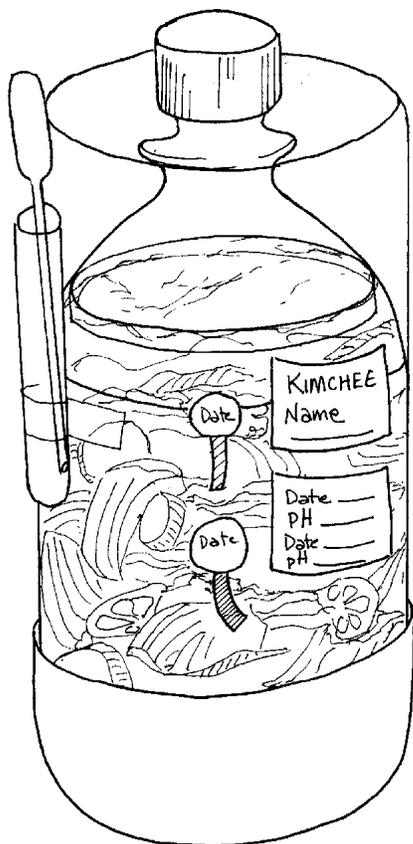




Kimchee: The Korean Delight

Pickling is one of the most ancient forms of preserving food. It involves the microbial conversion of sugars into lactic acid through the growth and activity of acid-forming bacteria known as *lactobacilli*. As *lactobacilli* grow, they convert the natural sugars in plant juices into lactic acid. Under the high acidity (low pH) created by the *lactobacilli* other food spoiling organisms cannot grow. *Lactobacilli* are found almost everywhere in our environment and are known as anaerobes because they grow under conditions in which oxygen is lacking.

Many foods can be preserved through natural pickling. Some common ones are sauerkraut, yogurt, dill pickles, and silage for cattle. The ancient Chinese and other cultures learned the value of pickling thousands of years ago. Today a spicy pickled Chinese cabbage product known as kimchee is a major part of the diet of Koreans.



You and your students can make kimchee and study lactic acid fermentation in a 2-liter bottle by using the following recipe and procedure.

Ingredients

- 1-1 1/2 kg head of Chinese cabbage (*Brassica rapa*, also called napa or petsai), cut leaves into 5-7 cm chunks
- 1 hot red chili pepper, chopped (or hot chili powder)
- 2 cloves garlic, thinly sliced
- 3 tsp non-iodized (or pickling) salt

Materials

- two 2-liter soda bottles
- large lid (92 mm diameter) of a plastic petri plate
- pH indicator paper
- small plastic pipette

Procedure

1. Cut each of the soda bottles as indicated in Figure 1. Cut the top of the second bottle just below the shoulder. This top will be used to form the sliding seal (see step 4).
2. Alternate layers of cabbage, garlic, pepper and a sprinkling of salt in a soda bottle, pressing each layer down firmly until the bottle is packed full.

Caution: When working with chili pepper, take care not to touch eyes or mouth. Wash hands thoroughly when finished.
3. Place petri dish lid, rim side up, on top of ingredients and press down again (Figure 2). NOTE: Within a few minutes liquid begins to appear in the bottom of the bottle as salt draws liquid from the cells of the Chinese cabbage.
4. Press down occasionally for an hour or two. After that there should be sufficient space to fit the lid cut from the second bottle inside the first, forming a sliding seal (Figure 3).

Kimchee ...

TRY IT, YOU'LL LIKE IT!

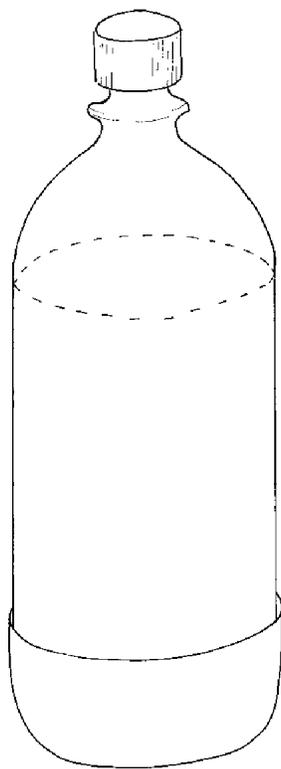


Figure 1

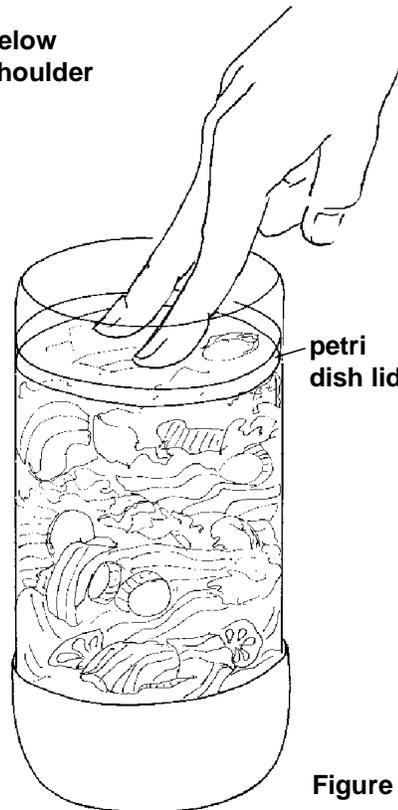


Figure 2

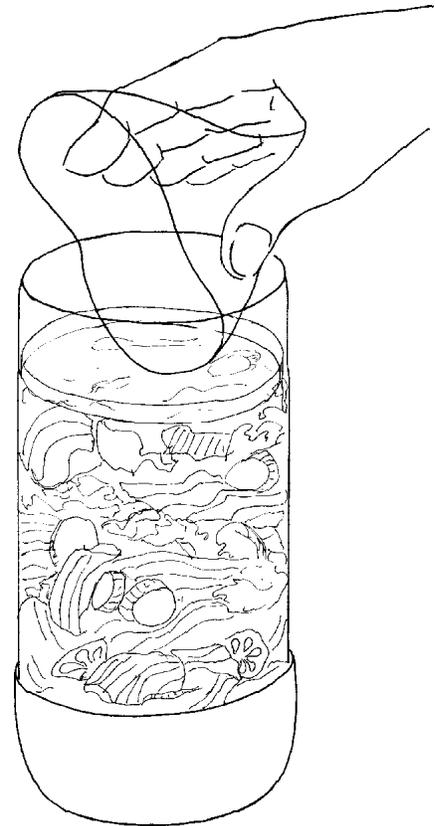


Figure 3

5. Upon pressing firmly with sliding seal, cabbage juice will rise above the petri plate and air will bubble out around the edge of the petri dish.
6. The Chinese cabbage will pack 1/2 or 2/3 of the volume of the bottle. Press daily on the sliding seal to keep the cabbage covered by a layer of juice at all times.
7. Notice bubbles of carbon dioxide gas escape each day when pressed. This gas is produced as lactic acid bacteria grow on the sugary contents of the Chinese cabbage juice in the salty solution.
8. Measure and record the acidity of the fresh juice on top each day with litmus paper. Tape the indicator paper on the bottle and write the pH (acidity level) above it.
9. With a gray line turbidity strip on the bulb of a plastic dropping pipette, each day take a quantity of juice and observe the degree of turbidity representing the growth of lactic acid bacteria in the fermentation solution.
10. Note the increase in turbidity and change in acidity together with the continued production of gas as the pickling process proceeds.

Did you notice the aroma of the garlic and pepper? These ingredients flavor the product. After a few days to a week or more (depending on the temperature), the pH will have dropped from 6.5 to about 3.5, and you will have kimchee.