

## STUDENT ACTIVITY GUIDE

### TESTING FOR CATALASE ACTIVITY

*Taken from IFT Experiments in Food Science Series*

#### ACTIVITY OBJECTIVE

Since all enzymes are proteins and have an optimum growth environment, they are subject to destruction as heat is applied. Control of undesirable enzymatic activity in processed fruits and vegetables can be achieved by blanching prior to freezing. This experiment will illustrate to the student that:

1. Enzymes are naturally present in plant tissue.
2. Enzymes can be controlled by altering their environment, e.g., adding heat.
3. Enzyme activity can be simply detected by monitoring its ability to decompose hydrogen peroxide into oxygen and water.

#### MATERIALS REQUIRED

- Small red-skinned potatoes
- Water
- Blender
- Coffee filters
- Beaker (250 mL) or measuring cup
- Plastic medicine cups (30 mL), 7 per group
- Hot plate
- Thermometers, 3-4
- Ice bath
- Test tubes (13 mm x 100 mm), 7 per group
- Hydrogen peroxide solution (3%)
- Dropping pipettes for dispensing the hydrogen peroxide
- Small glass rod, 1 per group
- Wax pencil or marker
- Metric ruler
- Paper punch
- Clock or other timing device

#### BACKGROUND INFORMATION

Enzymes are produced naturally in plant, animal, and microbial cells, and thousands of different enzymes can be found in any cell. Because each enzyme has a very specific function in the cell and is not used up during the reaction, only low concentrations need to be present to achieve a desired effect.

Two of the more heat-resistant and widely distributed enzymes in plant tissues are *peroxidase* and *catalase*. Although peroxidase is more heat stable than catalase, the activity of both enzymes has been used to determine if the blanching procedures are long enough or at a high enough temperature. If both are inactivated, it then can be assumed that other significant flavor- and texture-altering enzymes, such as lipoxygenase, also are inactivated.

The heating time necessary to destroy catalase or peroxidase depends on the type and size of the fruit or vegetable, the method of heating, the temperature of the heating medium, and the pH of the blanch water. If the catalase is not inactivated prior to freezing a product, enzymatic deterioration will continue and undesirable “hay-like” flavors and odors will be noted in the final product.

## **PROCEDURES**

### **PART I – PREPARATION AND HEAT TREATMENT OF POTATO MIXTURE**

1. Number your plastic medicine cups from 1 to 7.
2. Your instructor will prepare a filtered potato mash. Record the “initial temperature” of the mash in your data table. Place 5 mL of the filtered potato mixture into cup 1 and set it aside until later.
3. Your instructor will heat the remainder of the mash on a hot plate. Samples will be removed when they have reached 30, 35, 40, 45, 50, and 55°C and cooled in an ice bath.

### **PART II – TESTING FOR CATALASE ACTIVITY**

1. Number your test tubes from 1 to 7. Place a mark 5 cm from the bottom of each of the tubes. Use a dropping pipette to add hydrogen peroxide to each tube up to the mark.
2. Punch out 7 disks from a clean coffee filter using a hole punch. Dip one disk into the potato mixture in cup 1. Place the disk in tube 1 and push it to the bottom with a glass rod. When the disk reaches the bottom of the tube, remove the rod and begin timing to determine how long it takes for the disk to float to the surface of the liquid. Record the time in the data table. Repeat the procedure for the samples in cups 2-7. Compute class averages and record them in the data table.
3. Graph the average time versus temperature.

## KEY QUESTIONS

1. According to your graph, at what temperature does catalase begin to lose activity.
2. At what temperature is catalase completely inactivated?
3. How could you show that the potato is the source of the catalase enzyme?
4. Could you imagine other ways, besides heat, of controlling enzymatic activity.
5. Why do we mark a line 5 cm from the bottom of the test tube?
6. Would you expect catalase to be inactivated under normal blanching conditions for potatoes (60-65°C)? Why or why not?

## Data Tables

### The Effect of Heating on the Activity of Catalase in Potatoes

Tube #	Temperature Reached (°C)	Time (sec)	
		Group Data	Class Average
1 (initial)			
2	30		
3	35		
4	40		
5	45		
6	50		
7	55		

