Process development for citric acid production from sisal waste
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Process development for citric acid production from sisal bole juice was taken as a study on wider utilization of a sisal plant. The study based on establishing optimum conditions for inulin hydrolysis and parameters suitable for citric acid production from sisal bole juice by fermentation process. Before hydrolysis, sisal bole juice extract containing inulin was analysed for physical and chemical properties. The juice was found to have physical and chemical properties as indicated in Tables: 3.1 and 3.2 respectively. The mineral composition may vary depending on the soils where the sisal is grown. Sisal bole inulin was chemically hydrolysed using concentrated hydrochloric acid (36%w/w). Hydrolysis temperatures ranged from 60°C — 100°C, reaction time 0 — 60 minutes and pH 0.5 - 3.0. Inulin hydrolysis showed a maximum fructose yield of 116.52g/l at around pH range of 1.0 - 2.0, hydrolysis temperature of 100°C and reaction time of 50 minutes. The fructose yield of 116.52g/l corresponds to 92.5% conversion of sisal bole juice inulin into fructose, which compares well with that of 95% conversion achieved in commercial inulin hydrolysis by Zeolite LZ-M-8. A significant decrease in fructose yield was noted at pH less than 1.0 and pH greater than 2.0. Batch fermentations were carried out aerobically by incubating the cultured media into 300ml flasks for 23 days. Aspergillus Nigger strain was used to evaluate the effects of initial sugar concentration of 60g/l - 150g/l, Nitrogen and Phosphorous sources ranging from 0.1g/l - 3.0g/l and 1.0g/l - 3.0g/l respectively on citric acid yield. Ammonium Sulphate and Potassium di-hydrogen Phosphate were used as nitrogen and phosphorous sources. All experiments showed Aspergillus Nigger strain need high initial sugar concentration ranging from 90g/l - 150g/l in the medium to induce citric acid accumulation. This may be probably due to the dependence of Aspergillus Nigger to literally overfeed themselves before they start releasing the citric acid. In all experiments high yield of citric acid happened around day 17 for all initial sugar concentration of 60g/l - 150g/l, nitrogen and phosphorous supplements ranging from 0.1g/l - 3.0g/l and 1.0g/l - 3.0g/l. Citric acid yield increased with increase in initial sugar concentration from 60g/l - 120g/l where maximum citric acid yield of 83.65g/l was noted at 120g/l and thereafter a decrease in citric acid yield 73.14g/l happened at initial sugar concentration 150g/l, at too high sugar concentrations, the microbes might have difficulties to grow well. Batch B4 had same N/P sources concentration range as for Bl, B2 and B3, with constant initial pH 5.5 and initial sugar concentration of 120g/l. B4 results showed maximum citric acid yield of 80.88g/l at N/P sources concentration of 2.5/1.5(g/l). The N/P sources concentration in B4 were almost similar to Bl (3.0/1.5) with citric acid yield of 83.65g/l. The N/P concentration results indicated that N source to P source ratio by around 1 or 2 lead to better citric acid yield. The effect of pH in all experiments was noted at low initial pH. Bl with initial pH 5.5 showed maximum citric acid yield 83.65g/l as compared to maximum citric acid yield 42.67g/1 at initial pH 2.0 that being 49.0 % decrease in citric acid yield.