Determination of sweetness of intact Mango

Mango (*Mangifera indica* Linn.) is an important tropical fruit having a huge demand in world markets. India produces around 11.4 million tonnes of mangoes annually while contributing meagerly in the world market, mainly because of lack of precision in sorting methods based on internal quality. Consumer preference is mainly driven by sweetness. Increase in total soluble solids (TSS), carotenoid pigments and decrease in acidity are some indicators of sweetness of mango. Presently most consumers determine these by experiencing surface firmness, gloss, aroma, flavour, etc., which is often misleading.

Currently, non-destructive techniques for quality evaluation have gained momentum. These techniques, particularly for fruits and vegetables, are quick and easy to use. Scientists working at Central Institute of Post-harvest Engineering & Technology, PAU, Ludhiana and Abohar, Punjab, India explored the potential of a non-destructive method for predicting sweetness in term of total soluble solids using a handheld. Calibration models for different groups of wavelengths in the visual range for prediction of total soluble solids (TSS) using partial least-squares regression (PLS), principal component regression (PCR), and multiple linear regression (MLR) methods with respect to reflectance and its second-order derivatives, smoothing and multiplicative scatter correction (MSC), were developed and tested with validation sample sets. The MLR model of original spectra in the wavelength range of 440-480nm was found to be the best. The standard error of calibration (SEC), validation (SEP) and correlation coefficients were found to be 1.91 Brix, 1.97 Brix and 0.90, respectively. Similarity in SEC and SEP values and satisfactorily high correlations between predicted and measured values, however, indicated that the developed model has potential for the prediction of the TSS of intact mango non-destructively using the visual spectra, but for commercial use, it must include more mango varieties for better and more robust calibration [Jha SN, Chopra S and Kingsly ARP, Determination of Sweetness of Intact Mango using Visual Spectral Analysis, *Biosyst Eng*, 2005, 91(2), 157-161].

Accelerated storage, shelf-life and colour of mango powder

The drying of fruit pulp to powder is difficult mainly because of low molecular weight sugars such as fructose, glucose, sucrose and acids such as citric acid present in the pulp. Powdered dehydrated products of fruit juice, soup, custard, etc. require protection against ingress of moisture and oxygen and the loss of volatile flavourings and colour. The production of a free-flowing fruit powder is enhanced by the incorporation of food-grade anticaking agents such as tricalcium phosphate added to fruit pulp. Tricalcium phosphate binds water by competing with other materials present in food. Fruit powder can be produced by adding maltodextrin, glycerol monostearate and tricalcium phosphate to fruit pulp and by drying the pulp in a vacuum dryer. Because of the ingress of moisture through the packaging materials, the powder exhibits stickiness and colour change during storage.

The scientists at Department of Agricultural and Food Engineering, Indian Institute of Technology, Kharagpur conducted studies (i) to develop a prediction model for the shelf life of mango powder based on sticky-point temperature, moisture content and permeability of packaging material and (ii) to observe the colour changes of mango powder using accelerated storage conditions.

During experiment vacuum-dried mango powder was produced from mango (*Mangifera indica* Linn.) pulp through the addition of glycerol monostearate and tricalcium phosphate at 0.015kg each per kg mango solids and maltodextrin at 0.62kg per kg dry mango solids. The mango powder was packed in aluminum foil-laminated pouches and stored in an accelerated storage environment maintained at 90% relative humidity (RH) and 38±2°C. The sticky-point moisture content at 38±2°C was considered as the maximum moisture content to which the mango powder would remain stable. The shelf life of the powder predicted from this consideration and the Guggenheim-Anderson-de Boer (GAB) model for the water activity moisture content relationship was 114.68 days, whereas the actual shelf life was 105 days. The colour change of the powder during storage followed first-order reaction kinetics with a rate constant of 0.038 per day [S Jaya and Das H, Accelerated storage, shelf life and color of mango powder, *J Food Process Preserv*, 2005, 29(1), 45-62].
Infrared drying of Apple slices

Drying is one of the oldest methods of food preservation. One of the ways to shorten the drying time is to supply heat by infrared radiation. This method of heating is especially suitable to dry thin layers of material with large surface exposed to radiation. Infrared radiation has some advantages over convective heating. Heat transfer coefficients are high, the process time is short and the cost of energy is low.

Researchers at Department of Food Engineering and Process Management, Warsaw Agricultural University (SGGW), Warsaw, Poland carried out studies to investigate heat and mass transfer during infrared drying of apple slices and compare it with convective drying.

Laboratory dryer was designed in such a way that drying could be done either with infrared energy or by convection. It was equipped with near-infrared radiators with peak wavelength at 1200 nm. The energy efficiency of the infrared dryer was between 35 and 45%. Apple slices were dried with infrared energy and by convection under equivalent conditions. Kinetics of infrared drying was dependent on the distance between emitters and the heat-irradiated surface and air velocity. Drying kinetics was inversely proportional to both the distance and the air velocity. It was found that both surfaces of apple slice participate in water evaporation. However, the heat-irradiated surface evaporates much more water than that not heated by infrared energy until 80% of water is removed from the material. At the final stages of drying, there is no difference between upper and bottom surfaces of the apple slice as far as the flux of evaporated water is concerned. Comparison of infrared drying with convective drying done at equivalent parameters showed that time of the process can be shortened by up to 50% when heating is done with infrared energy.

Thus, infrared drying of apple slices is an effective method of water removal. Drying with application of infrared energy is much faster than convective drying done under equivalent parameters. Drying kinetics depends on the distance between infrared energy emitters and the heat-irradiated surface, and the air velocity as well. The air velocity is an important variable, since air flowing over the surface cools it down and lowers its temperature. Hence, the effect of air velocity on kinetics of infrared drying of apple slices is opposite to that observed during convective drying. Adjusting distance between infrared emitters and the slice surface as well as air velocity, a temperature of the material undergoing drying can be easily controlled. Both short time of drying and ease of control of material temperature are advantages of the use of infrared energy in food dehydration [Nowak Dorota and Lewicki Piotr P. Infrared drying of apple slices, Innov Food Sci Emerg Technol, 2004, 5 (3), 353-360].

Fuel

Preheated waste frying oil could be used as a diesel substitute

The scientists at Department of Mechanical Engineering, Pondicherry Engineering College, Pondicherry and Department of Mechanical Engineering, Anna University, Chennai, India have evaluated the performance and exhaust emissions of a diesel engine using preheated waste frying oil as fuel. During the investigation, waste frying oil a non-edible vegetable oil was used as an alternative fuel for diesel engine. The high viscosity of the waste frying oil was reduced by preheating. The properties of waste frying oil such as viscosity, density, calorific value and flash point were determined. The effect of temperature on the viscosity of waste frying oil was evaluated. It was determined that the waste frying oil requires a heating temperature of 135°C to bring down its viscosity to that of diesel at 30°C. The performance and exhaust emissions of a single cylinder diesel engine was evaluated using diesel, waste frying oil (without preheating) and waste frying oil preheated to two different inlet temperatures (75 and 135°C). The engine performance was improved and the CO and smoke emissions were reduced using preheated waste frying oil. It was concluded from the results of the experimental investigation that the waste frying oil preheated to 135°C could be used as a diesel fuel substitute for short-term engine operation [Pugazhvadivu M and Jeyachandran K. Investigations on the performance and exhaust emissions of a diesel engine using preheated waste frying oil as fuel, Renewable Energy, 2005, 30(14), 2189-2202].