

Editorial

Beyond water fluoridation; the emergence of functional foods for oral health

“Functional Foods” are foods or dietary components that have a beneficial effect on one or more target functions in the body beyond basic nutrition. The concept was developed in Japan in the 1980s where the Ministry of Health and Welfare saw the potential to use food as a vehicle to address the nation’s spiralling health care costs. They introduced a regulatory system to approve certain foods with documented health benefits in the hope of improving the health of the nation’s aging population. Although the terminology is relatively recent, the concept of “Functional Foods” is well embedded amongst those interested in oral health; a classic example being the adjustment of fluoride in water to benefit oral health, an initiative which preceded the concept of functional foods by 40 years.

In the rapidly growing area of functional foods research, health promoting food components have been derived from mineral, animal and plant sources to tackle oral diseases such as caries, periodontal disease and oral cancer

The use of minerals includes the caries preventive benefit of fluoride which has been exploited by adding it to water, salt, milk and sugar (the latter on an experimental basis). Other minerals are calcium and phosphate which are major components of enamel and dentine and have been incorporated in sugar free chewing gum in various forms to try and increase enamel remineralisation.

The cariostatic effects of animal products, e.g. milk and cheese have been reported in a variety of studies over the last 25 years. Postulated mechanisms of action include salivary stimulation, reduction of bacterial adhesion, reduction of enamel demineralisation, and/or promotion of remineralisation by casein and ionisable Ca and P. The cariostatic properties of cheese may result from a combination of the effects described in addition to the action of biologically active peptides in the protein fraction and/or naturally occurring probiotics. Development of technology to isolate some of the many peptides in cheese has opened the door to future research which will determine their bioactivity in the mouth. Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) nanocomplexes, derived from bovine milk protein, casein, calcium and phosphate is the subject of ongoing research in the prevention of dental caries. Identification and isolation of the components of dairy products which protect against dental caries could lead to an enhancement of the oral health benefits and functionality of dairy products or other products to which these components were added.

The word probiotic is a relatively new word meaning “for life” and it is currently used to describe bacteria associated with beneficial effects for humans and animals. Probiotics have been defined as “live microorganisms,

which, when administered in adequate amounts, confer a health benefit on the host.” (FAO, WHO, 2001). A small number of probiotics with potential for reducing caries risk by decreasing the level of *S. mutans* in the mouth have been identified and it is likely that this number will increase in the future as our knowledge and understanding of this area continues to improve. Probiotics may not replace conventional caries preventive approaches but the incorporation of strains with even slight oral health benefits in commonly consumed foods such as dairy products may provide a useful improvement in oral health at the population level. Further well conducted randomised controlled human trials will be needed to test the efficacy of existing and new probiotics in controlling dental caries. The use of probiotics to prevent or control oral disease looks like a promising area for future development.

In addition to mineral and animal products, plant products have shown great promise in the fight against caries. As sugar is the food most commonly associated with caries, sugar substitutes, many of which are derived from plants are commonly associated with caries prevention. The replacement of fermentable non milk extrinsic sugars by sugar alcohols or artificial sweeteners make confectionary safer for teeth as they carry a reduced risk of dental caries.

Polyphenols are phytochemicals that are found in food substances produced from plants such as fruits, vegetables, cereals, olive, dry legumes, chocolate and beverages, such as tea, coffee and wine. They are active against a wide spectrum of microbes. Polyphenols are found in many different commonly-consumed foods and beverages, for example tea, cranberries, coco and grapes. Their activity against bacteria including *S. mutans* and biofilm has been studied; the positive results indicate a need for further carefully controlled studies

Compared to research on foods with caries protective properties, there has been little progress in the development of foods with specific periodontal benefits. Cross sectional studies indicate the need for further research on vitamins such as 25-hydroxyvitamin D (3) and Folic acid (a B-complex vitamin) in the promotion of periodontal health. Reported associations between increased intake of dairy products and a lower prevalence of periodontal disease also warrant further investigation. The use of probiotics in food for periodontal health is another area ripe for future research.

Cranberry juice and tea are two plant products which have been studied for their effect on inhibiting microbial adhesion to hard and soft tissues. Inhibition of co-aggregation among oral bacteria may disturb the development and maturation of dental plaque and could, therefore, potentially improve plaque control. Again further research is needed.

There is some preliminary evidence that probiotic microorganisms can prevent or delay the onset of certain cancers outside the mouth. However, it is too early to arrive at definitive clinical conclusions regarding the efficacy of probiotics in cancer prevention and further research is required. Research suggests that regular consumption of green tea may be of use in the prevention of oral cancer as green tea polyphenols are found to induce apoptosis (programmed cell death) in many types of tumor cells, including oral cancer cells.

The use of probiotics in cheese for the control of *Candida albicans* has also been studied with some promising results in the elderly.

The promising findings of the relatively small cohort of researchers in this emerging field of study suggest a topic worthy of investment. It is likely that we will see major developments in functional foods for oral health in the future, as new effective agents are identified and developed. Regulation of oral health claims for functional food will be important to avoid misleading the public with exaggerated claims.

As the food industry forges ahead with research on functional foods, regulators have wrestled with the complex area of regulation. In most developed economies, the use of medicine is highly regulated and well controlled for safety reasons. As foods are developed which target specific diseases, the boundary between food and medicine becomes less clear and issues of safety and appropriate dosage are raised. Unlike medicine, it can be difficult to control the use or over-use of a particular food. The indications or contraindications for use are further considerations as it is now up to the consumer to decide whether the use of a functional food is warranted or appropriate. In the case of medicine, manufacture and storage are also tightly controlled, a requirement that is reflected in the high price of many medicines. The food industry is also well regulated, but to a lower level, and regulation may be required to ensure the stability of active ingredients over the shelf life of a food. Thus there are many potential beneficiaries of foods with enhanced health benefits, however the manipulation of foods in this way increases the need for regulation to minimise the risks and maximise the benefits to the consumer. Good regulation will also underpin the development and promotion of high quality effective functional foods.

The EU (2007) adopted Community rules on the use of nutrition and health claims on foods to standardize provisions relating to such claims thereby removing impediments to free movement of foods across the EU and equalizing conditions of competition. Full implementation of the regulation (2010) includes a publicly available list of permitted and rejected claims.

The regulation defines its terms and 'health claim' is defined as 'any claim that states, suggests or implies that a relationship exists between a food category, a food or one of its constituents and health'; 'reduction of disease

risk claim' means any health claim that 'states, suggests or implies that the consumption of a food category, a food or one of its constituents significantly reduces a risk factor in the development of a human disease'.

Authorisation of health claims is the responsibility of the European Food Safety Authority which also presides over the wording to be used in the claim.

An application to the Panel on Dietetic Products, Nutrition and Allergies to deliver an opinion on the scientific substantiation of a health claim related to dairy foods (milk and cheese) and dental health, received a negative judgment. The panel found that 'on the basis of the data presented, a cause and effect relationship has not been established between the consumption of milk or cheese and dental health in children' (EU, 2008). It is therefore likely that the new EU regulations will provide an impetus for the conduct of well designed studies to determine the validity of this and other historical widely accepted health claims for foods.

Technological progress has facilitated the identification of new products with potential for development as functional foods with oral health benefits. Further progress will be needed to optimize these benefits and capture the synergies among mineral content of foods, probiotics, antimicrobial peptides and plant extracts. Scientific development has been followed by the development of regulations to protect the consumer and to encourage safe and effective innovation in food science.

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