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Marine Yeast

Marine yeast is a type of fungi that is responsible for some of the most important ecological process in the natural world. Without fungi life on Earth would look completely different or may even cease to exist entirely. This paper is going to focus on the different types of marine yeast and their complex nature. First, we must understand exactly what marine yeast is. Marine yeast is a type of fungi was first discovered in the Atlantic Ocean and is now found in mass by many coastal bodies of water around the world (Sreedevi, 2008).

Perhaps the most interesting, and least understood, aspect of marine yeast is exactly how they reproduce. There are two main forms of reproduction in marine yeast shown by Saccharomyces cerevisiae and Schizosaccaromyces pombe. Saccharomyces cerevisiae reproduce through budding and Schizosaccaromyces pombe reproduce through fission (Moseley, 2019). Budding is when a small bud begins to form on a spherical cell and eventually that bud is cut off from the parent cell which creates a whole new cell. Fission is when an oblong cell duplicates and separates its organelles into separate parts of the cell and they separate entirely. Both processes are very similar in the sense that they both ultimately create new cells. However, a big difference is the budding cells grow on the parent cell asymmetrically, while the fission cells grow with the parent cell until it is ready to become its own. The process of budding is not like normal mitosis because the parent cell is completely unchanged. Fission is like normal mitosis because one cell splits up to form two identical cells (Editors, 2019).

There are four types of marine yeast that typically come up when discussing marine yeast: Candida, Cryptococcus, Debaryomyces, and Rhodotorula. Candida and Cryptococcus are budding yeast while Debaryomyces and Rhodotorula are fission yeast. These yeasts are important because they are capable of the normal responsibilities of fungi like breaking down organic material, biodegradation of oil, and recycling nutrients (Jedryczka, 2018). However, the fact that they live in water is a very big deal. Candida and Debaryomyces are found in shallow waters while Cryptococcus, and Rhodotorula are found in the deep ocean (Sreedevi, 2008). Pollution also plays a major role in this scenario. All these strains of yeast have one thing in common, the more concentrated the pollution is the higher concentration of yeast is produced. So, what does all this mean. It means there is a natural way to clean up the pollution in the ocean. These different marine yeasts thrive where there is concentrated pollution like oil spills and heaps of garbage, and their sole purpose is to break it down and recycle the nutrients, so we can use these marine yeasts to clean our oceans. Yeasts were also studied from the beaches in southern Brazil. Nine different strands of yeast were extracted and studied, but the most interesting find was from the Candida strand. The Candida yeast was able to identify if there was pollution in the coastal water (Sreedevi, 2008). These marine yeasts are incredible, they can identify and break down pollution in the water, but we are just scratching the surface of what these impressive organisms can do.

In 2019 a group of scientists decided to travel to Massachusetts and collect a bunch of samples of marine yeast. In their synopsis they focused mainly on the black yeast because they showed the most interesting characteristics. The four main yeast they focused on were H. Werneckii, K. Petricola, A. Pullulans, P. Salicorniae (Mitchison-Field, 2019). These four marine yeasts have many similarities and differences and all of them have interesting ways of life.

Perhaps the most exciting part of the marine yeasts' life cycle is how they reproduce. All four of the marine yeasts reproduce through budding at some point, but some add a bit of flavor. K. Petricola and A. Pullulans reproduce solely through budding, while H. Werneckii and P. Salicorniae have some extra steps. H. Werneckii has a step before budding called septation. Septation is when the mother cell creates a new cell wall in the middle to separate genetic material. After the new cell wall has been formed budding occurs. New dark blue, rugby ball shaped cells form and the process repeats. P. Salicorniae has the most complex reproductive process. It reproduces through budding, but its budding works differently. At first the mother cell buds normally except it doesn't fully separate into two distinctly different cells. Instead, the new cells remain close together until they become extremely clustered. This tight cluster of cells continues to bud properly, but it also creates long arm like cells called hyphae. These Hyphae extend far out and take up more space until the whole organism looks like a silver and orange octopus with the meristematic cluster at the center and the hyphae extending out. Those two have the most complex forms of reproduction, but that doesn't mean the others are boring. A. Pullulans has many nuclei inside the mother cell and when the mother cell is ready to bud it can shoot multiple yellow, balloon shaped cells out of one end all at once. One thing they all have in common is they have one nucleus per compartment except for A. Pullulans. The mother cell for A. Pullulans has multiple nuclei until it buds off into new cells (Mitchison-Field, 2019).

Another interesting part to consider about these marine yeasts is time. How long it took each yeast to produce its first bud and how long the overall cell cycle duration was is two very important aspects to look at. It is important to consider the timing of the cells because if the daughter cell is too small or too big when it buds off from the mother cell it may not survive (Xili Liu, 2015). H. Werneckii and K. Petricola both had relatively long cell cycle duration times with a mean of 730 and 499 minutes respectively. A. Pullulans had a shorter cell cycle duration time with a mean of 159.5 minutes. H. Werneckii had the longest time to first budding with a mean of 253 minuets while K. Petricola and A. Pullulans both had shorter times to first bud with an average of 110 and 135 minutes respectively (Mitchison-Field, 2019). I believe H. Werneckii had the longest time to bud and cell cycle duration because it does all of the work inside the mother cell before budding. It creates and separates genetic material inside the mother cell and only after the septation happens in the mother cell can budding take place. K. Petricola and A. Pullulans both split up the workload to some extent. P. Salicorniae is an outlier when talking about time because there is no cell cycle duration or time to first bud data in the research paper (Mitchison-Field, 2019). I believe this is because there was no ending to the cell cycle. The cells continued to grow and expand without completely separating into a new distinct cell.

There are thousands of different kinds of marine yeasts in every corner of the world, and this paper only scratched the surface on a handful of different species. The research done by the team of scientist in Massachusetts has led to a deeper understanding of this aquatic fungi world (Mitchison-Field, 2019). Hopefully more research will continue, and our understanding of these incredible fungi will lead to a greater purpose.

	H werneckii	**K Petricola**	**A pullulans**	**P salicorniae**
Cell cycle duration	730 min	499 min	159.5 min	N/A
Time to first bud	Mean of 253 min	10-320 mean of 110	Mean of 135 min	N/A
Growth pattern	Alternation of septation and budding	Mother cell creates d cell linear and gd cell at angle	Multiple buds shoot out at same spot from mother cell	Single cell become cluster of cells with long protuberances (hyphae)
# of Nuclei	1 per compartment	1 per compartment	Mother Cells: multiple Buds: most have 1 but some have 0	1 per compartment
Cell Shape	Oval and rugby ball shaped	Chains of circles	Balloon shaped	Wedge shaped
Colony Color	Dark blue and brown	Dark blue and grey	yellow	Silver and orange

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