Effect of different flours and salt amounts on sourdough activity and pH

Grade level 4

Science Fair 2025

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The Academy of Science - St. Louis Science Fair

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2025 Safety Form

☑ I have written a research plan that includes the following:
- The question or problem being addressed and the expected outcome
- Describes in detail the method and procedures including all safety precautions Includes all procedures to be used for data collection and/or building your prototype, if an engineering project
- Identifies any potential risks and safety precautions to complete the project safely
- Who will be supervising your project? For approval, an adult over 18 must be present and supervising during experimentation or prototype development and building.

☑ I have reviewed this research plan with my:
- Teacher
- Parent/Guardian
- Any other 18+ Adult who will be supervising the project (if not listed above)

☑ I have reviewed the rules for The Academy of Science – St. Louis Science Fair and verified with my teacher that my project adheres to the rules.

☑ I have reviewed the additional rules that apply if my project involves any of the following:
- Mold
- Bacteria
- Humans

I acknowledge that all of the above safety precautions will be followed and that this project will be completed in a safe manner. I also acknowledge that no humans or animals (vertebrates or invertebrates) will be harmed in any way.

Print or Type Student Name	Student Signature	Date
Elanor Sung	Elanor Sung	1-21-2025
Print or Type Parent/Guardian Name	**Parent/Guardian Signature**	**Date**
Liang-I Kang Michael Sung		1-21-25
Print or Type Teacher Name	**Teacher Signature***	**Date**
Brendan Kearney	Brendan Kearney	1-16-2025

*You may include a project approval email from your teacher in lieu of a teacher signature.

Questions? Contact your science teacher, or the Academy Fair Director at sciencefair@academyofsciencestl.org

Revised for 2025 Fair

Visit sciencefairstl.org for more information.

2025 Academy of Science - St. Louis Science Fair Project
RESEARCH AND SAFETY PLAN

Student Name: Elanor Sung
Project Name: **Effect of different flours and salt on sourdough activity and pH**

1. What is the question or problem being addressed and the expected outcome?

   Many people have sourdough starters. I would like to test if different kinds of flours and salt content change the sourdough growth and pH (how sour it is).

   We expect that rye, whole and white flour will have different sourdough growth and pH. We also think salt will affect sourdough growth.

2. Describe in detail the method and procedures including all safety precautions. Include all procedures to be used for data collection and/or building your prototype, if an engineering project.

   We will create multiple sourdoughs with different flours and salt content and attempt to measure variables in sourdough activity and pH. Each type of flour will be sampled three times.

   Yeast studies involving BSL-1 organisms are exempt from prior SRC review and require no additional forms.
   Elanor has experience baking and we will continue to supervise her during the process.

3. Identify any potential risks and safety precautions to complete the project safely.

   Elanor has experience baking, will have eye-protection and an apron, and will be supervised throughout the process. Sourdough creation does not include any inherently hazardous materials. Sourdough fermentation does create acids but skin contact will be minimal.

4. Teacher or parent oversight. Who will be supervising your project? For approval- An adult must be present and supervising during experimentation or prototype development and building.
   - ☑ ~~Parent/guardian~~
   - ☐ Teacher
   - ☐ Other (Please specify):

   _____

5. If your project involves human subjects then please answer the additional information below.

   - Not applicable

Testable Question:

How does different flours and salt amounts affect the way how sourdough starter grows and changes acidity levels?

Background Info:

I chose this project because…

I wanted to figure out if using different flour types affects sourdough sourness and sourdough rising, and seeing if adding different salt percentages affects how sourdough develops.

In my research I found out that…

1. Sourdough starter contains a mixture of wild yeast and bacteria from the environment.
2. Different bread doughs have different recipes that ask for different kinds of flour and different amounts of salt.
3. Yeast in the sourdough produces acids, and the dough can have different sourness levels depending on the recipe, ingredients and amounts.
4. Sourness is a sign of acidity and pH scale is used to measure acidity.
5. I learned that Rye is another type of grain, like wheat but the type of protein in Rye is more stretchy and less strong. It also has lots of nutrients and sugars that help sourdough grow.
6. White flour is made by removing the bran and germ from wheat kernel before grinding. Whole Wheat has all 3 parts, the bran, endosperm and germ. The endosperm has lots of nutrients.

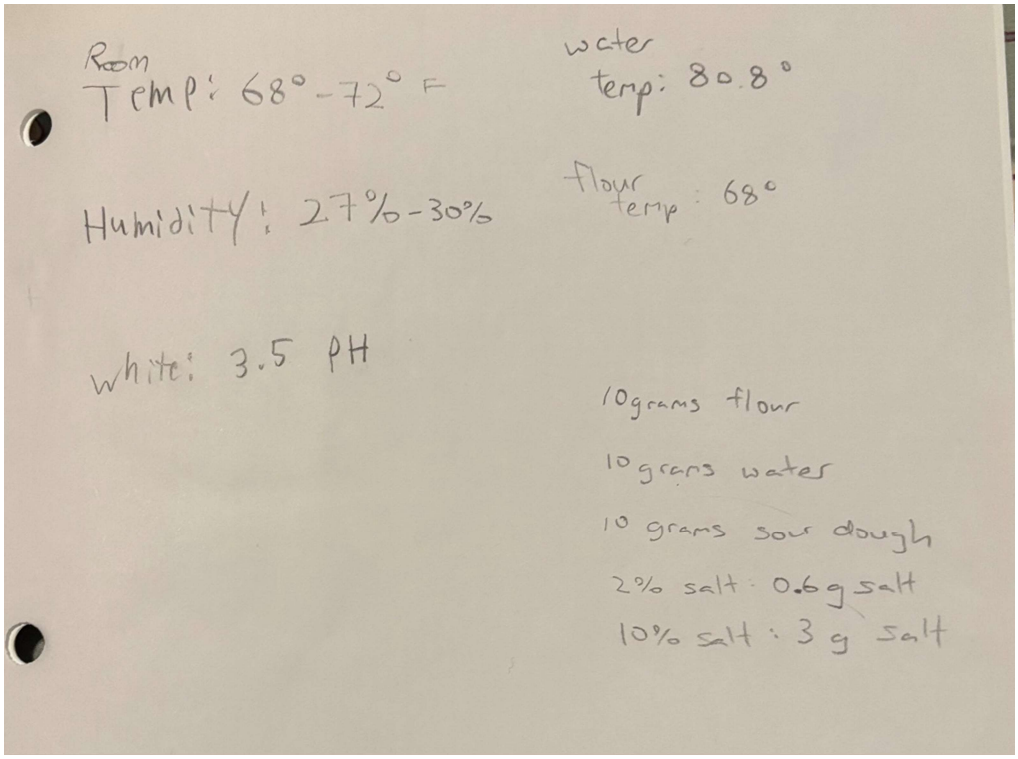
This project is important to me because...

I want to learn about baking and sourdough, learn how pH works, and see how salt amounts affect yeast. My family has a sourdough starter named Gus and it is 13 years old. It is our “pet”.

Hypothesis:

If there is a difference in the kinds of flour and salt amounts, then it will impact how fast the sourdough grows and its acidity levels.

Variables and Constant Conditions:



Independent Variable:

Type of flour:

1. White All Purpose Flour
2. Whole Wheat Flour
3. Rye Flour

Salt amounts:
1. 0% Salt (White All Purpose Flour)
2. 2% Salt (White All Purpose Flour)
3. 10 % Salt (White All Purpose Flour)

Dependent Variable:

Rise levels of dough (percent change in height)
pH levels (how much acidity/sourness)

Constant Conditions:
1. Same shape and type of jars the whole time
2. Same amount of weight flour, water and starter
3. Same day, time and indoor temperature and humidity

Procedures:

1. For each jar, we put 10 g of starter (existing White All Purpose flour starter with pH of 3.5), 10 g of water, and 10 g of flour. I used different flour for each set of 3 jars. The flours were White All Purpose Flour, Whole Wheat Flour, and Rye Flour.

2. I also did salt amounts, 2 sets of 3 jars, 2% (0.6 g) salt, and 10% (3 g) salt. For the salt jars, I used White All Purpose as the flour, following the same 10 g of starter, 10 g of water, and 10 g of flour.

3. Then I mixed the flour, water and starter (if salt, then mixed that too) together in the jar, until it became sticky and one color.

4. We put measurement lines on the jar as a starting point for measuring the rise. Then we dipped the pH test paper in the dough then placed it on a paper and compared it using the pH acidity scale. We did these at time points 0, 6, 12, 18, 24 hours (I didn't measure pH at 18 hours).

5. After 24 hours, I measured the rise markings on the jars and compared them.

Results:

Table 1: Rise of Sourdough within 24 hours

Timepoint	0 hr	6 hr	12 hr	18 hr	24 hr
	Rise (cm)	Rise (cm)	Rise (cm)	Rise (cm)	Rise (cm)
White Flour #1	1.2	2	2.7	2.7	2.7
White Flour #2	1.1	1.7	2.4	2.4	2.4
White Flour #3	1.1	1.7	2.3	2.4	2.4
Whole Flour #1	1.1	1.6	2	2	2
Whole Flour #2	1.1	1.7	2.3	2.2	2.2
Whole Flour #3	1	1.3	2.1	2.1	2.1
Rye Flour #1	0.9	1.1	2	2	2
Rye Flour #2	0.9	1.3	2.1	2	2
Rye Flour #3	1	1.2	2.2	2.2	2.2
White Flour 2% Salt #1	0.9	1.4	2.1	2.4	2.4
White Flour 2% Salt #2	0.9	1.4	2.1	2.4	2.4
White Flour 2% Salt #3	1	1.3	1.8	2.2	2.2
White Flour 10% Salt #1	1.2	1.2	1.4	1.5	1.5
White Flour 10% Salt #2	1	1.2	1.3	1.4	1.4
White Flour 10% Salt #3	1	1.1	1.2	1.3	1.3

Table 2: pH of Sourdough within 24 hours

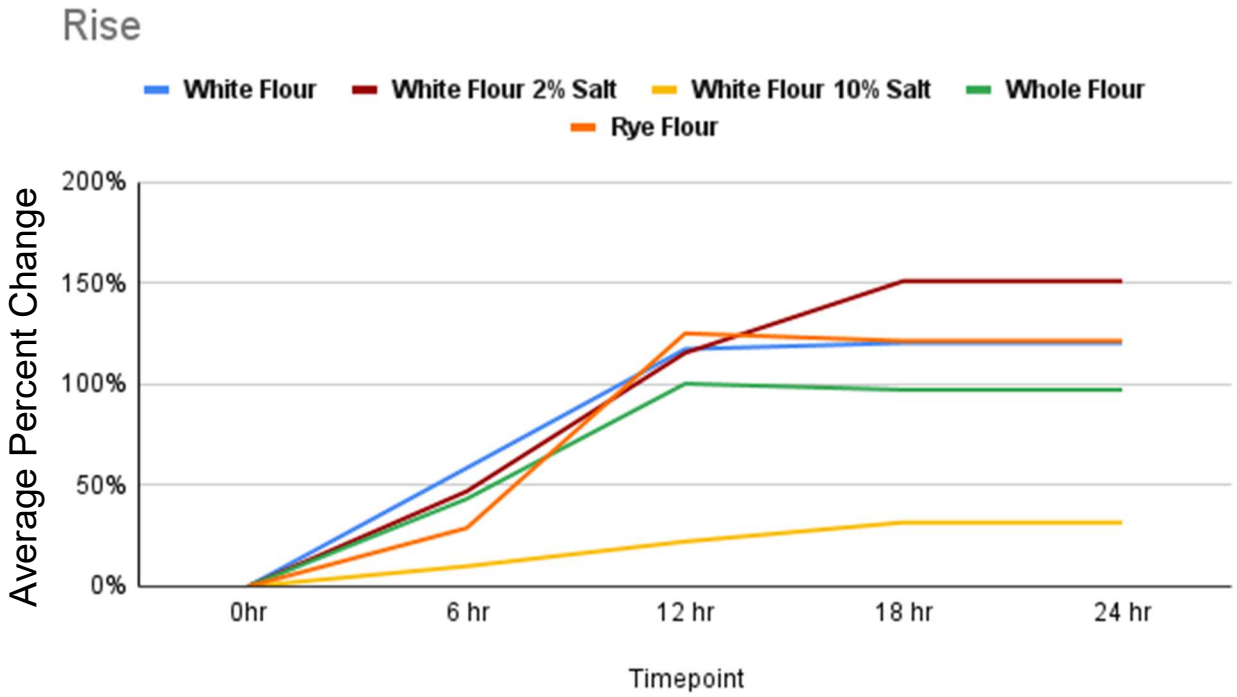
Timepoint	0 hr	6 hr	12 hr	18 hr*	24 hr
	pH	pH	pH	pH	pH
White Flour #1	4.5	4	4	-	3
White Flour #2	4.5	4.5	4.5	-	3
White Flour #3	5	4.5	4.5	-	3
Whole Flour #1	5	5	4.5	-	3.5
Whole Flour #2	5	4.5	4.5	-	3.5
Whole Flour #3	5	4.5	4.5	-	3.5
Rye Flour #1	4	4.5	4	-	3.5
Rye Flour #2	4.5	4.5	4	-	3.5
Rye Flour #3	4.5	4.5	4	-	3
White Flour 2% Salt #1	5	4	4	-	3
White Flour 2% Salt #2	4.5	4	4.5	-	3.5
White Flour 2% Salt #3	5	4.5	4.5	-	3.5
White Flour 10% Salt #1	4	5	5	-	4.5
White Flour 10% Salt #2	4	4.5	4.5	-	4
White Flour 10% Salt #3	5	5	4.5	-	4

*We did not take pH at 18 hr time point

Table 3: Calculated Percent Change in Rise

Percent Change in Rise (Averaged)					
Timepoint	0hr	6 hr	12 hr	18 hr	24 hr
White Flour	0%	59%	117%	120%	120%
White Flour 2% Salt	0%	47%	116%	151%	151%
White Flour 10% Salt	0%	10%	22%	32%	32%
Whole Flour	0%	43%	100%	97%	97%
Rye Flour	0%	29%	125%	121%	121%

Percent Change = ((Time point height – 0 hour height) / 0 hour height) x 100


Rise
White Flour
White Flour 2% Salt
White Flour 10% Salt
Whole Flour
Rye Flour
Average Percent Change
200%
150%
100%
50%
0%
0hr
6 hr
12 hr
18 hr
24 hr
Timepoint

Conclusions:

I found out that…

That 10% of salt (3 g) was too much for the yeast to handle and that 2% salt (0.6 g) was slow to rise at first, but caught up at the end. Some of the flours (whole wheat and rye) deflated between 12 hours and 18 hour timepoints.

The pH steadily changed from jar to jar with different flours and salt amounts. The most acidic (lowest pH) were the White All Purpose Flour jars and White All Purpose Flour with 2% salt jar #1. The least acidic (highest pH) were the jars with 10% salt, which was probably too much salt for the yeast to handle.

I was surprised that…

That 2% salt started slower but in the end caught up and had the highest rise.

After my experiment, I read that there is some reaction between salt and gluten that makes the risen dough stronger. (Bread Science: The Chemistry and Craft of Making Bread by Emily Buehler)

If I did this project again…

I would do more research on pH. I focused a lot on how yeast grows and how salt and flour affected it, but less on acidity/pH.

Bibliography

1. Buehler, Emily. (2006). ***Bread Science: The Chemistry and Craft of Making Bread*****. Carrboro, North Carolina: Two Blue Books.**

2. Hamelman, Jeffrey. (2004). ***Bread: A Baker's Book of Techniques and Recipes.*** **Hoboken, New Jersey: John Wiley & Sons, Inc.**

3. Pallant, Eric. (July 4, 2024). ***The Whys of Ryes.*** **The Perfect Loaf. https://www.theperfectloaf.com/the-whys-of-ryes/**

4. Chin, Tim. (March 22, 2023). ***The Best Flour for Sourdough Starters*****. Serious Eats. https://www.seriouseats.com/the-best-flour-for-sourdough-starters-an-investigation**

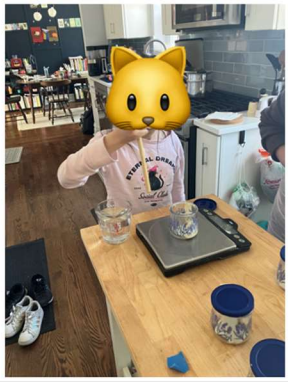
Daily Log

February 21, 2025 – Friday

My mother fed the sourdough starter some new flour and water to prepare for our experiment.

February 22, 2025 – Saturday

Today we are going to start doing the experiment. We found 15 jars that are the same size. We measured each ingredient precise using a scale, no measurement was different. We started the experiment at 11:30 a.m. We put tape on the side of each jar so we can draw a line to measure the sourdough's rise in height at each time point up to 24 hours. We also used pH test paper to measure how acidic the sourdough was at each time point. We measured again at 5:30 p.m., 11:30 p.m., 5:30 a.m., and 11:30 a.m. My parents helped me measure the 11:30 p.m. and 5:30 a.m. because I was asleep.



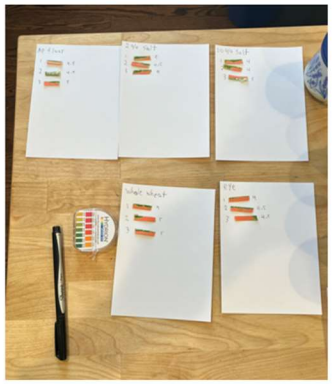
Step 1: Put 10 g of sourdough starter in a jar, over a scale. Then put 10 g of water in the jar.

Step 2: Measure 10 g of flour and put it in the jar with the starter and water.

Measure salt (3 g for 10% salt jars and 0.6 g for 2% salt jars).

Step 3: Mix the starter, flour and water together. Mix until only one color remains and all the ingredients are mixed.

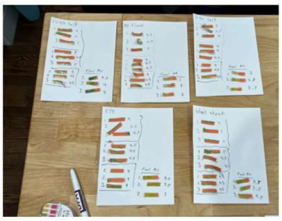
Step 4: Measure the height of the dough, draw a line, this is the starting point of the rise.



Step 5: Dip the pH test paper in the dough, this is to measure acidity levels in the dough. The paper should turn a different color. (0 being the most acidic and 6 being the least on the scale we used)

Step 6: Cover the jar and wait for 6 hrs for the sourdough to rise and the pH to change.

Step 7: Repeat steps 4-6. When you come back this will be timepoint 6 hrs, then wait another 6 hrs, timepoint 12 hrs, do steps 4-6, then another 6 hrs, timepoint 18 and then the last 6 hrs of waiting, time point is now 24! Make sure to do steps 4-6 after every 6 hrs of waiting.

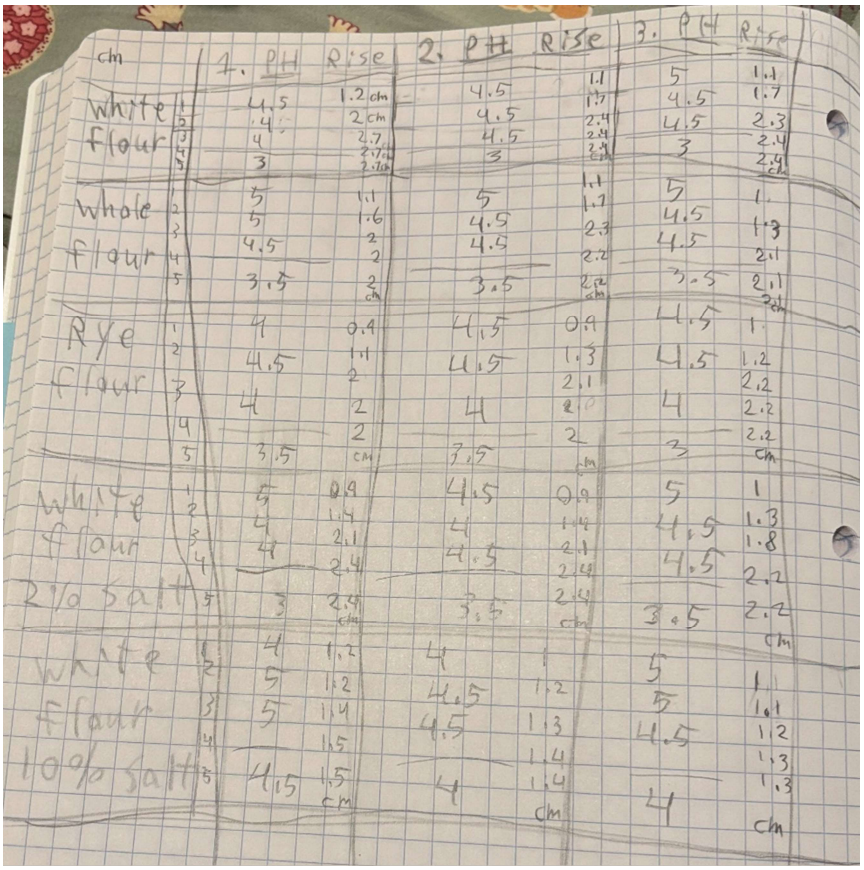


Step 8: You now have sourdough that you measured the rise and took the pH of!

February 23 2025 – Sunday

Today we finished the experiment. We used a ruler to measure the heights of all the sourdough starters at different time points and I copied the pH numbers from paper to notebook. Then we made yummy crumpets from all the starter – except from the 10% salt starters. It was delicious!

Here are my data recordings:



February 25 2025 – Tuesday

We kept the 10% salt starter around to see if it would eventually grow but even after 2 extra days there was no change in growth. I think we killed the starter with too much salt. We threw it away.