REVIEW ARTICLE

A COMPREHENSIVE REVIEW OF APPLICATION OF PROBIOTICS IN DENTISTRY

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ABSTRACT

Probiotics and oral health is an emerging concept. Probiotics are the live micro-organisms which when administered has a beneficiary effect on host, these probiotics are isolated and experimented, studied for use in the treatment of many diseases related to the intestine, where a imbalance in the normal floral have caused the disease, hence these can be reversed and treated by the probiotics. The similar kind of imbalance occurs in oral micro-floral and its environment, resulting in dental caries, periodontal disease and candidal infections, hence application of these probiotic have shown beneficial in prevention as well as in treatment of disease. A condition halitosis is also preventable by the usage of probiotics, our review focus on the probiotics and mechanism by which these help in prevention and reduction of oral disease incidence and severity.

KEY WORDS

Probiotics, oral health, dental caries, periodontal disease, halitosis.

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INTRODUCTION

The oral cavity is a highly complex homeostatic chamber with precise balance. As multiple studies have consistently shown, oral health and the overall composition of the oral microbiota are intimately related, and the disturbance of this relationship is a critical first step in the development of oral disease[1]. The incidence of dental caries has declined significantly as a result of the use of fluorides, chemoprophylactic medicines, and other preventive methods, but there hasn't been much progress in controlling the root cause of the condition. A healthy oral microbiota can be established via replacement therapy used in conjunction with early colonization of beneficial probiotics in the oral cavity[2]. Probiotics have been defined as, “Live microorganisms which when administered in adequate amounts confer health benefits on the host”, by The Food and Agriculture Organisation and World Health Organisation in 2001.

HISTORY

The earliest research on the positive impacts of probiotics on health was conducted in the early 1900s by The Nobel laurate Eli Metchnikoff, who postulated that these effects came about as a result of pathogenic bacteria being inhibited, which improved the gut microbial balance. The word "probiotic" was initially used by Ferdinand Virgin to distinguish it from antibiotics. Lactobacillus acidophilus by Hull et al. in 1984 and Bifidobacterium bifidum by Holcombh et al. in 1991 were the first probiotic species to be used in research[3].

FEATURES OF PROBIOTICS

Probiotics are referred to as microorganisms that are advantageous to their host and whose genus and species can be identified and described using internationally recognized protocols. To determine the organism's pathogenicity, it must pass numerous in vitro, animal, and clinical experiments. According to the recommendations of the FAO and WHO probiotic strains should be identified by:

• Their ability to produce toxins in immunosuppressed animal models

• Their range of antibiotic resistance.

• Their metabolic and hemolytic activities.

• Their pathogenicity.

• To prevent the lateral gene transfer of antibiotic resistance genes, it is important to investigate the resistance pattern of probiotic strains (Duncan, 2003).

• Capable of regulating pH and boosting action on the oxidation reduction potential, it should be able to establish a favourable environment, preventing establishment of pathogenic organism.

ROLE OF PROBIOTICS IN GENERAL HEALTH:

Without bacteria, life would not be possible. Our bodies work together and coexist with billions of bacteria; the total number of bacteria in our bodies is greater than the total number of cells. The bacteria live in symbiosis with our bodies, performing vital functions that are necessary for our survival, like:

- Intestinal development[4]
- Development and operation of the nervous system;
- Dental caries[5,6]
- Host nutrition;
- Resistance to pathogens[7,8]
- Regulating the intestinal epithelium proliferation;
- Energy production[9,10]
- Immune System development[11,12,13]

The process of bacterial colonization starts as soon as the baby is born. The development of the innate and adaptive immune systems depends on the proper establishment of the intestinal flora following birth. Factors such as the baby's diet, mode of delivery, and gestational age can affect this initial colonization. Infants born prematurely, by caesarean section, or after being exposed to prenatal and perinatal antibiotics exhibit a delay in the colonization of their intestinal commensal probiotic bacterial colonization. Breastfed babies are found to have a predominant colonization of Bifidobacteria, while formula-fed babies exhibit equal colonization with Bacteroides and Bifidobacteria species[14]. Due to the impact of bacteria in the immune system, distinct bacterial colonization has been linked to the ensuing emergence of several diseases[15]. Diseases such as type 1 diabetes, celiac disease, allergic rhinitis, and obesity are more common in babies born via caesarean section.

ROLE OF PROBIOTICS IN ORAL HEALTH:

Numerous bacterial communication systems cover every surface of the oral cavity, which is home to a wide variety of microbial species. More than a thousand different kinds of bacteria have been found, according to Keijser et al. These bacteria may be planktonic or integrated into biofilms[16]. The two probiotic strains that are most frequently found in the oral cavity are Bifidobacterium and Lactobacillus. Probiotics have the following effects on the oral cavity in addition to helping to lower pathogenic oral microflora:

- Reduces halitosis;
- prevents candidiasis;
- encourages periodontal health;
- and aids in the prevention of dental caries[17]

MECHANISM OF ACTION OF PROBIOTIC PREVENT DENTAL CARIES :

Direct action:

• By competing pathogenic bacteria for nutrition, growth factors, and adhesion sites, probiotic bacteria prevent the production of biofilms.

• Interfere with the pathogenic bacteria's ability to metabolize substrates.

• They may produce fatty acids, hydrogen peroxide, mutacin, bacitracin, lactase, bacteriocin, organic acids and biosurfactants, which can be used to combat pathogens. (Meurman, 2009)[18]

Indirect action:

• Additionally, probiotics reduce peroxidase levels, which enhances saliva's antibacterial action

• Neutralize free electrons to stop plaque from forming.

• Induce non-specific immunity and adjust cellular and humoral immunity

• By producing IgA and defensins, it strengthens the host immunological response.

• Reduces production of metalloproteinases.

For probiotics to start working, they need to be placed in the oral cavity for a certain amount of time. In order to have a cariostatic impact on oral tissues, they must stick to them; hence, they must form a biofilm to combat cariogenic bacteria[19].

CLINICAL STUDIES WITH PROBIOTIC BACTERIAS:

Studies on prevention of caries

• Research on the impact of the probiotic Lactobacillus rhamnosus GG on the risk of tooth decay was conducted by Nase et al.[20] (2015) and Wu et al[21] (2014–follow-up to six months). Results showed

that patients taking the probiotics of Lactobacillus group had lower levels of Streptococcus mutans and caries.

• Steckson-Blicks et al[17] have found that regular usage of probiotics and fluorine determines a reduction of caries in preschool children

• Hillman et al.'s research revealed that JH 145, a S.rattus variation, was more easily able to colonize tooth surfaces, compared to S.mutans. Consequently, S.rattus JH 145 may be used as a probiotic to prevent dental caries[22].

• According to Petti et al., yogurt containing L. bulgaricus and S. thermophilus demonstrated specific bactericidal effects against streptococci belonging to the mutans group[23].

• S. salivarius M[18] (previously strain Mia) shown broad spectrum activity against many streptococcal infections, most notably S. mutans, according to a research by Hang et al.

• According to research by Petersson et al., frequent probiotic use can reverse primary root caries in older people[24].

• Weisselicin 110, a bacteriocin that inhibits the colonization of some gram positive bacteria, is produced by the bacterium W.cibaria 110, which was isolated from fermented fish in Thailand (Srionnual et al., 200)[25].

• Lactococcus lactis NCC2211 can be integrated into a biofilm and has the ability to control Streptococcus sobrinus OMZ176 growth, according to Comelli et al[26].

Probiotics in controlling periodontal infection and halitosis

• After scaling and root planning, Teughels et al. found that the subgingival application of a bacterial mixture containing Streptococcus sanguis, Streptococcus salivarius, and Streptococcus mitis significantly suppressed the re-colonization of Porphyromona gulae (canine P. gingivalis) and P. intermedia in a beagle dog model[27].

• Treatment for halitosis may also involve the use of probiotics. Kang and colleagues observed a noteworthy decrease in volatile sulphur compounds with twice-daily gargling with 15 ml Weissella cibaria CMU for a duration of two minutes[28].

• When probiotic Streptococcus was utilized, Burton et al. observed significant reductions in volatile sulphur compounds for the probiotic group compared to the placebo group[29].

Probiotics and oral candidasis

According to one study, people who ate cheese that included the probiotic L. rhammnosus GG showed a decrease in the prevalence of oral Candida, which may have a preventive effect on oral candidasis. The laboratory study that showed the Candida-infected mice fed L. acidophilus cleared C. albicans from their mouths more quickly is pertinent to this[30].

VEHICLES FOR PROBIOTIC SUPPLEMENTS:

• Probiotics can be found in a variety of forms and are added to food products.

• Added as a type of cultural concentration to food or drink.

• Introduced into fibres that are prebiotic

• Inoculated milk or dairy-based foods, including cheese, yoghurt, kefir, and milk. The probiotics in non-dairy goods including powder, capsules, and gelatine tablets are produced commercially.

New Evora kids Probiotic Chew is a commercially available product which has Streptococcus oralis strain KJ3, Streptococcus uberis strain KJ2, Streptococcus rattus strain JH145, which is useful for maintenance of dental and gingival health.

Plidenta Pro-t-action toothpaste is another commercially available toothpaste containing Lactobacillus paracasei, which causes co-aggregation cariogenic

CONCLUSION

Probiotic is a live microorganism which when consumed in adequate amounts have a beneficiary effect on host health[4]. Probiotics and oral health is a newer prospective to prevent most common diseases of dentistry that is the dental caries and periodontal disease, other like halitosis, candida infections, hence application of knowledge of probiotics is important. Development of oral microflora occurs at the time of birth, mode of delivery, feeding habits also influences the microbiota. Studies shown that breast feed and formula feed babies have difference in the micro floral[15]. studies and ecological plaque hypothesis have shown that the dental caries and periodontal disease is a result of imbalance in oral microbiota, resulting in increase of pathogenic bacteria and disease, hence the oral diseases being viewed as a consequence of imbalances in the resident oral microflora, which can be treated or prevented by the administration of probiotics[15]. A study done by Stecksén-Blicks concludes use of long erm consumption of milk with probiotics and fluoride can reduce the incidence of dental caries and reduces the duration of antibiotic intake[17].

Various studies stated anticipated mechanism of probiotics in caries prevention is by, interfering with attachment and colonisation of pathogenic strains and further sugar fermentation and for periodontal

disease prevention, probiotics helps by interfering with the oral biofilm development[18].

Guided pocket recolonization (GPR), where the periodontal pocket are treated by scaling and root planning and selective species of microbes as a probiotics are added as a adjunct have shown the significant reduction in the inflammation in the area after application of this probiotics[27].

Study by mi sun kang et al, where they used a lactobacillus strain called Weisella Cibaria possess the ability to prevent the volatile sulphur compounds which causes halitosis, and concluded that it has potential scope of use as probiotic to prevent halitosis[28]. Several studies shown apart from usage of probiotics in treating a gut related diseases, they can be used for prevention of oral diseases, probiotics with food supplementation or food substitute or in conjunction with other treatments is on long term basis is highly useful in prevention of the dental caries, periodontal pathologies, halitosis and candidal infections, these probiotics acts a protected shield to prevent other pathogenic strains to develop colonize and by neutralising their toxins, by-products helps in prevention and reduces the duration of the antimicrobial therapies[17,24,25,26,27,2829,30].

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