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UTILIZATION OF SUGARCANE BAGASSE AS A SUBSTRATE FOR PLANKTON PRODUCTIVITY

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Abstract
The present investigation has been conducted to evaluate the effect of sugarcane bagasse as an artificial substrate for plankton productivity. Sugarcane bagasse bundles (Length 50 cm; diameter 4cm) of 5 kg were hung in a large cement tank (5x5x1 cm) with 15 cm soil base with well water. Water quality parameters (Temperature, pH, dissolved Oxygen, Alkalinity and dissolved carbondioxide) and plankton biomass were monitored for 15, 20, 40 and 60 days respectively. Bagasse substrate did not adversely affect water quality but variations in plankton density were noted. The result demonstrate that sugarcane bagasse can effectively use as a substrate for plankton productivity.

Key Words: Sugarcane bagasse, artificial substrate, Plankton productivity

Introduction

In recent years there is a growing interest in the potential of artificial substrates for plankton production in ponds to reduce costs and to increase nutrient utilization [1]. Organic substances such as plant materials, food scraps and paper products can be recycled using biological process. Diversity, distribution, abundance and variation in the biotic factors provide information of energy turnover in the aquatic systems [2]. In these systems plankton is of great importance [3]. Their sensitivity and large variations in species composition are often a reflection of significant alteration in ambient condition within an ecosystem [4,5]. Hence for any scientific utilization of water resources plankton study is of primary interest. Several studies on plankton diversity made in India and abroad on the ponds, lakes and reservoirs [6, 7, 8, and 9] but the data dealing with the effect of substrate on plankton population are scanty. The intention of biological processing is to control and accelerate the natural process of decomposition of organic matter. Sugarcane bagasse is the fibrous residue remaining after sugarcane stalks are crushed to extract their juice and is currently used as a renewable resource in the manufacture of pulp and paper products and building materials. Sugarcane bagasse, a byproduct of sugar industry is generated in large quantities Hence in present study efforts have been made to understand whether sugarcane bagasse can effectively be used as a substrate for plankton productivity.

Materials and Methods

The experiment was conducted in a 25 m^2 (5 x 5 x1 m) cement tank with 15-cm soil base. Water was filled to the tanks from a perennial well. Sugarcane bagasse collected from E.I.D. Parry (I) Ltd., Nellikuppam, Cuddalore district was sun dried and bundles were made using nylon rope (Length 50 cm; diameter 4cm) and were introduced into the tank randomly at the rate of 5 kg, by suspending the bundles at regular distances from bamboo poles keeping across the tanks. Sampling for water quality parameters and evaluation of the plankton were carried out for 15, 20, 40 and 60 days intervals. Water temperature, dissolved oxygen, and pH were measured using a Horiba (Japan) water quality analyser (Model U 10). Total alkalinity, dissolved carbondioxide [10] and Plankton were collected from 40 l of water using a 60-μm net and numerical estimation done by the Direct Census Method using a Sedgewick Rafter Cell having 100 equal squares.

Results and Discussion

The water quality parameters analysed were given in Figure 1. The water temperature varied form 27 - 29°C. pH value of well water was 7.01. After the addition of the substrate the value decreased as an average of 6.99. Several studies have shown that pH variations within these ranges influence plankton abundance and species distribution. Freshwater studies have suggested that species succession is determined by the ability of certain species to proliferate at high pH's presumably due to their tolerance of low CO2 levels [11,12,13]. The narrow range of pH (7.01 -6.99) indicated stability as most of the aquatic organisms are adapted to an average pH and do not withstand abrupt changes [14]. Similarly the free CO_2 value (10.7-12.9 mg l-1) did

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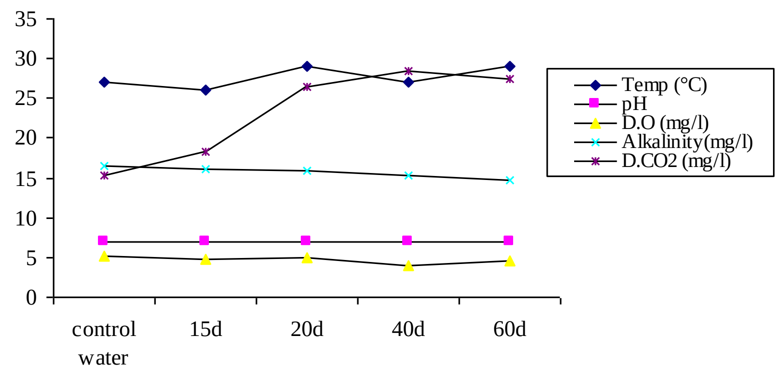
not show much fluctuations contributing to the fitness of natural water as it serves to buffer the environment against rapid shifts in the acidity or alkalinity and also regulates the biological processes in aquatic communities [15]. The total alkalinity varied from 17.15 to32.84 mg l-1 with the highest value recorded after 40 days. The highest plankton density after 60 days could be linked to this as natural waters containing 40 mg l-1 or more total alkalinity is more productive [16]. Moreover, water with low alkalinity will have large swings in pH, while high alkalinity may only produce slight changes in pH.

Fig 1 Showing the variations in water quality parameters



In the present study the dissolved oxygen content showed a decreasing trend from well water (5.1 mg/l) upto 60 days. The maximum decrease in dissolved oxygen was noted after 40 days (3.89 mg/l). According to Pokorny et al., [17], the reduction in dissolved oxygen level was due to large populations of planktons especially zooplankton and microcrustacea as a result of respiratory consumption. The changes in distribution of nutrients result in rapid growth of many organisms capable of taking advantage of altered nutrient availability. Population responses may be temporary and transient. If however, long term changes in oxygen regulated nutrient availability are sustained, the productivity of the water medium can be radically altered [18].

Table 1. Showing the number of planktons , Ash Free Dry Matter (AFDM), Ash content of planktons in well water and substrate treated water for 60 days.

Parameters	Control water	Substrate added water			
		15d	20d	40d	60d
Number of Plankton	2.0 ± 0.02	7.0 ± 0.01	11.0 ± 0.12	16.0 ± 0.11	29.0 ± 0.15
AFDM (mg/l)	0.45 ± 0.12	0.58 ± 0.01	0.61± 0.05	0.69 ± 0.50	0.72 ± 0.15
Ash (mg/l)	0.58 ± 0.28	0.66 ± 0.52	0.85 ± 0.51	1.92 ± 0.25	2.08 ± 0.10

* Average values with SEM (n= 5)

In the present investigation the amount of dissolved carbon dioxide showed an increasing trend. The relative concentrations of CO_2, HCO_3^-, and CO_3^{2-} of the carbonate system and the pH of water are closely linked. As pH increases, carbonate increases and bicarbonate and molecular CO_2 decrease. At the average pH of a water (pH 8.2), only about 1 % of total CO_2 is found as molecular CO_2, 90 % as HCO_3^-, and the rest as $CO_3^{'-}$ [19]. At any given pH, the concentrations of these species are set by total alkalinity. The replacement processes include atmospheric CO_2 influx via diffusion, respiration, fermentation and the slow hydration and dehydration reactions of dissolved CO_2 [20,21].

In the present study, the density of planktons increased with increasing supply of the substrate, sugarcane bagasse. Within aquatic ecosystem, changes in pH, alkalinity and dissolved oxygen are probably the strongest temporal signals [22]. Plankton species composition, numerical abundance, spatial distribution and total biomass are in a direct relation with the environmental factors. Actually, environmental and temporal changes determine the community present in water. Among the environmental factors are the nutrients availability and temperature and alkalinity. According to Wetzel [23], community structure and growth rates among species are likely to be limited by different resources, including differing nutrients. Therefore different species can survive on varying nutrient concentrations. The changes in the nutrient availability can lead to variations in plankton diversity and species composition in aquatic systems. Moreover elevated pH and dissolved oxygen level also favour the growth of planktons [24]. Furthermore, nutrient concentration level changes due to manuring or fertilizing the aquatic systems, affects the community structure of plankton in the system. The increase in nutrient concentrations leads to differences in plankton community structure. These factors, in addition to high temperatures and nutrient concentrations in water have enabled it to attain its characteristic plankton community structure. From all these studies it is confirmed that increase in the density of plankton may be due to nutrients present in sugarcane bagasse [25].

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