In this paper, Taguchi method is applied to optimize ultrasound thermal process for extracting caffeine and flavor from coffee. The use of ultrasound can abridge experiments in cost, energy loss and time; the different operating conditions for extraction experiments are executed and the results are also compared. The results show that the best design factors for caffeine are 95 °C of extraction temperature, 28 kHz of operating frequency and 30 s of extraction time. The proposed optimized extraction method is efficient and energy-saving compared with the general process for making coffee.

Key words: energy-saving, Taguchi, ultrasound, coffee

Introduction

Traditional experimental design focused on the design of the factors; as long as the control factor increases, however, it often leads to the increment of the numbers of the experiments as well as the complexity of the process, however, lots of experimental factors can be simplified or removed by The Taguchi method, which is applied to decrease the numbers of experiments by using orthogonal table: firstly, select the experimental variables, secondly, determine the level of each variable, and finally, solve the analysis of variance [1]. It focuses on how to decrease the variability of experimental results, so as to find out the best combination of parameters in accordance with the beneficial results of cost [2, 3].

Ultrasonic extraction is the way of using the powerful energy which is produced by the burst of the bubbles-produced by the change of the pressure when ultrasound is in the liquid-to accelerate the contact speed of the solvent and the extract. The main feature of the approach is that it can rapidly and evenly blend the extract and the solvent; in the process of extracting useful constituents from the natural substances, it can bring the extract from the matrix to the solvent without damaging the structure of the extract [4, 5].