National Institute of Technology Rourkela

Progress Seminar

Seminar Title	: Development of In-pack Microwave Pasteurization Process for Hot Spice Blend (Garam Masala)
Speaker	: Chinglen Leishangthem (Rollno : 519fp1002)
Supervisor	: Parag Prakash Sutar
Venue	: CH 113
Date and Time	: 22 Aug 2025 (05:00 PM)

Abstract : *Garam Masala* is a mixture of ground spices commonly used in Indian and some Asian cuisines and generally has a high microbial load and relatively higher moisture content (10-12 % wb). The product having such high moisture content is not shelf-stable for longer durations due to its vulnerability to microbial growth. Pasteurization of *Garam Masala* can eliminate the risk of microbial growth and minimize cross-contamination. In this research work, the thermal stability, quality and microbial reduction in *Garam Masala* were studied by applying high-power microwaves (10-20 Wg^{-1}) for short times (60-70 s) and low-power microwaves (3 Wg^{-1}) for relatively longer times (4.7-6.4 min), followed by UV-C exposure for 10 min. In the high power process, the *Garam Masala* in bulk condition was subjected to three different levels of microwave power densities of 10, 15, and 20 Wg^{-1}. This process exhibited a significant reduction in moisture content, the total aerobic mesophilic bacterial count (2.79 log) and *Bacillus cereus* (1.83 log). Total phenolic content, total flavonoid content, and antioxidant capacity were significantly enhanced in *Garam Masala* during microwave treatment, but the rise in the product temperature was very fast, resulting in charring through hot spots after 60 s. During low-power microwave heating, the *Garam Masala* at different initial moisture contents was packed in polyethylene terephthalate (PET) bottles, and exposed to microwaves at 3 Wg^{-1} in continuous as well as pulsation mode until the target temperatures of 85°C, 95°C and 105°C were achieved. The temperature profiles indicated that vapour generation and operation in pulsation mode during the microwave treatment improved the overall heating uniformity. After the microwave heating experiments, the PET bottles were immediately cooled in a UV-C chamber. The combination of microwave and UV-C showed a log reduction of 1.85 to 5.51 in *S. enterica*, and 2.34 to 5.56 in *B. cereus*. During the UV-C treatment period of 10 min, a log reduction of 0.28 to 0.69 in *S. enterica* and 0.26 to 0.80 in *B. cereus* was achieved. The log-linear and Weibull models were fitted to microbial reduction data, and it was found that lower moisture content of the product and lower temperature result in larger decimal reduction values. The Weibull model was found to be the best-fitted model. The total phenolic contents and antioxidant activity in *Garam Masala* were also enhanced. The spectral signatures of the microwave-treated and untreated samples remain almost unaltered, indicating that microwave treatment did not change their functional group makeup. Microbial inactivation was most effective in the *Garam Masala* heated to 105°C, having an initial moisture content of 18.23 %. It achieved a 5-log microbial reduction for both the microbes, balancing a critical safety margin with preserving quality attributes like colour, total phenolic contents and antioxidant activity. The developed microwave and UV-C in-pack pasteurization process was a scalable solution for microbial reduction.