



Department of Mechanical Engineering  
University of Hong Kong

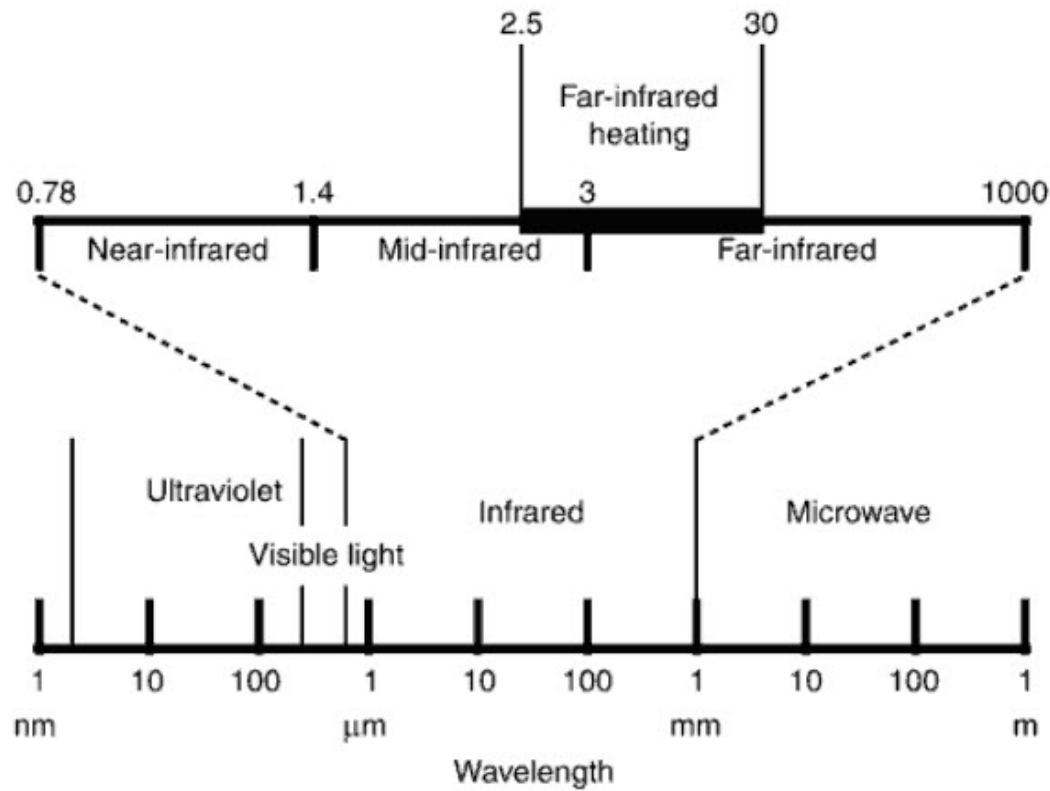
**Workshop on Application and Productization Design  
for Far Infrared Rays (FIR) Technology  
– Food Processing**

**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.

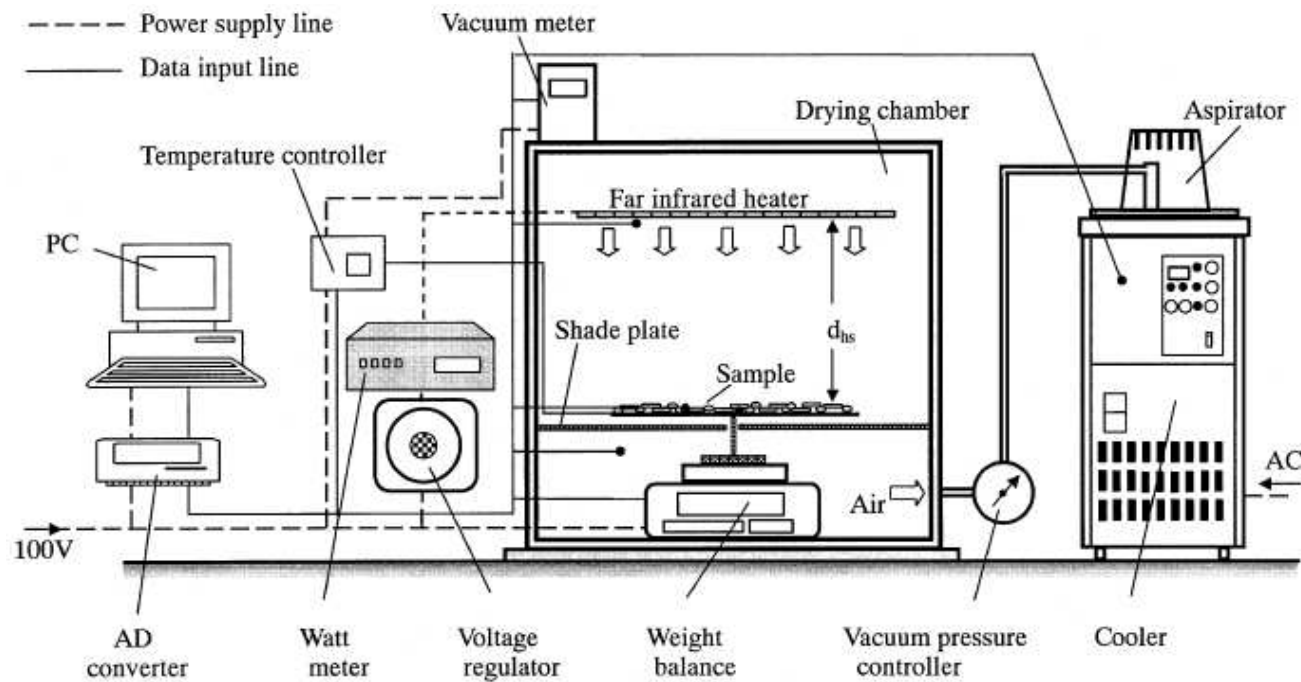


## Accelerated Vacuum Drying Using Far Infrared Radiation

- ❖ 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.



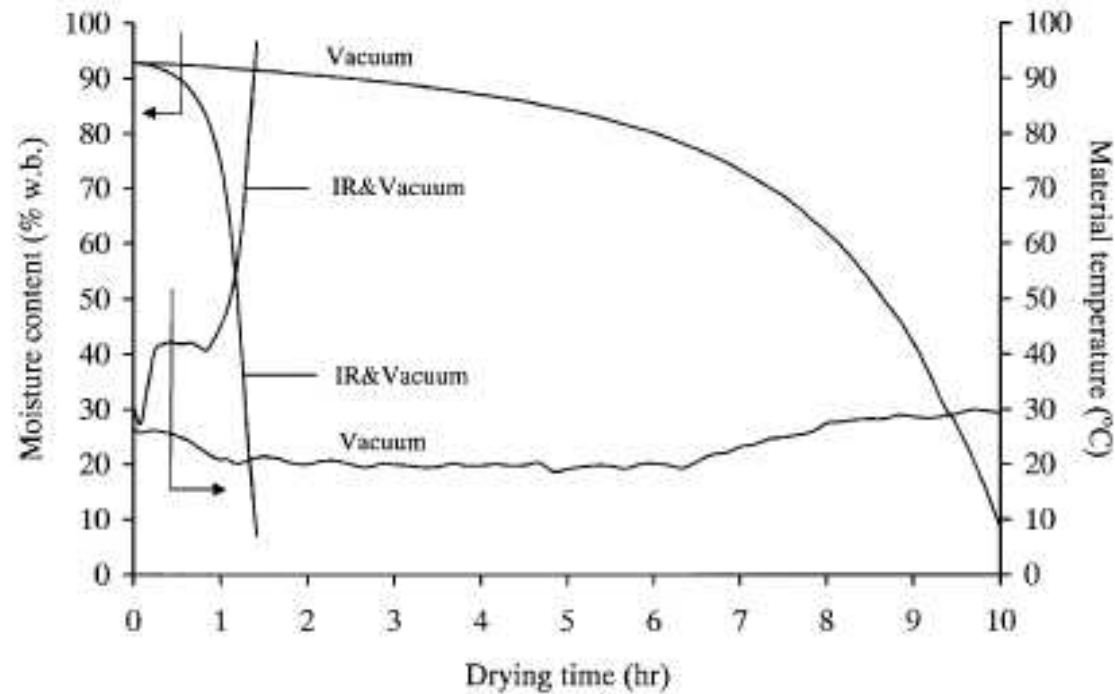
# Accelerated Vacuum Drying Using Far Infrared Radiation



Far infrared dryer with vacuum extractor



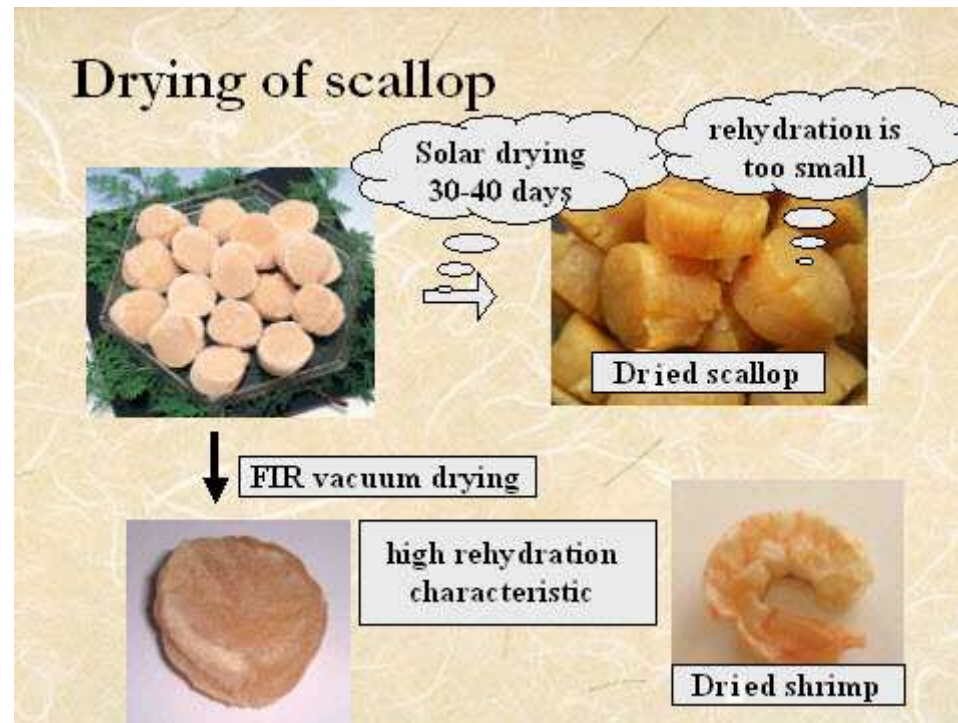
## Accelerated Vacuum Drying Using Far Infrared Radiation



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

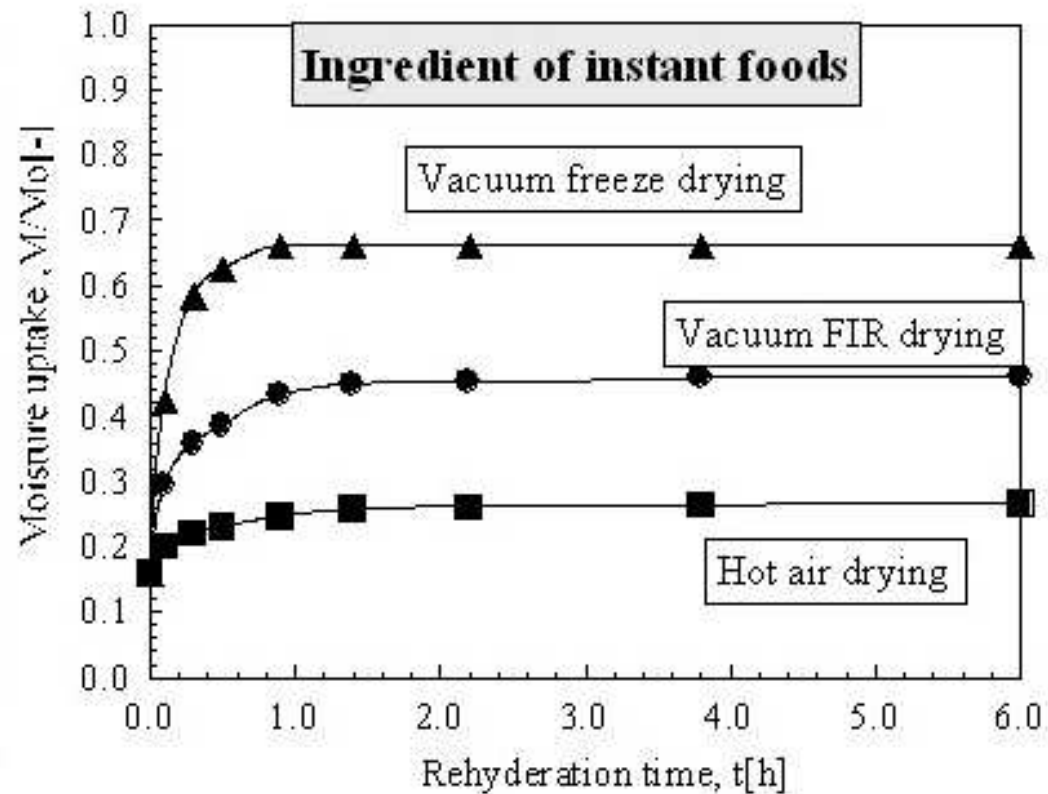


Comparison of FIR vacuum drying with solar drying





## Application to Drying of Scallop



Comparison of rehydration times for different drying methods

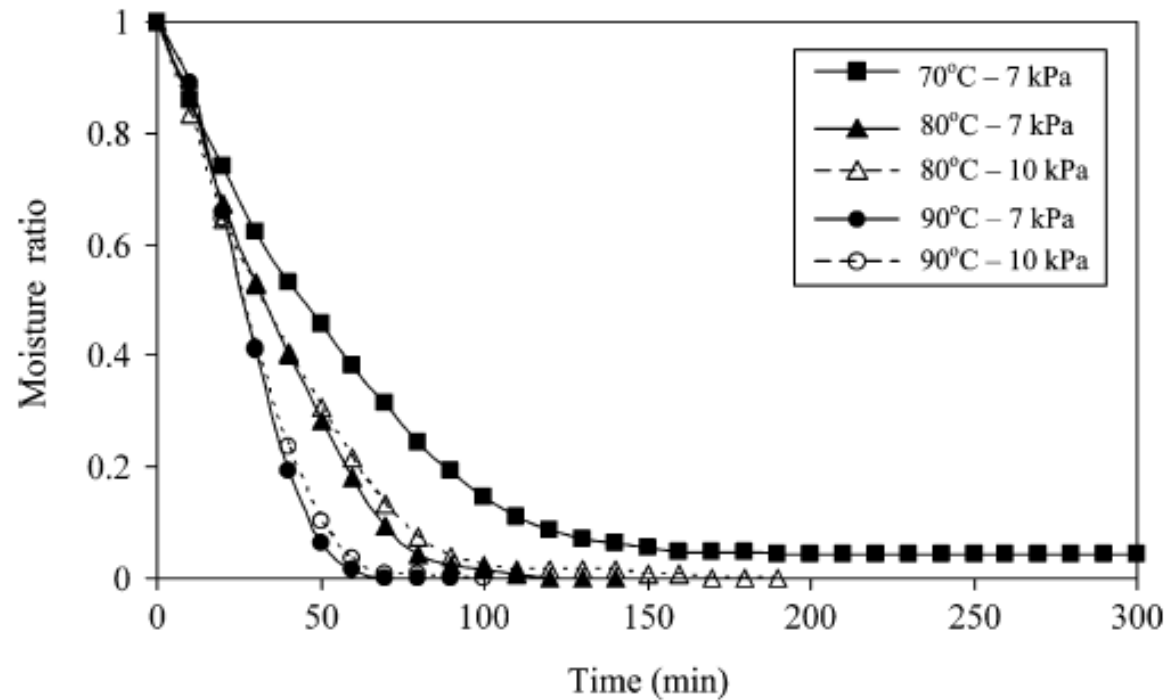


## Drying of Banana Slices Using FIR and Superheated Steam

- ❖ 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

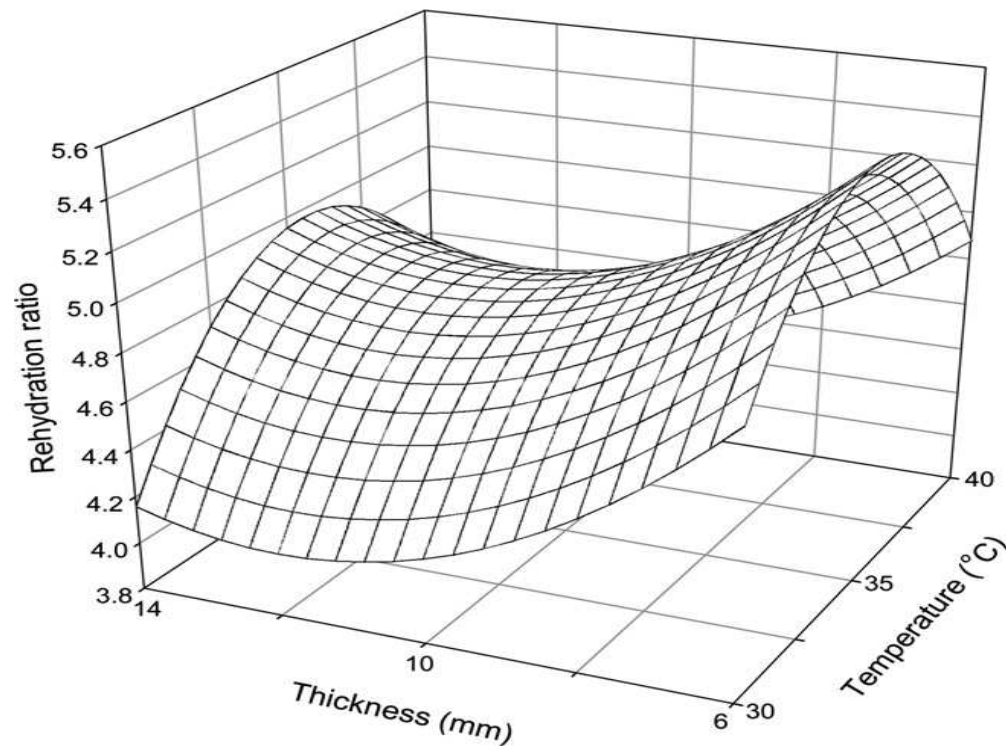


## Dehydration of Yam Slices Using FIR-assisted Freeze Drying

- ❖ 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**

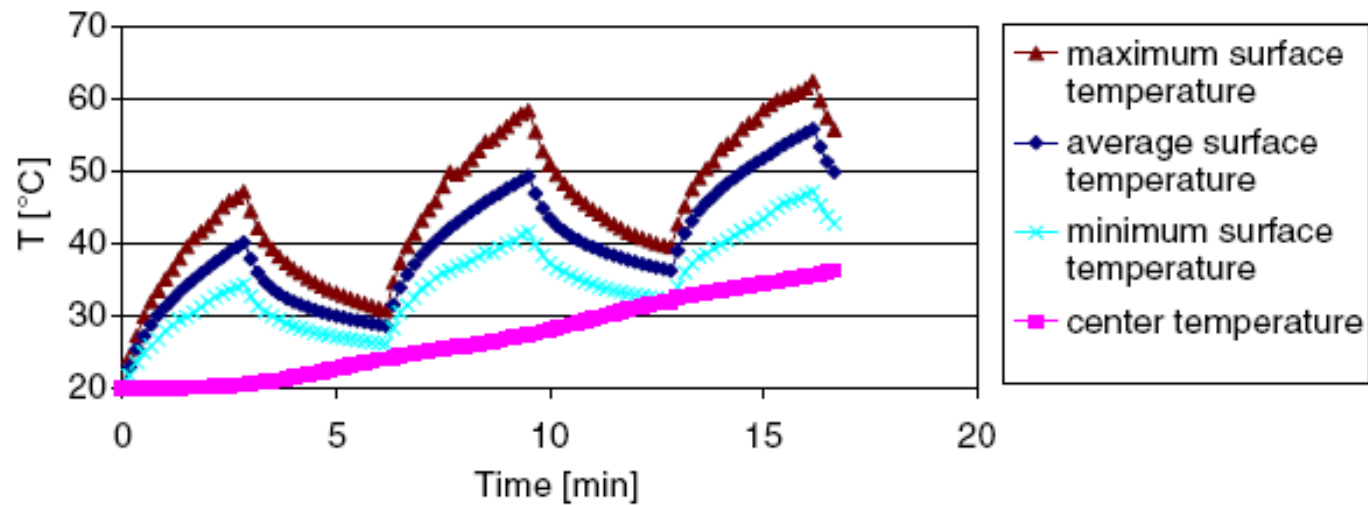


## FIR for Surface Decontamination of Strawberry

- ❖ 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



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**End – Thank You**