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Improving Sustainability Concept in Developing Countries

Utilization of Palm Wastes for Production of Invert Sugar

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Abstract

An economically attractive technique was adopted using date palm fibers as a new carrier for invertase adsorption and for invert sugar production. Experiments were carried out to evaluate the results of incubation of Baker's yeast with palm fibers in aqueous solution at 40 ° C for half an hour. CO2 produced from this reaction was employed as a reactant and it succeeded to modify the cellulosic surface of the palm fibers. This increased the capacity of invertase that had been secreted from Baker's yeast to be immobilized tightly on the cellulosic surface of the fibers. These results confirmed by FTIR and SEM. Characterization of the enzyme indicated that 1 gram of immobilized invertase on such wastes can produce 600 mg of invert sugar. By this technique, Egypt would be able to supply 6 million kg invert sugar per year. Molasses used instead of sucrose to assess the sustainability of the process.

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Keywords: invertase;Palm; Fibers; Invert sugar; molass; Immobilization

1. Introduction

Date Palm tree has been widely cultivated for its fruits. It is a main fruit crop in some Arab countries. The Arab world is characterized by about 70 percent of the 120 million trees in the world according to the Conference of the Arab palm and dates for 2011. They are responsible for 67% of the global date production. Date Palm economic life is at about 25-30 years. The quantity and quality of the fruit are directly dependent on the leaves which should be

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pruned. After old leaves begin to die, turn brown and hang with no longer value on the trunk of the palm, dead leaves should be cut, and removed [1]. Date palm produces different types of by-products, leaf fibers, bast fibers, wood fibers and surface fibers [2].The production of these by-products fibers is to some extent more important than the crop itself. They can be considered as a large source of income if they were utilized. About 12–15 new leaves are formed every year that can be removed as part of the maintenance of the palm ,[3] reported that each tree produces 34 Kg residues annually which 7% of them are sheath that equal to 3 Kg of fibrous sheath are produced by each tree yearly. In Egypt, there are about 10 million palm trees that make the utilization of by-products of date palm as raw material source for industrial purposes promising issues. Utilization of palm industry waste, in the environmental technology field is still limited but they deserve special attention due to their high adsorptive capability as they are source of natural cellulose. In this study and at the request of date palm industry in Egypt, an economically attractive technique was adopted using date palm fibers as a new carrier for invertase adsorption and for invert sugar production. As far as the author aware, few studies only deals with fibers obtained from date palm trees. As most of studies deal with: the utilization of these fibers for reinforcing composites [4, 5& 6], for water treatment as eco-friendly flocculants or filters [7&8] and for studying the comparison of different date palm fibers. It is therefore, considered useful, at present study, to carry out a research on the possibility of using palm residues of date palm tree for invertase immobilization. Invertase (EC 3.2.1.26) is an important enzyme in the food industry due to low cost, good stability and high specific activity. Invertase is usually derived from Baker's yeast.

Baker’s yeast is an economically attractive biocatalyst because of its available and cost effective and safety for food and pharmaceutical industries. It is important to mention that reactions carried out in the presence of baker’s yeast are fit within the concept of green chemistry Invertase catalyzes the hydrolysis of sucrose into (invert sugar) a mixture of glucose and fructose [9]. Invert sugar has a lower crystallinity than sucrose, which is important in the food industry due to the products remain fresh and soft for a long time [10].

2. Materials and Methods

1.1. Materials

Investigated fibers are collected from Upper Egypt date palm tree. These fibers were chosen due to their abundance in Egypt. The source of these fibers is the foliage of the palm tree in particular from the leaf sheath. Sodium acetate was obtained from Fluka. Sucrose was obtained from Merck. Baker's yeast was obtained from Egyptian Integrated Company for Sugar.

2.2. *Methods*

2.2.1. Treatment of palm fibers and Immobilization of Invertase

The fibers used are collected and were cut into small particles. Fibers were then activated by incubation in microwave, autoclave or hot water for 15 minute. Then washed with distilled water and dried at room temperature in air. The fibers were observed using a Scanning Electron Microscope (SEM) to characterize the morphology of treated and untreated fibers and analyzed by FTIR to prove the modification. Immobilization of invertase on palm fibers was achieved by suspending 1g of dry yeast in 50 ml of distilled water and stirring the mixture for 2 min .Then the solution was incubated with 1 g of palm fibers at 40 ˚C in a rotary shaker for half an hour. Complete removal of yeast is required by repeated wash for several times.

2.2.3. Assay of Invertase

The immobilized invertase was assayed in 1 ml reaction volume containing 0.1 g immobilized enzyme and 1 ml of 100 mM sucrose in0.1 M sodium acetate buffer (pH 5.2). The amount of reducing sugars in the supernatant was estimated with Somogyi reagent.