18 DETERMINATION OF RATE OF OXYGEN CONSUMPTION IN COCKROACH USING A RESPIROMETER

18.1 INTRODUCTION

Aerobic organisms require a continuous supply of oxygen for the conversion of nutrients into energy. Carbon dioxide and water are the end products of the respiratory matabolism. In effect the utilisation of oxygen and release of CO_2 are the two major components of respiration in living organisms. In this experiment you will attempt to quantify the rate of oxygen consumed by an insect using a simple respirometer. Aerial respiration is studied by manometric techniques. Warburg's manometer is the instrument of choice for such studies. But this instrument is quite expensive and you may construct a simple device of your own to make measurements of oxygen consumption in small organisms.

Objectives

At the end of this exercise, you should be able to:

- construct simple devices for measuring certain of biological activities
- measure the rate of respiration in small organisms using simple respirometers

18.2 MATERIALS REQUIRED

4 oz. bottles – 2

One holed rubber stopper – 2

2ml. graduated pipette – 2

Filter paper bits

Small pieces of wire gauze (about 1" square)

15% KOH solution

Cockroaches

18.3 PROCEDURE

1. Fit the 4 oz. bottle with one holed rubber stopper (Fig. 18.1).
2. Insert a 2ml. graduated pipette through the hole in such a way that only 1/5th to 1/4th of the pipette is inside the bottle and rest is projecting out.
3. Place at the bottom of the bottle filter paper bits soaked in 15% KOH solution. A piece of wire gauze may be used to wrap around the filter paper bits so that when the insect is introduced in the bottle it does not come in contact with the alkali.
4. Weigh the cockroach in a balance. Introduce it into the respirometer and close tightly.
5. Prepare a control respirometer (a thermobarometer) without the insect. (This means you will prepare a respirometer similar to the experimental one except that you will not introduce the insect into it.)
6. Immerse both the experimental and control respirometers for equilibration in a tray

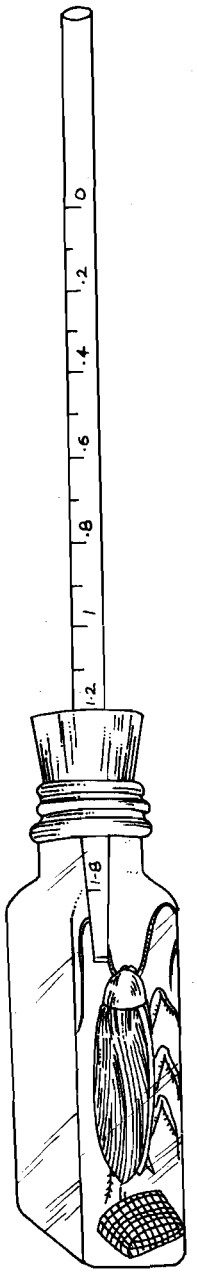

Fig. 18.1: A respirometer.

containing water. While doing so, let the open end of the pipette of each respirometer be outside the water. This procedure equilibrates the temperature between air and water, and takes about fifteen minutes. At the end of the equilibration period submerge the open tip of the respirometers into the water.

Precaution: When the respirometer is immersed, water should not enter rapidly into the graduated pipette. This would suggest leakage in the system. You should have an air-tight device for the success of the experiment. If necessary you may seal the mouth of the bottle with molten wax. Insufficient equilibration may also cause the rapid entry of water into the graduated pipette. In that case, equilibrate the respirometer for a longer period.

18.4 OBSERVATIONS AND RESULTS

Observe the slow entry of water into the graduated tube even as the insect consumed oxygen and the released carbon dioxide is absorbed by KOH. In this experimental set up water in the tray serves as the manometric fluid, and you would observe the water meniscus in the pipette moves continuously. Record the volume of water that has entered into the pipette after one hour. This volume represents the volume of oxygen consumed by the insect in millilitres or cubic centimeters in one hour.

The respirometer is very sensitive to changes in temperature and pressure. This is the reason why you have to set a control thermobarometer. Any volume changes occuring due to changes in temperature and pressure will be recorded by this control device. Note volume changes in the control respirometer and this would represent the correction factor. The correction factor has to be added to or subtracted from the experimental value.

Volume of O_2 consumed by the insect = volume recorded in the experimental respirometer ± volume recorded in the control respirometer

The rate of oxygen consumed per gram weight of the body of the insect per unit time

$$= \frac{\text{Weight of oxygen consumed in one hour}}{\text{Weight of the insect}}$$

= .....ml of oxygen/gram weight of cockroach/hr at the given temperature

SAQ

1. List the problems if any that you encountered while performing this experiment. How did you solve them?

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2. Assuming you want to study the effect temperature on oxygen consumption in the insect, what additional steps you would introduce in the procedure?

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