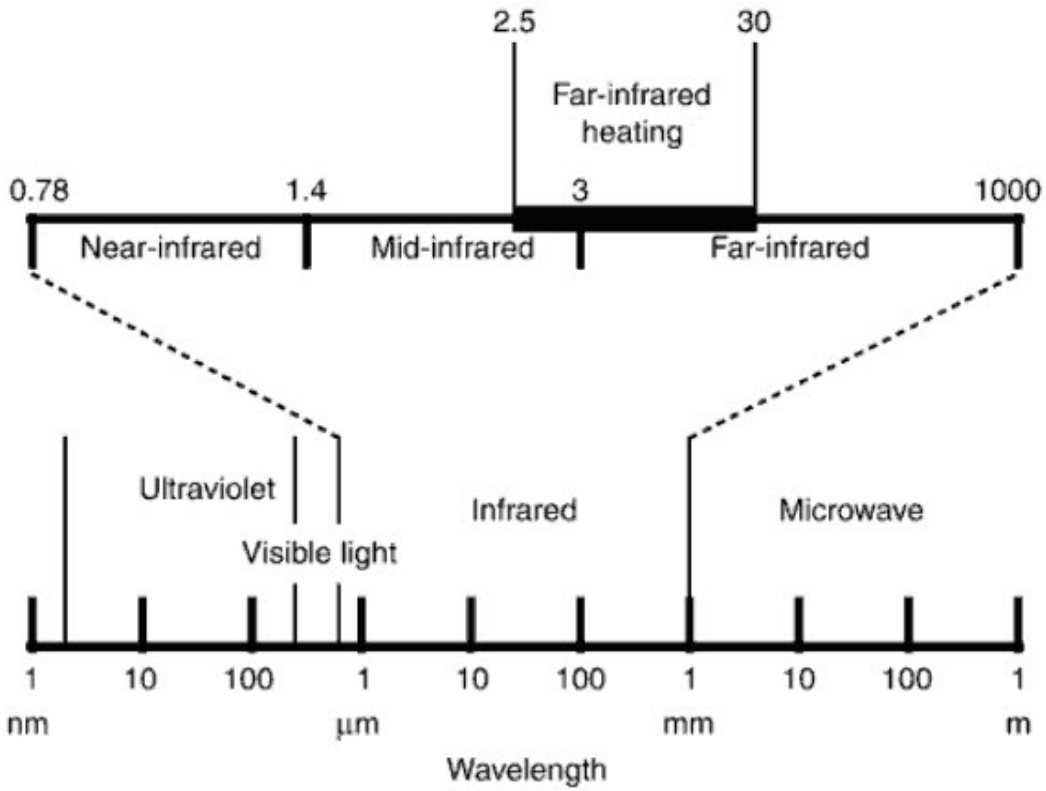
Department of Mechanical Engineering
University of Hong Kong

Workshop on Application and Productization Design for Far Infrared Rays (FIR) Technology – Food Processing

Application of Far Infrared Radiation to Food Processing

Ir HN Lam
Associate Professor

Far Infrared Heating



Far Infrared Heating

- FIR heating can be classified into 4 major categories: baking, drying, thawing and pasteurization
- Using FIR heating, baking time can be shortened, energy consumption can be reduced, and nutrition and appearance can be better preserved.
- FIR heating helps reduce beta-carotene and chlorophyll degradation in the heating process.
- FIR irradiation is more effective for pasteurization than NIR, killing bacteria and spores.

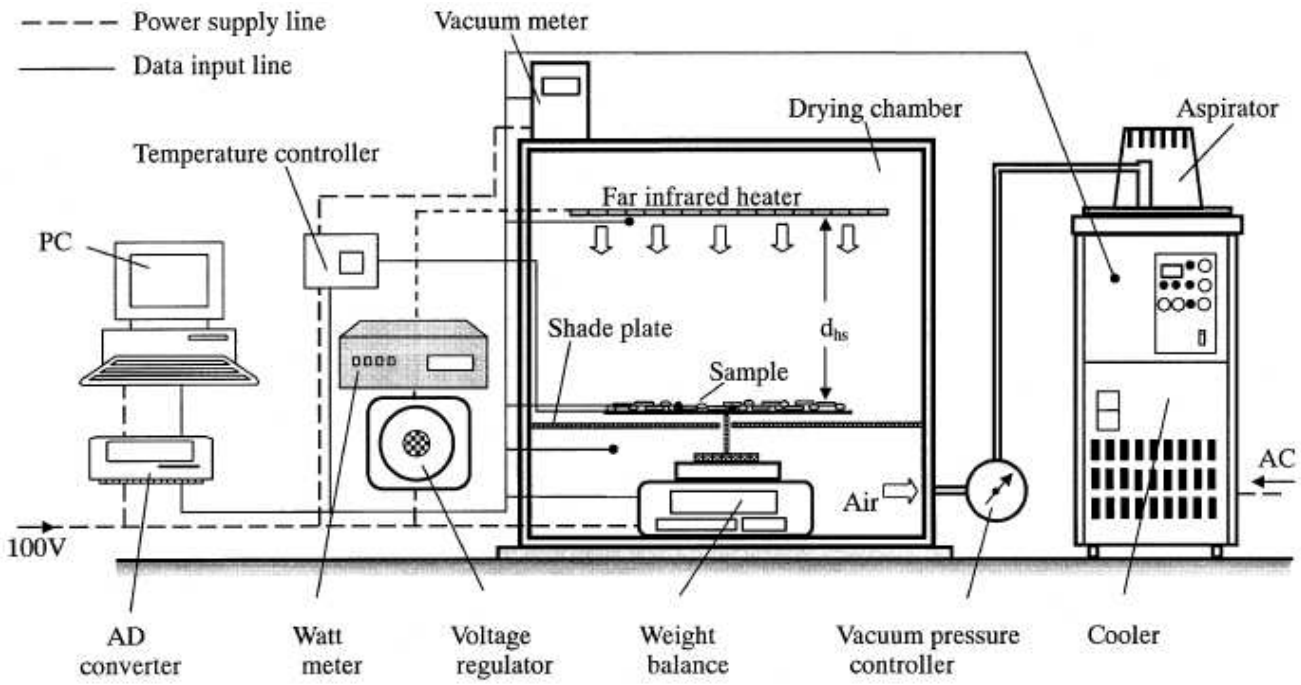
Far Infrared Radiation for Cooking Meat Products

- Publication: Application of Far Infra-red Radiation to Cooking of Meat Products, *Journal of Food Engineering, 1999, 41:203-208.*
- With the far infra-red radiation source, target core temperature was achieved at a lower surface temperature, with less surface drying and charring. The propane gas consumption when using the longer-wavelength infra-red source was reduced by 55% over that for the shorter-wavelength, higher-energy source.

Accelerated Vacuum Drying Using Far Infrared Radiation

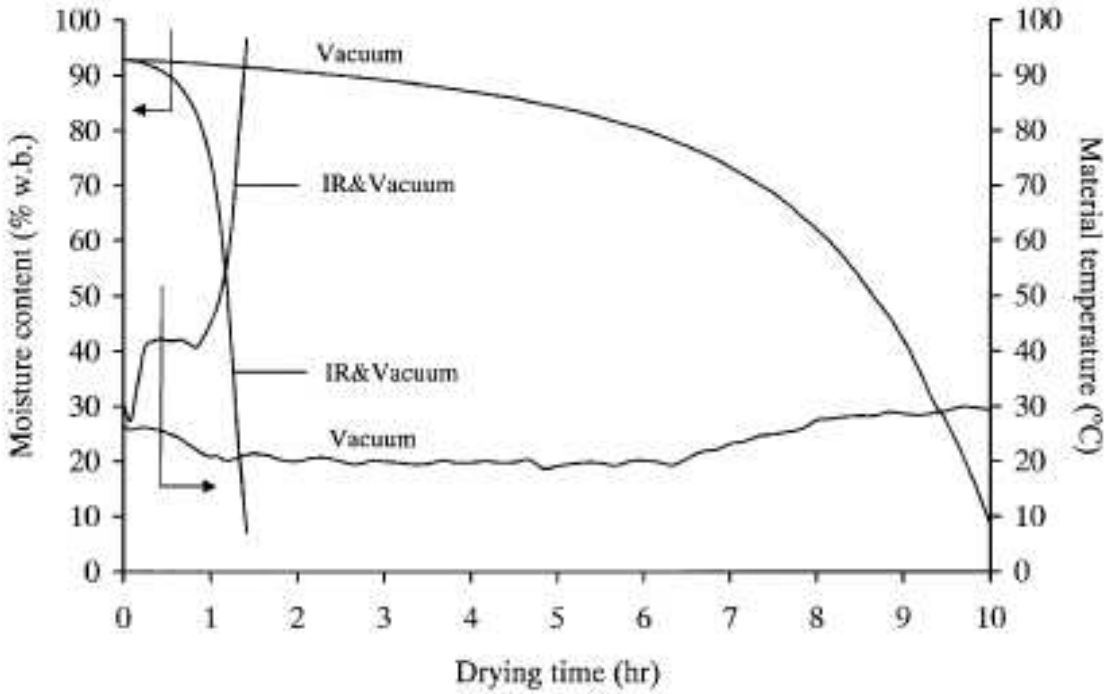
- Publication: Accelerated Drying of Welsh Onion by Far Infrared Radiation under Vacuum Conditions, *Journal of Food Engineering, 2002, 55: 47–156*.
- Using vacuum alone was not enough to completely dry the food. Far infrared radiation provided the external heat source for continuous water evaporation.
- At the 70W FIR heater power level, rehydration yielded fresh-like properties of the Welsh onion leaves.

Accelerated Vacuum Drying Using Far Infrared Radiation



Far infrared dryer with vacuum extractor

Accelerated Vacuum Drying Using Far Infrared Radiation

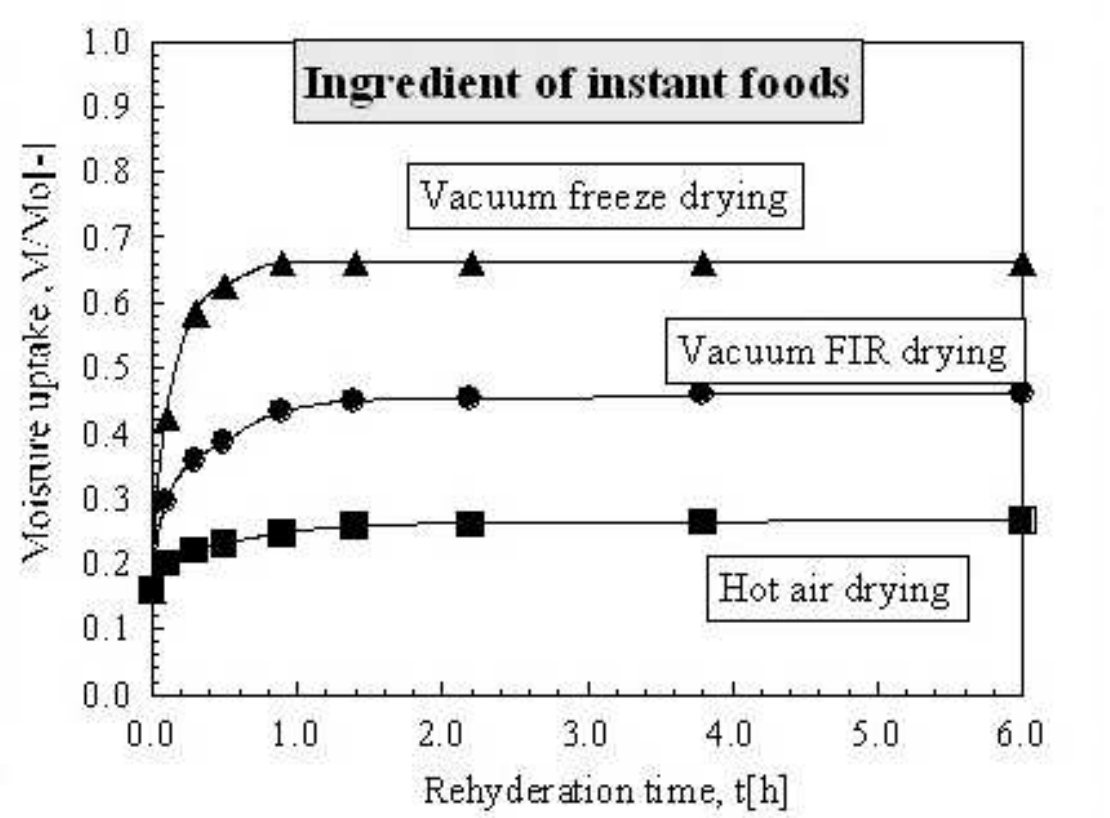


Comparison of effect on moisture content and material temperature by far infrared radiation and vacuum against a vacuum operation alone

Application to Drying of Scallop

Comparison of FIR vacuum drying with solar drying

Application to Drying of Scallop

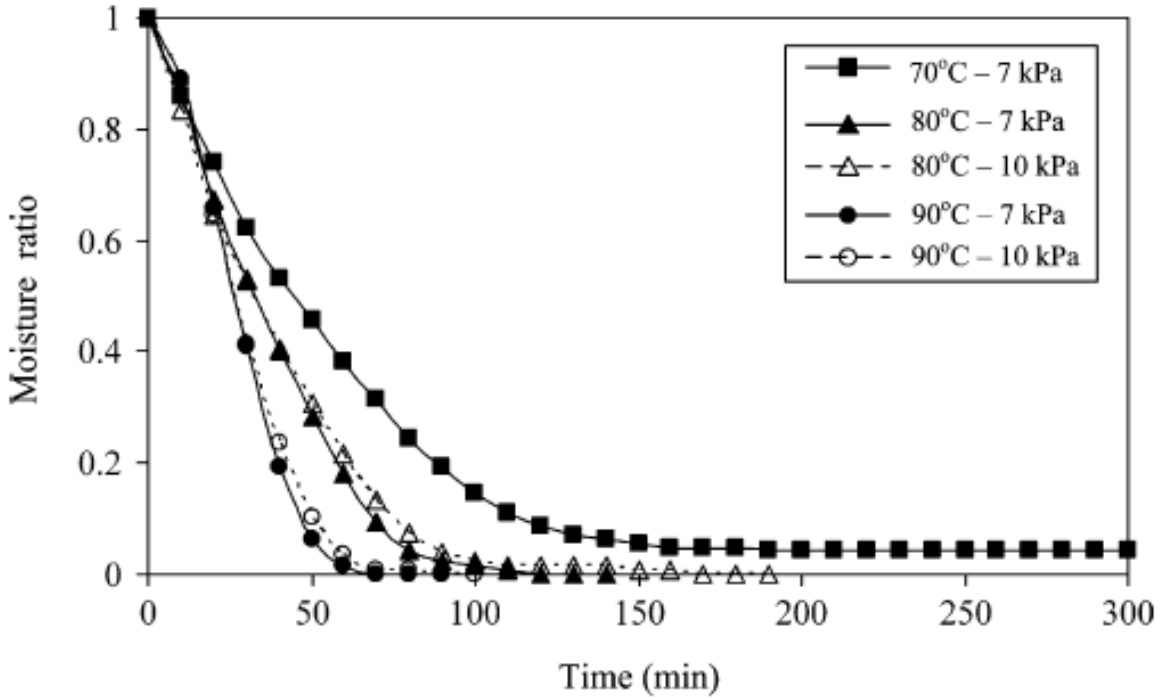


Comparison of rehydration times for different drying methods

Drying of Banana Slices Using FIR and Superheated Steam

- Publication: Drying of Banana Slices Using Combined Low-pressure Superheated Steam and Far-infrared Radiation, *Journal of Food Engineering, 2007, 81: 624–633.*
- Low-pressure superheated steam with far-infrared radiation (LPSS–FIR) was investigated as a novel drying method to shorten the drying time.
- LPSS–FIR at 80°C was found to be the best drying condition with a good compromise between drying time and colour of the product.

Drying of Banana Slices Using FIR and Superheated Steam

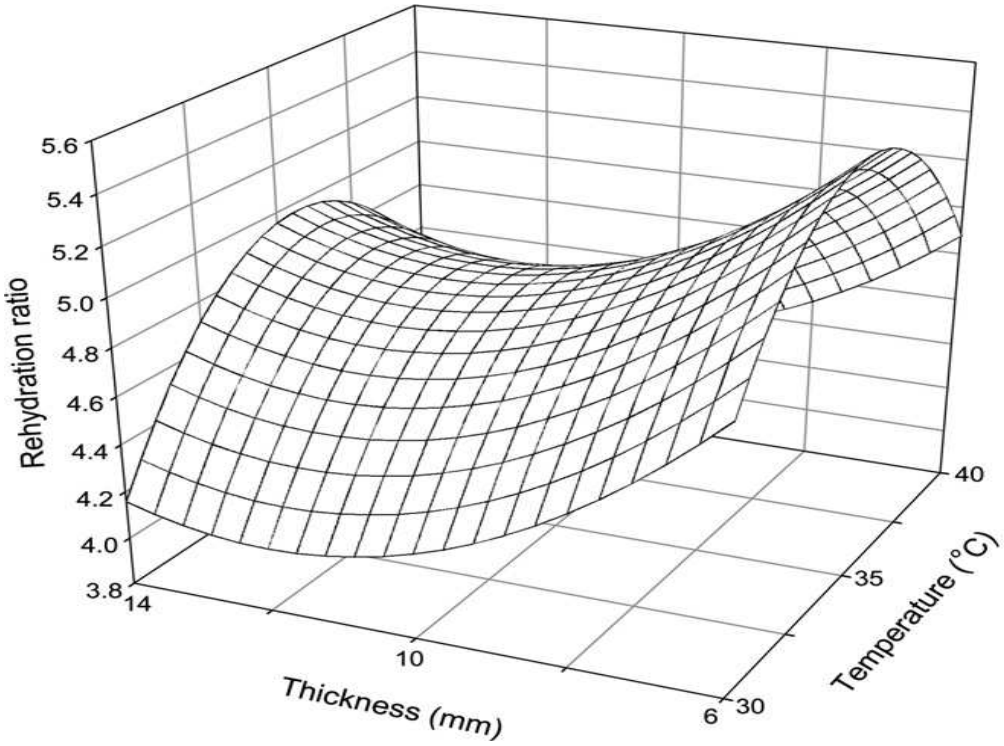


Drying curves of banana slices undergoing LPSS–FIR drying

Dehydration of Yam Slices Using FIR-assisted Freeze Drying

- Publication: Dehydration of Yam Slices Using FIR-assisted Freeze Drying, *Journal of Food Engineering, 2007, 79: 1295–1301.*
- The optimum drying processing could be established at 50 mm distance from the FIR plate.
- The drying temperature was controlled within the range of 34–37°C and slice thickness maintained at 7–8 mm for FIR-assisted freeze drying of products.

Dehydration of Yam Slices Using FIR-assisted Freeze Drying

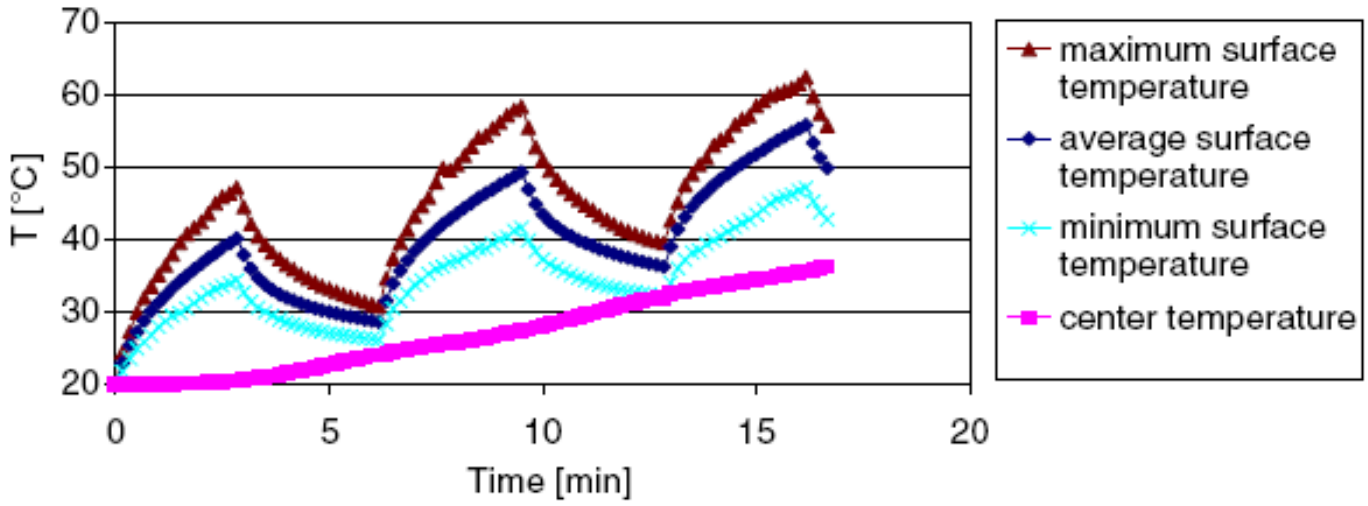


Response surface of rehydration ratio as related to plate temperature and slice thickness

FIR for Surface Decontamination of Strawberry

- Publication: Investigation of Far Infrared Radiation Heating as an Alternative Technique for Surface Decontamination of Strawberry, *Journal of Food Engineering, 2007, 79: 445–452*
- Post-harvest heat treatments have recently received much attention as a means to prevent fungal spoilage of strawberry during shelf life.
- FIR heating achieved more uniform surface heating than air convection heating, with a maximum temperature well below the critical limit of about 50°C at the same average temperature.

FIR for Surface Decontamination of Strawberry



Time–temperature profiles of the surface and center temperature of a strawberry during cyclic FIR heating

End – Thank You