly, small amount of different metals enhance the plant growth like nickel in *Macrotyloma uniflorum* (Arzoo *et al*.,

2014).Compost prepared from organic waste (Hartz *et al*., 1996) [8] increases soil organic matter on land (Smith *et al*., 1992) [14] and provide plant nutrients in slowly available form (Shanks and Gouin, 1992) [13]. Similarly a report showed that the addition of fruit waste in soil also enhances soil fertility (Arzoo *et. al*, 2020). Similar result were also reported in growth of peanut crops grown with *Salvinia* waste treated soil (Daud *et al*., 2016) [7].

Conclusion

Salvinia molesta D. S. Mitch. Waste can be used as bio-fertilizer due to presence of different valuable macro and micro nutrient for plants. In the present study, it was found that the *Salvinia* waste treated soil contains much more nutrient than the normal garden soil. So this research can say that *Salvinia* waste can fulfill the mineral requirement for the plant growth. Overall it is an excellent organic manure for plants. It can be recommended for utilization at crop field for better growth and development of plant without causing any harm to the plant.

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