ANALYSIS OF SWEET ORANGE PEEL EXTRACT (CITRUS SINENSIS) IN ORTHODONTIC BRACKET FRICTION CHANGES

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Abstract

Fixed orthodontic treatment is a treatment in dentistry that aims to correct malocclusion. An important component of this treatment is orthodontic brackets and wires. When there is an interaction between the wire and the bracket, a resistance (friction) is formed. The formation of this resistance (friction) is caused by several factors, one of which is corrosion. The increased friction of the orthodontic bracket can cause various negative effects such as increased treatment time, toxic reactions, allergies, and even more costs for the treatment required. Several studies have proven that the content of orange peel is able to be an inhibitor of corrosion on wire and orthodontic brackets made of stainless steel, so that it can reduce or maintain bracket friction with use.

Objective: to assess the ability of sweet orange peel extract (Citrus sinensis) in reducing friction on orthodontic wire and brackets.

Research method: the research method used a quasi-experimental research object, namely 20 maxillary premolar brackets and 2 stainless steel orthodontic wires immersed in a solution of sweet orange peel extract (Citrus sinensis) with a concentration of 1000 ppm. Independent Sample t Test is used to compare the results between groups.

Result : Extracts of sweet orange peel effect in maintaining bracket friction. This is evidenced by the average value of friction between the control group and the extract group which showed no significant difference between the control group (T0) and the extract-immersion group (T1).

Conclusion : There is a difference in bracket friction value between the control group and the treated group. Thus, the sweet orange peel extract has an effect to maintain orthodontic bracket friction.

Keywords: extract, sweet orange peel, friction, bracket, orthodontics

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1. Introduction

Tooth movement can be achieved through interaction between a wire and brackets supported by healthy periodontal tissue. The types of brackets orthodontists usually use are those made from stainless steel, because they are more economical, not easily fractured and deformed, more resistant to corrosion, and biocompatible. [1] Orthodontic wires work in conjunction with other orthodontic components to produce a light and continuous biomechanical force.[2] When there is interaction between wire and bracket slot, there will be resistance or friction. Friction is a force that is produced due to a pressure applied opposite to the desired direction.[3] The increase of friction can be caused by several things, one of which is corrosion. Corrosion will weaken orthodontic bracket and the surface rough, and the result in systemic effects are hypersensitivity and toxicity.

Corrosion is basically cannot be avoid, but can be controlled with inhibitor agents. There are several plants and fruits can be used to make natural corrosion inhibitors, including citrus. Citruses are ingredients that are widely used in everyday life and all parts of citrus have been widely studied, such as their leaves, juice, roots, and peels. [4] Its anti-bacterial, anti-fungal, anti-oxidant, anti-carcinogenic and anti-inflammatory properties make citrus are widely developed in medical science.[5] There are also researces show that orange peel extract can be a natural corrosion inhibitor in 1M HCL medium. [6]

From this description, there are no studies reviewing the the effect of these inhibitors on friction. Therefore, this study was done to evaluate the inhibitory effect of sweet orange peel extract in orthodontic bracket friction changes.

2. Materials And Methods

This study was conducted with a quasi-experimental research design with research samples, namely wires and orthodontic brackets immersed in sweet orange peel extract (Citrus sinensis) on January-December 2021 at Orthodontic Laboratory and Pharmacy Laboratory, Hasanuddin University.

Research design used in this study was a randomized complete design consisting of 4 treatments and 5 samples for each of it, so there were 20 trials in total.

This study used rotary evaporator, bottles, digital scales, measuring cup, oven, blender, aluminum foil, incubator, filter, and digital force gauge.

Materials used in this study were sweet orange peel waste (Citrus sinensis), artificial saliva (pH 6.8), orthodontic brackets (20 premolar bracket stainless steel edgewise slot 0.022 inch), orthodontic wires (stainless steel 0.016 inch in diameter), acrylic plate, HNO_3 65%, and ethanol 96%.

2.1 Sweet Orange Peel Extraction Process

The sweet orange peels were cleaned and then cut into small pieces using scissors. Sweet orange peel pieces were dried by aerating under indirect sunlight for two days. It was then dried in an oven for two days at 37^0C and the dry weight of the sweet orange peel was obtained. Sweet orange peel pieces that have been dried were then mashed using a powder blender. Sweet orange peel powder was macerated with 96% ethanol solvent for 1x24 hours. After maceration, it was evaporated using a rotary evaporator to obtain pure sweet orange peel extract.

2.2 Making Sweet Orange Peel Extract Solution

Each extract of the material to be tested was weighed. Then the sweet orange peel extract was mixed with artificial saliva to form an extract solution according to the required concentration, the desired consentration is 1000 ppm (P1).

2.3 Resistance Measurement (Friction)

Installment of 10 upper first premolar and second premolar edgewise brackets each on acrylic plate with no mix adhesive, and the distance between brackets are 8 mm. The wire was ligated to the brackets with elastomeric using a gun shooter. The plate was placed on the grip in a vertical position. The top wire was inserted into the pulling spindle. The wire was pulled in a speed of 1 mm/minute on digital force gauge. [(15)] Then the sample with the smallest frictional resistance was determined.

2.4 Statistic analysis

All data collected were analyzed using independent sample t test and correlation test using SPSS version 24 program.

3. Results

Table 1 shows average friction value of each sample tested, each sample was tested 10 times. Table 2 shows the difference between friction test values of control group and 1000 ppm sweet orange peel extract group. From the table, we can conclude that 1000 ppm sweet orange peel extract could significantly inhibit orthodontic bracket and wire friction ($p<0.000$).

Table 1 shows the average friction values from the samples. On the third pair, it was found that the average friction value of the bracket immersed in saliva for 4 weeks showed a significant increase. It means that saliva can increase orthodontic brackets and wires surface roughness, so there will be more retention and cause an increase of friction for orthodontic bracket and wire.[8] In Table 2, third pair shows the comparison between bracket friction values immersed in saliva and in sweet peel orang extract for 4 weeks. From this comparison, it was found that there was a significant difference between the bracket friction values immersed in those two conditions. The bracket immersed in the sweet orange peel extract showed a constant increase in friction when compared to the bracket immersed in saliva for 4 weeks. This indicates the effectiveness of sweet orange peel extract in inhibiting the increase in friction values on orthodontic brackets and wires.

Table 1. Friction value of wire and bracket immersed in saliva and 1000 ppm sweet orange peel extract.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T0 Saliva	2.2200	10	.07972	.02521
	T1 Saliva	2.5740	10	.00699	.00221
Pair 2	T0 Ekstrak 1000 ppm	2.2200	10	.07972	.02521
	T1 Ekstrak 1000 ppm	2.2480	10	.03011	.00952
Pair 3	T1 Saliva	2.5740	10	.00699	.00221
	T1 Ekstrak 1000 ppm	2.2480	10	.03011	.00952

Table 2. Differences of the friction test value of wire and bracket immersed in saliva and 1000 ppm sweet orange peel extract and p-value

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	T0 Saliva - T1 Saliva	-.35400	.07820	.02473	-.40994	-.29806	-14.315	9	.000

Pair 2	T0 Ekstrak 1000 ppm T1 Ekstrak 1000 ppm	-.02800	.06286	.01988	-.07297	.01697	-1.409	9	.193
Pair 3	T1 Saliva - T1 Ekstrak 1000 ppm	.32600	.02836	.00897	.30571	.34629	36.347	9	.000

4. Discussion

The increase of friction values can caused by several factors, one of which is corrosion. Manufacturers are well aware of the susceptibility of orthodontic alloys to the various forms of corrosion and have taken steps to combat this potentially destructive process, including alloy substitution of addition, coating, modification of the production process (finishing polishing, cold working). Another method of reducing corrosion of metal during manufacture is to add corrosion inhibitor to a solution into which the material is placed, resulting in the formation of a protective layer of coating. A similar effect might also occur in the oral environment, with certain salivary proteins, amylase, and γ-globulin forming a biofilm that acts as a corrosion inhibitor. [11] Inorganic inhibitors were extensively used (phosphates, chromates, nitrites). Actually, their production is not only expensive but also often toxic, and regulated by toxicological and ecological standards. Some organic molecules extracted from food by products appear as alternative in the field of corrosion inhibition due to their biodegradability and easy availability. Various natural substances have been tested as corrosion inhibitors of steel in acidic media, among these plant extracts[12], leaf extracts[13], fruit peel extracts[14],[15], or even coffee ground[16] have shown their efficiency.

The corrosion inhibition ability of plant extract is generally attributed to the presence of secondary metabolites There is a difference in bracket friction value between the control group and the treated group. Thus the sweet orange peel extract has the an effect to maintain containing antioxidant polyphenolic compounds constituents like alkaloids, flavonoids, of condensed tannins. [17],[18],[19] Actually, orange peel remaining after juice extraction constitutes almost 50% of the total fuit mass.[20] This waste is valuable since it is a rich source of phenolic compounds. Especially, flavonoids which possess a significant antioxidant activity. The friction value test of the bracket immersed in saliva and extract orange peel showed a significant difference. The bracket immersed in sweet orange peel extract showed a constant increase in friction when compared to the bracket immersed in saliva for 4 weeks. This indicates the effectiveness of sweet orange peel extract in inhibiting the increase in friction values on orthodontic brackets and wires. This results are consistent with the researches before which showed that orange peel extract can be used as an organic inhibitor in 1M HCL medium. The significant inhibition efficiency obtained with the extract is due to the precipitation of a covering film on steel surface, which could be formed by other marcomolecules acting in synergy with the antioxydant molecules. [6],[21],[22] With it's ability as inhibitor and to inhibit corrosion of steel, sweet orange peel extract also can inhibit orthodontic bracket's corrosion. The inhibition of orthodontic bracket's corrosion can decrease the friction value of orthodontic brackets and wires during orthotontic treatment.

5. Conclusion

orthodontic bracket friction. Furthermore, sweet orange peel extract can be considered as a raw material for oral care such as

toothpaste or mouthwash given to fixed orthodontic appliance patients.

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