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Experimental study and modelling of drying kinetics of peppermint tea (*Mentha piperita*) treated by thermal and biochemical treatment

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The objective of this work is to study the solar drying kinetics of two different samples of peppermint tea: Peppermint washed with water and peppermint treated by citric acid solution (2.5 g/l) which is a natural conservation agent. The experiments were conducted in real conditions. We aim to present an experimental approach of the drying kinetics on a thin layer of peppermint tea. For this purpose, the behavior of this drug has been studied at temperature of 80°C and at drying air velocities of 200 $m^3.h^{-1}$. An indirect forced convective solar dryer in continuous regime was used. Ten mathematical models have been used for describing the drying curves. The Wang and Singh models showed the best fitting of experimental data of treated peppermint tea with citric acid solution and diffusion approach model is the best to describe the drying curves of peppermint tea (control) washed with distilled water.

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Lyophilization process of therapeutic proteins: Strategies for prevent loss of activity

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The development of protein pharmaceuticals after the discovery of their biological activity is often considered to be easier than the development of conventional pharmaceuticals since most such proteins are found in the human body and therefore pose few safety concerns beyond the biological activity. On the other hand, development of the formulation and fill-finish process for proteins has been much more challenging, as they have only marginal stability during routine pharmaceutical handling conditions. In addition, proteins are difficult to deliver systemically by noninvasive routes due to their poor bioavailability. Proteins' marginal stability and the strong preference of a parenteral delivery route make freeze-drying a common means for manufacturing protein products. Lyophilization or freeze-drying consists of three steps: freezing, primary drying and secondary drying. One critical parameter for an effective drying is the temperature that sample collapses (Tc) or presents a glass (Tg)/crystalline melting transition (Te). Primary drying settings below Tc/Tg avoid collapse of the freeze-dried cake, which may cause: higher residual moisture, lengthy reconstitution times or even loss of biological activity. Hence, thermal characterization is essential to screen the best formulation. When a formula collapses or changes its physicochemical and biological properties throughout the process, a protective excipient is needed to perform the drying without product damage. Excipients can confer cryo-protection and lyo-protection, depending on whether the protection occurs during freezing or drying, respectively. Other functions can also optimize the outcome, as bulking agents, buffers and protein stabilizers.

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