Co-crystals successfully turn liquids into solids

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A new approach for formulating the active chemical ingredients of common drugs and agricultural products has been developed by researchers in Italy, and it holds broad potential to make such products more durable, safer, cheaper, easier to manufacture and less harmful to the environment.

The technique involves taking the active chemical ingredients found in human drugs and agrochemicals, many of which are liquids, and stabilizing them with other molecules into "co-crystals," essentially rendering them solid. Co-crystals are materials composed of two or more molecules in the same crystal lattice—conceptually you can picture a checkerboard stacked up and down and right to left with black and red pieces together.

While the idea is still in its infancy, a presentation at the 23rd Congress and General Assembly of the International Union of Crystallography, next week in Montreal will describe the first initial results of this approach, which were successful.

"The work is promising because we successfully combined into crystals a set of liquid pharmaceutical and agrochemical molecules with carefully chosen molecular partners, and thus we were able to obtain solid forms containing the liquid active molecules embedded in the ordered solid," said Alessia Bacchi, a professor at the University of Parma in Italy who led the research.

As a general approach, co-crystallization should be able to stabilize many types of liquid chemicals into solid form, Bacchi said. Reformulating pharmaceuticals in this way could give some drugs a longer shelf life, eliminate the need for refrigeration for others, simplify some manufacturing processes, possibly reduce costs and provide patients with a pill form of a drug they could take easier than a liquid.

For agrochemicals, co-crystallizing liquid products should offer greater control over how they are delivered onto farmlands, possibly helping to curtail their inadvertent release into the environment.

The research results show that designing robust co-crystals is feasible and promising—though not necessarily easy, Bacchi said. The initial work she will be presenting in Montreal required lengthy analyses of the molecular behavior of the liquid molecules they sought to stabilize as solids. They had to study their thermal stabilities, rates of decomposition, solubilities in water and many other parameters before picking partners that would interact and stabilize those molecules into co-crystals.

But that's the beauty of crystallography, Bacchi said. "Crystallographic knowledge allows us to manipulate compounds at the molecular level and build new systems."

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