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EFFECT OF SUGARCANE BAGASSE AND SUPPLEMENTAL FEED ON NUTRITIONAL VALUE OF THE CATFISH *HETEROPNEUSTES FOSSILIS* (BLOCH)

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ABSTRACT

The proximate composition (Moisture, Protein and Lipids) and amino acid profile of the catfish *Heteropneustes fossilis* was determined to understand the effect of sugarcane bagasse substrate and supplemental feed for a period of 358 days. Adult *H. fossilis* (av.wt. 200g) were reared at 20 tanks $^{-1}$. No feed was provided to the fish in three of the substrates added tanks (T_1), while a pelleted diet was fed to the fish in the remaining three substrates added tanks (T_2) and the other three tanks without substrate (T_3). Finding showed that the proximate composition as well as the amino acid profile was more in feed + sugarcane bagasse (T_2) followed by supplemental feed alone group (T_3) and sugarcane bagasse alone group (T_1). In the present study the T_1 group showed a positive relationship in all the nutritional values. Hence, sugarcane bagasse can effectively be used as a substrate for the culture of the catfish *Heteropneustes fossilis.*

Keywords: Sugarcane bagasse, artificial substrate, nutritional value, protein, amino acid profile.

INTRODUCTION

In recent years a variety of nutrient carriers have been used for optimum growth of fish as well as overall productivity of fish culture (Brady,1991). When too much nutrient carriers (organic and inorganic) are used for fish culture, a substantial amount is lost through several ways and may become pollutants. Therefore, a large application of nutrient carriers may become hazardous to fish (Kumaraiah*et al.*, 1997). Although inorganic fertilizers and organic manure contain various essential elements, all of them are not necessary for fish growth, so need to be conserved and carefully managed (Brady, 1991). Organic substances such as plant materials, food scraps and paper products can be recycled using a biological process. 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 juice and currently used as a renewable resource in the manufacture of pulp, paper products and building materials. Sugarcane bagasse, a by-product of sugar industry is generated in large quantities which can be used as potential nutrients enriched resource for the growth of periphytons in fish ponds (Wahab *et al.*, 1999; Kesavanath *et al.*, 2001). Moreover, among protein sources available wastes are most important because they are available in plenty and are left unnoticed. The bioavailability and richness, the available nutrients from the wastes are to be evaluated.

Heteropneustes fossilis, commonly known as stinging catfish or singhi, is considered one of the most highly demanded freshwater air breathing fish species in the Indian subcontinent and Southeast Asian region. The fry and fingerlings of the Indian catfish are difficult to collect from natural water bodies. Such carnivorous species generally need a high protein diet and hence, their production is more expensive. The costs, however, depend largely on local availability and the price paid for the feed stuff. Most carnivorous species, therefore, command higher market prices and greater export value attracting substantial investments. Hardy species and can tolerate unfavourable conditions and have the advantage of better survival in relatively poor environmental conditions that may occur occasionally in cultural situations. The ability of *H. fossilis* to adapt to fresh and brackish waters with very low oxygen content and to grow under generally poor environmental conditions make these fish extremely valuable for small and large scale rural fish farming (Pillay, 2001). The present investigation is concerned with the effect of sugarcane bagasse as a substrate on the nutritional value of the catfish *Heteropneustes fossilis* (Bloch).

MATERIALS AND METHODS

Collection of fish and experimental setup: Irrespective of sex, healthy fingerlings of *H. fossilis* (av.wt. 3.12 ± 2g) were collected locally from a single population and confined to large cement tanks in the laboratory were used for the experiment. Nine 25 m^2 (5X5X1m) cement tanks with 15cm soil base (Dharmaraj *et al.*, 2002). Quicklime (0.25 kg) and poultry manure (2.5 kg) were added in all the tanks. The water was filled with the tanks from a perennial well maintain a depth of 90 ± 2 cm throughout the experiment. Subsequently, poultry manure (0.3 kg per tank) was applied every 15 days. Sugarcane bagasse, procured locally, was sun dried. Bundles were made using nylon rope and suspended into 6 of the 9 tanks randomly (5 kg in each), at regular distances from bamboo poles kept across the tanks. After 45 days, 1.25 kg of the substrate was again added in each tank. *H. fossilis* (20 per tank) were stocked two weeks after the addition of manure and substrate. No feed was provided in 3 of the substrate-added tanks (T_1), a pelleted diet (fish meal) was added in 3 substrate-added tanks (T_2) and the last 3 tanks had fish meal but no substrate (T_3) at 5% body weight of fish for the first 30 days and 2% thereafter, in two equal rations daily. After 358 days 10 fish (av.wt. 200 ± 2g) group were collected. All the fish were kept in running de-chlorinated tap water for two days for complete defecation of stomach contents, then slaughtered and dressed. The analysis was conducted on ventral, dorsal and tail white muscles of the fish's body.

Proximate analysis: Fillets were minced and freeze dried at -30°C. Duplicate fresh minced fish samples were immediately dried at 105°C in convection oven for 24 hours to determine moisture contents (AOAC,1995). Crude protein was determined by microkjeldahl method (AOAC,1995). The amino acids were analyzed by the Pico-Tag method (Bennett and Solomon, 1986) that involves protein hydrolysis (Ng *et al.*, 1987) and pre column derivatization of the amino acids followed by reverse phase HPLC (O'Hare *et al.*, 1987). Lipid fraction was extracted by the Bligh and Dyer method (Bligh and Dyer, 1959) as modified by Kates (1986).

Statistical analysis : The values obtained were subjected to standard statistical analysis by one –way analysis of variance (ANOVA) using the SPSS version 10.0 for windows on PC (Statistical Graphics Corp, US). Significant mean differences were noted at the 5% level (Steel *et al.*, 1997) where appropriate and values were expressed as means ± SE.

RESULTS

Moisture contents: When moisture contents of different experimental groups were compared, the substrate along with feed group (T_2) showed a higher value of 80.12%. In feed alone group (T_3), the value was 79.72% and substrate alone group (T_1) recorded 79.10%. All the values were statistically non significant (Figure 1).

Crude protein: The protein content of control group (T_3) was 17.62%. The protein content was maximum in substrate along with feed group (T_2) *i.e.* 17.92%. In substrate alone group (T_1), the value was 16.51% (Figure 1).

Lipid content: Lipid composition showed a different trend when compared to moisture and protein contents. The feed alone group (T_3) showed an increased value of 3.18%, followed by 3.16% in feed + substrate group (T_2) and substrate alone group (T_1). More details about the proximate composition were given in Figure 1.

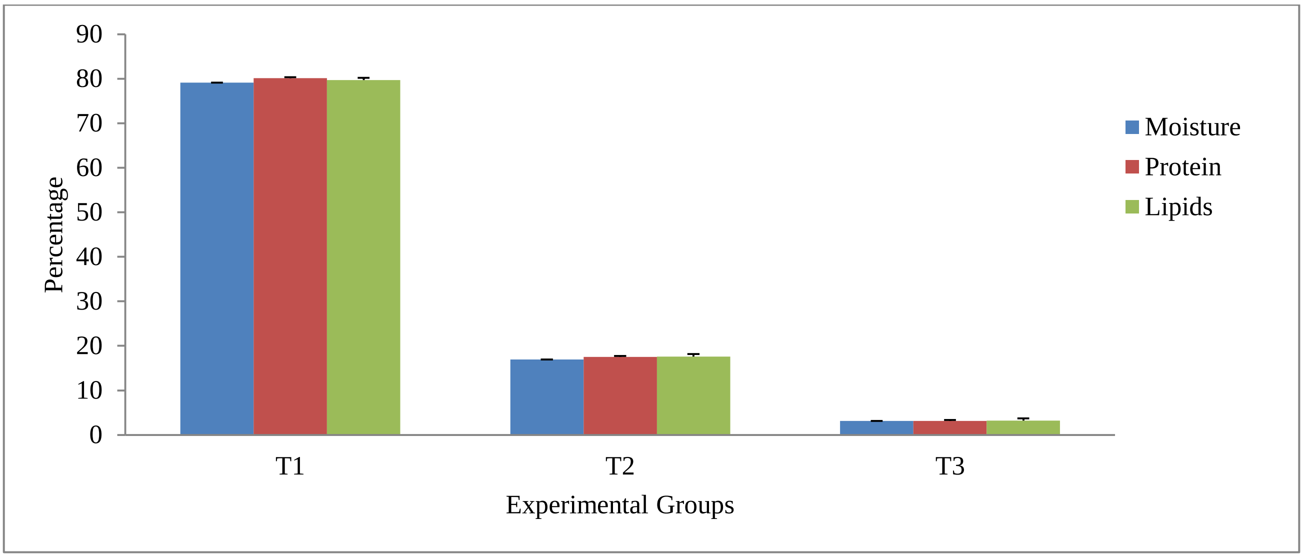

Figure 1. Showing the proximate composition of *Heteropneustes fossilis.*

Amino acid profile : The values of amino acids (feed + substrate) were more in T_2 group except histidine, followed by substrate free controls (T_3) . The substrate alone group (T_1) also showed a very close similarity with T_3 group. More details were given in Figure 2.

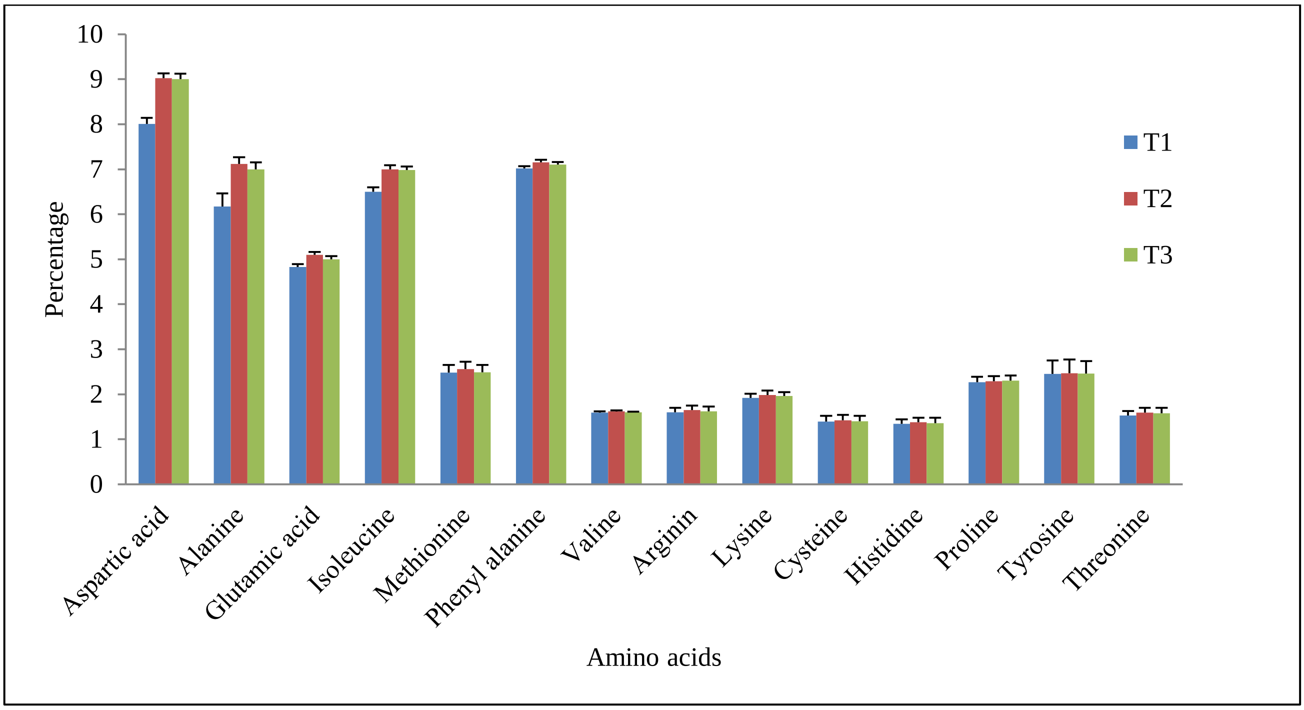

Figure 2. Showing the amino acid composition of *Heteropneustes fossilis.*

DISCUSSION

Despite the growth in the aquaculture sector, fish production still needs to be doubled to satisfy the minimum protein requirement for human consumption. Inland fisheries production is declining due to new constructions, over-fishing, irrigation and land reclamation for human settlement. These developments also cause siltation, soil erosion, and pollution from industrial and municipal wastes, and destruction of mangrove forests. There is, therefore, a strong need to develop aquaculture techniques that enhance fish production in closed water bodies. Fish are a good nutritional source of proteins, essential fatty acids and minerals. Societies with high fish intake have lower rates of acute myocardial infarctions and atherosclerosis, better cognitive functions, and better neural and visual development in foetuses. The importance of understanding the body composition of fish in relation to growth and reproduction has long been recognized. Proximate composition is used as an indicator of fish quality and varies with diet, feed rate, genetic strain and age (Austreng and Refstie, 1979). In the present study, the proximate composition analysis revealed high moisture content and low protein and fat content. The quantity of moisture, protein and lipid was higher in substrate and supplemental feed group (T_2). The substrate alone group (T_2) showed a close similarity in values with feed alone group (T_3). It reveals that substrates in natural aquatic systems support fish production (Welcomme, 1972; Ferguson and Rublee, 1976; Kirchman, 1987) and provide sites for the production of epiphytic microbes to be consequently eaten by fish as food. Primary bacterial colonization determines the final biomass of attached microorganisms a substrate can harbor. Microbial biofilm that develops on the submerged surface of a substrate, is comprised of complex communities of autotrophic and heterotrophic bacteria, protozoa, fungi and algae embedded in an extracellular polysaccharide matrix secreted by bacteria (Costerton and Irvin, 1981). Microbes play a major role in aquatic food chains by forming an important part of the diet of the consumption for fish (Moriarty, 1997). Fish harvested bacteria and protozoa occur in significant quantities as a microbial film on detritus or as naturally occurring flocks in the water column (Odum, 1970; Schroeder, 1978).

In the present investigation when nutritional components were compared, moisture and protein contents were more while lipids decreased. The lipids in fish vary greatly and this variation is related to feed intake, migratory swimming or sexual changes in connection with spawning (Oduor-Odote, and Kazungu, 2008). Lipids vary in different parts of fish body and also they show enormous variation in different seasons of the year. Recently, Asma and Ashraf (2010) found a linear relationship between protein and age/size of fish in three carnivorous fish species (*Wallaguattu*, *Mystus seenghala* and *Channa morulius*) but quite the inverse in lipids, because there was a proportionate decline in lipid with increase in size. Further the changes in moisture, protein and phosphorous are function of body weight (Asma and Ashraf, 2010; Ali *et al.*, 2006), while lipid content appears to be function of body weight and may be simultaneously affected by lipid contents of the diet (Javaid *et al.*, 1992).

When the amino acid profile was analyzed the concentrations were prominent in the catfish under investigation. This is due to the balanced diets gotten from a wide variety of plankton and can meet its amino acid requirements more comfortably. It appears that body composition of fish is a true reflection of their natural and artificial food. Further study is required to understand the mechanism of conversion, qualitative and quantitative synthesis and accumulation of excess protein than taking in the food with limitations in certain fish species. Moreover, body composition varies from species to species and from habitat to habitat. The variations recorded in the concentration of the different nutritional components in the fish examined could have been as a result of the rate in which these components are available in the water body (Yeannes and Almandos, 2003), and the ability of the fish to absorb and convert the essential nutrients from the diet or the water bodies where they live (Adewoye *et al.*, 2003). The high amount of non-polar amino acids with aliphatic side chains and amino acids with a sulfur group and those with an aromatic ring on the side chains is a good indicator of stability of protein in these fish. Amino acids with aromatic side chains are also highly hydrophobic. Non-polar amino acids are hydrophobic, that is, they have an aversion to water and like to cluster (Stryer, 1995), while SH-containing side chains are hydrophilic (soluble in water). The present work has elucidated the fish as a good source of protein. A majority of consumers does eat fish because of its availability, flavor and palatability, while few do so because of its nutritional value. Therefore, it can be suggested that taste, size, freshness and other related external appearances should not be the only factors to be considered in making a choice for marketing and consumption. Since the interest in commercial culture of fish has increased to fill the gaps between supply and demand, therefore, this information is useful in developing nutrient-balanced, cost-effective diets and practical feeds for cultured fish. The chemical composition could influence the post-harvest processing and storage and could assist in determining the suitability of the different species to specific processing and storage techniques. In the light of above biodegradable substrate appear to be better in terms of promoting bacterial biofilm formation and the biomass. Traditionally, farmers fertilize their ponds or apply a combination of fertilizers and feed. In periphyton-based system, attached algae, zooplankton and invertebrates easily colonize the substrate in the water column, on which fish can graze more efficiently than on planktonic food (Dempster *et al.,* 1993).

CONFLICT OF INTEREST STATEMENT

We declare that we have no conflict of interest.

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