PARTIAL THERMAL DEGRADATION OF MIXED SACCHARIDES WITH PROTEIN INCLUSIONS

Materials Needed

Chemicals Needed:

sucrose crystals
3 M glucose
protein pellets
solidified mixed esters
4-hydroxy-3-methoxybenzaldehyde
sodium chloride
sodium bicarbonate
water

Materials Needed:

NOTE: This procedure uses special glassware. Do not use any apparatus from your laboratory locker unless specifically instructed to do so.
600-mL beaker
thermometer, 250ºC
10-mL graduated cylinder (or measuring spoons)
100-mL graduated cylinder (or measuring cups)
stirring rod, heavy glass, or a large wood spoon
pitcher or container for water
balance (or measuring cups)
small, disposable plastic weighing dishes or small plastic cups (5 - 10 mL capacity)
aluminum foil
beaker tongs
Hot plate OR Bunsen burners and ring supports with wire gauze
Zip-Lock bags (sandwich or quart size)

Safety

Safety glasses or goggles must be worn in the laboratory at all times.

All labware used in this experiment must be clean and free from laboratory chemicals. Special apparatus, reserved specifically for this experiment will be provided

If this experiment is performed in a chemistry laboratory, all work surfaces must be cleaned and free from laboratory chemicals. Is it advised to cover all work areas with aluminum foil or a food-grade paper covering.

CAUTION: Materials in this experiment will be very hot. Handle hot beakers with beaker tongs. Allow hot plates to cool to room temperature before handling them.

There are no safety hazards associated with the chemicals used in this experiment.

Disposal

Generally, all solid waste materials in this experiment can be disposed in the trash and all liquid wastes poured down the drain with running water.

Procedure

Work in groups of 2 to 4 persons.

Using soap and water, wash all the glassware that is to be used in this experiment. Also, wipe down the benchtop where you are working with a soap solution, wipe clean, and dry with paper towels. This cleaning is extremely important as dirt will interfere with the results of this experiment.

It is recommended that the benchtop be covered with aluminum foil.

Weigh 97 g (1/2 cup) of sucrose and 78 g (1/4 cup) glucose solution into a 600-mL beaker. Add 30 mL water (2 tablespoons or 1/8 cup) and stir to mix.

Heat the mixture on a hot plate (or with a burner), stirring constantly until the mixture starts to boil. (While this is going on, one member of the group should be assembling the rest of the components.) At the boiling point, add 14 g (1 tablespoon) of solidified mixed esters and continue heating and stirring.

When the temperature reaches 110°C, the mixture usually starts to foam. This problem can quickly be solved by quickly stirring the top layers, or by leaving the mixture alone, however, the same action will not work every time.

The mixture should start to thicken at 125°C and turn brown at 128°C. At this point, stirring will become difficult and it is handy to have one member of the group use beaker tongs to hold the beaker while stirring.

When the mixture reaches 138°C, add 0.75 g (1/8 teaspoon) sodium chloride and 83 g (1/2 cup) of protein pellets.

Stirring and heating are continued. One member of the group should obtain a piece of aluminum foil about 30 cm square (one foot square) and lightly coat it with some solidified mixed esters.

Measure 2.5 mL (1/2 teaspoon) of 4-hydroxy-3-methoxy-benzaldehyde and 5 g (1 teaspoon) of sodium bicarbonate into separate small plastic weighing dishes or small plastic cups. Keep these near the reaction mixture until needed.

When the mixture reaches 154°C, the hot plate or burner is turned off and the beaker is removed from the heat and set down near the 30 cm aluminum foil square. Add the 2.5 mL of 4-hydroxy-3-methoxy-benzaldehyde and the 5 g of sodium bicarbonate. Stir the mixture fast to mix the ingredients. Reduce the stirring rate, and allow the mixture to foam. As the foaming mixture reaches the top of the beaker, pour the mixture onto the aluminum foil. Use the stirring rod to scrape the sides of the beaker and to spread the mixture over the foil.

When cool, the mixture can be broken up, placed in Zip-Loc bags, and taken home.

Glassware and work areas can be cleaned with warm soapy water after completion of the experiment.

Please return all apparatus to the designated location as indicated by your instructor.

Reference

This experiment is based on a procedure by R. C. Adams, Journal of Chemical Education, **49**, 536 (1972).

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Teacher Notes

This experiment is the preparation of peanut brittle. The product is foamed, that is, it has a honeycomb-type of texture that is not as hard and sticky as some types of peanut brittle.

Label each ingredient with the "chemical" name of the material using self-sticking labels. Allow the actual label of the ingredient to be visible and readable.

The materials used in this experiment are:

sucrose crystals = granulated sugar
3 M glucose = white Karo syrup (corn syrup)
protein pellets = raw peanuts
solidified mixed esters = margarine
4-hydroxy-3-methoxybenzaldehyde = vanilla extract
sodium chloride = table salt
sodium bicarbonate = baking soda

If measuring spoons are used instead of weighing all the ingredients, you will need:

Measuring cups:
2 ½ cup
¼ cup
1/8 cup

Measuring spoons:
1 Tbs.
1 tsp.
½ tsp.
1/8 tsp.

Use a permanent marker to write the metric equivalents on the measuring devices.