An Economical Method for Generating and Delivering an Even Flow of CO_2-Gas

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The laboratory exercise "Carbonic Anhydrase" (modified from Maren, 1960) in conjunction with the "Oxygen Dissociation" lab gives the student exposure to various aspects of the gas transport function of blood. The procedure is rather straight forward. The only limiting factor has been the carbon dioxide supply, being too costly for our budget. Two modifications developed in our lab have made it possible to reintroduce this exercise.

The first obstacle to overcome was finding a cost-effective source of carbon dioxide gas. The second hurdle was devising an affordable system which would deliver the gas to the reaction mixture at a controllable even flow rate. The suggestion of sodium bicarbonate and an acid as a low cost source of carbon dioxide gas got us started. The following is a brief outline of the method we now use with the students.

The gas is generated by mixing baking soda and vinegar (1:3, v/v), trapping the gas in a plastic bag, from which most of the air has been removed by flattening it out as much as possible prior to evolving the carbon dioxide gas. (To slow down the rate of the carbonic anhydrase catalyzed reaction, we actually use a 1:1 CO_2-air mixture. This is obtained by taking measured volumes of the generated CO_2-gas and of regular air using a large syringe and transferring these to another plastic bag to arrive at the final gas mixture to be used for the assay.)

With small alterations an aquarium pump is converted to a "closed system." Once alterations are complete the intake tubing of the pump is connected to the plastic bag containing the prepared gas mixture and the outflow tubing is connected to the gas delivery arm of the reaction vessel. Electrically hooked up to a dimmer switch, this pump is transformed into a variable speed pump. The gas mixture can now be delivered to the reaction vessel at an appropriate flow rate, which will remain relatively constant throughout the experiment.

Maren, T. H. 1960. A simplified micro method for the determination of carbonic anhydrase and its inhibitors. Pharmacological and Experimental Therapy, 130(1):26–29.