Probiotics research looks to 3D printing to get the good stuff in the gut

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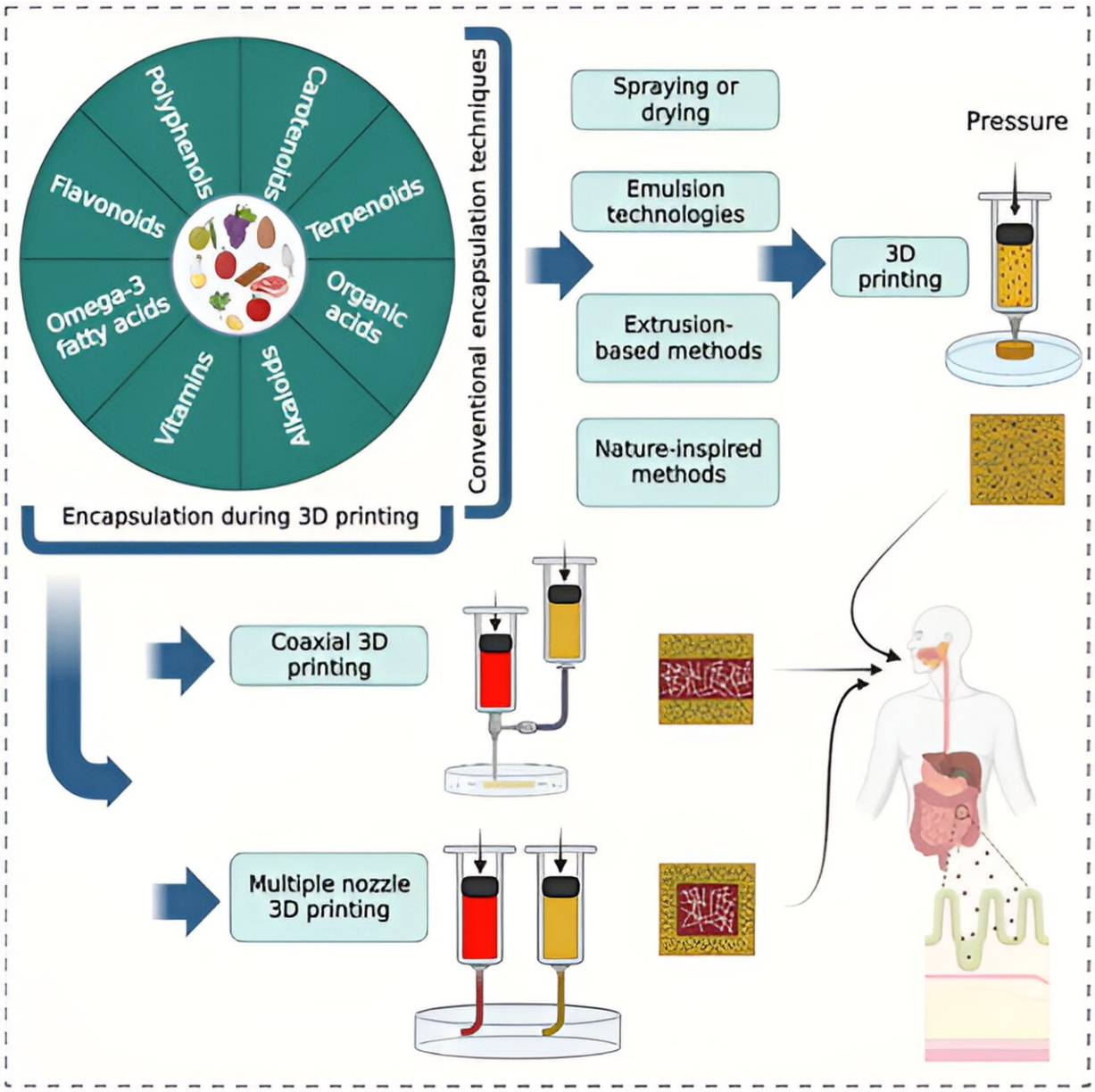

Graphical abstract. Credit: *Critical Reviews in Food Science and Nutrition* (2023). DOI: 10.1080/10408398.2023.2273446

Nutrition and food science researchers at the Arkansas Agricultural Experiment Station are working to improve the impact probiotics can have on gut health using 3D food printers.

Probiotics, living microorganisms like those found in some yogurts, are helpful for gut health. However, because of environmental conditions, the active microorganisms in probiotics like Lactobacillus and Bifidobacterium don't always make it to the gastrointestinal tract, said Sun-Ok Lee, associate professor of nutrition with the food science department.

Lee is giving 3D printing a shot at improving the survival of probiotics. Improved delivery methods for probiotics could benefit animal and human health with further testing, said Lee, who conducts research for the experiment station, the research arm of the U of A System Division of Agriculture.

"There is a critical need for an innovative encapsulation technique that will promote probiotics' stability during food processing while enabling effective delivery to the colon," Lee said. In other words, Lee is seeking a way to protect the probiotics through the food processing, transportation and storage phases, and then survive the stomach acids once consumed.

"Gut health is connected to heart and brain health and the immune system. So, it is important in the prevention of chronic diseases," she said.

Lee is working with Ali Ubeyitogullari, assistant professor of food engineering in the Food Science and Biological and Agricultural Engineering departments. They are using his 3D food printing technology to protect the probiotics in alginate-pectin microgel beads. The alginate is made from seaweed extract, and pectin is a polysaccharide, a chain of simple sugar molecules, obtained from fruits such as apples.

The goal is to encase the probiotics in a pH-sensitive material that is resistant to low pH, highly acidic conditions, like the stomach, but will open in less acidic levels found in the colon.

Their study includes infusing the probiotic microgel beads into yogurt and cookies to evaluate their viability during processing, storage and digestion.

"During almost all the processing steps, the probiotics are exposed to external pressures like temperature, so we are trying to make them stable during food processing. With 3D printing, we can precisely locate and encapsulate them at the same time," Ubeyitogullari said. "And this can be infused directly into the product, where you deal with the right amount and position." Their work has been published in *Critical Reviews in Food Science and Nutrition*.

Ubeyitogullari said the objective is for the 3D printer to deliver streams of encapsulated probiotic microgel beads with high precision and flexibility. These beads would be printed using "ink" made from probiotics that are precisely mixed with a gel-like starchy material made from corn.

The microbeads are then freeze-dried and coated with a layer of soluble lipids that allows the probiotics to be released at the right time and location—the colon—with the pH-sensitive alginate-pectin.

Lee noted they measure probiotics by cell counts—millions of cells per gram of food. Incorporating probiotics into microgel beads allows them to be weighed more precisely when making probiotic-filled foods.

More information: Safoura Ahmadzadeh et al, Designing future foods: Harnessing 3D food printing technology to encapsulate bioactive compounds, *Critical Reviews in Food Science and Nutrition* (2023). DOI: 10.1080/10408398.2023.2273446

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