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Biological Reprocessing Of Marine Waste

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ABSTRACT

The world consumption of marine food is about 1,234,332 tons in a week that leads to the production of marine food processing waste namely, fish scales, crab shells and prawn shells, fins, bones etc. These wastes pollute the environment by emanating bad odour due to the action of microorganisms. This paper deals with the biological reprocessing of marine waste by using them as a substrate for the production of commercially useful industrail enzymes like protease and amylase.

KEY WORDS: Amylase, Protease, Marine Waste, Biological Reprocessing.

1. INTRODUCTION

The management of waste either in the form of sustainability or biological reprocessing has paved way for a vast potential leading to the innovative fair utilization of waste. Hence resulting in the minimization of waste and thereby pollution. Waste can be classified into hazardous and non-hazardous waste. Though there are many methods to degrade these wastes, the cost of managing the waste as per the standards provided by the central pollution control board has caused a major economic impact on the industries or the organizations that generate the waste. Sustainability of waste deals with the utilization of waste within the industry or organization so that it does not pollute the environment. Biological reprocessing is a method of using microorganisms or plants to utilize the waste leading to the production of certain primary and secondary metabolites like industrial enzymes, tannins, phenolics, antibiotics etc. This can be a source of additional income to the industry thereby minimizing the amount spent for the management of the waste.

This paper deals with the biological reprocessing of marine waste. Crustaceans include animals such as crabs, prawns, crayfish, krill and barnacles. They possess an exoskeleton that molt while growing. About 10 million tons of crustaceans are produced for human consumption by fishery farming practices and the majority of it is shrimps and prawns.

Industrial enzymes are produced using a wide variety of substrates by different organisms. There has been a rise in the production of industrial enzymes in the last few decades. The industrial enzyme market has risen to nearly 85 enzymes, which are currently in commercial production. Enzymes are used in the food, dairy, pharmaceutical, and textile industries and are produced in large amounts by microbes. The free proteases are used in dry cleaning, cosmetics, detergents, pharmaceuticals, meat processing, cheese making, silver recovery from photographic film, etc,. Plants, animals and microbes are used for its production, though microbes serve as the preferred source due to their faster growth, limited space and the ease in genetic manipulation to generate new enzymes with altered properties.

Although bacterial alkaline proteases such as subtilisin Carlsberg, subtilisin BPN and Savinase are commercially available, in the form of detergents enzymes, fungal alkaline proteases offer an advantage over bacterial proteases due to the following parameters (i) ease of removal of the mycelium from the final product by simple filtration, (ii) fungal growth on cheaper substrate, (iii) immobilization of mycelium for repeated use, (iv) stable at broad range of pH and (v) wide substrate specificity resulting in low cost of production. There is an increasing demand to exploit fungal proteases in detergent industry as not much work has been done on that.

Very few microorganisms are recognized as commercial producers of industrial enzymes. Additional sources for the large scale production of these enzymes have to be explored to meet the market needs. Moreover out of the 100 million tons of marine products harvested annually worldwide, about half of the total catch is discarded as food processing waste. In the present study the marine waste was used as substrate to isolate and purify amylase and protease using *A. niger*.

2. MATERIALS AND METHODS

Test organism: *A. niger* wild type strain was used to produce proteases and amylase using marine waste as substrate. It was plated on potato dextrose agar and the pure culture was stored at 4ºC.

Figure.1. Crab shell waste

Figure.2. Prawn shell waste

Figure.3. Fish scale waste

Processing of marine waste: Marine waste namely, fish scales, crab shells and prawn shells (Fig. 1, 2 and 3) were collected from Tambaram market, washed and dried for 4 h at 100°C in an oven. The wastes (1g) were steamed for 30 min to denature the collagen thereby increasing moisture uptake. It was later dried and then powdered and stored. Powdered marine waste (5 g) was used as substrate for SSF.

Medium and culture conditions: The SSF was carried out in sterile 150 ml conical flasks. About 5 g of powdered marine waste was taken and in each of the flasks and 1 ml of 10 %TCA was added in all the flasks to moisten the powder and also to serve as a buffer. About 2 ml of 10 % TCA was used to elute the enzyme. The enzyme activity was recorded starting from the 5th day.

Enzyme Assay: On the fifth day of fermentation, the mycelium was separated from the media by filtering using Whatman No. 1 filter paper and about 0.5 ml of 1:10 diluted clear filtrate was used to determine protease and amylase activity. The protease activity was determined at 660 nm using casein as substrate. The amylase activity was determined at 620 nm using starch as substrate.

3. RESULTS AND DISCUSSION

In the present study protease and amylase activity was determined using SSF using marine waste as the substrate. The results of protease and amylase activity are tabulated in Tables 1 and 2. The set up for SSF is shown in Fig 4.

Figure.4. Solid state fermentation set up

The enzyme activity was measured spectrophotometric ally at 660 nm for protease and at 620 nm for amylase. Among the three marine wastes, fish scales showed more protease activity when compared to the other two wastes.

Table.1. Protease activity

Samples	Enzyme activity (units/mg of protein)
Prawn	0.923
Crab	0.705
Fish scale	2.496

Table.2. Amylase activity

Sample	Enzyme activity (units/mg of protein)
Prawn	0.261
Crab	1.5672

The amylase activity was more in crab shell than in prawn shell. Thus the marine wastes are a good source of industrial enzymes of commercial value and can be harnessed for the mass production of these enzymes.

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