HYBRID SOLAR DRYING OF MEDICINAL AND HERBAL PLANTS

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Abstract

The main aim of this work utilize the hybrid solar dryers. Different drying temperatures and air recirculation rates tested their effects on the weight losses, moisture content and energy consumption. To achieve that different drying temperatures (50, 55 and 65 °C) and air recirculation rates (70, 80 and 90 %) were used. A mathematical model developed for heat and mass balance to predict the temperature inside the drying chamber and moisture loss from the product. The obtained results indicated that the air temperature of the drying chamber during the winter season ranged from 24 to 50, 24 to 50, 20 to 50 °C, from 27 to 55, 29 to 55 and 13 to 55 °C and from 25 to 60, 29 to 60 and 18 to 60 °C. and during the summer season ranged from 24 to 50, 26 to 50 and 24 to 50 °C , from 28 to 55, 29 to 55 and 28 to 55 °C for and from 25 to 60, 29 to 60 and 34 to 60 °C at 50, 55, 60 °C drying temperature for 70, 80 and 90 % air recirculating rates, respectively. The accumulated weight loss of mint leaves during winter season increased from 79.93 to 80.10, 79.99 to 80.15 and 80.05 to 80.29 %, and during summer season increased from 79.86 to 80.14, 80.01 to 80.18 and 80.06 to 80.29 %. and for basil leaves winter season increased from 83.94 to 84.13, 84.06 to 84.31 and 84.21 to 84.46 %, and during summer season increased from 83.98 to 84.15, 84.05 to 84.27 and 84.22 to 84.43 %, when the drying temperature increased from 50 to 60 °C, respectively, for 70, 80 and 90 % air recirculating rates. The moisture content of mint leaves winter season decreased from 396.03 to 2.78, 400.00 to 4.40 and 402.01 to 5.62 % d.b., from 400.00 to 0.80, 402.01 to 2.01 and 404.03 to 3.23 % d.b., from 402.01 to 1.61, 404.03 to 7.26 and 408.13 to 14.23 % d.b. During summer season decreased from 396.03 to 1.98, 400.00 to 5.2 and 404.03 to 6.45 % d.b., from 400.00 to 0.80, 402.01 to 4.42 and 404.03 to 3.23 % d.b., from 402.01 to 2.01, 404.03 to 8.47 and 408.13 to 10.98 % d.b., At 50, 55, 60 °C drying temperature for 70, 80 and 90 % air recirculating, respectively. For basil leaves winter season decreased from 521.12 to 3.73, 528.93 to 6.92 and 528.93 to 5.03 % d.b., from 528.93 to 3.77,

532.91 to 5.70 and 536.94 to 6.37 % d.b., from 532.91 to 5.7, 536.94 to 6.37 and 545.16 to 12.90 % d.b., and during summer season decreased from 525 to 6.88, 528.93 to 6.94 and 532.91 to 3.80 % d.b., from 528.93 to 6.92, 532.91 to 5.70 and 536.94 to 3.80 % d.b., from 532.91 to 7.59, 536.94 to 5.10 and 541.03 to 19.23 % d.b., At 50, 55, 60 °C drying temperature for 70, 80 and 90 % air recirculating rates, respectively. The drying rate of mint leaves during winter season increased from 98.31 to 121.96, 122.83 to 171.77 and 133.47 to 214.86, and during summer season increased from 112.59 to 144.57, 122.83 to 171.77 and 133.33 to 176.51 g_{water} kg^{-1} h^{-1}, when the drying temperature increased from 50 to 60 °C, respectively, for 70, 80 and 90 % air recirculating rates after 15 min of drying period. For basil leaves during winter season increased from 137.97 to 174.63, 161.59 to 192.94 and 175.74 to 212.90 And during summer season increased from 148.04 to 176.37, 160.62 to 193.86 and 191.02 to 231.91 g_{water} kg^{-1} h^{-1}, when the drying temperature increased from 50 to 60 °C, respectively, for 70, 80 and 90 % air recirculating rates after 15 min of drying period. The highest value of total chlorophyll of dried mint was 749.1, at 50°C and 90 % air recirculating rate and lowest value of total chlorophyll was 706.7 at 60°C and 70 % air recirculating rate. The highest value of color of dried mint was 37.72 at 50°C and 90 % air recirculating rate and lowest value of color of dried mint was 34.97 at 60°C and 70 % air recirculating rate. The highest value of mint essential oil content was 2.1, at 50°C and 90 % air recirculating rate and lowest value of mint essential oil was 1.5 at 60°C and 70 % air recirculating rate. The total cost of dried mint increased from 8.60 to 7.44, 9.73 to 8.03 and 10.91 to 8.85 EGP kg^{-1} of mint, when the air recirculating rates percentage increased from 70 to 90 %, respectively at 50, 55 and 60 °C drying temperature. The model results were in a reasonable agreement with the experimental ones.

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