IFT Experiments in Food Science Series

Microbiology in Food Systems

Activity #2

Root Beer Production

A Science Unit for Secondary School Curriculum

Institute of Food Technologists
The Society for Food Science and Technology

TEACHER ACTIVITY GUIDE

Root Beer Production

EXPECTED OUTCOMES

This activity will allow students an opportunity to explore yeast fermentation by producing old-fashioned root beer.

ACTIVITY OBJECTIVE

This experiment will illustrate to the student that fermentation processes, as in yeast fermentation, can be used to produce a naturally carbonated beverage.

ACTIVITY LENGTH

Approximately 30 minutes for setup and 1–2 weeks to conduct.

SCIENTIFIC PRINCIPLES

Traditional root beer was naturally carbonated by the action of yeast. This action is known as fermentation, a process that converts sugars into alcohol and carbon dioxide.

MATERIALS REQUIRED

4-liter (1-gallon) plastic container for food
1 package of brewing yeast (not bread yeast)
Root beer flavoring extract, 15–20 mL
Sugar
Warm tap water (37°C)
6–8 plastic, 2-L soft drink bottles with caps
5% bleach rinse to clean bottles
Stirring spoons
Balance
Permanent marker

STUDENT EXPERIMENTAL PROCEDURE

1. Dissolve 0.12 g (1/4 tsp) of yeast in 250 mL of warm water (37°C). Let this mixture stand for 5 minutes or longer.

2. With the permanent marker, mark the plastic container at the level where 4 L of liquid would be.

3. In the plastic container, combine root beer extract and 45 g of sugar with sufficient warm water (37°C) to dissolve the sugar (approximately 2 cups). Use 15–30 mL of extract, depending on your personal taste preference for root beer flavor. Refrigerate the leftover extract.

4. Taste for overall flavor. Add more sugar or root beer extract to suit your taste.

5. Add the yeast mixture. Make sure that the yeast is suspended completely before adding it. Mix thoroughly.

6. Add additional warm water to bring the level to within 8 cm of the top of the container.

7. Wash the soft drink bottles well with detergent and hot water. Rinse with a 5% bleach solution to sanitize. Finally, rinse several times with warm water.

8. Fill bottles with the root beer formula, up to 2.5–5 cm from the top. Tightly secure the caps on the bottles. Lay bottles on

their side to check for leaks. Reseal bottles that show signs of leakage. Bottles not sealed properly may become flat or sour.

9. Age bottles 3–4 days at room temperature (approximately 24°C). Keep them in a cardboard box, with corrugated cardboard between each bottle. If one should explode because of increased gas pressures, the box will contain the spill and the pieces of plastic.

10. After 3–4 days, move the bottles to a cooler (15–18°C), dark place. The total aging process should take at least one week, with 2 weeks improving the flavor. **Refrigerate the bottles before opening them.**

11. As natural carbonation takes place, a slight yeast deposit will form on the bottom of the bottle. When serving the root beer, pour carefully to leave most of the yeast deposit undisturbed. This deposit is not harmful in any way, but it sometimes gives the drink an off-flavor.

12. Taste the products initially, after 5 days, and at the end of the fermentation (10 days). Compare the experimental sample to a commercial root beer for flavor intensity, sweetness, and degree of carbonation, using the following scale: 1 = more, 2 = same, and 3 = less. Enter the data in the table provided.

TEACHING TIPS

- Brewing yeast can be purchased from a local home brewing store or hobby store carrying brewing supplies. Ale yeasts are the best. Champagne yeasts can be used, but tend to cause too much carbonation and internal pressure. Root beer extract can also be purchased from a hobby store.

- Use containers that are specifically for food. Chemical containers, although they may look clean, may still have chemical residues on them. Emphasize the proper water temperature (warm) for CO_2 development.

- If the yeast mixture is not mixed correctly, the carbonation process will be impeded and the end product will not have the proper amount of carbonation.

- Too much sugar can be detrimental to proper yeast growth.

- 5% *v/v* bleach rinse is made by adding 5 mL of bleach to 95 mL of water. Emphasize good cleaning and rinsing of the bottles and caps.

- Fill only to 1–2 inches from the top. Bottles filled too full won't allow enough expansion for the gas. Bottles filled too low will give too much headspace above the liquid, and the gas will escape from the liquid into that area.

- Store the bottles in the refrigerator for only 1–1.5 weeks past the processing time. Although refrigeration slows the fermentation process, it doesn't stop it completely.

- Yeast-carbonated root beer will contain some alcohol. However, it would take 100 root beers to equal the amount of alcohol in one beer!

- Plastic soft drink bottles are less dangerous than glass bottles. The pieces of an exploded plastic bottle do less damage than pieces of an exploded glass bottle.

Also, plastic containers can be squeezed to determine the internal pressure.

QUESTIONS & ANSWERS

1. Why should brewing yeast be used rather than the yeast used to make bread?

Ans. There are many strains of yeast. As yeasts carry out their metabolic function, they produce flavors that are incorporated into the product. Each product is characteristic of the flavor and odor of these different strains. For example, it would be undesirable to have a "bready" flavor and odor in the the root beer. This would occur if common baker's yeast is used.

2. When suspending the yeast, you were to use warm water (37°C). What would happen if hotter or colder water is used? Why?

Ans. Appropriate water temperature not only improves the ability of the yeast to soften and dissolve but is essential in providing the necessary conditions for proper yeast activity. Water that is too cold inhibits and slows the process, whereas water that is too hot could kill the yeast or interfere with optimal fermentation. The end product in either case will be a product with little or no carbonation.

3. What is the purpose of sugar in the formula?

Ans. *Because yeasts are unable to produce their own energy through photosynthesis, they require a carbon source. Sugar serves as this source. Because excess sugar is put into the formula, there is enough for the fermentation process as well as extra for sweetening.*

4. Is it possible to produce a low-calorie root beer using this method? Why?

Ans. Using minimal amounts of sugar will supply the necessary amount of food the yeast will need. The sugar will be nearly or totally consumed by the yeast during the fermentation process, leaving little or no sugar left to contribute to the caloric content. An artificial sweetener can be added to increase the sweetness but cannot be used to replace the sugar, since the bacteria cannot use artificial sweeteners as a food source.

5. What is the natural carbonation process?

Ans. As the yeast consumes the sugars during the incubation or processing time, it converts them into CO_2 and alcohol.

EXPERIMENTAL VARIATIONS

- Try different yeast strains to determine changes in the carbonation, flavor, and odors.
- Substitute other sweetening agents for the sugar and compare end products.

DATA TABLE—Comparison of Experimental Sample to a Commercial Root Beer

Scale: 1 = more, 2 = same, and 3 = less

Time	**Root beer flavor intensity**	**Sweetness**	**Degree of carbonation**
0 days			
5 days			
10 days			