ABSTRACT

Garlic (*Allium sativum* L.) belongs to the *Liliaceae* family and it is a common food spice used widely in many parts of the world. It has also been used quite extensively as a popular remedy for various ailments and psychological disorders. Garlic oleoresin has a dark brown colour of intense garlic odour and repugnant taste. It represents the complete flavour profile of the spice. In spite of the many advantages over ground spices, the sensitivity to light, heat, and oxygen is a disadvantage which can be overcome by microencapsulation. Hence, microencapsulation of garlic oleoresin using maltodextrin as a wall material by spray drying technology is investigated in this research work following experimental treatments designed in Design Expert 8.0.7.1 software package using response surface methodology.

The physico-chemical properties of raw materials were determined using standard methods. The emulsions were prepared using 40, 50 and 60% maltodextrin concentrations with 10, 20 and 30% of garlic oleoresin concentrations as independent parameters for the experimental runs derived from two factors at three levels central composite response surface design. The dependent parameters of the emulsion characteristics such as pH, total soluble solids, stability index and viscosity were determined and the ranges varied from 3.67 to 4.35, 37.4 to 58.2°Brix, 0.50 to 0.85 and 13.8 to 78.5 cP, respectively. Besides, the emulsion colour value was measured using Hunter lab colorQuest which observed that the Hunter “L” value and Hunter “a” value increased with increase in maltodextrin concentration and garlic oleoresin concentration.
correspondingly. The emulsion characteristics were analyzed statistically which inferred that a quadratic polynomial model was significant and sufficient to represent the actual relationship between the independent and dependent parameters. Based on the low p value (<0.0001) and high coefficient of determination (above 0.90) in the emulsion study, this research work was further carried out to the encapsulation process.

Seventeen experimental runs including 5 centre points were obtained using three factors and three levels of Box-Behnken design (garlic oleoresin concentrations, 10, 20 and 30%; maltodextrin concentrations, 40, 50 and 60% and drying inlet air temperatures, 180, 200 and 220°C) to carry out the encapsulation process of garlic oleoresin. The emulsions prepared were spray dried in a laboratory model tall type spray dryer which has water evaporation capacity of 3 l h⁻¹ with 0.7 mm diameter nozzle. The pressure of compressed air flow of the spray was adjusted to 350 kPa. The outlet temperature was maintained at 96±2°C. The resultant microencapsulated garlic oleoresin powder was packaged in self-sealing aluminium foil pouches and stored in a desiccator containing calcium chloride to prevent moisture absorption until further analyses. The dependent parameters of the encapsulated powder characteristics such as bulk density, moisture content, redispersion time, water activity, Hunter “L” value, Hunter “a” value, encapsulation efficiency and allicin content were determined and their ranges varied from 0.315 to 0.505 g cm⁻³, 2.07 to 5.82% d.b.; 34.9 to 47.6 s; 0.197 to 0.511; 54.29 to 72.77; 5.55 to 6.94, 64.7 to 82.1% and 75.3 to 94.21%, in that order. The relationships between the independent and dependent parameters were represented using response surface and contour plots. A second order polynomial regression model
showed good fit of the experimental data with high coefficient of determination along with predicted values. The adequacy of model summary indicates that the quadratic model is found to be the most suitable model for the present encapsulation process. The data points on the diagnostic plot lie reasonably close to the straight line and indicated that an adequate agreement between real data and the data obtained from the developed models. Based on Derringer’s desired function methodology, the optimum conditions obtained for microencapsulation of garlic oleoresin was found to be 10% garlic oleoresin concentration as core material, 60% maltodextrin concentration as wall material and drying inlet air temperature of 200°C with overall desirability value of 0.819. The optimized conditions were validated experimentally and the mean value of the triplicate measurements for all the quality analyses were compared with the predicted values obtained from the second order polynomial model to calculate error percentage which varied from -0.337 to 1.145%. This indicates that it could be effectively used for microencapsulation of garlic oleoresin by spray drying technology. Total ash content, 1.05±0.2% ; pH, 3.84 ±0.01; total antioxidant activity by DPPH radical scavenging activity, 62.8±0.3% and water solubility index, 33.2±0.1% were recorded for optimally produced microencapsulated garlic oleoresin powder. The microstructural characteristics were observed to be 10.67 to 35.42 µm size, smooth, spherical shape and without dents which indicates good encapsulation efficiency and retention of active compounds. Sensory evaluation by triangular test for garlic flavoured hung-curd was conducted to assess the quality of microencapsulated garlic oleoresin powder and the results indicated that 90% of the panel member thought the sample which
incorporated the raw garlic extract was the odd one out. This result proved that microencapsulation technique has been used not only to retain the active compounds, but also to mask the original core (pungency of garlic) taste. The cost of production of microencapsulated garlic oleoresin powder was estimated to be Rs. 852/kg.