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A Brief Review on *Eichhornia* Extract as Liquid Fertilizers for Aquaculture Pond

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A B S T R A C T

In modern era due to explosive increase in population leads to increasing demand of food, encouraged the traditional aquaculture practices to high intensification of fish culture. These aquaculture practices mainly based on application of protein rich fish feed and fertilizers. Excess feed and fertilizer application are the main reasons for deterioration of water quality and disease outbreak. Therefore liquid fertilizer can be used as an alternative for this type of problem. Since it originated either from plant or animal (natural) or chemically derived (man-made), it is easy to use and readily available to phytoplankton growth. This paper will provide a brief review on application of *Eichhornia* extract for aquaculture practices.

Introduction

Aquaculture is the main source to fulfil the demand of fish. Fast development of aquaculture and increasing fish demand lead to intensification of fish culture. Fertilization is an important way of semi-intensive and intensive aquaculture pond management that supports the successful production of culture organism. Fertilizers are natural or synthetic substances that are used in ponds to increase the production of the natural food organisms to be eaten by the fish. These organisms include phytoplankton, zooplankton and insects. In Semi-intensive and intensive aquaculture pond management are characterized by high stocking rate of the culture animal that limited use of fertilizers, they use of compound or complete feeds, and water quality monitoring and management, including use of mechanical aeration (Hickling, 1971; Bardach *et al.*, 1972; Avault, 1996). Fertilization contributes to establishing and maintaining the environmental condition of pond that allows the culture organism to efficiently utilize the compound or complete feeds offered. The source of fertilizer is chemical and organic, which include agricultural by-products and animal manures. Chemical fertilizer usually composed of

nitrogen, phosphorus, and potassium compounds that dissolve readily to provide nutrients to phytoplankton. Organic fertilizer includes agricultural by-products, for example, rice bran, cottonseed meal, and animal manures, for example, poultry litter, cow manure, which first must undergo decomposition to release nutrients for the growth of phytoplankton and zooplankton. Among the cattle dung or poultry dropping are the most commonly used organic manure. Besides cattle dung and poultry dropping other organic manure are also use that contain high nitrogen and phosphorus such as pig manure. Among the benefits of pond fertilization are the productions of natural food organisms that contribute nutrition to culture organism. The development of phytoplankton blooms that provide dissolved oxygen, utilize excreted feed nitrogen, shade out benthic vegetation, and provide contrast for fish to locate and consume floating, extruded feed, and the control of clay turbidity.

Liquid fertilizer

As name indicates liquid fertilizers are nothing but "fertilizer in liquid form", have densities around 1.4 kg/l and sink to the bottom if applied directly to ponds or other water bodies for aquaculture purposes. It may be originated either from plant or animal (natural) or chemically derived (man-made).These liquid fertilizers have substantially replaced traditional, standard, agricultural field-dominated fertilizers (commonly available in granular form) for use in sport-fish ponds in the South Eastern United States (Boyd, 1990). These must be diluted before application since it is highly concentrated after that either splashed over pond surfaces or slowly released into the pond water from outboard (Boyd and Tucker, 1998). These liquid fertilizers commonly available in packed bucket or drums therefore little difficult to store and handle. For example a liquid pond fertilizer, consists of finely pulverized mono-ammonium phosphate and muriate of potash having active ingredients 10% N, 52% P_2O_5, and 4% K_2O. Other common liquid fertilizers are 10-34-0, 10-37-0 and 13-38-0 (N-P-K % wise). Recently plant extract used as fertilizer in liquid form so called "liquid fertilizer or silage" e.g., fermented water hyacinth.

Advantages of liquid fertilizers over granular fertilizers

1. Do not bind to clay if diluted with a larger volume of water before application
2. Readily available to phytoplankton or primary producers
3. Application rates are much less compare to granular fertilizer
4. The phosphorous (especially orthophosphate) is reported to be immediately available to the phytoplankton or primary producers.
5. Heavier than water so it will sink and be less effective if not diluted before application.

Importance of *Eichhornia* in aquaculture

Water hyacinth belonging to the family Pontideraceae and it is listed as one of the most productive plant in the earth and hence is considered as world's most worst aquatic weed (Wasterdahl and Getsingr, 1988; Charudattan, 1996; Grodowitz, 1998;). It can multiply rapidly and clog lakes, rivers and ponds, hence considered as nuisance species. The thick mats formed unfavourable conditions for other aquatic animals often obstruct other activities viz. fishing, shipping and irrigation. It is difficult to eradicate if once invaded somewhere (aquatic system).

Previously it got attention because of its negative effect on aquaculture and bad impact

on environment but now for its potentials use in different form as shown in Figure 1. It offers the potential for use as fodder, as fish feed, for the production of biogas and for the environmental clean up as removal of excess nutrients (Nitrogen, Phosphorus: Reddy and De Busk, 1985), pesticides (Ethion, dicofol, cyhalothrin, pentachlorophenol: Roy and Hanninen, 1994, Xia *et al.,* 2002), and heavy metals (Fe, Cr, Cu, Zn, Cd, Ag, Pb, Se: Zhu *et al.,* 1999; Schneider *et al.,* 1999; Hu *et al.,* 1987) from polluted waters. According to Reddy *et al.,* (2005) about 1 million L/day of domestic sewage could be treated over an area of 1 ha through water hyacinths, reducing the BOD and COD by 89 and 71 %, respectively.

Apart from above mentioned potential uses, it can be used in other forms viz. its petioles fiber can be used to make rope, baskets, carpet, and other accessories etc. (Malik, 2007). It is reported that water hyacinth seems to be a good source of organic carbon and has been used as an organic fertilizer (Oroka, 2012; Elserafy *et al.,* 1980). There have been positive responses reported for water hyacinth compost on growth and yield of *Brassica juncea* (green mustard cabbage) (Nuka and Dubey, 2011) and *Celosia argentea L* (Lagos Spinach) (Sanni and Adesina, 2012). Nageswaran *et al.,* (2003) reported that water hyacinth, act as a good substrate for oyster mushroom (*Pleurotussajor caju*) cultivation at a proportion of 25% with rice straw, and increased yield has been noticed by 19% compared to pure rice straw. According to Goswami and Saikia (1994) water hyacinth pulp can be used to produce grease proof paper. In the Khmer community in the Mekong Delta of Vietnam, it provides one of the sources of income by selling its flowers (Thuy, 2012). Water hyacinth can be used to remove excess nutrients from water bodies and to produce biogas and is considered as technically feasible options for water hyacinth control and its management Wang and Calderon, (2012). Aswathy *et al.,* (2010) reported that water hyacinth biomass (lingo cellulosic compound) used as production of ethanol in many tropical regions of the world. The combination of water hyacinth and pig manure used to produce biogas and generate electric power has been reported by Tran *et al.,* (2011). With the increase in population and rapid industrial development, there is a need for environmentally sustainable energy sources and it can be potential source of the same (Ganguly *et al.,* 2012).

Nutrient composition of Eichhornia extract

It has been reported that the proximate composition leaf extract of Eichhornia on % wet basis, Moisture content - 90.2; Nitrogen content-1.03; P content- 0.42; K content-1.81; Ca content- 0.02 (Abdalla and Hafeez, 1969). According to Agrupis (1953) the Nutrient composition value of water hyacinth as silage (Table 1).

For better understanding and feed / fertilization management, it is necessary to have knowledge about nutritive value of different form available as *Eichhornia* extract. Proximate composition of raw and fermented *Eichhornia crassipes* leaf meal (% dry matter basis) shown in Table 2. Gunnarsson and Petersen, (2007) in a review that covered water hyacinths collected from various sources, also reported levels of some other components: hemicellulose 22-43.4 %; cellulose 17.8-31 %; lignin 7-26.36 %; and magnesium 0.17 %.

Preparation and application of liquid fertilizer

Most commonly used method for preparation of liquid fertilizer is composting or fermentation.

Composting: It is one of the most widely used techniques (processing) for preparation of liquid fertilizer or fish feed from water

hyacinth. The availability of abundant quantity of nutrients like phosphorus and inorganic nitrogen in the root of *Eichhornia* makes it suitable material for making liquid fertilizers or fish feed. According to Kamal and Wee, (1985) Flow diagram showing the preparation method for liquid fertilizer as follows:-

Take whole water hyacinth plants

↓

Cut into 2-3 cm pieces (by using a rotary chopper)

↓

Sun-dried on an elevated platform (Moisture content of about 20 %)

↓

Compost is made by mixing dried and freshly chopped water hyacinth
(With an initial pile moisture content of 65-70 %)

↓

Mixture is made into a pile (of 2.5 x 2 x 1.3 m (l x b x h)

↓

Perforated bamboo poles are inserted for aeration

↓

The mixture is turned occasionally (to facilitate decomposition) The Composting process will finish within 50 days.

Some times 2% urea is added to speed up the decomposition process. Large quantity of water hyacinth and cow dung mixed with 2-3 % urea and lime also practiced for preparation of liquid fertilizer or fish feed.

Application methods

Liquid fertilizers are highly concentrated form so must be diluted before its application. It can be slowly released into the pond water from outboard of boat. There are following ways commonly practiced to do same such as:

• Direct application to the pond surface

• Using a garden hose sprayer for its application

• Splashed method can be used

• Dripping the fertilizer onto the propeller wash of the boat, soil helps the proper mixing and even distribution of the fertilizer into the water (this method commonly practiced in large ponds or reservoirs). According to the MAEP the recommended rate of compost application is @18,000 kg/ha/year.

Table.1 Nutrient composition of water hyacinth as silage

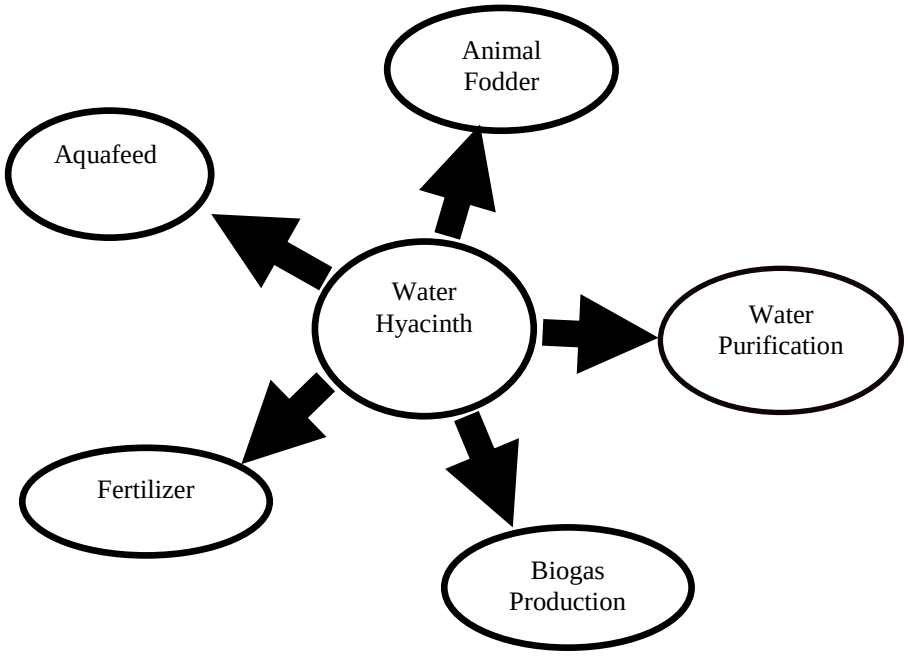
Water hyacinth analyses	%
Crude protein	0.9
Nitrogen free extract	3.9
Crude fats (ether extract)	0.4
Crude fibre	2.2
Ash	2.0
Calcium	0.3
Potassium	0.1

Table.2 Proximate composition of raw and fermented *Eichhornia crassipes* leaf meal (% dry matter basis)

Parameters	Raw leaf meal	Fermented (*B. megaterum* C13)	Fermented (*B. subtilis* CY5+LAB)
Crude protein	13.37	14.44	16.88
Ash	17.00	14.00	12.60
Crude fibre	1.00	1.50	1.00
Crude lipid	15.00	12.00	13.50
NFE*	47.63		
Gross energy	14.22		
Free amino acids	0.36	0.79	0.98
free fatty acid	2.80	3.30	3.80
Cellulose	11.40	7.65	5.80
Hemicellulose	0.15	0.06	0.10
Tannin	0.98	0.38	0.20
Phytic acid	0.42	0.32	0.37

Source; NFE* Nitrogen free extract; Source: S. Saha and A.K. Ray (2011)

Fig.1 Showing potential use of water hyacinth



In conclusion, water hyacinth has both negative and positive effect on ecosystem, socioeconomic value of a community and on welfare. If excess growth it can damage the related ecosystem and other activities (aquaculture, fishing, tourism and agriculture). It has potential as feed for livestock owning high crude protein content and high dry matter yield approximately 400 kg/ha/week. Silage form of water hyacinth easy to conserve and may be improved by the addition of molasses or rice bran used for cattle feed. Moreover the socioeconomic effects of water hyacinth are dependent on the extent of its invasion, the uses of the impacted water body, control methods, and the effectiveness of the control efforts. Ecosystem level research programmes need to be improving viz. Simultaneous monitoring of the effects of water hyacinth on multiple trophic levels and are needed to further extend our understanding of this invasive species, so it can be properly manage and utilized. Since it is considered as nuisance so all efforts must be made to control these plants, but there is need to step up more research efforts towards optimum utilization of these recourses for human welfare.

References

Abdalla, A.A. and Abdel Hafeez, A.T., 1969. Some aspects of utilization of Water hyacinth (*Eichhornia crassipes*). *Pest Articles and News Summaries, 15(2),* 204–7.

Agrupis, F.M., 1953. The value of water hyacinth as silage. *Philipp. Agric., 37(1-2),* 50- 6.

Aswathy, U.S., Sukumaran, R.K., Devi, G.L., Rajasree, K.P., Singhania, R.R. and Pandey, A., 2010. Bio-ethanol from water hyacinth biomass: An evaluation of enzymatic saccharification strategy. *Bioresource Technology, 101(3),* 925-930.

Boyd, C. E., 1990. Water quality in ponds for aquaculture. Auburn University, Alabama Agricultural Experiment Station, Auburn.

Boyd, C. E. and Tucker, C.S., 1998. Pond aquaculture water quality management. Kluwer, Boston.

Charudattan, R., 1996. Pathogen for Biological Control of Water Hyacinth. In: Strategies for Water Hyacinth Control, Carudattan. R., R. Labarada, T. D. Center and C. Kelly-Begazo (Eds.). FAO, Fort Lauderdale, Florida, USA. PP: 90-97.

Edwards, P., Kamal, M. and Wee, L., 1985. Incorporation of composted and dried water hyacinth in pelleted food for tilapia *Oreochromis niloticus* (Peters). *Aquacult. Fish. Manage, 16,* 233-248.

Elserafy, Z.M., Sonbol, H.A. and Eltantawy, I.M., 1980. The problem of water hyacinth in rivers and canals I. Production of compost from plant. *Soil Science and Plant Nutrition*. 26(1): 135-138.

Ganguly, A., Chatterjee, P.K. and Dey, A., 2012. Studies on ethanol production from water hyacinth-A review. *Renewable and Sustainable Energy Reviews, 16(1),* 966-972.

Goswami, T. and Saikia, C.N., 1994. Water hyacinth. A potential source of raw Material for grease proof paper. *Bioresource Technology, 50(3),* 235-238.

Grodowitz, M.J., 1998. An active approach to the use of insect biological control for the management of non-native aquatic plants. *Journal of Aquatic Plant Management, 36,* 57-61.

Gunnarsson, C.C. and Petersen, C.M., 2007. Water hyacinths as a resource in Agriculture and energy production: A literature review. *Waste Management, 27,* 117-129.

Holm, L.G.D.L., Plucknett, J., Pancho, V. and Herberger, J.P., 1977. The World Worst Weeds: Distribution and Biology. University Press Hawaii, Honolulu, USA. PP. 72-77.

Hu, C., Zhang, L., Hamilton, D., Zhou, W., Yang, T. and Zhu, D., 2007. Physiological responses induced by copper accumulation in *Eichhornia crassipes*. Hydrobiologia, 579, 211. Xia, J., Wu, L. and Tao, Q., 2002. Phytoremediation of methyl parathion by water hyacinth (*Eichhornia crassipes* Solm.). *Chemical Abstracts, 137*, 155879.

Malik, A., 2007. Environmental challenge vis a vis opportunity: The case of water hyacinth. *Environment International, 33(1),* 122-138.

Nageswaran, M., Gopalakrishnan, A., Ganesan, M., Vedhamurthy, A. and Selvaganapathy, E., 2003. Evaluation of water hyacinth and paddy straw waste for culture of oyster mushrooms. *Journal of Aquatic Plant Management, 41*, 122-123.

Nuka, L. and Dubey, V. 2011. Response of water hyacinth manure on growth attributes and yield in *Brassica juncea*. *Journal of Central European Agriculture, 12(2),* 336-343.

Oroka, F.O., 2012. Water hyacinth based vermicompost on yield, yield Components, and yield advantage of cassava and groundnut intercropping system. *Journal of Tropical Agriculture, 50(1-2),* 49-52.

Reddy, K.R. and De Busk, W.F. 1985. Growth characteristics of aquatic macrophytes cultured in nutrient-enriched water: 2. Azolla, duckweed, and Salvinia. *Economic Botany, 39*, 200-208.

Reddy, P.V.G.K., Ayyappan, S., Thampy, D.M. and Krishna, G., 2005. Textbook of Fish Genetics and Biotechnology. New Delhi, Indian Council of Agricultural Research. 218 pp.

Roy, S. and Hanninen, O., 1994. Pentachlorophenol: Uptake/elimination, kinetics and metabolism in an aquatic plant, *Eicchornia crassipes*. *Environmental Toxicology Chemistry*, 13, 763.

Sangbrita, S. and Ray, A. K. 2011. Evaluation of Nutritive Value of Water Hyacinth (*Eichhornia crassipes*) Leaf Meal in Compound Diets for Rohu, *Labeo rohita* (Hamilton, 1822) Fingerlings after Fermentation with Two Bacterial Strains Isolated from Fish Gut. *Turkish Journal of Fisheries and Aquatic Sciences,* 11, 199-207.

Sanni, K.O. and Adesina, J.M., 2012. Response of water hyacinth manure on growth attributes and yield of *Celosia argentea* L (Lagos Spinach). *Journal of Agricultural Technology, 8(3),* 1109-1118.

Schneider, I.A.H. and Rubio, J., 1999. Sorption of Heavy Metal ions by the nonliving biomass of freshwater macrophytes. *Environmental Science and Technology, 33*, 2213-2217.

Thuy, T.N., 2012. Poverty reduction strategies in an ethnic minority community: Multiple definitions of poverty among Khmer villagers in the Mekong Delta, Vietnam. *Asian Social Science, 8(6),* 196-208.

Tran, T.T., Nguyen, V.D., Do, D.N., Nguyen, H.P. and Choi, J., 2011. Assessment of electric power generation via water hyacinths and agricultural waste. *Journal of Energy and Power Engineering,* 5, 627-631.

Wang, Z. and Calderon, M.M., 2012. Environmental and economic analysis of Application of water hyacinth for eutrophic water treatment coupled with biogas production. *Journal of Environmental Management,* 110, 246-

253.
Westerdahl, H. E. and Getsinger, K.D., 1988. Aquatic Plant Identification and Herbicide use Guide: Aquatic Plant and Susceptibility to Herbicides. Vol. 2, Waterways Experiment station, Vicksburg, MS.

Zhu, Y.L., Zayed, A.M., Qian, J.H., De Souza, M. and Terry, N. 1999. Phytoremediation of trace elements by wetland plants: II. Water Hyacinth. *Journal of Environmental Quality,* 28, 339-344.

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