ADVISORY STATEMENT:

INFORMATION ON THE NATURE AND USE OF AN IMPROVED SYSTEM FOR RECORDING QUALITY CONTROL DATA DURING THE BRINING OF CUCUMBERS.[1]

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[1]This material was prepared by: John L. Etchells, Head, U.S. Food Fermentation Laboratory, USDA, Southern Region, Raleigh Area, ARS, and Professor, Departments of Food Science and Microbiology, North Carolina State University, Box 5578, Raleigh, North Carolina 27607; and, Lloyd H. Hontz, Vice President, Mount Olive Pickle Company, Mount Olive, North Carolina 28365, USA.

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INTRODUCTORY STATEMENT

The attached card, designed for reporting quality control data during the fermentation and storage of brined cucumbers, including evaluation of cured brine-stock, has been especially prepared for the pickling industry. The card is divided into four Sections; two are on the front side and two on the reverse: (I) The material brined--amount and sizes, etc.; (II) Quality of the cured brine-stock as to; (A) Firmness and (B) Bloater content; (III) Suggestions for 10 determinations to be made on the brine during fermentation and storage; and, (IV) Provisions for plotting data from the fermentation (such as brine acidity, pH, salt, and temperature). By plotting the data mentioned, one can see at a glance the progress of the fermentation as to development of brine acidity, changes in brine pH, brine strength (NaCl), and brine temperature. Also, there is space to record the results of analyses for several other brine constituents if facilities and trained personnel are available.

We can already hear some people say, "This is too much for me; I can't do that graph stuff!" Nonsense! If you can count "ten over" and "ten up", you are in business! The fact that there are four items to plot (acid, pH, salt, and temperature) need not be a problem; take them one at a time! Each item, such as "% Acid as Lactic", has its own "ordinate" which is the <u>vertical</u> part of the graph. All items have a common "abscissa" which is the <u>horizontal</u> part, and is labelled "Fermentation Age in Days". We believe those persons that try, will find the results most rewarding because, instead of looking at long columns of numbers that tend to become blurred and meaningless, you will see emerging from this multiplicity of numerals, definite curves representing the progress of the brine fermentation of cucumbers (or other vegetables).

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We realize that this reporting procedure for following the fermentation changes during the brining and salting of cucumbers, including graphing facilities, may not be of any great challenge to some of our pickle plants that have well equipped quality control laboratories, manned by capable food scientists. Even so, many plants do not have such facilities or personnel but are in need of better methods to record and graphically present brining data as well as evaluate their cured, brine-stock pickles.

This particular card, dealing with "Quality Control for Brining and Salting Cucumbers", as you may have noticed, mentions additional properties of the brine that have not routinely been measured or determined by the pickling industry. These tests will become more and more important as time goes on--particularly so, as we advance to controlled fermentation of cucumbers brined in bulk using pure culture starters. This procedure will be released in the near future, but for the present, particular attention should be paid to the new brining procedure, based on the temperature of the cucumber-brine-mass. A detailed description of this brining procedure appears in the current issue of Pickle Pak Science (Vol. II (1): 18-19, 1972, published by Pickle Packers International, Inc., St. Charles, Illinois 60174). This procedure has been tested for the past six years under commercial conditions in several geographical locations of the country. Current brining studies under commercial conditions show that, with several important but practical modifications directed chiefly to the control of undesirable microbes, it will become the basis for controlled fermentation of cucumbers, brined in bulk!

Thus, slowly but surely, we are moving the brining process from the "Art" toward the "Science". We are not impressed with reams of figures on salometer readings and acidity tests on brines. Better, we believe that emphasis should be put on obtaining and maintaining a given initial equilibrated brine strength for the length of time required to develop a given brine acidity, prior to raising the brine strength. This, as mentioned earlier, is brining according to the Q-BAT[2] procedure, which is listed as a determination in Section III of the Reporting Card.

We realize that no one salting, brining, or quality report card could meet all of the requirements and needs of pickling companies located in various geographical areas of the USA. Even so, we believe that, with the adoption of the newer brining treatments (referred to earlier), food technologists, pickle briners, and others responsible for quality of pickle products will find much they can use in the Report Card being proposed herein. We would expect that concerned companies would revise or modify the card to suit their own operation. We would indeed appreciate comments from users of the Report Card in the interest of improving its usefulness!

EXPLANATORY COMMENTS

Let us examine, as briefly as possible, the four Sections of the report form.

Section I contains the necessary information to answer the following important questions:

1. What sizes of cucumbers are in the tank?
2. Is the tank properly filled (brine to solids ratio)?

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[2]"Quick Brine Acidity Test" (J. Food Sci., Vol. 36: 1036-1038. 1971).

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3. Were the cucumbers covered with brine within a reasonable period?
4. Was the correct amount of salt added on the head and at the proper intervals?
5. From question No. 1 above, did the tank require draining to prevent enzyme softening? If so, was the draining done at the proper time?
6. Were the cucumbers in good condition before brining?

Section II gives us information on the effectiveness of our treatments. A minimum of two samples of brine-stock for bloaters and two for firmness should be drawn. An ideal sample would be one which contained pickles from every level of the tank; this can be done with our Brine-Stock Sampling Tube. Bloater determinations are usually made on the largest uniform size in the tank. Pressure tests are made on one or more uniform size from the tank, and an adjective rating may be objectively made for each size according to the average pressure test values. Earlier studies[3] have shown that as the size of the cucumbers that are brined increases, the firmness of the resulting brine-stock pickles also increases. This amounts to 1 to 1-1/2 lbs. between sizes, depending on how close the grading is within a given size. This is true only where the brined material comes from fermentations considered to be free from enzymatic softening. The tabulated information to follow reflects these firmness differences according to sizes--No. 1, 2, and 3, in the categories of Very Firm, Firm, and, to some extent, Inferior. We consider brine-stock pickles that, by the pressure test, receive Soft or Mushy

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[3]"Varietal Differences in Cucumbers for Pickling", Food Technology, Vol. 8: 415-418 (1954).

adjective ratings, to be essentially the same as to firmness quality, regardless of size. It is also important to note that different varieties can show considerable difference in brine-stock firmness[3], even though all are brined in the same container, and shown to be free from enzymatic softening!

FIRMNESS RATINGS FOR BRINE-STOCK PICKLES

Adjective rating	Pressure test (av. of 20 brine-stock pickles)		
	Sizes[4]		
	No. 1	No. 2	No. 3
	lbs.	lbs.	lbs.
Very Firm	18 and above	19 and above	20 and above
Firm	14-17	15-18	16-19
Inferior	11-13	11-14	11-15
Soft	5-10	5-10	5-10
Mushy	4 and less	4 and less	4 and less

[4]Sizes commonly in use: No. 1 size, up to 1-1/16 inches in diameter; No. 2, 1-1/16 to 1-1/2; No. 3, 1-1/2 to 2. Pressure tests for the No. 1 size were made on stock measuring 1 to 1-1/8 inches in diameter; the range in values shown for No. 1's would be acceptable for the 1-1/16 inch diameter size. For No. 2's and 3's, the pressure test values on uniform stock within the given size ranges shown are acceptable.

Section III - What is the purpose of each of these determinations?

1. Salt Added in CWT (Cumulative): Is the proper amount of salt being added at the right time? How much salt was used on this tank?
2. Salometer Degrees (Top and Bottom) from Tank Test Box: With some methods of adding salt or brine, strong concentrations often appear at the bottom of the tank, while the top salometer readings are much lower. There can be no effective

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control of desired, equilibrated brine strength of a fermentation unless the top and bottom salt tests are fairly close; within 2 to 3° salometer, allowing for temperature differences.

3. Acidity, as % Lactic: This test represents a titration with standard alkali solution on a sample drawn, preferably, from the depth-center of the tank. The results tell us the amount and the rate at which lactic acid is being produced by the fermentation. Although the Q-BAT procedure may be replacing the titration of brine samples in many plants, a limited number of tanks of different sized cucumbers should be titrated to inform us about the rate and total amount of acid development during the fermentation of cucumbers, covering a range of different ages and brine temperatures.

4. Brine pH: This determination reveals the concentration (as to hydrogen ions) of brine acid and the point at which acid production by lactic acid bacteria usually stops (about 3.10-3.15 pH). It, along with acid titration or Q-BAT determination, is a good indicator of the orderly progress of the lactic acid fermentation.

5. Temperature °F.: This sample from the depth-center of the tank is important in determining what degree salometer should be maintained during the holding period prior to the positive Q-BAT determination. Further information about this relationship can be found in the current issue of "Pickle Pak Science", Vol. II (1): 18-19 (1972).

6. Days Needed for a Positive "Quick Brine Acidity Test" (= Q-BAT): When the brine acidity reaches 0.6% as lactic, the Q-BAT turns yellow. After two consecutive daily tests show yellow, then sufficient sugar has been used to permit raising the salt concentration of the brine (5° Salometer per week).

7. Turbidity, or Light Transmittance in %: Turbidity is the result of the growth of organisms in the brine. Here, the lactic acid bacteria and other organisms become so numerous that they interfere with the passage of light through a test tube containing the brine sample. The degree of turbidity is measured on a 5-point subjective scale ranging from "0", which is clear to practically clear, to "5", which is very cloudy or milky, which we cannot see through. Light transmittance, in percent, is measured by a colorimeter. This is the same as turbidity, except that personal judgment is replaced by a measurement with a photoelectric cell. In either case, an increase in turbidity of the brine during the early days of fermentation is a definite indicator that active microbial fermentation is under way. Again, this sample should come from the depth-center of the tank.

8. Reducing Sugars; %: The prime objective of any brining treatment is to convert the natural cucumber sugars to lactic acid by fermentation with desirable lactic acid bacteria. Sugars that remain in the brine after the lactic fermentation stops are usually utilized by fermentative yeasts which produce considerable amounts of carbon dioxide gas; this can cause bloaters (hollow pickle-stock).

9. Microscopical Yeast Count; Thousands/ml: Yeast counts are run on fermenting brine samples. The results indicate the degree of success of the fermentation by lactic acid bacteria in using up the sugars from the cucumbers before the yeasts become numerous enough to produce an undesirable gaseous fermentation.

10. CO_2; mg/100 ml Brine: Carbon dioxide gas dissolves in fermentation

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brines in much the same manner as in champagne or carbonated soft drinks. When the CO_2 concentration is great enough, it enters the cucumber or pickle at high levels and may cause bloaters.[5] Therefore, measurements of the carbon dioxide concentration in the brine can provide useful information relating to the potential bloater production in the tank during fermentation.

Section IV--Fermentation Curves: The purpose of this section is to present graphically the progress of the fermentation in the brine. The development of the brine acid, changes in brine pH, salt concentrations (NaCl), and brine temperature can be observed for the active period of the fermentation and indicate the degree of success of the brining treatment. If top and bottom salometer readings are taken routinely, they should be averaged for a given fermentation date for the purpose of plotting. Some pickling plants may want to substitute values for other tests for the examples shown at the top of the graph (Section IV) and make additional curves from data collected, such as percent reducing sugars, microscopical yeast counts, and carbon dioxide concentrations in the brine.[6]

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[5]"Bloater Formation by Gas-Forming Lactic Acid Bacteria in Cucumber Fermentations", Applied Microbiology, Vol. 16 (7): 1029-1035 (1968).

[6]Procedures for specific tests mentioned herein may be obtained by writing to the authors or to Pickle Packers International, Inc., Box 31, St. Charles, Illinois 60174.

QUALITY CONTROL REPORT FOR BRINING AND SALTING CUCUMBERS

Providing a means of following the active fermentation and evaluating the quality of the cured, brine-stock pickles as to firmness and bloater content.

Company _____ Brining Station _____ Location _____

Tank No. _____ Capacity in Bu. _____ in Cwt. _____ in Gal. _____

Date Filled _____ Time _____ a.m. p.m.; Time Headed _____ a.m. p.m.; Time Brined _____ a.m. p.m.

I. Green-Stock in Tank—Sizes[1] and Amounts. (List Number of Bushels or Hundredweight)

Date added	Size	Size	Size	Culls and Oversize	Total in Tank		Remarks on Stock, Source, Lot No. and Condition
					Bu.	Cwt.	
Total							

[1] Sizes commonly in use: No. 1's, up to 1-1/16 inches in diameter; No. 2's, 1-1/16 to 1-1/2 inches; No. 3's, 1-1/2 to 2 inches; No. 4's over 2 inches.

Salt Added on Head After Brining: 1st Addition _____ lbs; 2nd _____ lbs; 3rd _____ lbs.

Draining: Scheduled Time _____ a.m. p.m.; Actual Time _____ a.m. p.m. Recorded by _____

II. Quality of Cured Brine-Stock Pickles When Tank is Opened or Graded: Date _____

A. Firmness of 20 pickles[1], measured by the USDA Fruit Pressure Tester with 5/16 inch tip.

Sample No. & Location	Pickle Size Tested	Pounds resistance for Pickle Number																			Average (lbs)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
1)																						
2)																						
3)																						

[1] Selected for uniform size pickles, fairly straight, and free from bloaters, crooks, nubs, and 2 or 4 carpels. **Firmness Ratings:** 18 pounds resistance and above = Very Firm; 14 to 17 = Firm; 11 to 13 = Inferior; 5 to 10 = Soft; 4 and below = Mushy.

B. Bloater Content of 50 to 100 Pickles[1]

Sample No. & Location	Pickles		Bloaters Found[1]							
	Size	No. Cut	Balloon Type		Lens Type		H.C.[2] Type		Total	
			No.	%	No.	%	No.	%	No.	%
1)										
2)										
3)										

[1] Selected for fairly uniform size, shape, and 3 carpel development. With balloon bloaters, the carpels separate because of gas pressure and press the tissue toward the skin leaving a large cavity with much loss of liquid from the cucumber tissue. For lens bloaters, the gas pockets are smaller and are lenticular in shape (bi-convex) and usually occur perpendicular to the long axis of the cucumbers.

[2] Honeycomb; consists of a small (2-5 mm diameter) cavity that forms around individual, immature seeds of the cucumber. It is helpful to give an idea of the extent or degree of bloater damage. This can be done by using the letter "A" to mean advanced or extensive damage, with large cavities; "M" meaning moderate damage, less than one-half of the cavity areas as for advanced bloating; and, "S" meaning bloating was slight, but still noticeable. The latter category, as well as the H.C. type of bloating, is not, as a rule, recorded by most pickle companies.

[3] Rating sheets (devised by personnel of the U.S. Food Fermentation Laboratory) for use in evaluating cured brine-stock pickles as to **"Overall Commercial Acceptability"** can be obtained from Pickle Packers International, Inc., P. O. Box 31, St. Charles, Illinois 60174.

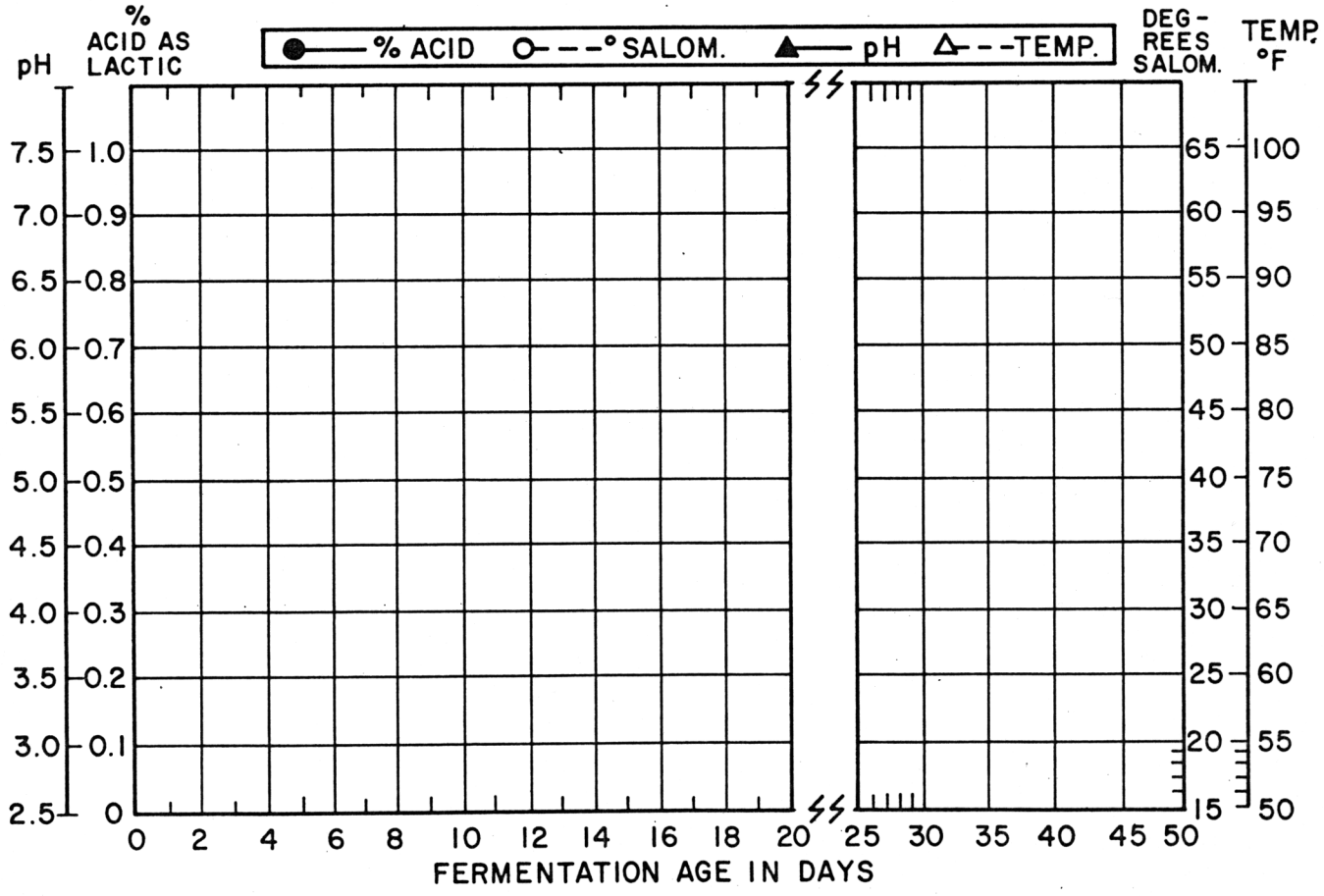
III. Suggested Determinations to Be Made on the Brine; During the Active Fermentation Period and Storage (up to 50 Days).

Determination or Procedure	Write appropriate dates in the spaces provided for the fermentation age in days printed below:																		
	0	1	2	3	4	6	8	10	12	14	16	18	20	25	30	35	40	45	50
Salt added; in cwt[1] (cumulative)																			
Salt; ° Salometer, Top & Bottom T→ B→																			
Acidity; as lactic, %																			
pH																			
Temperature; °F (center area of tank)																			
Days needed for positive Q-BAT[2] (√)																			
Turbidity; visual (0 to 5+); or, light transmittance, %																			
Reducing sugars; %																			
Microscopic yeast count; thous./ml																			
CO_2; mg/100 ml brine																			

[1] For salt additions made on days not shown above, list them with the correct date written above amount of salt. For a 25° salometer treatment that has reached 0.6% acid in about 10 days, the brine strength should be increased 5° salometer per week to the holding strength.

[2] Quick Brine Acidity Test (J. Food Sci., Vol. 36: 1036-1038 (1971).

IV. Fermentation Curves[1] (prepared from Part III data).



[1] If desired, pens using different colored inks can be used for plotting fermentation data, instead of the symbols shown above.

This material was prepared by: John L. Etchells, Head, U.S. Food Fermentation Laboratory, USDA, Southern Region, Raleigh area, ARS, and Professor, Departments of Food Science and Microbiology, North Carolina State University, Box 5578; Raleigh, North Carolina 27607; and, Lloyd H. Hontz, Vice President, Mount Olive Pickle Co., Mount Olive, North Carolina 28365. USA.