

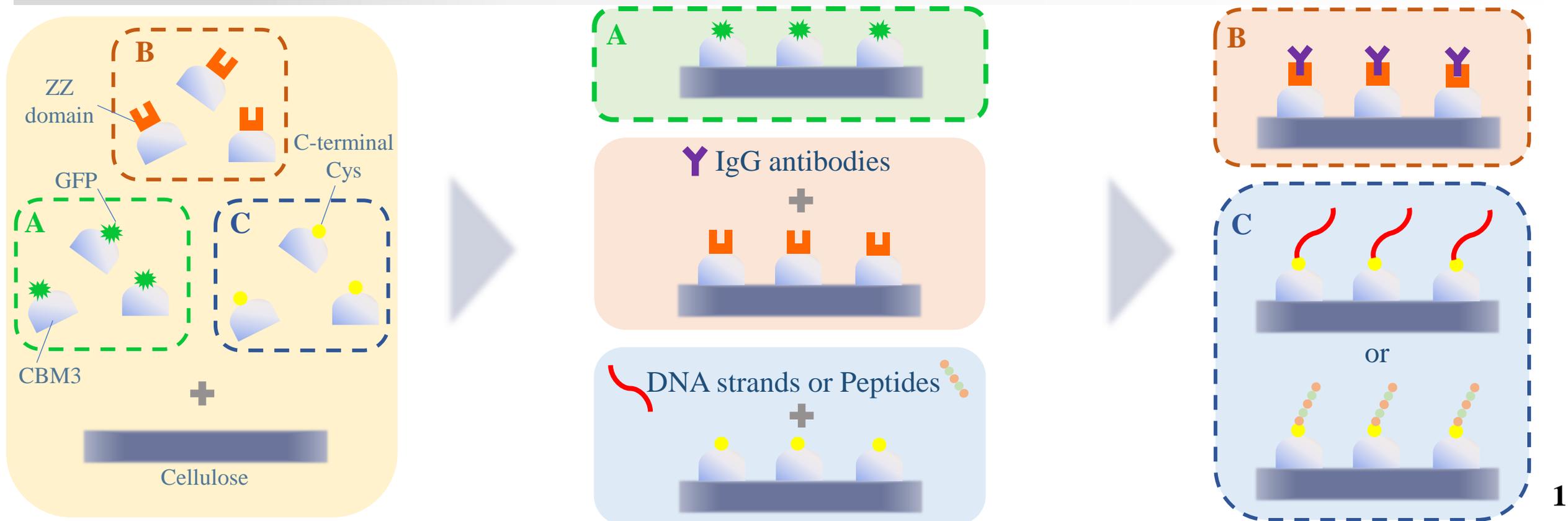
A biorecognition approach for surface modification of cellulose-based hydrogels using versatile derivatives of carbohydrate-binding modules

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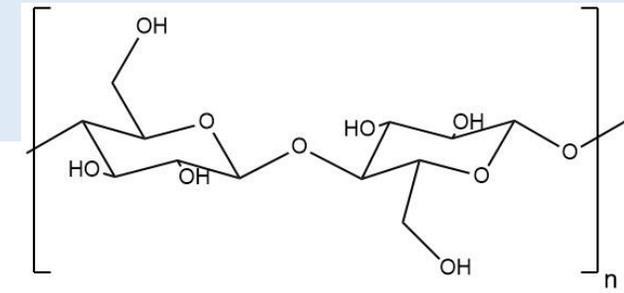
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Cellulose, a natural biopolymer of biomedical relevance



Characteristics of cellulose:

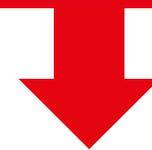
- Biocompatible,
- Highly crystalline structure,
- Most abundant biopolymer on Earth.



Cellulose hydrogels can be prepared from cellulose solutions by forming hydrogen-bonded network through physical crosslinking via the hydroxyl groups in the molecule



Cellulose is extremely difficult to dissolve in water and in most common organic solvents



Alternatives

Ionic liquids (ILs)

- 1-*N*-butyl-3-methylimidazolium chloride ([BMIM][Cl]),
- 1-Ethyl-3-methylimidazolium acetate ([EMIM][Ac]).

Cellulose, a natural biopolymer of biomedical relevance

The growing demand for **sustainable functional biomaterials** can be partially met by adding relevant functionalities to cellulose. **Cellulose-derived materials** can be engineered by **chemical modification or physical adsorption**.

Specific recognition properties of proteins

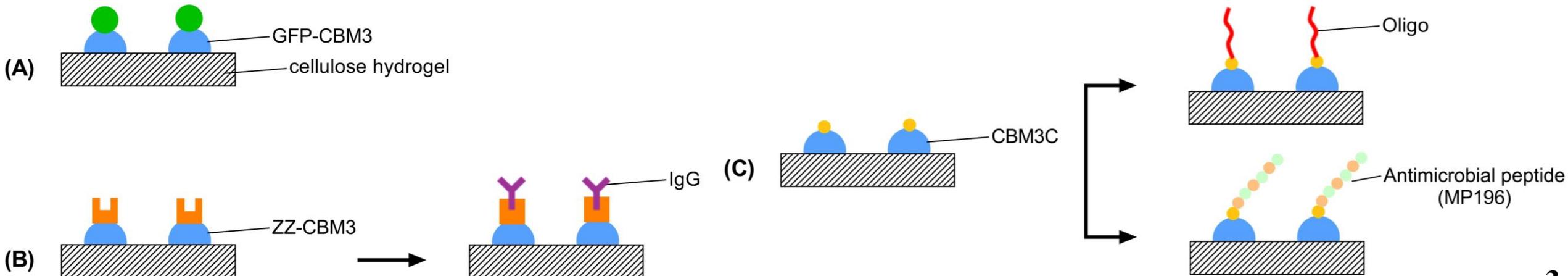


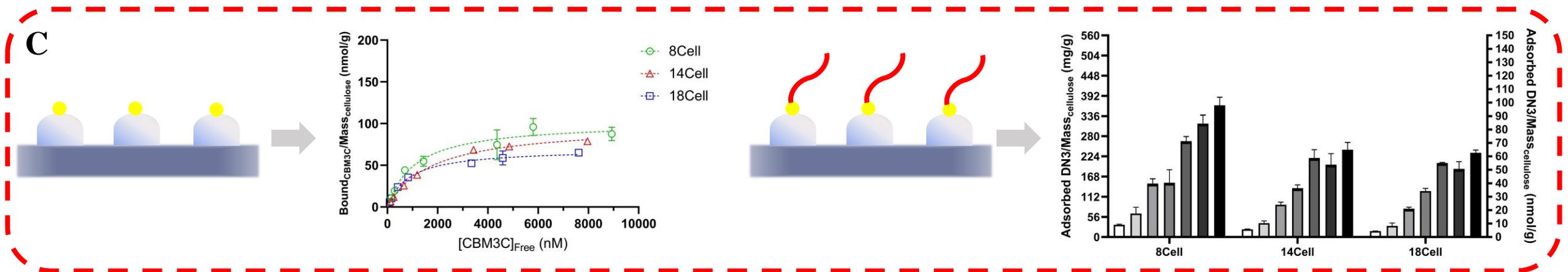
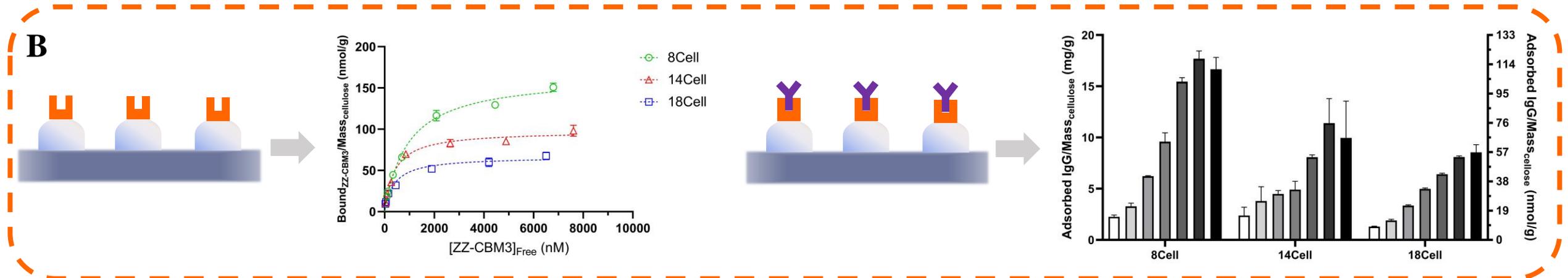
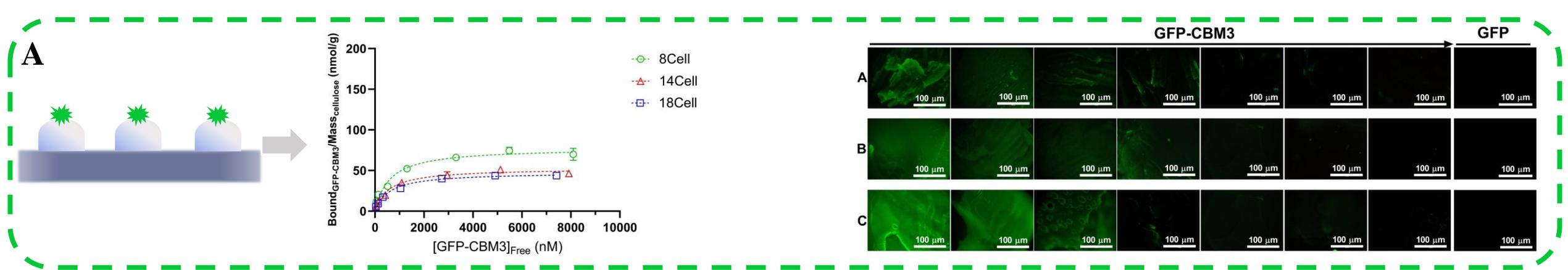
Carbohydrate binding modules (CBMs)

Modular proteins with high binding specificity towards carbohydrates

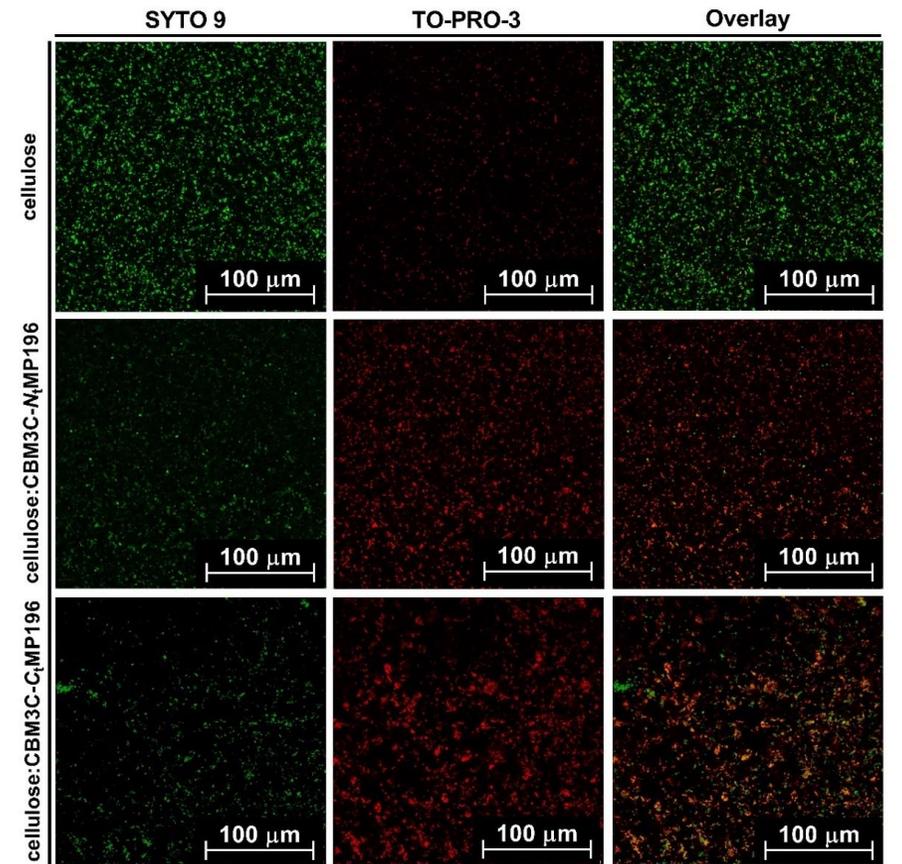
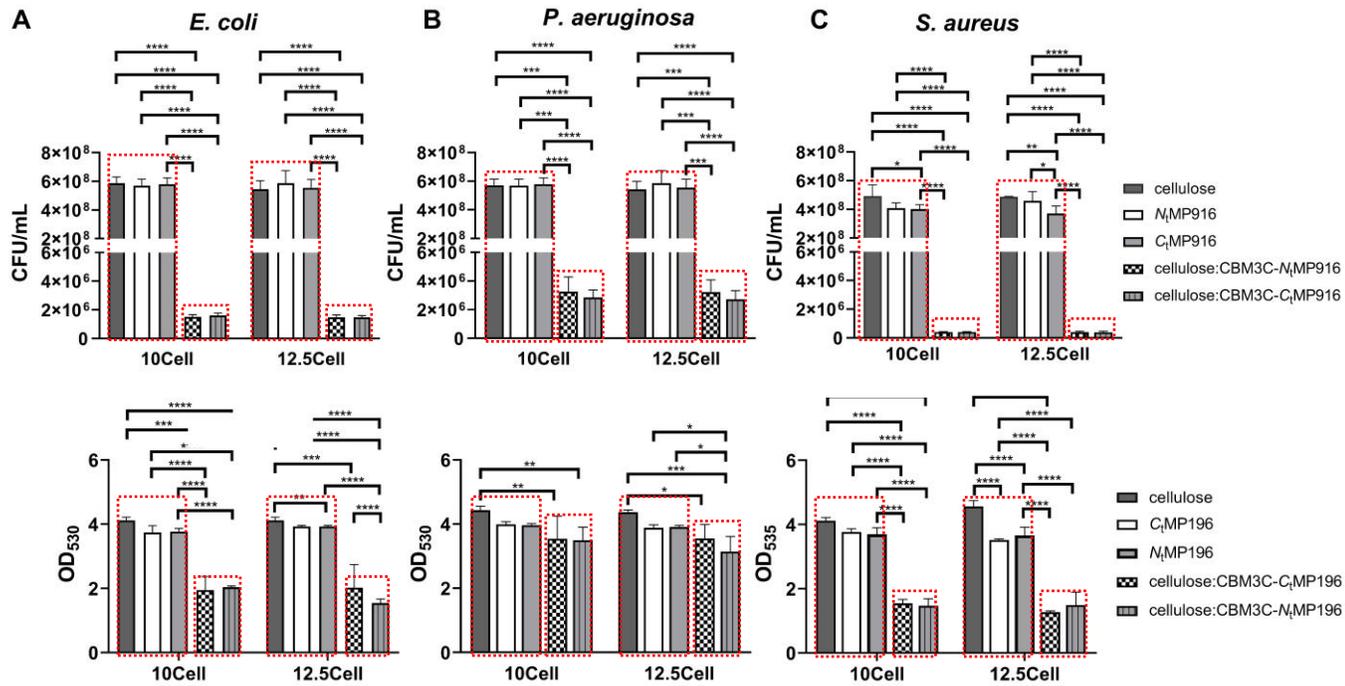
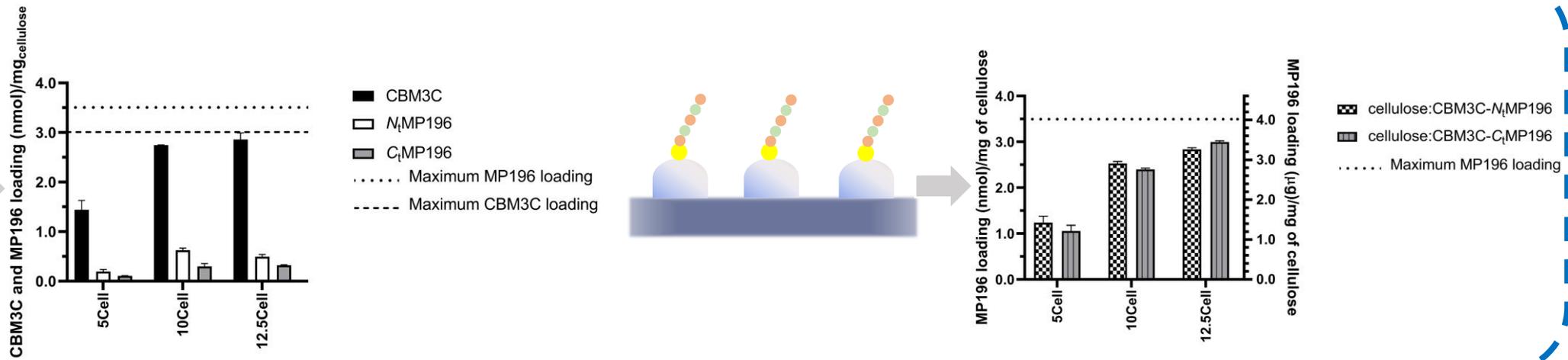
CBM3, a type A CBM, displays a planar carbohydrate-binding interface and binds to the crystalline surface of the microfibrils in cellulose-based materials

Biorecognition method to modify cellulose-based hydrogels





C



Biomolecular recognition is a successful approach for the functionalization of cellulose-based hydrogels

Fluorescent protein;

Protein domain that recognizes IgG antibodies;

C-terminal cysteine to covalently link DNA strands or antimicrobial peptides.

GFP-CBM3 was immobilized on the hydrogels and GFP retained its **fluorescence**

Effective anchoring of IgG on cellulose hydrogels via the bound bi-functional fusion tag **ZZ-CBM3**

Effective binding of CBM3C fusion protein to cellulose hydrogels and subsequent grafting of oligonucleotide **DN3**

Formation of a **disulfide bond** between Cys-terminated derivatives of **MP196** and **pre-anchored CBM3**. CBM3-MP196-functionalized hydrogels displayed potent **antibacterial activity**

Bi-functional fusion tags of CBM3 can be applied to other biomolecules and could form the basis of a highly versatile platform for the development of cellulose-based materials, including hydrogels, with multiple biomedical applications.

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