

Study of the antimicrobial properties of dental
phytofilms with propolis N.V. Kudashkina, S.R.
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The study of antimicrobial properties of dental bee glue phytofilms
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SUMMARY

The article deals with the issues of studying the antimicrobial properties of medicinal plants for the development of the original composition of dental phytofilms. Antimicrobial activity was determined by the agar diffusion method to suppress the growth of various strains of pathogenic microorganisms. As a result of the research, it was found that phytofilms containing propolis tincture and a mixture that includes dry extracts of calendula, yarrow and propolis tincture have the highest antimicrobial activity against all studied species of pathogenic gram-positive and gram-negative bacteria, as well as fungi.

Key words: orthodontics, phytofilms, calendula flowers, yarrow herb, propolis.

RESUME

This article examines matters relating to the study of antimicrobial properties of medicinal plants for the development of original dental phytofilms. Antimicrobial activity was determined using the method of diffusion in agar to suppress the growth of different strains of pathogens. As a result, maximum antimicrobial activity against all researched kinds pathogenic Gram-positive and Gram-negative bacteria, as well as fungi, have phytofilms containing bee glue tincture and a mixture that includes dry extracts of calendula, yarrow and tincture of bee glue.

keywords: orthodontics, phytofilms, calendula flowers, yarrow herb, bee glue.

Currently, the actual problem of modern dentistry in patients with traumatic lesions of the oral mucosa is the prevalence of caries and periodontal diseases that occur during or after orthodontic treatment. Also, insufficient attention is paid to the problem of timely diagnosis of rapidly progressing periodontitis in this group of patients [1]. All this indicates the need to develop new drugs and forms for the treatment of traumatic lesions of the oral mucosa.

Traditionally, for the treatment of inflammatory diseases of the periodontal and oral mucosa, depending on the etiology and pathogenesis of diseases, drugs of various pharmacological groups are used - a variety of antibacterial drugs (metronidazole, dioxidine), antibiotics (azithromycin, erythromycin, gramicidin), antiseptic drugs (chlorhexidine, hydrogen peroxide, rivanol, furatsilin) [2]. Application agents used in therapeutic dentistry (solutions, ointments, pastes, gels, etc.) are not effective enough due to the impossibility of ensuring the constancy of the concentration of the medicinal substance in the oral cavity, the short duration of its contact, discomfort and long-term treatment.

According to Gorbatoeva E.A. (2000), herbal remedies in dentistry have fewer undesirable side effects than synthetic ones, including they are less likely to cause allergic reactions [3]. In this regard, the development of new drugs with prolonged action in the form of medicinal films based on polymers for medical purposes (with the inclusion of plant extracts and herbal medicines) is a promising scientific task.

The aim of the work was to develop the optimal composition of medicinal phytofilms, with a pronounced antimicrobial effect, for use in dentistry with

orthodontic treatment.

MATERIALS AND RESEARCH METHODS

The objects of the study were calendula flowers, yarrow herb and propolis tincture, which were selected by us on the basis of an information search. In accordance with the available bibliographic sources, extracts from them have antimicrobial, wound healing, anti-inflammatory, angioprotective, hemostatic, antiseptic, regenerating, immunostimulating, and antioxidant properties [4–6]. Dry extracts of calendula flowers and yarrow herb were obtained by percolation in cylindrical glass percolators under laboratory conditions, followed by drying at a temperature of 50–60 °C to a moisture content of 5%. As a 10% propolis tincture, a pharmacy drug of the same name was used.

To determine the antimicrobial activity, strains were used as test microorganisms. *Escherichia coli* No. 25922, *Candida albicans* No. 24433, *Staphylococcus aureus* #966 from the collection Clinics and strains *Streptococcus oralis* No. 27417 and *Streptococcus sobrinus* No. 28417 from the collection of the Department of Fundamental and Applied Microbiology of the Federal State Budgetary Educational Institution of Higher Education of the Belarusian State Medical University of the Ministry of Health of Russia, isolated from patients with periodontal disease. Sensitivity was determined by a semi-quantitative disk diffusion method on the Muller-Hinton medium (HiMedia, India), on which a standard inoculum was sown within 15 minutes after preparation as a "solid lawn", corresponding to a value of 0.5 according to McFarland and containing 1.5×10^8 cfu/ml of bacteria.

Films containing 0.01 g of yarrow herb extract (No. 1) were used for the experiment; 0.09 g 10% propolis tincture (No. 2); 0.01 g of calendula flower extract (No. 3) and a mixture of yarrow herb extracts 0.01 g; calendula flowers 0.01 g and 10% propolis tincture 0.09 g (No. 4). Discs with oxacillin at a concentration of 1 µg per disc (HiMedia, Russia) were used as a reference drug. Film disks without any impregnation were used as control. The crops were incubated for 24 hours at a temperature of 37°C under aerobic and microaerophilic conditions ("burning candle" method) in an atmosphere enriched with CO₂. The studies were carried out in 3 series. Activity was assessed by the arithmetic mean of the diameter of growth inhibition zones (mm).

RESULTS AND DISCUSSION

To develop the optimal composition of phytofilms and substantiate the proposed composition, the antibacterial properties of the obtained plant extracts were studied: calendula flowers, yarrow herb and propolis tincture separately and in the joint presence. Based on the studies and the average diameters of growth inhibition zones (Table 1), the highest antimicrobial activity against all types of tested microorganisms was found in propolis tincture (from 12 to 17.3 mm) and a mixture of calendula + yarrow + propolis (from 8 up to 16.3 mm), on average.

Table 1

Dynamics of growth inhibition zones (mm) (n = 3)

Types of bacteria	Objects of study				Comparator drug
	#1	#2	No. 3	#4	Oxacillin (concentration in disk 1 mcg)
<i>Escherichia coli</i>	4.3±0.2	12±0.5	-	8±0.4	10±0.5
<i>Candida albicans</i>	12.3±0.6	17.3±0.8	-	16±0.7	-
<i>Staphylococcus aureus</i>	7±0.4	17±0.6	4.3±0.2	16.3±0.8	6.7±0.3
<i>Streptococcus oralis</i>	4.3±0.2	10.3±0.5	-	11.7±0.5	-
<i>Streptococcus sobrinus</i>	5.7±0.2	12±0.6	-	13.3±0.6	-

The obtained values significantly exceeded the antimicrobial activity of the reference drug (from 6.7 to 10 mm) only in two of the five studied strains of pathogenic microorganisms ($p < 0.05$). Phytofilms containing a dry extract of yarrow also had antimicrobial activity against all types of gram-positive and gram-negative bacteria, as well as fungi (*C. albicans*), but significantly inferior in effect size (from 4.3 to 12.3 mm) films with propolis tincture and a mixture of calendula + yarrow + propolis. The lowest antimicrobial activity and the effect on only one type of tested microorganisms, characterized by the average diameter of growth inhibition zones, occurred when testing films with calendula flower extract (4.3 mm).

When calculating significant differences using the Student's t-test, it turned out that the value of the antimicrobial activity of the mixture of calendula + yarrow + propolis does not differ from the antimicrobial activity of propolis tincture ($t_{\text{exp}} < t_{\text{kr}}; 0.3 < 2.31; p < 0.05$).

CONCLUSION

As a result of the experimental studies, it was found that the claimed original composition of the dental film provides a therapeutic agent with high therapeutic activity. In addition to the manifestation of known properties, each therapeutic component of the films in the aggregate enhances its effect, which is obviously due to the effect of their synergy [7–9]. The presented results make it possible to recommend the use of medicinal films in the treatment of traumatic lesions of the oral mucosa during orthodontic treatment as a promising dosage form for use in dental practice.

CONCLUSIONS

1. An experimental study of the antibacterial properties of plant extracts was carried out: calendula flowers, yarrow herb and propolis tincture (separately and in joint presence) as part of medicinal phytofilms for use in dentistry.
2. The optimal composition of medicinal phytofilms with a pronounced antimicrobial action, for use in orthodontic treatment.
3. It is shown that medicinal films based on a mixture of calendula + yarrow + propolis and propolis tinctures can be a promising dosage form for the treatment of traumatic lesions of the oral mucosa during orthodontic treatment in dental practice.

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