HYBRID BIOPOLYMER – METAL IONS FORMULATIONS FOR VIRUCIDAL TEXTILE COATINGS

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SUMMARY

The Sars-CoV-2 pandemic raised the need to develop strategies to prevent Covid-19 dissemination. Those strategies, which are notably valuable in healthcare settings, may now be extrapolated into people's daily life. Individual protection equipment, such as facemasks, has been widely used by the general population. An integral part of several clinical garments, textile materials are prone to airborne and contact contamination. The development of bioactive textile coatings could promote self-decontamination, reducing cross-contamination and long-lasting protection. This scenario brings attention to well-known antimicrobial agents, such as copper, which were explored against various pathogens and presented successful inhibition outcomes. Despite its effectiveness, antimicrobial agent incorporation in textile materials remains a challenge. Hybrid, biopolymers-copper salt formulations are an alternative to enhance both metal ion fixation and coating biocompatibility. Herein, alginate was chosen for this combination due to its low toxicity and abundance. However, their mixture favored a gelling process, limiting coating application via spray. To overcome this challenge, this formulation was directly applied on the fabric surface by alternately spraying a 0.5% w/v alginate and a

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240 mmol.L^{-1} Cu(II) solution, leading to the polymer-metal complexation on the textile surface. Although this process resulted in viral inhibition (99,99%) with low cytotoxicity to the L929 control cells, the gelling process covered the fibers' pores entirely, which could impact producing equipment such as masks. Hence, layer-by-layer (LbL) arises as a technique that allows convenient coating customization regarding the antiviral agent loading and coating micro/nanoarchitecture. LbL is a simple technique for self-assembly polyelectrolyte multilayers (PEM). This versatile strategy allows surface properties tunability such as thickness and roughness by pH and ionic strength manipulation. Biopolymer-based films have been explored in biomedical applications, including drug delivery, biosensors, and antibacterial surfaces due to their biocompatibility. Even though LbL films may present a high potential for biotechnological purposes, the literature does not present an in-depth investigation of antiviral LbL coatings. Carboxymethylcellulose (CMC) and chitosan (CHI) were assembled via LbL to obtain a surface coating to inactivate the SARS-CoV-2. CHI is a well-known antimicrobial polysaccharide with great copper complexation properties, whereas CMC facilitates interactions with textile surfaces. CMC/CHI films were buildup under 1 g.L^{-1}, pH 3.0, and 50 bilayers. $CuSO_4$, at a concentration of 240 mmol.L^{-1}, was adsorbed through 1 h into the PEM and washed for 1 s three times. The coating virucidal effect was assessed by contact with the coronavirus MHV-3 lineage, inactivating it in 99.999%. Copper incorporation in the LbL coating, evidenced by MEV-EDS analysis, was determined by atomic absorption spectroscopy 27±6 mg.g^{-1} (Cu(II)/sample mass), against 21±8 mg.g^{-1} incorporated via spraying. The LbL technique presented comparable Cu(II) incorporation, with higher virus inactivation and better customization and process control. The upcoming steps will include manipulating the number of bilayers and pH to control copper incorporation and coating thickness to create functional, bioactive coatings.