

Of Salt in Life: How Sourdough Starters Adapt to Increased Salt Levels

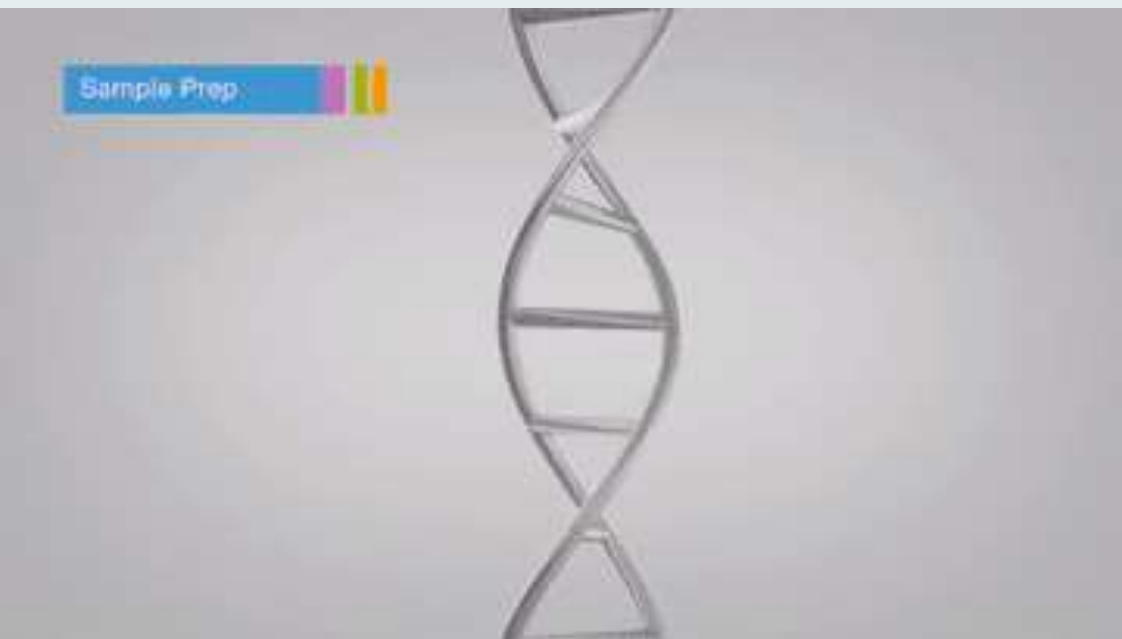
GN 312 Final Project by Jerry Yu



Research Question

How does Adding Salt Affect the Microbial Communities in Sourdough Starters, and how they digest food?

The Sourdough Team Sequencing



- ❖ Our Data was sequenced by Illumina Sequencing
- ❖ Illumina Sequencing is a technique where DNA, the instruction manual for the cell, is read by first being cut into many small pieces
- ❖ The pieces are then attached to a glass plate where they are copied many times
- ❖ Special DNA letters are then added that flash light, allowing us to read the DNA as it is being assembled
- ❖ Ultimately, we get millions of small lines of DNA, from genomes of all microbes present in our sourdough
- ❖ This work was conducted by our in-person lab section, go team!

The Sourdough Team Analyzing

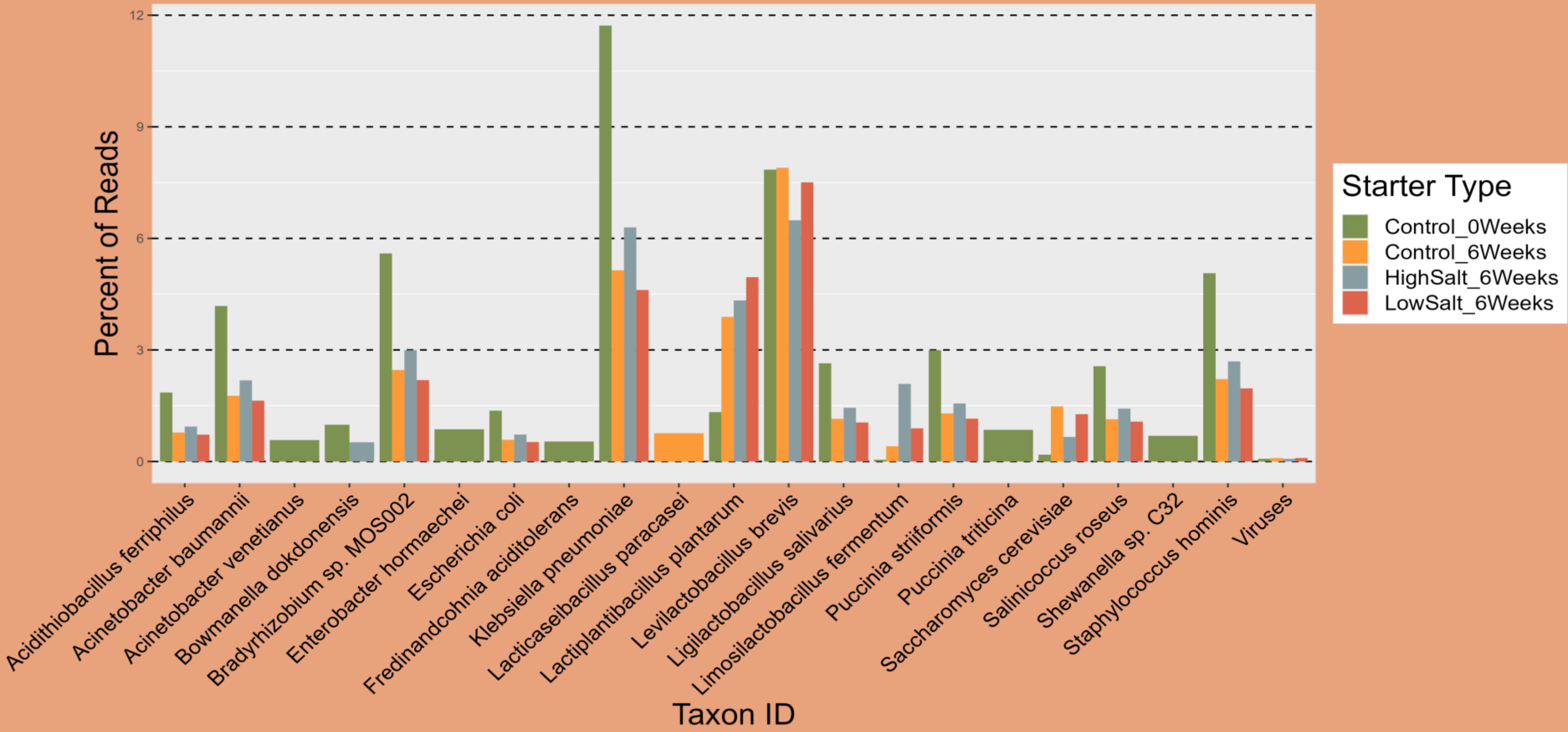


- ❖ Once our data is collected we need to put all the puzzle pieces together!
- ❖ The millions of DNA pieces were matched together using special algorithms in a program called Kbase
- ❖ The DNA was then grouped to form genomes for organisms in our sample
- ❖ We used the genomes to identify species by genome (phylogenomics)
- ❖ We also identified species by their protein sequences and estimated how abundant they were in the sample (phylogenetics)
- ❖ This work was conducted by our online lab section, go team!

Key Takeaway

Microbe communities living in sourdough starters changed over time and in response to increased salt levels.

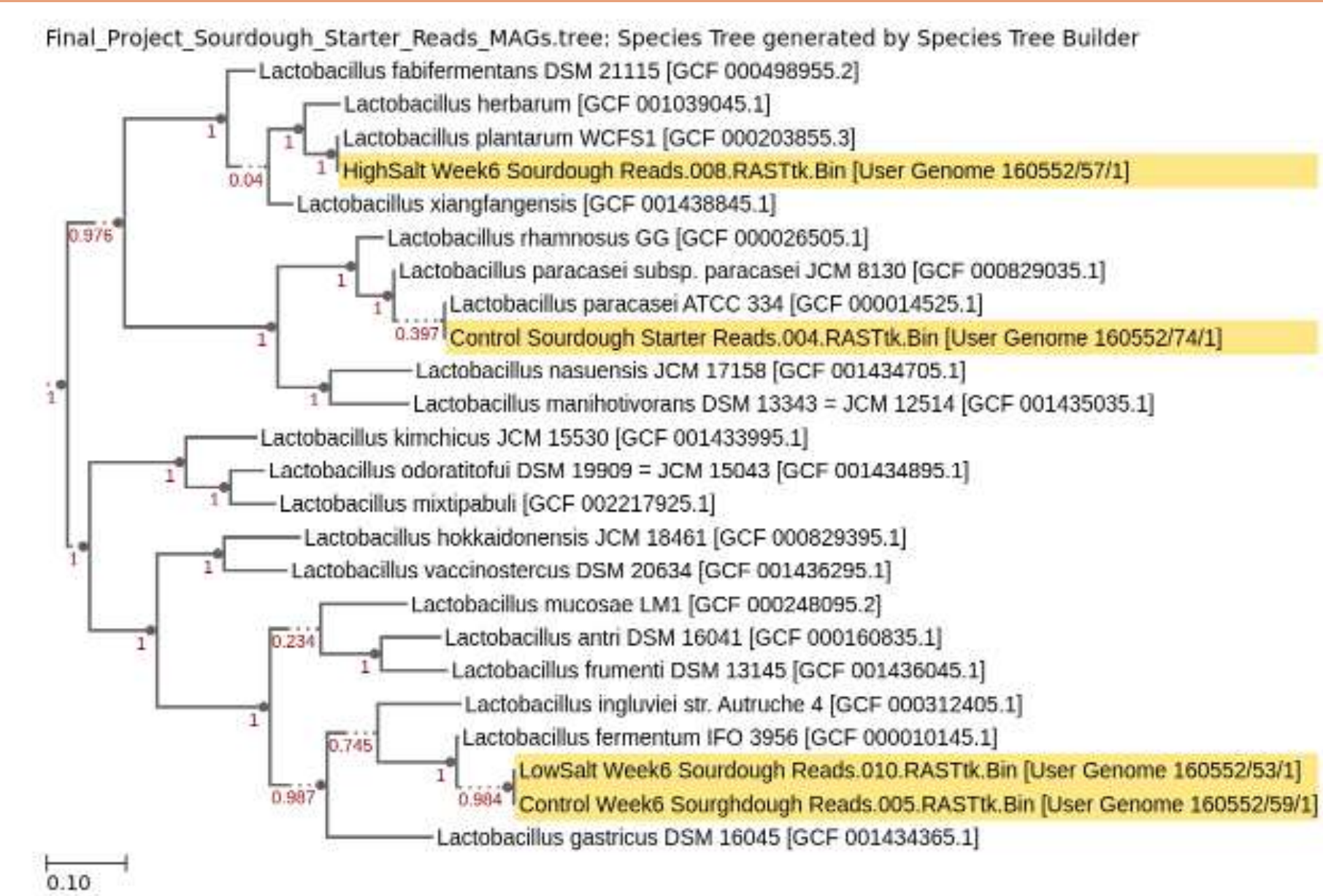
Figure 1: Different Percent Abundances of Reads at the Species Level for 4 Different Sourdough Cultures Grown at Different Salt Levels and Times



Other Results

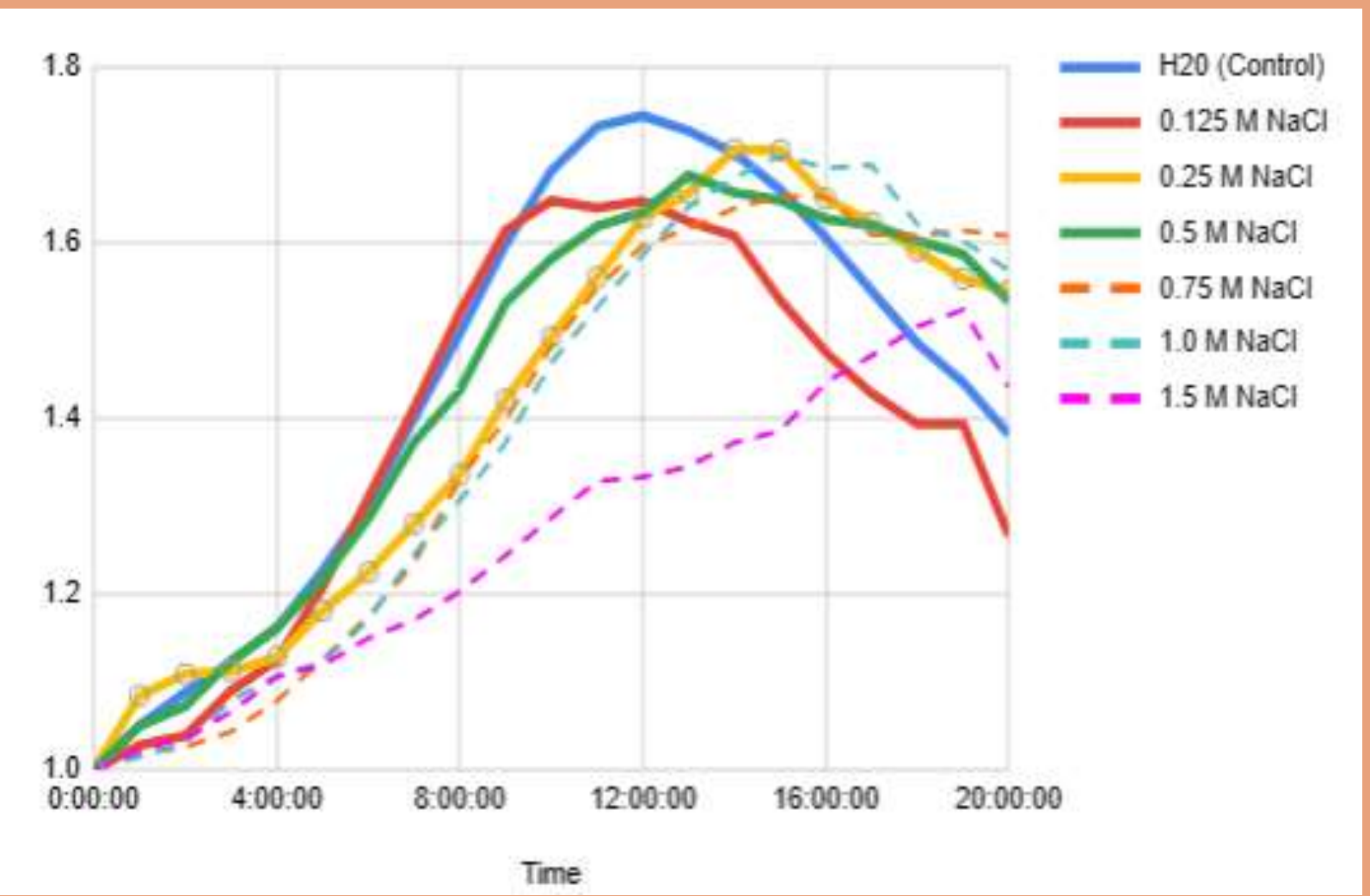
- ❖ Lactic Acid Bacteria (*Levilactobacillus brevis* etc), other bacteria associated with humans (*Klebsiella pneumoniae* etc), and yeast (*Saccharomyces cerevisiae* etc) were the most abundant in our original samples, according to Kaiju (Figure 1)
- ❖ For High Salt and Low Salt Cultures as compared to the control, after 6 weeks the relative abundance of other human associated bacteria declined, and lactic acid bacteria and yeast increased
- ❖ For most bacterial and fungal species, the High Salt Culture had higher numbers of fewer species than the Low Salt Culture, as indicated by having higher percent reads in Figure 1
- ❖ Bacteria adapted to acidic conditions became more common over time
- ❖ All 3 three of our MAGs (Metagenome Identified Genomes) in Figure 2 were detected by our Phylogenetic analysis in figure 1.
- ❖ Only our High Salt sample's MAG was one of the more abundant species in our sample according to our Phylogenetic analysis in figure 1.
- ❖ Sourdough Cultures with a higher level of salt were slower to rise and had diminished maximum rising rate, this is in line with out results in Figure 1 showing less yeast abundance

Figure 2. Species Tree of Relationships Between Bacterial Genomes, Including Ones We Sampled



Footnote: Control Sourdough Starter Reads.004 is from the control at 0 weeks

Figure 3. Rising Rate of Sourdough Cultures with different amounts of added salt (NaCl)



The Start of a Sourdough



- ❖ A Sourdough Starter is a special community of microbes formed by mixing flour and water
- ❖ These microbes all play an important purpose in making sourdough bread
- ❖ Some microbes, like lactic acid bacteria, turn sugar into lactic acid. They make the sourdough sour. Believe it or not, this sourness keeps the culture safe for us to eat!
- ❖ Other microbes, like yeast, can make Carbon dioxide. This causes they bread to rise
- ❖ We wanted to see how adding salty would change these microbe communities in sourdough starters!

Embrace Future Salt



- ❖ Our Future Research might consist of:
 - ❖ As our later samples sequences were late, we could follow up by sampling the microbe diversity of our samples after exposure to high salt levels after 6 weeks
 - ❖ Baking breads with the different types of cultures and tasting evaluating them on taste qualities like mouthfeel and acidity
 - ❖ The low abundance of yeast was surprising and seems to be related to the rising rate. Testing if adding baker's yeast to the high salt culture before rising could prove if the reduction in rising potential is due to yeast