

Student experiment
(10th - 13th grade)

The production of CO₂ during fermentation

🕒 Time: max. 30 min.

Safety:

safety glasses



Instruments:

- Erlenmeyer flask (500ml) with perforated stopper and one-way fermentation attachment
- various stoppers
- Erlenmeyer flask (100ml) with stopper
- water bath (35°C)
- folded filter

Chemicals:

- 0,05mol/L barium hydroxide solution, Ba(OH)₂ (H: 332-302-314; P: 280-301+330+331-305+351+338-309-310)
- cane sugar
- distilled water
- fresh or dry yeast

Experiment:

- Suspend 10g of fresh yeast or 2,8g of dry yeast in 250 ml of distilled water in the larger Erlenmeyer flask. Add 60 g of cane sugar. Seal the Erlenmeyer flask with a perforated stopper, which has been outfitted with an S-shaped fermentation barrier. The valley-shaped half of the glass tube should be filled with distilled water. This keeps atmospheric air and germs out of the apparatus, while allowing rapidly building pressure from CO₂ to escape harmlessly. Place the flask in a 35°C warm water bath for 15 minutes.
- While the flask slowly warms, filter roughly 50ml of Ba(OH)₂ solution into the smaller Erlenmeyer flask and seal it immediately.
- As soon as the yeast shows clear fermentation activity, quickly replace the distilled water in the fermentation barrier with some of the Ba(OH)₂ solution and replace the stopper on the Erlenmeyer flask with the yeast as quickly as possible.
- Use a second stopper to lightly block the fermentation tube.

Observations:

The distilled water in the fermentation barrier shows the clear evidence that gas bubbles are being produced by the yeast. The Ba(OH)₂ solution added to the tube immediately turns cloudy from a fine white precipitate.

Results:

During fermentation, the step from pyruvic acid to ethanal is facilitated by the enzyme pyruvate decarboxylase, which catalyzes the separation of a CO_2 molecule. The pressure in the apparatus builds until the gas pushes its way out of the fermentation barrier by bubbling through the movable distilled water in the tube. Replacing the water with $\text{Ba}(\text{OH})_2$ solution causes a reaction of the $\text{Ba}(\text{OH})_2$ with the escaping CO_2 . Insoluble barium carbonate (BaCO_3) is the result. It is a white, cloudy precipitate, which is constantly mixed by the escaping gas flowing through the tube.
