Digestive brilliance of breast milk unravelled

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Scientists have discovered that human breast milk forms into highly organized structures during digestion in the body.

The study by researchers from the Monash Institute of Pharmaceutical Sciences (MIPS) at Monash University has been published in the journal *Angewandte Chemie*.

Researchers believe this self-assembly process might be key to releasing the nutrients in human breast milk to ensure an infant's healthy development.

The findings, which show for the first time the structure of human breast milk during digestion, could potentially be used to develop new food supplements and nutritional formulas that are easily digested.

Funded by the Australian Research Council (ARC) and led by Dr Stefan Salentinig and Professor Ben Boyd from MIPS, and in collaboration with the Mercy Health Breastmilk Bank, the team looked at the nanostructure of milk to gain new insights into how milk interacts with the digestive system.

Lead researcher Professor Ben Boyd said while the nutritional value of human breast milk and other types of milk are well known, little research has been conducted into the detailed structure of milk during digestion and how the fats in milk interact with the digestive system until now.

"Human breast milk is key to the survival and development of humans, yet until now we had no idea of the rich structure formation when it is digested," he said.

"By finding out what happens to milk during digestion it will allow us to better understand how the essential nutritional components for building brain tissue and other parts of the body are absorbed. Potentially we could use these findings to design more effective food and nutritional supplements," Professor Boyd said.

The research team developed an 'artificial tummy' to simulate digestion, including tests that mimicked people with an underdeveloped digestive system such as a pre-term infant. The structures formed in the digesting milk were then studied using specialised instruments at the Australian Synchrotron, revealing that highly organised structures are formed from the by-products of milk when digested.

Professor Boyd said the results indicated that in people lacking normal mechanisms to aid digestion, the structure of milk adapts to overcome this. This finding may be particularly important for premature infants, whose digestive system is often not fully functional.

"We suspected that the fats in milk form structures to aid the digestive process but until now we've not been able to prove this. The Synchrotron was essential to this work because it allowed us for the first time to see what happens during the digestive process" he said.

"We need to do further work, but this study suggests that if you're lacking normal mechanisms to aid digestion, then there is a compensatory system present in human breast milk that adapts to allow those individuals to survive," Professor Boyd said.

The research into human breast milk builds on previous work by the MIPS team on cow's milk, which also revealed a highly organised structure.

Professor Boyd said the major difference between cow's milk and human breast milk is that with the latter it contains enzymes that enable the highly organised structures to form all on it's own. Whereas with cow's milk to induce digestion you have to add something – an enzyme called lipase, to kick-start the digestive process.

"Nevertheless in both cases, the highly organised structures are formed on digestion of mammalian milk, whereas subjecting soy milk to the same digestion process does not result in the formation of these structures," he said.

"The next step is to actively link the formation of these very interesting structures to the absorption of digestion products – we expect that different structures will have different abilities to transport and release

nutrients."

"Understanding this link will allow us to design more nutritious supplements and infant formulas, as well as give new insights into why these structures form under some conditions and not others," Professor Boyd said.

Provided by Monash University