Probing changes to infant milk formulations

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Infant milk formula is a widely accepted alternative to breast milk for babies in their first year of life. Since breast milk contains all the nutrients required by young infants, formula manufacturers aim to closely match their product's ingredients to those of breast milk.

"Functional proteins in human milk are essential for key biological functions such as immune system development," explains Ruige Wu from the A*STAR Singapore Institute of Manufacturing Technology. "However, some of these proteins are not found, or are present at lower concentrations, in infant formula products compared to human milk."

Recently, some manufacturers began advertising that their products contained elevated levels of functional proteins, such as α-lactalbumin and immunoglobulin G. "The ability to measure these functional proteins is very important to control and monitor the quality of infant formula products," explains Wu. "Supplementation of formula products is expected to be regulated shortly."

Regulation of these products requires an easy and inexpensive quantitative method to detect low levels of functional proteins in milk, which also contains abundant other proteins. However, Wu explains that existing techniques, based on high-performance liquid chromatography (HPLC), use expensive equipment and time-consuming methods, with pretreatment alone taking several hours. She and her co-workers have now developed a microchip capillary-electrophoresis (CE)-based method that is cheaper, has a shorter assay time and eliminates the need for pretreatment.

Wu's team fabricated a custom-made, microfluidic-chip CE device. The device separates the functional proteins from other, more abundant proteins in the formula using isoelectric focusing. In this process, the proteins move through a gel with a pH gradient, and the point at which they stop on the gel depends on their charge. Since each protein has a slightly different charge, separation occurs. This takes just two minutes.

"The functional proteins are then transferred into the embedded capillary for further separation according to their mass-to-charge ratio," explains Wu. This capillary zone electrophoresis separation step takes 18 minutes.

The team then identified and measured the amount of protein present—while still on the CE column—using ultraviolet detection. "The concentrations of functional proteins are determined from the respective absorbance values and calibration curves," she says.

The reliability of the device was tested with infant milk formula samples spiked with known amounts of various functional proteins. "Results close to 100 per cent recovery were obtained," says Wu.

"Our next steps are to collaborate with industry partners in the manufacturing, or quality-control testing, of infant formula or similar protein rich products," she says.

More information: Wu, R., Wang, Z., Zhao, W., Yeung, W. S.-B. & Fung, Y. S. "Multi-dimension microchip-capillary electrophoresis device for determination of functional proteins in infant milk formula." *Journal of Chromatography A* 1304, 220–226 (2013). dx.doi.org/10.1016/j.chroma.2013.06.073

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