Detection of mucin glycoproteins: looking for selective turn-on fluorescent probes

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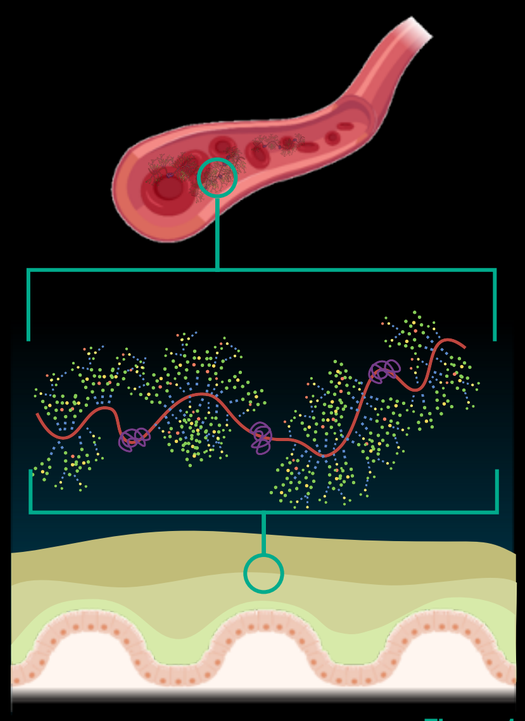


Figure 1

Introduction

Mucins are a family of long polymeric glycoproteins. Alterations or overexpression of mucins are associated to mucus-related disorders. Particularly, in the last years, great attention was addressed to expression of mucins in various cancers such as pancreatic adenocarcinomas, colon and rectal cancer, breast cancer, ovarian cancer and gastric carcinoma (Figure 1).

The early diagnosis is a key factor for outcome, treatments, and healthcare. Thus, the identification and detection of specific and sensitive biomarkers has become of crucial importance.

Aim

Up until now, fluorometric assays have received remarkable attention due to their unparalleled sensitivity, simplicity, non-invasive monitoring capability and usability in biological samples.

Here we are exploiting the fluorescence turn-on behaviour manifested by different fluorescent probes as a response of the binding to proteins.

The goal is to find and develop a turn-on fluorescent probe which is specific and selective for mucins at serum level (Figure 2).

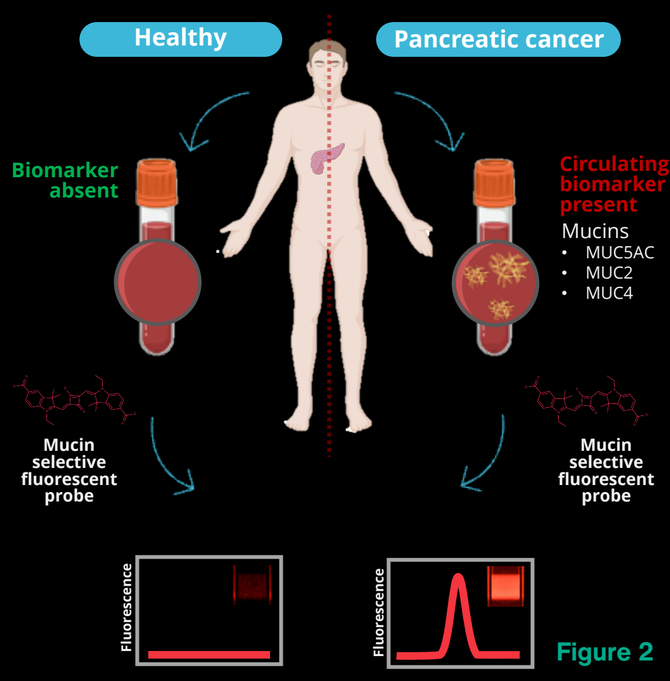
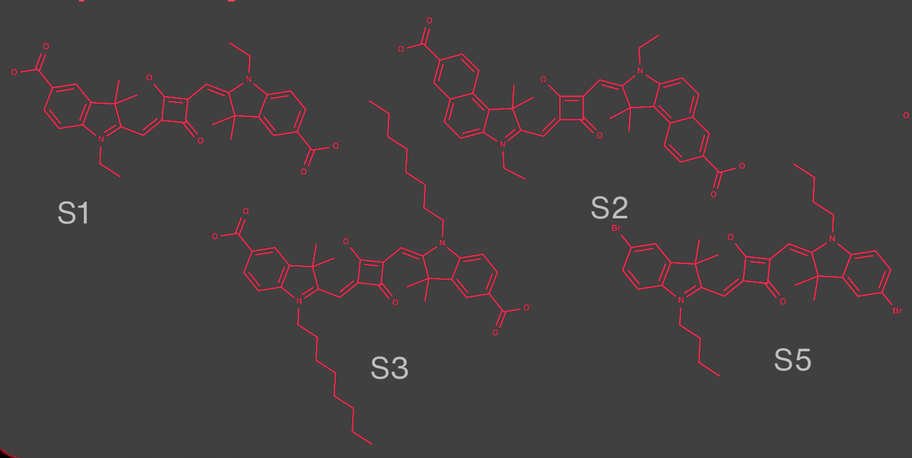


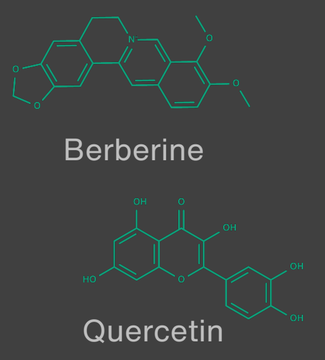
Figure 2

Dyes tested

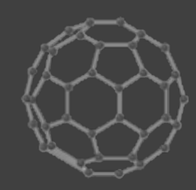
Squaraine dyes



Natural dyes



Nano systems



Carbon nano dots

Experimental

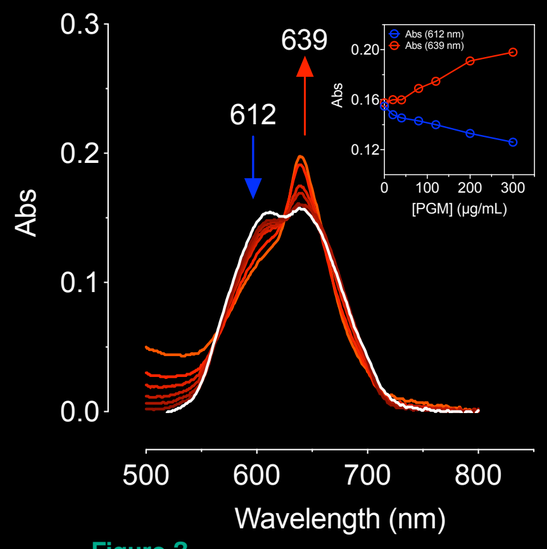


Figure 3

UV/Vis absorption spectroscopy

Addition of increasing concentrations of mucin (PGM) to a constant concentration of squaraine results in a disaggregation effect with a greater amount of solubilized squaraine (Figure 3).

Kinetics of interaction

The investigated dyes have different kinetics upon the interaction with mucin (Figure 4). Apparently, the bulkier the structure the longer the time to reach the plateau.

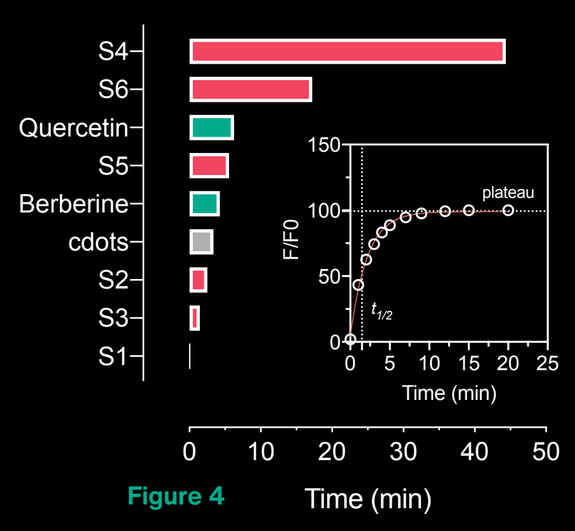


Figure 4

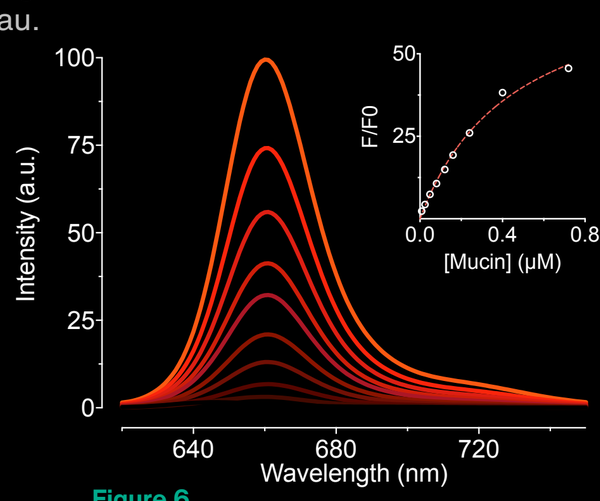


Figure 6

Steady-state fluorescence spectroscopy

Squaraine molecules are non emissive when suspended in water. The addition of of proteins (*i.e.* mucin or albumin) produces a turn-on of fluorescence (Figure 5).

Fluorescence "turn-on"

Among the structures studies, S6, S5, cdots, S3 quercetin and berberine showed higher sensitivities to mucin with respect to albumin (Figure 7).

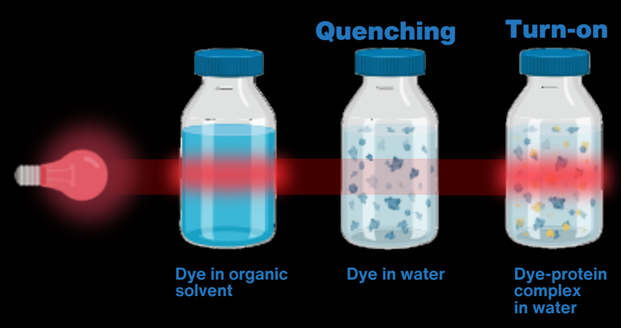


Figure 5

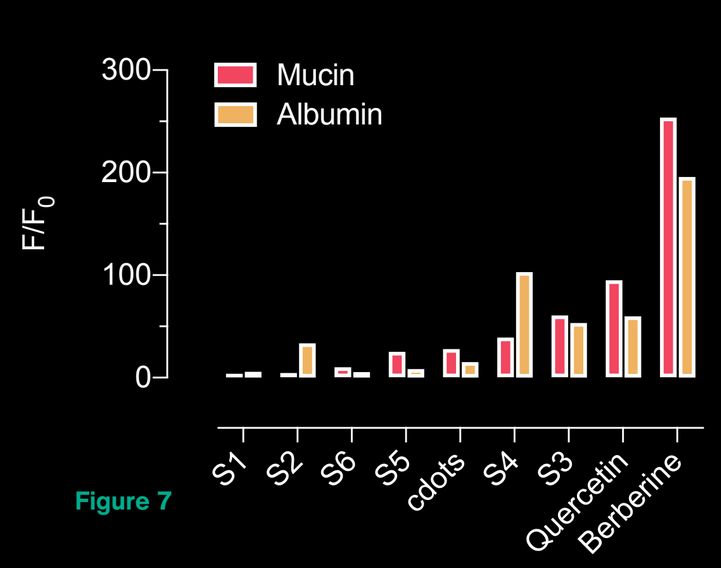


Figure 7

Take home messages

The dyes have a structure-relationship influence on the kinetic interaction with mucin.

Some dyes showed a higher response when interacting with mucin with respect to albumin. For an optimal mucin probe, the interaction with albumin and other serum proteins should be insignificant.

Protein-dyes adducts could be employed as potential probes or photosensitizers for different applications (bioimaging, photodynamic therapy, etc).

For more info scan the QR code

C. Butnarasu, N. Barbero, C. Barolo, S. Visentin, J. Photochem. Photobiol. B: Biol., 205, 111838 (2020).
[4] N. Barbero. C. Butnarasu, S. Visentin, C. Barolo, Chem. Asian. J., 14, 896-903, (2019).

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