Comparative Study of the Effect of Gum Arabic and Fluoride on Enamel White Spots

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List of Abbreviations

A.catechu :	Acacia catechu
ACP :	Amorphous calcium phosphate
AG :	Arabinogalactan
AGP :	Arabinogalactan-Protein
ALT :	Alanine transaminase
A.niger :	Aspergillus niger
A.nilotica :	Acacia nilotica
A.senegal :	Acacia Senegal
AST :	Aspartate transaminase
A.seyal :	Acacia seyal
B.cereus :	Bacillus cereus
B.subtilis :	Bacillus subtilis
BOP% :	Bleeding on probing index
^{o}C :	Celsius
Ca	Calcium
C.albicans :	Candida albicans
CRF :	Chronic renal failure
CPP-ACP :	Casein phosphopeptide amorphous calcium phosphate
d :	Average length of the diagonals in microns
Demin.	demineralization
DW	Distilled water
EDAX :	Energy dispersive X-ray analyzer
E.coli :	Escherichia coli
ESEM :	Environmental scanning electron microscope
ESRD :	End-stage renal disease
eV :	Electron volt
FAO :	Food and nutrition organization
GA	Gum arabic
GI :	Gingival index
GP :	Glycoprotein
GPC :	Gel permeation chromatography
h^{-1} :	Growth rate measurement unit
HDL :	High density lipoprotein
HPS :	Hand-picked selected

IgE :	Immunoglobulin E
K	Potassium
KDa :	Atomic mass unit
kTn/year :	Kilo ton per year
Kg/mm^2 :	Kilogram per millimetre square
KV :	Kilo voltage
LDL :	Low density lipoprotein
LFD detector:	Live fiber detection
M :	Mole per litre
Mg	Magnesium
mg/day :	Milligram per day
mg/ml :	Milligram per millilitre
MHV :	Vicker's microhardness unit
NaF	Sodium Fluoride
nm :	Nanometre
NSAIDs	Non- steroidal anti-inflammatory drugs
P :	Load in grams
P :	Phosphorus
P.aeruginosa:	Pseudomonas aeruginosa
pH :	Measure of acidity and alkalinity
PI :	Plaque index
ppm :	Parts per million
P value :	Probability value
S.aureus :	Staphylococcus aureus
SEM :	Scanning electron microscope
STD :	Standard deviation
um	Micrometre
VLDL :	Very low density lipoprotein
wt% :	Weight percent
w/v :	Weight/Volume
X :	Magnification power

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Abstract

Gum Arabic (GA) is an edible, gummy exudate of Acacia trees. It is the oldest and best known of all natural gums and is considered to have an ability to enhance remineralization, due to its high concentration of calcium. **Aim of the study**: Evaluate the effect of topical application of GA and the effect of NaF* on the surface topography, mineral content and surface micro-hardness of enamel white spot lesions. **Materials and methods**: 21 caries-free recently extracted premolars were equally divided into 3 groups according to the treatment solution used as follows: Group I (10mg/ml GA), Group II (1000ppm NaF) and Group III (DW*). First, all samples were examined to act as a baseline and were named as subgroups A (IA, IIA & IIIA). Then all the samples were subjected to artificial white spot lesions creation by immersion in a demineralizing solution and they were examined again as subgroups B (IB, IIB & IIIB). Samples were subsequently subjected to the three different treatment solutions previously mentioned in the form of pH demineralization-remineralization cycles and were examined again as subgroups C (IC, IIC & IIIC). **Results:** Surface topography evaluation using ESEM* showed signs of remineralization similarly after treatment with GA and NaF. Ca content and micro-hardness evaluation using EDXA* and Vicker's tester respectively showed significant increase in Ca wt% and micro-hardness values similarly after treatment with GA and NaF, while DW group showed no significant difference. **Conclusions:** Using GA as a treatment solution enhanced the remineralization of white spot lesions in vitro indicating that GA is a potential remineralizing agent.

*NaF: Sodium Fluoride. *DW: Distilled water. *ESEM: Environmental scanning electron microscope. *EDXA: Energy dispersive X-ray micro-analyzer

Dedication

I will never be grateful enough to my beloved parents who taught me everything in my life. They are the reason behind each and every step forward in my life. They supported me through the whole work and got worried till it came out to the light, my husband for standing beside me all over the way and for his extreme support and care, And last but not least my dear brother and sisters for their unconditional cooperation and help in this work and for being supportive throughout my life.

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Introduction
And Review of Literature

1. Enamel demineralization (white spot lesions)

Human dental enamel is known to be the most mineralized and hardest tissue in the human body. However, acidic attack of the enamel, typically due to the presence of acidogenic bacteria on the enamel's surface, can cause a dramatic reduction in the enamel's degree of mineralization and its mechanical strength. Also, prolonged exposure to acid can lead to the creation of an incipient carious lesion ‘‘white spot lesion’’ which can eventually penetrate deep into the enamel and dentin of the tooth ***(Dickinson et al., 2007).***

Enamel white spot lesions are the earliest microscopic signs of demineralization under intact enamel, which may or may not lead to the development of caries (cavitations), thus a cavity is the terminal stage of progressive mineral loss. The reason for the white spots is that the organic acids have etched the enamel layer and hence this loss of the mineralized layer creates porosities that change the refractive index of the normally translucent enamel.

Typically characterized by white or opaque areas on smooth enamel surfaces, white spot lesions can be present in both primary and secondary teeth and, depending on their cause and severity, can be treated noninvasively, in either case ***(Vick et al., 2007).***

These white spot lesions maybe confused initially with white developmental defects of enamel formation, which can be differentiated by their position (away from the gingival margin), their shape (unrelated to plaque accumulation) and their symmetry (usually affect the contra lateral tooth), also on wetting the carious lesions disappear while the developmental defect persists. While white spot lesions are often seen when orthodontic bands and brackets are removed. Adjacent causes of white spot lesions may include heavy plaque accumulation, inadequate oral home care routines, and a high sugar or acid content diet especially in people who drink a lot of soda, or eat lots of citrus fruits ***(Vick et al., 2007)***.

The reason why white spot lesions maintain an intact surface is that the crystals near the tooth surface are fluoroapatites which are less soluble in acids than hydroxyapatites, also saliva remineralizes the surface first and because the tiny hydrogen ions penetrate deeply in the tooth ***(Machale et al., 2013).***

There is no one specific etching pattern produced in human dental enamel by the action of acid solutions. These differences produced by acids are difficult to explain due to variation in chemical composition, crystalline orientation and variation in the structure that can occur in enamel not only from tooth to tooth, or surface to surface, but also from site to site on a single tooth surface ***(Galil & Wright, 1979)***.

The scanning electron microscopic investigation of the buccal surface of enamel after acid etching revealed that the enamel follows five distinct different patterns with a recognizable geographic distribution (regardless of etching time or acid type). According to the classification of ***Silverstone et al., (1975)***: Type 1 describes enamel prism cores preferential removal. Type 2 is the reverse pattern where the peripheral regions of the prisms were removed leaving relatively unaffected prism cores. Type 3 had areas corresponding to both types 1 and 2. A pitted enamel surface has been classified as a Type 4 pattern, while Type 5 pattern has a flat, smooth surface after etching.

Galil & Wright, (1979), stated the distribution of the etching patterns according to location as follows: Types 1 and 2 etches predominated on the coronal areas of the buccal surfaces. Type 3