

ORIGINAL ARTICLE

EFFECT OF ULTRASOUND ON *S. EPIDERMIDIS* MUSEUM CULTURE

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ABSTRACT

The aim of the present research project was to study the effect of ultrasonic waves on the *S. epidermidis* ATCC 14990 museum culture.

Materials and methods: A bibliosemantic method – for analyzing previous research based on scientific literature, electronic resources, empirical methods of scientific research (observation, comparison, measurement, experiment) – to study the effect of ultrasound on the strain of *S. epidermidis* ATCC 14990.

Results: A study showed that when exposed to ultrasound for four and a half minutes on a culture of microorganisms *S. epidermidis* in glass tubes, the number of viable cells in the suspension decreases.

Conclusions: The influence of ultrasound on the culture of *S. epidermidis*, studied in the work, showed that the selected and used parameters of ultrasound treatment cause destructive changes in microorganisms. These changes are not fatal for the entire bacterial culture used in the study, but they have a reliable antimicrobial effect.

KEY WORDS: ultrasound, microorganisms, medicine

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INTRODUCTION

The microflora of plaque plays an important role both in physiological processes and in the pathology onset. It is associated with dental caries and periodontal inflammatory diseases. According to modern concepts, microorganisms are the cause of these diseases [1, 2, 3]. However, this view is not common to everyone. Among other things, it changes with time [4].

The functionality of the microflora causes ambivalent attitude to it within the medical community in terms of their strategies and tactics in the approaches to the odontopoiesis and periodontal pathologies treatment [5]. The current strategy for the elimination of microorganisms and further infection suggests antimicrobial therapy, which includes the use of selective drug products, as well as thorough mechanical manual treatment of both the focal point and the tools. Along with the traditional methods, alternatives are used: the use of ultrasound, ozone, laser and other types of effects on the microbial factor [6, 7, 8].

Concerning the ultrasonic effect on microorganisms, it is ambiguous. Under its action, cellular associations and cells themselves are destructed [9]. However, the effect of ultrasound can also improve the functional abilities of microorganisms [10]. Such a contradiction contributes to the further study of the processes associated with the ultrasonic treatment of microorganisms.

THE AIM

The aim of the present research project was to study the effect of ultrasonic waves on the *S. epidermidis* ATCC 14990 museum culture.

MATERIALS AND METHODS

To perform the study, the daily culture of the *S. epidermidis* ATCC 14990 museum strain was used. A bacterial suspension was prepared in sterile normal saline solution up to 10^3 colony-forming units per milliliter (CFU / ml).

The amount of 1 ml bacterial suspension was introduced into glass tubes, to which piezoelectric ceramic radiators were fixed with silicone glue. After the ultrasound treatment of microorganisms, 0.1 ml of the suspension was plated on meat-peptone agar and, after incubation, the number of CFU / ml was counted.

To perform the study, an ultrasonic generator of low power with a frequency of 30 kilohertz was used. Piezoelectric ceramic radiators were connected to the generator output. The resonance frequency of the emitters was below 30 kHz, so they worked on harmonics. Emitters of different diameters were used: a piezoceramic emitter with the 27 mm diameter, a piezoceramic emitter with the 15 mm diameter, a piezoceramic emitter with the 12 mm diameter. The effect on the microorganisms culture was carried out for four and a half minutes.

RESULTS AND DISCUSSION

The performed study showed that the action of ultrasound during four and a half minutes on the *S. epidermidis* microorganisms culture suspension, located in glass test tubes, reduces the number of viable cells in suspension.

The results of *S. epidermidis* suspension inoculation, subjected to the action of ultrasound using different piezoelectric ceramic emitters, are presented in the table I.

As a result of the study performed, it was found that the ultrasound action caused a change in the number of

Table I. Results of the *S. epidermidis* growth before and after the ultrasound impact (CFU / ml)

Culture	Stat. index	Before impact (n=10)	Emitter 27 мм (n=10)	Emitter 15 мм (n=10)	Emitter 12 мм (n=10)
S.epidermidis	M	30.7	26.1	29.4	29.7
	±м	1.02	1.16	0.70	0.78
	p		0.0009	0.033	0.073

CFU / ml. If before the action of ultrasound the number of CFU / ml was 30.7 ± 1.02, then the use of a piezoelectric emitter with a diameter of 27 mm caused the reduction in the number of colonies obtained up to 26.1 ± 1.16 (p = 0.0009), a piezoelectric emitter with a diameter of 15 mm – reduction in the number of colonies up to 29.4 ± 0.70 (p = 0.033), a piezoelectric emitter with a diameter of 12 mm – reduction in the number of colonies up to 29.7 ± 0.78 (p = 0.073).

The obtained results are explained by the occurrence of sound chemical reactions in microorganisms under the impact of ultrasound. Ultrasonic waves caused a disorder of the cell membranes properties, changes in the concentration of substances dissolved in the cytoplasm. The cavitation phenomenon, which occurs under the influence of ultrasound in microorganisms, causes a disorder of the microorganisms integrity and their death [11]. Considering the fact that the oral cavity is populated with a large number of microorganisms that are part of the dental plaque, violate oral hygiene, contribute to the development of caries and inflammatory periodontal diseases [2, 3], the identified antibacterial effect of ultrasonic waves is important for dentistry. Along with the use of antiseptics [12, 13], ultrasound effects on the oral cavity microflora are considered promising in the treatment of caries and inflammatory diseases of periodontal tissues.

However, the fact that reduction in the population of microorganisms in our research was not total, leads to contemplations of another kind. The purpose of almost all experimental studies is to find such a set of input controlled variables in which the target function acquires an extreme value as a result of the minimum number of experiments at the lowest cost and means. Our study showed the dependence of the bacteria number on the area of the ultrasound emitting antenna. It follows that bacterial colonies can be controlled by changing the parameters of ultrasonic radiation. This dependence can be put into formulas for further research, which, quite likely, will concern not only individual cultures, but also their communities – bacterial biotopes.

CONCLUSION

The effect of ultrasound on *S. epidermidis* culture studied in this work showed that the selected and used parameters of ultrasound exposure introduce destructive changes into microorganisms. These changes are not lethal for the entire bacterial culture used in the study, but they produce a significant antimicrobial action with a controlling effect.

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Authors declare no conflict of interest.

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