“The Science of Pizza” Activity (2023)

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Instructions

Use the file “The Science of Pizza – Presentation" or a set of “Tabletop flyers” to guide the discussion with participants. If using the power point presentation, it is best that you download a copy, so the graphics stay in place.

While presenting “Slide 2” ask students if they like pizza, perhaps by a show of hands. Just get them interested in the topic. Then ask them where they would go to get pizza. They can suggest going to a restaurant, delivering it, buying frozen food in the store, or doing it themselves.

The next step is to make them think about the ingredients needed to prepare this pizza, whether they would buy, bake, or make it themselves. Ask about which ingredients would be needed to prepare the pizza. They will suggest many ingredients already included in the slides, and maybe some other ones.

Then ask them about where those ingredients come from? Who help develop and prepare them so they are available to us? The idea is to introduce them to the job of a food scientist.

A food scientist studies the deterioration and processing of foods by using microbiology, engineering, and chemistry. They determine nutrient levels of food by analyzing its content. They look for new nutritional food sources and investigate avenues for making processed foods taste good, safe, and healthy.

Present "Slide 3", and expand on the ideas shown in the slide to say that it is important that we understand how different molecules in foods interact with each other because we can use their properties and interactions to change textures, flavors and how our food looks like it.

Tell them they will have an opportunity to experience how two liquids containing different molecules can come together to form a different texture. Show them the first part of "Slide 4" where "The Reaction" is explained. Then run Demo 1.

DEMO #1 GUMMY WORMS

Concept: **Alginate cross-linking**

Materials	Demo
• Powdered calcium chloride • Sodium alginate powder • Hot Plate/Stir Plate or Microwave Oven • Stir Bar (X2) • 1 L Bottle with cap (X2) • 2 oz cups (# of students in class) • 2 oz cup lids (# of students in class) • Napkins (# of students in class)	

Preparation

2% Sodium Alginate Solution (1L)

- Weigh out 2% (w/v) sodium alginate [20g in 1 L].
- Add 900 mL DI water with a stir bar to a 1 L Bottle.
- On a hot plate set to 100 ºC, slowly add the sodium alginate while stirring constantly.
- Mix constantly (750 rpm) until dissolved.
- Volume up the solution to 1 L with DI water.
- Add 2-3 drops RED food coloring until reaches desired color.

*Alternatively, a microwave oven could be used to assist with dissolving the sodium alginate into water. Just make sure to try to hydrate the powder as much as possible before warming up the water. Then use the microwave to slowly warm up the solution using 30 sec increments. You want to avoid clumping the sodium alginate as it would make it more difficult to dissolve it.

5% Calcium Chloride Solution (1L)

- Weigh out 5% (w/v) calcium chloride [50 g in 1 L].
- Add 900 mL DI water with a stir bar to a 1 L Bottle.
- On a stir plate, slowly add calcium chloride while stirring constantly.
- Mix constantly (750 rpm) until dissolved.
- Volume up the solution to 1 L with DI water.

*Alternatively, a microwave oven could be used to assist with dissolving the calcium chloire into water. Just make sure to try to hydrate the powder as much as possible before warming up the water. Then use the microwave to slowly warm up the solution using 30 sec increments.

Procedure

1. Pour ~15 mL of sodium alginate solution and ~20 mL of calcium chloride solution into 2 oz cups. Lid cups.

2. Hand each student a napkin, one cup of the sodium alginate solution and one cup of the calcium chloride solution.

3. To make gummy worms, have students add CLEAR liquid (Calcium Chloride) to COLORED liquid (Sodium Alginate).

4. Using two fingers, have them immediately lift up some of the gummy solution from the middle of the cup straight into the air.

5. See who can get the longest gummy worm!

   If you would like to see how this demonstration may go with your participants, watch a segment of this lecture of "The Science of Food" FDST 131. Gummy worm demonstration will be shown from 1:03:00 to 1:05:00. Science of Food - Lecture 3 | MediaHub | University of Nebraska-Lincoln (unl.edu)

After participants have completed the first demonstration, then show them the second part of "Slide 4" so they see real food applications of the reaction they just experienced.

Move on to show "Slide 5" and present all the information included in this slide. If participants are not familiar with the concept of pH, you could help them relate to it by talking about acidic products, that have low pH, like lemon juice, orange juice and vinegar. And other foods that are not acidic and have a relatively high pH, such as corn, potatoes or carrots.

Then present "Slide 6" to show students how the protein in the milk can be separated because of a change in electrical charges due to pH changes. This leads to the production of cheeses like ricotta cheese. If desired, a commercial sample of this cheese could be part of the demo, as not all students may be familiar with this type of cheese. Run Demo 2.

DEMO # 2 CHEESEMAKING

Concept: Milk proteins (casein) coagulation upon the addition of acid

Materials	Demo
• Whole milk • Vinegar • Water • 100 mL graduated cylinder • Cups • Cheese cloths or 6-inch plastic strainer (small mesh is preferable) • Vinegar and water mixture • Plastic container	

Preparation

- Prepare ~70 ml of different vinegar and water concentrations to teach how milk coagulation occurs due to acid addition. Use a 0% vinegar (only water), 25%, 50%, and 100% vinegar solutions. Make sure each group of students has different vinegar and water concentrations.

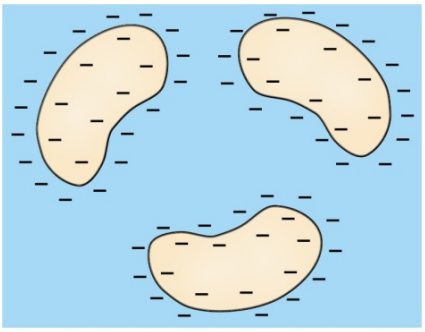
Procedure

1. Pour ~70 ml of milk into a large plastic container.
2. Add the vinegar/water concentration to the milk.
3. Wait for 2 minutes and observe protein separation.

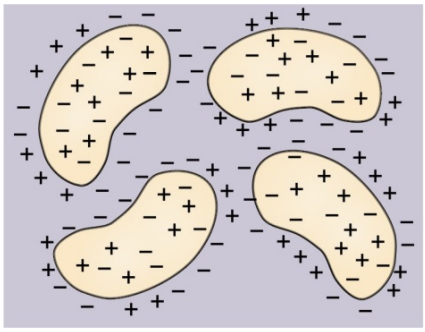
4. Place the cheesecloth or the colander and strain the milk and acid mixture into another container. Cheese should be obtained in certain vinegar/water concentrations.

5. Observe casein separation of all the groups. Ask students who got “cheese” and who didn’t and reflect on their experiment.

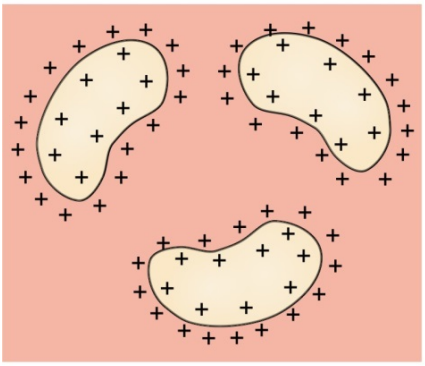
*Note that students that receive the 100% vinegar may not observe protein precipitation, as the precipitation of the protein can be reversible in the presence of too much acid. So if all works well, the 0% vinegar and 100% vinegar groups will not observe protein precipitation, while those using 25 and 50% vinegar should see the most. As a reference the figure below shows the reversible effect of pH on protein precipitation.



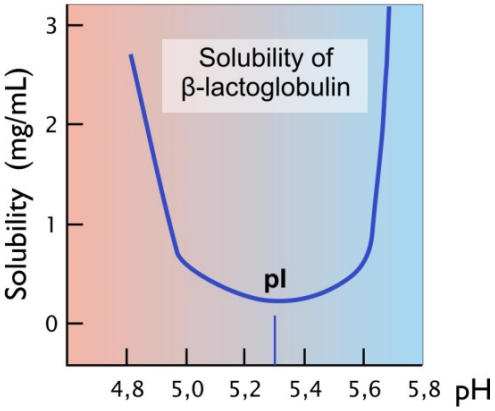
a) At pH values above the isoelectric point the protein is negatively charged



b) pH=pI, the number of negative and positive charges is equal



c) At pH values below the isoelectric point the protein is positively charged



d) pH-dependence of the solubility of the β-lactoglobulin protein

Demo # 2: Simple steps for making cheese
Complementary Activity for Middle School

Use this activity to demonstrate the basic steps in cheesemaking, and how protein molecules precipitate due to the presence of acid in a solution. If there's a big group of students, use ~30 children to play the role of a protein network in milk. Students hold hands, and happily walk inside an area in the classroom. Another student will have the role of an acid which is described as "sour" or has a "sour face". Instruct the student to enter the area where protein molecules are in solution. Being "sour" makes the student unfriendly to the protein network. As a result of the acid, all protein networks bundle together and try to avoid the acid, forming an interconnected mass. Because of this, they end up coagulating and falling out of the solution. In this way, students can understand how proteins are released from solutions.

Present "Slide 7" in its entirety. Then using the two types of bread prepared according to Demo 3 instructions, ask students to exam the products and compare them. First let them explore on their own and not guide the discussion. Tell them that thy can break the breads to exam the inside texture as well. After a couple of minutes let them share the similarities and differences that they may have noticed between the two products. Ask them if they noticed the bubbles in the inside of one of the breads. Ask them which one they think was leavened with yeast, and which one was not. Reinforce the idea that yeasts consume sugars in the dough to produce gas that is trapped by the gluten proteins, raising the product.

If desired, or if anyone mentions, the discussion could be expanded to include why usually gluten free breads do not have the same expected texture of regular bread. The reason is because in the absence of gluten proteins, gas bubbles cannot be trapped, and the resulting texture of the product is dense.

DEMO # 3 BREAD

Concept: Yeast alters the texture of bread

Materials	Demo
• 454 g of flour • 300 ml of water • 5 g of yeast (Active Dry) • 2 teaspoons of salt • 1 teaspoon of sugar • 2 tablespoons of oil	

Preparation

- Prepare two different pizza crusts: a flat bread and leavened bread. Do not use yeast and apply a resting time for flat bread. Add 5 g of yeast and a 30 min resting time for leavened bread. This recipe yields 4 small pizza crusts.

Procedure

1. Preheat the oven at 350 ◦F.
2. Mix the flour and salt in a container.
2. On a separate container mix water, sugar, and yeast.
3. Mix dry ingredients with wet ingredients and knead for 10 minutes.
4. Let it rest for 30 minutes.
5. Roll out the pizza dough and place it on a baking sheet
6. Bake at 350 ◦F for 15 to 20 min or until slightly browned.

Compare the thickness, texture, and color of both pieces of bread.

Demo # 3: Kneading of Gluten and Gluten-Free Breads
Complementary Activity for Middle School

Use this activity to demonstrate the basic steps in bread making and how air dispersion is different in gluten and gluten-free bread.

Two groups of students will be formed. If there's a big group of students, use ~30 children to play the role of gluten proteins in bread. Students hold hands and can move around the classroom, but they can not let go of their hands because of their strong linking to each other. For the gluten-free bread, students will not hold hands as firmly.

Other students will gently push out the bread students from outside. These students will mimic the process of "kneading" the dough. For the gluten students, they can move but not let go of each other. This way they trap the air (gas) that yeasts produce, forming the holes that are particular in breads that contain gluten.

For the gluten-free bread- students, they don't have a strong hold together so as you "knead" the dough, hand holding is lost, and the gas gets dispersed and doesn't get entrapped by the dough. That's why the bubbles don not get inside the bread network.

Show "Slide 8" to reinforce the role of yeasts and gluten proteins in bread texture. Present "Slide 9" in its entirety. You can also expand by mentioning that thermal processing allows the tomato sauce to be stored for longer periods of time at room temperature, while being safe to consume! Ask them if their parents or grandparents enjoy canning products at home. Run Demo 4.

DEMO # 4 TOMATO SAUCE

Concept: Lycopene in cooked tomato products versus fresh tomatoes

Materials

- 1 can of Dei Fratelli diced tomatoes
- 3 big fresh slicing tomatoes
- 2 glass jars

Procedure

1. Pour the Dei Fratelli diced tomatoes into a jar.

2. Blend the fresh tomatoes for 2 minutes. Make sure it's not too runny.

3. Pour the fresh tomatoes into the other jar.

4. Show both jars to the students. Compare color, viscosity, and odor of both products. Discuss the effect of heat on canned tomatoes versus fresh tomatoes. Ask them which one they would prefer to use for their pizza!

Demo # 5: Pizza Researchers
Complementary Activity for Youth and Middle School

As a wrap-up project, students can make their pizza with the ingredients provided in all the demos. While the pizzas are in the oven, students can further investigate the science behind pizza making. Divide students into groups and assign a research project, saying they are "pizza researchers for the day". Use the handouts and have a list of concepts and relevant videos for each group. Using tablets, students can look up and "research" those ideas to better understand them. Have the students create their own posters and teach their specific topic to the whole group. If students are missing key concepts, fill in the blanks for accuracy and completeness.

Show "Slide 10" to conclude the activity and highlight the work done by food scientists and our contributions to the pizza that we all enjoy!

Students could be invited to follow along using this digital magazine, or provided with the link for later review and recalling of the information:

https://www.flipsnack.com/7B5F5B66AED/digital-magazine-the-science-of-pizza.html (Links to an external site.)

The magazine is best viewed in the "View in full screen mode" option available in the lower right-hand corner of the magazine area.