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Remineralization of white spot lesion in the natural way – A review

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Abstract:

Successful growth and psychological development of a child depends on the oral health. Early childhood caries in preschool children and dental caries of permanent teeth are major oral health problem at the individual's level as well as a burden to the country as a whole. Initiation of carious lesion is denoted by the formation of white spot lesion. This white spot lesion can be arrested and prevented from further progression to cavitated lesion if the shift in equilibrium from demineralization to remineralization can be achieved. Fluoride is a proven agent for caries prevention and remineralization but with its own adverse effects. As an alternative to fluoride, various non fluoridated remineralization systems have been developed. Recently there is an increase in interest to find the natural medicinal plants and their extracts that have antibacterial, anticariogenic and remineralization potential. This article is a review about the potential natural herbal extracts in the remineralization of white spot lesion.

Keywords: remineralization, white spot lesion, incipient caries, anticariogenic, herbal extracts, natural agents.

1. Introduction

Successful healthy growth and development of a child depends on one of the important factor – The Healthy Teeth. Early Childhood Caries (ECC) affects this healthy tooth in preschool children and is a major oral health and psychological problem. A systematic analysis of global burden of diseases study 2017, estimated that oral diseases affected half of the world's population with dental caries in permanent teeth being the most prevalent condition assessed. World Health Organisation has estimated that 2.3 billion people suffer from dental caries of permanent teeth and 530 million children suffer from caries in primary teeth. Dental caries is the most prevalent disease among 328 chronic diseases which affects the quality of life and years lived with disability.[1,2] It is problem not only to the individuals affected, but also a burden even to the developed countries.

Enamel is uniquely organized outermost layer of tooth with ectodermal origin containing no collagen and its organic matrix made up of non collagenous protein, amelogenin. Enamel is predisposed to numerous challenges with in oral cavity and mature enamel cannot be regenerated due to lack of functional capacity of ameloblasts. Because of this limitation of enamel to regenerate, when the pH falls below the critical pH demineralization of enamel takes place. This denotes the caries initiation with sub surface mineral loss and relatively intact superficial layer appearing as white spots. These white spot lesions (WSL) are the

initial lesions of smooth surface caries which can be easily identified by air drying the enamel surface.[3] With the contribution of poor oral hygiene, cariogenic diet, plaque retentive factors like irregular surfaces of restorations, bands, brackets, attachments of orthodontic appliances and space maintainers results in formation of WSL which progresses to cavitated lesion if left untreated.

Recent concepts in the pathogenesis of dental caries have led to the understanding of the demineralization and remineralization capability of WSLs when the favourable environment is present. This led to the development of preventive and minimally invasive dentistry compared to the conventional drill and fill concept. Fluorides are considered first and foremost in preventing dental caries but equally with its own adverse effects. There are other methods of non fluoridated agents available with effective remineralising capacity of the WSL or incipient carious lesions. Recently there is an increase in interest among both the general people and researchers to explore the possibility of using the traditional systems of medicine like Ayurvedha, Yoga, Unani, Siddha and Homeopathy (AYUSH). The therapeutic measures used in most of these traditional systems depend on the use of plants and herbal extracts. This article reviews the potential natural herbal extracts in the remineralization of white spot lesion.

2. Remineralization systems

The dynamics of formation and prevention of white spot lesion is the interaction between demineralization, a process of removal of mineral ions from hydroxyapatite crystals of enamel, and remineralization, a process of restoring these lost mineral ions, especially calcium and phosphate ions to the voids in the hydroxyapatite crystals.

An ideal remineralising agent[4]

- Should deliver the optimum level of calcium and phosphate ions thereby enhancing remineralization and avoiding calculus formation
- Should penetrate deep into the sub surface demineralised zone
- Should be in active form even below the critical pH thereby preventing demineralization
- Should possess antimicrobial activity against the cariogenic micro organisms
- Should exert synergistic effect with the remineralising capacity of saliva
- Should be able to work even during reduction in salivary flow rate and in xerostomic patients
- Should not cause any adverse effect
- Should be easily acceptable by the general public

3. Types of remineralization systems

Currently available remineralization systems can be broadly classified into fluoridated and non fluoridated systems and various available remineralization systems are given in the flow chart (Fig.1).

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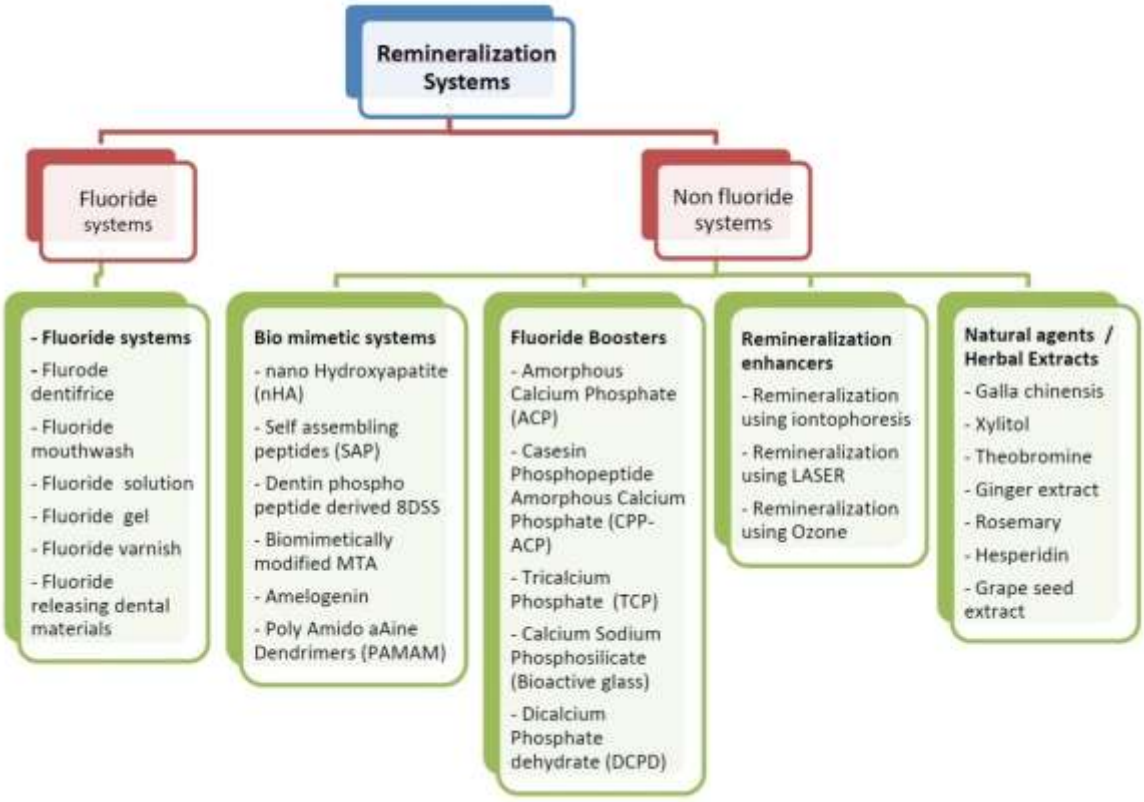

Figure 1: Chart showing the classification of various remineralization systems

Natural remineralization systems

The newer addition to the remineralization systems are the plant based alkaloids which has antimicrobial property and the potential to prevent demineralization and beneficially shift the equilibrium towards remineralization.[5] The natural and herbal extracts which has been tested through invitro and animal studies with promising remineralising capacity include cocoa bean, galla chinensis, xylitol, ginger, rosemary, hesperidin and grape seed extract.

Cocoa bean

Theobromine is an alkaloid available in cocoa bean (Theobroma coca) and chocolate. It is a white crystalline powder of methylxanthine family (3,7 dimethylxanthine). It has been shown that theobromine enhances crystalline growth, resistance to acid attack and increased enamel micro hardness.[6,7] In another in vitro study it has been reported that theobromine has comparable remineralization capacity to that of fluoridated dentifrices.[8]

Galla chinensis

Galla chinensis (Rhus chinensis) is a leaf gall produced by parasitic aphids, capable of shifting the equilibrium from demineralization to remineralization. It also increases the efficacy of fluoride. The possible effect of galla chinensis is through its polyphenols which interacts and stabilizes the organic matrix remnants and blocking the ion diffusion patways. The polyphenol compounds act as calcium ion carrier into the body of lesion.[5,9,10]

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Xylitol

Xylitol is a naturally occurring five carbon sugar polyol (pentilol), naturally found in fruits, vegetables and berries. It is mainly extracted from xylan rich plant materials such as birch and beechwood.[11] It is used as sugar substitute. It has been reported that the use of xylitol containing chewing gum increases salivary flow rate, improves protective properties of saliva and assists in remineralization. It is proposed that caries associated mutans streptococci are unable to utilize the xylitol in their metabolism and hence reduces acid formation in the oral biofilm. Also xylitol may ecologically select for mutans streptococci strains with an impaired adhesiveness or making plaque less adhesive for tooth surface. Xylitol has been reported to significantly reduce the caries incidence and increase tooth remineralization.[12,13]

Ginger extract

Ginger rhizome (Zingiber officinale) is a natural herb supplement with proven antimicrobial activity. The bioactive components of the oleoresin from the ginger rhizome include [6]-gingerol (1-[4′-hydroxy-3′- methoxyphenyl]-5-hydroxy-3-deconone), which is the primary pungent ingredient believed to exert various pharmacological and physiological activities. The bioactive components gingerol and shagelol derived from the ethonolic extracts of ginger exhibits antifungal and antibacterial activity. The remineralization capacity is attributed to the antimicrobial property and high amount of fluoride content in ginger.[14]

Rosemary extract

Rosemary (Salvia rosmarinus) is a small aromatic bush, composed of terpenoids, flavonoids, phenols and essential oils with antimicrobial, antifungal and antioxidant therapeutic properties. Al-Duboni et al 2013 reprted that the methanolic extract of rosemary (30g/100mL) has inhibitory effects on mutans streptococci and confluded that the rosemary extract was effective in the remineralization of enamel on fluorescence and microhardness assessments.[15] Bilgin G et al 2016, have reported the invitro remineralization capacity of mixture of rosemary, ginger extract and honey.[16]

Hesperidin

Hesperidin is a member of the flavanone group of flavonoids isolated in large amounts from the rinds of citrus furits like lemon, orange, grape and tangerine. Hesperidin has been shown to possess the antioxidant, anti-inflammatory and anti-carcinogenic therapeutic properties. It has been reported that hesperidin showed lowest lesion depth value and mineral loss, inhibited demineralization and probably enhanced remineralization on human root dentin and collagen preservation even under fluoride free conditions.[17,18]

Grape seed extract

Grape (Vitis vinefera) seed extract contains the polyphenol, proanthocyanidin, which is a potent antioxidant. It strengthens the collagen based tissues by increasing collagen cross links. It has been shown that proanthocyanidin interacts with microbial cell membrane proteins and lipids leading to lysis of cell membrane resulting in arrest of root caries. Proanthocyanidin treated collagen matrix inhibits the enzymatic activity of F-ATPase and

amylase. It also inhibits the glucosyl transferase enzyme produced by mutans streptococci thereby preventing bacterial adherence to the tooth surface, which in turn exhibits anti-cariogenic property. Grape seed extract has been shown as a potent substitute for fluorides in the prevention of root caries in elderly patients. It has been reported through a in-vitro study that the mouth rinse containing grape seed extract limits dentin matrix degradation and enhanced remineralization. A recent systematic review concluded that the caries prevention of grape seed extract is unique when compared to fluoride and it inhibited proliferation of bacterial biofilms on the tooth surface and promoted remineralization.[19,20,21]

4. Conclusion

Early diagnosis of white spot lesions and its remineralization has led to the new horizons in preventive dentistry. Among the remineralising systems the non fluoridated and natural systems will reduce the risk of fluoride toxicity. The plant based phytochemicals and bioflavonoids will be more acceptable by the general public compared to the artificial chemical derivatives and fluoride-based systems for remineralization of white spot lesion and hence prevention of dental caries. Also most of these are natural food substances, which show no toxicity and are considered 'generally recognized as safe' (GRAS) by the US Food and Drug Administration (FDA). Hence future research on the clinical efficacy of these natural extracts is needed to use it as the mainstream of remineralization systems in preventive dentistry.

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