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PROSPECTS OF APPLICATION DIHYDROXYBENZOATE-CAPPED SIDEROPHORES IN SOLVING SOME ECOLOGICAL PROBLEMS

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Анотація

За літературними джерелами проаналізовано можливості застосування дигідроксибензоат-кепованих сидерофорів для вирішення деяких екологічних проблем. Зазначено, що перспективними сполуками для ремедіації ґрунтів, забруднених важкими металами, є бацилібактин та петробактин; як зелені-розумні інгібітори корозії розглядаються бацилібактин та ентеробактин.

Ключові слова: дигідроксибензоат-кеповані сидерофори, біологічний контроль, екологія, зелені розумні-інгібітори корозії.

Abstract

According to the literature, the possibilities of using dihydroxybenzoate-capped siderophores to solve some environmental problems have been analyzed. It is noted that promising compounds for remediation of soils contaminated with heavy metals are bacillibactin and petrobactin; bacillibactin and enterobactin are considered as green-smart corrosion inhibitors.

Keywords: dihydroxybenzoate-capped siderophores, biological control, ecology, green smart-corrosion inhibitors.

Introduction

Siderophores are low molecular weight compounds that chelate Fe (III) ions, convert insoluble Fe (III) to the bioavailable form of Fe (II), and are synthesized by some bacteria, fungus, and plants with iron ion deficiency in the medium [1-2]. Siderophores are non-toxic, environmentally unobjectionable compounds [3], which exhibit a number of useful properties to solve some agriculture, environmental, technical problems and can determine the development of bacterial infections [3-5]. Their use is a biological control approach [1]. Currently, dihydroxybenzoate-capped (DHB-capped) siderophores deserve attention, which in the chemical structure contain a fragment that effectively chelates iron – 2,3-dihydroxybenzoate, and in the case of petrobactin 3,4-dihydroxybenzoate [6]. In the processes of biosynthesis of such siderophores there is a stage of dihydroxybenzoate adenylation, for which inhibitors are being developed [4]. In addition, there are reports that 2,3-dihydroxybenzoate and bacillibactin play an essential role in biofilm formation [7].

The aim of this study was to analyze and summarize information on DHB-capped siderophores with a view to using them to address some practical issues of ecology.

Presentation of the main material

DHB-capped siderophores are, in particular, acinetobactin, bacillibactin, enterobactin, petrobactin, salmochelins, trivanchrobactin, vanchrobactin, vibriobactin. DHB-capped siderophores are represented in the group of catecholate siderophores and the group of siderophores of mixed type [2, 4, 8-9]. Their producers are both pathogenic and non-pathogenic microorganisms [1, 3-7, 10-11].

Siderophores can be involved in solving some environmental problems [10]. The publications discuss the possibility of using enterobactin for gold detection and extraction [10]. Also noteworthy is bacillibactin, which effectively binds Fe (III) at a 1:1 ratio [12]. Possibilities of siderophores for complexation of heavy metal and use in bioremediation are discussed [5, 10, 13]. In our opinion, non-pathogenic bacteria *B. velezensis*, which produce bacillibactin, and siderophore itself can be considered as promising bioremediation agents. Currently, there are no reports

on the use of bacillibactin and/or its non-pathogenic producers for bioremediation in the available scientific and methodological base.

The involvement of some siderophores produced by marine bacteria (particularly petrobactin), in the biogeochemical cycling of Fe, in the remediation of petroleum hydrocarbons in the marine environment is discussed [3, 5].

Siderophores are environmentally unobjectionable compounds with high corrosion inhibitory properties of steel [14-17], promoting passivation of metals [18-20]. They are classified as green corrosion inhibitors [14]. It was found that bacillibactin-producing strains of *Bacillus velezensis* inhibit the formation of sulfate-reducing bacteria (the main agents of microbiologically influenced corrosion) biofilms on the polymeric material poly(ethylene terephthalate) [21]. It is likely that bacillibactin-producing strains or bacillibactin will inhibit the process of microbiologically influenced corrosion of steel, which is a prospect for further research.

Conclusion

The application of DHB-capped siderophores is promising for solving the problem of remediation of soils contaminated with heavy metals (bacillibactin and petrobactin), the use of green smart-corrosion inhibitors (bacillibactin and enterobactin) instead of toxic corrosion inhibitors.

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