



# Antioxidant, antimicrobial and antifungal activity of the obtained “Cachisept” tablets for resorption in the oral cavity for the treatment and prevention of dental caries

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Dental caries stands as a highly common chronic ailment affecting individuals globally, with susceptibility to this condition spanning their entire lifespan. Consequently, the search for novel medications aimed at treating and preventing dental caries holds significant importance in the field of pharmacy.

**The aim of the work** was to study the antioxidant, antimicrobial, and antifungal activity of the obtained oral tablets “Cachisept” for resorption in the oral cavity for the treatment and prevention of dental caries.

**Materials and methods.** The obtained tablets “Cachisept” with green tea leaf extract were the object of investigation. Antioxidant activity was established by the potentiometric method, and antimicrobial and antifungal activity was assessed by the agar well diffusion method.

**Results.** The level of antioxidant activity for tablets “Cachisept” was  $110.00 \pm 2.20$  mmol-equiv./m<sub>dry res</sub>, the obtained tablets had a high level of antioxidant activity according to Maslov’s conditional classification. *Staphylococcus aureus* ( $25.33 \pm 0.50$  mm), *Bacillus subtilis* ( $25.33 \pm 0.50$  mm) and *Streptococcus mutans* ( $25.33 \pm 0.50$  mm) were the most sensitive to the obtained “Cachisept” tablets, and the least – *Proteus vulgaris* ( $20.67 \pm 0.50$  mm), and it was observed strong growth inhibition in relation to the fungus *Candida albicans* ( $20.00 \pm 0.50$  mm).

**Conclusions.** The presented study has found that “Cachisept” tablets have a high level of antioxidant activity, and also have a high antimicrobial and antifungal effect against all investigated Gram-positive, Gram-negative bacteria, and the *Candida albicans* fungus. Thus, “Cachisept” tablets can be recommended for the treatment and prevention of dental caries.

**Key words:** tablets, green tea, dental caries, plant extract, Cachisept.

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## Антиоксидантна, антимікробна та протигрибкова активність таблеток «Качісепт» для розсмоктування в ротовій порожнині для лікування та профілактики карієсу зубів

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Карієс зубів – одне з найпоширеніших хронічних захворювань людей у всьому світі; люди схильні до цього захворювання протягом усього життя. Тому пошук нового препарату для лікування та профілактики карієсу зубів залишається актуальним для фармації.

**Мета роботи** – вивчити антиоксидантну, антимікробну та протигрибкову активність отриманих таблеток «Качісепт» для розсмоктування в ротовій порожнині для лікування та профілактики карієсу зубів.

**Матеріали та методи.** Об’єкт дослідження – таблетки «Качісепт» з екстрактом листя зеленого чаю. Антиоксидантну активність встановили потенціометричним методом, антимікробну та протигрибкову дії – методом «колодязів».

**Результати.** Рівень антиоксидантної активності для таблеток «Качісепт» становив  $110,00 \pm 2,20$  ммоль-екв./м<sub>екст</sub>; визначили, що отримані таблетки мають високий рівень антиоксидантної активності за умовною класифікацією Маслова. *Staphylococcus aureus* ( $25,33 \pm 0,50$  мм), *Bacillus subtilis* ( $25,33 \pm 0,50$  мм) і *Streptococcus mutans* ( $25,33 \pm 0,50$  мм) виявилися найбільш чутливими до таблеток «Качісепт», найменш чутливі – *Proteus vulgaris* ( $20,67 \pm 0,50$  мм); щодо грибка *Candida albicans* ( $20,00 \pm 0,50$  мм) спостерігали сильне інгібування росту.

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**Key words:** tablets, green tea, dental caries, plant extract, Cachisept.

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**Висновки.** У результаті дослідження встановлено, що таблетки «Качісепт» мають високий рівень антиоксидантної активності, а також характеризуються значною антимікробною і протигрибковою дією проти всіх досліджених грам-позитивних, грам-негативних бактерій і грибка *Candida albicans*. Отже, таблетки «Качісепт» можуть бути рекомендовані для лікування та профілактики карієсу зубів.

**Ключові слова:** таблетки для розсмоктування, листя зеленого чаю, карієс зубів, екстракт, Качісепт.

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Dental caries represents a bacterial infectious ailment marked by an advancing demineralization procedure that impacts the mineralized structures of the tooth [1]. According to the literature, *Streptococcus mutans* is considered the main causative agent of caries, but recent studies have shown that this strain is only a small part of the oral microbiota [2]. The microbiota of the oral cavity is represented by various bacteria that belong to the following genera: *Lactobacillus*, *Bifidobacterium*, *Enterococcus*, and *Staphylococcus* [3].

Dental caries is the most common oral illness and the main cause of periodontal disease and tooth loss. According to the World Health Organization (WHO) in 2012, 60–90 % of school-age children worldwide have caries, and in adults – 30–80 % [4]. In Ukraine, the prevalence of caries in the adult population is 95–98 %, and in schoolchildren – 81.0–99.5 % [5].

To solve this urgent problem is the possibility of using medicinal plants. A potential medicinal plant for averting and managing dental caries is the green tea leaf. In our studies, it was found that green tea leaf is rich in catechins (epigallocatechin-3-O-gallate, epicatechin, (+)-catechin), flavonols (rutin, quercetin), organic (citric, oxalic acid) and phenylcarboxylic acids (gallic, quinic and caffeic acid) [6,7]. The main group of compounds in green tea leaf are catechins that have antioxidant, anti-inflammatory, antimicrobial, and antifungal effects [8,9].

## Aim

Thus, the aim of the work was to study the antioxidant, antimicrobial, and antifungal activity of the obtained oral tablets “Cachisept” for resorption in the oral cavity for the treatment and prevention of dental caries.

## Materials and methods

Every solvents and additional chemicals employed in the investigation were of analytical quality.

The object of our study was tablets with green tea extract under the conditional name “Cachisept”, which was obtained at the Department of Analytical Chemistry and Analytical Toxicology (Series No. 22/09/21).

Potentiometric measurements were carried out using the HANNA 2550 pH meter (manufactured in FRG) equipped with a platinum electrode EZDO 50 PO (manufactured in Taiwan).

Strains of *Staphylococcus aureus* ATCC 25923, *Escherichia coli* ATCC 25922, *Proteus vulgaris* ATCC 4636, *Pseudomonas aeruginosa* ATCC 27853, *Streptococcus mutans* ATCC 25175, and *Candida albicans* 885/653 ATCC sourced from museum collections were employed, following estab-

lished guidelines for evaluating the antimicrobial effectiveness of medications.

The antibacterial activity of analyzed samples was carried out by the method of agar well diffusion [10,11,12]. We employed aqueous solutions of extracts at a concentration of 1 %. To compare the results, a control preparation was taken – a 1 % ethanol solution of Chlorophyllipt, which was produced by the Pharmaceutical Company “Zdorovye”, LTD (Kharkiv, Ukraine).

The antioxidant activity of analyzed samples was assessed with the potentiometric method [12,13]. The antioxidant activity was found using the subsequent formula and presented as: mmol-eqv./m<sub>extr</sub>:

$$AOA = \frac{C_{ox} - \alpha \times C_{red}}{1 + \alpha} \times K_{dil} \times 103 \times m_{extract}$$

where  $\Delta E$  – change of potential;  $F = 96485.33$  C/mol;  $R = 8.314$  J/mol  $\times$  K;  $T = 298$  K;  $n = 1$  (number of electrons);  $K_{dil}$  – dilution coefficient, mL;  $m_{extract}$  – extract mass in tablet, g;  $\alpha = C_{ox}/C_{red} \times 10^{(\Delta E - E_{ethanol})nF/2.3RT}$ ;  $E_{ethanol} = 0.0546 \cdot C_{\%} - 0.0091$ ;  $C_{\%}$  – ethanol concentration;  $C_{ox} = K_3[Fe(CN)_6]$  concentration, mol/L;  $C_{red} = K_4[Fe(CN)_6]$  concentration, mol/L.

For each experiment, five samples were subjected to analysis, with each assay conducted five times. The outcomes were presented as average values accompanied by confidence intervals. Statistical analysis was carried out using MS Excel 7.0 and Statistica 6.0 software.

## Results

We have developed an original composition of oral tablets with green tea leaf extract under the code name “Cachisept” (Ukrainian Patent for a utility model No. 151545 dated 11.08.2022) [14]. The composition of the tablets includes green tea leaf extract (10 % out of mass), polyvinylpyrrolidone extract (2 % out of mass), methylcellulose 101 (2 % out of mass), citral (1 % out of mass), calcium stearate (1 % out of mass) and sorbitol extract (84 % out of mass). The average tablet weight is  $800 \pm 24$  mg and the tablet diameter is 11 mm.

According to the results of the study, it was found that the antioxidant activity of the tablets “Cachisept” was more than 54 % than the reference drug “Ascorutin”. According to the developed conditional Maslov’s classification of the level of antioxidant activity [15], we determined that “Cachisept” tablets have a high level of antioxidant activity, and, in turn, the reference drug “Ascorutin” has a medium level (Table 1).

Table 1. Antioxidant activity of tablets “Cachisept” and reference drug

Samples	Antioxidant activity, mmol-eqv./m <sub>extr</sub>	Conditional level of antioxidant activity
“Cachisept”	110.00 ± 2.20	High
“Ascorutin”	51.10 ± 1.00	Medium

n = 5, p < 0.05

Table 2. Antimicrobial and antifungal activity of tablets “Cachisept” and reference drug

Samples	Diameter of the growth retardation zone, mm						
	<i>Staphylococcus aureus</i> ATCC 25923	<i>Streptococcus mutans</i> ATCC 25175	<i>Escherichia coli</i> ATCC 25922	<i>Proteus vulgaris</i> ATCC 4636	<i>Pseudomonas aeruginosa</i> ATCC 27853	<i>Bacillus subtilis</i> ATCC 6633	<i>Candida albicans</i> ATCC 653/885
“Cachisept”	25.33 ± 0.50	25.33 ± 0.50	23.67 ± 0.50	20.67 ± 0.50	21.67 ± 0.50	25.33 ± 0.50	20.00 ± 0.50
“Chlorophyllipt” (SSCM)	19.33 ± 0.50	19.33 ± 0.50	19.33 ± 0.50	17.67 ± 0.50	17.67 ± 0.50	19.33 ± 0.50	19.00 ± 0.50

n = 3, p < 0.05

The experimental results showed that the obtained tablets “Cachisept” have a high antibacterial and antifungal activity against Gram-positive and Gram-negative bacteria. *Staphylococcus aureus* (25.33 ± 0.50 mm), *Bacillus subtilis* (25.33 ± 0.50 mm), and *Streptococcus mutans* (25.33 ± 0.50 mm) were the most sensitive to the obtained “Cachisept” tablets among all strains bacteria, and among Gram-negative bacteria, the growth of *Escherichia coli* was strongly inhibited (23.67 ± 0.50 mm). *Proteus vulgaris* (20.67 ± 0.50 mm) was the most resistant strain among bacteria to “Cachisept” tablets. Also, the results showed that “Cachisept” tablets strongly inhibit the growth of *Candida albicans* (20.00 ± 0.50 mm) (Table 2).

## Discussions

Saliva has not only antiseptic and immunological effects but also antioxidant activity. The antioxidant system of saliva consists of various enzymes (superoxide dismutase, glutathione peroxidase) and other substances (vitamin E, C).

Ahmadi-Motamayel F. et al. [16] studied the total antioxidant capacity (TAC) of saliva in children aged 12–14 years with and without dental caries. The research showed that TAC was higher in children with caries than in children with healthy teeth. This fact is due to the fact that when the dentin of the tooth is damaged, the level of reactive oxygen species increases, which in response turns on the antioxidant mechanism of saliva, thereby increasing the level of antioxidant activity.

Thus, for the treatment of dental caries, the drug must have an antioxidant effect. In our studies, it was found that “Cachisept” tablets had a high level of antioxidant effect, so our drug can be used for the treatment and prevention of dental caries.

The development of dental caries directly depends on the microbiota of the oral cavity. Recent studies have examined the interaction between *Candida albicans* and *Streptococcus mutans*. Ren Z. et al. [17] showed that bacterial and fungal cells form stable conglomerates in saliva. At the initial stages of tooth colonization, the pseudomycelium of the fungus “walks” with hyphae along the substrate, carrying bacterial

cells on itself. This unusual type of movement increases the rate of colonization by a factor of three and the rate of development of dental caries by a factor of two.

In recent years, there has been growing evidence that not only acid-producing bacteria but also *Candida* fungi contribute to the development of inflammatory diseases of the oral mucosa and the occurrence of dental caries, despite the fact that *Candida albicans* itself does not destroy teeth. Hence, in the context of treating and preventing dental caries, the medication should not solely suppress bacterial growth but also effectively hinder *Candida* genus fungi. *Candida albicans* and *Streptococcus mutans* were highly sensitive to “Cachisept” tablets, which indicates the possibility of using our drug in the treatment and prevention of dental caries.

## Conclusions

1. In the presented research, it was found that “Cachisept” tablets had a high level of antioxidant activity.
2. Tablets “Cachisept” had a high antibacterial and antifungal activity against all investigated Gram-positive, Gram-negative bacteria and the fungus *Candida albicans*.
3. Grounded on the results of the investigation, “Cachisept” tablets can be recommended for the treatment and prevention of dental caries.

**Conflicts of interest:** authors have no conflict of interest to declare.  
**Конфлікт інтересів:** відсутній.

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