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Comparing and Contrasting Land and Marine Fungi

Saccharomyces cerevisiae also known as brewer's yeast or baker's yeast, is commonly found in everyday foods and beverages. It is a yeast utilized for baking, honey production, fermenting, cocoa production, winemaking, and beer brewing. Saccharomyces cerevisiae has been used since the beginning of time because it was experimentally discovered that this particular yeast is a single celled organism that is easily cultured because of its quick production and ability to maintain multiple strains (Stewart, 2011). It is generally found in ripe fruits particularly in grapes and other fruits after maturation. Saccharomyces cerevisiae is classified as a fungus because its cell walls are composed of chitin and does not contain any peptidoglycan. This yeast has the ability to do both sexual and asexual reproduction through haploid and diploid cells. Haploid cells undergo mitosis and growth which is described as asexual reproduction and diploid cells also undergo mitosis but under stress sporulates and enters meiosis producing four haploid cells that can mate and subsequently is described as sexual reproduction (Saccharomyces Cerevisiae, 2021).

Schizosaccaromyces pombe also known as fission yeast is also a species of yeast used in brewing, baking and as model organisms in biology. This particular yeast is unicellular, rod-shaped. grows by an elongation of the ends and measures around 2-3 microns in diameter. It is used in fermenting because of its rapid growth rate and cellular mitosis which produces two daughter cells of equal size. Schizosaccaromyces pombe can be found in alcohols containing fermented sugars from the subtropical regions (Schizosaccharomyces pombe, 2010). Mitosis occurs resulting in sexual reproduction which further produces a diploid zygote that enter meiosis creating four haploid cells that can mate. Schizosaccaromyces

pombe is also called the fission yeast because it divides and reproduces by fission. During reproduction fission yeast form a cell plate at the midpoint of a cell and divides it into two daughter cells (Schizosaccharomyces pombe, 2021).

Unlike Schizosaccaromyces pombe, Saccharomyces cerevisiae is a budding yeast that reproduces via budding. Two daughter cells are produced via mitosis and a bud is formed throughout the cell cycle and later leaves the mother cell at the conclusion of mitosis (Saccharomyces Cerevisiae, 2021). Budding yeast is usually roundish in shape and are mostly diploid unlike fission yeast. Key differences between Saccharomyces cerevisiae and Schizosaccaromyces pombe are that Saccharomyces cerevisiae is a budding yeast and Schizosaccaromyces pombe is a fission yeast. Cytokinesis begins at the G1 phase in budding yeast and at the G2 phase for fission yeast. Budding yeast tend to avoid previous division sites while fission yeast uses the previous division sites as a new growth site. While other differences such as shape and growth zone persist between the two species of yeast, there are also similarities such as being reproduction-based yeast which relies on mitosis. Both Saccharomyces cerevisiae and Schizosaccaromyces pombe are unicellular fungi belonging to the Ascomycota division and contain major lipids such as sterols, sphingolipids, and glycerophospholipids. Lastly, both budding and fission yeasts are organisms used commonly in biological research because of their easily manipulated genetic information which allows scientist to further study cell cycles.

Although scientist have begun to dive deeper into their studies of yeast, there lacks the same enthusiasm to study marine yeasts. Yeast is usually assumed to only habitat on land, but studies have proven that yeast has been identified in all marine samples studied so far but unfortunately many unknowns still present. They have confirmed that many different types of yeast inhabit our waters by obtaining samples and analyzing growth patterns to understand them better. For example, Dothideomycetes, also known as black yeast, was cultured from the Woods Hill marine environment in Massachusetts and were closely

analyzed and provided scientist a closer look at their characteristics. It was determined that black yeast inhabit environments where other life is unsustainable and are characterized as halotolerance, stress resistance, having complex cell growth, and extreme harmfulness and toxicity. Black yeast is unique from other yeast as it experiences unusual and unexpected cell division patterns. For example, the Hortaea Werneckii yeast cells divide via septation or fission and budding as opposed to Knufia Petricola yeast cells and A. Pullulans which divides only via budding. P. calicorniae yeast cells also uniquely divide by budding and hyphal cell growth which elongates buds providing them directional control. These black yeasts have many similarities but differ in areas such as speed of division, color, shape, and cell division type.

Hortaea Werneckii or H. werneckii is a form a black yeast that divides via septation or fission and budding. It is highly studied due to its high halotolerance which allows it to grow in environments up to 5 M NaCl which is very high in salt concentration. This yeast is very dark in color almost like a midnight black if being observed in a petri dish. As H werneckii yeast divides, each offspring inherits its own nucleus and appears pill shaped with a line running down the middle (while growing). This represents the cell walls dividing and becoming its own cell. The average time for a bud to produce from the parent cell of H werneckii is approximately 253 minutes as compared to the entire duration of its cell cycle which averages around 730 minutes (Mitchison-Field, et al., 2019).

Knufia Petricola or K. petricola is another form of black yeast also very dark in color but lighter than the H.werneckii yeast cells. This particular yeast is found on rock surfaces located in extremely freezing or hot environments such as the Antarctic or the desert. K. petricola is extremely tolerant of environments with extreme weather and survives and grows via a budding process during cell division. Budding yeast usually produce a single bud at a time to ensure that each daughter cell inherits a single nucleus during mitosis. K. petricola is circular in shape but connects like a chain of bubbles forming the shape of a dendrite from a neuron. As the yeast continue to bud, it begins to resemble the white Michelin tire

mascot that appears to have bubble like limbs. The average time for a bud to appear varies from 10 minutes to 110 minutes with 110 minutes being the average. The entire cell cycle was estimated to endure 499 minutes with it being confirmed that each bud presented one nucleus (Mitchison-Field, et al., 2019).

Furthermore, the Aureobasidium Pullulans or A. pullulans yeast is also a black yeast that appears white or creamish in color when being viewed on a petri dish. It is classified as a budding yeast but differs from the K. petricola because it has multiple origins (up to 6 in the same area) of budding from the mother cell. A. pullalans yeast is lemon or balloon shaped and produces so many buds at once that it appears clustered together. It was determined that the mother cells had multiple nuclei and depending on how many nuclei the mother cell hosted, budding occurs. The more nuclei the mother cell contains, the more buds produced. The average time for a bud to form was calculated at 135 minutes while the duration of the cell cycle lasts approximately 159.5 depending on the amount of budding (Mitchison-Field, et al., 2019).

Lastly, Phaeotheca Salicomiae or P salicomiae, another black yeast identified only 5 years ago in 2016 appears black in color with tips of orange on a petri dish. There is very limited information regarding this yeast due to its recent discovery. Although not much is known about P salicomiae yeast, it has the most unique and cell division pattern. It divides via budding and also produces hypha cells which elongate creating some sort of matrix that the daughter cells stay within. Many of the yeast cells cluster together in the center while the hyphal cells elongate around the cluster, formally known as the Meristematic cluster. As the hyphal cells extend, it provides the yeast an appearance of a gigantic spider. The P salicomiae yeast appears to be uninuclear in each bud which the hyphal cells do not contain much DNA. Unfortunately, there is not much information on how long the cell cycle is or how long it takes for a bud to present due the little time scientist has had to study this yeast (Mitchison-Field, et al., 2019).

It is apparent that further investigation into marine yeast must be conducted to fully understand the cell cycles and how they differ from fungi on land. It was interesting to see similarities and differences

between land and marine fungi. Both fungi could be classified between fission and budding cell division processes even though they sustain life in completely different environments. Just as fungi on land breakdown substances to release organic substances back into the atmosphere, fungi in marine environments work just the same.

References

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