

## Literature Reviews

# Pomegranate juice (*Punica granatum*) as an ideal mouthrinse for fixed orthodontic patients

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### ABSTRACT

**Background:** Prevention of caries as well as periodontal disease is mandatory during orthodontic treatment. Nevertheless, the use of antiseptic mouthrinse is contraindicated for prolonged use. Pomegranate juice is a polyphenol-rich juice with high antioxidant capacity as well as antimicrobial properties. It has been shown to exert beneficial characteristics for orthodontic patients such as antioxidant and anti-inflammatory effects. Moreover, it contained fluoride and phosphorous which are cariostatic. Previous study in fixed orthodontic patients revealed that rinsing with this juice showed reduced dental plaque and superior compared with chlorhexidine. If it has unwanted effect by reducing pro-inflammatory reaction that also needed in orthodontic movement is not clearly understood.

**Purpose:** The aim of the present review was to discuss the beneficial and unwanted effect of pomegranate juice mouthrinse towards orthodontic treatment. **Reviews:** Pomegranate has antimicrobial activity, its methanolic skin extract is the most potent followed by seed juice. Nevertheless, seed juice is not only tastier, easier to make but also has mild antimicrobial potency which is beneficial for long-term use. Healthy periodontal tissue is preferable for orthodontic movement since it resulted in less unwanted bone resorption.

**Conclusion:** Regarding its beneficial effect and safety of pomegranate juice if use daily mouthrinse in fixed orthodontic patients, it could be proposed as an ideal long term use mouthrinse for fixed orthodontic patients. However, further researches should be done to verify this concept.

**Key words:** Pomegranate juice, mouth rinse, fixed orthodontic

### ABSTRAK

**Latar belakang:** Pencegahan karies dan penyakit periodontal sangat penting dalam perawatan ortodontik. Walaupun demikian, penggunaan obat kumur antiseptik jangka panjang merupakan kontraindikasi. Jus buah delima sangat kaya akan polifenol dengan kemampuan antioksidan yang tinggi disertai kemampuan antimikroba. Beberapa penelitian telah menunjukkan dampak menguntungkan pada pasien ortodonti, yaitu sebagai antioksidan dan anti radang. Selain itu juga mengandung fluor dan fosfor yang bersifat kariostatik. Penelitian terdahulu pada pasien ortodonti cekat menunjukkan penurunan plak gigi yang lebih banyak dibanding dengan klorheksidin. Akan tetapi, apakah juga menyebabkan dampak merugikan yaitu mengurangi reaksi peradangan yang juga penting bagi pergerakan ortodonti masih belum jelas.

**Tujuan:** Membahas dampak menguntungkan maupun merugikan jus buah delima pada perawatan ortodonti.

**Tinjauan pustaka:** Buah delima merupakan antimikroba, ekstrak dari kulit yang mengandung metanol adalah paling kuat diikuti jus biji delima. Akan tetapi, jus biji lebih enak rasanya, mudah dibuat dan merupakan antimikroba ringan sehingga menguntungkan untuk pemakaian jangka panjang. Jaringan periodontal yang sehat diperlukan untuk pergerakan ortodonti karena dapat mengurangi resorpsi tulang. **Kesimpulan:** Berdasarkan dampak menguntungkan dan keamanan jus buah delima bila digunakan tiap hari, bahan ini dapat diusulkan sebagai obat kumur jangka panjang yang ideal untuk pasien ortodonti cekat. Walaupun begitu, penelitian lebih lanjut harus dilakukan untuk verifikasi konsep ini.

**Kata kunci:** Jus buah delima, obat kumur, ortodonti cekat

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## INTRODUCTION

A frequent asked question: “Is it safe to use mouthrinse when you have braces?”, it seems a simple question, nevertheless, to answer it many things should be considered. It is logical that wearing orthodontic appliances has been known to induce intraoral changes, such as increased plaque accumulation and elevated bacterial colonization along with potential enamel demineralization and a harmful effect on periodontal tissues such as gingivitis and periodontitis.<sup>1,2</sup> Fixed orthodontic appliances, such as orthodontic brackets, wires as well as elastomeric modules and chains etc., increase the number of retention places for dental plaque accumulation. All these factors make it even more difficult to maintain oral hygiene. Self-cleaning is also more difficult because of the reduced effect of mechanical chewing and rinsing the food residues off by saliva. Subsequent accumulation of plaque can causing to development of chronic periodontal inflammation and can progress to gingival enlargement. Gingival enlargement inhibits hygiene measures, slows down orthodontic tooth movement and cause aesthetic and functional problems.<sup>2,3</sup>

Even without brackets, for many people, especially children, it is difficult to adequately comply with recommended mechanical methods of plaque control and to achieve the necessary level of oral hygiene. Tooth brushing removes up to 50% of plaque biofilm, and is even more effective when used in combination with flossing.<sup>2,4</sup> Such inadequate home care put these patients at a greater risk of developing gingivitis, which may progress to periodontitis in approximately 20% of patients. Therefore, using mouth rinse is considered helpful.<sup>1-4</sup>

Several requirements for long term use of oral rinse should be followed in orthodontic treatment such as minimal adverse effect towards the properties of brackets and wires<sup>5</sup> as well as elastomeric modules and chains.<sup>6</sup> The force degradation of elastomeric chain was related to water absorption and chemicals, the amount of loss in dry is less than in wet environments and especially in biofresh mouthrinse more than the neutral saliva.<sup>6</sup> The role of pH fluctuation towards elastomeric chain force degradation.<sup>7</sup> Regarding the alcohol containing mouth rinse (ACM), several opinions suggested that long term use may cause xerostomia and oral cancer which were not proven by studies. However, in orthodontics view, the use ACM should be limited since a study by Larrabee *et al.*,<sup>8</sup> revealed that ACM increase force degradation of elastomeric chain.

The concept of mouthrinse is not new; they have been used for thousands of years, as mouthrinse ingredients containing salt, alum, and vinegar have been associated with Chinese, Indian, and Greek and Roman cultures. Although some rinses were historically used to freshen breath, there is evidence that modern therapeutic rinses may improve health. Therapeutic rinses may control oral biofilm, and biofilm is said to cause 70% to 80% of all human infections.<sup>9,10</sup>

The use of plants for treating diseases is as old as the human civilization. There are many plants which have been in use as traditional medicine, so they are called as medicinal plants. The use of plants for curing diseases was inevitable as is already proven by seeing the problems associated with synthetic antibiotics. Peels of some plants such as *Punica granatum* (having antibacterial properties) which are generally treated as wastes are true antibiotics as they are available for no cost, have no side effects and the most important benefit is that antibiotic resistant pathogens will be easily killed by these new and natural antimicrobials because they will take at least a few decades to get mutated and resistant to them.<sup>9</sup>

Pomegranate juice as mouth rinse for fixed orthodontic patients is not a new idea. Pomegranate mouth rinse was very effective to reduce dental plaque compared to chlorhexidine and distilled water in fixed orthodontic patients.<sup>11</sup> However, the adverse effect towards fixed orthodontics accessories (wires, elastomeric modules, coil springs) are still unclear. The aim of the present review is to discuss the beneficial and unwanted effect of pomegranate juice towards orthodontic treatment.

### Oral hygiene problem and maintenance in fixed orthodontic patients

Oral hygiene may be difficult to maintain during treatment, which may lead to plaque accumulation and gingival inflammation. It has been shown that orthodontic treatment induces changes in the oral environment, with an increase in the bacteria's concentration, and alterations in buffer capacity, pH acidity and salivary flow rate.<sup>2,3</sup> However, little is known about periodontal inflammation that results in diluted blood in saliva as well as the pH of dental plaque.<sup>12</sup> Plaque accumulation and subsequent gingivitis are common in orthodontic patients because of the challenge of controlling oral hygiene with the combination of brackets, bands, wires as well as elastomeric modules and chains present.<sup>2,3</sup>

The main goal of an at-home oral hygiene for fixed orthodontic patients is toothbrushing with a fluoride containing toothpaste. The role of fluoride as an inhibitor of demineralisation becomes important and it has been shown that the presence of fluoride in solution at the time of acidic attack on the enamel may considerably slow down the rates of decay. It has been suggested that if preventive measures (fluoride supplementation and good oral hygiene) are followed and maintained throughout the course of orthodontic treatment, then the number of white spot lesions may be reduced.<sup>12</sup>

### Mouthrinse

Mouthrinses or mouthwashes are generally formulated using antibacterial agents (fluoride, alcohol, and cetylpyridinium chloride), flavours (thymol, eucalyptol, menthol, and mint oils), humectants (sorbitol, glycerol, propylene glycol) and colorants in an aqueous/ alcoholic medium. The sweetener (sodium saccharin) may be used to reduce/ eliminate the base taste of the product. Surfactants

(sodium lauryl sulphate, cocoamidopropyl betaine) may also be used as foaming agents and water is the medium. Most of the currently available mouthwash products in the market contain alcohol. Though alcohol acts as an antiseptic and antibacterial, it induces dryness in the mouth and makes the environment more susceptible to the growth of bad breath producing bacteria. Hence, the recent trend in the market is to move from the alcohol-containing products to alcohol-free mouthrinses.<sup>1,13</sup>

Generally, some prescription of mouthrinse should be: (a) antimicrobial of oral pathogenic bacteria; (b) do not induce adverse effects (irritation, change taste buds perception, create oral flora imbalance, microbial resistance, decrease salivary flow and tooth or restoration staining); (c) contain fluorides.<sup>1</sup> Nevertheless, for fixed orthodontic patients several requirements should be added that does not affect the properties of elastomeric modules and chains<sup>14</sup> as well as brackets and wires.<sup>15</sup> In USA, mouthrinse should be compared with ADA and/or FDA Guidelines, two antiseptic mouthrinses (and their generic equivalents) have been awarded the ADA Seal for chemotherapeutic control of supragingival plaque and gingivitis: 0.12% chlorhexidine gluconate (CHG) mouthrinse (Peridex<sup>®</sup>) and essential oils (EO) mouthrinse (Listerine<sup>®</sup>).<sup>1</sup>

Some dental professionals may fear that antiseptic mouthrinses have a risk in killing or inhibiting normal flora with subsequent repopulation with opportunistic and/or more pathogenic or resistant organisms. The microbial shift would manifest as an overgrowth of opportunistic organisms, such as *Candida*. Fortunately, studies document no adverse effects on supragingival dental plaque microflora after 6 months of continued use with either CHG or EO. Evidence confirms that daily, long-term use (6 months or longer) of CHG or EO does not adversely affect oral microbial flora, including no microbial overgrowth, opportunistic infection, or development of microbial resistance.<sup>1,16</sup>

#### Benefits of herbal antimicrobials

The widespread use of commercially available antimicrobials led to the consequence of emergence of antimicrobial resistant pathogens that ultimately led to the threat to global public health. Since 1980 the introduction of new antimicrobials has declined due to the huge expense of developing and testing new drugs. All commercially

available antibiotics with prolonged use may have negative effect on human and animal health because they kill gut flora, so they need to take probiotics to replace the killed gut flora. All the above points make a clear way for herbal antimicrobials.<sup>14,15</sup>

The use of plants for treating diseases is as old as the human civilization. There are many plants which have been in use as traditional medicine, so they are called as medicinal plants. The use of plants for curing diseases was inevitable as is already proven by seeing the problems associated with synthetic antibiotics.<sup>15,17</sup> Peels of some plants as *Punica granatum* (having antibacterial properties) which are generally treated as wastes are true antibiotics as they are available for no cost, have no side effects and the most important benefit is that antibiotic resistant pathogens will be easily killed by these new and natural antimicrobials because they will take at least a few decades to get mutated and resistant to them.<sup>17,18</sup>

#### Pomegranate

Pomegranate (*Punica granatum L.*) is native to the Mediterranean region and has been extensively used in the folk medicine of many countries. Pomegranate juice has potential anti-atherogenic effects in healthy humans and atherosclerotic effects in mice along with other nutritional and health advantages. As a result, pomegranate juice has become popular worldwide. Numerous studies on antioxidant activity have shown that pomegranate juice contains higher levels of antioxidants than most fruit juice.<sup>14</sup>

Pomegranate juice is an important source of anthocyanins (cyanidin, delphinidin, pelargonidin), which gives the fruit and aril its red color, and phenolics and tannins (punicalin, pedunculagin, punicalagin, ellagic acid).<sup>18</sup> Pomegranate fruit contains many different kinds of polyphenolic antioxidants and commercial pomegranate juice has been shown to possess antioxidant activity three times higher than those of red wine and green tea (Table 1). The strongest antibacterial activity is the skin (rind, peel), followed by juice and the least is the seeds (red seeds are stronger than white). Other constituent of pomegranate juice which is beneficial to dental and periodontal health are calcium and phosphorus<sup>15</sup> as well as fluoride even only approximately 1/50th of green tea fluoride.<sup>19</sup>

**Table 1.** Phytochemical of pomegranate<sup>18</sup>

Plant component	Constituents
Pomegranate juice	Anthocyanins, glucose, ascorbic acid, ellagic acid, gallic acid, caffeic acid, catechin, EGCG, quercetin, rutin, numerous minerals, particularly iron, aminoacids
Pomegranate seed oil	95-percent punicalin, other constituents, including ellagic acid, other fatty acids, sterols
Pomegranate pericarp (peel, rind)	Phenolic punicalagins, gallic acid and other fatty acids, catechin, EGCG, quercetin, rutin and other flavonols, flavones, flavonones, anthocyanidins
Pomegranate leaves	Tannins (punicalin and punicalagin), and flavones glycosides, including luteolin and apigenin
Pomegranate flower	Gallic acid, ursolic acid, triterpenoids, including maslinic and Asiatic acid, other unidentified constituents
Pomegranate roots and bark	Ellagitannins, including punicalin and punicalagin, numerous piperidine alkaloids

### Pomegranate's mouth rinse and oral health

Investigators had been noted that Pomegranate's active components, including polyphenolic flavonoids (e.g., punicalagins and ellagic acid) (Table 1), are believed to prevent gingivitis through a number of mechanisms including reduction of oxidative stress in the oral cavity, direct antioxidant activity; antiinflammatory effects; antibacterial activity; and direct removal of plaque from the teeth.<sup>10</sup>

Changed of salivary measures relevant to oral health including gingivitis after rinsing with Pomegranate extract.<sup>20</sup> The changes were: (a) reduced total protein (which can correlate with plaque forming bacteria readings); (b) reduced activities of aspartate aminotransferase (an indicator of cell injury); (c) reduced alpha-glucosidase activity (a sucrose degrading enzyme); (d) increased activities of the antioxidant enzyme ceruloplasmin (which could give better protection against oral oxidant stress) and (e) increased radical scavenging capacity. A placebo of cornstarch in water did not affect these measures. Pomegranate juice anti-inflammatory and anti-oxidant effect.<sup>14</sup>

The effect of the hydroalcoholic extract (HAE) from pomegranate fruits on dental plaque microorganisms.<sup>11</sup> The results, expressed as the number of colony forming units per milliliter (CFU/mL), show that the HAE was very effective against dental plaque microorganisms, decreasing the CFU/ml by 84% after mouthrinse. While similar values were observed with chlorhexidine, used as standard and positive control (79% inhibition), only an 11% inhibition of CFU/ml was demonstrated in the distilled water group, negative control. Therefore, HAE had an antibacterial activity against selected microorganisms, and may be a possible substitute for the treatment of dental plaque bacteria.

Moreover, studies conducted by Bhandari *et al.*,<sup>10</sup> and Bhadbade SJ *et al.*,<sup>21</sup> indicate that the pomegranate mouth rinse has an antiplaque effect. It also states that pomegranate extract is succeeded against the *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, and *Prevotella intermedia* strains *in vitro*.

These investigators suggest that pomegranate mouth rinse should be explored as a long-term antiplaque rinse, with prophylactic benefits. Pomegranate extracts in especially fruit skin extract is highly effective on growth of *Streptococcus mutans* in comparison with other extracts and various concentrations of tooth pastes, this fact may reflect efficiency of antibacterial activity of plant extracts, and ability of bacteria to resist other antibacterial agents such as pastes and antibiotics.<sup>22</sup>

Pomegranate extract suppresses the ability of *S. mutans*, *mitis* and *sanguis* to adhere to the surface of the tooth.<sup>23</sup> The trick is to inhibit a common species of *Streptococcus*, preventing it from producing chemicals that create favorable conditions for fungi and other microorganisms to grow. Inhibition of interbacterial adhesion or *coaggregation* which important in biofilm formation was verified.<sup>24</sup> Investigate the methanolic extract of *Punica granatum* peel (MEPGP) revealed its effective concentrations in mg/mL against microbes (Table 2).<sup>17</sup>

### Effect of mouthrinse properties towards fixed orthodontic appliances

There are several mouthrinse properties that may affect the characteristics of fixed orthodontics appliances and accessories for example: (a) fluoride; (b) alcohol; (c) pH (acidity). Decay of elastomeric chain force in sodium fluoride 0.5% mouthwash plus saliva will degraded more rapidly than saliva only in higher force, that was 300 gram ( $p=0.020$ ).<sup>2</sup> Nevertheless, in low force the difference was insignificant. Meridol® mouthwash, which contains stannous fluoride, was the solution in which the nickel titanium (NiTi) wires coupled with the different brackets showed the highest corrosion risk, while in Elmex® mouthwash, which contains sodium fluoride, the CuNiTi wires presented the highest corrosion risk.<sup>6</sup>

Such corrosion has two consequences: deterioration in mechanical performance of the wire-bracket system, which would negatively affect the final aesthetic result, and the risk of local allergic reactions caused by released Ni ions. The results suggest that mouthwashes should be prescribed

**Table 2.** Antibacterial and antifungal properties of methanolic extract of punica granatum at three different concentrations<sup>17</sup>

Microbials strains	Antimicrobial activity at						Positive control**	P. value	F
	Conc. of 4		Conc. of 8		Conc. of 12				
	Mean	SD	Mean	SD	Mean	SD			
Staphylococcus aureus	7.5	0.57	11.5	0.56	12.5	0.58	30	0.000	155.66
Staphylococcus epidemis	11.5	0.57	13.5	0.59	13.5	0.58	29	0.000	20.00
Lactobacillus acidophilus	6.5	0.57	10.0	0.00	10.0	0	14	0.000	227.00
Actinomyces viscosus	6.0	0.00	6.5	0.57	6.5	0.57	25	0.168	2.00
Streptococcus mutans	6.0	0.00	9.5	0.57	9.5	0.57	24	0.000	98.00
Streptococcus sanguinis	6.5	0.57	10.0	0.00	11.5	0.58	25	0.000	172.00
Streptococcus salivarius	6.5	0.58	8.5	0.59	9.5	0.60	26	0.000	43.66
Candida albicans	6.0	0.00	6.5	0.57	6.5	0.57	40	0.168	2.00

\*measured by the diameter of zone of inhibition in mm, Conc= Concentration, \*\*Ciprofloxacin and nystatin are the positive control group.

according to the orthodontic materials used. A new type of mouthwash for use during orthodontic therapy could be an interesting development in this field.<sup>6</sup>

Regarding to the safety of long term use of alcohol mouthrinse for oral cancer, it was still inconclusive.<sup>13</sup> Additionally, alcohol containing mouthwashes afford little or no advantage in terms of efficacy over the alcohol free competitors. Alcohol causes a statistically significant ( $p=0.04$ ) increase in the amount of force decay seen in elastomeric chains exposed to alcohol and commercial mouth rinse containing alcohol compared to those exposed only to water.<sup>8</sup>

pH of the mouthwash products are varying from 3.7 to 6.5. The mouthwashes containing ethyl alcohol in the range of 6–8% are having pH in the range of 6.0–6.5 whereas those containing alcohol higher than 20% are acidic in nature (pH below 4 also).<sup>26</sup> There was chemical changes in pH and total ethanol of mouth rinse evaluated over time.<sup>27</sup> Therefore, it is recommend that mouthwash manufacturers routinely check the change of pH of the mouthwashes, and use preservatives that maintain desirable pH homeostasis in the products.

Elastomeric chain force degradation increase rapidly in neutral or alkaline pH,<sup>7</sup> thus acidic environment facilitate higher performance. Fruit juices including pomegranate (2.75–4.14) are acidic liquid.<sup>28</sup> As the result it is considered beneficial to elastomeric chain properties.

## DISCUSSION

Based on this review, the prime question: “Is it safe to use mouthwash when you have braces?”, should be answered: “No problem”. Until now the safety of alcohol-containing mouthrinses has been called into question, since many proprietary mouthwashes contain alcohol (ethanol) and in some, the concentration of ethanol can be as high as 26% have fuelled the controversy.<sup>13</sup> Studies which appear to establish a relationship between the use of these rinses and oral cancer, are significantly flawed or imperfect.<sup>1,29</sup>

High risk predisposition (children, alcohol dependent persons, and persons with genetic deficiencies in acetaldehyde metabolism) should use alcohol-free mouthwashes for the maintenance of oral health.<sup>30</sup> Apart from these considerations for the individual, the risk of alcohol-containing mouthwash for public health appears very low compared to other routes of exposure to alcohol and acetaldehyde. Nevertheless, in fixed orthodontic patients, especially in Indonesia with high humidity lead to accelerate elastomers degradation, slowing down the force degradation by using an alcohol-free mouthwash is advisable.

Pomegranate juice is considered as acidic (pH 2.75–4.1),<sup>7</sup> it is beneficial for orthodontic movement by slowing down elastomeric degradation. Even acidic, it is considered as a save mouthrinse, since pH of other mouthwash products

are varying from 3.7 to 6.5. The mouthwashes containing ethyl alcohol in the range of 6–8% are having pH in the range of 6.0–6.5 whereas those containing alcohol higher than 20% are acidic in nature (pH below 4 also).<sup>26</sup>

Another ingredients such as calcium and fluoride of pomegranate juice is beneficial for maintaining the integrity of tooth enamel.<sup>15</sup> Fluoride content of pomegranate juice is not as high as other fluoride containing mouthrinse. Excess of fluoride content in daily mouthrinse is disadvantageous for brackets and CuNiti wires since the are more prone to corrosion.<sup>6</sup>

Other than its non-alcoholic contains, pomegranate as a phytoplants mouthrinse have been shown to be good alternatives to synthetic chemical antimicrobial agents and antibiotics because of the serious side effects, antimicrobial resistance and the emergence of previously uncommon infections that have been reported to be on the increase due to inappropriate or widespread overuse of antimicrobials. On the other hand, clinicians should remind the potential risk of urticaria, alteration in taste, increase of calculus staining of teeth and mucous membranes and more rarely, oral mucosa desquamation and parotid swelling before prescribing chlorhexidine mouth wash as an antimicrobial agent.<sup>14,18</sup>

Extracts of *Punica granatum* peel in different concentrations were effective against *S. epidermidis*, *S. aureus*, *S. mutans*, *S. sanguinis* and *S. salivarius*.<sup>24,31</sup> Antibacterial activity may be related to the presence of hydrolysable tannins and polyphenolics in the pomegranate extract specifically punicalagin and gallagic acid.<sup>32</sup> It means that the antimicrobial effect of tannins is related to its toxicity and molecular structure. Tannins may act on the cell wall and across the cell membrane because they can precipitate proteins. They may also suppress many enzymes such as glycosyltransferases. Therefore, tannic acid has the highest antibacterial effect against tested sensitive strains even at low concentrations.

Plaque may involve four or more different microorganisms combining forces to colonize the surface of the teeth. Remarkably, nature’s own pomegranate fights the organisms’ ability to adhere by interfering with production of the very chemicals the bacteria use as “glue” in bacterial adhesion or *coaggregation*.<sup>24</sup> The use of pomegranate as anti-adhesion of microbes. Microbial adhesion is considered the first step in the sequence of events leading to colonization, is an important step leading to virulence and subsequent infection.<sup>33</sup>

Since every part of the pomegranate plants and fruit has its own active ingredients, therefore in producing a pomegranate mouthrinse one should refer to a reference such as in Table 1. Hence, the antibacterial activity of *Punica granatum* may be related to polyphenol structures because polyphenols may affect the bacterial cell wall, inhibit enzymes by oxidized agents, interact with proteins and disturb co-aggregation of microorganisms. Therefore, if our intention is to make mouthrinse with the phenolic

compound, thus the peel and rind of pomegranate should be included. If only mild antimicrobial effect needed, just made it from white seed pomegranate.<sup>16,19</sup>

As an antioxidant, the effect of Pomegranate mouthrinse towards orthodontic tooth movement (OTM) is still unclear. A rat model of orthodontic tooth movement which consumed anti oxidants Resveratrol or N-acetylcysteine.<sup>34</sup> It suppressed the expression of proinflammatory cytokines interleukin-1 $\beta$  and tumor necrosis factor- $\alpha$  in the periodontal ligament tissues compared to the vehicle-treated group, thus inhibit bone resorption and retard OTM. Consumption of pomegranate extract accelerate bone formation.<sup>35</sup> However, pomegranate consumption is different with mouthrinsing only, therefore the retardation of OTM should be minimal.

Based on the literatures it is concluded that pomegranate is an ideal mouthrinse for fixed orthodontic patients since it has abundant benefits for long term use. The beneficial properties are: (a) antimicrobial of oral pathogenic bacteria; (b) prevent the interbacterial adhesion (coaggregation) as well as bacteria to tooth adherence by interfering adhesive production; (c) do not induce adverse effects (irritation, change taste buds perception, create oral flora imbalance, microbial resistance, decrease salivary flow and tooth or restoration staining); (d) non-alcoholic; (e) as fruit juice it has acceptable taste; (f) do not accelerate elastomeric chain force degradation since it has acidic pH; (g) non corrosive for orthodontic brackets and CuNiTi wires, cause of its mild fluoride content; (h) Others are its antiinflammatory and antioxidant effect as well as calcium and phosphorus contents which beneficial towards dental and periodontal health. However, further researches should be done for its antiinflammatory and antioxidant effect towards bone remodelling which mandatory in orthodontic movement.

## REFERENCES

- Goldie MP. The role of oral rinse technologies in a new daily oral healthcare regimen. *Compendium* 2012; 32(3): 15–20.
- Perosa K, Mestrovic S, Anic-Milosevic S, Slaj M. Salivary microbial and nonmicrobial parameters in children with fixed orthodontic appliances. *Angle Orthod* 2011; 81(5): 901–6.
- Teixeira HS, Kaulfuss SMO, Ribeiro JS, do Rosário Pereira B, Brancher JA, Elisa Souza Camargo ES. Calcium, amylase, glucose, total protein concentrations, flow rate, pH and buffering capacity of saliva in patients undergoing orthodontic treatment with fixed appliances. *Dental Press J Orthod* 2012; 17(2): 157–61.
- Sanpei S, Endo T, Shimooka S. Caries risk factors in children under treatment with sectional brackets. *Angle Orthod* 2010; 80(3): 509–14.
- Al-Kassar SS. The force degradation of elastic chain in different environments and for different intervals (an in vitro study). *Al-Rafidain Dent J* 2011; 11(2): 231–7.
- Schiff N, Mickaël, Boinet M, Morgon L, Lissac M, Dalard F, Grosgeat B. Galvanic corrosion between orthodontic wires and brackets in fluoride mouthwashes. *Eur J Orthod* 2006; 28(3): 298–304.
- Christnawati. Pengaruh pH saliva terhadap sifat elastik rantai elastomerik. *MI Ked Gigi* 2007; 22(1): 16–20.
- Larrabee TM, Liu SSY, Torres-Gorena A, Soto-Rojas A, George J, Eckert GJ, Stewart KT. The effects of varying alcohol concentrations commonly found in mouth rinses on the force decay of elastomeric chain. *Angle Orthod* 2012; 82: 894–89.
- Ramesh KS, Shamim SF. Role of pomegranate in preventive dentistry. *IJRAP* 2012; 3(5): 5–10.
- Bhandari PR. Pomegranate (*Punica granatum* L.). Ancient seeds for modern cure? Review of potential therapeutic applications. *Int J Nutr Pharmacol Neurol Dis* 2012; 2: 171–84.
- Menezes SM, Cordeiro LN, Viana GS. *Punica granatum* (pomegranate) extract is active against dental plaque. *J Herb Pharmacother* 2006; 6(2): 79–92.
- Lara-Carrillo E, Montiel-Bastida NM, Sánchez-Pérez L, Alanís-Tavira J. Effect of orthodontic treatment on saliva, plaque and the levels of *Streptococcus mutans* and *Lactobacillus*. *Med Oral Patol Oral Cir Bucal* 2010; 15(6): 924–9.
- de A Werner CW, Seymour RA. Are alcohol containing mouthwashes safe?. *Br Dent J* 2009; 207(10): 1–10.
- Kukreja BJ, Dodwad V. Herbal mouthwashes – a gift of nature. *Int J Pharm Bio Sci* 2012; 3(2): 20–4.
- Eksi A, Özhamamcı İ. Chemical composition and guide values of pomegranate juice. *GIDA* 2009; 34(5): 265–70.
- Tufekci E, Casagrande ZA, Lindauer SJ, Fowler CE, Williams KT. Effectiveness of an essential oil mouthrinse in improving oral health in orthodontic patients. *Angle Orthod* 2008; 78(2): 294–8.
- Mousavinejad G, Zahra Emam-Djomeh Z, Karamatollah K. Identification and quantification of phenolic compounds and their effects on antioxidant activity in pomegranate juices of eight Iranian cultivars. *Food Chemistry* 2009; 115: 1274–8.
- Abdollahzadeh S, Mashouf RY, Mortazavi H, Roozbahani MN, Vahedi M. Antibacterial and antifungal activities of *Punica Granatum* peel extracts against oral pathogens. *J Dentistry Tehran* 2011; 8(1): 1–6.
- Dahham SS, Ali MN, Tabassum H, Khan M. Studies on antibacterial and antifungal activity of pomegranate (*Punica granatum* L.). *American-Eurasian J Agric & Environ Sci* 2010; 9(3): 273–81.
- Giljanović J, Prkić A, Marija Bralić M, Brkljača M. Determination of fluoride content in tea infusion by using fluoride ion-selective electrode. *Int J Electrode Sci* 2012; 7: 2918–27.
- DiSilvestro RA, DiSilvestro DJ. Pomegranate extract mouth rinsing effects on saliva measures relevant to gingivitis risk. *Phytother Res* 2009; 23(8): 1123–7.
- Bhadbhade SJ, Acharya AB, Rodrigues SV, Thakur SL. The antiplaque efficacy of pomegranate mouthrinse. *Quintessence Int* 2011; 42(1): 29–36.
- Alsaimary IE. Efficacy of some antibacterial agents against *Streptococcus mutans* associated with tooth decay. *Internet J Microbiol* 2009; 7(2).
- Vasconcelos LCS, Sampaio FC, Sampaio MCC, Pereira MCV, Higo JS, Peixoto M. Minimum inhibitory concentration of adherence of *Punica granatum* (pomegranate) gel against *S. mutans*, *S. mitis* and *C. albicans*. *Braz Dent J* 2006; 17(3): 223–7.
- Ramazanzadeh BA, Jahanbin A, Hasanzadeh N, Eslami N. Effect of sodium fluoride mouth rinse on elastic properties of elastomeric chains. *J Clin Pediatr Dent* 2009; 34(2): 189–92.
- Teki K, Bhat R. Composition analysis of the oral care products available in Indian market. Part I: Mouthwashes. *IJARPB* 2012; 1(3): 338–47.
- Lee CK. Determination of pH, total acid, and total ethanol in oral health products: Oxidation of ethanol and recommendations to mitigate its association with dental caries. *J Dent Oral Med Dent Ed* 2009; 3(1): 1–4.
- Akbarpour V, Hemmati K, Sharifani M. pH physical and chemical properties of pomegranate (*Punica granatum* L.) fruit in maturation stage. *American-Eurasian J Agric & Environ Sci* 2009; 6(4): 411–6.
- Iacopino AM. Use of Alcohol-containing rinses to reduce oral microbial burden: Safety and efficacy. *CDA* 2009; 75(4): 160–4.
- Lachenmeier DW. Alcohol-containing mouthwash and oral cancer—can epidemiology prove the absence of risk? *An Agric Environ Med* 2012; 19(3): 609–10.

31. Naz S, Siddiqi R, Ahmad S, Rasool SA, Sayeed SA. Antibacterial activity directed isolation of compounds from *Punica granatum*. *J Food Sci* 2007; 72(9): M341–5.
32. Reddy MK, Gupta SK, Jacob MR, Khan SI, Ferreira D. Antioxidant, antimalarial and antimicrobial activities of tannin-rich fractions, ellagitannins and phenolic acids from *Punica granatum* L. *Planta Med* 2007; 73(5): 461–7.
33. Sharma S, Sabnis S. Study of anti adhesive properties of fruit juices and plant extracts on urinary tract pathogens. *Asian J Exp Biol Sci Spl* 2010; 100–3.
34. Chae HS, Park HJ, Hwang HR, Kwon A, Lim WH, Yi WJ, Han DH, Kim YH, Baek JH. The effect of antioxidants on the production of pro-inflammatory cytokines and orthodontic tooth movement. *Mol Cells* 2011; 32(2): 189–96.
35. Monsefi M, Parvin F, Talaei-Khozani T. Effects of pomegranate extracts on cartilage, bone and mesenchymal cells of mouse fetuses. *Br J Nutr* 2012; 107(5): 683–90.