Virucidal Carboxymethyl-starch:iodine complexes. Case of respiratory coronaviruses.

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Abstract

Coronavirus disease (COVID-19) was caused by the highly transmissible and pathogenic **SARS-CoV-2** virus (still active under various variants). Various vaccines have been developed and several repurposed antiviral drugs were found as effective in inactivating SARS-CoV-2 virus.[1] Synthetic Polyvinyl-pyrrolidone-iodine (Povidone-iodine, PVP-I) known as Betadine®, was also reported as virucidal. We propose a new formulation consisting of a carboxymethylstarch:iodine complex (**CMS:I_2**) as an alternative to Povidone-I. The CMS:I_2 showed a high mucoadhesion [2] and an excellent sprayability, favoring the oropharyngeal administration. By on site hydrolysis with salivary amylase, CMS:I_2 liberates iodine exerting a strong virucidal activity against human coronavirus hCoV-OC43, an accepted model mimicking the SARS-CoV-2 virus. (2-3)

Experimental: The iodine loading of CMS and morphology of the CMS:I_2 microparticles [3] were characterized by FTIR, X-ray diffraction (XRD), and scanning electron microscopy (SEM). The susceptibility to the enzymatic hydrolysis by alpha-amylase (amylolysis) of the CMS:I_2 suspensions was also investigated. The molecular iodine (I_2) was spontaneously included in the CMS (presenting expanded V-form matrices) by sublimation, with no interventions during loading. This iodine self-inclusion was found for CMS only and not for other starch derivatives. It appeared that iodine complexation induced some structural modifications on the starch network. Unexpectedly, CMS:I_2 presents a higher susceptibility to amylolysis (Fig 1). The virucidal activity of CMS:I_2 was markedly augmented by addition of human saliva or α-amylase via on-site hydrolysis of the CMS and iodine release. The virucidal agents were investigated on HRT-18 epithelial cells in terms of viability and reducing the infectivity by hCoV-OC43 virus. None of the tested CMS:I_2 formulations presented a damaging effect on cell viability, but a drastic anti-infective action. Our study suggests that CMS:I_2 formulations could prevent the initial phases of SARS-CoV-2 infection by possibly interfering with viral attachment and entry into target cells [4-5].

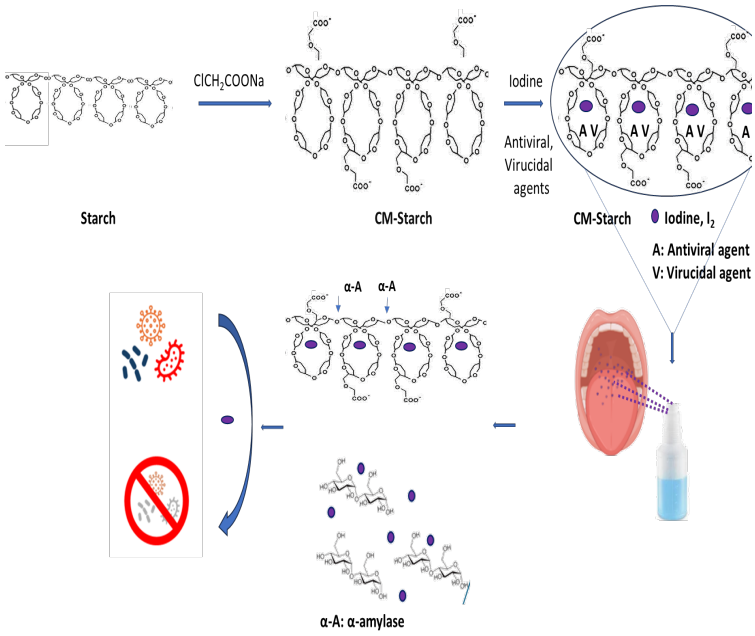

Figure 1 Starch carboxymethylation as CMS and its loading with iodine to obtain CMS:I_2 complex [A]; Iodine release from CMS:I_2 complex suspension when used as oral spray [B].

Recent Publications

[1] Anderson, D. E., Sivalingam, V., ... M., Eggers, M. Povidone-Iodine Demonstrates Rapid In Vitro Virucidal Activity Against SARS-CoV-2, The Virus Causing COVID-19 Disease. Infectious Diseases and Therapy, 9 (2020) 669-675.

[2] Mulhbacher, J., Ispas-Szabo P., ... Mateescu, M.A. Mucoadhesive properties of cross-linked high amylose starch derivatives. Int J Biol Macromol, 40 (2006) 9-14.

[3] Lemieux, M., Gosselin, P., Mateescu, M. A. Carboxymethyl starch mucoadhesive microspheres as gastro-retentive dosage form. Int. J. Pharm., 496 (2015) 497-508.

[4] Tajer Salma, M-A. Labelle, P. Ispas-Szabo; M.A. Mateescu. Carboxymethyl-starch:iodine anti-infective complexes: expanded v-helix and increased mucoadhesion. Int. J. Pharm. (2025)

[5] Tajer Salma. Y. Xiao, B Barbeau, M. A. Mateescu. Carboxy-methyl-starch:iodine complexes as virucidal agents: salivary amylase triggers on-site iodine release, preventing human coronavirus OC43 replication. Int. J. Pharm. (2025

Biography:

Mircea Alexandru Mateescu graduated in Chemistry-Biochemistry from University of Bucharest, earned a PhD from Bucharest Polytechnic University. Full Professor of Biochemistry at Université du Québec à Montreal (UQAM) Canada, he was frequently invited as visiting professor at Rome University *"Sapienza"* and at Université Paris 13. His research axes: *i)* self-assembled materials as pharmaceutical excipients for controlled drug delivery and as biomaterials for implants, and *ii)* copper-enzymes for treatment of inflammatory diseases and oxidative damages. Main achievements: about 200 articles, 38 patents, one book, 11 book chapters and launching of Contramid®/Cross-Linked Starch - Drug Delivery: a patented technology. Awards: ACFAS - Prize for Technological Innovation in Canada (1999); Prize Venezia: Italian Chamber of Commerce for major contributions to science in collaboration with italian universities (2012); Prize "Career in research" Faculty of Sciences - UQAM (2014) and several others. H-index 36 on Scopus.

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