S-layer proteins and bacteriocins in probiotics as living drugs - impact on microbiota

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Abstract

S-layer proteins and bacteriocin synthesis were tested in a large sample of autochthonous lactic acid bacteria (LAB). Only four Lactobacillus brevis strains express S-layer proteins, according to analyses of bacterial surface proteins using SDS-PAGE, 2D-PAGE, and PCR with specific primers for slp genes, while only three Lactobacillus plantarum strains were confirmed as bacteriocin producers using antibacterial activity assays and PCR with specific primers for genes encoding various bacteriocins. Although the biological activities of Lactobacillus S-layer proteins are unknown, our findings show that they mediate bacterial adhesion to intestinal epithelial cells and extracellular matrix proteins, as well as regulate the immune response, both of which are significant probiotic features. When employed as a mixed culture, the S-layer protein carrying strain and the bacteriocin generating strain had a significant impact on the microbiota composition of rats used as Alzheimer's disease animal models. Purified S-layer proteins from the L. brevis SF9B strain were discovered using the LC/MS technique, with a MW of 50.9 kDa and a pI of 9.54, and their secondary structure was predicted using I-TASSER modelling. The fact that pure S-layers are stable at non-physiological pH and protect cells from a variety of stresses offers up an intriguing possibility in the creation of vehicles for the oral delivery of pharmaceuticals or vaccinations, especially given LAB's GRAS status (Generally Regarded as Safe). Publications of Late 1. eme H., Bogovi Matijai B., Vigelj K., Langerholc T., Fujs S., Horvat J., Zlati E., Gjurai K., Petkovi H., tempelj M., Kos B., ukovi J., Kosec G. (2017) Generation of Lactobacillus plantarum strains with improved potential to target gastrointestinal disorders related to sugar malabsorption. Food Research. Hana Uranská, Peter Raspor, Ksenija Uroi, Nataa Goli, Blaenka Kos, Sanja Mihajlovi, Jelena Begovi, Jagoda Ukovi, Ljubia Topisirovi, and Nea Ade (2016) Folia Microbiol, Characterization of the yeast and mould biota in traditional white pickled cheeses using culture-dependent and independent molecular methods. 61:455–463. 3. Uroić, K., Beganović, J., Hynönen, U., Pietilä, T. E., Leboš Pavunc, A., Kant, R., Kos, B., Palva, A., Šušković, J. (2016) The role of S-layer in adhesive and immunological properties of probiotic starter culture Lactobacillus brevis D6 isolated from artisanal smoked fresh cheese. LWT - Food Sci. Technol. 69: 623-632. 4. M. Gačić, N. Bilandžić, Đ. Ivanec Šipušić, M. Petrović, B. Kos, N. Vahčić, J. Šušković (2015) Degradation of Oxytetracycline, Streptomycin, Sulphathiazole and Chloramphenicol Residues in Different Types of Honey, Food Technol. Biotechnol. 53 (2) 154–162. 5. M. Zivkovic, N. Cadez, K. Uroic, M. Miljkovic, M. Tolinacki, P. Dousova, B. Kos, J. Suskovic, P. Raspor, Lj. Topisirovic, N. Golic (2015) Evaluation of probiotic potential of yeasts isolated from traditional cheeses manufactured in Serbia and Croatia,

Food is a fundamental human need that satisfies an individual's nutritional requirements. Non-nutrient components, such as lipids, carbs, and proteins, provide energy for development and maintenance (fiber, phytochemicals, antioxidants, vitamins, minerals, probiotics, prebiotics, etc.) favourably modulate the host physiology and global epigenetic imprints to improve human health Nutraceuticals, foodiceuticals, functional foods, and medifoods are examples of foods that include active components that regulate disease-controlling processes as prophylactics or treatments. Probiotics, prebiotics, phytochemicals or herbs, natural antioxidants, bioactive peptides, and other health-promoting bioactive components have emerged as a result of intense innovation in the field of functional food. The presence of these active biologicals in food, either naturally or by external fortification, indicates that the meal is functional. Japan is the first country to propose legislation establishing specialised regulatory approval procedures for functional foods labelled as Food for Special Health Purposes (FOSHU). Following that, several other countries, including the US Federal Food and Drug Administration in the United States (USA), the Food Safety and Standards Authority of India (FSSAI) in India, and others, have structured their regulatory enforcement actions and civil litigations to govern regulatory issues regarding functional foods, China Food and Drug Administration (CFDA) in China, European Union (EU) in Europe, National Sanitary Surveillance Agency (NSSA) in Brazil, etc. Functional foods are described as "any food that, in addition to its nutritional content, has a favourable influence on an individual's health, physical performance, or state of mind." It should also be used to manage a specific bodily process, such as enhancing biological defence systems, preventing certain diseases, controlling physical and mental illnesses, and reducing the ageing process. These functional foods, on the other hand, can be classified as natural, converted, fortified, or improved foods. Probiotics are one of the most extensively researched and used functional dietary components. Probiotics are described as "live microorganisms that bestow a health benefit on the host when provided in suitable doses." The probiotic genera Lactobacillus and Bifidobacterium have been investigated the most. Regardless of their safety concerns, the Bacteroides and Clostridium genera are emerging as next-generation probiotics. Despite its numerous health advantages, research on probiotics has shown a number of drawbacks, including unclear molecular processes, strain-specific characteristics, and short-term effectiveness. Probiotics' niche-

specific activity (allochthonous or autochthonous), antibiotic resistance, virulence gene transfer, equivocal positive effects, challenges with viability and stability in the manufacturing process, a barrier to commensal gut microbiota colonisation Significant constraints include the potential to induce opportunistic infections, inflammatory response infective endocarditis, sepsis, bacterial translocation to tissue or blood, and bacteremia in immunocompromised people. Postbiotic components formed from probiotics are likely to be a desirable and promising alternative supplement for human health and wellbeing in order to solve such concerns.

Biography

Blaženka Kos has years of experience in research, evaluation and teaching in the field of biotechnological production of enzymes, antibiotics, probiotics and starter cultures at the Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia. Her scientific work covers different fields of biotechnology, especially industrial microbiology. The main area of her research is production and application of probiotics as living drugs and selection of strains within the probiotic concept. Microencapsulation technologies, as a useful tool to improve the delivery of probiotics and functional starter cultures, are of her special scientific interest

This work is partly presented at 8th World Congress on Biopolymers & Bioplastics

June 28-29, 2018 | Berlin, Germany