CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)

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Project Number

S1313

Project Title

Mutations in Saccharomyces cerevisiae After Exposure to Yeast-Killing Compounds

Abstract

Objectives/Goals

The purpose of this project was to study the effects of curcumin (a turmeric extract) and allyl disulfide (a garlic extract) on Saccharomyces cerevisiae. Both of these compounds are purported to have anti-fungal properties. The project evolved to include looking at whether mutations conferring resistance to azole (a common anti-fungal drug) also conferred resistance to the two compounds and whether mutants could be generated by UV radiation.

Methods/Materials

1)To test what compounds and concentrations killed yeast, creating mutants, wildtype S. cerevisiae was grown on plates with YPD (control), 0.1% and 0.3% allyl disulfide (A.D.), 150uM curcumin, and ethanol as a control for curcumin, which had been dissolved in ethanol. 2)To test if azole resistance conferred compound resistance, 10 strains with azole resistance mutations, wildtype yeast, and an RDRd mutant (increased cellular transport levels) were grown on the same compounds and concentrations as before. 3)To test the effects of UV radiation on mutation, about 5x10^7 S. cerevisiae cells were spread onto each of 22 plates, with the same compounds and concentrations as before. The A.D. plates were subjected to 0, 5K, 10K, 20K uJ/cm2 of ultraviolet radiation and the curcumin plates to 0 and 20K.

Results

1)Both A.D plates showed diminished growth proportional to their concentrations. The YPD, curcumin, and ethanol plates showed normal growth. 2)The 0.3% A.D. plate was the only one that showed remarkable diminished growth in certain strains. It is possible that A.D. does not inhibit growth through an ergosterol pathway, as an ERG (increased ergosterol metabolism) strain showed poor growth. It seems that the transporter mutant (RDRd) is not resistant either. 3)Despite aberrant lack of growth on some plates, 5K and 10K uJ/cm2 of UV radiation seemed to produce normal or slightly increased growth.

Conclusions/Discussion

These experiments should be repeated to test if curcumin is lethal at higher concentrations. The team's hypothesis that A.D. inhibits growth was supported by the diminished growth on the A.D. plates. Some of the azole resistance genes tested may confer resistance to A.D. and curcumin, but azole resistance may be less relevant to compound resistance than the team previously believed. UV radiation seems to be effective in producing successful growth at medium concentrations (5K and 10K uJ/cm2), but it led to sporadic growth at 20K uJ/cm2.

Summary Statement

Investigated the effect of chemicals, radiation, and mutations on the growth of S. cerevisiae; investigated the pathways by which certain chemicals kill yeasts; tested whether certain mutations lent multiple substance resistances.

Help Received

Obtained yeast samples from Kim Williams of FibroGen; used lab equipment at Stanford University under the supervision of Kim Williams and her colleagues; carried out almost all research at Homestead High School