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Development of a cost effective microwave extraction process to assess the factor-response relationship buried in the experimental data collected from the extraction process of potent bioactives by soft computing technique

Anup Kumar Das[1], Vivekananda Mandal[2] and Subhash C. Mandal[1]
[1]Jadavpur University, India
[2]Guru Ghasidas Central University, India

Objective: (1) To device a mathematical model for the microwave extraction parameters for an optimized bio-active marker yield(s).

(2) To validate the model using R^2 (regression coefficient) values.

(3) To optimize the extraction process by using fractional factorial design to evaluate the factor-response relationship.

Methods: Extractions were carried out based on the results obtained from preliminary experimental trials using absolute ethanol with Microwave power range (60-80 % W of 700 W), Radiation time (2-6 min) and loading ratio (15:1-25:1 ml/g). A three level-three factor Box-Behnken design of experiment was followed to obtain the optimized yield of a potent bio-active triterpene for the studied parameters. The independent variables (i.e the factors) were transformed into a range between -1 and 1 for the related factors with three levels of design (-1, 0, +1) with equally spaced intervals between them (software generated).

Result: The factors microwave power, radiation time and loading ratio were subjected to a second order polynomial equation to determine their effects on the overall marker yield. The optimum conditions for these three factors were obtained from the contour and 3D surface plots and concurrently extraction trials were carried out to cross-validate their predictability about yield by slightly altering the optimized conditions to suite laboratory limitations. The optimal conditions were microwave power of 65.67 (%) W, extraction time of 4.27 min and solvent-sample/loading ratio of 21.33 mL/g. Confirmation trials under the optimal conditions gave an experimental yield (18.52 μg/g of dry leaves) close to the RSM predicted value of 18.71 μg/g.

Conclusion: Under the optimal conditions the mathematical model was found to be well fitted with the experimental data. MAE was found to be more rapid, convenient and appropriate extraction method with a higher yield and lower solvent consumption when compared with conventional extraction techniques.

Keywords: Microwave extraction, soft computing technique, Triterpene.

anup.das82@gmail.com