

Batch and Fed-Batch Production of Betalains by Red Beet (*Beta vulgaris*) Hairy Roots in a Bubble Column Reactor

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Z. Naturforsch. **62c**, 439–446 (2007); received March 12, 2007

Hairy root cultures from red beet (*Beta vulgaris* L.), which could be used for the commercial production of biologically active betalain pigments, were cultivated in a 3 L bubble column bioreactor in batch mode with various rates of air supply. Both the growth of the roots and betalain volumetric yields were highest (12.7 g accumulated dry biomass/L and 330.5 mg/L, respectively) with a 10 L/h (0.083 vvm) air supply. The air flow rate also influenced the betacyanins/betaxanthins ratios in the cultures. Growth and betalains production were then examined in two fed-batch regimes (with a 10 L/h air supply), in which nutrient medium was fed just once or on five occasions, designated FBI and FBII, respectively. The root mass accumulation was increased in the FBI feeding regime (to 13.3 g accumulated dry biomass/L), while in FBII the betalains content was ca. 11% higher (15.1 mg betacyanins/g dry weight and 14.0 mg betaxanthins/g dry weight) than in the most productive batch regime. Data on the time course of the utilization of major components in the medium during both operational modes were also collected. The implications of the information acquired are discussed, and the performance of the hairy roots (in terms of both growth and betalains production) in the bubble column reactor and previously investigated cultivation systems is compared.

Key words: Betalains, *Beta vulgaris*, Bubble Column Bioreactor, Hairy Roots