IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 23, Issue 7 Ser. 1 (July. 2024), PP 06-08
www.iosrjournals.org

Evolution of microspheres by adding fluoride releasing ions in restorative materials and it's effects: A review study

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Abstract:
Background: *Molecular engineering is a technique through which microspheres and other forms can be generated. Their size varies from varying hundreds of micrometers and proves to be advantageous in varying fields. These microspheres are also known as microparticles and are helpful in various means such as core protection, cellular preservation from external environment, targeting at a particular site, efficiency oriented, drug release in a controlled manner. It has a role which is very much elaborated as it can be used in multiple forms. It has main role which is being projected in the form of carrier of different molecules or ions in order to provide sustained release and prolonged effectiveness.*

Keywords- *Microparticles, microspheres, microcapsules, microsponges, fluoride recharge, fluoride release*

Date of Submission: 24-06-2024 Date of Acceptance: 03-07-2024

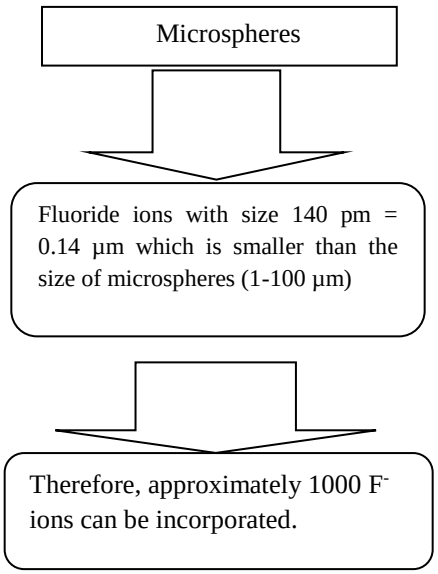
I. Introduction

Molecular engineering is a technique in which incorporation of molecules or ions is engineered in such a way that proteins, polymers, ceramics encassed required substance in order to allow prolonged release of molecules or ions.[1] Since in one of the study it has been proved slow release of amoxicillin into the root canal system.[2] There are different forms of microspheres available which acts differently and reveals different modes of actions. For example, biodegradable polymeric microspheres helps in repairing dentinal defects in forms of injectiomns, medicines incorporation which are therefore, less invasive and helpful in short handling time.[3] Ceramic microspheres attain substantial bioactive property and it's porosity helps in releasing molecules at a progressive level.[4] Since fluoride ion size is 0.14µm, so it can be easily adjustable within microspheres.

II. Review

Fluoride ions are the integral component in prevention of dental caries and inducing remineralisation process.[5] According to American Dental Association, fluoride elements are available in
different forms such as tablets, drops, lozenges.[6] Fluorides have a tendecy to recharge and release at it's own pace which is incorporated within the dental restorative materials.[7]

Chart no.1



Numerical analysis of fluoride ions incorporated within microsphere

On the basis of the thickness of hydrogel matrix formation, fluoride ions will be discharged accordingly.[8] Degree of discharge of fluoride ions depend on the kind of media it is released.[9,10] Therefore, kind of media in which microsphere will be kept has to be considered.

On the other hand, nanofibrous impregnated microspheres with fluoride ions included can show effective results in future. The main advantage of fluoride ion is it not only release ions but also regulates pH and induces remineralisation by formation of hydroxyapatite layer formation.[11] In relation to certain reports, it is documented that even 0.03-0.07 ppm F^- ion can show greater transformation of dentinal structure as it tends to convert from demineralisation to remineralisation phase.[12,13] This phase is stimulated by supersaturation of Ca^{+2} and PO_4^{3-} ions from the saliva as pH is maintained.[14] Dynamics of tooth and saliva in terms of ions exchange is proportionately balanced by substitution of hydroxyl ions by hydroxyapatite and formation of calcium fluoride.[15] The key phenomenon of alkalinity is formation of hydroxyapatite. The formation of thin surface layer formed by fluoride ions encountered not more than 3 atoms layer thick.[16] At very low concentrations, of the order of $3x10^{-5}$ mg/L under both static and stirred conditions. At high concentrations of fluoride ions I.e., in the range of 100-1000 ppm and static conditions, uptake has been shown to follow pseudo second order kinetics.[17] Conventional restorative materials not only tends to discharge fluorine ions but also able to absorb at it's own pace.[18,19] CaF(OH) has tendency to increase the fluoride concentration in the tooth mineral as increased fluoride ions can be easily uptake by dentine and cementum.[20,21] Ions tends to dissolute in oral fluids so ions to be sufficiently present in any form of substitutes such as microspheres or restorative materials.[22,23]

III.Conclusion:

With the overview of complete analysis, it has been concluded that carrier of any ions and subsequently it's release is important in order to come to a certain conclusive remarks.

IV.Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

Acknowledgement

Dr.Gitanjali Singh has contributed as the corresponding author in the manuscript.

References

[1]. Das MK, Ahmed AB, Saha D. Microsphere a drug delivery system-A review. Int J Curr Pharm Res. 2019;11(4):34-41
[2]. Sousa FF, Luzardo Alvarez A, Perez Estevez A, Seoane Prade R, Blanco Mendez J. Development of a novel AMX-loaded PLGA/zein microsphere for root canal disinfection. Biomed Mater.2010;5(5):055008
[3]. Wang W, Dang M, Zhang Z, Hua J, Eyster TW, Ni L, et al. Dentin regeneration by stem cells of apical papilla on injectable nanofibrous microspheres and stimulated by controlled BMP-2 release. Acta Biomater.2016;36:63-72
[4]. Wu C, Zreiqat H. Porous bioactive diopside ($CaMgSi_2O_6$) ceramic microspheres for drug delivery. Acta Biomater. 2010;6(3):820-9
[5]. Hamilton I. Biochemical effects of fluoride on oral bacteria. J Dent Res. 1990;69:682-3
[6]. Ismail AI, Hasson H. Fluoride supplements, dental caries and fluorosis: a systematic review. J Am Dent Assoc .2008;139:1457-68

[7]. Zafar MS. Effects of surface pre-reacted glass particles on fluoride release of dental restorative materials. World Applied Sciences Journal.2013;28:457-62
[8]. Itota T, Carrick TE, Yoshiyama M, Mc Cabe JF. Fluoride release and recharge in giomer, compomer and resin composite. Dent Mater. 2004;20:789-95
[9]. Garcia-Godoy F, Chan DC. Long term fluoride release from glass ionomer-lined amalgam restorations. Am J Dent.1991;4:223-5
[10]. Garcia Godoy F, Olsen BT, Marshall TD, Barnwell GM. Fluoride release from amalgam restorations lined with a silver-reinforced glass ionomer. Am J Dent.1990;3:94-6
[11]. Cury JA, Tenuta LMA. Enamel remineralisation: controlling the caries disease or treating early caries lesions. Braz J Oral Res. 2009;23(1):23-30
[12]. Forss H, Nase L, Seppa L. Fluoride concentration, mutans streptococci and lactobacilli in plaque from old glass ioonomer fillings. Caries Res.1995;29:50-3
[13]. Svanberg M, Krasse B, Ornefeldt HP. Mutans streptococci in interproximal plaque from amalgam and glass ionomer restorations. Caries Res. 1990;24:133-6
[14]. Hojo S, Takahashi N, Yamada T. Acid profile in carious dentine. J Dent Res. 1991;70:182-186
[15]. Larsen MJ, Fejerskov O. Chemical and structural challenges in remineralisation of dental enamel lesions. Scand J Dent Res. 1989;97:285-296
[16]. Fejerskow O, Kidd EAM (eds). Dental caries: The disease and it's clinical management, Oxford: Blackwell and Munsgaard, 2008.
[17]. de Leeuw NIL. Resisting the onset of hydroxyapatite dissolution through the incorporation of fluoride. J Phys Chem B.2004;108:1809-1811
[18]. Arora V, Bogra P. Giomer: A new hybrid aesthetic restorative material. J Conserv Dent. 2002;5:149-155
[19]. Perrin C, Persin M, Sarazin J. A comparison of fluoride release from four glass ionomer cements. Quintessence Int.1994;25:603-608
[20]. Dionysopoulos D, Koliniotou Koumpia E, Helvatzoglou-Antoniades M, Konstantos N. Fluoride release and recharge abilities of contemporary fluoride containing restorative materials and dental adhesives. Dent Mater J. 2013;32:296-300
[21]. Rolla G,Ogaard B, Cruz RA. Topical apllication of fluorides on teeth. New concepts of mechanism of interaction. J Clin Periodontol.1993;20:105-108
[22]. Adusei GO, Deb S, Nicholson JW. The role of the ionomer in glass component in polyacid modified composite resin dental restorative materials. J Mater Sci Mater Med. 2004;15:751-754
[23]. Eronat N, Kocatas N, Alpoz AR. A comparative study of fluoride uptake from dentin bonding agents and glass ionomer cements in permanent and primary tooth enamel. Quintessence Int.1999;30:496-500