Thesis title: "Preparation of Curcuminiods Enriched Powder from Turmeric (*Curcuma longa* L.) Rhizome and its Efficacy as a Natural Antioxidant"
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Abstract: Curcuminoids are natural antioxidants present in turmeric (*Curcuma longa* L.) rhizomes. The present study was focused on solvent (acetone) extraction of oleoresin from dried turmeric powder using Soxhlet extractor followed by separation of curcuminoids from oleoresin by subsequent hexane and water washing; the residue was dried to yield curcuminoid enriched powder. Experiment was conducted to test the efficacy of curcuminoid enriched powder to act as an antioxidant in sunflower oil.

Fresh turmeric rhizomes (85.8 ± 2% moisture content, MC), both peeled and unpeeled were dried under sun (39.6 ± 1.35 ℃, 87.1 ± 2.88% RH), in hot air oven dryer (60 °C) and microwave-convective dryer (60 °C, 2.45 GHz, 1.5 kW). The maximum retention of curcumin was observed in microwave-convective dried samples with 10 ± 2.07% MC. Pertaining to extraction of oleoresin, equilibrium-time was determined by studying extraction kinetics; first order kinetic model was found to be the best-fit representing extraction kinetics. To optimize parameters of extraction process, response surface methodology was used; the independent variables were: temperature, solvent-to-solid ratio and particle size; dependent variable was: yield of oleoresin, curcumin and total phenolic content. Optimized results were temperature: 50℃, solvent-to-solid ratio: 21:1 (w/w) and particle size: 0.24 mm. A systematic study of stirred batch extraction under equilibrium was conducted to develop the Equilibrium-Distribution-Relationship (EDR) between oleoresin concentration in miscella (solvent+oleoresin) and residual oleoresin concentration in marc (de-oiled rhizome); EDR was found to follow a linear relationship with high coefficient of determination. Oleoresin is a viscous, oily substance, brown red in color and consists of curcuminoids, oils, resins, polysaccharides and other unwanted components. Oleoresin was washed with hexane to remove the oil at 70 °C in 4 stages – yielding crude curcuminoids powder as residue which was then washed with hot water, to remove polysaccharides and other unwanted components, for 2 h at 100 °C to yield curcuminoids-enriched powder (CEP); curcuminoid-content in oleoresin was found to be 43.13% and that in curcuminoids-enriched powder (CEP) 76.63%. Analysis was carried out to identify the optimum time and solvent-to-solid ratio in each stage. The CEP was characterized by employing tandem mass spectrometry (MS/MS) at m/z 367, 337 and 307. It was free of hexane residues and residual acetone level was below permissible limit (6.8-7.2 ppm). The CEP also showed α–amylase inhibitory, α–glucosidase inhibitory and radical scavenging activity with IC_{50} values of 1.77, 3.47 and 11.42 µg/mL respectively. Food borne pathogens *E. coli* and *S. aureus* showed susceptibility towards CEP with a minimum inhibitory concentration of 125 and 250 µg/mL, respectively. Sunflower oil samples containing CEP at different concentrations (100, 200, 300, 400 and 500 ppm) along with 2% w/w kalonji (*Nigella sativa* L.) extract showed higher oxidative stability compared to control sample (without any added antioxidant). Addition of 500 ppm CEP with 2 % kalonji extract in sunflower oil provided oxidative stability upto 30 days at 27 ℃, 15 days at 45 °C and 8 days at 60 °C, respectively. Rapid, non-destructive FT-NIR spectroscopic method was cross validated for the estimation of curcumin in sunflower oil using PLS regression analysis.
Keywords: Curcuma longa, curcuminoids, Soxhlet extraction, oleoresin, equilibrium, kalonji, response surface methodology, kinetics, FT-NIR spectroscopy