Probiotics In Oral HealthCare - A Review

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Abstract— This review focuses on the use of probiotics as preventive and therapeutic products for oral healthcare and the potential risks associated with dietary probiotics. Probiotics are live microbial food supplements or components of bacteria, which have been shown to have beneficial effects on human health. Current data suggest that dietary probiotics do not confer a major risk for oral health.There is a great need to elucidate the role of the oral beneficial microbiota, to identify and conduct proper large-scale studies on the usefulness of probiotics to maintain or improve oral health.

Index Terms—aging probiotics, oral health, beneficial bacteria, periodontics

INTRODUCTION

The age-old quote by Hippocrates, 'Let food be thy medicine and medicine be thy food', is certainly the tenet of today. The market for functional foods that promote health beyond providing basic nutrition, is flourishing. Within the functional foods, is the small but rapidly expanding arena of probiotics.1 The term probiotic is derived from the Greek, meaning "for life" are microorganisms proven to exert health-promoting influences in humans and animals.2 The Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) have stated that there is adequate scientific evidence to indicate that there is potential for probiotic foods to provide health benefits and that specific strains are safe for human use.2 In 1994, the World Health Organization deemed probiotics to be the next-most important immune defense system when commonly prescribed antibiotics are rendered useless by antibiotic resistance. The use of probiotics in antibiotic resistance is termed microbial interference therapy (replacement therapy or bacteriotherapy) and is sometimes used interchangeably with probiotics. With increasing understanding that beneficial microbes are required for health, probiotics may become a common therapeutic tool used by health care practitioners in the not-too-distant future.[3]

PROBIOTIC BACKGROUND, CONCEPT

The idea of probiotics dates back to the first decade of 1900 when the Ukrainian bacteriologist and Nobel Laureate Ilya Metchnikof (1908) proposed that lactic acid bacilli may have beneficial health effects and attributed his own longevity to regular probiotic ingestion. The currently used consensus definition of probiotics was put forward by the World Health Organization and by the Food and Agriculture Organization of the United States and officially adopted by the International Scientific Association for Probiotics and Prebiotics term outlining the breadth and scope of probiotics as they are known today: Live microorganisms which when administered in adequate amounts confer a health benefit on the host.4,5,6,7

The term probiotics, the antonym of the term antibiotics, was introduced in 1965 by Lilly & Stillwell as substances produced by microorganisms which promote the growth of other microorganisms.8

Probiotics are live bacteria that can resist the rigors of the human digestive system, compete with pathogens, and that help to improve the gut flora balance. There are several basic characteristics of bacteria that may be effective probiotics. They should be preferably of human origin, innocuous, able to withstand processing conditions, and able to survive transit through the gut and colonize mucosal surfaces. They also should act against pathogens by means of multiple mechanisms and elicit minimal resistance to their effects. The onset of beneficial effects should be rapid in comparison with the time required for a vaccine to be fully protective. Optimally, they should function with or without antibiotics.9

COMPOSITION OF PROBIOTICS

Probiotics can be bacteria, moulds, yeast. But most probiotics are bacteria. Among bacteria, lactic acid bacteria are more popular.1 Fuller10 in 1989 listed the following organisms as species used in probiotic preparation: Lactobacillus bulgaricus, Lactobacillus plantarum, Streptococcus thermophillus, Enterococcus faecium, Enterococcus faecalis, Bifidobacterium species, and Escherichia coli. With the exception of L. bulgaricus and S. Thermophilus, all the other organisms are all intestinal strains.

A probiotic may be made out of a single bacterial strain or it may be a consortium as well (may contain any number up to eight strains). The advantage of multiple strain preparations is that they are active against a wide range of conditions and in a wider range of animal species.1 Probiotics can be in powder form, liquid form, gel, paste, granules or available in the form of capsules, sachets, etc.

Characteristics of good probiotics

Fuller10 in 1989 listed the following as features of a good probiotic:

It should be a strain, which is capable of exerting a beneficial effect on the host animal, e.g. increased growth or resistance to disease.

It should be non-pathogenic and non-toxic.

It should be present as viable cells, preferably in large numbers.

It should be capable of surviving and metabolising in the gut environment e.g. resistance to low pH and organic acids.

It should be stable and capable of remaining viable for periods under storage and field conditions.

Probiotics and general health[11]

Probiotics have traditionally been used to treat diseases related to the gastrointestinal tract. Studies suggest that probiotics may be useful in treatment of patients with hypertension, uro-genital infections, lactose intolerance, and elevated levels of cholesterol. Other areas of application include probiotic effects against Helicobacter pylori infections in the stomach, alcoholic liver disease, small bowel bacterial overgrowth, ulcerative colitis, allergy to milk protein, juvenile chronic arthritis, antioxidative effects, asthma, hepatic encephalopathy and their use as vaccine delivery vehicles.

Probiotic strains in the oral cavity[4]

An essential requirement for a microorganism to be an oral probiotic' is its ability to adhere to and colonize surfaces in the oral cavity. Microorganisms generally considered as probiotics may not have oral cavity as their inherent habitat and, subsequently, their possibility to confer benefit on oral health is then questionable. Studies suggest that lactobacilli as members of resident oral microflora could play an important role in the micro-ecological balance in the oral cavity. The studies further demonstrated that lactobacilli strains with probiotic properties may indeed be found in the oral cavity. Yet there is no evidence whether these lactobacilli strains were detected due to the frequent consumption of dairy products leading to temporary colonization only, or if the oral environment is their permanent habitat.

Probiotics and periodontal disease[8,4,12]

The oral microbiota is at least equally as complex as the gastrointestinal or vaginal microbiota. The many and varied microbial associations within the oral cavity include some that appear critical for maintaining health, according to Socransky. DNA probe studies of 40 taxa of oral bacteria obtained from subgingival plaque samples of healthy individuals and others with periodontal disease indicate that several bacterial taxa, including those associated with gingival health, co-occur in the periodontal crevice.

This group, designated the "green cluster," includes Capnocytophaga species, Campylobacter concisus, Eubacterium nodatum, and Streptococcus constellates. Moreover, dental biofilms are considered to be difficult therapeutic target. The current view on the etiology of plaque-related periodontal inflammation considers three factors that determine whether disease will develop in a subject: a susceptible host; the presence of pathogenic species; and the reduction or absence of so-called beneficial bacteria. In 1954, a beneficial effect of lactic acid bacteria on inflammatory infections of the oral mucosa was reported.5 The presence of periodontal pathogens could be regulated by means of antagonistic interactions. A decrease in

gum bleeding and reduced gingivitis has been observed by Krasse et al with the application of L. reuteri. Koll-Klais et al reported that resident lactobacilli flora inhibits the growth of Porphyromonas gingivalis and Prevotella intermedia in 82% and 65%, respectively. Probiotic strains included in periodontal dressings at optimal concentration of 108 CFU ml were shown to diminish the number of most frequently isolated periodontal pathogens: Bacteroides sp., Actinomyces sp. And S. intermedius, and also C. albicans. These authors registered a 10- to 12-month remission period after periodontal treatment by application of the periodontal dressing that comprised collagen and L. casei.

Studies Mohammad S. Al-Zahrani13 have shown an inverse association between the intake of dairy products and prevalence of periodontitis. Yoshihiro Shimazaki14 concluded that the routine intake of lactic acid foods may have a beneficial effect on periodontal disease.

Candida albicans is among the most common infectious agents in the oral cavity. The incidence of yeast infections is higher at older age and under conditions of impaired immunity. Testing the pattern of colonization of L. acidophilus and L. fermentum, Elahi et al showed a rapid decline in C. albicans in mice after the intake of probiotic strains. Continuous consumption of probiotics led to almost undetectable numbers of fungi in the oral cavity, maintaining the protective effect for a prolonged period after cessation of application.

However, there is not yet any true evidence on the effect of probiotic therapy on periodontal disease, and the effect of the ingested probiotics needs further investigation.

Probiotics and dental caries[4]

The impact of oral administration of probiotics on dental caries has been studied in several experiments utilizing different test strains. Lactobacillus rhamnosus GG and L. casei have proved their potential to hamper growth of these oral streptococci. C. Aglar et al registered definite S. mutans count reduction after a 2-week consumption of yoghurt containing L. reuteri. A temporary reduction in S. mutans was observed during the period of yogurt intake and few days after cessation of consumption, indicating the necessity of continual administration of the probiotic in order to achieve an effect. Considering the growing body of evidence about the role of probiotics on caries pathogens, however, it has been suggested that the operative approach in caries treatment might be challenged by probiotic implementation with subsequent less invasive intervention in clinical dentistry. However, more studies are definitely needed before this goal could be achieved.

Probiotics and imbalanced oral ecosystem[4,8]

Halitosis, the oral malodor, is a condition normally ascribed to disturbed commensal microflora equilibrium. It has recently been positively affected by regular administration of probiotics. Given that oral microorganisms, especially those on the tongue, are the primary cause of halitosis, current treatments focus on the use of chemical or physical antibacterial regimes to reduce the numbers of these bacteria. However, most of these treatments exhibit only a temporary effect or are associated with undesirable side-effects when used over a long period of time.

Kang et al (2006) have shown a definite inhibitory effect on the production of volatile sulfur compounds (VSC) by F. nucleatum after ingestion of Weissella cibaria both in vitro and in vivo. In children, a marked reduction in the levels of H2S and CH3SH by approximately 48.2% ($P < 0.01$) and 59.4% ($P < 0.05$), respectively, was registered after gargling with W. cibaria containing rinse. The possible mechanism in the VSC reduction is the hydrogen peroxide generated by W. cibaria that inhibits the proliferation of F. nucleatum. Streptococcus salivarius, also a possible candidate for an oral probiotic, has demonstrated inhibitory effect on VSC by competing for colonization sites with species causing an increase in levels of VSC.

However, the few studies published on the role of probiotics in the treatment of halitosis do not entitle any evidence-based conclusions.

Safety aspects[4,5]

The issue of safety is of special concern during the past few years due to the increased probiotic

supplementation of different food products. Probiotics are often regulated as dietary supplements rather than as pharmaceuticals or biological products. Thus, there is usually no requirement to demonstrate safety, purity, or potency before marketing probiotics. This can lead to significant inconsistencies between the stated and actual contents of probiotic preparations, as shown in a recent South African study.

From the safety point of view, the putative probiotic microorganisms should not be pathogenic, should not have any growth-stimulating effects on bacteria causing diarrhea, and should not have an ability to transfer antibiotic resistance genes. The probiotics should rather be able to maintain genetic stability in oral microflora (Grajek et al, 2005) The most important area of concern with probiotic use is the risk of sepsis. One theoretical concern with the safety of probiotics is that some have been designed or chosen to have good adherence to the intestinal mucosa, and this is considered important for their mechanism of action. Adherence to the intestinal mucosa may also increase bacterial translocation and virulence. The most potent probiotics, therefore, may have increased pathogenicity. The relation between mucosal adhesion and pathogenicity in Lactobacillus spp. is supported by the finding that blood culture isolates of Lactobacillus spp. adhere to intestinal mucus in greater numbers than do isolates from human feces or dairy products. Lactobacillus bacteremia is a rare entity, and data on its clinical significance are mainly found through case reports. For the last 30 years there have been approximately 180 reported cases (Boriello et al, 2003). Clinical characteristics of Lactobacillus bacteremia are highly variable, ranging from asymptomatic to septic shock-like symptoms. Any viable microorganism is capable of causing bacteremia, however, especially in patients with severe underlying diseases or in immunocompromised state. Nevertheless, the present literature supports the conclusion that the incidence of Lactobacillus bacteremia is unsubstantial and that all the cases where it has been registered are individuals with other systemic diseases such as diabetes, cardiovascular diseases, gastrointestinal disorders, malignancies, or organ transplant patients. However, it is evident that careful monitoring is needed in this regard in the future.

The absence of acquired antibiotic resistances is another safety criterion to be tested in potential probiotic candidates. Some probiotics are closely related to opportunistic bacteria and this may also cause transferral of antimicrobial resistance genes in between microorganisms. Several results from antibiotic susceptibility tests claim that the tet(W) and tet(S) genes in some probiotic lactobacilli and bifidobacteria strains are responsible for gentamycin, sulfamethoxazole, polymyxin B, and tetracycline resistance. These investigations emphasize the need for a minimal safety evaluation during the selection of strains for probiotic use.

The way forward[2]

The use of probiotics in general clinical practice is not far away. Molecular tools will continue to be used to understand and manipulate lactic acid bacteria with a view to producing vaccines and new and improved probiotic products. The critical step in wider application will be to make products available that are safe and clinically proven in a specific formulation easily accessible to physicians and consumers. Efforts are needed to advance the scientific knowledge of probiotics and determine their mechanisms of action, as well as describe when and why they fail in certain situations.

Conclusion

Probiotic agents are living microorganisms belonging to the normal flora, with low or no pathogenicity and a positive effect on the health and well-being of the host. Probiotic therapy uses bacterial interference and immuno-modulation in the control of several infectious, inflammatory, and immunologic conditions. Similar to their better known actions in the gastrointestinal tract, probiotics exert their effects in many ways also in the oral cavity. Based on the currently available clinical data, it seems that dietary probiotics do not confer a major risk for oral health. However, the risk of transferring antibiotic resistance from probiotics to virulent microorganisms requires more evaluation.

However data on oral probiotics' are yet insufficient and it is not known whether the putative probiotic strains could modulate, for example, immune response in the oral cavity as has been suggested to take place in the gut mucosa.

In conclusion, probiotics have made their way into oral healthcare and are more likely to be our friend than our enemy. Despite our rapidly increasing knowledge of pathogen–host interactions, the role of beneficial bacteria in preventing the emergence of pathogenic species and oral health remains obscure. There is a great need to elucidate the role of the oral beneficial microbiota, to identify beneficial bacteria and to conduct proper large-scale studies on the usefulness of probiotics to maintain or improve oral health.

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