Microwave heating and conventional roasting of cumin seeds

Processing and preservation of spices are important for assuming the quality of the end-product. Microwave processing and cooking of foods is a recent development, which is gaining momentum in household as well as large-scale food applications. Processing of spices using microwaves is a newer dimension. This alternative methodology is preferred, due to the convenience and ease of handling. In Indian tradition, most of the spices are subjected to roasting before addition to food preparations. *Cuminum cyminum* Linn. is one widely used spice. Crushed cumin seeds are used as a condiment in a variety of dishes. Cumin seeds contain volatile oil (2-5%) that imparts the characteristic aroma to the seeds. In the present study which is conducted at Plantation Products, Spices and Flavour Technology Department, Central Food Technological Research Institute, Mysore, India, cumin seeds are subjected to heating by microwaves, using various power levels and conventional roasting at different temperatures. The conditions were standardized in both methods. Conventionally roasted and microwave heated samples were compared; the optimum condition in the former method was found to be 125°C for 10 minutes and in the latter method, the best condition was found to be 730 W for 10 minutes. Under these conditions, the yields of the volatile oils were similar in both cases. Physicochemical properties, such as refractive index, for both sample oils, showed no significant difference from the fresh sample. The volatile oils distilled from these samples were analysed by GC and GC–MS. The results indicated that the microwave-heated samples showed better retention of characteristic flavour compounds, such as aldehydes, than did the conventionally roasted samples. Earlier GC reports showed the presence of only cuminaldehyde as the major aldehyde present in Indian cumin oil. But the present studies resulted in identification of two more aldehydes (*p*-mentha-1,3-dien-7-al, *p*-mentha-1,4-dien-7-al) in Indian cumin oil. Thus, the microwave treatment, inspite of losing terpene hydrocarbons, retained aldehydes in the volatile oil, making microwaves the best choice as an alternative-heating medium for processing [Behera Sushmita, Nagarajan S and Rao L Jagan Mohan, Microwave heating and conventional roasting of cumin seeds (*Cuminum cyminum* L.) and effect on chemical composition of volatiles, *Food Chem*, 2004, 87 (1), 25-29].

Anticarcinogenic effects of cloves

Spices and flavouring agents are now receiving increasing attention as many of them have been shown to have anticarcinogenic properties. Cloves, sun-dried unopened flower buds from the plant *Syzygium aromaticum* Linn., are commonly used as a spice and food flavour. A study conducted at Department of Cancer Chemoprevention, Chittaranjan National Cancer Institute, Kolkata was designed to investigate the chemopreventive action of aqueous infusion of cloves on 9, 10-dimethyl benz(a)anthracene (DMBA) and croton oil induced skin carcinogenesis in Swiss mice. The results indicate protection against skin papilloma formation in a dose dependent manner. It has been found that oral administration of aqueous infusions of clove at a dose of 100 microl/mouse/day not only delays the formation of papilloma but also reduces the incidence of papilloma as well as the cumulative number of papillomas per papilloma bearing mouse. The result suggests a promising role for cloves in restriction of the carcinogenesis process [Banerjee S and Das S, Anticarcinogenic effects of an aqueous infusion of cloves on skin carcinogenesis, *Asian Pac J Cancer Prev*, 2005, 6(3), 304-308].
Drying kinetics of red chillies in a rotary dryer

Chillies are the ripe fruits of the species of genus *Capsicum* Linn. and are used as a condiment, culinary supplement or vegetable. In India, among the spices consumed (per capita consumption), dried chillies contribute a major share. Chillies are grown throughout India. Chillies which contain high moisture content (300-400% db) after harvest are highly perishable and hence processing and storage of chillies are of considerable importance both to the farmers as well as to the processor and consumer. The shelf life of freshly harvested chillies is estimated to be 2-3 days based on 12–15% cumulative loss. It is essential to reduce the moisture content and provide aeration to the chillies after harvesting to prevent the development of microflora and subsequent loss of quality or total spoilage. The most important quality attributes in chillies are the colour and the pungency. The red colour of chillies is due to the carotenoid pigments. The pungency of chillies is due to the compound capsaicin. Therefore, chillies need to be dried quickly without impairing colour and pungency.

Researchers at Department of Agricultural Engineering, SV Agricultural College, Tirupati and Department of Food and Agricultural Process Engineering, Tamil Nadu Agricultural University, Coimbatore, India conducted studies with the following objectives: (1) to study the drying characteristics of red chillies in a rotary dryer; (2) to evaluate the suitability of the empirical drying model; and (3) to optimize the drying parameters of chillies based on drying time, capsaicin content and red colour.

Drying kinetics of red chillies in a rotary dryer was determined within a temperature range of 50-65°C. The time required to dry 10·5kg chillies (loaded to 75% of dryer volume) from an initial moisture content of around 330% dry basis (db) to the final moisture content of around 10·5% db was 32, 27·23 and 20 hours at 50, 55, 60 and 65°C of drying air temperature, respectively. The average capsaicin content and value for the red/green chromaticity coordinate $a^*$ of dried chillies decreased from 0·54% to 0·28% and 22·83 to 12·31, respectively, as the drying air temperature increased from 50 to 65°C. The overall performance of the chillies dried at 55°C was the best, when the quality attributes, viz. drying time, capsaicin content and red colour, were considered. Suitable models are identified to predict the moisture ratio of chillies at different drying air temperature of a rotary dryer. The effective moisture diffusivity $D_{eff}$ of chillies increased from 13·635 to 19·949mm$^2$/hour as the drying air temperature of a rotary dryer increased from 50 to 65°C. The activation energy of diffusion $E_a$ was calculated as 24476MJ/kg/mol [Kaleemullah S and Kailappan R, Drying Kinetics of Red Chillies in a Rotary Dryer, *Biosystems Eng*, 2005, 92 (1), 15-23].

Growth and enterotoxin production by spore-forming bacterial pathogens from spices

Spices often act as important vectors for various micro-organisms, specially sporeformers implicating possible health problems for consumers. *Bacillus cereus* enterotoxin (BCET) and *Clostridium perfringens* enterotoxin (PET) were estimated by scientists at Microbiology Laboratory, Department of Botany, University of North Bengal, Siliguri, India using the latex agglutination method. Some market spices, like cumin powder contained a high BCET titre (64 ng/g). After intentional inoculation of black pepper powder with a toxigenic strain (120-B1) of *B. cereus* and 14 day-storage at room temperature, there was no significant ($P<0.05$) change in the cell count and BCET production. To assess safety of spicy foods, *aloos dam* (a potato-based food) and goat meat gravy were taken as subjects for the respective growths of *B. cereus* and *Cl. perfringens*. Freshly prepared *aloos dam* did not contain *B. cereus*, however immediate to seasoning with small cardamom the count of *B. cereus* cells was 533/g and the BCET content was 8 ng/g. After keeping the food at 30°C for 21 hours, the cell count increased to 10$^6$/g and the BCET content increased to 128 ng/g. A similar situation happened when *aloos dam* was intentionally inoculated with *B. cereus* 120-B1. A toxigenic strain of *Cl. perfringens* multiplied rapidly in the gravy; after 19 hours at 37°C the cell count increased from 10$^3$ to 10$^7$/g, however the PET content (2 ng/g) remained unchanged. After boiling the 19 hour-long incubated gravy for 15 min in a water bath, the cell count fell to 10$^3$/g and the PET content went below the limit of detection. The results confirmed that these foods are capable of supporting outgrowth of bacterial pathogens introduced in contaminated spices and the production of enterotoxins. It is concluded that contaminated spices, when added to foods, are able to introduce the pathogens which may subsequently outgrow and produce enterotoxins. The spice microflora can shorten market life of the products through spoilage and/or conceivably contribute to consumer illness [Banerjee Mousumi and Sarkar Prabir K, Growth and enterotoxin production by sporeforming bacterial pathogens from spices, *Food Control*, 2004, 15 (6), 491-496].