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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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THE IMPACT OF ALOE VERA GEL ON REMINERALIZATION OF THE TOOTH AND ITS EFFECT AGAINST ENTEROCOCCUS FAECALIS: AN IN VITRO STUDY

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Abstract.

Background: The Aloe vera plant is a cactus-like plant in the Liliacea family that has been known and utilized for its medical benefits. It has been attempted to be used as a remineralizing agent and shows an antibacterial effect.

Aim of the study: Assessment of the remineralizing effect of solution of saturated Aloe vera gel compared to distal water by microhardness Vickers test and Densometric X-Ray Analysis and effect of Aloe vera gel against *Enterococcus faecalis*.

Materials and methods: 10 extracted permanent molars were used in this in vitro study. each tooth enrolls in Teflon tape and only the enamel of the occlusal surface was exposed to a demineralizing solution (acid etch) for 45 seconds in-vitro and randomly assigned to two groups: Group 1 was treated with distal water; group 2 was treated with Aloe vera gel. All groups except the control baseline group were treated with their respective remineralizing solution for 10 days. Vicker's Microhardness Number (VHN) and Densometric X-Ray Analysis were carried out at baseline, post-demineralization and later post 10 days of remineralization. The antibacterial effect of Aloe vera gel was assessed by the disc diffusion method. The filter paper was immersed in 20µl of different concentrations of Aloe vera gel extract as fresh Aloe vera (100 %) and (50 % and 25 %) diluted with de-ionized water after that the disc was distributed in a plate containing the *E. faecalis*. Antibiotics disc of Augmentin (Amoxicillin and Clavulanic acid 30ug) were also poured in the same plate and incubated at 37°C for 24 hours and the zone of inhibition of antibiotic was measured for comparison with a zone of inhibition of filter paper saturated with Aloe vera gel.

Results: Densitometric X-Ray Analysis and Microhardness Number (VHN) evaluation showed improvement in the enamel density and the surface hardness after remineralization. The mean value in the group treated with Aloe vera solution was higher than the recorded mean value for the group treated with distal water. There was a significant difference between Aloe vera solution and distal water. Significant (p-value≤0.05) after 10 days. The antibacterial effect showed that *E. faecalis* was resistant to Aloe vera gel in different concentrations compared with Augmentin (Amoxicillin and Clavulanic acid 30ug).

Conclusion: Aloe vera gel could be used for caries prevention in terms of safety and efficiency. While *E. faecalis* show resistance activity against Aloe vera gel.

Key words. Aloe vera, Remineralization, Microhardness, Densitometric analysis *Enterococcus faecalis*.

Introduction.

Dental caries is the most predominant oral disease worldwide and the main etiological factor of tooth loss within the population and can be defined as a progressive demineralization process that affects the mineralized tissues of tooth structures caused primarily by the complex interaction of cariogenic oral flora (biofilm) with fermentable dietary carbohydrates on the tooth surface over time [1] Dental caries results from a dynamic process of demineralization and remineralization. These events take place several times a day and are modulated by several factors, such as the number and type of microbial flora in the biofilm, oral hygiene, genetics, diet, dental anatomy, and the use of fluorides and other therapeutic agents [2].

Enterococcus faecalis is a Gram-positive bacterium, non-spore-forming, catalase-negative, ferments glucose, and fermentative. Moreover, they are a part of the habitual flora found in the mouth, *E. faecalis*, although not usually considered to be part of the normal oral microflora, has been found in common dental diseases such as periodontitis, periimplantitis and dental caries. *E. faecalis* has been found primarily in secondary endodontic infections with a prevalence of 24% to 70% [3].

Numerous medicinal plant extracts have shown the ability to inhibit the formation of dental biofilms by reducing pathogen adhesion to the tooth surface, a primary event in caries formation [4]. Among all the different herbs used in the dental field, modern science corroborates Aloe vera (AV)'s antimicrobial properties. Studies suggest that AV (Aloe barbadensis) extract is appropriate for treating gingivitis and oral infections since it inhibits plaque formation and bacterial growth [5].

Aloe vera belongs to the Liliaceae family which includes garlic and onion. Only two species are grown commercially: Aloe barbadensis Miller and Aloe arborescens, of which Aloe barbadensis Miller is the most biologically active among 400 species, 75 active ingredients have been identified in stabilized A. vera gel including vitamins, minerals, enzymes, sugars, anthraquinones or phenolic compounds, lignin, saponins, sterols, amino acids, and salicylic acid [6]. AVG has various pharmacological actions like antibacterial, anti-fungal, antioxidant, anti-inflammatory, hypoglycemic and immune-boosting properties.

Several published studies have further reported the use of AV in dentistry for various purposes, However, there are only a few other studies about the particular effect of AV in the remineralization of early carious lesions [7], This study intends to evaluate the in vitro effects of the local application of AV gel to demineralized teeth and its antimicrobial effect against E.faecalis with agar disc diffusion method.

Materials and methods.

Dental study: In this study 10 sound permanent molar teeth extracted for diverse purposes were collected from Alhur specialized dental centre in Karbala and different private dental clinics with patients' age range (25-30 years), the study was approved by the Research Ethics Committee and Scientific Committee Department of Dental Basic Science/ College of Dentistry/ University of Mosul.

All teeth were clinically sound and cleaned with a toothbrush aided. Sometimes with a scalpel to remove the periodontal ligament and intercostal bone remnants and rinse under running tap water.

After extraction, all the teeth were immediately stored in 37% formalin solution and the teeth were to be used for no more than 1 month after extraction. Before beginning the procedure, the teeth were rinsed under a running tap waterfall for 24 hours to remove any remnant of formalin saturation. After that, each tooth was mounted in the wax hard block.

To standardize, the area of treatment and evaluation was the cusps of the occlusal surface on the mesial side and each tooth enrolled in Teflon tape and only the occlusal surface expose. To induce demineralizing on the enamel, the occlusal surface was dryness with air for 10 seconds after that acid etch (37% phosphoric acid) apply to the enamel for 45 seconds to inducer demineralizing effect and then wash with a triple syringe of water and dryness for 5 seconds that show the chunky white appearance of the occlusal surface.

Study design: teeth samples were randomly divided into two study groups one for the solution of saturated Aloe vera gel and a group with distal water, each group consisted of five teeth that were measured with a microhardness test and Densitometric analysis.

It is worth mentioning that enamel microhardness was measured initially for normal enamel (control) and after induction of demineralization and remineralization effect, also the same steps were done with densitometric analysis to measure enamel density.

Each group was treated with the solutions of the selected agents by emerging each tooth separately in 20 ml of the selected agent solution for three minutes at 10 AM and 8 PM with manual shaking, then the teeth were restored in de-ionized water for the next day at a temperature of 37°C, this procedure was repeated daily for 10 days, It is worth to mention that each solution agent was replaced in each day during the time of procedures, the samples were reexamined for the microhardness and densitometric analysis and compare between groups [5].

The microhardness measurement was done by Vicker's microhardness device [8] in the Department of Mechanical Technologies, Northern Technical University, by a vertical impact with a square based diamond indenter with 136° angle. This tester has a light microscope of high resolution and contrast with magnification of X40. The measurement of enamel VHN in the present studies was performed using the microhardness measurement OTTO WOLPERT

In this measuring system for VHN, the sample is placed on the measuring table. Indentations were made with static loads of 500g (5 Newton) for 15s [8]. The formula of the VHN is:

$VHN=1.8544^{*}F/D^{2}$

Where F= applied load (Kg), and D = mean of the diagonal's length (d1+d2)/2 (mm) (Figure 1).

Densiometric analysis: The mesial surface of each tooth subjected to the radiological examinations. Tube head dental digital radiological machine with dental imaging software version 6.13.0 were used for these examinations.

All teeth were examined and calculate the image in dental imaging software (version 6.13.0) to be analyzed by densiometric analysis which is one option of this program. We examined the enamel density by drawing a horizontal line from the cusp tip to marginal ridge on the mesial surface of the tooth (Figure 2). The program gives the average enamel density that is considers this line as point and it calculates average density of this points [9].

Statistical Analysis: statistical data analysis was performed by using the Statistical Package Software for the Social Sciences (SPSS for Windows, Version 25.0, Chicago, Illinois, United States). The mean and standard deviation of each group were subsequently calculated. Kolmogorov–Smirnov's tests were used to verify the distribution normality of quantitative variables. Student 't' test was performed to compare Aloe vera

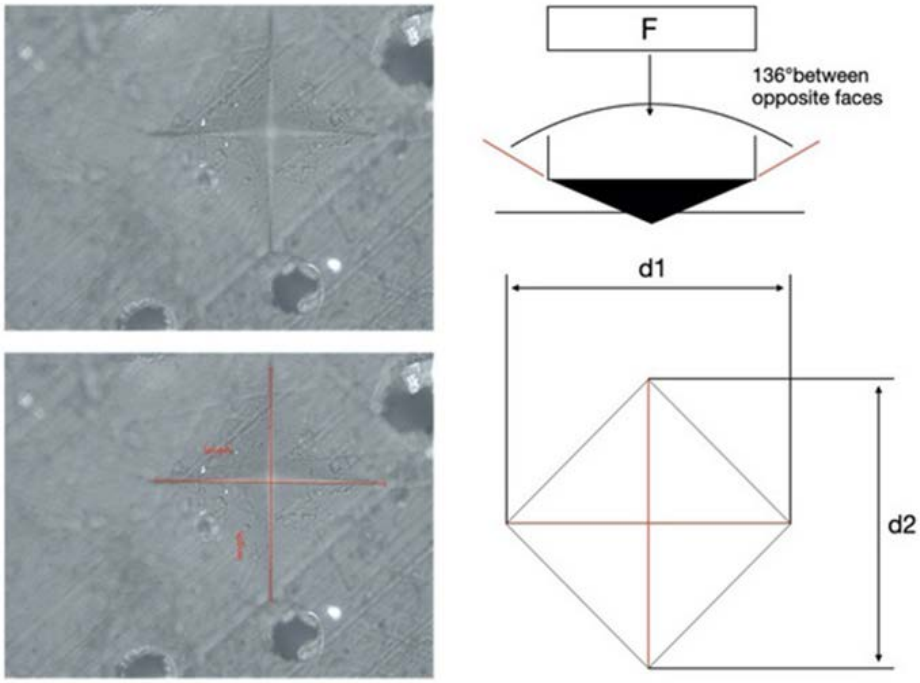

Figure 1. *Vickers microhardness test [8].*

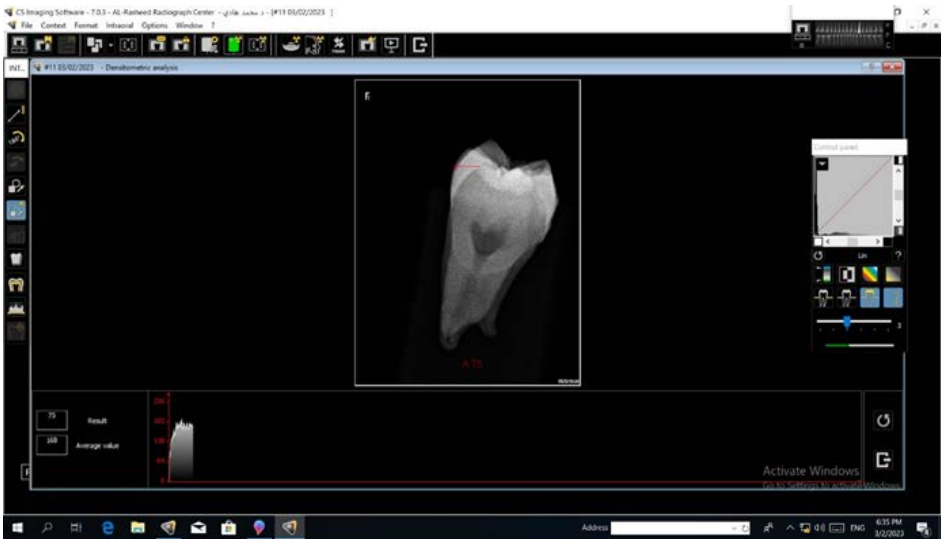

Figure 2. *Densiometric analysis.*

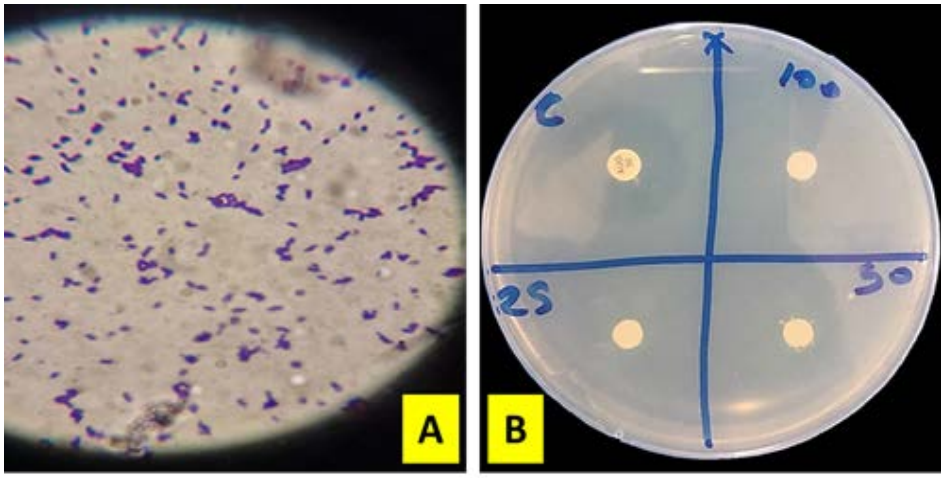

Figure 3. *Culture sensitivity test for Enterococcus faecalis. (A) Enterococcus faecalis was identified by the gram staining technique. (B) Agar disc diffusion method of Aloe vera gel and antibiotic disc.*

and distal water. ANOVA test was also performed for inter-group comparisons. A p-value less than <0.05 was considered to be statistically significant and p<0.001; highly significant.

Microbiological study: The microbiological study was carried out in the Microbiology Laboratory, Department of Dental Basic Sciences, College of Dentistry, University of Mosul. Isolated *Enterococcus faecalis* and cultivated on M-Enterococcus agar, identified by gram staining technique and Vitek 2 system as shown in (Figure 3A). An overnight culture of cultivated *Enterococcus faecalis* brain-heart broth was prepared to be used for an antimicrobial sensitivity test .

Preparation of the Extract: The plant of A. vera (leaves) was harvested from a local farm in Mosul and Mature fresh leaves of Aloe vera were thoroughly washed with sterile distilled water to remove dirt and their thick epidermis was removed and the solid mucilaginous gel was collected in a sterile container under aseptic environment [10].

Antibacterial activity of plant extracts against *E. faecalis*: The agar disc diffusion method was used to determine the antibacterial activity of Aloe vera extract. Different concentrations of the plant extract were tested against *E. faecalis*. The fresh bacterial suspension was dispersed on the surface of Muller Hinton agar plates. The filter paper resembles an antibiotic disc and is sterile by autoclave and immersed in 20µl of different concentrations of Aloe vera gel extract as fresh Aloe vera (100 %) and (50 % and 25 %) diluted with de-ionized water after that the disc is distributed in a plate containing the *E. faecalis*. Antibiotics disc of Augmentin (Amoxicillin and Clavulanic acid 30ug) were also poured in the same plate against *E. faecalis*. plates were incubated at 37°C for 24 hours and the zone of inhibition of antibiotic was measured for comparison with a zone of inhibition of filter paper saturated with AVG (Figure 3B).

Results.

Vickers hardness test: The mean values and standard Deviation of the microhardness of sound enamel surfaces as the control group, after demineralization and following treatment with distal water and with Aloe vera extract as shown in (table1).

The microhardness between groups of distal water and aloe vera extract (baseline control and after demineralization and following the treatment) shows a highly significant difference in enamel surface was seen between groups of each agent as shown in (table 1).

Table 1. *Parameters of microhardness of enamel surfaces treated by distal water, Aloe vera extract.*

	Group	N	Min.	Max.	Mean	SD
Normal enamel	Control baseline	5	296	371	324*	29.1
Demineralization	Acid etch	5	219	245	234	9.8
Remineralization	Distal water (DW)	5	226	241	233	7.5
	Aloe vera	5	275	295	287#	8.4
*#p<0.05 significant differences, * comparison between control and other groups, # comparison between *Aloe vera* and acid etch and DW						

Table 2. *The density of enamel surfaces treated by distal water and Aloe vera.*

	Group	N	Min	Max	Mean	SD
Normal enamel	Control Baseline	5	180	212	193.8*	12.3
Demineralization	Acid etch	5	127	152	141.2	11.4
Remineralization	Distal water	5	125	153	140	13.4
	Aloe vera	5	163	198	175.2#	13.5
*#p<0.05 significant differences, * comparison between control and other groups, # comparison between *Aloe vera* and acid etch and DW						

After remineralization, the microhardness treated with distal water and that treated with the Aloe vera extract show a highly significant difference as shown in.

Densiometric analysis: The sound enamel surfaces, after demineralization and following treatment with distal water and with Aloe vera extract as shown in Table 2. The enamel density between groups of distal water and Aloe vera extract (baseline and after demineralization and following the treatment) shows a highly significant difference between groups of each agent. After remineralization, the enamel density treated with distal water and that treated with the Aloe vera extract showed highly significant differences.

Antibacterial effect of aloe vera extracts: Antibacterial effect of Aloe vera gel extract as fresh Aloe vera (100 %) and (50 % and 25 %) diluted with de-ionized water was detected by disc diffusion method, which was dependent on measuring the inhibition zone. the result was that different concentrations of Aloe vera gel extract showed no antibacterial activity against *E. faecalis*, while Augmentin Antibiotic (Amoxicillin and Clavulanic acid 30ug) show antibacterial activity against *E. faecalis* with the zone of inhibition measure with calibration 22 mm.

Discussion.

Dental caries is considered the most predominant oral disease worldwide and the main etiological factor of tooth loss within the population [11]. The topical application of various remineralizing agents was efficient in promoting remineralization. One of the goals of modern dentistry is to use remineralization to treat non-cavitated carious lesions to reduce disease progression and improve strength, function, and aesthetics [12]. There are many chemical agents used for the prevention and remineralization of dental caries, In recent times, there is a preference for organic agents due to their immense bio characteristics, cost-effectiveness, availability and wider safety margin [13].

Some plants can regulate the demineralization - remineralization cycle of enamel. The Aloe vera plant has anti-inflammatory, antiviral, antibacterial and antioxidative effects [14], its use as an herbal remedy in dental conditions and in remineralization due to its unique contents is promoting [7]. However, the studies in the literature on the remineralizing potential of organic ingredients are very few [5,15,16].

In vitro models are the most conventional techniques in caries research and artificial caries like lesion production was first described by Featherstone JD in 1983 [17]. The period for assessment of remineralization was chosen following the previous study as 10 days, two weeks, and four weeks [5,15].

The results of this study showed that there was an increase in the mean value of enamel hardness and density when treated with Aloe vera gel which indicates an effective remineralizing potential while no remineralization effect of distal water.

The comparison between groups of the same solution showed that distal water gives a statically significant difference attributed to the demineralization effect of acid etch compare with normal enamel while the Aloe vera gel shows a highly significant difference attributed to remineralizing potential.

The remineralizing effect of Aloe vera and distal water was also confirmed by microhardness and densimetric analysis indicating an effective remineralization potential of aloe vera gel with a highly statistically significant difference.

The remineralization potential of Aloe vera gel may be attributed to that it is considered one of the polyphenols plants that can regulate the demineralization - remineralization cycle of enamel [18] the gel is composed of 98.5% of water and the remaining components represent a mixture of vitamins, minerals, enzymes, polysaccharides, phenolic compounds, and organic acids in different proportions [19]. Polyphenols, including anthraquinones, seem to be the essential active chemical component responsible for the AV gel's capacity in inducing remineralization. Because of the porous nature of the demineralized enamel, it facilitates the passage of those active ingredients into the enamel improving the remineralization.

The result of this study was parallel to the result reported by Silva et al. (2016) that in terms of preventing white spot lesions, an Aloe vera-based dentifrice is just as beneficial as a fluoride-based dentifrice [16].

Al Haddad et al. (2021) reported that Aloe vera gel promotes remineralization in the same way that a 1,450ppm fluoride toothpaste does. Those findings are consistent with this study

where a significant rise in remineralizing effect was found after application [5].

Dina Nassar, et al. (2022) reported that Aloe vera gel showed a slightly higher degree of remineralization than sodium fluoride gel. Those findings are consistent with this study which showed effective remineralization of both mild and severe enamel caries [7]. Results of the current study are in disagreement with those reported by Ranjana et al. (2021) as they reported that herbal pediatric dentifrice (Aloe vera dentifrice) shows an insignificant result compared with fluoride-based dentifrice making it, not an effective remineralizing agent for primary teeth [18]. This disagreement may be a result of the short duration of the study (7 days) and the delivery of Aloe vera was in the form of toothpaste not in gel form.

Aloe vera extract was a naturally occurring substance which has been long used in the treatment of inflammation and infectious diseases of the mouth [21]. Therefore, it's used in this study to evaluate the role of the antimicrobial effect of aloe vera extract against *E. faecalis* by using the disc diffusion method. The result was that different concentrations of Aloe vera gel extract showed no antibacterial activity against *E. faecalis*, while Augmentin Antibiotic (Amoxicillin and Clavulanic acid 30ug) show antibacterial activity against *E. faecalis* with a zone of inhibition measure with calibration 22 mm.

Yavagal et al. (2019) reported that the Aqueous extract of Aloe vera gel did not demonstrate antibacterial properties against *Enterococcus faecalis* by disc diffusion method. No zone of inhibition was appreciated surrounding the wells containing different volumes of aqueous extract of Aloe vera gel [22]. Ehsani M et al. (2013) reported that Aloe vera gel which showed weak antibacterial activity in disk diffusion and microdilution tests failed to show any activity in the direct contact test [23]. Results of the current study are in disagreement with those reported by Tatekalva P et al. (2021) as they reported that the extracts of Aloe vera, showed significant activity against the investigated microbial strains, Streptococcus mutans and *Enterococcus faecalis*, which is promising [24]. This disagreement may be a result of using extracts that are not pure compounds and despite it, antimicrobial results were obtained. Further research evaluating the potential of Aloe vera extract as an antibacterial should be conducted before it is used in vivo conditions. And it is useful to evaluate and compare the antimicrobial potential of Aloe vera gel and whole leaf extract in future studies. Aloe vera could be helpful providing a supportive or curative therapy for drug-resistance cases, such as, non-invasive treatment of multiple enamel hypoplasia [25] and odontogenic myxoma [26].

Conclusion.

With the limitation of this study, we conclude that Aloe vera gel significantly increased enamel density and surface hardness and could be considered an effective natural remineralizing agent, and the pure extract of Aloe vera gel showed no significant activity against the investigated microbial strain *Enterococcus faecalis*.so Further research evaluating the potential of Aloe vera extract as an antibacterial should be conducted before it is used in vivo conditions. And it is useful to evaluate and compare the antimicrobial potential of Aloe vera gel and whole leaf extract in future studies.

Conflict of interest: The authors declare no potential conflict of interest.

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