PROBIOTICS AS A FUNCTIONAL FOOD

Presented by

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INTRODUCTION

- There is already a wide range of foods available to today's consumer but now the impetus is to identify those functional foods that have the potential to improve health and well-being, reduce the risk from, or delay the onset of, major diseases such as cardiovascular disease (CVD), cancer and osteoporosis.
- Combined with a healthy lifestyle, functional foods can make a positive contribution to health and well being.
- Functional foods are foods that have a potentially positive effect on health beyond basic nutrition. Functional foods promote optimal health and help reduce the risk of disease.
- Examples of functional foods include foods that contain specific minerals, vitamins, fatty acids or dietary fibre, foods with added biologically active substances such as phytochemicals or other antioxidants and **probiotics** that have live beneficial cultures.

- Majority of the probiotic foodstuffs are categorized as functional foods. It has been predicted that probiotic foods comprise about 60–70% of the total functional food market.
- Probiotics are good or friendly bacteria that found in the gut and provide a number of health benefits to the host.
- Probiotics are viable microorganisms that either enhance or maintain a beneficial balance of the autochthonous microbial population of the gastrointestinal tract.
- Such kind of microflora may not essentially be the constant resident of the gastrointestinal tract but they should have valuable effects on the health of humans and animals (Fuller, 1989).
- Intake of probiotics stimulates the growth of beneficial microorganisms and reduces the number of the harmful pathogens. Thus, improve the intestinal balance of the host and reduce the risk of gastrointestinal disorders.

CONCEPT OF FUNCTIONAL FOOD

- The functional food concept was developed in Japan at the early 1980s and as food for specified health use (FOSHU) was established in 1991.
- Functional food can be defined as any food or ingredient that has a positive impact on an individuals health, physical performance or state of mind, in addition to its nutritive value.
- Functional food should be naturally occurring, can be consumed as apart of daily diet and when ingested should enhance or regulate a particular biological process or mechanism to prevent or control specific disease.

WHY DO WE NEED FUNCTIONAL FOODS?

- Consumer interest in the relationship between diet and health has increased substantially. There is much greater recognition today that people can help themselves and their families to reduce the risk of illness and disease and to maintain their state of health and well being through a healthy lifestyle, including the diet.
- Ongoing support for the important role of foods such as fruits and vegetables and wholegrain cereals in disease prevention and the latest research on dietary antioxidants and combinations of protective substances in plants has helped to provide the impetus for further developments in the functional food market in Europe.

WHY ALL THE INTEREST

- Rapid advances in science and technology

  e.g., biotechnology and nutrigenomics
- Evidence linking diet to chronic disease risk
- Desire to attain wellness through diet
- Aging population
- Healthcare costs
- Changes in food laws e.g., label and product claims

FUNCTIONAL FOOD IS BIG BUSINESS

- Health conscious consumers are driving the demand for the development and promotion of products that

1. Promote wellness
2. Increase longevity
3. Prevent or manage chronic disease

- US sales of functional foods continue to increase, weathering economic downturn netter than other food categories
- Asia-pacific also has a large market
- Brazil has strong market potential
- The world market for functional food and drinks is expected to reach $130 billions by 2016.
- Functional foods market growth is driven by product innovation and growing population of health conscious consumers.

CATEGORIES OF FUNCTIONAL FOODS

1. Conventional foods (Whole foods) – Garlic, nuts and tomatoes
2. Modified foods-

- Fortified- Isodised salt
- Enriched- Folate enriched breads
- Enhanced- Energy bars, snacks and yogurts formulated with bioactive compounds

3. Foods for special dietary use- infant foods, weight loss food, gluten free foods and lactose free foods

Today, functional food ingredients consists of probiotics, prebiotics, vitamins and minerals; which are currently used for human consumption in the form of fermented milks and yogurts, sports drinks, baby foods, sugar-free confectionery and chewing gum.

WHERE DOES FUNCTIONAL FOODS PLAY A ROLE

- The FUFOSE (Functional Food Science in Europe) and PASSCLAIM (Process for the Scientific Support for Claims on Foods) activities reviewed several aspects of human health and well being from the perspective of the availability of target functions that might be susceptible to dietary influence. The concept was tested and evaluated to provide an initial characterization of the evidence base supporting innovation and the development of functional foods and any claims associated with them. Some of these are discussed below in order to illustrate the concept of food functionality:
- Early development and growth
- Regulation of energy balance and body weight
- Cardiovascular function
- Defence against oxidative stress
- Intestinal function-the gut microflora
- Mental state and performance

PROBIOTICS

- The term probiotic comes from the Latin or Greek pro, “before, forward”and bios, or “life”- thus probiotic are life promoting.
- According to World Health Organization and Food and Agriculture Organization of the United Nations probiotics are “live microorganisms, which when administered in adequate amounts, confer health benefits to the host”.
- According to the American Food and Drug Administration, LAB are generally regarded as safe (GRAS) due to their long history of safe use in fermented foods and their presence in the human beings.
- Microorganisms such as *Bifidobacterium*, *Bacillus*, *Lactobacillus and Sachharomyces cerevisiae* are found in the most commercial probiotic products.
- Being as a probiotic it must survive passage through the upper gastrointestinal tract and have the ability to function in the gut.

SELECTION CRITERIA AND REQUIREMENTS FOR PROBIOTIC STRAINS

- According to the suggestions of the WHO, FAO, and EFSA (the European Food Safety Authority), in their selection process, probiotic strains must meet both safety and functionality criteria.
- The safety of a strain is defined by its origin, the absence of association with pathogenic cultures, and the antibiotic resistance profile. Functional aspects define their survival in the gastrointestinal tract and their immunomodulatory effect.

1. Safety

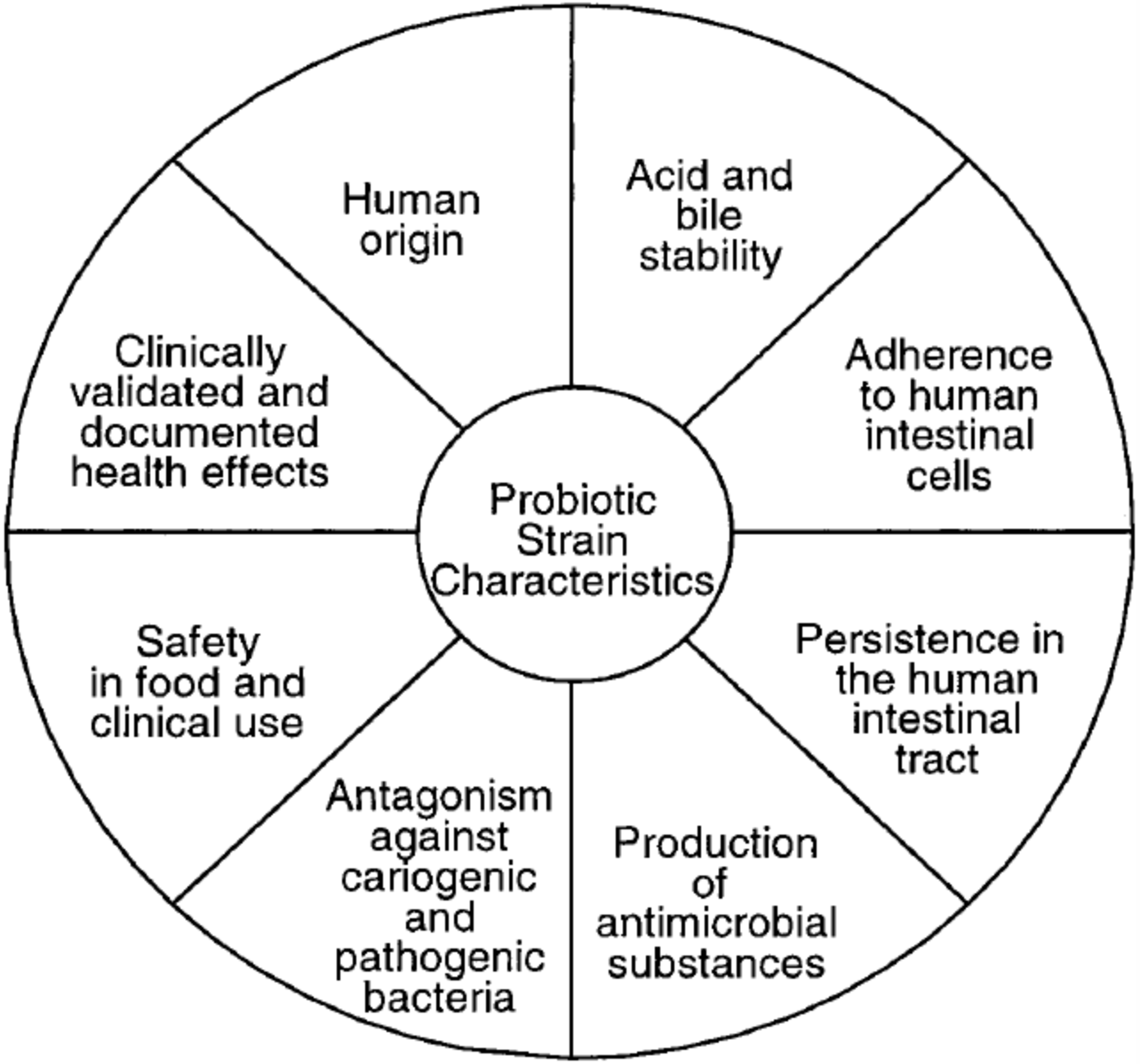
- Human or animal origin.
- Isolated from the gastrointestinal tract of healthy individuals.
- History of safe use.
- Precise diagnostic identification (phenotype and genotype traits).
- Absence of data regarding an association with infective disease.
- Absence of the ability to cleave bile acid salts.
- No adverse effects

2. Functionality

- Competitiveness with respect to the microbiota inhabiting the intestinal ecosystem.
- Ability to survive and maintain the metabolic activity, and to grow in the target site.
- Resistance to bile salts and enzymes.
- Resistance to low pH in the stomach.
- Competitiveness with respect to microbial species inhabiting the intestinal ecosystem (including closely related species).
- Antagonistic activity towards pathogens (e.g., *H. pylori*, *Salmonella* sp., *Listeria monocytogenes*, *Clostridium difficile*).
- Resistance to bacteriocins and acids produced by the endogenic intestinal microbiota.
- Adherence and ability to colonise some particular sites within the host organism, and an appropriate survival rate in the gastrointestinal system

3. Technological usability

- Easy production of high biomass amounts and high productivity of cultures.
- Viability and stability of the desired properties of probiotic bacteria during the fixing process (freezing, freeze-drying), preparation, and distribution of probiotic products.
- High storage survival rate in finished products (in aerobic and micro-aerophilic conditions).
- Guarantee of desired sensory properties of finished products (in the case of the food industry).
- Genetic stability.
- Resistance to bacteriophages.


Probiotic Strain Characteristics
Human origin
Acid and bile stability
Adherence to human intestinal cells
Persistence in the human intestinal tract
Production of antimicrobial substances
Antagonism against cariogenic and pathogenic bacteria
Safety in food and clinical use
Clinically validated and documented health effects

PROBIOTIC MICROORGANISMS

- Probiotic products may contain one or more selected microbial strains. Human probiotic microorganisms belong mostly to the following genus: *Lactobacillus*, *Bifidobacterium*, and *Lactococus*, *Streptococcus*, *Enterococcus*.
- Moreover, strains of Gram-positive bacteria belonging to the genus *Bacillus* and some yeast strains belonging to the genus *Saccharomyces* are commonly used in probiotic products.
- In the USA, microorganisms used for consumption purposes should have the GRAS (Generally Regarded As Safe) status, regulated by the FDA (Food and Drug Administration)

LIST OF PROBIOTIC MICROORGANISM

Microorganisms	Genus	Species
Bacteria	*Lactobacillus*	*L.acidophilus, L.brevis, L.reuteri, L.casei, L.rhamnosum, L.bulgaricus, L.cellobiosus, L.delbrueckii, L. fermentum.*
	Bifidobacterium	*B.thermophilus, B.infantis, B .longum, B.bifidum, B.animalis.*
	Streptococcus	*S.lactis, S.thermophilus, S.cremonis, S.alivarius.*
	Bacillus	*B.Coagulans*
	Pediococcus	*P.acidilactici*
	Leuconostoc	*L.mesenteroides*
	Enterobacter	*E.faecium, E.faecalis.*
Fungi	*Aspergillus*	*A.niger, A.oryzae.*
Yeast	*Saccharomyces*	*S.boulardii, S.cerevisiae, S.carlsbergensis.*

MECHANISM OF ACTION OF PROBIOTICS

Probiotics have numerous advantageous functions in human organisms. Live microorganisms meeting the applicable criteria are used in the production of functional food and in the preservation of food products.

- Their positive effect is used for the restoration of natural microbiota after antibiotic therapy.
- A positive effect of probiotics on digestion processes, treatment of food allergies, candidiases, and dental caries.
- Antagonism through the production of antimicrobial substances ;
- Competition with pathogens for adhesion to the epithelium and for nutrients.
- Immunomodulation of the host
- Inhibition of bacterial toxin production

- Probiotic bacteria (e.g., *Lactobacillus* and *Bifidobacterium*) produce the so-called de-conjugated bile acids (derivatives of bile acids), demonstrating stronger antibacterial effect than the bile salts produced by their host.

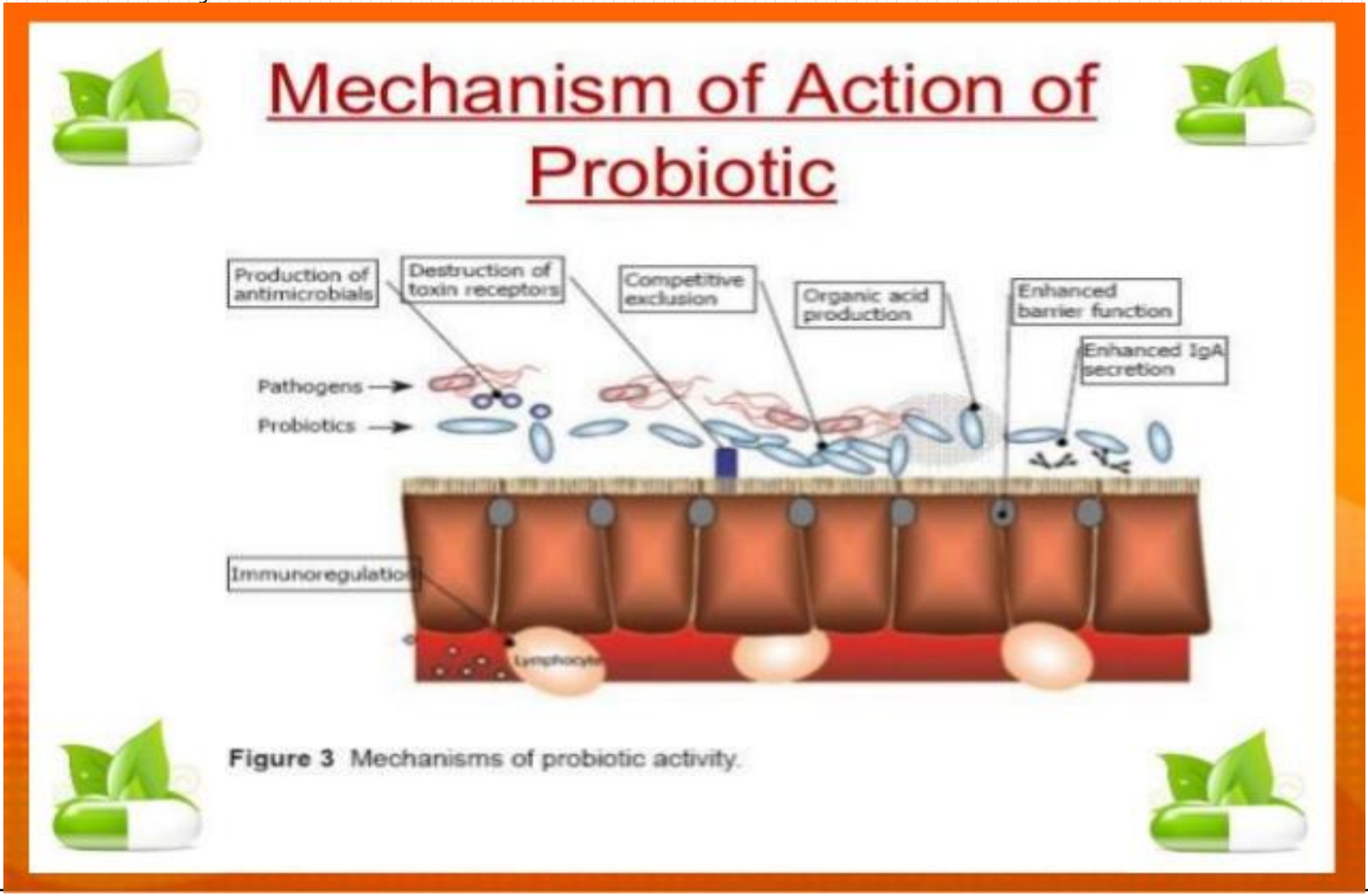
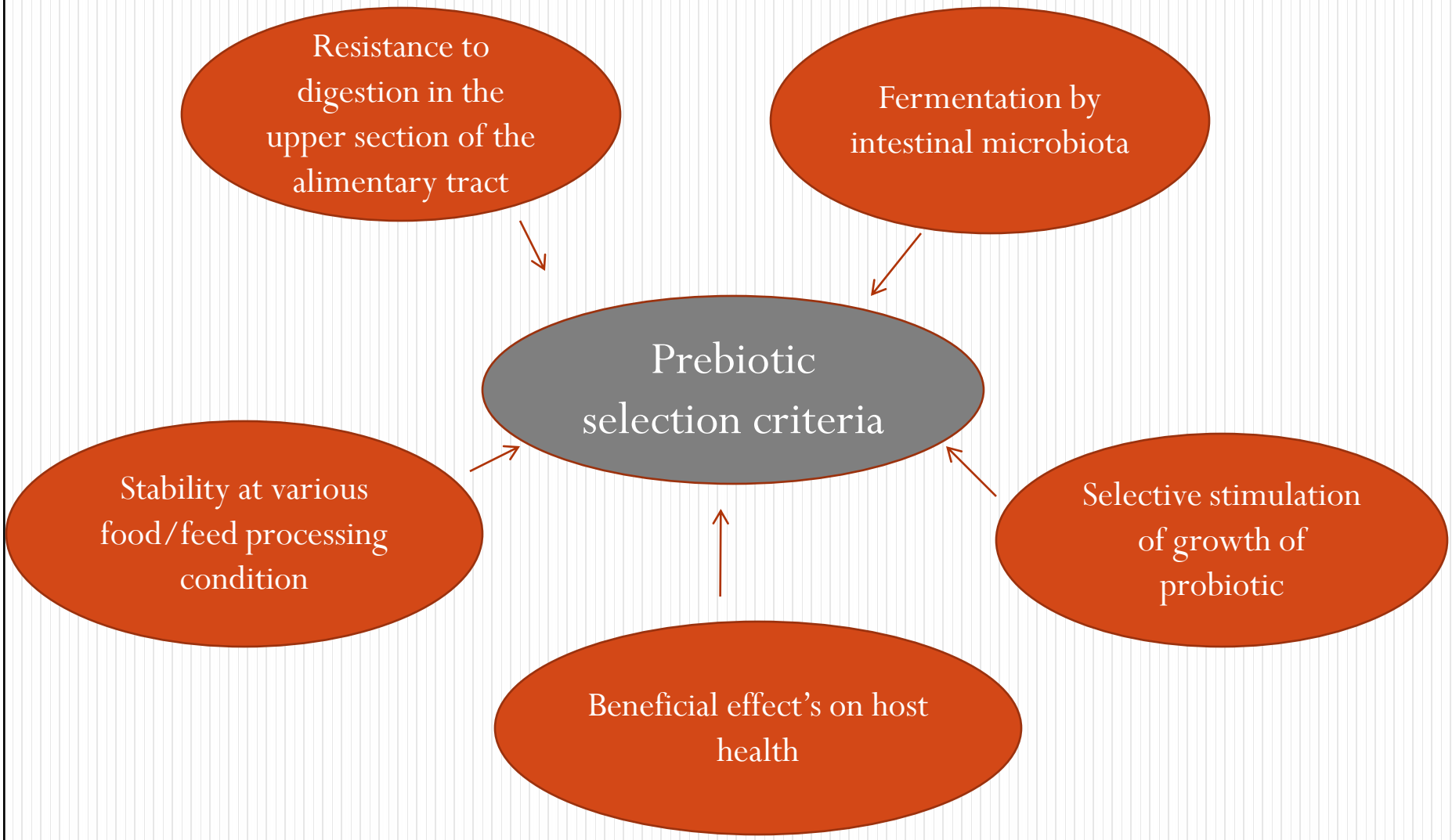


Figure 3 Mechanisms of probiotic activity.

PREBIOTIC

- Non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon that can improve host health.
- Fruit, vegetables, cereals, and other edible plants are sources of carbohydrates constituting potential prebiotics.
- The following may be mentioned as such potential sources: tomatoes, artichokes, bananas, asparagus, berries, garlic, onions, chicory, green vegetables, legumes, as well as oats, linseed, barley, and wheat.
- Some artificially produced prebiotics are, among others: lactulose, galactooligosaccharides, fructooligosaccharides, maltooligosaccharides, cyclodextrins, and lactosaccharose.

PREBIOTIC SELECTION CRITERIA



SYNBIOTIC

- Synbiotics is a combination of probiotics and prebiotics products which provide the survival and the implantation of the live microorganism dietary supplements in the gut.
- *Lactobacillus* spp., *Bifidobacteria* spp., *S. boulardii, B. coagulans* are one of the probiotic strains that are used in synbiotic formulations, whereas the prebiotics used are as follows: oligosaccharides (fructooligosaccharide (FOS), GOS and xylo-seoligosaccharide (XOS)), and inulin (from natural sources like chicory and yacon roots)
- The health benefits claimed by synbiotics consumption by humans include: 1) Increased levels of lactobacilli and bifidobacteria and balanced gut microbiota,

  2) Improvement of liver function in cirrhotic patients,

  3) Improvement of immunomodulating ability,

  4) Prevention of bacterial translocation and reduced incidences of nosocomial infections in surgical patients etc.

RESEARCH CHALLENGES FOR FUNCTIONAL FOODS

- Key research challenges for functional foods are the need to identify new functional food ingredients and to gain consumer acceptance of such products. In particular, research needs to:
- Identify potential functional ingredients that could provide benefits in terms of health and well-being;
- Identify individual biological responses to functional foods;
- Define the bioavailability of functional food ingredients;
- Develop appropriate biomarkers for a wider range of functional endpoints;
- Develop the potential utility of nutrigenomics, bioinformatics, proteomics, metabolomics and nanotechnology in the development of functional foods;

- Anticipate demand for personalised nutrition and the potential role of functional foods;
- Ensure stability of functional food ingredients during manufacturing and passage through the GI tract to reach the target organ intact;
- Establish Dietary Reference Intakes (DRIs) for a wider range of nutrients to enable commercial exploitation of more functional components

CONCLUSION

- Globally, probiotics represent the novel buzzword in human dietary selection and are at present the main focus because of their vast health potential.
- Probiotics and prebiotics share unique roles in human nutrition, largely centered on manipulation of populations or activities of the microbiota that colonize the human GI tract.
- Regular consumption of probiotics or prebiotics has health implications that include enhanced immune function, improved colonic integrity, decreased incidence and duration of intestinal infections, down-regulated allergic response, and improved digestion and elimination.
- Functional foods offer great potential to improve health and/or help prevent certain diseases when taken as part of a balanced diet and healthy lifestyle.

- The research opportunities in nutrition to explore the relationship between a food or a food component and an improved state of health and well-being, or reduction of disease, present the greatest challenge to scientists now and in the future.
- The communication of health benefits to consumers is also of critical importance so that they have the knowledge to make informed choices about the foods they eat and enjoy.


Thank you...