INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: LUTEIN PRODUCTION BY CHLORELLA VULGARIS USING POULTRY LITTER ANAEROBIC DIGESTATE AND ITS POTENTIAL APPLICATIONS

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SHORT ABSTRACT

Lutein is an alpha carotenoid, and it is used as an antioxidant, colouring agent, and for treating age related macular degeneration. Lutein is currently produced from petals of marigold grown on agricultural land. Production and harvest of marigold flowers involves huge amount of land, man power and fresh water. Besides, utilization of fertilizers, and pesticides for its cultivation are drawbacks of lutein production from marigold flower petals. This study aimed to produce lutein from marine microalgae using anaerobic digestate and explore its potential applications. Four different halophilic microalgae strains, namely *Chlorella vulgaris* 92001, *Chlorella vulgaris* 52091, *Chlorella vulgaris* 10241 and *Tetraselmis indica*, and three different synthetic anaerobic digestate (municipal, dairy litter and poultry litter) were evaluated for lutein production. Lutein production was high using diluted poultry digestate for *Chlorella vulgaris* 92001 as compared to the other microalgal strains. Parameters involved in lutein production where screened and optimized using Plackett-Burman screening design and response surface methodology. Maximum amount of lutein obtained was 3.412 mg/L in the optimised condition, i.e. 22.12 dilution factor, 27 g/L, NaCl, 4.5 g/L $NaHCO_3$ and 4.82×10^9 cells/L inoculum size. Kinetics of substrate utilization ($NaHCO_3$ and CH_3COONa), biomass growth and lutein production by *C. vulgaris* was studied and evaluated using different bio kinetic models. Lutein production by *C. vulgaris* 92001 was carried out in indigenously designed and fabricated split column and continuously stirred tank photobioreactor. In the batch mode operation, maximum biomass growth of 0.96 g/L and lutein production of 4.379 mg/L was attained at 336 h for split column photobioreactor. The lutein production in the continuously stirred tank photobioreactor was however lower as compared to that using the split column photobioreactor. Downstream processing strategies, namely electrocoagulation flocculation (ECF), sonication and nanofiltration were employed for cell separation, cell disruption and lutein purification, respectively. Cytotoxicity and insecticidal activity of the lutein was established against SF9 cell line and armyworm. Lutein enhancement in egg yolk was finally demonstrated by supplementing lutein, lutein ester and microalgae at different concentrations (75 to 450 mg/kg) in the basal diet of hen. Lutein content of the eggs increased significantly ($p<0.001$) with the increase in lutein concentration with lutein, lutein ester and microalgae containing basal diet. Increase in egg yolk colour was observed in all the diets for different lutein concentrations.