The Mpemba effect mainly describes the influence of the initial temperature on the freezing time and supercooling capacity (SC). This research uses a cellular automata model (CA) that applies thermodynamic restriction rules inside a finite element space to simulate the propagation of the nucleation temperature during supercooling of strawberries (Fragaria ananassa), frozen inside an airblast freezer.

Computational simulations were performed inside the following operational zone: i) initial temperature (0 °C to +20 °C); ii) air temperature (-45 °C to -20 °C); and iii) air velocity (1 m s⁻¹ to 10 m s⁻¹). Furthermore, the influence of shape and morphology of strawberries was analyzed during simulations. Five different shapes of strawberries combined with four morphologies with higher and lower volumes of pulp, vascular tissue and central air void, totaling 14 strawberries shape/morphology characteristic patterns.

The thermodynamic restriction rules allowed to estimate the supercooling capacity across the physical domain. Furthermore, according to the CA, nucleation inside strawberries is likely to occur by: i) thermal compression of a supercooled liquid; or ii) thermal expansion of the supercooled liquid. The same rules distinguish between the conditions that lead to the existence of a nucleation front or a freezing front. Further developments on the molecular structure of water will help in the future to improve the ability to predict the SC.

Shape and morphology are also important factors which affect the SC of strawberries. The existence of a central air void increases the SC. Furthermore, the vascular tissue promotes the propagation of lower nucleation temperatures than the pulp. It is expected that strawberries with larger pulp volumes will obtain a poorer texture retention, due to the growth of larger crystals and also because the pulp tissue has less mechanical resistance to expansion and compression forces, leading to drip loss during thawing.