

A SOLAR DRYER PERFORMANCE OF ONION SLICES UNDER FAYOUM CLIMATIC CONDITIONS

ABSTRACT

A solar drying unit was developed and constructed for drying onion slices under Fayoum conditions. The drying unit consists of a solar collector, which oriented and tilted with an optimum tilt angle and attached with drying chamber. The drying experiments were carried out to examine the effect of onion slice thicknesses (3, 6 and 10 mm) and airflow rate (2.4 and 1.6 m³.min⁻¹) on the onion slices drying rate. The obtained results indicated that the daily average total solar radiation flux incident on the tilted solar collector surface (7.32kWh.m⁻².day⁻¹) was greater than that incident on the horizontal surface (6.13kWh.m⁻².day⁻¹) by 19.41%. The higher air temperatures were obtained at the lower airflow rate (1.6 m³.min.⁻¹) whereas; the amount of heat gained to the air from the solar collector was relatively higher at the higher airflow rate as compared with the lower airflow rate. Consequently the higher efficiency of the solar collector was obtained at the higher airflow rate. The solar collector with the higher airflow rate increased the overall thermal efficiency by 12.56% as compared to the lower airflow rate. The moisture content of dried onion slices was strongly affected by the onion slices thickness and the airflow rate. The final moisture content of dried onion slices ranged from (6.8% to 7.7% dry-basis) depending on the drying temperature cycle. Effect of the individual variables (airflow rate, onion slice thickness, moisture removed, and their interactions) on the drying rate was statistically analyzed. A forward step-wise regression technique was applied to arrive at a reasonable good best set of independent variables. The coefficient of determination (R²) was above 0.97 when comparing observed and predicted drying rate.