BIOCIDAL PREPARATIONS BASED ON THIOSULPHONATES AND BIOSURFACTANTS

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Abstract - The deficit of effective biocides and disinfectants for medicine and veterinary determines the need to develop safe drugs, in particular, green synthesis products. Thiosulfoesters and biosurfactants of microbial origin, rhamnolipids, correspond these criteria. The presence of rhamnolipids in the compositions significantly reduces the effective concentrations of biocides, enhances the antimicrobial effect.

Keywords - rhamnolipids, thiosulfonates, biocides, antimicrobial activity, disinfectants.

Introduction

Intensive technologies for the production of livestock products are often accompanied by the spread of opportunistic and pathogenic microflora and the occurrence of various animal diseases. An important role here is played by disinfection measures to ensure the destruction of pathogenic microorganisms, including mycobacteria. Therefore, new, more effective methods are needed to ensure the stable veterinary welfare of livestock industries. Existing means for the prevention of tuberculosis and other diseases of farm animals are not effective and often contain toxic substances. Therefore, green chemical products are especially relevant. Sulfur-containing organic compounds are used as biologically active substances in pharmacy and agrochemistry, as well as reagents in organic synthesis [1]. The development of green methods for their synthesis is an urgent task for specialists in the chemical, pharmaceutical and other industries. Compounds with a disulfide bond (thiosulfonates), structural analogs of the unstable antibiotic garlic allicin, are of particular interest [2]. Thiosulfonates exhibit a wide spectrum of antimicrobial activity and are more stable than allicin. These compounds are already promising as preservatives, antimicrobial, insecticidal [3,4], antitumor [5], antithrombotic [6] substances.

A new method of green synthesis of S-alkyl-4-R-benzenethiosulfonates with biocidal action without organic solvents (in an aqueous medium) has been developed at the Department of Technology of Biologically Active Substances, Pharmacy and Biotechnology. However, thiosulfonates are low soluble in water, which limits their bioavailability and application. The ability of biosurfactants to disperse hydrophobic compounds and regulate the permeability of cell membranes can be used in disinfection compositions. The high efficiency of biosurfactants is due to the physicochemical properties and biological activity, as well as their biodegradability and low toxicity. In the compositions, a synergistic effect can be achieved, that is, the active concentrations of biocides can be reduced [7,8]. New biocidal preparations based on thiosulfonates (methyl thiosulfonate - MTS, ethyl thiosulfonate - ETS, allyl thiosulfonate - ATS) with biosurfactants (rhamnolipids of the *Pseudomonas* sp. PS-17 strain - RL), which active against the cultures *Esherichia coli*, *Mycobacterium luteum*, *Staphylococcus aureus*, *Candida tenuis*. The optimal ratio of the components was selected, their minimum inhibitory (MIC) and bactericidal (MBC) concentrations were determined (Table 1).

It was shown that in the compositions of ETS with rhamnolipids, the MIC is reduced by 2 times in comparison with the biocide itself, and the composition ETS + RL (10: 1) was effective against test microorganisms.

Thus, the results indicate that the addition of biosurfactants to the composition with ETS contributed to a decrease in its minimum inhibitory and biocidal concentrations to the tested

pathogens. This can be explained by the increase in the permeability of microorganisms cell membranes under the action of biosurfactants and their ability to solubilize low soluble biocides.

Table 1

Antimicrobial activity of compositions of ethylthiosulfonylate with rhamnolipids

Compositions	Minimum inhibitory and bactericidal concentrations, μg / ml	Test microorganisms			
		Esherichia coli	*Mycobacterium luteum*	*Staphylococcus aureus*	*Candida tenuis*
ETS+RL(1:1)	MIC	62,5	7,8	7,8	0,9
	MBC	125,0	31,3	31,3	15,6
ETS+RL (10:1)	MIC	31,2:3,1	15,6:1,6	15,6:1,6	15,6:1,6
	MBC	62,5:6,2	31,3:3,1	31,3:3,1	31,3:3,1
ETS+RL (20:1)	MIC	15,6;0,8	15,6:0,8	31,2:3,15	31,2:3,15
	MBC	31,3:1,5	31,3:1,5	62,5:3,1	62,5:3,1
ETS	MIC	62,5	31,2	31,2	31,2
	MBC	12,5	6,2	6,2	62,5
RL	MIC	-	15,6	15,6	62,5
	MBC	-	62,5	125,0	-

The bactericidal effect of MTS and ATS at concentrations of 0.5% and exposure for 24 hours against atypical *Mycobacterium fortuitum* and the causative agents of tuberculosis *M. bovis*, *M. avium* was established. The results obtained indicate the advisability of using a composite disinfectant based on thiosulfonates and rhamnolipids for disinfection in the following modes: "MTS-ATS-RL" - 1% - 48 hours (bactericidal effect); 1% - 30 hours (inhibitory effect). So, the efficiency of the synthesized green substances of thiosulfonates for disinfectants against tuberculosis and other pathogens has been shown. The combination of biocides and biosurfactants makes it possible to significantly reduce their effective concentrations and increase antimicrobial activity.

Conclusion

It has been established that the use of thiosulfonates obtained by green synthesis is promising for the creation of new biocidal and disinfectants, including against tuberculosis pathogens and other pathogens. The combination of thiosulfonates with biosurfactants of microbial origin can significantly reduce the effective concentrations of biocides, enhance the antimicrobial effect, and has environmental and economic significance. The obtained results indicate the prospects of green chemistry products for the creation of safe and effective means for veterinary medicine.

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