III Міжнародна науково-практична інтернет-конференція

ПРОБЛЕМИ ТА ДОСЯГНЕННЯ СУЧАСНОЇ БІОТЕХНОЛОГІЇ

24 березня 2023 р.
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Effective probiotics' delivery system: problems and perspectives

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The development of an effective probiotic delivery system depends on understanding the nature of the harsh conditions to which it is exposed before and after ingestion. A number of physicochemical factors affect the viability of probiotics during the production of functional foods based on them, as well as their storage, transportation, and passage through the GIT.

The most important challenges in designing optimal probiotic delivery systems are:

- In the preparation process, the use of ingredients or processes that adversely affect the viability of probiotics (organic solvents, strong acids or bases, surfactants, excessive heat, intense mechanical stress, and aeration) should be avoided. For many foods, heat treatment is used to inactivate pathogens and spoilage organisms, but these processes can also inactivate probiotic microorganisms. Therefore, it is necessary to select or create heat-resistant strains of probiotic microorganisms for their further microencapsulation.
- Many colloidal delivery systems designed to encapsulate small molecules can't be used for probiotics because the particles are too small to contain bacteria. Microbial cell sizes typically range from 1 to 10 μM, while many colloidal delivery systems contain particles smaller than 1 μM, such as microemulsions, nanoemulsions, and biopolymer nanoparticles. Moreover, the concentration of viable probiotic microorganisms present in commercial products should typically be greater than 6—7 log10 CFU/g, which means that the loading capacity of any colloidal delivery system should be higher. Probiotics can be encapsulated in tablets or capsules that are large enough to encapsulate a large quantity of probiotics. However, probiotics included in tablets or capsules may not enter the human colon in a viable form because they are too large to pass directly through the pyloric sphincter. Instead, they break down and

release probiotic microorganisms in the stomach, where they are susceptible to degradation due to harsh conditions. Moreover, if probiotic microorganisms are encapsulated in too large colloidal particles, they can adversely affect the sensory and textural properties of products.

- Many delivery systems previously developed to encapsulate probiotic microorganisms do not provide adequate protection during storage and passage through the gut. Any probiotic microorganism delivery system must be designed so that the probiotics are released in the colon to fully realize their health benefits. Probiotic microorganisms must adhere to and colonize the colonic mucosa, otherwise, they will transit through the human body.

Due to the importance of the intestinal microbiota for human health, as well as the increasing number of negative factors affecting the microbiota of the host organism, the development of systems for the oral delivery of microencapsulated active viable probiotic microorganisms to the large intestine is one of the important tasks of modern biotechnology. Microencapsulation of probiotics into polymer microcapsules successfully protects them from aggressive and changing conditions of the GIT, and also allows the delivery of living cells of probiotic microorganisms without loss of their functional activity to the target biotope of the host organism. Microcapsules also protect probiotic cells during storage over a wide range of temperatures and can significantly extend the shelf life of the final product. Joint microencapsulation of prebiotics with probiotic microorganisms can further increase the survival of the latter during storage and passage through the GIT. It has been shown that alginate is an ideal biopolymer material for microencapsulation of probiotic microorganisms for targeted delivery of them to the intestine. Alginate is biocompatible, environmentally friendly, has a low cost, and, most importantly, is characterized by ease of use. Thus, the development of functional foods enriched with microencapsulated probiotic microorganisms as effective means of maintaining and restoring the intestinal microbiota is one of the urgent and important tasks of modern science.