Comparing Morphological Responses to Stimuli in Candida albicans and Neurospora crassa

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**ABSTRACT**

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Comparing Morphological Responses to Stimuli in *Candida albicans* and *Neurospora crassa*

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**INTRODUCTION**

*Candida albicans* is a fungus that is part of the human microflora. The fungi can be found in moist areas of the human body, such as parts of the skin, mouth, intestines, and vagina. When exposed to certain environmental stimuli (stressors), *Candida albicans* has been recorded to undergo a morphological change from a harmless yeast to a filamentous fungus. This is a cause for concern, as filamentous *C. albicans* can use their hyphae to drift into healthy human cells, resulting in an infection known as *candidiasis*.

*Neurospora crassa* is a filamentous bread mold commonly used as a model organism for fungal and genetics research. Although *N. crassa* is distantly related to *C. albicans*, it is relatively harmless and not part of the human microflora. Thus, our research focuses on investigating the possible applications of *N. crassa* as a model for morphological research on *C. albicans*.

**RESEARCH METHODS**

Stock cultures of *C. albicans* were stored at 4°C while stocks of *N. crassa* were stored at -20°C. Plates of *C. albicans* were prepared using the sterile loop-and-streak method. *N. crassa* plates were made by placing a single drop of cells (diluted in sterile water) on the edge of each plate. After inoculation, plates of *C. albicans* were given two days to grow while *N. crassa* plates were left to grow overnight. Minimal (Vogel's) media and Spider media were used for plating. The tested stimuli were salinity (osmotic stress), cold shock, Estradiol (E2), and Fetal Bovine Serum (FBS).

Modified minimal media was used to test salinity. A measured amount of NaCl, for each concentration, was mixed into 250 mL flasks of minimal media. The modified media flasks were then autoclaved and made into plates. The test concentrations were 0.03M, 0.3M, and saturated (+M). Minimal plates were used for *N. crassa* cold shock while Spider plates were used for *C. albicans*, as spider induced filamentation. Cold shock plates were grown at a higher temperature before being moved to a colder temperature. They were then left to grow in the colder temperature overnight.

Plates for liquid stimuli solutions, such as E2 and FBS, were prepared by micro-pipetting 80 μL of solution onto plates and spreading the solution until it was evenly across the surface of the agar. Plates were left to dry before inoculation.

Spider media was used for E2 plates, to observe any possible inhibitory effects E2 may have on *C. albicans* filamentation. The concentrations of E2 tested were 0.1 nM, 1 nM, and 1 μM. FBS plates were made with plain minimal media. Approximately 1 mL of pure liquid FBS was aliquoted into sterile Ep tubes and inoculated with *C. albicans*.

**DATA & RESULTS**

**OSMOTIC STRESS**

<table>
<thead>
<tr>
<th><em>C. albicans</em> colony on minimal media with no NaCl</th>
<th><em>C. crassa</em> colony on minimal media with no NaCl</th>
</tr>
</thead>
<tbody>
<tr>
<td>No hyphal growth</td>
<td>Thin damaged hyphae</td>
</tr>
</tbody>
</table>

**ESTRADIOL (E2)**

<table>
<thead>
<tr>
<th><em>C. albicans</em> colony on Spider media with no E2</th>
<th><em>C. crassa</em> colony on minimal media with no NaCl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistent hyphal growth</td>
<td>Thin damaged hyphae</td>
</tr>
</tbody>
</table>

**FETAL BOVINE SERUM**

<table>
<thead>
<tr>
<th><em>C. albicans</em> colony on minimal media with 80 μL of FBS</th>
<th><em>C. crassa</em> colony on minimal media with no NaCl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal branching</td>
<td>Thin damaged hyphae</td>
</tr>
</tbody>
</table>

**COLD SHOCK**

<table>
<thead>
<tr>
<th><em>C. albicans</em> hyphae grown at 30°C</th>
<th><em>C. crassa</em> colony on minimal media with no NaCl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced hyphal growth</td>
<td>Thin damaged hyphae</td>
</tr>
</tbody>
</table>

**CONCLUSIONS**

Even when exposed to the stimuli under similar conditions, the morphological responses between *C. albicans* and *N. crassa* differed greatly. This was to be expected, as both fungi come from very different environments, and thus are exposed to different environmental factors.

- *C. albicans* displayed greater salt tolerance and survivability in salty environments compared to *N. crassa*.
- *N. crassa* displayed a drastic morphological change to cold shock. *C. albicans* had no visible change in morphology.
- *N. crassa* experienced a reduction in hyphal diameter in response to Estradiol (E2) exposure. *C. albicans*, on the other hand, experienced an inhibition of hyphal growth.
- When exposed to Fetal Bovine Serum (FBS), a morphological change from yeast to filamentous was seen in *C. albicans*. *N. crassa* had no visible change in morphology.

**FUTURE WORK**

- Investigating potential causes of filamentation in *C. albicans* grown in FBS
- Studying conditions in which E2 has different effects on *C. albicans*
- Quantization of the effects of E2 on *C. albicans* under various research conditions
- Potentially grow and test *N. crassa* in liquid media

**ACKNOWLEDGMENTS**

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