

[54] CONTROLLED FERMENTATION ACIDITY OF BRINED CUCUMBERS

[75] Inventors: Thomas A. Bell; John L. Etchells; Raymond E. Kelling, all of Raleigh; James L. Olsen, Chapel Hill, all of N.C.

[73] Assignee: The United States of America as represented by the Department of Agriculture, Washington, D.C.

[22] Filed: May 11, 1972

[21] Appl. No.: 252,409

[52] U.S. Cl. 426/49; 426/231; 23/253 TP; 252/408
[51] Int. Cl. A23b 7/10
[58] Field of Search 99/156; 23/253 TP; 252/408; 426/50, 49

Bell, T. A., et al., Journal of Food Science, 26, No. 1, pp. 84-90, 1961.

Whitehead, T. H., Chemical Abstracts, vol. 53, 21366i, 1959.

Fossum, J. H., Chemical Abstracts, vol. 45, 4599i, 1951.

Riddick, J. A., Chemical Abstracts, vol. 56, 10884d, 1962.

Etchells, J. L. et al., Food Technology, vol. XII, No. 5, pp. 204-208, May 1958.

The Canning Trade, A Complete Course in Canning, 9th ed. 1969, pp. 473-481.

Primary Examiner—A. Louis Monacell
Assistant Examiner—Curtis P. Ribando
Attorney, Agent, or Firm—Irons & Sears

[56] References Cited

UNITED STATES PATENTS

3,236,601	2/1966	Harvill	23/253 TP
3,255,019	6/1966	Engelland	99/156
3,374,099	3/1968	Bell et al.	99/156

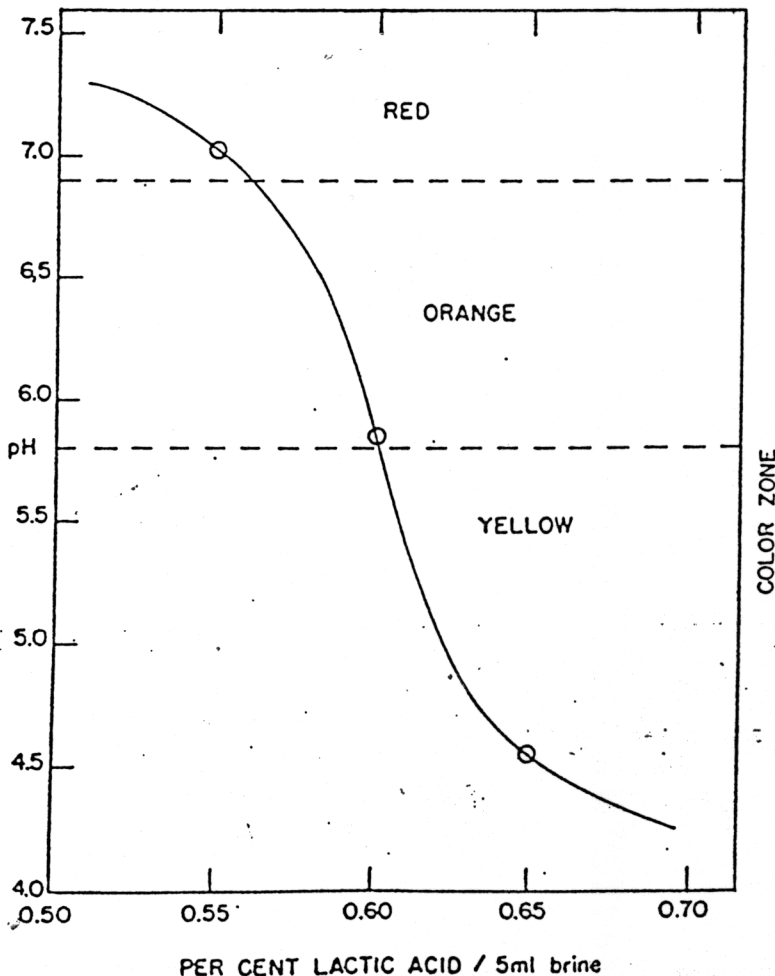
OTHER PUBLICATIONS

Bell, T. A., Etchells, J. L., and Kelling, R. E., Journal of Food Science, 36, 1036-1038, Nov. 1971.

[57] ABSTRACT

In the salting of vegetables, such as cucumbers, control of fermentation using brine acidity as the monitor and continually and rapidly determining brine acidity with tris(hydroxymethyl)aminomethane as a standard.

7 Claims, 1 Drawing Figure



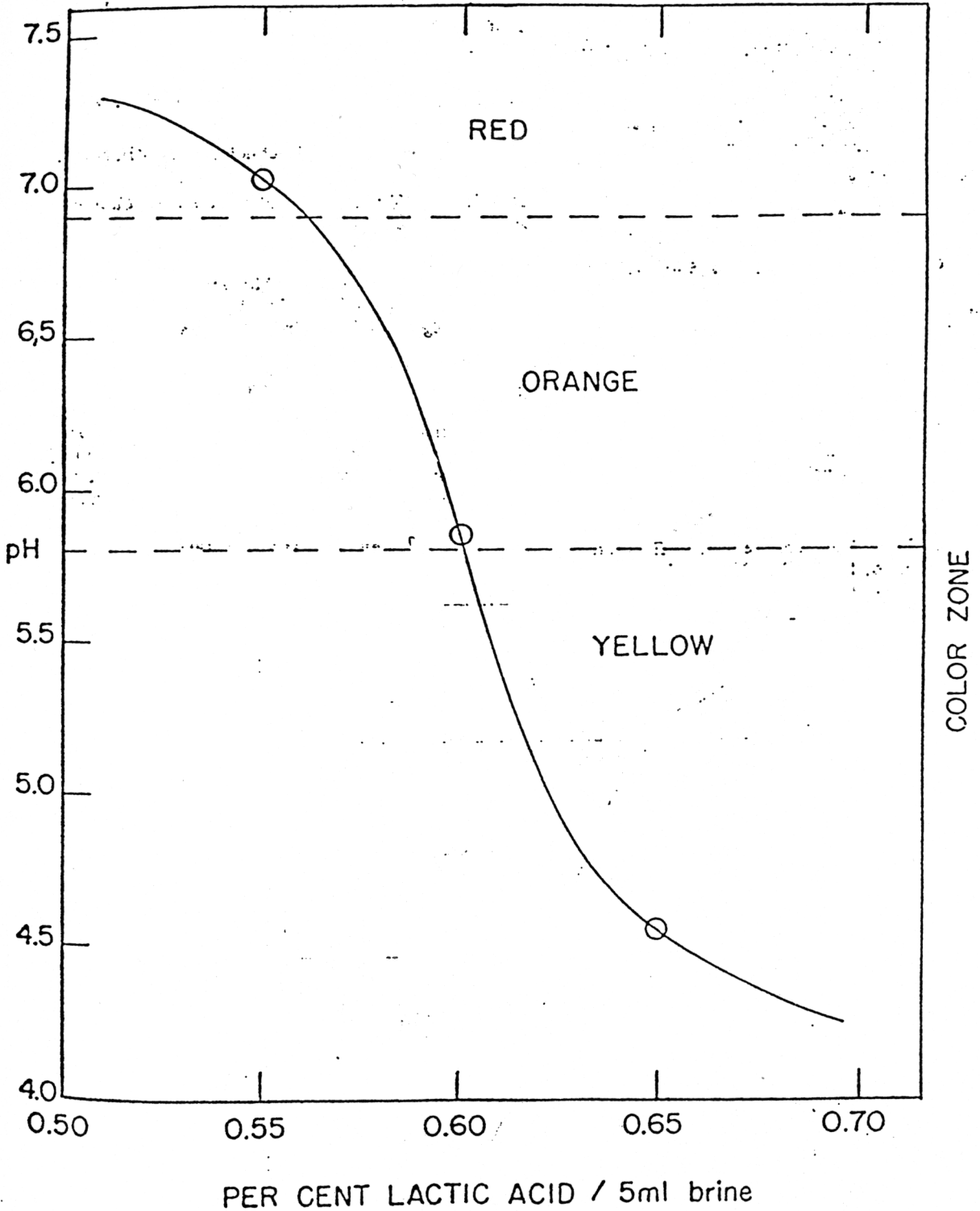


FIGURE I

CONTROLLED FERMENTATION ACIDITY OF BRINED CUCUMBERS

A non-exclusive, irrevocable, royalty-free license in the invention herein described, throughout the world for all purposes of the United States Government, with the power to grant sublicenses for such purposes, is hereby granted to the Government of the United States of America.

BACKGROUND OF THE INVENTION

Controlled fermentation has long been one of the objectives in the vegetable salting industry, such as cucumber pickling. For years, the chemical, bacteriological and physical phenomena involved in the manufacture of, say, salt stock from green cucumbers by natural fermentation in brine, have been studied fairly definitively as has conversion of the salt stock to sweet, sour and mixed pickles followed by pasteurization and canning. This is likewise true of brine preservation of green beans, carrots, green tomatoes, okra, peppers, corn, and other vegetables and fruits, e.g., olives.

These studies quite naturally took into consideration salt concentrations and control thereof during brining and curing so that proper media for resultant microorganism activity could be effectively provided. It was found, for example, that among the microbial groups which grow during fermentation, sufficient salt-tolerant bacteria must be present to provide for the production of fermentation acids. The predominant acid is lactic acid, with a small amount of acetic acid being present. Obviously, the size and variety of cucumbers being pickled, brine temperature, general environmental conditions, and the like, are important to proper fermentation. It is also very important to avoid brine stock spoilage, including bloating and softening. Absence of proper conditions for the development of brine acidity can deleteriously affect the salt stock and the finished pickle products, such as dills, relishes, sours, sweets, and hamburger slices.

It can be appreciated, for example, that the brining of cucumbers for salt stock purposes in the South, such as the South Atlantic States, has generally been conducted in an environment which is significantly warmer than that in which similar brining procedures are carried out in the northern areas of the country, usually Midwestern States. One of the factors which has been of substantial concern is that the rate of lactic acid formation can vary greatly from area to area and even from vat to vat. Further, what is the effect of the traditional use of an inflexible schedule in which dry salt is introduced into the fermentation-brine solution throughout the salting operation? While much has been written about the desirability of controlling the brine concentration throughout the salt stock production, what effect does this have on the bacterial growth rate? For instance, it has been pointed out that brine acidity resulting from microbial activity develops more readily using low initial salt concentrations. On the other hand, high initial salt concentrations retard growth of lactic acid bacteria and consequently less acid is formed.

As is suggested from these facts and others prevalent in the literature, proper control of fermentation throughout the salting operation has been the subject of a great deal of concern. Accordingly, the present invention is directed to providing a means of control

using brine acidity as the monitor to effect rapid and simple determination of the brine acidity.

A still further object of the present invention is a simple procedure for enhancing fermentation under varied conditions, such as conditions of temperature, brine concentrations, vegetable (e.g., cucumber) sizes, vegetable varieties, time of harvest, microbial flora, geographical area and the like.

Of interest in this regard are the following literature and patent references:

Jones, I. D., *Industrial and Engineering Chemistry*, 32, No. 6, 858-861 (1940).

Etchells, J. L., and Jones, I. D., *American Journal of Public Health*, 36, 1112-1122 (1946).

Etchells, J. L., Jones, I. D., and Bell, T. A., 1950-1951 *Yearbook of Agriculture*, 229-236 (1950).

Etchells, J. L., Bell, T. A., and Williams, C. F., *Food Technology*, 204-208, (May, 1958).

Etchells, J. L., and Moore, W. R., Jr., *Pickle Pack Science* 1:1-17 (1971) published by Pickle Packers International, Inc.

U.S. Pat. Nos. 3,480,448; 3,420,676; 3,410,755; 3,403,032; 3,374,099; 3,051,661; 2,905,594; 2,345,814.

West Germany: 1,199,023; 1,115,476.

Insofar as the standard used herein is concerned, viz., tris(hydroxymethyl)aminomethane, the following references are likewise of interest:

Fossum, J. H., Markunas, P. C., and Riddick, J. A., *Analytical Chemistry*, 23, No. 3, 491-493 (1951).

Whitehead, T. H. *Journal of Chemical Education*, 36, No. 6, 297 (1959).

Bell, T. A., Etchells, J. L., and Kelling, R. E., *Journal of Food Science*, 36, 1036-1038 (1971).

THE INVENTION

The present invention relates to a means of control of acid fermentation during the brining of vegetables, e.g., cucumbers, using brine acidity as the monitor and quickly determining brine acidity during intervals of the brining and curing period.

Schedules for the additions of dry salt to brined vegetables without careful regulation of brine acidity can readily retard desired bacterial growth and result in undesirable salt stock. As suggested hereinbefore, variables such as cucumber sizes and varieties, brine concentration, microbial flora present in the brine, temperature, other environmental conditions, etc., are very important in the pickling process. In brining and curing, certain salt-tolerant microorganisms called lactic acid bacteria are responsible for the necessary utilization of various organic constituents of the cucumber fruit which dissolve in the brine and become a source of nutrients for the microorganisms.

Since it is important not to noticeably retard or inhibit the growth of lactic acid bacteria, i.e., the rate of acid production, to insure final quality and preservation of brine-stock pickles, it behooves picklers to avoid going beyond the brine concentrations that retard or inhibit growth of lactic acid bacteria.

In the above-identified Etchells and Moore (1971) reference, it is pointed out that for effective brining the brine strength should be increased only after the lactic acid concentration has reached about 0.60% weight/volume, generally in about 7 to about 14 days, usually about 10 days. Unfortunately, checking the acidity during brining operations has heretofore been time

