

Brazilian company doubles shelf life of pasteurized fresh milk

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Agrindus, an agribusiness company located in São Carlos, São Paulo state, Brazil, has increased the shelf life of grade-A pasteurized milk from seven to 15 days.

This feat was achieved by incorporating silver-based nanoparticles with bactericidal, antimicrobial and self-sterilizing properties into the rigid plastic bottles used as packaging for the milk.

The technology was developed by Nanox, also located in São Carlos. Supported by FAPESP's Innovative Research in Small Business (PIPE) program, the nanotechnology company is a spinoff from the Center for Research and Development of Functional Materials (CDFM), one of the Research, Innovation and Dissemination Centers (RIDCs) supported by São Paulo Research Foundation (FAPESP).

"We already knew use of our antimicrobial and bactericidal material in rigid or flexible plastic food packaging improves conservation and extends shelf life. So we decided to test it in the polyethylene used to bottle grade A fresh milk in Brazil. The result was that we more than doubled the product's shelf life solely by adding the material to the packaging, without mixing any additives with the milk," said the Nanox CEO, Luiz Pagotto Simões.

According to Simões, the microparticles are included as a powder in the polyethylene preform that is used to make plastic bottles by blow or injection molding. The microparticles are inert, so there is no risk of

their detaching from the packaging and coming into contact with the milk.

Tests of the material's effectiveness in extending the shelf life of fresh milk were performed for a year by Agrindus, Nanox and independent laboratories. "Only after shelf life extension had been certified did we decide to bring the material to market," Simões said.

In addition to Agrindus, the material is also being tested by two other dairies that distribute fresh milk in [plastic bottles](#) in São Paulo and Minas Gerais and by dairies in the Brazilian southern region that sell fresh milk in flexible plastic packaging.

"In milk bags, the material is capable of extending shelf life from four to ten days," he said.

Nanox plans to market the product in Europe and the United States, where much larger volumes of fresh milk are consumed than in Brazil.

The kind of milk most consumed in Brazil is ultra-high temperature (UHT), or "long life" milk, which is sterilized at temperatures ranging from 130°C to 150°C for two to four seconds to kill most of the bacterial spores. Unopened UHT milk has a shelf life of up to four months at room temperature.

Whole milk, known as grade A in Brazil, is pasteurized at much lower temperatures by the farmer and requires refrigeration. "Doubling the [shelf life](#) of whole milk translates into significant benefits in terms of logistics, storage, quality and food safety," Simões said.

Countless applications

The silver-based microparticles developed by Nanox are currently being

used in several other products other than packaging for fresh milk, including plastic utensils, PVC film for wrapping food, toilet seats, shoe insoles, hair dryers and flatirons, paints, resins, and ceramics, as well as coatings for medical and dental instruments such as grippers, drills and scalpels.

But the company's largest markets today are makers of rugs, carpets, and white goods, such as refrigerators, drinking fountains and air conditioners.

"We've supplied several products to white goods manufacturers since 2007," Simões said. "This material is shipped to the leading players in the market." Nanox currently exports the product to 12 countries via local distributors in Chile, China, Colombia, Italy, Mexico and Japan, among others.

The company now wants to enter the United States, having won approval in 2013 from the Food & Drug Administration (FDA) to market the bactericidal material for use in food packaging.

"We've applied for clearance by the EPA [the Environmental Protection Agency] so that we can sell to a larger proportion of the US market," Simões said.

Neither Brazil nor the US has clear legislation on the use of particles at the nanometer scale [a billionth of a meter] in products that involve contact with food, so the company uses nanotechnology processes that result in silver-based particles at the micrometer scale [a millionth of a meter], he said.

The core of the technology consists of coating ceramic particles made of silica with silver nanoparticles. The silver nanoparticles bond with the ceramic matrix to form a micrometre scale composite with bactericidal

properties.

"The combination of silver particles with a ceramic matrix produces synergistic effects. Silver has bactericidal properties, and while silica doesn't, it boosts those of the silver and helps control the release of silver particles to kill bacteria," he said.

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