

Probiotics, prebiotics and plant antioxidants as functional food compounds: biotechnological methods of production and evaluation

Włodzimierz Grajek

Department of Biotechnology and Food Microbiology, August Cieszkowski Agricultural University of Poznań, ul. Wojska Polskiego 48, 60-627 Poznań, Poland, grajek@au.poznan.pl

One of the main fields of research carried out in our Department is functional foods. Our investigations are focused on probiotics and prebiotics as well as on plant antioxidants. Poland is the UE country with good developed and competitive agriculture and food industry, producing foods of the highest quality and low contamination with xenobiotics. In this context, our research has a good scientific and national background.

Our research on the prebiotics includes two projects: (1) isolation of α -oligogalactans from the seeds of pea, lupine and lentils and (2) enzymatic synthesis of oligosaccharides using hydrolases and transferases. In view to obtain oligosaccharide prebiotics, we investigated also the synthesis of oligosaccharides using hydrolases and high concentration of sugar substrates and transferases from *Streptococcus mutans*. The first process based on the galactosyl transferase activity of beta-galactosidases from *Aspergillus oryzae* and *Kluyveromyces lactis*. The maximum yield of oligosaccharide synthesis reached 30% using the *A. oryzae* enzyme, and 16 % using enzyme from yeasts. The second process based on the CGT-ase from *Thermoanaerobacter* allowed obtaining the oligosaccharides of DP6-DP8 with the yield over 50% on the basis of maltose.

Some other projects are focused on the lactic acid bacteria belonging to the specimens, which include probiotic strains. The main problem investigated are: (1) biosynthesis of bacteriocins by lactic and propionic acid bacteria, (2) examination of bacteriocin preparations in the protection of food against pathogenic bacteria, (3) adherence of lactic acid bacteria to the solid surfaces, including human intestinal cell line models, (4) elaboration of new model of epithelial cell cultures to study anaerobic, probiotic bacteria, (5) computer image analysis of cell shape changes caused by stress culture conditions, and (6) technological aspects of production of bacteria preparates: encapsulation, membrane filtration and spray drying. We have isolated many bacteria able to produce bacteriocins with an antibacterial and antifungal activities. The main interest is focused to the bacteriocins of *Carnobacterium* sp. We have elaborated a technology of divercin and cell biomass (starter culture) production in pilot plant scale.

Our investigations on the probiotic properties of lactic acid bacteria are based on the in vitro epithelial cell cultures as a model to study bacteria adhesion, as well as the anticarcinogenic, antimutagenic and antiallergenic activities of bacteria and food compounds. We have elaborated a new, accelerated method of the Caco-2 culturing, which allows ending the epithelial cell culture in 6 days. This model was used to study the cell adhesion and other probiotic properties.

The second part of our investigation on functional foods is directed to the plant antioxidants. The research program includes the following problems: the chemical changes of antioxidants during food processing, chemical changes related to enzymatic digestion in alimentary tract using the in vitro models, and bioavailability of antioxidants using epithelial cell cultures as an in vitro model. The key parameter studied is antioxidant potential of foods. We investigate the antioxidant changes and bioavailability, which are contained in red beet, broccoli, pea and bean, and rape oil.