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14 November 2026

Azole-loaded mucosomes as multidrug delivery platform to counteract infections caused by *Candida Albicans*

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Test your knowledge on the theme!

Mucin glycoproteins form the **structural network of mucus**, which covers surfaces of various tissues throughout the human body. **Carbohydrates** like N-acetylglucosamine, fucose, galactose, and sialic acid, are **components** present **on mucins** and serve as **binding sites for glycan-binding proteins** present **on pathogens** (Figure 1).

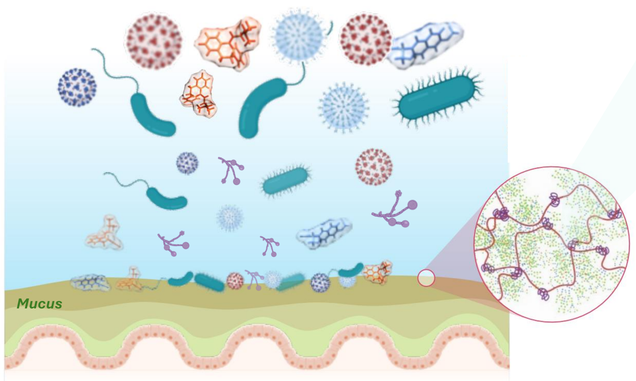
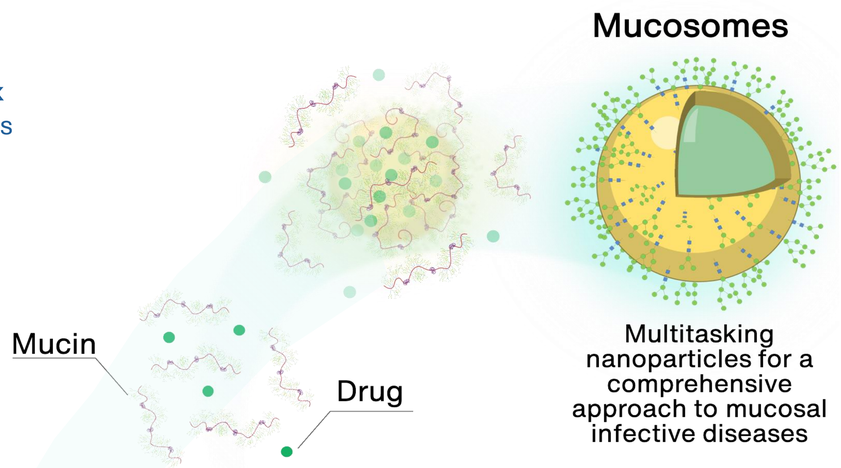
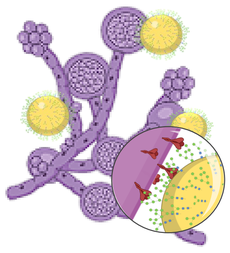


Figure 1



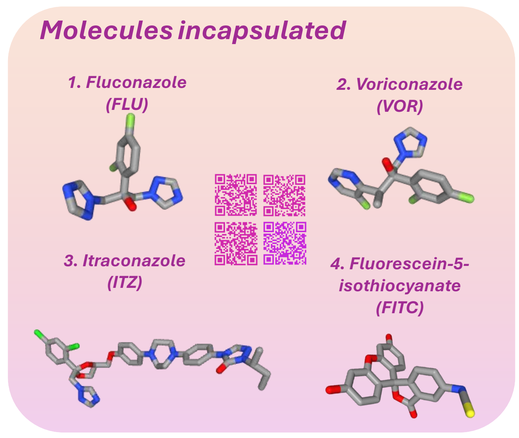
Exploiting the chemical-physical properties of mucins, we developed a **new class of nanosystems** called **mucosomes** with natural **binding and mucoadhesive properties** [1]. Mucosomes, capable of encapsulating drugs, are designed to be highly **selective, targeting specific body areas and microorganisms** through interaction with specific adhesion proteins.

At least once in their lifetime, **75% of women experience vaginal yeast infections caused by fungi of the genus *Candida*.** Among the various species, ***Candida albicans*** remains the **most prominent pathogen associated with this condition**, significantly **impacting women's health globally**.



One of the **critical factors** contributing to the persistence of these infections, despite antifungal therapy, is the **formation of biofilms** by C. albicans. These biofilms create a protective barrier that enhances the **pathogen's resistance to conventional treatments** [2], often resulting in **recurrent** or **persistent infections**.

Mucosomes (BSM-NPs) synthesis and quantification



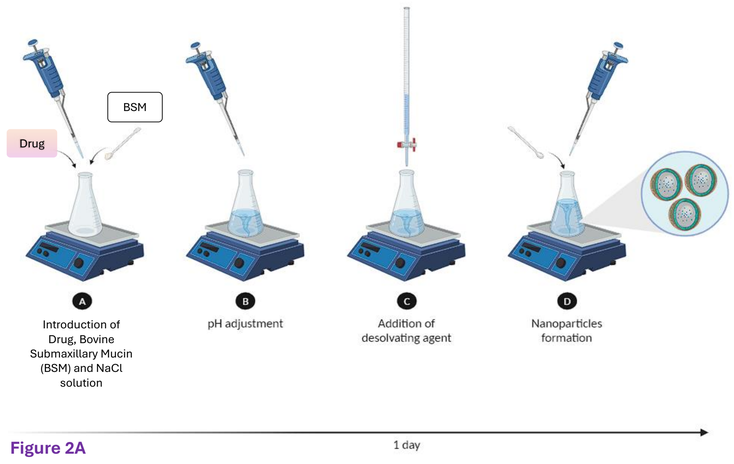
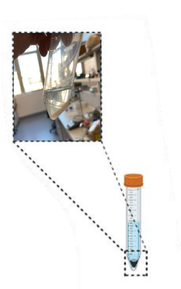


Figure 2A



$$EE\% = \frac{mi - mf}{mi} \times 100$$

mi = inital mass of drug

mf = total mass of the drug in the supernatants

Figure 2B

Aware that mucin O-glycans inhibit *C. albicans* pathogenicity [3], **we aimed to assess mucosome efficacy against C. albicans in planktonic and mucosal environments**, using a Bac3Gel® mucus model. We encapsulated **three antifungals** and **a dye in BSM-based mucosomes** (NPs) (Figure 2).

MUCOSOMES	Entrapment (%)
BSM NPs + Flu	32
BSM NPs + Vor	33
BSM NPs + Itra	50
BSM NPs + FITC	10

Table 1

Effect of mucosomes (BSM-NPs) on *Candida albicans* cells

Viability of Susceptible C. albicans in mucus

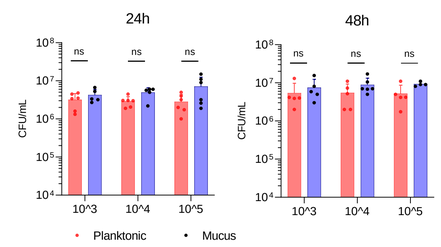


Figure 3

Candida growth occurs in **both planktonic and mucosal environments** (Figure 3). However, there is **no statistically significant difference** in the growth rates between the two conditions, suggesting that **the presence of mucus does not notably affect the proliferation of *Candida*** under the tested conditions.

Effect of mucus on drug efficacy

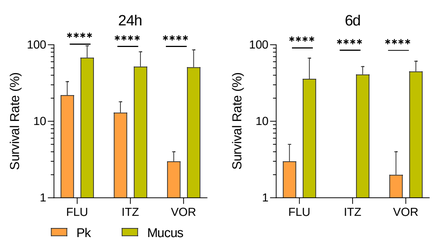


Figure 4

The noticeable **effect of the drugs** on *Susceptible Candida* strains is significantly **reduced in the presence of mucus**. This **reduction in efficacy persists throughout** the entire observation period, extending up **to 6 days**, as illustrated in Figure 4.

Effect of BSM-NPs on the growth of Susceptible C. albicans

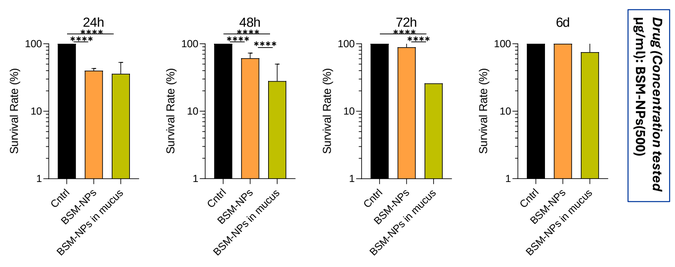


Figure 5

BSM nanoparticles have an effect on *Susceptible C. Albicans*, even in the mucus environment (Figure 5). This suggests that **BSM nanoparticles may enhance the efficacy of antifungal** treatment by improving drug delivery or retention within the mucosal matrix.

Confocal microscopy

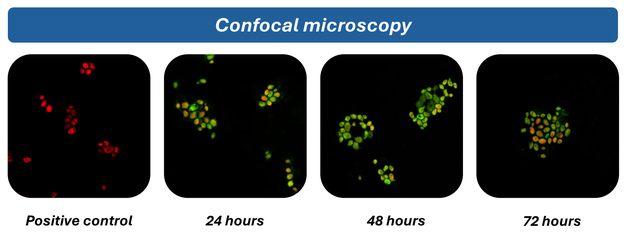


Figure 6

Confocal microscopy demonstrated a clear **colocalization** between **BSM nanoparticles loaded with FITC and *C. albicans*** **cells** over a period of **24 to 72 hours**.

This observation indicates that the mucosomes effectively associate with the fungal cells, suggesting their potential as **efficient carriers for localized drug delivery**.

Comparing free drugs to **drug-loaded BSM-NPs** in mucus shows **a stronger effect** on **cell viability**, especially **at 24h** and **48h** (Figure 7). This underscores **the potential of BSM-NPs for targeting** *Susceptible Candida*, while also highlighting the challenges posed by the mucus in achieving consistent drug efficacy over time.

Antifungal properties of drug loaded mucosomes

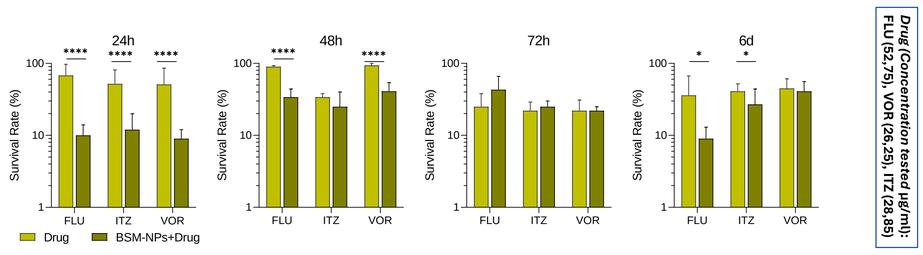


Figure 7

Take home messages

BSM nanoparticles enhance antifungal efficacy in mucus, effectively **targeting Susceptible Candida**. Given the ongoing **challenges in maintaining consistent drug performance in mucosal environments**, future research will explore their application against resistant Candida strains as well.

[1] C.B et al., *Advanced Healthcare Materials,* 11, 2200340 (2022)
[2] S.D. et al., *Current Opinion in Microbiology*, 34, 111–118.
[3] T.J. et al., *Nature Chemical Biology*, 18(7):762-773.