

# CABBAGE TODAY, SAUERKRAUT SOON



Do you think your food is bacteria-free? Well, think again! It isn't and it's a good thing!

Without naturally occurring bacteria on cabbage, we wouldn't have foods like sauerkraut and kimchee to tingle our taste buds.

But cabbage doesn't just magically turn into sauerkraut in the fields. What conditions are required for the change to occur?

## Goal

To demonstrate how bacteria naturally present on cabbage can change it into the common, fermented food called sauerkraut.

## Activity Time

14 days

## Time to Get Ready

30 minutes

## What You Need

Have the following for each group of 3:

- 1 head of green cabbage (do not use pre-shredded)
- 1 sharp knife
- 3 teaspoons non-iodized table, kosher, or pickling salt
- 1 1.5 to 2-quart bowl
- 1 plate that fits into the bowl
- 1 30 x 30-cm square of cheesecloth
- 1 zippered, plastic 1-gallon freezer bag
- 1 large spoon
- variety of fermented foods such as sauerkraut, pickles, yogurt, kimchee
- 1 jar of commercially prepared sauerkraut (demonstration only)
- 1 vial pH paper or red cabbage pH indicator

## Getting Ready

- The facilitator may choose to chop the cabbage for the participants prior to the meeting.
- The cabbage/salt mixture must be stirred daily and any scum must be skimmed off.
- If a pH meter or pH paper is not available, make pH indicator solution from red cabbage. Liquefy 2 cups of chopped red cabbage leaves and 1 cup of water in a food processor or blender. Strain through cheesecloth or a coffee filter. To use: add 10 drops of cabbage juice to 1 tablespoon of a sample to be tested. Or soak strips of white paper in the cabbage juice. Allow to dry, then dip paper strips into the sample to be tested. Color changes correspond to the following pH values shown in Figure 1.

## Useful Information

Many foods are products of natural fermentation. Yogurt, cheese, and sauerkraut are just a few. Often a series of natural microbes breaks down complex compounds like sugar into simple substances like carbon dioxide and alcohol, and changes one food into another. Some bacteria produce acid in air-free environments as they grow. The acid and alcohol are toxic to food-spoiling microbes and can act as natural preservatives.

Different foods like cabbage, cucumbers, and grapes host different microbes. The microbes found naturally on cabbage produce a variety of acids and alcohols in air-free environments. Sauerkraut's flavor is the result of these chemicals. Salt draws water and sugars from the cabbage. The microbes use the sugars to make acids. With the right saltiness and temperature, the bacteria change the color, consistency, smell, and flavor of the cabbage. Sometimes these fermented foods are seasoned. For example, kimchee is fermented cabbage seasoned with garlic, red peppers, and ginger.

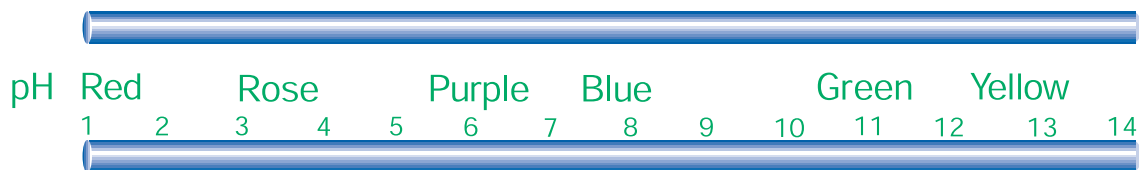


Figure 1. Color values that correspond to pH values for red cabbage indicator.



## Suggestions to Modify the Activity for Those Who Are Exceptional

Specific modifications for this activity are found here. For common considerations when modifying activities for exceptional participants, see page V of the **Introduction**.

### Blind or Visually Impaired

- Utilize the **Introducing the Activity** and the **Useful Information**. These sections contain well-defined questions and references for participants with visual impairments. Using the senses of smell, touch, and taste will allow the participant to understand the purpose of this activity.
- Follow the instructions recommended in the activity for group work. The steps and procedures are basic. This will allow the participant to follow voice instructions. Assign tasks where possible.
- Use a cheese grater in place of a knife if participants shred the cabbage.
- Provide detailed group discussions to develop an understanding of pH levels. Refer often to the color. Individuals who are blind have a good understanding of color and will appreciate the detailed observations. Have participants use descriptive terms, such as "fiery red" or "green grass."

### Deaf or Hard-of-Hearing

- See the **General Modifications** for *Blind or Visually Impaired* listed in the **Introduction**, page V.

### Mobility Impaired

- See the **General Modifications** for *Mobility Impaired* listed in the **Introduction**, page V.

### Physically Impaired

- Provide a cheese grater in place of a knife if participants will cut the cabbage. A larger and wider handle on the spoon may also be adapted.

### Cognitively Impaired

- See the **General Modifications** for *Cognitively Impaired* listed in the **Introduction**, page V.

## For More Information

Access Excellence. Teaching Ideas. Mixed-plate biology, Hawaiian style: kimchee fermentation. <http://www.gene.com/ae/atg/released/0275-JeanineNakakura/index.html>. This site is dedicated to teachers and provides lesson plans, resources, and an activities exchange for biology curriculum.

Brody, J.E. (1998). Adding cumin to the curry: A matter of life and death. *The New York Times*, CXLVII(51,085).

Burros, M. (1995). The virulent *E. coli* found in salami. *The New York Times*, CXLIV(49,952).

## How to Start the Activity

Show the participants the sauerkraut and a head of cabbage. You might ask, "What if I told you these are the same thing?" Have the participants use their senses of smell and vision to identify how the sauerkraut and the cabbage are alike and different. Have them develop an explanation for why they are different. Guide their discussion to the presence of natural microbes on the cabbage and how under air-free conditions they change the cabbage into sauerkraut.

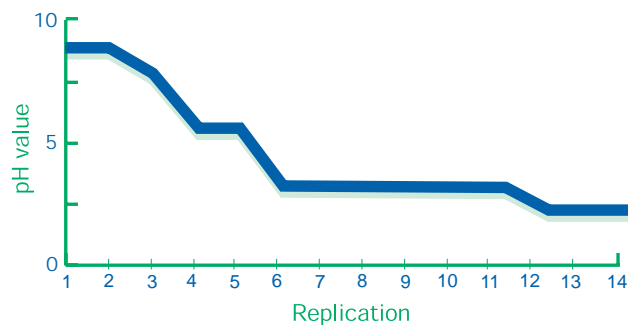
## Let's Make a Hypothesis

Discuss the following questions to help guide the participants to make hypotheses.

- What product does the bacteria on cabbage produce during fermentation?
- What if you didn't shred the cabbage?
- What if you did not trim the damaged leaves from the cabbage?
- What if you used too much salt?
- What if you used another shredded vegetable instead of cabbage?

## What the Data Mean

### How does the pH of cabbage change over time?



**Figure 2.** Change in pH during the incubation period. As the cabbage ferments, the pH decreases and then levels off.



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## Questions to Think About

Kimchee and pickles are just two of many fermented foods. How many others can you name? Can you describe them? How are they different? How are they similar? How are they made? What special environmental conditions are necessary to make them? How can you find answers to these questions?

## Safety Notes

- Wash hands before and after touching the fermenting cabbage.
- Discard the sauerkraut at the end of the activity.
- Food, drinks, and gum are not allowed.
- Use the knife carefully when shredding the cabbage. Cut away from your body.
- Do not eat the cabbage/sauerkraut.

## What to Do

1. Carefully examine the head of cabbage. Do you see any organisms on the leaves? Does that mean the leaves do not have organisms on them? Trim the cabbage head, removing any damaged leaves. Look again. Did you expose anything that looks like an organism?
2. Shred the cabbage and place it in a large bowl. Liberally sprinkle the cabbage surface with 3 teaspoons of salt. Compress the mixture slightly. Cover the cabbage with a clean plate. Weigh the plate down with a zippered, plastic 1-gallon freezer bag filled with water. Cover the bowl, plate, and freezer bag with cheesecloth to prevent insects from contaminating the mixture. Place in a warm, dry place. The temperature should be consistent at approximately 21°C (75°F).
3. Stir the cabbage/salt mixture each day. If the water has scum on top, skim it off. Observe changes in odor, color, texture, and pH on days 2, 7, and 14. Graph your results. Be sure the plate remains weighted to compress the cabbage and maintain as much of an air-free environment within the bowl as possible.
4. After you check the pH of the cabbage, taste one of the other fermented foods. How would you describe its taste? What is its pH? How does it compare with the pH of the cabbage?
5. What questions come from your results? To what other topics is this activity related? What did you learn from this activity? How does this activity relate to your life? What factors influence fermentation?

6. How can you learn more about fermentation? What factors could you manipulate to alter your results? What role did the salt play? Did the type of salt, such as pickling versus table salt, make a difference? What if you had used sugar, instead? What if you left the cabbage-salt mixture exposed to air?

7. Design a new experiment based on data you gathered or questions you asked during this investigation. Develop a hypothesis that can be tested in a controlled experiment that gathers quantitative data. Write a procedure in a numbered list to test your hypothesis. What is your control? What variables are important? How many trials have you included? What will you measure? How can you show your results in a graph?

## What Did You Find Out By Doing the Activity?

Before doing "Cabbage Today, Sauerkraut Soon," did you know:

- why things taste sweet or sour?
- that sauerkraut is made from cabbage?
- that the same food can take many different forms?

From this activity, did you discover:

- that the same food item, such as apples, can take different forms (apple sauce, juice, cider, vinegar, etc.)?
- how sauerkraut is made from cabbage?
- how to find out what ingredients make sauerkraut taste different from cabbage?
- how to make sauerkraut at home?
- how to make other foods change form through fermentation?
- if the fermented foods you eat can grow mold?
- how refrigeration or some other method of preservation prevents mold from growing?

