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Additives meant to protect vitamin C actually cause more harm

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Anti-caking agents in powdered products may hasten degradation of vitamin C instead of doing what they are supposed to do: protect the nutrient from moisture.

Lisa Mauer, a Purdue University professor of food science; Lynne Taylor, a professor of industrial and physical pharmacy; and graduate student Rebecca Lipasek study deliquescence, a reaction in which humidity causes a crystalline solid to dissolve. They wanted to understand how anti-caking agents protect substances such as vitamin C from humidity.

In Mauer's laboratory, different anti-caking agents were blended with powdered sodium ascorbate, a common form of vitamin C, and were exposed to different relative humidities. Normally, sodium ascorbate deliquesces, or dissolves, at 86 percent relative humidity and is stable below that level. Some anti-caking agents, however, caused the degradation to begin at lower humidity levels.

"The additives that the food industry puts in to make these powders more stable didn't help the vitamin C, and in some cases actually made things worse," Lipasek said.

Once vitamin C changes chemically, it no longer holds its nutritional value.

The findings suggest that foods made with powdered vitamin C may lose the vitamin's nutrients at a lower humidity than once thought. The team's findings were published in the current issue of the *Journal of Food Science*.

A variety of anti-caking agents were studied.

"Some of the agents act like little raincoats, covering the particles and protecting them from moisture. Others will absorb the water themselves, keeping it away from the vitamin C particles," Mauer said. "I really thought some of those anti-caking agents would help, but they didn't."

The problem, according to the research, is the chemical properties of the anti-caking agents themselves.

The water-repellent agents, which act like raincoats, are mobile, Lipasek said. When they move around, they clump together and leave some of the vitamin C uncovered. When that happens, moisture is able to reach and degrade the exposed vitamin C.

The moisture-absorbing agents, which absorb the water at a lower humidity than vitamin C, may be absorbing so much moisture that they become saturated. When that occurs, Mauer said, the pH level around the vitamin C can change, or water can move and interact with the vitamin C. Both of these scenarios could lead to further reactions that lower the humidity at which vitamin C deliquesces and changes from solid to liquid. Once the vitamin C dissolves, it is unstable.

Next, Mauer and Lipasek plan to test more complex blends that contain more ingredients along with vitamin C. They also plan to determine how much water is necessary to destabilize vitamin C and how temperature affects the destabilization of vitamin C with anti-caking agents.

More information: ABSTRACT

Effects of Anti-caking Agents and Relative Humidity on the Physical and Chemical Stability of Powdered Vitamin C
Rebecca A. Lipasek, Lynne S. Taylor, and Lisa J. Mauer

Vitamin C is an essential nutrient that is widely used by the food industry in the powder form for both its nutritional and functional properties. However, vitamin C is deliquescent, and deliquescence has been linked to physical and chemical instabilities. Anti-caking agents are often added to powder systems to delay or prevent caking, but little is known about their effect on the chemical stability of powders. In this study, various anti-caking agents (calcium phosphate, calcium silicate, calcium stearate, corn starch, and silicon dioxide) were combined with sodium ascorbate at 2% and 50% w/w ratios and stored at various relative humidities (23%, 43%, 64%, 75%, 85%, and 98% RHs). Chemical and physical stability and moisture sorption were monitored over time. Additionally, saturated solution samples were stored at various pHs to deter mine the effect of surface pH and dissolution on the vitamin degradation rate. Storage RH, time, and anti-caking agent type and ratio all significantly affected (P

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