Thesis Title	Fruit Drying Using Heat Pump for Small-Scale Industry
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Candidate	Mr. Warraboon Kaewassadorn
Supervisors	Prof. Dr. Somchart Soponronnarit
	Assoc. Prof. Warunee Tia
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Abstract

This thesis focuses on the design, testing and performance evaluation of small-scale heat pump dryer. The dryer capacity is 80 – 100 kg of fruit and vegetable per batch and its drying chamber should accommodate a mobile cabinet with 12 tiers. The dryer comprises of a heat pump, R-22 refrigerant, a compressor 1.3 kW, an evaporator 3.7 kW, an internal condenser 4.6 kW , an external condenser 2.2 kW and a fan 0.75 kW. The experiment was conducted in close encasement at 53^{o}C with the air flow rate of 0.54 m^{3}/s of which 78% was by pass air. Pineapple, beansprout, cabbage and banana were tested.

The experimental results were as follows : pineapple of 44.4 – 90.0 kg was dried from 641-767% to 17 – 21% dry basis in 40 – 55 hours; beansprout of 24.6 kg was dried from 1872% to 16.8% dry basis in 21 hours; cabbage of 21.32 kg was dried from 1590% to 17.6% dry basis in 20 hours and lastly banana, which was dried in two steps, at the initial weight of 98.2 kg was dried from 287% to 57.8% dry basis in 55 hours. It is noted that drying rate and specific moisture extraction rate (SMER) increased when the volumes of vegetable and fruit were closer to the maximum capacity of the dryer. The best measured values of drying rate and SMER were 1.41 kg water evap./h and 0.778 kg water evap./kWh, respectively. With regard to specific energy consumption (SEC), the lowest point was 4.63 MJ/kg water evap. Besides, the power consumption reduced as the drying unit was working at its maximum loading capacity. COP_{hp} was measured between 4.53 – 4.99. The percentage of heat generated from the internal condenser in comparison with the overall heat.

generated from all condensers was measured at 73 – 89. It is worth noting that using medium high temperature produced better quality product. The cost analysis indicates that in order to dry fruit and vegetable, it would cost 6.94-9.33 baht/kg water evap.; 2.18-2.99 baht/kg water evap. for the machine cost , 4.2-6.33 baht/kg water evap. for power consumption and 0.42-0.57 Baht/kg water evap for maintenance.

Keywords : Drying / Energy / Fruit / Heat pump / Vegetable