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PROBIOTICS- A REVIEW ARTICLE

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ABSTRACT
Probiotics, live cells with different beneficiary characteristics, have been extensively studied and explored commercially in many different products in the world. Their benefits to human and animal health have been proven in hundreds of scientific research. *Lactobacillus* and *Bifidobacterium* are the main probiotic groups; however, there are reports on the probiotic potential of *Pediococcus, Lactococcus, Bacillus* and yeasts. Some of the identified probiotic strains exhibit powerful anti-inflammatory, antiallergic and other important properties. Apart from that, the consumption of dairy and non-dairy products stimulates the immunity in different ways. Various food matrices have been used with probiotics, which are briefly documented. In this review, the history of probiotics, their application in the health and food areas and new trends in probiotic products and processes are presented.

KEYWORDS: probiotics, intestinal microflora, *Bifidobacterium*, *Lactobacillus*, immune stimulation, probiotic production, food carriers, dairy products, non-dairy products

INTRODUCTION
Probiotic is a relatively new word meaning 'for life', which is used to name microorganisms that are associated with the benefical effects for humans and animals. These microorganisms contribute to intestinal microbial balance and play a role in maintaining health. The probiotic microorganisms consist mostly of the strains of the genera *Lactobacillus* and *Bifidobacterium*, but strains of *Bacillus, Pediococcus* and some yeasts have also been found as suitable candidates. Together they play an important role in the protection of the organism against harmful microrganisms and also strengthen the host's immunesystem. Probiotics can be found in dairy and non dairy products. They are usually consumed after the antibiotic therapy (for some illnesses), which destroys the microbial flora present in the digestive tract (both the useful and the targeted harmful microbes). Regular consumption of food containing probiotic microorganisms is recommended to establish a positive balance of the population of useful or beneficial microbes in the intestinal flora.

Probiotic Microorganisms
The probiotic potential of different bacterial strains, even within the same species, differs. Different strains of the same species are always unique, and may have differing areas of adherence (site-specific), specific immunological effects, and actions on a healthy *vs.* an inflamed mucosal milieu may be distinct from each other. Current probiotic research aims at the characterization of the normal, healthy gut microbiota in each individual, assessing the species composition as well as the concentration of different bacteria in each part of the intestine. The target is to learn to understand host–microbe interactions within the gut, microbe–microbe interactions within the microbiota and the combined health effects of these interactions. The goal is to define and characterize the microbiota both as a tool for nutritional management of specific gut-related diseases and as a source of new microbes for future probiotic bacteriotherapy applications.

This may eventually include organisms specifically isolated to provide site-specific actions in disorders such as the irritable bowel syndrome. According to Shah and Chow the most popular strains are represented by the following genera: *Lactobacillus*, *Streptococcus*, and *Bifidobacterium*, but other organisms including enterococci and yeasts have also been used as probiotics. Some of these strains have been chosen based on selection criteria that are believed to be important for their efficacy such as origin of strain, *in vitro* adherence

to intestinal cells and survival during passage through the gastrointestinal tract.

The genus Bifidobacterium

Bifidobacteria were first isolated and described in 1899–1900 by Tissier, who described rod-shaped, non-gas-producing, anaerobic microorganisms with bifidobacterial morphology, present in the faeces of breast-fed infants, which he termed *Bacillus bifidus*. Bifidobacteria are generally characterized as Gram-positive, non-spore forming, non-motile and catalase-negative anaerobes. They have various shapes including short, curved rods, club-shaped rods and bifurcated Y-shaped rods. Presently, 30 species are included in the genus *Bifidobacterium*, of which are from human sources (dental caries, faeces and vagina), from animal intestinal tracts or rumen, two from wastewater and one from fermented milk.

Bifidobacteria are microorganisms of paramount importance in the active and complex ecosystem of the intestinal tract of humans and other warm-blooded animals, as well as of honeybees. They are distributed in various ecological niches in the human gastrointestinal and genitourinary tracts, the exact ratio of which is determined mainly by the age and diet. The indigenous microflora of infants is dominated by bifidobacteria, which are established shortly after birth. Their proliferation is stimulated by the glycoprotein components of k-casein in human colostrum and, to a lesser extent, human milk. The number of bifidobacteria decreases with increasing age of an individual and eventually becomes the third most abundant genus (accounting for approx. 25 % of the total adult gut flora) after the genera *Bacteroides* and *Eubacterium*.

Mechanisms of action

The mechanisms by which probiotics exert biological effects are still poorly understood, but the nonspecific terms such as colonization resistance or competitive exclusion are often used to explain their mode of action. Colonization resistance or competitive exclusion describes a phenomenon whereby the indigenous anaerobic flora limits the concentration of potentially pathogenic (mostly aerobic) flora in the digestive tract. The concept of competitive exclusion was first developed during the early 1970s when it was discovered that the administration of mixed adult intestinal microorganisms conferred adult-type resistance against *Salmonella* infection to newly hatched chicks.

- Oelschlaeger reported that the effects of probiotics may be classified in three modes of action:
- Probiotics might be able to modulate the host's defences including the innate as well as the acquired immune system.This mode of action is most likely important for the prevention and therapy of infectious diseases but also for the treatment of (chronic) inflammation of the digestive tract or parts thereof. In addition, this probiotic action could be important for the eradication of neoplastic host cells;
- Probiotics can also have a direct effect on other microorganisms, commensal and/or pathogenic ones. This principle is in many cases of importance for the prevention and therapy of infections and restoration of the microbial equilibrium in the gut
- Finally, probiotic effects may be based on actions affecting microbial products like toxins and host products, *e.g.* bile salts and food ingredients. Such actions may result in inactivation of toxins and detoxification of host and food components in the gut.

The same author also stated that the kind of effect(s) a certain probiotic executes depends on its metabolic properties, the molecules presented at its surface or on the components secreted. Even integral parts of the bacterial cell such as DNA or peptidoglycan might be of importance for its probiotic effectiveness. The individual combination of such properties in a certain probiotic strain determines a specific probiotic action and as a consequence its effective application for the prevention and/or treatment of a certain disease.

Probiotics and Prebiotics

In a recent review, Ranadheera *et al.* Reported that food substrate/diet is considered as one of the major factors in regulating colonization of microorganisms in the gastrointestinal tract. Food helps to buffer the bacteria through the stomach and may contain other functional ingredients that could interact with probiotics to alter their functionality. Colonic foods, which encourage the growth of favourable bacteria, are referred to as prebiotics.

Oligosaccharides such as lactulose, galactooligo-carbohydrates are some of the well known examples of prebiotics. There is an obvious potential for a synergetic effect when combining probiotics and prebiotics appropriately, because prebiotics promote the growth and activities of probiotics. By increasing the amount of prebiotics in the diet, it is possible to increase and maintain healthy bacterial gut flora in the host. Ingredients in certain food products may naturally contain prebiotics, which help to improve the functional efficacy of probiotics.

Many other foods such as dairy and meat products, cereals, beverages and infant formulas can be fortified with prebiotics during manufacturing process to increase probiotic efficacy. In addition, a number of other suitable food components including non specific substrates, plants and their extracts, metabolites of microorganisms and polyunsaturated fatty acids may also be important in probiotic efficacy.

New Trends in Probiotic Products and Processing

In general, consumer's understanding of the potential benefits of foods containing viable bacteria/probiotics is

poor, particularly in the countries without a tradition of cultured/sour dairy products. There are many barriers to communicating messages about probiotics and the role of diet in the gut flora modulation. However, in the countries where there have been well planned educational programmes among consumers and health professionals, the degree of awareness has increased.

In the future, health claims may help inform consumers of the potential benefits, but it is crucial that appropriate communication guidelines are adhered to and that all claims are scientifically substantiated. As it was presented by Reid, the number of scientific publications on probiotics has doubled in the past three years and this recent interest has been further stimulated by several factors: (*i*) exciting scientific and clinical findings using well documented probiotic organisms; (*ii*) concerns over limitations and side effects of pharmaceutical agents; and (*iii*) consumer's demand for natural products. The key to the future of probiotics will be the establishment of a consensus on product regulation, including enforcement of guidelines and standards, appropriate clinical studies that define strengths and limitations of products, and basic science studies that uncover the mechanisms of action of strains. Besides, the molecular elucidation of the probiotic actions *in vivo* will help to identify true probiotics and select the most suitable ones for the prevention and/or treatment of a certain illness (*82*). In fact, not only new probiotic food must be developed, but the study and development of new medications to combat diseases should be continously performed.

CONCLUSIONS

Probiotics have been extensively studied and explored commercially in many different products in the world. Recent studies have suggested that probiotics have demonstrated beneficial effects to human and animal health. Much of the clinical probiotic research has been aimed at infantile, antibiotic-related and traveller's diarrhoea. The non-pathogenic organisms used as probiotics consist of a wide variety of species and subspecies, and the ability to adhere, colonise and modulate the human gastrointestinal system is not a universal property. *Lactobacillus* and *Bifidobacterium* are the main probiotic groups; however, there are reports on the probiotic potential of yeasts. Some of the identified probiotic strains exhibit anti-inflammatory, anti-allergic and other important properties. Besides, the consumption of dairy and non dairy products stimulates the immunity in different ways. Future research must investigate the mechanisms by which gut microflora interacts with the intestinal epithelium in health and disease. With this knowledge, optimal probiotic strains can be developed. The viability of probiotics is a key parameter for developing probiotic food products. New technologies have been developed to enable high cell yield at large scale and ensure probiotic stability for a long period in food. Various food matrices, dairy and non-dairy, have been used with probiotics and were briefly documented. With different technologies, such as microencapsulation, cell immobilization and continuous fermentation, the probiotics will become an important and viable ingredient in the functional foods, expanding the probiotic application outside the pharmaceutical and supplement industries.