

# **GEORGIAN MEDICAL NEWS**

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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 ВИНТИ 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 ВИНТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებშიდან.

## WEBSITE

[www.geomednews.com](http://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](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. Корректур авторам не высылаются, 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 computer-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.nlm.nih.gov/bsd/uniform_requirements.html)  
[http://www.icmje.org/urm\\_full.pdf](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 საყურადღებო!

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, შემავსებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრაფიის ფოტოსურათები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შედეგების 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 ფხიხლებში 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.

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## DETERMINATION OF ROOT CANAL MICROBIOTA IN CHRONIC APICAL PERIODONTITIS AND EVALUATION OF THE MICROBIOLOGICAL ACTIVITY SPECTRUM OF POLYHEXANIDE AGAINST THE IDENTIFIED MICROBIAL FLORA

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### Abstract.

**Introduction:** Chronic apical periodontitis is characterized by the formation of a stable mixed microbial flora within the root canal system. To improve the effectiveness of endodontic treatment, it is necessary not only to identify the microbiological composition of infected canals but also to select an irrigant with proven activity against key pathogens.

**Materials and Methods:** Microbiological samples were obtained from 35 patients with chronic apical periodontitis. The identification of microbiota was performed using cultural methods, MALDI-TOF MS, and 16S rRNA sequencing. The antibacterial activity of various irrigants, including Lavasept solution at concentrations of 0.1% and 0.2% (polyhexanide-based) sodium hypochlorite 3% and 2% chlorhexidine bigluconate, was evaluated against the most frequently isolated strains of primary microflora.

**Results:** The most frequently detected microorganisms in the samples were *Streptococcus mutans* (42.86%), *Streptococcus sanguinis* (28.57%), *Actinomyces israelii* (34.29%), and *Porphyromonas gingivalis* (31.43%). Upon one-hour exposure, Lavasept solutions at concentrations of 0.1% and 0.2% completely inhibited the growth of these microorganisms, demonstrating equivalent effectiveness to 2% chlorhexidine bigluconate and 3% sodium hypochlorite.

**Conclusions:** Polyhexanide-based solutions exhibit pronounced bactericidal activity against the main pathogens of chronic apical periodontitis. The obtained data support the feasibility of using polyhexanide-based solutions as an antiseptic irrigant in endodontic practice.

**Key words.** Apical periodontitis, polyhexanide, root canal, microbiota, irrigation, antiseptic.

### Introduction.

The primary microflora of infected root canals in chronic apical periodontitis is predominantly represented by obligate and facultative anaerobes, among which representatives of the genera *Streptococcus*, *Actinomyces*, *Peptostreptococcus*, *Porphyromonas*, and others are significant [1,2]. These microorganisms participate in the stages of the inflammatory process formation in the periodontium, play an important role in the establishment and stabilization of biofilms, and initiate a cascade of immune responses that provoke bone tissue

resorption in the periapical region. In particular, *Streptococci* are early colonizers capable of producing exopolysaccharides that promote biofilm maturation [3]. *Actinomyces spp.* are characterized by a pronounced ability to invade dentinal tubules and persist for a prolonged period. *Peptostreptococcus spp.*, as obligate anaerobes, contribute to maintaining the inflammatory process by producing proteases and other metabolites [4].

For effective elimination of the microbial population in chronic apical periodontitis, it is necessary to use irrigants possessing bactericidal action against both gram-positive and gram-negative bacteria. Currently, sodium hypochlorite 3% (NaOCl) remains the "gold standard" for irrigation, combining antiseptic and proteolytic properties. It exhibits high activity against most representatives of the anaerobic microflora, including *Streptococcus spp.* and *Peptostreptococcus spp.* However, its effect may be reduced in the apical part of the canal due to difficult penetration and inactivation by organic debris [5].

Chlorhexidine bigluconate (CHX), often used in endodontics at a 2% concentration, demonstrates activity against gram-positive bacteria, including *Streptococcus spp.*, although its effectiveness against mature biofilms is limited. Moreover, it is unable to dissolve organic substrate and does not affect tissue remnants, necessitating its combination with other agents [6]. It is also known that the interaction of CHX with sodium hypochlorite 3% may produce a para-chloroaniline-like precipitate, a potentially toxic compound that restricts the combined use of these agents [7].

As an alternative to traditional agents, polyhexanide (PHMB) is considered, capable of disrupting the bacterial membrane structure without pronounced cytotoxicity to somatic cells. Current studies indicate its effectiveness against *Actinomyces* and *Streptococcus spp.*, potentially including their biofilm forms [8-10].

The aim of this study is to determine the microbial landscape of chronic apical periodontitis and to evaluate the effectiveness of 0.2% and 0.1% Lavasept solution (polyhexanide-based) as root canal irrigants in the treatment of chronic apical periodontitis in comparison with traditional irrigants such as 3% sodium hypochlorite and 2% chlorhexidine bigluconate.

### Materials and Methods.

**Patient Selection:** Microbiological samples were obtained



**Table 1.** Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> <li>- Age from 18 to 65 years.</li> <li>- Signed informed consent of the patient and voluntary willingness to participate in the study.</li> <li>- Diagnosed chronic apical periodontitis K04.5.</li> <li>- Endodontic treatment of the studied tooth is performed for the first time.</li> <li>- No history of antibiotic therapy during the last 3 months.</li> </ul>	<ul style="list-style-type: none"> <li>- Age under 18 and over 65 years.</li> <li>- Diagnosed exacerbation of chronic apical periodontitis.</li> <li>- Previous endodontic treatment of the tooth under study.</li> <li>- Fractures and fractures of the tooth root.</li> <li>- Tooth mobility of the 3rd degree.</li> <li>- Resorption of bone tissue more than ½ the length of the tooth root.</li> <li>- Perforations and resorption of the tooth root.</li> <li>- Pregnant women at any term.</li> <li>- Allergologically aggravated anamnesis.</li> <li>- Any general systemic diseases in decompensation stage.</li> <li>- Intolerance to the irrigant under study.</li> <li>- Taking antibacterial drugs during the last 3 months for any reason.</li> <li>- Patient's voluntary desire to withdraw from the study at any stage.</li> <li>- Non-compliance with the study protocol.</li> <li>- Decompensation of any comorbid conditions.</li> </ul>

from 35 patients diagnosed with chronic apical periodontitis (ICD-10 code K04.5). The diagnosis was based on the clinical and radiographic symptoms in accordance with the Clinical Guidelines of the Russian Federation, dated December 20, 2024.

All patients included in the study were informed about the purpose and procedures of the study. Individual voluntary consent and information sheets were signed and received. The methods used in this study were approved by the local Ethics Committee of the Federal State Autonomous Educational Institution of Higher Education "Peoples' Friendship University of Russia" (RUDN), protocol No. 23 dated December 21, 2023. The inclusion and exclusion criteria are described in Table 1.

#### Collection of Microbiological Samples:

The following steps were used to collect microbiological material from the root canals:

1. Before starting endodontic treatment, patients were asked to rinse their mouths with a 0.05% chlorhexidine solution.
2. After anesthesia and cleaning of plaque from the teeth, including the adjacent teeth, a rubber dam system was placed, and the operative field was disinfected with a 3% sodium hypochlorite (NaOCl) solution, followed by the preparation of the carious cavity using sterile burs.
3. The classic endodontic access was performed with a new sterile bur until optimal visualization of the pulp chamber floor.
4. After completing the endodontic access, the rubber dam was replaced, and the tooth, rubber dam, and clamp were re-disinfected with a 3% NaOCl solution.
5. Sterile Gates Glidden burs (for multi-rooted teeth) and Largo burs (for single-rooted teeth with wide, straight, round root canals) were used to enlarge the canal orifices.
6. To collect the material, two sterile Hedström files (N-files) of small size were sequentially introduced to the working length using vertical sawing movements.
7. Immediately after collecting the microbiological material, the files, without touching any objects in the oral cavity, were placed in Eppendorf tubes containing 1 mL of transport thioglycolate medium (Liquid Thioglycolate Medium (FTM), Qingdao Hope Bio-Technology Co., China) and transported to the microbiological laboratory within no more than 40 minutes.

#### Cultivation and Identification of Microorganisms.

**Microbial cultivation and identification were performed at the bases:** Department of Microbiology named after V.S. Kiktenko of the Peoples' Friendship University of Russia, Moscow, Russia; Central Research Institute of Dentistry and Maxillofacial Surgery, Moscow, Russia; Pirogov Russian National Research Medical University, Moscow, Russia. The collected samples were transported to the microbiological laboratory by placing the used Hedström files from the infected root canals into test tubes with 1 mL of thioglycolate transport medium.

Anaerobic microorganisms were isolated by inoculating into Sheddler anaerobic agar (Oxoid, Basingstoke, UK) with 5% sheep defibrinated blood, anaerobic basal agar (Oxoid, Basingstoke, UK) with sheep defibrinated blood, and Lactobacillus MRS Agar (Himedia Labs. Inc., India) with sheep defibrinated blood. For aerobic microorganisms, the following media were used: Endo Agar (Becton Dickinson and Company, USA), Gelatin Mannitol Salt Agar (Staphylococcus Agar # 110, Himedia Labs Inc., India), and m-Enterococcus Agar (Difco Laboratories, Franklin Lakes, USA). Serial dilutions of the root canal contents were prepared in liquid Columbia Broth (Himedia Labs Inc., Mumbai, India). The inoculation was carried out in 102, 103, 105, and 107 dilutions.

After inoculation, Petri dishes with anaerobic bacteria were placed in anaerostats (Schutt Labortechnik GmbH, Göttingen, Germany) with a gas mixture (85% N<sub>2</sub>, 10% H<sub>2</sub>, 5% CO<sub>2</sub>) in the presence of platinum catalysts at a temperature of 37°C for 72 hours.

After the incubation period, the inoculated plates were macroscopically examined for colony growth. The morphological types were determined, and the number of each colony was counted. Microscopically, colonies were examined after Gram-staining.

Identified colonies were separated and transferred to new Petri dishes with the same medium. They were then incubated under anaerobic or aerobic conditions to obtain bacterial biomass for further identification and storage. Some strains of identified microorganisms were processed by freeze-drying microbial suspensions after freezing in a cryoprotectant solution

(10% sucrose/1% gelatin (weight/volume)) in a freeze dryer SB1 (Chemlab, UK) for further preservation. The test tubes with lyophilized strains were stored at -80°C (cryopreserved samples).

#### **Quantitative Determination of Bacterial Load Using Colony-Forming Units (CFU) Analysis:**

The laboratory weighed the test tube and calculated the mass of the sample as follows:

Sample mass = M (tube + medium + sample) - M (tube + medium).

All samples were cultured for two hours after collection. After homogenization, 10-fold serial dilutions from  $10^2$  to  $10^7$  were made in liquid Columbia Broth (HiMedia Labs Inc., Mumbai, India). From the corresponding dilutions, 0.1 ml of the sample was plated on selective and non-selective media. The number of bacteria was expressed in log<sub>10</sub> colony-forming units per 1 g of the sample (log<sub>10</sub> CFU/g).

#### **MALDI-TOF MS and 16S rRNA Sequencing:**

Initial identification of microorganisms was performed using MALDI-TOF MS on the Vitek MS Plus instrument (bioMérieux) in accordance with the manufacturer's recommendations. For bacterial strains that could not be identified using mass spectrometry, identification was performed by 16S rRNA gene sequencing. For this, a fragment of the 16S rRNA gene was amplified by PCR using universal bacterial primers 27F (5'-AGAGAGTTTGATCCTGGCTCAG-3') and 1492R (5'-ACGGGGGGYTACCTTTTGTGTTTACGACTT-3') for 35 cycles with the following program: initial denaturation at 94°C for 20 seconds; primer annealing at 58°C for 20 seconds; elongation at 72°C for 90 seconds. The obtained PCR product was purified using the Cleanup Standard kit (Evrogen, Moscow, Russian Federation). The next step involved sequencing the amplified DNA fragment using Sanger sequencing with the UF1 primer, which was performed by Evrogen (Moscow, Russian Federation). Sequence trimming was performed visually based on electropherogram quality using Chromas Lite version 2.6.6 software (Technelysium Pty. Ltd., Australia). The bacterial species were characterized by searching the obtained nucleotide sequences in the GenBank database using the Megablast algorithm. A result was considered to be species-level identification if the partial sequence of the 16S rRNA gene showed at least 98.7% similarity with the sequence of the nearest known bacterial species in the GenBank database.

#### **Determination of Antibacterial Activity of Polyhexanide After Short Exposure to Microorganisms in the Cultivation Medium.**

Determination of antiseptics antibacterial activity was performed at the base of Microbiology Department named after V.S. Kiktenko of the Peoples' Friendship University of Russia, Moscow, Russia.

In this part of the experiment, the antibacterial effects of the following irrigant solutions were investigated:

1. Lavasept 0.1% and 0.2% (diluted polyhexanide hydrochloride 20% aqueous solution, B. Braun Melsungen AG, Germany).
2. Belodez 3% (sodium hypochlorite 3% solution, VladMiVa, Russia).

3. Chlorhexidine bigluconate 2% (aqueous solution, Omega-Dent, Russia).

Based on the previously obtained data on the frequency of isolating different microorganisms from root canals, the following bacteria were selected for this phase of the work:

- Standard strains *Staphylococcus aureus* ATCC 6538; *Escherichia coli* ATCC 2582 and *Candida albicans* ATCC 10231 (as reference microorganisms), obtained from the American Type Culture Collection (ATCC, USA).
- Strains of microorganisms were obtained from the working collections of the Department of Microbiology named after V.S. Kiktenko, Medical Institute of the Peoples' Friendship University of Russia and Pirogov Russian National Research Medical University: *Streptococcus sanguinis*, *Streptococcus gordonii*, *Streptococcus mutans*, *Actinomyces oris*, *Actinomyces naeslundii*, *Actinomyces israelii*, *Porphyromonas gingivalis*, *Enterococcus faecalis*.

Bacterial suspension for sowing was prepared from microbial sediment according to the McFarland turbidity standard 0.5 (HiMedia, India), in physiological solution (0.9% NaCl, Helicon, Russia). Inoculated into the appropriate culture medium. The antiseptic solution under study was added to the medium with microorganisms, bringing the final concentration of active ingredient per milliliter to the previously indicated concentration. Incubation was carried out at 37 °C under aerobic or anaerobic conditions, corresponding to the requirements of cultivation of the microorganism under study, and amounted to one hour. After incubation, the microorganisms were washed three times with physiological solution, followed by sowing the culture in the volume of 100 µl on a dense nutrient medium by the "lawn" method with subsequent incubation in the thermostat. After cultivation, visual counting of colonies was performed and further conversion to the CFU/mL value, based on the number of grown colonies, sowing volume and dilution factor.

#### **Results.**

##### **Results of microbiological diversity determination in root canals with chronic apical periodontitis:**

In 35 microbiological samples obtained from 35 patients, bacteria and fungi were found belonging to 5 phyla and 15 families at various CFU concentrations. The bacterial phyla were represented by the following taxonomic groups: *Bacillota* (40%), *Actinomycetota* (26.7%), *Bacteroidota* (13.3%), and *Pseudomonadota* (6.7%). Fungi from the *Debaryomycetaceae* family belonged to the *Ascomycota* phylum (6.7%).

Furthermore, during species identification, a bacterium was isolated that could not be identified by MALDI-TOF MS. After 16S rRNA sequencing using universal bacterial primers, this microorganism was identified as belonging to the *Veillonellaceae* family. Further studies are needed to clarify the properties of the new microorganism. The new bacterial species is marked with an asterisk "\*" in the Table 2.

Based on the analysis of the obtained data, it can be concluded that the predominant flora in patients included in this study consisted of bacteria from the *Bacillota* taxonomic units, specifically *Lactobacillus acidophilus* (25.71%), *Streptococcus sanguinis*

**Table 2.** Distribution of identified microorganisms and fungi by taxonomic affiliation and samples.  
**Note:** *M* – mean value, *SD* – standard deviation, new species – “\*”.

Phylotype	Species	Group 1		Group 2		Group 3	
		%	<i>log10</i> CFU/g ( <i>M</i> ± <i>m</i> )	%	<i>log10</i> CFU/g ( <i>M</i> ± <i>m</i> )	%	<i>log10</i> CFU/g ( <i>M</i> ± <i>m</i> )
Bacillota	<i>Lactobacillus spp.</i>	76 %	4,5± 0,18	58 %	2,9± 0,10	-	-
	<i>Streptococcus salivarius</i>	83 %	6,3± 0,11	67 %	7,4± 0,16	10 %	0,7± 0,08
	<i>Streptococcus oralis</i>	-	-	12 %	4,4± 0,11	40 %	6,0± 0,21
	<i>Streptococcus sanguinis</i>	93 %	6,8± 0,19	77 %	5,1± 0,18	35 %	3,3± 0,10
	<i>Streptococcus intermedius</i>	88 %	7,6± 0,20	52 %	2,6± 0,11	-	-
	<i>Staphylococcus aureus</i>	-	-	21 %	4,2± 0,18	48 %	6,0± 0,16
	<i>Veillonella spp.</i>	72 %	8,6± 0,12	58,3 %	6,1± 0,20	10,2 %	-
	<i>Enterococcus faecalis</i>	44 %	4,7±0,18	57 %	5,0± 0,14	67 %	6,0± 0,11
Actinomycetota	<i>Peptostreptococcus stomatis</i>	15 %	4,4± 0,19	41 %	6,6± 0,20	55 %	5,6± 0,10
	<i>Actinomyces odontolyticus</i>	-	-	49 %	8,5± 0,18	-	-
	<i>Actinomyces naeslundii</i>	30 %	4,3± 0,12	66 %	7,5± 0,20	27 %	3,0± 0,17
	<i>Actinomyces viscosus</i>	-	-	33 %	2,8± 0,21	-	-
	<i>Actinomyces israelii</i>	43 %	4,0± 0,16	39 %	2,4± 0,19	16 %	1,2± 0,30
Bacteroidota	<i>Capnocytophaga gingivalis</i>	23 %	2,2± 0,21	41 %	4,5± 0,17	42 %	4,0± 0,18
	<i>Porphyromonas gingivalis</i>	67 %	4,5± 0,14	78 %	8,5± 0,16	93 %	8,7± 0,11
	<i>Tannerella forsythia</i>	53 %	5,3± 0,16	70 %	4,8± 0,12	77 %	5,1± 0,12
	<i>Prevotella intermedia</i>	48 %	3,5± 0,17	59 %	2,7± 0,09	73 %	5,6± 0,16
Fusobacteriota	<i>Prevotella oralis</i>	30 %	5,0± 0,11	26 %	2,6± 0,09	-	-
	<i>Fusobacterium nucleatum</i>	100 %	7,1± 0,10	100 %	8,0± 0,11	98,3 %	6,3± 0,21
	<i>Eikenella corrodens</i>	40 %	2,1± 0,08	-	-	-	-
Pseudomonadota	<i>Aggregatibacter actinomycetemcomitans</i>	5 %	4,6± 0,12	2 %	0,5± 0,12	3 %	0,3± 0,20
	<i>Enterobacter cloacae</i>	4 %	3,0± 0,21	15 %	7,4± 0,16	18 %	6,1± 0,21
	<i>Escherichia coli</i>	28 %	2,7± 0,11	34 %	5,1± 0,19	38 %	7,6± 0,19
Ascomycota	<i>Candida albicans</i>	44 %	3,2± 0,14	41 %	4,6± 0,18	75 %	7,0± 0,10

(28.57%), *Streptococcus mutans* (42.86%), *Streptococcus gordonii* (28.57%), as well as *Actinomycetota* – *Actinomyces oris* (34.29%), *Actinomyces naeslundii* (34.29%), *Actinomyces israelii* (34.29%), and *Bacteroidota* – *Porphyromonas gingivalis* (31.43%), which indicates a mixed flora in the root canals. Both aerobic and anaerobic microorganisms were present, mediating the pathogenic mechanisms that maintain the peri-apical area of bone tissue destruction by releasing various toxic and antigenic substances, through immune mechanisms osteoblast-dependent co-activation of osteoclasts.

It is noteworthy that even with primary endodontic infection, a certain number of patients were identified with *Enterococcus faecalis* (22.86%) and *Candida albicans* (22.86%). The presence of these pathogens in the root canal microbiome could indicate potential resistance of the endodontic infection to elimination and an increased risk of treatment failure if these organisms are not sufficiently removed from the root canal system.

#### Results of determining the antibacterial activity of polyhexanide during short-term exposure of the antiseptic to microorganisms in the culture medium.

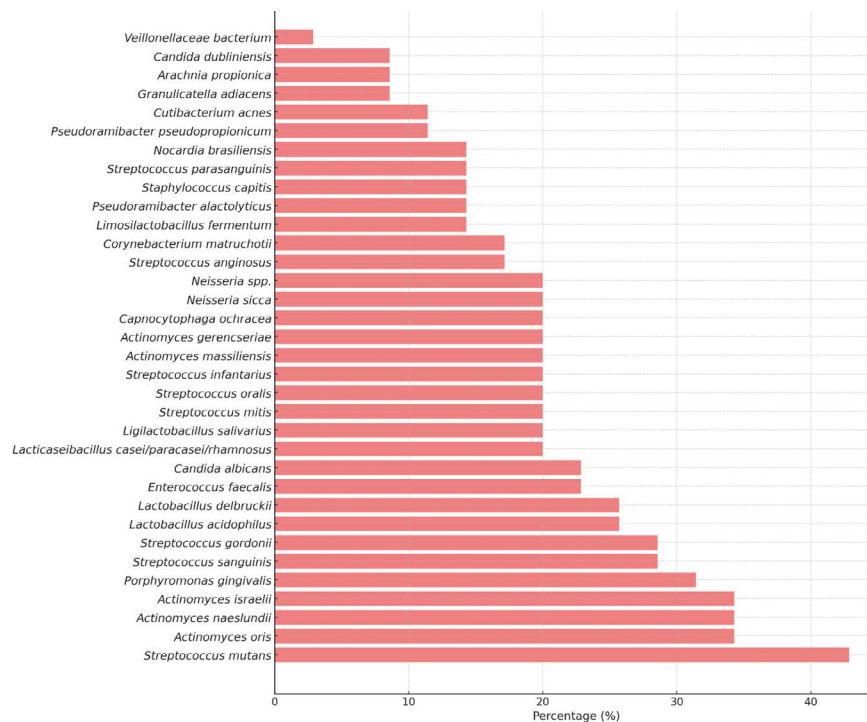
In this part of the work, the time interval for the contact of microorganisms with antiseptic solutions was set to 1 hour, simulating the duration of antimicrobial therapy in root canals during endodontic treatment. This choice is based on the average total exposure time of irrigants in the root canal.

As shown in Figure 3, chlorhexidine bigluconate at a concentration of 2%, Lavasept at concentrations of 0.1% and 0.2% and sodium hypochlorite 3% exhibit bactericidal activity against *Streptococcus sanguinis* to an equal degree, as evidenced by the absence of growth after one hour of incubation of the microorganism culture with the antiseptic solutions.

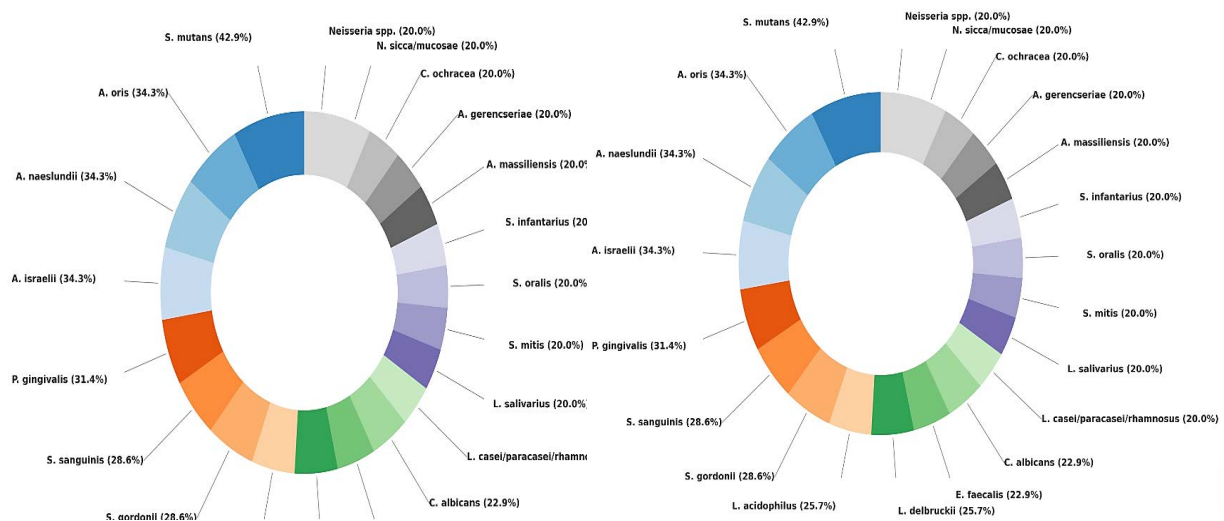
Figure 4 demonstrates that chlorhexidine bigluconate at a concentration of 2%, Lavasept at concentrations of 0.1% and 0.2% and sodium hypochlorite 3% have a bactericidal effect against *Streptococcus gordonii* to an equal degree of severity, as evidenced by the absence of growth after one hour of incubation of the microorganism culture together with antiseptic solutions.

Figure 5 illustrates that chlorhexidine bigluconate at a concentration of 2%, Lavasept at concentrations of 0.1% and 0.2% and sodium hypochlorite 3% have a bactericidal effect against *Streptococcus mutans* to an equal degree of severity, as evidenced by the absence of growth after one hour of incubation of the microorganism culture together with the antiseptic solutions.

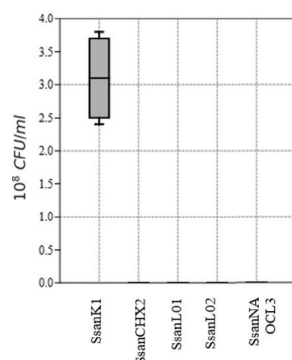
Figure 6 illustrates that chlorhexidine bigluconate at a concentration of 2%, Lavasept at concentrations of 0.1% and 0.2% and sodium hypochlorite 3% have a bactericidal effect against *Actinomyces oris* to an equal degree of severity, as evidenced by the absence of growth after one hour of incubation of the microorganism culture together with the antiseptic solutions.



**Figure 1.** Percentage (%) of bacteria in samples expressed as log<sub>10</sub> CFU/g. Note: Each horizontal bar represents the mean value (M), and the error at the ends of the bar represents the standard deviation (SD).



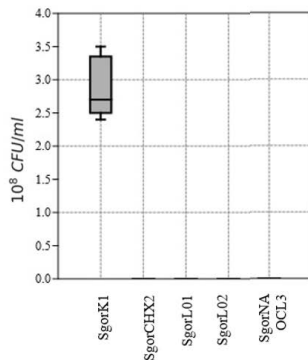
**Figure 2.** A – relative number of bacterial families isolated from patients with chronic apical periodontitis. B – most frequently isolated bacteria from patients with chronic apical periodontitis (≥20%).



**Figure 3 - Streptococcus sanguinis**

Note - SsanK1 - growth control of *Streptococcus sanguinis* on culture medium without antiseptic solution after 1 hour of incubation, SsanCHX2 - growth of *Streptococcus sanguinis* on culture medium with chlorhexidine gluconate 2%, SsanL01 - growth of *Streptococcus sanguinis* on culture medium with application of 0.1% Lavasept solution, SsanL02 - growth of *Streptococcus sanguinis* on culture medium with application of 0.2% Lavasept solution, SsanNAOCL3 - growth of *Streptococcus sanguinis* on culture medium with application of sodium hypochlorite 3%.

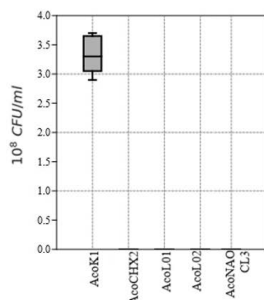
**Figure 3.** *Streptococcus sanguinis*.



**Figure 4. *Streptococcus gordonii***

Note - SgorK1 - growth control of *Streptococcus gordonii* on culture medium without antiseptic solution after 1 hour of incubation, SgorCHX2 - growth of *Streptococcus gordonii* on culture medium with chlorhexidine gluconate 2%, SgorL01 - growth of *Streptococcus gordonii* on culture medium with application of 0.1% solution of Lavasept, SgorL02 - growth of *Streptococcus gordonii* on culture medium with application of 0.2% solution of Lavasept, SgorNAOCL3 - growth of *Streptococcus gordonii* on culture medium with application of sodium hypochlorite 3%.

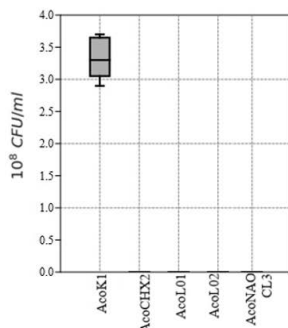
**Figure 4. *Streptococcus gordonii*.**



**Figure 6 - *Actinomyces oris***

Note - AcoK1 - growth control of *Actinomyces oris* on culture medium without antiseptic solution after 1 hour of incubation, AcoCHX2 - growth of *Actinomyces oris* on culture medium with chlorhexidine gluconate 2%, AcoL01 - growth of *Actinomyces oris* on culture medium with application of 0.1% solution of Lavasept, AcoL02 - growth of *Actinomyces oris* on culture medium with application of 0.2% solution of Lavasept, AcoNAOCL3 - growth of *Actinomyces oris* on culture medium with application of sodium hypochlorite 3%

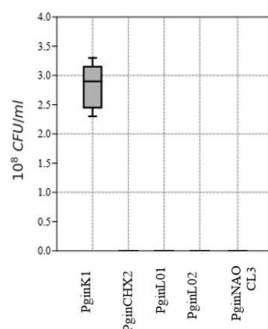
**Figure 5. *Streptococcus mutans*.**



**Figure 6 - *Actinomyces oris***

Note - AcoK1 - growth control of *Actinomyces oris* on culture medium without antiseptic solution after 1 hour of incubation, AcoCHX2 - growth of *Actinomyces oris* on culture medium with chlorhexidine gluconate 2%, AcoL01 - growth of *Actinomyces oris* on culture medium with application of 0.1% solution of Lavasept, AcoL02 - growth of *Actinomyces oris* on culture medium with application of 0.2% solution of Lavasept, AcoNAOCL3 - growth of *Actinomyces oris* on culture medium with application of sodium hypochlorite 3%

**Figure 6. *Actinomyces oris*.**



**Figure 7 – *Porphyromonas gingivalis***

Note - PginK1 - growth control of *Porphyromonas gingivalis* on culture medium without antiseptic solution after 1 hour of incubation, PginCHX2 - growth of *Porphyromonas gingivalis* on culture medium with chlorhexidine gluconate 2%, PginL01 - growth of *Porphyromonas gingivalis* on cultivation medium with application of 0.1% solution of Lavasept, PginL02 - growth of *Porphyromonas gingivalis* on cultivation medium with application of 0.2% solution of Lavasept, PginNAOCL3 - growth of *Porphyromonas gingivalis* on cultivation medium with application of sodium hypochlorite 3%.

**Figure 7. *Porphyromonas gingivalis*.**

Figure 7 demonstrates that chlorhexidine bigluconate at a concentration of 2%, Lavasept at concentrations of 0.1% and 0.2% and sodium hypochlorite 3% have a bactericidal effect against *Porphyromonas gingivalis* to an equal degree of severity, as evidenced by the absence of growth after one hour of incubation of the microorganism culture together with antiseptic solutions.

As can be seen from Figure 8, chlorhexidine bigluconate at a concentration of 2%, Lavasept at concentrations of 0.1% and 0.2% and sodium hypochlorite 3% have a bactericidal effect against *Actinomyces naeslundii* to an equal degree of severity, as evidenced by the absence of growth after one hour of incubation of the microorganism culture together with antiseptic solutions.

As can be seen from Figure 9, chlorhexidine bigluconate at a concentration of 2%, Lavasept at concentrations of 0.1% and 0.2% and sodium hypochlorite 3% have a bactericidal effect against *Actinomyces israelii* to an equal degree of severity, as evidenced by the absence of growth after one hour of incubation of the microorganism culture together with antiseptic solutions.

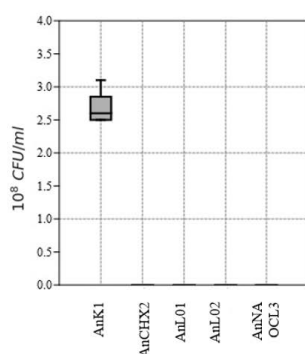
As can be seen from Figure 10, chlorhexidine bigluconate at a concentration of 2%, Lavasept at concentrations of 0.1% and 0.2% and sodium hypochlorite 3% have a bactericidal effect against *Enterococcus faecalis* to an equal degree of severity, as

evidenced by the absence of growth after one hour of incubation of the microorganism culture together with antiseptic solutions.

As can be seen from Figure 11, chlorhexidine bigluconate at a concentration of 2%, Lavasept at concentrations of 0.1% and 0.2% and sodium hypochlorite 3% have a bactericidal effect against *Staphylococcus aureus* ATCC 6538 to an equal degree of severity, as evidenced by the absence of growth after one hour of incubation of the microorganism culture together with antiseptic solutions.

As can be seen from Figure 12, chlorhexidine bigluconate at a concentration of 2%, Lavasept at concentrations of 0.1% and 0.2% and sodium hypochlorite 3% have a bactericidal effect against *Escherichia coli* ATCC 2582 to an equal degree of severity, as evidenced by the absence of growth after one hour of incubation of the microorganism culture together with antiseptic solutions.

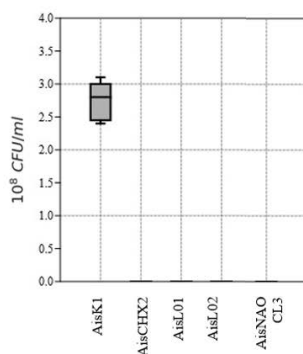
As can be seen from Figure 13, chlorhexidine bigluconate at a concentration of 2%, Lavasept at concentrations of 0.1% and 0.2% and sodium hypochlorite 3% have a bactericidal effect against *Candida albicans* ATCC 10231 to an equal degree of severity, as evidenced by the absence of growth after one hour of incubation of the microorganism culture together with antiseptic solutions.



**Figure 8 - *Actinomyces naeslundii***

Note - AnK1 - growth control of *Actinomyces naeslundii* on culture medium without antiseptic solution after 1 hour of incubation, AnCHX2 - growth of *Actinomyces naeslundii* on culture medium with chlorhexidine gluconate 2%, AnL01 - growth of *Actinomyces naeslundii* on culture medium with application of 0.1% solution of Lavasept, AnL02 - growth of *Actinomyces naeslundii* on culture medium with application of 0.2% solution of Lavasept, AnNAOCL3 - growth of *Actinomyces naeslundii* on culture medium with application of sodium hypochlorite 3%

**Figure 8. *Actinomyces naeslundii*.**

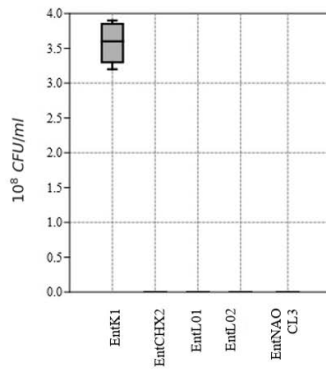


**Figure 9 - *Actinomyces israelii***

Note - AisK1 - growth control of *Actinomyces israelii* on culture medium without antiseptic solution after 1 hour of incubation, AisCHX2 - growth of *Actinomyces israelii* on culture medium with chlorhexidine gluconate 2%, AisL01 - growth of *Actinomyces israelii* on culture medium with application of 0.1% solution of Lavasept, AisL02 - growth of *Actinomyces israelii* on culture medium with application of 0.2% solution of Lavasept, AisNAOCL3 - growth of *Actinomyces israelii* on culture medium with application of sodium hypochlorite 3%

**Figure 9. *Actinomyces israelii*.**

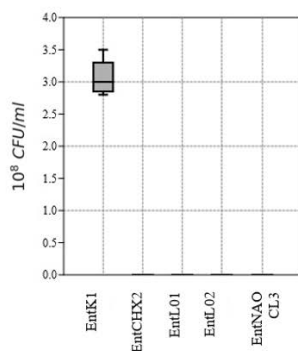




**Figure 10 - *Enterococcus faecalis***

Note - EntK1 - growth control of *Enterococcus faecalis* on culture medium without antiseptic solution after 1 hour of incubation, EntCHX2 - growth of *Enterococcus faecalis* on culture medium with chlorhexidine gluconate 2%, EntL01 - growth of *Enterococcus faecalis* on culture medium with application of 0.1% solution of Lavasept, EntL02 - growth of *Enterococcus faecalis* on culture medium with application of 0.2% solution of Lavasept, EntNAOCL3 - growth of *Enterococcus faecalis* on culture medium with application of sodium hypochlorite 3%

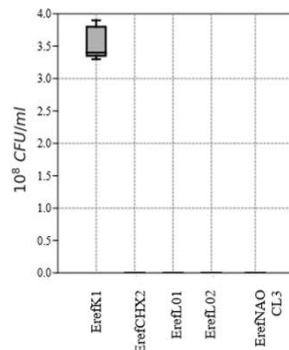
**Figure 10. *Enterococcus faecalis*.**



**Figure 11 - *Staphylococcus aureus* ATCC 6538**

Note - SrefK1 - growth control of *Staphylococcus aureus* on culture medium without antiseptic solution after 1 hour of incubation, SrefCHX2 - growth of *Staphylococcus aureus* on culture medium with chlorhexidine gluconate 2%, SrefL01 - growth of *Staphylococcus aureus* on culture medium with application of 0.1% Lavasept solution, SrefL02 - growth of *Staphylococcus aureus* on culture medium with application of 0.2% Lavasept solution, SrefNAOCL3 - growth of *Staphylococcus aureus* on culture medium with application of sodium hypochlorite 3%

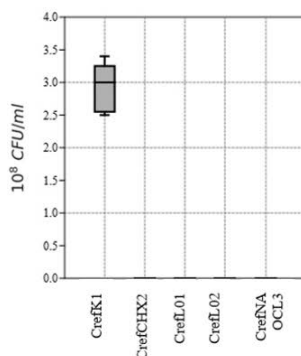
**Figure 11. *Staphylococcus aureus*.**



**Figure 12 - *Escherichia coli* ATCC 2582**

Note - ErefK1 - growth control of *Escherichia coli* on culture medium without antiseptic solution after 1 hour of incubation, ErefCHX2 - growth of *Escherichia coli* on culture medium with chlorhexidine gluconate 2%, ErefL01 - growth of *Escherichia coli* on culture medium with application of 0.1% solution of Lavasept, ErefL02 - growth of *Escherichia coli* on culture medium with application of 0.2% solution of Lavasept, ErefNAOCL3 - growth of *Escherichia coli* on culture medium with application of sodium hypochlorite 3%

**Figure 12. *Escherichia coli* ATCC 2582.**



**Figure 13 - *Candida albicans* ATCC 10231**

Note - CrefK1 - control of *Candida albicans* growth on culture medium without antiseptic solution after 1 hour of incubation, CrefCHX2 - growth of *Candida albicans* on culture medium with chlorhexidine gluconate 2%, CrefL01 - growth of *Candida albicans* on cultivation medium with application of 0.1% solution of Lavasept, CrefL02 - growth of *Candida albicans* on cultivation medium with application of 0.2% solution of Lavasept, CrefNAOCL3 - growth of *Candida albicans* on cultivation medium with application of sodium hypochlorite 3%

**Figure 13. *Candida albicans* ATCC 10231.**

## Discussion.

The fundamental etiological factor for caries and its complications is the microbial factor. To determine the most effective medicinal protocol for endodontic treatment for eliminating microorganisms from the root canal system, conducting microbiological studies is essential. Determining the microbial composition in infected root canals is one of the key sources for selecting appropriate antiseptic and/or antimicrobial therapy, both in endodontics and general medicine. Knowledge of the main microorganisms causing infectious-inflammatory diseases of the apical periodontium, as well as their sensitivity to specific irrigants, including experimental ones, can positively influence the selection and ultimately the quality of local medical therapy for chronic apical periodontitis.

After cultivating and isolating pure cultures under anaerobic and aerobic conditions, we obtained the following results: from 35 microbiological samples from patients with chronic apical periodontitis, bacteria and fungi from five phylogenetic groups and 15 families were detected in varying concentrations of CFU. The bacterial phylogenetic groups were represented by the following taxonomic units: *Bacillota* (40%), *Actinomycetota* (26.7%), *Bacteroidota* (13.3%), and *Pseudomonadota* (6.7%). Fungi from the *Debaryomycetaceae* family belonged to the *Ascomycota* phylum (6.7%).

It is also worth mentioning that, during the identification of microorganisms, a new species was discovered that was not represented in the microbiological libraries. After 16S rRNA sequencing using universal bacterial primers, it was determined that this microorganism was related to the *Veillonellaceae* family.

According to our data, the predominant flora in the patients included in this study consisted of bacteria from the *Bacillota* taxonomic units, namely, *Lactobacillus acidophilus* (25.71%), *Streptococcus sanguinis* (28.57%), *Streptococcus mutans* (42.86%), *Streptococcus gordonii* (28.57%), as well as *Actinomycetota* - *Actinomyces oris* (34.29%), *Actinomyces naeslundii* (34.29%), *Actinomyces israelii* (34.29%), and *Bacteroidota* - *Porphyromonas gingivalis* (31.43%), which indicates the mixed flora of the root canals. Both aerobic and anaerobic microorganisms are represented, mediating the pathogenic mechanisms for maintaining the peri-apical destructive lesion through the release of various toxic and antigenic substances, via immune mechanisms co-activating osteoclasts osteoblast-dependently.

An interesting microbiological fact for primary endodontic treatment in our study was the detection of *E. faecalis* and *C. albicans*, more characteristic of secondary endodontic infections or failed endodontic treatments. These organisms often accompany each other, as shown in our study, with a frequency of 22.86% for both pathogens. *Enterococcus* can promote biofilm formation by *C. albicans* and the production of exopolymeric substances. The presence of these pathogens in the root canal microbiome may indicate the potential resistance of the endodontic infection to elimination, increasing the risk of treatment failure if these organisms are not adequately removed from the root canal system. This makes the search for new irrigants even more urgent.

When cultivating bacteria under anaerobic or aerobic conditions in the presence of antiseptic solutions for 1 hour, all solutions showed excellent results. After 1 hour, none of the groups of antiseptics showed the presence of any bacterial species. These results allow us to conclude that the decontaminating and antiseptic activities of the solutions based on Lavasept 0.1% and 0.2% are equally effective as traditional irrigation solutions.

All the results presented indicate that for *Streptococcus sanguinis*, *Streptococcus gordonii*, *Streptococcus mutans*, *Actinomyces oris*, *Porphyromonas gingivalis*, *Actinomyces naeslundii*, *Actinomyces israelii*, *Enterococcus faecalis*, and typical strains of *Staphylococcus aureus* ATCC 6538; *Escherichia coli* ATCC 2582, *Candida albicans* ATCC 10231, the antiseptic solutions at the concentrations studied (chlorhexidine bigluconate 2%, Lavasept 0.1% and 0.2% and sodium hypochlorite 3%) exhibit equivalent bactericidal effects and are capable of completely inhibiting the growth and proliferation of microorganisms after one hour of exposure.

Based on the data above, it can be stated that the use of polyhexanide-based solutions (0.2% Lavasept, 0.1% Lavasept) as endodontic irrigants for root canals is microbiologically justified, and the results of the tested solutions are comparable to the antimicrobial endodontic standard - sodium hypochlorite 3%.

In the microbiological experiment, after one hour of interaction between endodontic pathogens and all concentrations of polyhexanide-based medication, no colony growth was observed, indicating complete decontaminating bactericidal effect. It should be noted that such a prolonged exposure of antiseptics in endodontic procedures is not typically achievable; however, for minimizing microbiological risks, the use of a 0.2% Lavasept solution as an effective decontaminant can be recommended. The limitation of this work is its failure to employ a biofilm model. Further studies are needed to investigate the effect of Lavasept solution on biofilms [11-18].

## Conclusion.

The use of 0.2% Lavasept solution (polyhexanide (PHMB)) as an irrigant in the treatment of chronic apical periodontitis demonstrates high antimicrobial activity against key representatives of the primary endodontic infection microbiota, including *Streptococcus spp.*, *Actinomyces spp.*, and *Peptostreptococcus spp.*, *Porphyromonas gingivalis*, and others, as well as specific endopathogens - *Enterococcus faecalis*, *Candida albicans*. Despite the positive results obtained, further clinical and microbiological studies are required to assess the long-term efficacy and safety of PHMB in endodontic practice.

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