EFFECT OF *Averrhoa bilimbi L.* A NATURAL DENTAL BLEACHING ON THE ROUHNESS OF NANOHYBRID COMPOSITE

(EFEK Averrhoa bilimbi L. PEMUTIHAN GIGI ALAMI PADA ROUHNESS KOMPOSIT NANOHYBRID)

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JHDS.unjani.ac.id/jite
Doi: 10.54052/jhds.

Article History
Received:03/06/2024
Accepted: 20/06/2024

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ABSTRACT

Averrhoa bilimbi can be used as a natural tooth-bleaching ingredient because it can increase the brightness of tooth colour. In bleaching treatments, there are times when it is found that the patient's teeth have composite restorations. This study aims to determine the effect of *Averrhoa bilimbi* extract gel as a natural dental bleaching agent on the roughness of nanohybrid composites. The research method used 17 nanohybrid composite samples of 5 x 2 mm. Samples will be measured for surface roughness before treatment, and then samples will be applied with 50% *Averrhoa bilimbi* extract gel for 2 hours every day for up to 14 days and surface roughness test after treatment. The data were processed with t-test statistics; the statistical test results showed a p-value of 0.0001 ($p<0.05$), which means that the roughness value before and after 50% *Averrhoa bilimbi* extract gel treatment is a significant difference. It can be concluded that 50% of the *Averrhoa bilimbi* extract gel affects the roughness of nanohybrid composites. The average

roughness value of the nanohybrid composite after 50% *Averrhoa bilimbi* extract gel treatment is 0.16 μm, which is still below the critical limit of roughness, so even though it is significant, 50% *Averrhoa bilimbi* extract gel can still be used safely as a natural tooth bleaching agent.

Keywords: *Averrhoa bilimbi L.*; nanohybrid composite; surface roughness

ABSTRAK

Belimbing wuluh (Averrhoa bilimbi L.) dapat dimanfaatkan sebagai bahan alami bleaching gigi karena dapat meningkatkan kecerahan pada warna gigi. Pada perawatan bleaching ada kalanya ditemukan keadaan gigi pasien terdapat restorasi komposit. Penelitian ini bertujuan untuk mengetahui pengaruh gel ekstrak belimbing wuluh sebagai bahan alami bleaching gigi terhadap kekasaran komposit nanohybrid. Metode penelitian menggunakan 17 sampel komposit nanohybriddengan ukuran 5 x 2 mm. Sampel akan dilakukan pengukuran kekasaran permukaan sebelum perlakuan kemudian sampel akan diaplikasi gel ekstrak belimbing wuluh 50% selama 2 jam setiap hari sampai 14 hari dan dilakukan uji kekasaran permukaan setelah perlakuan. Data diolah dengan statistik uji t-test, hasil uji statistik gel ekstrak belimbing wuluh 50% menunjukkan nilai p 0,0001 (p<0,05) yang berarti nilai kekasaran sebelum dan setelah perlakuan gel ekstrak belimbing wuluh 50% terdapat perbedaan yang signifikan. Nilai rata rata kekasaran komposit nanohybrid setelah perlakuan gel belimbing wuluh 50% sebesar 0,16 μm yang masih dibawah batas kritis kekasaran sehingga meskipun signifikan gel ekstrak belimbing wuluh 50% masih dapat digunakan dengan aman sebagai bahan alami bleaching gigi.

***Kata kunci**: gel belimbing wuluh; kekasaran permukaan; komposit nanohybrid*

INTRODUCTION

The beauty of a smile with white teeth is the desire of every person because it can increase self-confidence.[1] Teeth that experience discolouration, or what is usually called discolouration, is a problem that can psychologically affect the sufferer.[2] Patients often ask for teeth whitening treatment. Bleaching treatment chemically restores teeth' aesthetic function by re-whitening discoloured teeth until they are close to the desired tooth colour.[3] The ingredients in bleaching agents include hydrogen peroxide and carbamide peroxide.[4]

Bleaching is used on vital teeth and even on discoloured non-vital teeth. How to carry out bleaching treatment on critical teeth can be done at home (home bleaching) or in a dentist's clinic (in-office bleaching).[5] However, using chemicals in teeth whitening can cause side effects on hard tissue, irritating gums, teeth hypersensitive, sore throat, and difficulty biting.[6] The requirements for a good bleaching agent are that the concentration of the ingredient is not excessive, has stable properties, and is not mutagenic so that it does not cause side effects on the surrounding tissue.[7]

During bleaching treatment, it is sometimes discovered that a patient's teeth contain composite restorations. Composite restoration materials are not immune from the influence of bleaching materials, namely nanohybrid composites, which come from a mixture of 0.1-2 µm microparticle size and 100 nm nanoparticles (heterogeneous particles).[8] Hybrid-type composite resins are widely used because they have a smooth surface that is more than average. This type of composite resin has small particles and aesthetics comparable to micro-based composites when used in anterior restorations.[9] Nanohybrid composites are commonly used as restorative materials for anterior and posterior teeth because they have better resistance to fracture and more excellent abrasion resistance.[10]

Composite resins have unstable polymer bonds and are quickly degraded due to acidic materials, which affect the surface roughness of the composite resin.[1,11] Research on several bleaching agents shows that the organic matrix content, namely peroxide, can cause degradation of the composite resin polymer network, which causes the surface roughness to increase.[12] Increasing the surface roughness of the restorative material will facilitate plaque accumulation on the tooth surface so that secondary caries can occur.[13,14] Therefore, a natural tooth whitening agent has been developed, which is expected to be safer.[15]

One of the natural ingredients that can be used as a bleaching agent is *Averrhoa bilimbi.* 60% *Averrhoa bilimbi* extract gel can improve colour changes significantly.[16]

METHOD

This research used experimental laboratory methods with a pre-and post-test control group design approach. The study included 17 samples of nanohybrid composite resin with a diameter of 5 mm and a height of 2 mm. The sample was fabricated using a round acrylic mould with a diameter of 5 mm and a height of 2 mm. A thin layer of petroleum jelly was then applied to the mould. A nanohybrid composite resin material was applied to the mold until it filled the mold and then covered with a 1 mm thick glass slide and pressed with a weight of 500 g on the glass slide so that the excess composite material would come out of the mold, and a flat and compressible composite resin sample was obtained. The composite resin was exposed to light using a light curing unit for 20 s at a distance of 1 mm with the mold still under a 500-gram load, after which the nanohybrid composite resin sample was removed from the mold.

Averrhoa bilimbi extract gel was prepared using *A. bilimbi* (1.5 kg), washed with water until clean, and dried and ground using a blender. Subsequently, the decoction was made below 100 °C to avoid thickening and damaging the star fruit's oxalic acid content. Hydroxypropyl Methyl Cellulose (HPMC) was added to prepare the gel.

Seventeen samples of the nanohybrid composite resin were soaked in artificial saliva in an incubator at 37°C for 24 h. Subsequently, the surface roughness of the nanohybrid composite resin was measured on the first day before the treatment. Next, the sample was treated with 50% *Averrhoa bilimbi* extract gel for two h, rinsed with distilled water, and soaked in artificial saliva in a 37°C incubator for 24 h. This treatment was repeated daily until the 14th day. On the 15th day, roughness measurements were again performed using a surface roughness tester.

Data on the surface roughness of the nanohybrid composite resin were analyzed using a normality test. If the data were normal, a t-test was conducted to determine the effect before and after applying 50% *Averrhoa bilimbi* extract gel.

RESULT

The surface roughness data value of the nanohybrid composite before and after the application of 50% *Averrhoa bilimbi* extract gel was analyzed using the Shapiro–Wilk normality test and obtained a

p-value > 0.05, which means that all samples were normally distributed, then analyzed using the t-test, which can be seen in Table 1 and Figure 1.

Table 1. Roughness value of the nanohybrid composite before and after application of 50% Averrhoa bilimbi extract gel.

Variable	Averrhoa bilimbi extract gel 50%		p-value
	Before	After	
	N=17	N=17	
Roughness value			
Mean±SD	0.15±0.025	0.16±0.023	**0.0001***

In Table 1, the results of the data analysis show that the 50% *Averrhoa bilimbi* extract gel has an average roughness value before treatment of 0.15 ± 0.025. In contrast, the roughness value after treatment averages 0.16 ± 0.023. The results of statistical tests in the research group above showed that the p-value for the roughness value variable was smaller than 0.05 (p-value <0.05), which means it is statistically significant. Thus, it can be explained that there is a statistically significant mean difference between the variables—roughness value before and after the application of 50% *Averrhoa bilimbi* extract gel.

DISCUSSION

The critical limit for the surface roughness value of composite resin is 0.2 μm, where if the surface roughness value is more than 0.2 μm, bacterial adhesion will increase, which can cause plaque accumulation on the restoration and tooth surfaces.[17,18,19] Teeth whitening agents can contain acidic peroxide, which can cause an increase in the roughness value on the composite resin surface. The research results by Alexandru in 2023 stated that the roughness of composite resin bleached with carbamide peroxide showed a significant increase.[20] It is known that tooth whitening agents can change the composite resin matrix, and matrix degradation occurs where organic particles move, causing the exposed particles to become exposed. Will ultimately increase the surface roughness.[21]

The community usually uses Averrhoa bilimbi as a natural flavouring because it contains some acid content. The contents of *Averrhoa bilimbi* include vitamin C, phosphate, calcium, terpenoids, tannins, oxalic acid, and flavonoids. The oxalic acid in the *Averrhoa bilimbi* plant, which comes from the fruit, is used in the medical world for teeth whitening, so in this study, we used *Averrhoa bilimbi* extract as a natural ingredient for teeth whitening.[22-24]

The more significant the concentration of *Averrhoa bilimbi* extract in the gel, the lower the pH in the gel will result in increased roughness in the composite.[25] This research uses *Averrhoa bilimbi* extract gel with a concentration of 50% because it is good enough to be used as a teeth-bleaching agent. Kintan (2018) conducted research using 50% *Averrhoa bilimbi* extract gel, which could increase the degree of brightness in the colour of the teeth of New Zealand rabbits.[26]

According to Khalifa, in 2021, saliva can neutralize acidic pH because saliva contains carbonic acid-bicarbonate, urea, calcium, phosphate, and ammonia.[27] In the oral cavity with an acidic pH, the bicarbonate enzyme in saliva catalyzes the reaction between free H^+ ions and bicarbonate ions to produce distilled water in the oral cavity, and the saliva pH will return to normal. This process can occur by immersion in artificial saliva.[28]

In this study, using 50% *Averrhoa bilimbi* extract gel, which was carried out within 2 hours every day for up to 14 days, the results showed that the roughness value of the nanohybrid composite before and after treatment was statistically significant or statistically there was a difference in the roughness value of the nanohybrid composite before and after treatment, which is meaningful.

This research shows that the 50% *Averrhoa bilimbi* extract gel has an average roughness value of the nanohybrid composite resin before treatment of 0.15 μm and after treatment of 0.16 μm. The roughness value in the sample is still below the critical limit of roughness value, so this research proves that 50% *Averrhoa bilimbi* extract gel is still safe to use.

Even though the 50% *Averrhoa bilimbi* extract gel has a more acidic pH, namely 4.7, the roughness of the 50% *Averrhoa bilimbi* extract gel is still below the safe limit for the composite surface roughness value. It is because *Averrhoa bilimbi* contains calcium and phosphate, which are substances that can encourage saliva to remineralize and neutralize acidic pH.[29]

CONCLUSION

Based on the results of data processing and discussions carried out, the conclusion obtained from this research is that *Averrhoa bilimbi* (*Averrhoa bilimbi L.*) extract gel with a concentration of 50% significantly increases the roughness on the surface of the nanohybrid composite resin.

CONFLICT OF INTEREST

There is no interest in this research.

ACKNOWLEDGEMENT

Our thanks go to the professionals who assisted in the research and preparation of the paper.

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