International Journal of Current Science Research
www.drbgrpublications.in

Volume: 2; Issue: 6; June-2016; pp 731-737. ISSN: 2454-5422

Bio-Conversion of wastewater nutrients using *Eichornia crassipes*

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Abstract

Fish Orange molly selected for the present investigation. Three types of feed were prepared viz; Conventional control feed (D1), Raw Eichornia incorporated feed (D2), Decomposed Eichornia incorporated feed (D3) using different ingredients. 40% protein was maintained in all the three types of feeds. The experiments were conducted for 21 days in 13-lt plastic troughs. The D3 showed the best assimilation efficiency (98.9%), Gross growth efficiency (11.67%) and Net growth efficiency (11.80%). But D1 recorded the best consumption (2.4%), Assimilation (2.31), Metabolism (2.14). The D3 showed the best final dry wt (0.36 mg/g). best mean wt. (0.11g) and production of (0.21g) respectively.

Keywords: Molly, Sewage, Nutrition and *Eichornia*.

Introduction

Sewage consists of approximately 99.5 to 99.9% water and 0.1 to 0.5 percent inorganic and organic matters in suspended and soluble forms. The main organic components are nitrogenous compounds, protein and urea, carbohydrates including sugars, starch and cellulose; Nogales *et al.,* (1994) studied the nutrient removal potential of water hyacinth. Eichornia are free floating plant with their leaves above the water surface, roots are within water. The water hyacinths are found to be very efficient in scavenging inorganic and organic compounds from water. The use of water hyacinth to treat domestic sewage is also being used in the state of Texas USA, (Deiges, 1979). The nutritional quality of water hyacinth is greatly enhanced when grown in highly fertile environments. Water hyacinth grown in two heavily loaded sewage lagoons gave the following average analysis 22.9% crude protein 2.12% fat 18.3% fibre17.8% ash 3.65% kjeldhal nitrogen and 0.87% phosphorus (Wolverton and Mc Donald, 1980). Freshly harvested aquatic plants contain enormous quantities of minerals depending on plant type.

Raw wastewater may contain pollutants such as oxygen-depleting substances, suspended solids, nutrients, toxic chemicals and pathogens (Mihelcic and Zimmerman, 2010), that must be given suitable treatment before it is released to the environment. Over the years, several wastewater treatment technologies have been designed and operated at full scale while some more recent ones are on experimental scale. These technologies are classified as physical, aquatic, or terrestrial systems (UNEP-IETC, 1998). Recent studies have confirmed that in aquatic wastewater treatment systems, aquatic weeds are low-cost powerful bioagents which purify wastewater lying under them by physical, chemical and biological actions (Abbasi and Abbasi, 2010).

Among these aquatic weeds, water hyacinth (*Eichhornia crassipes*) has received great attention because of its obstinacy and high productivity especially when grown in domestic sewage lagoons (McDonald and Wolverton, 1980). Water hyacinth is also known to have a promising potential for the removal of toxic metals and other pollutants from aquatic environments (Mahamadi and Nharingo, 2010), though the purification of sewage by water hyacinth has not yet been generally embraced in some parts of the world (Alade and Ojoawo, 2009). Meanwhile in other parts, majorly developed countries, water hyacinth has been used to remove nutrients or pollutants from wastewaters (Yedla *et al*., 2002; Xia, 2008; Abbasi and Abbasi, 2010).

Materials and Methods

Sewage water collected from the buckle channel of Tuticorin town was subjected to aeration for improving the dissolved oxygen availability for 15 days. The different nutrient parameters were analyzed as per the methodologies of FAO (1975) and Eichornia was introduced after the oxidation was completed after two weeks. The Eichornia grown in this sewage was harvested and used as a feed component. The biochemical constituents like carbohydrates, protein, and fat were estimated as per methods of FAO (1975). The harvested Eichornia was dried and the compounded diet was prepared by using tapioca flour, Rice bran, Fish meal and ground nut oil cake along with sun dried Eichornia powder in different percentages based on their protein contents (Table -2). Three types of feeds experimental Eichornia feed (raw) Eichornia feed (decomposed) and control feed each containing 40% protein were prepared adopting the box model of Ali (1982). Feed trials were conducted in *molly* fingerlings of average weight 0.15g and the different growth parameters viz: gross growth rate, net growth rate, relative growth rate and FCR were calculated at the end of the feed trials.

Results

The biomass of the plant cultured was found to be considerably increased from 50 g to 130 g during a period of 40 days. In the feed trials conducted the assimilation efficiency did not vary significantly between control and raw Eichornia feed. But there was significant difference ($P<0.025$) between raw and decomposed feed. The gross growth efficiency varied significantly ($P<0.005$) between all the three types of feed and the decomposed feed ranked first followed by the raw eichornia incorporated feed. The mean net growth efficiency also showed the same phenomenon. The food conversion ratio recorded in the three- test feeds showed high level of significance ($P<0.005$) in all the comparisons.

Discussion

Feed trials conducted with the control and two types of feeds (all with 40% protein content) showed high variation in the growth parameters recorded. Similar trials with weeds incorporated in pelleted feeds in fish have been reported by Tan (1970) Hajra and Tripathi (1985), Hajra (1987), Patra and Ray (1988) and Das *et al.,* (1989). The highest production of 0.21gm was registered in the case of decomposed Eichornia incorporated feed, while in the fresh plant was used as a component of fish feed; the recorded production (0.14g) was comparably lower than that grown in the control feed (0.17gm). Manimaran *et al.,* (1997) reported that in the feed trials conducted with the koi carp fed with lemna-incorporated feed it showed higher net growth efficiency than that fed with control feed. However the converse was true in the case of gross growth efficiency. Higher values of net growth efficiency recorded showed that most of the assimilated feed was converted into body protein, with minimum loss of energy through metabolism. In this experiment also it was observed that the assimilation efficiency gross growth efficiency and net growth efficiency were observed to decrease in the following order.

Decomposed Eichornia feed → Raw Eichornia feed → Control feed

The crude protein content of Eichornia offers much scope as a component of low cost feed for ornamental fishes. Similar observation was made by Hyde *et al*., (1984). The water hyacinth grown in sewage water had a high concentration of protein, fat nitrogen and phosphorus (Wolverton and Mac Donald, 1980). In this experiment during the process of decomposition the protein level was found to be elevated and these decomposed plants were used for the preparation of feed. Because of their higher protein content growth rate in the fishes are also high. But in the raw Eichornia feed, production was very low while comparing with other two types of feeds. This might be due to some anti-nutritional factors or neuro-inhibitors present in the plant. If we eliminate these factors by using advanced technologies the rate of production in turn may also be increased.

Conclusion

In domestic wastewater, the water hyacinth can produce tremendous. Quantities of biomass that is high in protein and minerals such as potassium, calcium and phosphorus. This harvested biomass can be used for protein extraction and concentration. So this study is an attempt to convert this biomass into animal protein. It is also a means of converting the waste nutrients into useful protein instead of allowing such wastewaters to cause ecological imbalance in coastal water biotopes. Further studies on the limiting factors in the nutrition and the actual uptake of protein by the animal tissues are needed.

Acknowledgement

The author want to thankful to College Secretary and Principal of V.O.Chidambaram College, Tuticorin for providing lab facilities and successfully carryout this work. And also the authors greatly acknowledged our college Secretary and Principal of V.H.N.S.N College (Autonomous), Virudhunagar.

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Table 1.Growth parameters of molly fish fed with control and experimental feeds

Growth Parameter	Conventional Control feed	Raw Eichornia Incorporated feed	Decomposed Eichornia incorporated feed
Initial wt (g/mg)	0.15	0.15	0.15
Final day wt (g/mg)	0.32	0.29	0.36
Weight mean w2 - w1 --------- (w) 2	0.09	0.07	0.11
Production (P=w2-w1)	0.17	0.14	0.21
Consumption (C)	2.4	1.5	1.8
Faceal output	0.09	0.05	0.02
Assimilation(A=c-f)	2.31	1.45	1.78
Metabolism (R=A-P)	2.14	1.31	1.57
Assimilation efficiency (A/C x 100)	96.3	96.7	98.9
Gross Growth efficiency (k_1) (%) (p/c x 100)	7.08	9.33	11.67
Net growth efficiency (k_2) (%) (p/a x 100)	7.36	9.66	11.80
Relative growth efficiency (g/d) (p/w/day)	0.09	0.10	0.09
FCR (c/li. increased)	2.82	2.14	1.71