

ADVISORY STATEMENT^a:Quick Method for Estimating CO₂ in Cucumber Brines

Commercial cucumber briners are actively interested in evaluating the "controlled fermentation process" recently developed by our laboratory (1). The process includes use of nitrogen for purging of the brine to remove dissolved CO₂ and thereby prevent bloater formation. We devised a method for determining CO₂ in brines (2), but results from the analysis cannot be obtained until the next day. Although our method is highly suitable for use in certain types of brining research, it is desirable to learn the results immediately in some instances, particularly when one is testing the efficiency of CO₂ removal from brine by the purging system.

The Harleco CO₂ Apparatus (3) was designed for rapid (about one minute) determination of CO₂ in blood. By careful handling of the sample, this simple apparatus can be used to determine CO₂ in cucumber brines. It is important to recognize, however, that blood has a pH of about 7.0, while that of fermenting cucumber brines varies between about 5.8 and 3.1. CO₂ is trapped in the bicarbonate form in blood and is not volatile; but, at pH values below 6, as with brines, the CO₂ is highly volatile and easily lost. Extra care must be taken in sampling and analyzing for CO₂ under these conditions. The following procedure is recommended:

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Sampling Procedure:

Samples may be taken from brining tanks through the tank sampling slot by means of the syringe device described previously (2).

Alternatively, samples may be taken through a siphoning arrangement as described herein. "A suitable length of 3/16 inch diameter stainless steel tubing (sealed at one end with lead or solder and perforated with several 1/16 inch diameter holes for a distance of 6 to 8 inches from the sealed end) is inserted through an opening in the false head, down into the brine toward the center of the vegetable material," (quoted from Etchells and Jones, 1946, ref. no. 4). A rubber tube is connected to the end of the steel tubing extending above the brine surface. The other end of the tube is fitted to a glass "T" connector which, in turn, is connected to another piece of rubber tubing of sufficient length to extend over the side of the tank and below the brine surface. The steel tube can be raised or lowered in the tank to take samples from various depths. The "T" is capped on the open side with an appropriate size rubber serum stopper. To obtain a sample, siphoning action is begun. After allowing brine from the tank to flush out the tubing, an 8.5 ml sample is taken through the rubber septum of the "T" by means of a 12-ml plastic, disposable syringe (20 gauge needle). The brine sample is drawn slowly to prevent loss of CO₂ from solution and is injected immediately into a Vacutainer tube (10 ml draw, Becton-Dickinson, ref. no. 5). These tubes contain 0.5 ml of about 3 N NaOH, which must be added to them prior to adding the brine sample. Important: the flow of brine through the glass "T" will not contain bubbles unless

there is an air leak in the system; avoid this! The sampling arrangement is shown in Figure 1.

Analysis:

Samples contained in the Vacutainers should be taken into the quality control laboratory and allowed to equilibrate to the same temperature as the standard prior to analysis. Follow the procedure outlined in the brochure which accompanies the Harleco Apparatus for the analysis. The procedure calls for determining a standard with each set of samples. It is important that the temperature of the sample and the environment in which it is analyzed be the same as for the standard.

Calculations:

The Harleco instructions for calculation result in concentrations being expressed as millimoles of CO₂ per liter, which is common terminology used in clinical chemistry. The conversion to concentration in terms of mg/100 ml brine, which has been used in our previous work (6,7), may be obtained as follows:

$$\text{mg CO}_2/100 \text{ ml brine} = \text{mmol CO}_2/\text{liter} \times 4.4$$

if the sample is analyzed directly. However, if the sample is stored in a Vacutainer containing 0.5 ml NaOH prior to analysis, as we recommend, the appropriate calculation is:

$$\text{mg CO}_2/100 \text{ ml brine} = \text{mmol CO}_2/\text{liter} \times 4.66$$

Note:

Concentrations of CO₂ in controlled fermentations (1) of cucumber brines may reach 80 to 100 mg/100 ml brine (ca. 18 to 23 mmol/liter) unless the brine is purged. Natural fermentations predominated by yeasts or high gas-forming bacteria may attain

values well over 100 mg/100 ml brine. It is recommended in the controlled fermentation process that the brine be purged with nitrogen gas to prevent the CO₂ concentration from reaching values over 20 mg/100 ml brine (1).

References Cited

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2. Fleming, H. P., Thompson, R. L. and Etchells, J. L. 1974. Determination of carbon dioxide in cucumber brines. *J. AOAC*, volume 57: 130-133.
3. Harleco CO₂ Apparatus. Harleco, 60th Woodland Ave., Philadelphia, Pa. 19143.
4. Etchells, J. L. and Jones, I. D. 1946. Procedure for bacteriological examination of brined, salted and pickled vegetables and vegetable products. *Am. J. Public Health*, volume 36: 1112-1123.
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7. Fleming, H. P., Thompson, R. L., Etchells, J. L., Kelling, R. E., and Bell, T. A. 1973. Carbon dioxide production in the fermentation of brined cucumbers. *J. Food Sci.*, volume 38: 504-506.

Acknowledgments

R. G. Switzer, Western Canning Company, LaJunta, Colorado, has tested the Harleco CO₂ Apparatus independent of our work and confirmed that it is a practical, easy-to-use method for measuring CO₂ in cucumber brines.

Mention of a proprietary product does not necessarily imply endorsement by the U.S. Department of Agriculture or the North Carolina Agricultural Experiment Station.

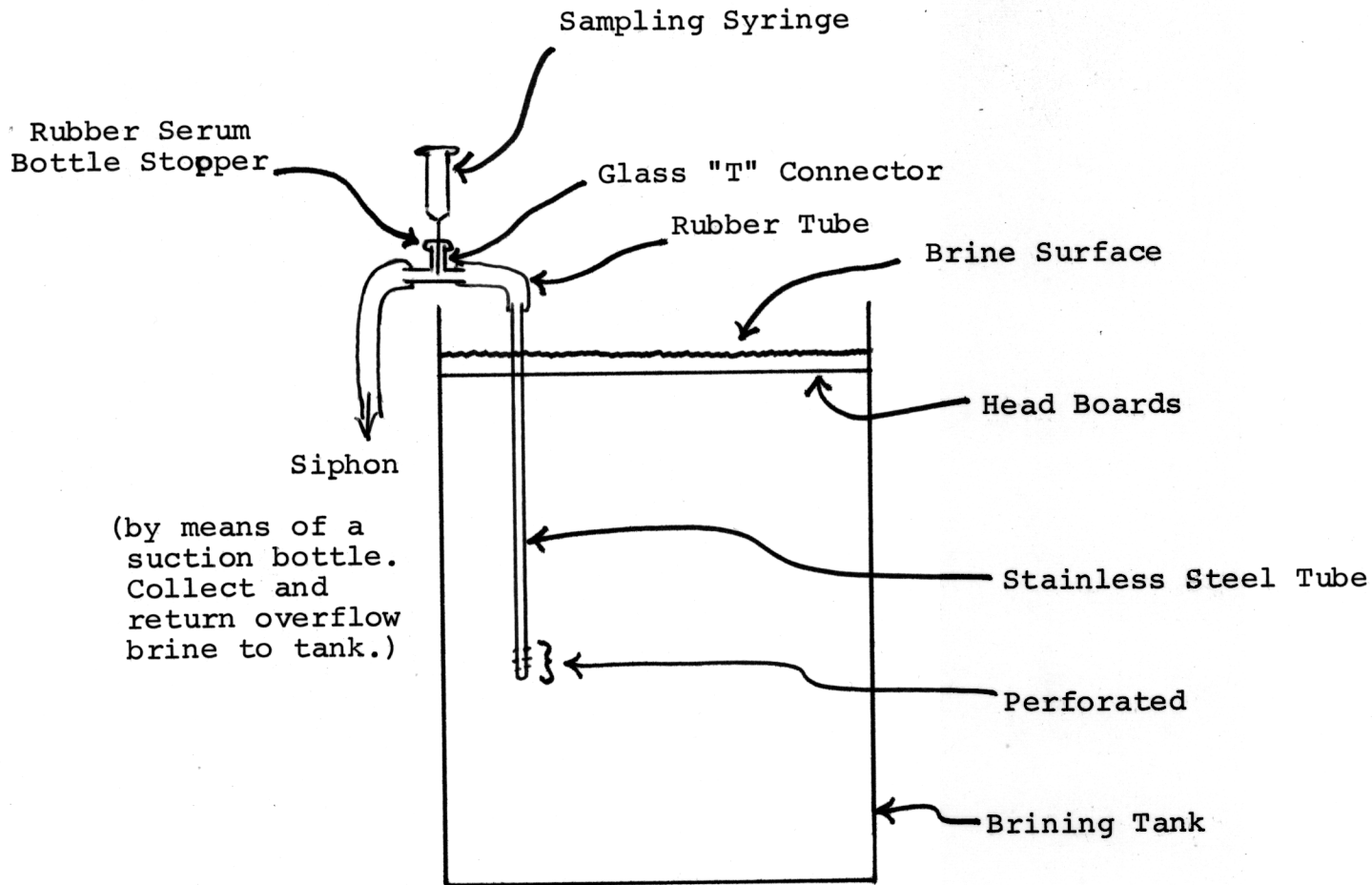


Figure 1. Device for withdrawing brine samples for CO₂ analysis from a cucumber brining tank. Not drawn to scale.

