Lotus seeds: Do they contain the ultimate prebiotic?

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Bio
Dr Xu Lu is an associate professor, School of Food Science at Fujian Agriculture and Forestry University, China, Deputy Director of the China-Ireland International Cooperation Food Material Science, and Director for Structural Design Center, China. Lu focuses on the extraction and structural characterisation of natural functional components, food storage technology, improvement of food physical properties, food product development, and food functional research.

Dr Yi Lei graduated from the Faculty of Food Science, Fujian Agriculture and Forestry University, China. She has devoted her post-graduate studies to the extraction, component analysis, and functional research of lotus seed polysaccharides.

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Further reading
You have probably heard of the terms 'prebiotic' and 'probiotic', but what do they actually mean? Probiotics are external bacteria which can be consumed and can help to bolster the bacteria which naturally occur in the gut. Scientists refer to the trillions of microorganisms living in the human gut as the gut microbiome. Probiotics help support the gut microbiome. Probiotics are important – research shows that the quality of the bacteria present in the microbiome massively impacts the human health. Prebiotics, on the other hand, come from fruits and vegetables and when eaten, provide a source of food for the probiotics in the gut.

Dr Xu Lu and Dr Yi Lei at Fujian Agriculture and Forestry University, China, have set out to uncover the potential of a popular medicinal plant seed from the lotus. They carried out experiments to find out whether the lotus seed could be developed as a prebiotic. Their work is particularly important, as there is currently a limited availability of prebiotics. Prebiotics and probiotics work together

Prebiotics are not easily digestible. However, instead of being discarded out of the body as waste, they are transported to the colon where they are gradually broken down to supply the gut microbiome (probiotics) with the nutrition that it requires to thrive. As the gut bacteria break down probiotics, a product called short-chain fatty acids is produced. Previous evidence suggests that these short-chain fatty acids can be beneficial for protecting the colon from damage. Healthy gut bacteria are also thought to aid in the digestion of minerals, such as calcium and magnesium.

Good sources of prebiotics help promote healthy probiotics, and, in turn, lower inflammation and have beneficial effects on the immune system, metabolism, and control of blood sugar. Prebiotics may also aid in weight loss by balancing the microbiome and thus reduce cravings for unhealthy foods. Currently, only a few oligosaccharides used as prebiotics are available. However, there are many other potential sources of prebiotic oligosaccharides which could be harnessed for human health.

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Lotus seed oligosaccharides
Plants are an important source of natural prebiotics, and are known as prebiotic oligosaccharides. The term oligosaccharide simply refers to a carbohydrate which is composed of three to ten sugars. This puts oligosaccharides bang in the middle between a simple sugar and a complex sugar. Some examples of common prebiotics extracted from plants include hawthorn and grape seeds. The oligosaccharides can be extracted from plant material such as orange-peel using enzymes, using a process called hydrolysis.

Lotus seeds have a long history of being used in traditional medicine for benefits on the gut and immune system. They are known to stimulate bowel movement and encourage the growth of healthy bacteria within our gut. Despite the widespread use of traditional methods, there is currently a limited availability of prebiotics. Prebiotics are external bacteria which can be consumed and can help to bolster the bacteria which naturally occur in the gut. Prebiotics come from fruits and vegetables and when eaten, provide a source of food for the probiotics in the gut.

While probiotics are the healthy gut bacteria, prebiotics are the bacteria’s food source derived from plant carbohydrate.
NMR analysis of lotus seed oligosaccharides recorded in D2O solution.

There is an urgent need to extract prebiotic oligosaccharides from more accessible sources as current commercial availability is limited.
Are there any other sources of prebiotic oligosaccharides that you are planning to research other than lotus seeds?

Firstly, we plan to research natural plants such as vegetables, fruits, grains, and legumes. Prebiotic oligosaccharides have attracted an increasing amount of attention due to their physiological importance and functional impact on human health, as well as physicochemical properties. As we know, oligosaccharides are present in small amounts in many natural plants, including vegetables, fruits, grains, and legumes. Therefore, prebiotic oligosaccharides can be extracted from these natural plants.

Secondly, we will investigate seaweed. Seaweed is rich in polysaccharides which are different from polysaccharides of land plants. Seaweed polysaccharides are mostly rich in sulfuric acid groups, which makes them have unique biological activities, such as improving immunity and lowering blood lipids, so they have extremely high application value in the fields of health, food, and medicine. As the degradation products of seaweed polysaccharides, seaweed oligosaccharides as a prebiotic has gradually attracted attention. Most seaweed oligosaccharides cannot be digested by the digestive enzymes in the human gastro–gut tract, but are fermented and converted to short-chain fatty acids (SCFAs) by bacteria in the gut. Then, seaweed oligosaccharides can selectively enhance the activity of some beneficial bacteria and stimulate a series of prebiotic effects. However, the exact structure of seaweed oligosaccharides and their prebiotic activity have largely remained unexplored and thus warrant further investigation.

What would be the next steps to fully elucidate the functioning of lotus seeds to develop a probiotic?

Based on the relationship between gut microbiome and host metabolism, the probiotic effect of lotus seeds oligosaccharides on high-fat diet mice will be studied to provide a reference for further development of probiotic products that can improve metabolism.

Why do you think the gut microbiome has such an important impact on our health?

The human gastro-gut tract have a wide variety of microbiome, including bacteria, fungi, and viruses. Most of them are distributed in the gut, and the number is roughly equivalent to the number of cells in the human body. Only 10–20% of the bacteria in the human gut are identical to other people. Other microbiome vary from person to person, depending on diet, lifestyle, and other genetic factors. The microbiome affects a person’s health, appetite, weight, and mood. Generally speaking, the gut microbiome is a complex ecosystem which participates in the physiological and pathological processes of the human body, and forms a state of dynamic balance. If this balance is broken, it may lead to and aggravate the occurrence and development of diseases.