DEVELOPMENT OF STOMATOLOGICAL GEL OF THE ONIONAL HEXAFLUOROSILICATES

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INTRODUCTION

An effective method of preventing caries is mineralization and fluoridation of the enamel. In the Odessa National Medical University, “onional” hexafluorosilicates have been synthesized, among which cetylpyridinium hexafluorosilicate of composition (CP-HFS) $(C_{21}H_{38}N)_2SiF_6$ and octenidine-hexafluorosilicate (O-HFS) $(C_{36}H_{64}N_4)SiF_6$ carry the most effective preventive action. They increase the activity of alkaline phosphatase (the marker of osteoblasts) in the pulp and reduce the activity of acid phosphatase (mainr osteoclasts). They also possess mineralizing (increase the mineralizing index (MI) in the dental pulp) and antibacterial action. It was found that these compounds in effective concentrations have no negative effect on the white blood cells, hemoglobin level and markers of hepatic activity (ALT and APh), and do not significantly alter the activity of lysozyme, which testifies to their safety.

Pharmacological studies showed higher caries prophylaxis effectiveness of these onional hexafluorosilicates in comparison with sodium fluoride and sodium monofluorophosphate.

Perhaps, this is due to the fact that the action of the fluoride complex is supplemented by the antimicrobial and lysozyme stimulating action of the cetylpyridinium and octenidine cation. In addition, it should be noted that the use of hexafluorosilicate in oral gels creates a more effective local concentration of active substances.

PURPOSE

The aim of the scientific work was to study the effect of onyx hexafluorosilicates on the properties of gel bases and the dynamics of release of medicinal substances from gels

MATERIALS AND METHODS

Diverse HMC were used as gel forming agents: sodium alginate, xanthan gum, derivatives of cellulose (HEC, CMC, MC and NaCMC) and polyacrylic acid – carbomer. Experimental samples were evaluated by organoleptic parameters, rheological properties, thermal stability, colloidal stability and pH values. The antimicrobial activity and dynamics of release of drugs were determined from gel bases . The antimicrobial activity of the gels was determined by the method of diffusion in agar, the dynamics of release of medicinal substances by dialysis through a semipermeable membrane.

RESULTS

Studies have showed that medicinal substances affect the stability of gels. When they are introduced, regardless of the sequence of the process salting of carbomer and sodium alginate gels takes place. For gels based on derivatives of cellulose and xanthan gum there is a significant decrease in viscosity indexes. Gels obtained from derivatives of cellulose and xanthan gum remain stable, withstand the colloidal and thermal stability test, indicating the possibility of their use in the production of caries prophylactic agents based on hexafluorosilicates.

Choice of a gel forming agent among cellulose derivatives was carried out in view of their effect on the antimicrobial activity of gels. The antimicrobial action of cetylpyridinium hexafluorosilicate and octenidine-hexafluorosilicate gels was investigated in an effective caries-prophylactic concentration of 1.66 and 3.0 mg/ml, respectively. The chosen gel forming agents were used in a concentration that provides the necessary viscosity parameters of the samples. The results of the study indicate a certain effect of the gel forming agent on the strength of the antimicrobial action of onional hexafluorosilicates. It can be related to the concentration of the gel and the possibility to slow down the release of active substances when using a denser three-dimensional grid.

Gels based on xanthan gum and hydroxyethylcellulose higher antimicrobial action in relation to *Staphylococcus aureus*, *Bacillus subtilis Escherichia coli* and yeast-like mushroom *Candida albicans*.

Table

Results of antimicrobial activity of samples (n=5)

Sample containing the appropriate gel forming agent	Cultures of microorganisms			
	S. aureus ATCC 25293	B. subtilis ATCC 6633	E. coli ATCC 25922	**C. albicans ATCC 885-653**
	Diameters of the growth retardation zone of microorganisms, mm			
Gels with CP-HFS				
hydroxyethylcellulose	19.4±0.2	18.6±0.4	17.6±0.4	**19.2±0.4**
carboxymethylcellulose	15.2±0.3	14.2±0.2	14.0±0.3	**15.4±0.2**
methylcellulose	16.4±0.2	14.6±0.4	15.6±0.4	**14.5±0.2**
sodium carboxymethylcellulose	13.6±0.3	12.4±0.2	13.4±0.3	**14.8±0.3**
xanthan gum	17.4±0.2	17.5±0.3	16.8±0.3	**18.0±0.2**
Gels with O-HFS				
hydroxyethylcellulose	18.2±0.2	17.8±0.4	16.4±0.2	**18.0±0.5**
carboxymethylcellulose	14.0±0.2	14.0±0.2	13.5±0.2	**14.6±0.2**
methylcellulose	15.6±0.3	14.2±0.4	15.2±0.2	**14.2±0.3**
sodium carboxymethylcellulose	13.0±0.2	12.0±0.3	13.2±0.4	**12.6±0.3**
xanthan gum	**16.6±0.2**	**17.2±0.4**	**16.0±0.5**	**16.8±0.4**

In addition, the rate and degree of release of substances in the dialysis fluid were determined by the method of dialysis through a semipermeable membrane. Quantitative contents of CP-HFS and O-HFS was determined by the HPLC method, which allows determination of active substances in the presence of auxiliary substances.

Represented on fig. 1 and 2 kinetics of the release of CP-HFS and O-HFS from experimental gel bases characterizes the direction of diffusion processes. As seen from the data obtained, the kinetics and the degree of release of CP-HFS and O-HFS from gels are similar. More active release comes from the gel base on hydroxyethylcellulose. The most dynamic release is observed in the first 6-8 hours of the experiment, after which there is a slowdown in the release of substances.

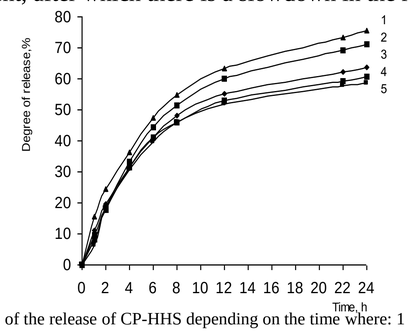

Fig. 1. Kinetics of the release of CP-HHS depending on the time where: 1 - gel of hydroxyethylcellulose, 2 xanthan gum, 3 - methylcellulose, 4 - carboxymethylcellulose, 5 - sodium carboxymethylcellulose

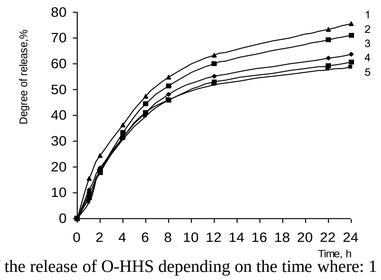

Fig. 2. Kinetics of the release of O-HHS depending on the time where: 1 - gel of hydroxyethylcellulose, 2 xanthan gum, 3 - methylcellulose, 4 - carboxymethylcellulose, 5 - sodium carboxymethylcellulose

CONCLUSION

To make a conclusion, hydroxyethylcellulose was chosen as gel forming agent for the development of caries prophylactic gels with cetylpyridinium hexafluorosilicate and octenidine hexafluorosilicate

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