Production of N-acetylglucosamine by Chitinibacter tainanensis

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ABSTRACT

N-acetylglucosamine has been used as a treatment for osteoarthritis, inflammatory bowel diseases and as an enhancer of skin moisture. N-acetylglucosamine has also become a popular research topic in the area of food processing and medical applications. Current methods for producing N-acetylglucosamine have advantages and drawbacks. In this study, N-acetyl-glucosamine was produced in a two-stage culture of Chitinibacter tainanensis. In the first stage, the medium glucose concentration was increased to create a high cell density. In the second stage, the medium pH was controlled to increase the productivity of N-acetylglucosamine. To investigate the effect of glucose concentration on the biomass, Chitinibacter tainanensis was cultivated in media with various glucose concentrations. The highest biomass production was obtained when Chitinibacter tainanensis was cultivated in a 0.3% glucose medium. In this case, the microbe was first cultivated in the 0.3% glucose medium, and 8 h later was transferred to a Bushnell-Hass broth containing 2% chitin, the reducing sugars (mainly N-acetylglucosamine) had a maximum productivity of 14.7 g/L after 96 h of incubation. The highest chitinase activity was 725.3 U/L after 72 h of incubation; the N-acetyl-glucosamine production was the highest (15.8 g/L) at 144 h, and the conversion rate from chitin into N-acetyl-glucosamine was 79.0%. To investigate the effect of glucose concentration on the biomass, Chitinibacter tainanensis was cultivated in media containing various glucose concentrations. The result showed that the medium containing 2.5% glucose yielded the highest biomass, and therefore, the first stage culture contained 2.5% glucose as a carbon source. When Chitinibacter tainanensis was cultivated in a two-stage process in a fermenter, minor modifications were made, such as a set pH of 7 and use of a modified BH-1 medium containing 2.5% glucose. With this process, the maximum biomass (2.42 g/L) was attained at 24 h. In the second stage, the culture was transferred to a modified medium containing 2% chitin (designated as Medium BH-2). At 96 h, the biomass, reducing sugars and chitinase activity reached their maximums of 1.99 g/L, 16.1 g/L, and 800.3 U/L, respectively. During cultivation of Chitinibacter tainanensis, chitin was hydrolyzed into N-acetylglucosamine with a maximum production of 15.6 g/L at 72 h, and a chitin conversion rate of 77.8%. When Chitinibacter tainanensis was cultivated in a two-stage culture, the first stage culture was transferred into the second stage with a modified BH-2 medium after 24 h. Tthe pH in the culture was not regulated at this stage and fell rapidly from 7.0 to 5.31 by the 48 h. Maximum chitinase activity (710 U/L) was reached at 72 h, and the reducing sugars reached maximum concentration (16.7 g/L) at 96 h. The production of N-acetylglucosamine in the second stage was highest (16.1 g/L) at 120 h, and the chitin conversion rate was 80.1%. When the chitin concentration was raised to 4%, Chitinibacter tainansnsis was cultivated using a two-stage fermentation with no pH control in the second stage. The maximum concentrations of reducing sugars (33.7 g/L) and biomass (2.47 g/L) were both achieved at 120 h. The chitinase activity reached the highest (650.0 U/L) at 72 h. N-acetyl-glucosamine production was highest (31.2 g/L) at 96 h, when the chitin conversion rate was 78.0%.

Keywords : N-acetylglucosamine ; Chitinibacter tainanensis ; two-stage culture

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