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Influence of the air humidity on the drying of a liquid droplet on a solid plate and on bacterial destruction

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Abstract

This study was carried out in order to develop experimental methodology using a camera to monitor the evolution of the surface of a liquid droplet deposited on a solid surface composed of polypropylene. The droplet was exposed to various ambient relative humidity conditions (11.3%, 43.2%, 68.9% and 75.5%). Two types of liquid were investigated: distilled water and water containing nutritive substances (salmon "juice"). At 11.3% relative humidity, it takes 40% longer to evaporate a water droplet (initial weight 0.36 g, volume 360 µL, radius 6.5×10^{-3} m) than a salmon "juice" droplet (3.66h for distilled water, 2.83h for salmon "juice"). In the case of the distilled water droplet, the wet surface decreases gradually and completely disappears at the end of the process. In the case of the salmon "juice" droplet, the wet surface is constant for about 2 h and then decreases gradually because of drying from the edge towards the center of the droplet. A simple equation making it possible to predict the drying rate as a function of air humidity was developed. Also, measurements of the loss of cultivability of *Listeria monocytogenes* under different relative humidity conditions were carried out experimentally. The relationship between the relative humidity, droplet drying time and loss of cultivability was analyzed. It was observed that for 11.3%, 43.2% and 68.9% relative humidity conditions, the drying time and the loss of cultivability can be correlated, while at 75.5% relative humidity, the phenomena are more complex. This study shows that the relative humidity of air can potentially be controlled in order to limit bacterial growth, thus enhancing hygiene in food plants.

Keywords: droplet, evaporation, drying rate, relative humidity, *Listeria monocytogenes*

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