Optimisation of supercritical fluid extraction of astaxanthin from Penaeus monodon waste using ethanol-modified carbon dioxide

ABSTRACT

Some studies demonstrated that astaxanthin surpasses the antioxidant benefits of beta-carotene, zeaxanthin, canthaxanthin, vitamin C, and vitamin E. Penaeus monodon (Tiger shrimp) is one of the most valuable traded crustacean products in which astaxanthin can be found in its by-products. The extraction of thermolabile compound like carotenoids at lower temperatures through supercritical carbon dioxide (SC-CO2) can reduce the potential isomerization and degradation of the extraction product. In this study, astaxanthin had been extracted using SC-CO2 with 15% (v/v) ethanol as an entrainer and the recovered astaxanthin was analyzed using High performance liquid chromatography (HPLC). A central composite design (CCD) was employed to study the effect of three SC-CO2 parameters namely temperature (X1) from 40 to 80°C, pressure (X2) from 150 to 250 bar and extraction flow rate (X3) from 1 to 3 ml/min on the astaxanthin complex yield, (Y1) and free astaxanthin content, (Y2). The nonlinear regression equations were significantly ($p<0.05$) fitted for both responses with high R2 (>0.9261), which had no indication of lack of fit. The results indicated that a combined set of values of temperature (56.88°C), pressure (215.68 bar) and extraction flow rate (1.89 ml/min) was predicted to provide the optimum region in terms of astaxanthin complex yield, (58.50 ± 2.62 μg/g) and free astaxanthin content (12.20 ± 4.16 μg/g) studied.

Keyword: Penaeus monodon; Astaxanthin; Carotenoids; SFE; Optimization; HPLC