AN ACCURATE, INEXPENSIVE, CALIBRATED DRINKING TUBE[1,2]

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Frequently in studies on small mammals it is desirable to measure the animals' consumption of fluids. However, accurate measurement of fluid consumption is often hampered by the expense or inconvenience of offering the fluids in calibrated glassware or of weighing the fluid bottles daily. In this paper it is shown how a disposable plastic syringe can be easily modified into an acceptable, yet inexpensive (less than 15¢ for a 10-ml size) calibrated drinking tube.

Disposable syringes with twist-lock tips are modified by passing a ¼-inch drill bit through the tip from the inside (Figure 1A). The opening is then reamed and smoothed by redrilling from the outside with a 5/16-inch bit (Figure 1B). If this redrilling is not performed, rough pieces of plastic will adhere to the opening, leading to the formation of airlocks. Figure 1C shows an unmodified tube and one that has had the standard tip removed by double drilling. A drinking spout is made by cutting 8-mm (outer diameter) glass tubing to the desired length, then rounding the ends slightly in a flame. The appropriate length and shape of the spout is determined by the cage to which it will be attached. A short, straight spout is best if the tube is to be introduced through an opening in the top of a cage, while a longer, curved spout is preferred for introduction through a lateral opening. The spout is attached to the modified syringe with a collar of ¼-inch (inner diameter), clear, flexible tubing (Figure 1D).

The resulting calibrated drinking tube is filled simply by dipping the tip into the desired fluid and pulling the plunger. This allows all tubes to be filled to precisely the same level, thereby eliminating the need to record beginning levels for each cage. Fluid consumption is read directly from the calibrations on the syringe. Readings to 0.1 ml can be obtained from 5-ml and 10-ml syringes, and readings to 0.25 ml can be obtained from larger syringes.

The tubes are easily cleaned by removing the plunger and rinsing with running water, or scrubbing with a tapered pipette brush and rinsing with water or disinfectant. After extensive use, the plungers sometimes become sticky and difficult to operate. This is remedied by the application of slight amounts of silicone high-vacuum lubricant to the rubber portion of the plunger.

To determine the accuracy of these tubes, measurements were made of their evaporative water loss and of their accuracy in actual use. Evaporative water loss was measured by allowing 100, 10-ml tubes to remain on empty cages for 10 days at 22–25°C and 50–60% relative humidity. The mean per-day water loss was 0.17 ml, the standard deviation was 0.04 ml, and the greatest loss was 0.29 ml. The accuracy of measurement with these tubes was tested by having an assistant fill 50, 10-ml tubes to a predetermined level with distilled water at 4°C. Next some water was removed from each tube and weighed on an electronic balance. Then the assistant was asked to record the volume of water removed. An error value was calculated by taking the absolute value of the difference between the weighed value and the assistant's measured value. The mean error

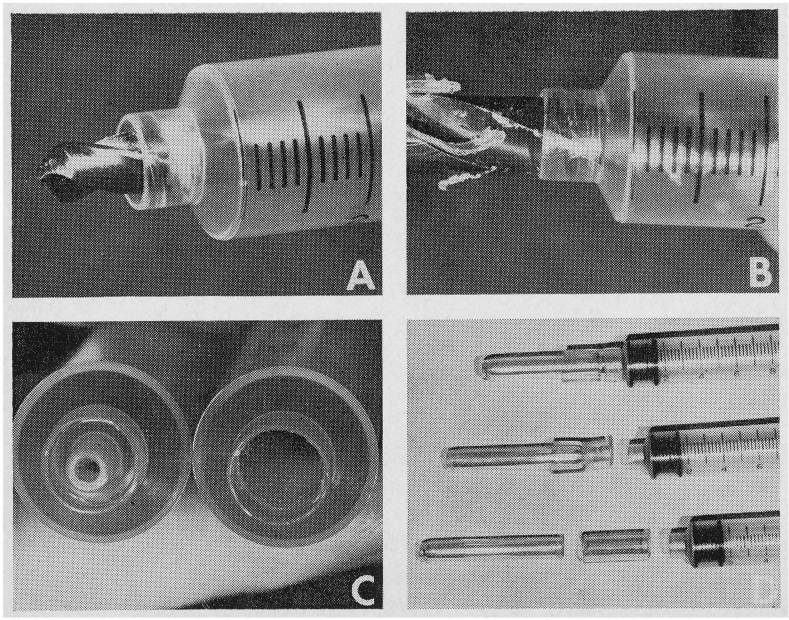

Fig 1. *Steps in conversion of disposable syringe into calibrated drinking tube. A. Drilling tip from inside with 1/4-inch bit. B. Reaming and smoothening opening from outside with 5/16-inch bit. C. Unmodified and modified syringe tips. D. Glass drinking spout and flexible tubing attachment.*

was 0.05 ml, the standard deviation was 0.04 ml, and the largest error was 0.14 ml. The actual (not absolute) errors were found to be symmetrically distributed around zero, indicating no problem with systematic error.

These tubes have been used extensively in our laboratory and have proven to be quite acceptable to the animals. Not once in thousands of mouse-days of use has a tube formed an airlock. The tubes are easy to fabricate, inexpensive, and accurate.

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