

AUGUST, 1969
Vol. 32 P. 287-338 No. 8

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MILK and FOOD TECHNOLOGY

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The Journal of Milk and Food Technology is issued monthly beginning with the January number. Each volume comprises 12 numbers. Published by the International Association of Milk, Food and Environmental Sanitarians, Inc. with executive offices of the Association, Blue Ridge Rd., P. O. Box 437, Shelbyville, Ind.

Entered as second class matters at the Post Office at Shelbyville, Ind., March 1952, under the Act of March 3, 1879.

EDITORIAL OFFICES: Dr. Elmer H. Marth, Dept. of Food Science, University of Wisconsin, Madison, Wis. 53706. H. L. Thomasson, Managing Editor, P. O. Box 437, Shelbyville, Indiana 46176.

Manuscripts: Correspondence regarding manuscripts and other reading material should be addressed to Dr. Elmer H. Marth, Dept. of Food Science, University of Wisconsin, Madison, Wis. 53706.

"Instruction to Contributors" can be obtained from the editor for the use of contributors of papers.

Page Charge: Effective January 1, 1969 a charge of \$25.00 per printed page will be made for all research papers which are published. See Volume 31, issues 10, 11, or 12 for details.

Journal of

MILK and FOOD TECHNOLOGY

INCLUDING MILK AND FOOD SANITATION

Official Publication

International Association of Milk, Food and Environmental Sanitarians, Inc.
 Reg. U. S. Pat. Off.

Vol. 32 August, 1969 No. 8

Instructions to Contributors—Journal of Milk and Food Technology...287

Proceedings of the Twelfth National Conference on Interstate Milk Shipments290

The Role of an Industry Sanitation Consultant in Food Plant Sanitation as Related to Regulatory Compliance
Edward L. Holmes295

Tests for Estimating Shelf-Life of Milk and Milk Products
C. K. Johns301

Cheddar Cheese: Comparison of Effects of Raw and Heated Milk on Quality and Ripening
Walter V. Price and Ara O. Call304

Manufacture and Keeping Quality of Low Fat Dairy Spread
M. C. Goel, H. E. Calbert and E. H. Marth312

A Research Note—A Comparison of the Oxidase Test and the Wisconsin Mastitis Test for the Detection of Abnormal Milk
C. Vanderzant and R. Nickelson319

Imitation and Filled Dairy Products
 Production and Processing Standards
W. C. Lawton321

The Spokane City Health Department Mastitis Control Program
Roy T. Olson323

Sanitation in the Single Service Container and Closure Industry—A Status Report
Fred DeSieghardt329

News and Events334

Classified Ads338

Index to Advertisers338

Business Matters: Correspondence regarding business matters, advertising, subscriptions, orders for single copies, etc., should be addressed to H. L. Thomasson (address above).

Subscription Rates: One volume per year. Individual non-members, Governmental and Commercial Organization subscription.
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The *Journal of Milk and Food Technology* is primarily intended for publication of papers dealing with dairy and food science, sanitation in the dairy and other food industries, technological developments in the dairy and food industries, and public health problems related to the production and distribution of dairy and other food products. Additionally, the *Journal* publishes papers dealing with laboratory procedures used to evaluate the safety and quality of foods, the operation of food production facilities, and other environmental conditions which need not be directly related to food products. Papers concerned with other subjects in the areas of sanitation and environmental health also are suitable for publication in the *Journal*. Authors who may have a question about the suitability of their manuscript for publication in the *Journal* are invited to request an opinion from the Editor.

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All materials intended for the "Association Affairs" and "News and Events" sections of the *Journal* should be submitted in flat form by first class mail to the Managing Editor, Mr. H. L. Thomasson, Box 437, Shelbyville, Indiana 46176. Subjects suitable for inclusion in the "News and Events" section include: announcements of meetings, short courses, or other events of interest to the readership; notices of position changes and promotions; announcements of new products of interest to the readership; and notices of death and obituaries of members. Any questions on suitability of material can be answered by the Managing Editor.

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The author is notified when a manuscript is received and also when it is submitted to the printer for preparation of galley proofs. An author must return galley proofs promptly or publication of his paper may be delayed.

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and Environmental Sanitarians, Inc. is *not* a prerequisite for acceptance of a manuscript for publication. Nonmember scientists from the U. S. and from foreign countries are invited to submit papers for consideration for publication.

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Most institutions accept the page charge as a necessary cost of conducting research and communicating the results. Nevertheless, it is realized that some authors may not have funds available for this purpose and hence exceptions can be made when necessary. Inability to pay the page charge shall not prohibit publication of an acceptable manuscript. An author will be informed of the cost of publishing a paper when he receives galley proofs.

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Research paper

The research paper reports results of original research which has not been published elsewhere. It usually consists of 8 to 12 double-spaced typewritten pages plus appropriate tables and figures. A research paper deals in some depth with its subject.

Research note

A research note is a short paper which describes observa-

tions made in a rather limited area of investigation. Negative results are sometimes best reported in the form of a research note. The research note should not be used as a vehicle for reporting inferior research. A research note generally consists of less than 5 double-spaced typewritten pages of text together with appropriate figures or tables. Organization of a research note is the same as that of a research paper. The designation, "A Research Note" will appear above the titles of these papers since the *Journal* does not devote a separate section to research notes.

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Well written, thorough, well documented review papers on subjects of concern to the readers of the *Journal* are encouraged and will be published promptly. If a review paper substantially exceeds approximately 25 double-spaced typewritten pages, it may be necessary to subdivide the manuscript so that it will appear in several issues of the *Journal*. Authors are invited to discuss their plans for review papers with the Editor.

General interest-nontechnical

The *Journal* regularly publishes some nontechnical papers as a service to those readers who are not involved with the technical aspects of dairy and food science. These "grass-roots" papers might deal with such topics as working with people, organization of a sanitation program, organization of a regulatory agency, organization of an educational program, use of visual aids, and similar subjects. Papers of this type should be well written and properly organized with appropriate subheadings. Often talks given at meetings can be modified sufficiently to make them appropriate for publication. Authors planning to prepare general interest nontechnical papers are invited to correspond with the Editor if they have questions about the suitability of their material.

Letter to the Editor

Readers are invited to submit letters to the editor to express their opinion on papers published in the *Journal* or on other matters which may be of concern to the entire readership. The letter to the editor may also be used to report limited observations made in the field or in the laboratory which cannot be published as a research note. This mechanism should be particularly valuable for the exchange of information by persons who are unable to attend annual meetings of IAMFES or by laboratory workers whose duties preclude publication of full-fledged research papers. A letter to the editor must be signed by its author(s).

Book reviews

Authors and publishers of books in the fields covered by this *Journal* (see earlier discussion of Subject Matter) are invited to submit their books to the Editor. Books will then be reviewed by a specialist in the field covered by the book and a review will be published in an early issue of the *Journal*.

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- A. All manuscripts should be typed double-spaced on 8.5 by 11-inch bond paper. Lines on each page should be numbered to facilitate review of papers. Use of paper with prenumbered lines is satisfactory. Side margins should be one inch wide and pages should not be stapled together.
- B. The Editor assumes that the senior author has received proper clearance from his organization for publication of

the paper. Authors should be aware of procedures for approval within their own organization.

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- E. *Organization of research papers and research notes*
 1. The title should appear at the top of the first page. It should be as brief as possible, contain no abbreviations, and be truly indicative of the subject matter discussed in the paper. Care should be exercised by the author in preparing the title since it is often used in information retrieval systems. *Good information can be lost through a poor title!*
 2. Name(s) of author(s) and affiliation(s) should follow under the title. If an author has changed location since the work was completed, his new address should be given in a footnote.
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Frazier, W. C., E. H. Marth, and R. H. Deibel. 1968. *Laboratory manual for food microbiology*. 4th ed. Burgess Publishing Co., Minneapolis. 122 p.
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Hussong, R. V., E. H. Marth, and D. G. Vakaleris. 1964. *Manufacture of cottage cheese*. U. S. Pat. 3,117,870. Jan. 14.

For citation of bulletins, annual reports, publications of federal agencies, etc., see *Style Manual for Biological Journals*. References should be listed in alphabetical order and num-

bered. Numbers in parentheses, independently or in conjunction with last names of authors, should be used in the text for designating references.

F. *Organization of review and general interest papers*

These papers should have a title, give name(s) of author(s) and affiliation(s), and the text should begin with an abstract. See items 1, 2, and 3 under E. The remainder of the text should begin with an introductory statement and then should be subdivided into appropriate sections each with a subheading which is descriptive of the subject matter in the section. Review papers, by their very nature, utilize a large number of references. Citation of references in the text and listing of references at the end of the paper should be done as mentioned in section E-5 above.

G. *Preparation of figures*

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by 11-inch tracing paper, white drawing paper, or blue linen. Do not use paper with green, red, or yellow lines since they cannot be removed and will appear in the final copy. A lettering guide must be used to prepare all letters which appear on figures. *Titles for all figures must be on separate sheets and not on the figures.* Use Arabic numbers for numbering of figures.

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REPORT OF THE COMMITTEE TO STUDY HOW THE STRUCTURE AND ORGANIZATION OF THE INTERSTATE MILK SHIPPERS CONFERENCE SHOULD BE CHANGED IF ITS SCOPE IS TO BE BROADENED TO INCLUDE PRODUCTS NOT COVERED BY THE PASTEURIZED MILK ORDINANCE AND REPORT BACK TO THE CONFERENCE IN 1969 RECOMMENDATION FOR THESE CHANGES

The above named Committee, composed of 23 members, representing all interests in the Interstate Milk Shipment Agreements operation met on three occasions in 1968 and 1969, to discuss and form some recommendation to the Conference on their assignment.

Preliminary to reporting the deliberations and recommendations of the Committee, a brief review of the background leading up to the formation of this Committee may be useful.

The request for the establishment of this Committee was endorsed by regulatory officials who daily face the administrative problems concerning the reciprocity of some manufactured dairy products in inter and intrastate commerce, common carriers and other areas under their jurisdictions. Because of the lack of a uniform sanitary standard for the production, processing and packaging of certain manufactured milk products officials in importing states are sometimes without necessary information on the sanitation standards and enforcement procedures practiced in the areas from which these products are received.

By the same token officials of the exporting state are unable to assure states receiving products that the sanitation standards and enforcement procedures in the exporting state are equivalent to those in effect in the importing state. In addition, those concerned would like us to understand that in the absence of a common operating vehicle for uniformity and reciprocity, conflicting standards and enforcement methods are certain to be developed individually, thus creating islands, obstruction of free movement of basic dairy products and other evils and conditions which brought about the Interstate Milk Shipment Agreements.

With this background the Committee conceived that its first inquiry should be: The necessity of broadening the "scope" of the Conference to include products not now covered by the Pasteurized Milk Ordinance. It was understood that even if there were agreement that the Conference should interest itself in such other products, the question as to how the structure and organization of the Conference should be changed, was secondary.

Notwithstanding this general understanding, it proved difficult in discussion to separate these matters. As an example, there were expressions to the effect that the Conference might well interest itself in promoting uniformity in sanitation standards for manufactured milk product plants and in encouraging reciprocity among states adopting such standards. But among those who expressed such sentiments, there was insistence that methods other than expanding Conference agreements be considered as means for achieving the desired goals.

At the first meeting of the Committee it was believed that its work could be facilitated by assigning to two sub-committees special inquiries as follows:

1. A sub-committee to gather information "concerning the need for uniformity and reciprocity with dairy products not now covered by the agreements"
2. A sub-committee "to study the available framework and standards which would provide for including products not covered by the Grade A Pasteurized Milk Ordinance in the provisions of the Interstate Milk Shippers Agreement"

The reports of the two subcommittees will be summarized at the end of this report.

Actions taken by the Committee which form the recommendations to the Conference are as follows:

1. The Committee further concludes there is a need for uniform standards for reciprocal acceptance of manufactured milk products, and that the Conference should concern itself with manufactured milk products. Procedures other than existing Conference Agreements for fluid milk which are designed to promote uniformity and reciprocity should be explored and recommended.
2. The Committee recommends the 1969 Interstate Milk Shippers Conference delay action on the proposal for the inclusion of standards of manufactured dairy products within the provisions of the conference agreement pending the completion of the joint effort of U. S. Department

(Continued on Page 294)

PROCEEDINGS OF THE TWELFTH NATIONAL CONFERENCE ON INTERSTATE MILK SHIPMENTS

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EXECUTIVE BOARD MEETING May 26, 1969

The Executive Board meeting was convened by Chairman Shelby Johnson at 10 a.m. All Board members except C. E. Henderson, New Mexico and Dr. Howard K. Johnston, Pennsylvania, were in attendance. The Secretary's Report covering the interim board meeting held at the Chase-Park Plaza Hotel, St. Louis, Missouri, August 27, 1968 was accepted as read. The Treasurer's report indicating a balance of \$1,720.48 as of May 23, 1969 was accepted. To this balance was added \$1,500 in pre-registration fees for the 1969 Conference.

Harold J. Barnum, Chairman of the Local Arrangements Committee, and Earl Wright, Chairman of the Program Committee, reported on the current status of their activities. Both reports were unanimously accepted as presented.

Chairman Johnson read, with the Board, the procedures that would be used in the task force operations. There being no new business, the meeting adjourned at 11:25 a.m.

FIRST GENERAL SESSION

The first general session of the Conference was called to order at 1:30 p.m., on Monday, May 26 by Chairman Shelby Johnson. S. O. Noles, Florida State Health Department, gave the invocation. The address of welcome was delivered by Roy L. Cleere, Executive Director, Colorado Department of Public Health. The keynote address was given by C. C. Johnson, Jr., Administrator, Consumer Protection and Environmental Health Service, U. S. Department of Health, Education and Welfare, Washington, D.C. Shelby Johnson, Chairman of the Conference, thoroughly defined the various functions of the Conference. His presentation was pointed particularly at individuals who had not attended previous meetings. Dr. K. G. Weckel, University of Wisconsin, presented a thought provoking discussion on "Review of Accomplishments and Problems of the NCIMS".

The biennial report of the Public Health Service to the Conference was presented by H. E. Thompson, Jr., Chief Milk Sanitation Officer, Cincinnati, Ohio.

The first general session closed with the charge by Chairman Johnson to both the Resolutions Committee and the Nominating Committee.

SECOND GENERAL SESSION

The second general session was convened by Chairman Johnson at 8:43 a.m. on Tuesday, May 27. The following committee reports were presented at this session: (a) "Abnormal Milk" by Dr. J. C. Flake, National Mastitis Council; (b) "Single-Service Containers" by Dr. Richard M. Parry, Con-

necticut Department of Agriculture and Natural Resources; (c) "Reciprocity"—since committee chairman Carl Henderson, New Mexico Health Department, was unable to be present, a summation was given by Chairman Johnson; (d) "Structure and Organization of the Conference" by Harold J. Barnum, Denver Department of Health and Hospitals, and Clarence K. Luchterhand, Wisconsin Division of Health; and (e) "Over-The-Road Tankers" by Enos G. Huffer, Illinois Department of Public Health.

Program Chairman Earl Wright concluded this general session by outlining the plan of operation for the various task forces and assigning meeting rooms. It was announced that Tuesday afternoon and Wednesday morning would be devoted to task force deliberations.

THIRD GENERAL SESSION

The third general session was convened by Chairman Johnson at 11 a.m. on Wednesday, May 28.

The chairman of each task force reported on the problems submitted and the disposition thereof. Chairman Johnson mentioned at the conclusion of this session that all task force reports would be available at the registration desk by 6 p.m. for registrants that might wish to study them before the Thursday morning general session.

FINAL GENERAL SESSION

The final general session convened at 8:35 a.m., Thursday, May 29 with Shelby Johnson presiding. John Newlin served as parliamentarian. The roll call of states and delegates authorized to vote on Conference Agreements showed that 42 states were represented, 15 by both health and agriculture, 11 by agriculture and 16 by health. The health departments of the District of Columbia and Puerto Rico were also represented. The minutes of the previous Conference were accepted as mailed to those who had been in attendance at Miami Beach in 1967. The Treasurer's report was accepted as read.

Brace Rowley, Kansas Department of Agriculture, reported the selections of the Nominating Committee for Executive Board members from Region I. These selections were: E. Marion Causey, South Carolina State Board of Health; Wendell I. Carr, Vermont Department of Agriculture; Samuel C. Rich, Meck Co. Health Department, Charlotte, North Carolina; William L. Arledge, Dairymen, Inc., Bristol, Virginia; and H. E. Thompson, Jr., U. S. Public Health Service.

Sam Noles moved, seconded by Ford P. Brendle, that the nominations be closed and the Secretary be instructed to cast a unanimous ballot for the slate presented. Motion passed.

RESOLUTIONS

The Resolutions Committee, under the chairmanship of Professor Evert Wallenfeldt, presented the following resolutions, all of which were unanimously accepted by the Conference.

(a) The Conference approves the Board actions towards implementation of Conference agreements in the interim between the previous general meetings and the 1969 meeting.

(b) The Conference directs the Executive Board to implement the 1969 agreements and to transact such business as is necessary to further the declared objectives of the Conference in the interim between general meetings.

(c) The Conference acknowledges and endorses the important role of the Public Health Service in the work of the Conference since its inception and expresses its appreciation to the Public Health Service for its help and participation. The Conference emphasizes the need for a more active role by the Public Health Service in assisting the states to achieve uniformity.

(d) We respectfully request that the Secretary of Health, Education, and Welfare provide the necessary directives, funds and personnel to give effective support for discharging the Department's responsibilities incurred in the "Procedures Governing the Cooperative State-Public Health Service Program for Certification of Interstate Milk Shippers" and to keep the identity of the I.M.S. Program.

(e) The Resolutions Committee continues to recommend that persons submitting questions or problems should be present or submit a statement of clarification for the appropriate task force session.

(f) The Conference recognizes that the Standard Plate Count does not adequately determine the bacteriological quality of *bulk cooled* milk. Therefore, the Conference requests that the Public Health Service make more intensive studies towards the development of test procedures designed to give results which would be more indicative of the sanitation followed in modern production, processing, and handling of milk.

(g) The Twelfth National Conference on Interstate Milk Shipments expresses its sincere appreciation and a vote of thanks to the Local Arrangements Committee, Harold Barnum, Chairman, for the many excellent ways in which Conference needs were handled.

(h) The Conference expresses its appreciation and thanks to the Program Committee, Earl O. Wright, Chairman, for planning and carrying out such an excellent program.

(i) The Conference gives a vote of thanks and commendation to the New Albany management for the

fine help given in providing for the many needs of the Conference.

(j) The Conference expresses appreciation to the speakers and all the other participants in the Conference program.

(k) The Conference expresses its special appreciation and commendation to Shelby Johnson, Chairman, and the other officers and directors, committee and task force chairmen for their outstanding leadership and service to the organization.

(l) The Conference recommends that any unfinished action on committee recommendations be referred to the Executive Board for further consideration.

(m) The Conference urges that all interested individuals and/or organizations forward suggestions and comments to the Executive Board for consideration and action where necessary.

(n) The Conference suggests that greater effort be made in acquainting the entire milk industry with the activities and purposes of this Conference and urges greater participation by the industry in our common goal: "To promote the best possible milk supply for all the people".

(o) The Conference requests that our Conference Chairman convey these resolutions to the appropriate persons.

TASK FORCE REPORTS

Chairman Johnson next called for reports of the task forces. Complete task force reports are in the Secretary's file. However, only the changes in, or additions to, procedures are included in this report.

Task force on standards

This task force was given four problems. Problem 1 recommended that the NCIMS adopt, under "Section 1, Standards" of the "Procedures Governing the Cooperative State-Public Health Service Program for Certification of Interstate Milk Shippers," the "Recommended Sanitation Ordinance for Condensed and Dry Milk Products used in Grade A Pasteurized Milk Products," 1969 Edition, Supplement 1 to the Grade A Pasteurized Milk Ordinance-1965 Recommendations of the U. S. Public Health Service. The task force approved the recommendation and the delegates concurred.

Problem 2: Should imitation milk be included as a Grade A milk product under Conference Agreements? The task force recommended no action and the delegates so voted.

Problem 3 recommended that the Public Health Service (PHS) develop standards for Grade A fluid sterile milk as a supplement to the PMO. The task force voted no action, and the delegates concurred.

Problem 4 involved asking the PHS to consider re-

vising Rating Methods so that when more than 50% of the "in-compliance" raw milk for pasteurization is received from beyond the limits of routine inspection, its ratings be included. The task force recommended that the present rating methods be retained, and the delegates approved.

Task force on supervision

This task force was given three problems. Problem 1 asked what action has been taken by PHS to adopt an official laboratory indicating tests(s). The task force moved that no action be taken, but did acknowledge the report of the PHS on the five approved screening tests. The task force decision was approved by the delegates.

Problem 2 concerned the committee report on broadening the scope of the Conference. The task force moved the adoption of the committee report on "Structure and Organization of the Conference." The action was approved.

Problem 3 involved the report of the committee on Abnormal Milk Control. The task force recommended the adoption of an amended report. Section C, of the report, first and second paragraphs, was amended as follows: "The third milk sample shall be taken after a lapse of 3 days and within 14 days of the inspection required under "B" above. If 3 of the last 5 samples indicate a count greater than 1,500,000 somatic cells per ml, the milk regulatory agency shall proceed with its responsibility to suspend the dairyman's permit for violation of Item 1r or other applicable requirements of the Grade A Pasteurized Milk Ordinance.

Upon written application by the dairyman stating that the causes(s) for the abnormal milk has been corrected within 1 week an inspection shall be made. If the results of the farm inspection indicate that there is no longer a violation of Item 1r, a temporary permit shall be issued. Samples shall then be taken at the rate of not more than 2 per week on separate days within a 3 week period. The health authority shall reinstate the permit when the results of these samples indicate that there is no longer a violation of the standards for abnormal milk."

Burdet Heinemann presented a minority report in the form of an amendment recommending that the penalty clause enforcement date in Section II, A., 7 of the "Procedures" be changed from July 1, 1970 to July 1, 1972. The amendment was voted on by the delegates and was defeated by a tie vote.

The original motion to adopt the Committee report, as amended by the task force, was approved by the delegates.

Task force on rating and certification

This task force was given two problems. Problem

1 asked for a consideration of changing rating procedures to include provision for rating large, complex associations or cooperatives located in two or more regulatory jurisdictions. The task force recommended no action, but requested that the Conference Chairman appoint a committee to study the wide scope of survey rating. The voting delegates approved. Problem 2, which involved questions regarding official survey policies, was tabled.

Task force on uniform bill of lading and seals

This task force was given one problem which was a request for a liberal attitude toward common definitions of dairy products in the PMO. After considerable discussion, the task force decided that the request would necessitate a drastic change in the PMO and that the change would not be within the province of the Conference. They, therefore, recommend no action, but did recommend that the PHS keep the PMO up-to-date by frequent reviews of product definitions. The recommendation was approved.

Task force on responsibilities of participating states

This task force was given six problems. However, problems 2 and 4 were combined.

Problem 1: Should split samples be reduced to a frequency of once a year? The task force recommended that the present requirement of two sets of split samples per year be retained. The recommendation was unanimously approved by the delegates. Problems 2 and 4 called for ways of making volume control more meaningful and for stricter compliance with volume control provisions. The task force recommended that, when inadequacies are found by either the shipper or receiver, the methods presently outlined in Section VII of the "Procedures" dealing with "Complaints and Challenges" should be used. The delegates approved this recommendation.

Problem 3 recommended changing the first line in Section V-C, Subitem 4 to read, "If results of the laboratory and sampling surveys are not" The task force recommended the adoption of this change and the recommendation was approved by the delegates.

Problem 5: Consider the need for a specific and detailed sampling procedure to be developed to sample milk in receiving states. The task force stated that Section IV, A, 3, dealing with uniform Bill of Lading and Seals, and Section VII, dealing with Complaints provide adequate guidelines to handle the situation. The delegates approved the recommendation.

Problem 6 asked for methods for identifying the manufacturer of single-service containers. The task force stated that the Public Health Service report on this subject as presented to the Conference provides

for adequate means of identifying the manufacturer. The delegates approved the recommendation.

Task force on responsibilities of the PHS

This task force was given five problems. Problem 1 asked the PHS to consider establishing an advisory committee composed of experienced survey officers to review and revise Bulletin No. 678 to place greater emphasis on enforcement procedure evaluation. The task force recommended that the PHS review and up-date Bulletin No. 678, "Methods of Making Sanitation Rating of Milk Sheds, 1966 Edition" as soon as possible so as to reflect current conditions. The delegates approved this recommendation.

Problem 2 requested that new survey officers be accredited by a written or an oral examination along with an evaluation. The task force recommended no action on this request. The recommendation was approved by the delegates.

Problem 3 asked that recertification of survey officers be conducted simultaneously with spot checks. The task force felt that present procedures already allow for this and, therefore, recommended no action. The delegates approved. Problem 4 recommend that PHS establish bacteriological procedures and standards for co-mingled raw milk prior to its entrance into a milk plant. The task force recommended no action and the decision was approved by the delegates.

Problem 5 asked that the PHS be encouraged to carry on adequate training of survey officers in certifying single-service manufacturing plants. The task force felt that steps for adequate training have already been taken and therefore recommended no action. This decision was approved by the delegates.

Task force on procedures for handling complaints and challenges of validity of ratings

This task force was given two problems. The task force recommended that the IMS Conference require, by July 1, 1973, the delisting of all shippers from the IMS list from any state or municipality which does not have reciprocal inspection agreements or does not abide by the Conference Agreements for all IMS rated supplies, and it further recommended that the IMS Executive Board refer this matter to the proper task force for implementation. James Smathers presented a minority report concerning the above mentioned recommendation stating that the industry should not be penalized for conditions over which it had no control. After considerable discussion, the recommendation was tabled until the report of Task Force 8 could be presented. After the completion of the report of Task Force 8, the above mentioned task force recommendation was voted upon and defeated by the delegates by a vote of 35-7.

The task force recommended that the IMS Conference require, by July 1, 1973, the delisting of all shippers from the IMS list from any state or municipality which does not accept the accreditation program for brucellosis and tuberculosis as outlined in the U. S. Public Health Service Grade A Pasteurized Milk Ordinance, 1965 Recommendation. It further recommended that the IMS Executive Board refer this matter to the proper task force or to a special committee for implementation. This recommendation was tabled until after the report of Task Force 8 was presented. It was then formally voted upon and defeated by a vote of 40.5 to 1.5.

Task force on application of conference agreements and special problems

This task force was given five problems. Problem 1 recommended that the PHS up-date the Frozen Dessert Ordinance and make it a standard under Conference Agreements. The task force recommended no action and the delegates concurred. Problem 2 asked that consideration be given to including aseptically packaged milk and cream under the scope of the Conference. Sam Noles moved that the recommendation be amended as follows: "That the Conference request the PHS to develop definitions and standards for production, processing, ultra-high temperature treatment, and aseptic packaging of sterilized or sterile milk and milk products." The amended motion was passed with only two negative votes.

Problem 3: Recommend to the PHS that "Acceptable Enforcement Rating" be deleted from Section II of the PMO. The task force recommended that this change not be made. The delegates approved the recommendation. Problem 4 recommended that the wording in Section VIII, A.1 of the "Procedures" be changed to read, ". . . shall apply to raw milk for pasteurization and to pasteurized milk and milk products." The task force recommended that the "Procedures" be changed accordingly so that the entire section involved reads: "Section VIII, Application of Conference Agreements. A. Products Covered. 1. Agreements adopted by the National Conference on Interstate Milk Shipments shall apply to raw milk for pasteurization and to pasteurized milk and milk products." The recommendation was approved by the delegates.

Problem 5 asked for ways to eliminate duplicate inspection, including the possible formation of a study committee. The task force recommended that the Conference chairman appoint an operating committee of five charged with the responsibility of receiving reports of lack of reciprocity, investigating such reports and taking, in respect to the facts determined, warranted action within the powers of the Conference Agreements, that the financing of the

committee's expenses be arranged by the Executive Board of the Conference and finally that the committee submit to the 1971 Conference a resume of its functions with recommendations. After considerable discussion by the delegates Sam Noles proposed to amend the recommendation by striking out the words "that the financing of the committee's expenses be arranged by the Executive Board of the Conference." The amended motion was unanimously accepted by the delegates.

After the conclusion of the task force reports, Chairman Johnson called for any unfinished business. Dr. Richard Parry of Connecticut recommended that the Committee for Single-Service Containers be continued. His recommendation was approved by the delegates. Chairman Johnson then announced that the 1971 Conference will be held at the Chase-Park Plaza Hotel, St. Louis, Missouri, May 16-20. The final general session of the 12th meeting of the National Conference adjourned at 11:45 a.m., Thursday, May 29, 1969.

EXECUTIVE BOARD MEETING
May 29, 1969

Chairman Shelby Johnson convened the meeting of the new Executive Board at 12 o'clock noon on Thursday, May 29, 1969. All members, with the exception of Carl Henderson and Dr. Howard K. Johnston, were in attendance. Chairman Johnson introduced the new members of the Board from Region I, namely Sam Rich, Bill Arledge, Wendell Carr, and E. Marion Causey.

Each member of the Board received a list showing the various hotels which had submitted proposals to host the 1973 meeting. After a considerable discussion, the meeting was awarded to the Savery Hotel, Des Moines, Iowa. The exact dates will be arranged later.

Chairman Johnson then called for the election of new officers. Both Chairman Shelby Johnson and Secretary-Treasurer J. C. McCaffrey were unanimously re-elected to their respective offices.

It was decided to hold an interim board meeting at Louisville, Kentucky, during the meeting of the International Association of Milk, Food, and Environmental Sanitarians, Inc., the time to be determined by the Chairman.

Chairman Johnson appointed John Schilling to serve as Local Arrangements Chairman for the 1971 meeting which is scheduled to be held at the Chase-Park Plaza Hotel, St. Louis, May 16-20.

There being no further business, the meeting was adjourned at 1:35 p.m.

REPORT OF COMMITTEE

(Continued from Page 289)

of Agriculture, U. S. Public Health Service, and Food and Drug Administration to develop standards for the production, processing and packaging of manufactured dairy products.

3. All standards adopted by the conference should be the result of a joint effort of the U.S. Public Health Service, U. S. Department of Agriculture, and Food and Drug Administration. At present no such single standard is available; therefore, the subcommittee recommends this project receive special priority by these agencies.
4. That the work of the committee be continued to enable it to obtain and consider further information and data.
 - A. Further information on the product side of the charge which is needed includes but is not limited to: a) the variation in quality of manufactured dairy products now in interstate transfer, b) the current sanitation rating of dairy manufacturing products in interstate transfer, and c) the degree of public hazard of various categories of manufactured products currently in interstate trade.
 - B. Further information on the structure and organization side which is needed include: a) the extent to which the basic organization of the Conference might be restructured, b) re-examination of the role of federal agencies and industry in Conference deliberations, c) methods and procedures for investigation of issues, d) the structure of task forces and committees, e) development of basic standards to be used in reciprocal agreements between the states, and f) systems for supervision and certification.

In accordance with the instruction given the Committee in 1967 by the Conference the "Committee on Scope" respectfully submits this report. It will be presented at the business session on Thursday on the question of its adoption.

Harold J. Barnum, Co-Chairmen
Clarence K. Luchterhand, Co-Chairmen

*Summary of Recommendations
Subcommittee on Available Procedures
and Standards*

Existing standards and model regulations for products not included in the Pasteurized Milk Ordinance were studied by this subcommittee. Some of the subcommittee recommendations have been incorporated into the main body of this report. Additional recommendations by the subcommittee include:

1. All products covered by the provisions of the Agreement should be supervised and coordinated by the state and federal agencies which are presently operating the program.
2. Where applicable products should bear the plant identification number as outlined by the recommendations of the National Labeling Committee.
3. The committee considers the framework for determining sanitation compliance ratings of sources already existing within the provisions of the Conference agreements. Should the inclusion of other dairy products within the provisions of the agreement materialize, federal agencies could establish a numerical evaluation for sanitation items.

*Summary of Recommendations
Subcommittee on Need for
Uniformity and Reciprocity*

This subcommittee was assigned the task of gathering in-
(Continued on Page 300)

THE ROLE OF AN INDUSTRY SANITATION CONSULTANT IN FOOD PLANT SANITATION AS RELATED TO REGULATORY COMPLIANCE¹

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ABSTRACT

Modern day food sanitation is not concerned primarily with aesthetic cleanliness but with freedom from disease carrying factors within the plant.

This latter involves considerable understanding and activity on the part of food plants, such as management; employees must be trained in simple hygiene; the plant must be free from parasitic vermin; there must be adequate clean-up facilities; and there must be proper quality control facilities which embrace sanitation as well as product control.

Why do sanitation hazards, subject to regulatory control occur? This problem is discussed in detail. Then the role of the industry private consultant is discussed under five basic headings: (a) enlightenment of management as to scope and responsibilities, (b) techniques for doing this throughout corporate structure, (c) determination of deficiencies within individual plants, (d) the setting up of programs for correcting deficiencies, and (e) scheduling and training of employees.

The Sanitation Consultant also has a role in helping management prepare for regulatory citations in order to present the best possible picture and to aid the industrial firm in developing programs that will be effective in bringing about preventive sanitation for the future, rather than mere correction.

Finally, an industry Sanitation Consultant can be used to great advantages by manufacturing firms to advise and supplement, in the event of large chain organizations, their own Corporate Sanitarians. In some instances, a Consulting Sanitarian may be retained to actually serve with the staff as the Company's Corporate Sanitarian.

One fact must be recognized as a basic premise. This is that no food manufacturer or dairy products manufacturer ever became involved in regulatory action and failed to wonder why it had happened. It always comes as a surprise. There are several reasons for this, all of which might be summed up in the word *complacency*.

People who manufacture food and dairy products are so involved in the course of manufacture, that they become complacent with the way they are doing things, whether right or wrong, and in food manufacture particularly, there are a great many firms that have never had regulatory criticism until it has occurred formally by citation or prosecution.

This is occasioned by lack or infrequency of regulatory visits. It often surprises a consultant when he locates a new client to find that they have never

had a Federal Food and Drug inspection, even though they do interstate business. Admittedly, they usually have had some sort of State or local inspection but perhaps this has been made with a different objective in view so that management was totally surprised at the findings of the Federal Food and Drug inspector.

One might put this another way by saying that complacency most frequently stems from a mistaken belief that the company's current sanitation program is truly effective, simply because management has not investigated the situation thoroughly themselves.

INADEQUATE INSPECTION

There are contributing factors which are causes of this situation, one of the most serious of these is that a false feeling of security is created because the only inspections ever made of the plant have been purely perfunctory or walk through inspections. Sooner or later there comes a competent inspection on the part of some regulatory agency, which is a true revelation of the situation, and management becomes embarrassed.

Occasionally, it is also found that companies may receive complementary sanitation reports from their local or area inspectors, only to have them contradicted shortly thereafter by Federal or State Food and Drug inspections, made with more care and disclosing insanitary conditions, actionable for citation, and even perhaps prosecution. If the initial local inspections had revealed these actual insanitary conditions, undoubtedly corrections would have been made then, thus, avoiding the more serious penalties resulting from federal action. Thus, it can be seen that some inspections can be more harmful than helpful when they fail to be exhaustive in their evaluations or imaginative on the part of the inspector. All too often, local inspections are made from a check list and the inspector fails to use his imagination to look into things that are not listed specifically.

Sanitation consultants, from experience, know, and advise management of plants that they have not really been inspected by any one unless the inspector, when he finishes, actually has gotten dirty. It is impossible to make an adequate inspection in street clothes, or even in a white uniform without getting ones clothes soiled. Frequently, inadequate inspections are made because the inspector simply does not

¹Presented at the 55th Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, Inc., St. Louis, Mo., August 18-22, 1968.

spend sufficient time, or perhaps poorly trained personnel are utilized and, sad to say, occasionally we even find that a few inspectors are corruptible. Unfortunately for management who takes advantage of these situations, sooner or later, either a local or federal inspector will make a competent inspection and find sanitation hazards, that management has never dreamed of, through their complacency in simply letting the case rest with a long line of previous inadequate inspections.

In the food industry particularly and even in the dairy industry, it is impossible to make an adequate inspection without the inspector climbing on top of equipment, looking under and in machinery and disassembling units that are not readily available for sight and feel inspections.

EXCESSIVE DEPENDENCE ON FAVORITE PROGRAMS

All the blame, however, for this sense of complacency cannot be placed upon inadequate inspections from regulatory officials. Another of the most common sources is an inherent tendency, on the part of manufacturers, to place too much dependence on a favorite system, or type of sanitation program. They may over-emphasize the use of a specific type of pest control, for example, or some one spraying technique or rely entirely upon general fumigation, feeling sure that therein lies the answer. Granted, perhaps, the factor upon which they rely may well rate as a valuable sanitation tool, singly, but no one tool in itself is a panacea; rather each of these various tools have a part in the over-all requirement for good sanitation control.

Most important of all, even with a good combination of such practices, management must take an active, personal role in the plant's sanitation program if it is to be truly effective.

QUALITY CONTROL VERSUS SANITATION

One of the more cardinal sins, in this regard, often occurs with large plants that have a quality control group, which is primarily involved in product control to assure uniformity of composition and pack. It is felt by management here that sanitation is part of quality control and they assign it entirely to such a unit only to find that people involved in quality control of production identity and of pack, simply are not sanitarians. This latter has been remedied, to some extent in recent years, by a development of what are called "Quality Assurance Programs," which it is believed are basically, a combination of good sanitation programs as well as a quality control program, which takes into consideration the quality, including the sanitation involved of everything from ingredient receipt up to the time of final sale of the

finished product by the plant. It will be interesting to see how this trend develops but it is fairly new and experience is lacking to appraise its acceptance adequately.

THE PLANT SANITARIAN

We cannot leave this sector of thought without pointing out that another prime factor in developing complacency on the part of management is found in excessive dependence upon a single man within the plant to control sanitation. Maybe that man is even termed the "plant sanitarian." Of course, the more skillful he is the better. There is no argument here, but if the "one responsible man" is only seemingly qualified and does not actually carry out a good program then stormy waters lie ahead.

This, plus the fact that the top management, only, can assure the assignment of adequate funds for labor and equipment, to such a supervisor and his staff, adds up to the positive requirement that top management must be personally familiar with sanitation problems.

The world changes and never stands still. This is as applicable to sanitation management in food and dairy plants as it is anywhere else.

EXTENDING DAIRY SANITATION PRACTICES

Many years ago, dairy production and handling was revolutionized because of the need for control of bacteria to eliminate spread of disease. Some of us recall, perhaps, days when typhoid fever epidemics often occurred through lack of pasteurization and poor sanitation in milk plants. Such gross problems have been eliminated through the marvelous dairy sanitation programs that we have today. Basically, these programs have been designed with a view to eliminating the spread of disease by dairy products, but unfortunately until recent years they have perhaps been confined to fluid milk only. Recent problems in the dry milk industry have shown, for example, that a large percentage of dry milk production has been contaminated with *Salmonella* organisms; a situation which possibly never occurred to anyone before so that appropriate steps would be taken to prevent it. So even as dairy plant sanitarian, let us not be too complacent.

However, in food manufacture, sanitation started out somewhat differently. It was at first more concerned with aesthetic cleanliness. In early days, a food manufacturing plant such as a bakery was considered sanitary if it looked neat, the floors and aisles were well swept and there was no particular evidence of debris about. In other words, good housekeeping was the word.

Then with passage of the Federal Food and Drug

Act of 1938, it was discovered that there were many hidden places in food plants, these varying, of course, between different industries. In these insects and rodents might harbor, breed and actually contaminate the product without being readily apparent. This, too, was considered objectionable primarily from an aesthetic viewpoint, or that of consumer revulsion. Admittedly rodents are the source of the spread of disease, as are cockroaches and flies and birds, and these facts were used as a basis for urging that a food plant must be free of these pests, but the sanitarian's interest primarily was placed upon whole or comminuted parts of pest debris getting into the product in contrast to simple housekeeping. This was rightly so, for certainly no one wants to eat food products or dairy products that consist, in whole or in part, of such filthy substances as rodent pellets, bird excreta, and chopped insects. In the early days of enforcement of the Food and Drug Act of 1938, there were some food manufacturers foolish enough or brave enough, however, to contest even this concept in the courts. The federal courts supported the contention that the consuming public was entitled to be protected under the Federal Food and Drug law from products that were so contaminated and as a result these factors became a matter of greatest legal concern.

However, more modern day food sanitation, which, let us say, has begun within the last 2 to 3 years, probably resulting from the *Salmonella* infections and the *Salmonella* contamination of basic food products, has developed a re-evaluation on the part of the federal authorities and certainly other authorities investigating food manufacturing. Today the primary concept in food sanitation has shifted to the same as that of dairy sanitation, namely, food now must be manufactured in such a way that it will not become a vector of disease to the consuming public.

ADDITIONAL SANITATION CONCEPTS

From a practical standpoint, in relation to plant management and individuals working as sanitarians, either for the plants or as a regulatory official, certain additional concepts in developing a good program have developed around this idea.

First, it has now become necessary to train all employees in a food plant in simple hygiene in relation to their job. This means that an employee in a cake bakery must be taught to be just as conscious of personal hygiene and sanitary methods of operation in his job as a similar employee in dairy or even food service organizations.

Second, we must not forget that parasitic vermin such as rats, mice, birds, cockroaches, storage products insects, and even bats cannot be tolerated in any

area associated with the storage, manufacture, and handling of raw ingredients, for these are also inherent sources of disease organisms. We should not neglect the concept of large animals being eliminated entirely from food storage, particularly and even occasionally from food manufacturing areas. Experience has shown that manufacturers are still prone to keep cats to control mice and such obscure vermin as the opossum have been found infesting food plants.

ROLE OF CONSULTANT

In the light of these problems, there arises the main question of this paper, namely, "what is the role of the industry sanitation consultant in aiding food manufacturers to meet all regulatory requirements?"

Seminars

The first and primary responsibility of the consulting sanitarian is to enlighten management as to understanding and knowledge of the problem, before they become subjected to regulatory action. Probably the most effective way to accomplish this is to provide a seminar, or 1 or 2 day short course in basic principles of food plant sanitation embracing the type of regulatory action to which they are liable and to discuss the type of sanitation hazards that are likely to occur in their particular industry with methods and procedures for combating these hazards. This latter includes an analysis of pest control methods; of planning and organization within the company as a whole and in individual plants; and a resumé discussion of employee hygiene problems, employee training problems, and management responsibility.

In this seminar management should be taught to realize two basic obligations, first a legal obligation to maintain a sanitary plant or plants, and second, an industry obligation to do so as well.

Specific details as to materials and equipment and types of employee responsibilities that must be assigned must all be outlined so that management gets the whole picture.

Such seminars have been very effectively held on an open basis, regionally, inviting one and all in the food and dairy industry in specific areas to attend, at a nominal cost. Usually a small registration fee is charged to reimburse the basic expenses.

However, in large companies, they are often held on a company wide basis or even for one division of a company at a time. Smaller or single plant companies that are not national in scope may hold such a seminar with the aid of the sanitation consultant for key working employees in the plant. In such instances, the subject matter must be tailored to fit the audience and their responsibilities.

Inspections

However, experience has shown that even with some basic understanding of the problem and their responsibilities, food plants generally are unable, without help, to determine actually what their sanitation level is, and the nature of the sanitation hazards or deficiencies that are occurring. The sanitation consultant, therefore, seeks to make arrangements to set up a program of periodic inspections. These might be described as unofficial thorough regulatory inspections designed to determine just what is wrong at the time of the inspection.

Thus it may be found that one or more plants have become complacent because of too much reliance on a pest control operator who only comes into the plant periodically to control pests. Usually, it is necessary, therefore, to set up the plant with auxiliary pest control programs and to train some of the plant personnel in the technique or methods of control. In any event, it is usually necessary in these inspections to train a plant sanitarian in every aspect of this work so that he can evaluate his pest control operator's personal performance, and the need or extent of auxiliary program required. Admittedly, in many instances food plants with proper knowledge of pest control programs prefer to carry out their own work but it is not the function of an industry consultant to advocate this practice but merely to familiarize personnel with the requirements of a good total pest control program so that they are in a position to set one up as they see fit.

Microbial contamination

At the same time, the sanitation consultant, in surveying or inspecting the plant, makes a careful analysis of the potentialities for bacterial infection. These embrace employee practices, bacteriological control of raw ingredients where this is a key factor, and similarly bacteriological control of the finished product. The plant's entire program is evaluated and recommendations made for setting up a program of training and laboratory control where there is none, or of improvement where such is indicated.

Of particular interest here are those factors involving employee practices. For even in a plant which relies upon pasteurization of production at some point in manufacturing, there are a multitude of avenues for bacterial contamination that can develop from faulty employee practices. These must be rigidly regulated and rules set up by consultation between management and the consultant for avoiding contamination.

We have in mind here, by way of illustration, such a gross example as an avenue of contamination with *Salmonella* sometimes encountered when dry milk plants permit unauthorized personnel such as truck

drivers from farm routes to walk through the plant with contaminated feet and thus distribute bacteria throughout areas where pasteurized material is being held. Another example in the dry milk industry that has been known to occur more than once, is the practice of permitting cleaning employees to enter the dryers for cleaning purposes in street clothing rather than requiring them to wear clean, sterile clothes and sterile boots. These are but two examples of a multitude of possibilities.

Scheduling of sanitation measures

Then there is always the problem of scheduling of various routine sanitation measures that have to be undertaken by the plant. These involve pest control measures and in-plant inspections, that is, inspections to be made at periodic intervals by plant key personnel, in addition to the quarterly or semi-annual inspections by the sanitation consultants. It also includes an analysis of scheduling cleanup procedures ranging from equipment cleanup to building cleanup and involves correlated scheduling of sanitation programs with production operations all of which have to be worked out by the plant, but under the guidance of the consulting sanitarian, to insure that they are adequate. And then, last, but not least, there is the problem of training of employees in basic hygiene and an understanding of why this is necessary.

Inspection by the consultant

It is believed that the best technique for a sanitation consultant in his phase of the work is to make an inspection and take notes in duplicate as he does so. At the conclusion of the inspection, one complete set of notes is bound up and presented to the management and an intensive conference held to evaluate the findings. Then, subsequently, based upon the second set of notes which is retained by the consultant, a final edited typed report is submitted which embodies the findings of the notes and the points raised in the management discussion and the scheduling recommendations.

It is also believed that for comparative purposes, relative grades should be assigned to each inspection. These should be based upon weighted number of points for different categories such as: (a) planning and understanding, (b) plant engineering in structure and equipment, (c) production sanitation, (d) cleanup and sanitizing procedures, (e) rodent control factors—here discussing the program for rodent control rather than simply what was found, and (f) insect control factors—here emphasizing the status of maintenance of the program rather than simply making a count of the number of cockroaches found. An evaluation of employee practices is observed and their relative contribution to perhaps bacterial con-

tamination of the product, but also with an evaluation of the extent to which the plant has an established, continuous training program so employees are adequately trained in understanding the sanitation requirements of individual jobs.

Locker room facilities must be evaluated with a feeling that any plant that does not have first class locker room and toilet room facilities cannot properly instill true appreciation of sanitation on the part of the employees. Lunch rooms are evaluated with the same view as locker and toilet rooms.

In those instances where applicable, handling of returned goods, handling of reground materials, and presence of birds and bird control programs are also included in the grading system.

With a well rounded over-all plan a sanitation consultant, in giving such grades based upon a weighted number of points for each of the above categories, can help the plant in developing a better understanding of whether they are making improvements from inspection to inspection. Further, in a multi-plant organization, there is a great deal to be gained by competition between plants. A modern sanitation consultant should have a program of offering different types of certificates to plants reaching a certain level, such as one level might be where a certificate is given to all plants that, in the sanitation consultant's opinion, are sufficiently high to justify the feeling they are not subject to regulatory action and a second or higher certificate might be given to such plants in the same chain that are showing an exemplary sanitation level.

Experience has shown by the use of certificates and by the use of grading a great deal of competitive interest can be aroused within the company, which is all to the good.

Visual aids

A good sanitation consultant also studies plant problems to develop visual aids, such as a poster program whereby the posters are issued from time to time and placed within the plant to impress upon individual employees the insanitary practices that they might be inadvertently committing.

The basic role of a sanitation consultant might probably be considered one of education, both of management and plant employees rather than to make inspections to evaluate. The consultant's work should emphasize the development of preventive sanitation programs rather than simply coming in to find things that are wrong and suggest individual corrections.

Aims of the consultant

It has often been said that any good consultant's work should *first* determine *what is wrong*, then why it is wrong and then *how to correct it*. It is felt that actually his work goes beyond this. He should also

recommend programs that will prevent these things from occurring before they actually do. This is really the *ultimate aim* of *both regulatory officials* and the *sanitarian consultant* and unless he makes every effort to do so, a consultant is not performing his best service to the plant he serves or to sanitation in general.

Legal action

There are always a few food plants that, despite the efforts of regulatory officials and consultants, will get themselves in a legal jam. It should also be a function of the sanitation consultant to be able to help in such a case first, to develop an adequate program, and then to emphasize preventive sanitation in this programming, to regulatory officials before whom the client appears. These then will be impressed with the fact that effort is being made to prevent the violations from recurring.

Experience has shown that when a food manufacturer is cited for poor sanitation either by the Federal, State, or local authorities, that the regulatory agency is primarily interested in seeing to it that these conditions do not recur. Today there is little punitive desire on the part of regulatory agencies against plants for insanitary conditions. They, too, are concerned with education and improvement.

Therefore it is the function of the sanitation consultant to see to it that the client goes before a hearing office, let us say, and shows him that he understands this and that he is setting up programs that will prevent what the regulatory inspector found wrong from recurring.

CHANGES IN FOOD PLANT SANITATION

Sanitation has become such a factor in modern food and dairy plant manufacture, that those involved are actually in a new profession. Individual plants need a sanitarian to conduct and operate the plant's management of all sanitation operations. Large, multiple chains need someone to coordinate all efforts within the chain. Today such a person is sometimes known as a corporate sanitarian. For instance, large corporations that manage multiple food and dairy plants often have such a corporate sanitarian. His work is very complex and he needs all the assistance that he can get, so very commonly he employs the services of a good sanitation consultant and his staff to assist him, either in making periodic inspections or by holding seminars or training courses for him, or any one of a number of ways. It has therefore become a primary function of the sanitation consultant to be in a position to advise and supplement the work of the corporate sanitarian.

Some large corporations have even been known to hire a good sanitation consulting firm to actually

serve in the capacity of the corporate sanitarian and to carry out his functions in training individual plant sanitarians and other personnel throughout the company and providing inspection service.

It is felt that the work of an industrial consulting sanitarian has truly progressed and is still in the course of progressing towards even higher levels. At the beginning he usually was responsible for merely solving the individual problems for the plants when they felt they had them. He then became responsible for finding problems, first, to make sure they would not get into trouble with regulatory officials. Now it is felt that he is responsible for developing and ad-

vising plants on how to prevent problems from recurring.

Today, it is felt that also the industrial sanitarian is one of the best friends of the regulatory official. No competent industrial sanitarian has any quarrel with regulatory officials. He is not an antagonist but a co-worker. If there are any consulting sanitarians, either individuals or firms, that feel their primary role is one of antagonism, or one of trying to get their clients off the regulatory hook, by any means when they are caught, they are doomed to failure. The real success of the consulting sanitarian lies primarily in getting at the problems for his clients before there is need for regulatory action to be taken.

REPORT OF COMMITTEE

(Continued from Page 294)

formation on existing state and local regulations for manufactured dairy products and to evaluate the extent of uniformity and reciprocity now being practiced and the problems encountered. A questionnaire was developed and forwarded to 100 state and local regulatory agencies. Sixty-two percent of those receiving the survey form responded. More local health departments responded to the questionnaire than state agencies.

The tabulated results of the survey are summarized as follows:

1. 85% of the agencies were responsible for frozen desserts and cottage cheese and to a lesser extent milk powder, condensed milk and filled and imitation milk.
2. 66% use USPHS standards on the products included in the questionnaire, 26% follow state and local standards and 35% find variations in standards from one area to another.
3. 50% indicated difficulty in obtaining information on the quality of dairy products manufactured outside their jurisdiction.
4. 80% accept dairy products on a reciprocal inspection arrangements, while 34% indicated that inspections are made in outside shipping areas prior to issuing a permit.
5. A majority of those responding to the survey indicated they would favor reciprocal agreements, provided adequate inspection and survey procedures were instituted.

Within both the IMS Committee and those responding to the survey, there was a difference of opinion as to the procedures which should be used in order to achieve greater uniformity and reciprocity both within a state's boundaries and between states. Some favored the broadening of the Interstate Milk Shipment Agreements, while others advocated exploring other procedures.

COMMITTEE MEMBERS

H. J. Barnum, Co-Chairman, C. K. Luchterhand, Co-Chairman; D. J. Conner, Kentucky State Health Department; F. E. Fenton, Adv., U. S. Department of Agriculture; C. M. Fistere, Adv., Fistere, Habberton & Durland; G. C. Fulkerson, Tennessee Department of Health; E. P. Gadd, Missouri De-

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REPORT OF COMMITTEE ON STANDARDS FOR SINGLE-SERVICE CONTAINERS AND CLOSURES

The 1965 National Conference on Interstate Milk Shipments made the following recommendations to the conference:

"The Task Force recommends that the United States Public Health Service be requested to publish a list of acceptable single-service container manufacturing plants and processors, provided that prior to the publication of such a list the United States Public Health Service shall establish criteria for issuing; and provided that the conference establish a committee to assist the Public Health Service in this function."

A committee was organized in the fall of 1965 to prepare standards for the listing of manufacturers of single-service containers and closures for milk and milk products. This publication issued by the U. S. Department of Health, Education, and Welfare, Public Health Service, Publication No. 1465 may be obtained from the Superintendent of Documents, Washington D. C.

This bulletin was made available to the industry in September 1966. The Public Health Service also made available a score sheet No. 723-3 for the scoring of manufacturing plants of single-service containers and closures.

This committee did not establish a point system for the requirement of listing of plants.

(Continued on Page 318)

TESTS FOR ESTIMATING SHELF-LIFE OF MILK AND MILK PRODUCTS¹

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ABSTRACT

Two general types of procedure are employed for estimating shelf-life of pasteurized milk products. The first encourages the growth of psychrotrophic contaminants by refrigerated storage before testing; the second, applied to fresh samples, utilizes inhibitory agents to repress Gram-positive bacteria. Examples of both types are given in this paper.

The continuing interest in the shelf-life of milk and milk products has led to the development of tests for its estimation. This paper reviews this development.

When considering the shelf-life of refrigerated milk and milk products we must remember that we are concerned almost exclusively with those microorganisms which grow rapidly at storage temperatures. These bacteria are usually referred to as psychrophiles, a term which means "cold loving". This is a misnomer as they are not "cold loving" but "cold enduring"; while they are able to grow below 50 F (10 C) they grow much better at room or higher temperatures. A more appropriate name is "psychrotrophs" (cold-enduring) and this term will be used in this paper.

Psychrotrophs are generally present in pasteurized products in very small numbers—usually less than 10/ml—so obviously a Standard Plate Count (SPC) (1) on a fresh sample is virtually useless for detecting their presence. The same is true, to a lesser degree, of the coliform count, since many samples showing no coliforms in 1 ml portions contain enough psychrotrophs so that millions develop within 5 days at 45 F (7.2 C). Incubation of plates at this temperature for 10 days will bring these out, but such a long incubation period seriously limits the usefulness of such a test (1).

While there have been a few reports of psychrotrophs surviving laboratory pasteurization in very small numbers, there is abundant evidence that in commercial operations this rarely happens. Consequently there is almost 100% certainty that their presence in a pasteurized product represents recontamination beyond the pasteurizer, although in rare instances this recontamination may occur in the pas-

teurizer through leaking gaskets, hairline cracks in plates, etc.

In the detection of these contaminants in processed products there have been two lines of approach. One has relied upon the use of selective media, or the addition of substances which inhibit the growth of Gram-positive bacteria, to facilitate the growth and recognition of the Gram-negative rods which are the common causes of spoilage. The other approach has resorted to incubation of the sample before testing, to allow these organisms to grow and reach substantial numbers. Sometimes both approaches have been combined in a single test. These various tests will now be described.

TESTS ON STORED SAMPLES

Over 10 years ago the W. K. Moseley Laboratory at Indianapolis began conducting a second SPC on processed samples after holding them at 45 F (7.2 C) for 5 days. Many samples with initially low counts "blew up" to give counts in the tens of millions after 5 days, with accompanying off-flavors and other defects. This procedure is now widely used and has helped many plants pinpoint the source or sources of recontamination. By eliminating these, shelf-life has been markedly improved, to the point where plants today can show no significant increase in SPC after 10 days storage at 45 F (7.2 C). Realizing the limited value of the SPC on the fresh sample, many plants have dropped it, relying upon the Moseley test to detect even very low levels of recontamination.

Some investigators have employed lower temperatures, such as 41 F (5 C), for evaluating shelf-life. However, there is fairly general agreement that 45 F is a safer temperature; growth at 41 F is so much slower that the count after storage might still be reasonably low while that at 45 F would be considered dangerously high.

USE OF SELECTIVE MEDIA

The chief objection to Moseley's storage quality test (1) has been that a week or more elapses before the results are available. Consequently, various workers have suggested different ways of shortening the waiting period. Gyllenberg et al. (6), in Finland,

¹Presented at the 48th Dairy Industry Conference, University of California, Davis, March 19, 1968.

used ammonium lactate agar, and ammonium lactate crystal violet agar, incubating plates 2 to 4 days at 28 C for determining the incidence of organisms responsible for the spoilage of refrigerated milk. In 1964, Freeman et al. (5), at the University of Kentucky, investigated the inhibitory action of various chemicals on Gram-positive organisms. They reported that 0.5% sodium desoxycholate (SDC) was the most effective of all those tested.

In the same year Olson (9) at Oklahoma State University recommended the CTV test, in which 2 ppm of crystal violet plus 50 ppm of 2, 3, 5 triphenyl tetrazolium chloride are incorporated into the plating medium [Plate Count Agar (1)] to repress Gram-positive bacteria and also make Gram-negative colonies more distinctive. One-half milliliter portions of milk are placed in each of 2 plates, the plates poured with CVT agar and incubated at 32 C for 48 hr. Only red colonies are counted. Olson also reported that the sensitivity of his method could be increased by holding samples at 55-60 F (12.8-15.6 C) for 24-48 hr before plating.

Recently Sing et al. (10) reported poor correlation between CVT counts and SPCs after 7 days storage at 45 F, with only 15% of 90 samples agreeing. They also noted that storing samples at room temperature for 18 hr before plating on CVT agar only improved the correlation slightly. They comment, "Results suggest that inhibitors in CVT medium actually depress considerable numbers of bacteria that develop in milk at 45 F. The CVT test may serve as a useful tool for dairies with excessive post-pasteurization contamination. However, it is doubtful that accurate information can be derived from the CVT test for dairies having good control of post-pasteurization contamination."

A study of Olson's results suggests that this criticism may be a little too severe. It appears to be based upon their view that "CVT plates containing over 100 colonies suggest poor keeping quality." There is nothing in Olson's paper that suggests he held such a view, for he has stated that, "Even one vigorous spoilage organism in a whole quart of milk may cause rapid deterioration at refrigeration temperatures." He went on to say, "The CVT method was designed for the detection of post-pasteurization contamination and, as with other methods commonly used, is not an accurate measure for predicting shelf life."

Olson also studied the generation times of spoilage organisms in milk and obtained an average value of 8 hr at 45 F, with some organisms growing considerably faster. At the average rate he reported, a single cell would multiply to over a million in 7 days! Olson's studies also showed the filler to be the main

source of contamination.

In 1966, Lightbody, working in Queensland, Australia, reported (7) using 10 I.U. of penicillin plus TTC to suppress Gram-positive organisms. She found, "a highly significant correlation between counts on samples after holding 24 hr at 68 F (20 C) and those after 4 days at 41 F (5 C) or 50 F (10 C) with plates incubated for 3 days at 30-32 C."

A somewhat different approach was tried by workers at the University of Saskatchewan. Blankenagel and Humbert (2) in 1965 described a surface disc method using crystal violet as an inhibitor. The following year Boyko and Blankenagel (3) utilized the findings of Freeman et al. (5) that 0.5% SDC was the best inhibitor of Gram-positive organisms. They found that all 45 test organisms which grew in milk containing SDC were killed by laboratory pasteurization and therefore assumed that organisms present in processed milk which grew in the presence of SDC were contaminants.

For more rapid detection of contaminants they added 1 ml of a 5% solution of SDC to 9 ml of milk in a sterile test-tube. The mixture was incubated at 32 C for 18 hr, then 1 ml of resazurin solution (1) was added and incubation continued at 37 C. Of all samples judged by other tests (coliform, psychrotrophs, Moseley) to be contaminated, 85% reduced resazurin to beyond the Munsell 5P/7/4 endpoint (1) in less than 3 hr.

In 1967 Catchick and Gibson (4), at the same institution, sought a way to shorten the test to 16 hr so that results would be available next day before bottling commenced. They modified the method of Boyko and Blankenagel (3) by adding resazurin along with SDC, incubating at 37 C for 16 hr, then comparing against Munsell Color Number PBP 7/5.5 (1). They reported the results agreed well with those of the Boyko and Blankenagel test.

These dye reduction tests are simple to conduct and should be of value where no attempts have been made to pinpoint sources of contamination.

A MODIFIED CATALASE TEST

A still different approach is that of Maxcy (8) at the University of Nebraska. Taking advantage of the fact that Gram-negative contaminants are catalase-positive, strongly aerobic, and not repressed by surface-active agents, he developed the following procedure: (a) plates are poured with 10-15 ml of nutrient agar containing 0.05% of alkyl aryl sulfonate, (b) plates are dried for 48 hr at 32 C then 0.5 ml of milk is carefully "spotted" onto the surface in separate droplets, (c) plates are then allowed to stand undisturbed for 30 min while the milk is absorbed before

being incubated in an upright position for 16-20 hr at 32 C, plus 1 hr at 45 C with covers removed, and (d) plates are then flooded with a 5% solution of hydrogen peroxide and placed in a horizontal position on a Quebec Colony Counter. Catalase-positive colonies decompose the hydrogen peroxide and are recognized by the gas bubbles released; only these colonies are counted.

In studies with processed milk samples from the university dairy plant, the shelf-life at 41 F was not over 14 days when any gassy colonies showed on the plate; with a heavy contamination shelf-life dropped to 7 days.

Additional studies were made of the validity of this "rapid test" in predicting shelf-life of milk in a large commercial plant. The criterion for acceptable shelf-life was the absence of any organoleptic defects after 10 days at 45 F. A single plate was prepared from each sample, and the occurrence of a single gassy colony constituted a positive test. Of 159 samples only 5 with a positive test had over 10 days shelf-life; 24 others with a positive test failed the shelf-life test, whereas 15 with a negative test failed it. This latter figure emphasizes the principal disadvantage of this and other tests applied to fresh samples; Maxcy's rapid test can only detect contamination at the level of not less than 2 colonies per ml. Smaller numbers may still multiply sufficiently to cause organoleptically detectable defects during storage at 45 F. Another disadvantage lies in the need for an additional incubator at 45 C (113 F).

DIRECT SHELF-LIFE EVALUATION

Certain plants dispense with the bacteriological testing and evaluate shelf-life directly by holding samples of products from each day's production and examining them at the end of the storage period, usually 7 or 10 days. If storage is at 45 F, this procedure has considerable merit. However, if samples are held at a lower temperature, such as that at which processed products are commonly held in a

well-operated plant, no defect may show up by the end of the storage period, yet the products may lack adequate shelf-life at 45 F. The difference in growth rates of psychrotrophs at 41 and 45 F is really startling, hence the need for using the higher temperature when evaluating shelf-life.

Not all contaminants growing at 45 F will cause spoilage. However, the majority will, hence it is necessary to regard each contaminant as a potential threat to shelf-life. The aim should be to detect and eliminate all sources of recontamination. When this has been accomplished shelf-life should no longer be a problem.

REFERENCES

1. American Public Health Association. 1967. Standard Methods for the Examination of Dairy Products, 12th ed. Am. Public Health Assoc., Inc., New York, N. Y.
2. Blankenagel, G., and E. S. Humbert. 1965. A rapid method to determine post-pasteurization milk contamination. *Canad. Dairy Ice Cream J.* 44 (8):28.
3. Boyko, A., and G. Blankenagel. 1966. Detection of contamination in pasteurized milk. *Canad. Dairy Ice Cream J.* 45 (6):20.
4. Catchick, A., and D. L. Gibson. 1967. Sixteen hour method for detecting post-pasteurization contamination in market milk. *Canad. Dairy Ice Cream J.* 46 (6):25.
5. Freeman, T. R., N. V. Nanavati, and W. E. Glenn. 1964. Faster enumeration of psychrophilic bacteria in pasteurized milk. *J. Milk Food Technol.* 27:304.
6. Gyllenberg, H. 1960. Contamination and deterioration of market milk. III. A selective plating test for the demonstration of significant numbers of pseudomonads. *Acta. Agric. Scand.* 10:65.
7. Lightbody, L. 1966. The effect of low temperature storage of pasteurized milk on bacterial counts using penicillin agar. *Austral. J. Dairy Technol.* 21:94.
8. Maxcy, R. B. 1967. A rapid test for determining post-pasteurization contamination of market milk. *J. Dairy Sci.* 50:938.
9. Olson, H. C. 1964. How to improve shelf-life. *Proc. 57th Ann. Conv. Milk Ind. Foundation, Chicago, Oct. 9.*
10. Sing, E. L., P. R. Elliker, L. J. Christensen, and W. E. Sandine. 1967. Effective testing procedures for evaluating plant sanitation. *J. Milk Food Technol.* 30:103.

CHEDDAR CHEESE: COMPARISON OF EFFECTS OF RAW AND HEATED MILK ON QUALITY AND RIPENING

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(Received for publication December 20, 1968)

ABSTRACT²

Portions of identical milk of manufacturing quality were made into cheese: (a) without heating; (b) after pasteurizing by the holder method; (c) after short-time heating at 71 C; (d) over 71 C (74-87); and (e) less than 71 C (50-69). These variations in heating did not require extensive modifications of cheese-making operations. Measurements were made of moisture, pH, and salt. Cheese was cured at 7 C, scored at 1, 3, 6, and 12 months, and analyzed for total nitrogen, water-soluble nitrogen, and amino nitrogen at 3, 6, and 12 months. Milk pasteurized by the holder method or by heating to 71 C produced better cheese than raw milk or milk heated for a short time at less than 71 C. Raw-milk cheese cured most rapidly, had the most intense flavors, and was least stable in storage. Rate of curing and intensity of flavor decreased and storage stability increased with the severity of heat treatments. Changes in protein were less extensive in heated-milk cheese and were more extensive in cheese of lower grades. Although there are risks involved, markets for cheese with pronounced cheese flavor can be met with the products produced from milk heated for short times at less than 71 C.

Pasteurization of milk for cheese is commonly accepted for almost all varieties. Heat treatments which do not produce a phosphatase-negative product are widely used in the Cheddar industry. Such treatments are used to control objectionable bacterial changes while producing the desired flavors and rate of ripening of raw-milk cheese.

Heat treatments of milk for Cheddar cheese are rarely used to assure freedom from pathogenic organisms, although epidemics of typhoid (4, 8, 25) and food poisoning (3) have been traced to cheese. Recent studies have been concerned with *Staphylococcus aureus* or its toxin in cheese (31, 33, 35, 36, 37, 38) and with *Salmonella* (7, 15).

Many studies have considered the effects of heating milk used for cheese. Workers who have heated milk to temperatures and times which duplicated or closely approximated 71 C for 15 sec generally agree (2, 5, 18, 20, 23, 24, 26, 30), with few exceptions (13, 14), that cheese made from it is better than comparable raw-milk cheese. Most of them, with

one possible exception (18), noted slower curing (9, 14, 23, 26, 27, 30).

Pasteurization of milk for cheese controls coliforms (5, 12) and *Staphylococcus aureus* (38). Underpasteurization does not do so (12, 37) and is associated with higher populations of bacteria in cheese and lower quality, or the risk of it (11, 12). One study suggested that cheese is better when more nonstarter lactic organisms survive the heat treatments (6).

Changes in milk fat and protein are decreased in ripening of cheese from heated milk (14, 17, 18, 27, 28, 29) and effects increase with the severity of heat treatments (17). Heating milk for 16 sec at 66.7 C inactivates 88% of phosphatase, whereas heating to 60 C for 16 sec inactivates only 24% (16).

Heating at temperatures and times less than required for pasteurizing usually produces cheese which resembles raw-milk cheese in quality and rate of curing (11, 13, 23, 26). Flavor may equal that in cheese from pasteurized milk (22) or may be even better (6, 13).

Milk which has been overpasteurized produces cheese with defective flavor and body (6, 14, 17, 18, 20, 21, 23, 26, 30). Slower curing is associated with high heat treatments.

This report presents results of studies in 1942-1944 on the use of heated milk for Cheddar cheese. The experiments were designed to compare the quality and ripening of cheese made from raw milk with that made from identical milk exposed to varied heat treatments. Since 1960 much attention has been given to the presence and significance of undesirable microorganisms and toxins in cheese (6, 7, 15, 31, 33, 35-38); the studies reported here may be useful to sanitarians who question the effects of various heat treatments of milk in Cheddar cheese making and curing.

METHODS

Manufacturing. Each day a mixed batch of milk of manufacturing quality was divided into four vat lots weighing about 420 lb. (190 kg). One vat contained raw milk. Each lot of milk in the other three vats was heated by a different method. Curd from each vat was pressed in Daisy style hoops to give two cheese, each weighing approximately 20 lb. (9 kg). Each cheese was waxed and ripened on open

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²Temperature equivalents: 100 C (212 F), 80 C (176 F), 74-87 C (165-189 F), 71 C (160 F), 63 C (145 F), 62 C (143 F), 50-69 C (122-156 F), and 7 C (45 F).

TABLE 1. MEANS AND RANGES OF HEAT EXPOSURES^a OF EACH FLASH HEAT TREATMENT IN THE TUBULAR HEATER.

Treatment	No. of lots	Temperature (C)		Time (Sec)		Log R10 ⁵	
		Mean	Range	Mean	Range	Mean	Range
Flash	26	71.37	70.9-71.8	15.19	14.7-15.2	5.11	4.97-5.26
Flash > 71 C	21	79.32	74.1-86.8	6.63	1.3-15.2	6.26	4.72-7.50
Flash < 71 C	15	58.13	49.5-68.7	16.74	14.7-20.4	2.19	0.30-3.86

^aSeverity of exposure $R = T_e/T_s$. T_e = Time of exposure at experimental temperature. T_s = Time indicated by standard pasteurization curve for pasteurization at the experimental temperature.

TABLE 2. MEANS AND STANDARD DEVIATIONS OF FINAL GRADES OF NONPAIRED LOTS OF CHEESE MADE FROM RAW AND HEATED MILK.

Treatment	No. of lots	Age of cheese in months			
		1	3	6	12
Flash	26	2.7 ± 0.51	2.1 ± 0.48	2.2 ± 0.66	2.0 ± 0.47
Holder	16	2.7 ± 0.74	2.3 ± 0.58	2.1 ± 0.58	2.2 ± 0.54
Flash > 71 C	21	2.7 ± 0.72	2.5 ± 0.86	2.3 ± 0.64	2.2 ± 0.65
Flash < 71 C	15	3.0 ± 0.72	2.6 ± 0.85	2.6 ± 0.76	3.0 ± 0.98
Raw	26	3.8 ± 0.54	3.1 ± 0.87	3.0 ± 0.71	3.5 ± 0.84

TABLE 3. MEANS AND STANDARD DEVIATIONS OF DIFFERENCES^d BETWEEN FINAL GRADES OF PAIRED LOTS OF CHEESE MADE FROM RAW AND HEATED MILK.

Characteristic	Age	Raw-milk cheese grades minus heated-milk grades			
		Flash 71 C	Flash > 71 C	Flash < 71 C	Holder
	(mo.)	(26) ^a	(21) ^a	(15) ^a	(16) ^a
Flavor	1	1.1 ± 0.82	1.0 ± 0.84	0.7 ^b ± 0.94	1.1 ± 0.87
	3	0.9 ± 1.01	0.8 ± 1.16	0.7 ± 0.64	0.7 ± 0.68
	6	0.7 ± 0.91	0.7 ± 0.78	0.7 ^b ± 0.72	0.4 ^c ± 0.24
	12	1.5 ± 0.79	1.3 ± 0.88	0.8 ± 0.74	1.1 ± 0.75
Body	1	0.4 ± 0.74	0.4 ^b ± 0.84	0.3 ± 0.50	0.6 ± 0.73
	3	0.6 ± 0.62	0.3 ^b ± 0.65	0.2 ^c ± 0.50	0.3 ^b ± 0.60
	6	0.6 ± 0.74	0.4 ^b ± 0.74	0.3 ^b ± 0.60	0.4 ^c ± 0.82
	12	0.8 ± 0.54	0.7 ± 0.66	0.4 ^b ± 0.52	0.6 ± 0.45
Texture	1	0.8 ± 1.01	0.9 ± 0.92	0.5 ± 0.57	1.0 ± 0.82
	3	0.6 ± 0.97	0.6 ± 0.66	0.4 ^c ± 0.70	0.7 ± 0.85
	6	0.6 ± 0.71	0.6 ± 0.66	0.4 ± 0.49	0.5 ^b ± 0.85
	12	0.8 ± 0.80	0.8 ± 0.68	0.5 ^c ± 0.58	0.6 ± 0.49
Final grade	1	1.1 ± 0.70	1.0 ± 0.84	0.7 ± 0.89	1.1 ± 0.90
	3	0.9 ± 0.91	0.6 ^b ± 1.15	0.6 ± 0.56	0.5 ± 0.71
	6	0.8 ± 0.93	0.8 ± 0.74	0.7 ± 0.65	0.7 ± 0.93
	12	1.5 ± 0.68	1.3 ± 0.91	0.8 ^c ± 0.68	1.0 ± 0.75

^aNumbers in parentheses are number of pairs in series

^bDifference is significant, $P < 0.05$

^cDifference is not significant

^dAll differences are highly significant, $P < 0.01$, with the exceptions noted by ^b and ^c.

shelves at 45 F (7 C) and 65% relative humidity for 12 months.

Heating milk. An internal tubular heater and cooler, previously described (19), was used for this study; it was made especially for small scale experimental treatments by the Cherry Burrell Corp. Milk flow through this 8-tube heater was regulated by a variable-speed, Waukesha positive pump.

The flow of hot water pumped through the header of the tubular heater was manually regulated at each tube to control milk temperature. Thermometers were fixed in the outlet ends of tubes.

Heat treatments used in these experiments were varied widely in temperature and duration as shown in Table 1. The severity of each heat treatment was related to that required for

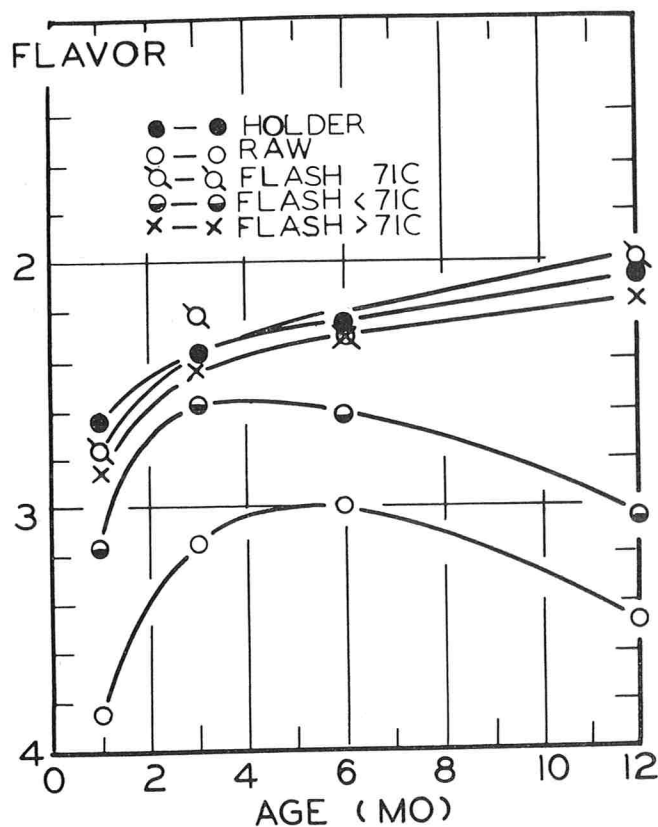


Figure 1. Average flavor grades of all lots made from raw and heated milk.

strict pasteurization as shown by the standard curve of required times and temperatures (10). The severity of treatment was recorded as the ratio (R) between time of exposure at the experimental temperature and the time required for pasteurization at that temperature according to the standard curve. Durations of some exposures were so short and temperatures so low that R values were as small as 0.00002, whereas others, more severe, had R values of 300. The R values were therefore converted to logarithms of $R \times 10^5$ to study relations between treatments and effects.

To avoid confusion of these unusual treatments with the well known high-temperature, short-time pasteurization, these treatments will be called flash treatments in this report.

Milk pasteurized by the holder method was heated to 62 C for 30 min or 63 C for 20 min.

Analyses. Total nitrogen in the cheese was measured at 3, 6, and 12 months of age by the Kjeldahl method. At the same times, Kjeldahl measurements were made of percentages of total nitrogen soluble in distilled water (water-soluble nitrogen) by dispersing 7.5 g samples in 150 ml water at 50 C with a Waring Blendor, holding for 60 min at 50 C, and filtering through No. 42 Whatman filter paper. A 10 ml aliquot portion of this clear filtered solution was also used to measure amino nitrogen by the Van Slyke apparatus following official methods (1).

Moisture tests were made by drying 5 g cheese for 18 hr at 100 C followed by 1 hr under 25 inches vacuum at 100 C. Acidity was measured as pH with the quinhydrone electrode (32). Salt tests were made by modified Vollhard method (34).

Cheese grades. Averages of grades of at least three judges were recorded at 1, 3, 6, and 12 months. Judges evaluated flavor, body, and texture, each on a scale of 1 to 6, signifi-

ing: Excellent, Desirable, Satisfactory, Objectionable, Very Objectionable, and Unsalable, respectively. Final grades, using the same scale, summarized each judge's opinion of the cheese as a whole.

RESULTS

Quality of cheese. Averages and standard deviations of final grades of all lots of cheese during 12 months of curing are shown in Table 2. Flavor grades are shown in Fig. 1. All lots improved in quality during the first 3 to 6 months. During the last 6 months of curing, the lots made from raw milk and milk heated to less than 71 C decreased in quality. All other lots remained constant or improved in quality.

Differences in quality between paired lots of cheese made from identical milk, raw and heated, are shown in Table 3. The heated-milk lots averaged better in final grade at every age than the raw-milk cheese. These differences in grades were great enough to be important commercially ($P < 0.05$).

Cheese made from milk flashed at 71 C showed the greatest improvement in final grade over the paired lots of raw-milk cheese made from identical milk. Flash heating at less than 71 C caused the least improvement in the cheese.

Improvements in quality of cheese made from heated milk were evident in flavor, body, and texture. Flavors of raw-milk lots were most often criticized for being feedy, unclean, and showing effects of undesirable fermentations.

Raw-milk cheese developed characteristic Cheddar cheese flavor more rapidly, reached its best at 3 to 6 months, and then generally developed over-cured defects. Lots made from milk flash heated under 71 C tended to resemble raw-milk lots in characteristic flavor development and faults.

Texture and body differences between heated-milk and raw-milk lots were most apparent when graded at 1 and 12 months. More open texture of raw-milk cheese was the most common criticism; body was frequently weaker. Lots from milk flashed under 71 C were most like the raw-milk cheese. Cheese from milk heated by the holder method, and by the flash method at 71 C and over were, in general, smoother in body than comparable lots of cheese from raw milk. The exceptions were instances of shortness or brittleness of body observed in lots from milk flash heated to temperatures above approximately 80 C.

The purpose of using heat treatments less severe than pasteurization is to retain in the heated milk some of the cheese-ripening enzymes and bacteria from the original milk. Such heat treatments alone do not eliminate flavors and odors of raw milk which may also contribute some of the raw-milk character-

TABLE 4. CORRELATION COEFFICIENTS BETWEEN FINAL GRADES OF RAW-MILK CHEESE AND CHEESE MADE FROM IDENTICAL MILK AFTER THE DIFFERENT HEAT TREATMENTS

Paired lots	No. of pairs	Age of cheese in months			
		1	3	6	12
Raw: Fl <71 C	15	+0.21	+0.77 ^b	+0.60 ^a	±0.74 ^b
Raw: Holder	16	+0.17	+0.52 ^a	-0.09	+0.48 ^a
Raw: Flash	26	+0.18	+0.21	+0.02	+0.59 ^b
Raw: Fl >71 C	21	+0.18	+0.18	+0.28	±0.37

^aSignificant, $P < 0.05$.

^bHighly significant, $P < 0.01$.

istics to the heated-milk cheese. How closely characteristics of raw-milk cheese tended to carry through into the lots of cheese made from milk subjected to the different heat treatments is shown by the coefficients of correlation in Table 4. These data show a direct relation, most evident at 12 months, between final grades of paired lots of raw-milk and heated-milk cheese. Factors which produced better quality in raw-milk cheese apparently also improved the quality of the cheese made from heated milk. The relationship was least evident in cheese made from milk which had received excessive heat treatments, and most evident following flash heating at less than 71 C.

Within groups of cheese in the underheated and overheated lots, the severity of the heat treatments affected the quality. Correlations between R values and final grades at 12 months showed that when flash heating was less than 71 C, quality was impaired as severity of heating decreased ($r = -0.81$, $P < 0.01$); and as severity of heating above 71 C increased, quality of cheese decreased slightly ($r = +0.43$, $P < 0.05$).

Water-soluble nitrogen. Measurements of water-soluble nitrogen (WSN) as per cent of total nitrogen in the cheese were made at 3, 6, and 12 months. The data are summarized in Table 5 to show the means and standard deviations of observations of the paired lots of cheese made from identical milk, heated and not heated.

Increases in WSN were greatest in raw-milk cheese and were closely approximated by increases in cheese made from milk flashed to less than 71 C. Averages of measurements at 3 and 6 months in these 15 paired lots were not significantly different ($P > 0.05$). At 3 months of age, only the raw-milk and holder-heated pairs were not significantly different. All other paired lots showed significant differences ($P < 0.05$) at all ages.

In Fig. 2, differences in WSN between paired lots of raw-and heated-milk cheese are plotted to show trends of differences during ripening. Excess of WSN in raw-milk lots of the pairs increased between 3 and 6 months and remained fairly constant to 12 months with the exception of pairs including holder-heated milk; these pairs showed differences in WSN increasing up to 12 months of age.

The severity of the heat treatment (R) of the milk from which the cheese was made affected the development of WSN in the cheese. As heat treatments increased in severity, amounts of WSN in the cheese decreased. At 3, 6, and 12 months, the coefficients of correlation between these factors were -0.54 , -0.50 , and -0.45 ($P < 0.01$), respectively.

Each time the cheese was graded, the quality of cheese made from heated milk tended to decrease with increases in water-soluble nitrogen as per cent of total nitrogen. Coefficients of correlation between grades and WSN at 3, 6, and 12 months were: $+0.20$,

TABLE 5. MEANS AND STANDARD DEVIATIONS OF OBSERVATIONS OF WATER-SOLUBLE NITROGEN AS PER CENT OF TOTAL NITROGEN DURING RIPENING OF PAIRED LOTS OF RAW- AND HEATED-MILK CHEESE.

Paired treatments	No. of pairs	Age of cheese in months		
		3	6	12
Raw vs Holder	16	{24.0} ^a ± 4.85	31.4 ± 1.34	38.7 ± 6.14
		{21.6} ± 1.66	28.3 ± 3.62	34.0 ± 2.20
Raw vs Flash 71 C	26	26.4 ± 6.24	32.9 ± 6.42	39.8 ± 6.04
Raw vs Flash > 71 C	21	22.5 ± 2.52	28.2 ± 3.82	35.1 ± 2.95
		26.5 ± 6.82	32.4 ± 6.66	39.7 ± 6.39
Raw vs Flash < 71 C	15	{28.9} ^a ± 5.25	{35.2} ^a ± 3.91	42.0 ± 4.53
		{27.8} ± 7.46	{27.8} ± 5.36	39.7 ± 5.72

^aMeans enclosed in brackets are not significantly different. Differences between other pairs are significant ($P < 0.05$).

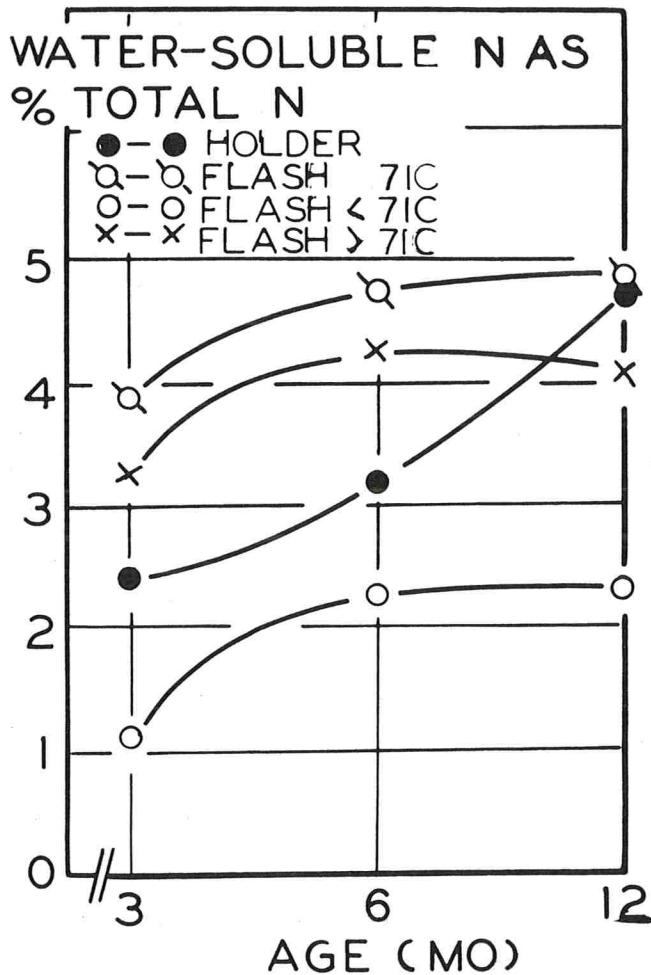


Figure 2. Differences in water-soluble nitrogen as per cent of total nitrogen between paired lots of raw- and heated-milk cheese (Raw minus Heated).

+0.32, and +0.62, respectively. Only the relationships at 6 and 12 months were significant ($P < 0.01$).

The lots of cheese made from milk heated to less than 71 C had WSN approaching the amount in raw-milk cheese and approximated the quality of the raw-milk cheese. Judges commented on the same pronounced flavors, open texture, and weaker body.

Amino nitrogen. Measurements of amino nitrogen as per cent of total nitrogen (AmN) in the cheese were made at 3, 6, and 12 months. Means and standard deviations of these measurements are shown in Table 6.

Amounts of AmN increased from 3 months to 12 months, but did so most rapidly between testing periods at 6 and 12 months. Values in raw-milk cheese were always greater than in comparable lots made from heated milk. Changes in cheese made from milk after heating to less than 71 C for substandard pasteurization times most closely resembled those occurring in raw-milk cheese.

Figure 3 shows differences at each analytical period between AmN in comparable lots of cheese made from raw and heated milk. All differences from raw-milk cheese were significant ($P < 0.05$) at each age excepting those differences at 3 months between lots from milk flash heated to less than 71 C and comparable raw-milk cheese. The differences between pairs increased steadily during curing. Amino nitrogen as per cent of total nitrogen in raw-milk cheese always exceeded that in cheese from milk subjected to any heat treatment.

Amounts of AmN were affected by temperatures and durations of the flash heat treatments. As the severity (R) of the heat treatments increased, the amounts of AmN in the cheese decreased; this was apparent at each period of analysis. Coefficients of correlation between these factors calculated at 3, 6, and 12 months of ripening were: -0.60 , -0.57 , and -0.54 ($P < 0.01$), respectively.

At each grading period, the quality of cheese made from heated milk tended to decrease as the AmN in the cheese increased; this relationship increased in importance with the age of the cheese. Coefficients of correlation between grades and AmN at 3, 6, and 12 months were: $+0.04$, $+0.30$, and $+0.50$, re-

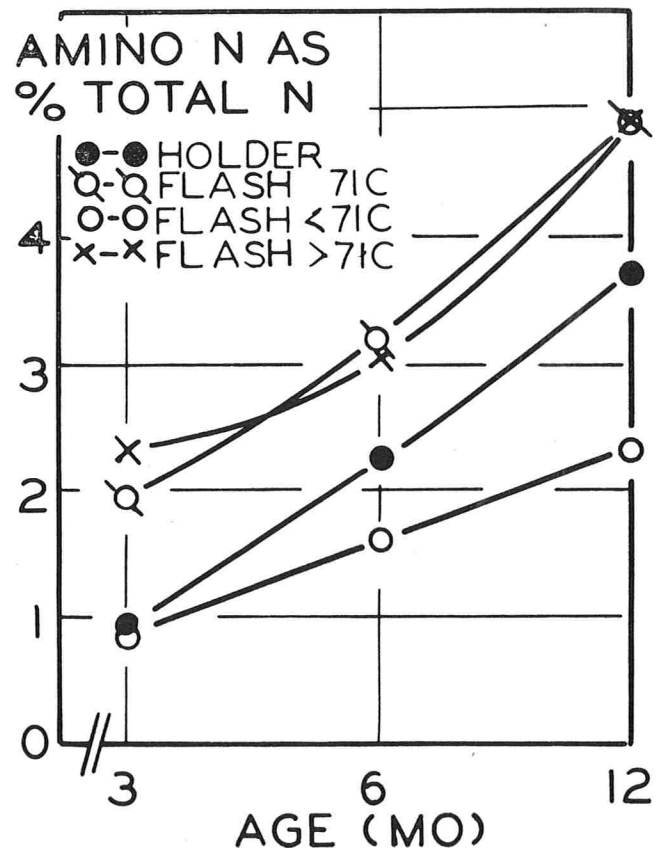


Figure 3. Differences in amino nitrogen as per cent of total nitrogen between paired lots of raw- and heated-milk cheese (Raw minus Heated).

TABLE 6. MEANS AND STANDARD DEVIATIONS OF OBSERVATIONS OF AMINO NITROGEN AS PER CENT OF TOTAL NITROGEN DURING RIPENING OF PAIRED LOTS OF RAW- AND HEATED-MILK CHEESE.

Paired treatments ^a	No. of pairs	Age of cheese in months		
		3	6	12
Raw vs Holder	16	6.7 ± 1.08	10.5 ± 1.91	15.5 ± 2.83
Raw vs Flash 71 C	26	7.3 ± 1.65	10.8 ± 1.82	16.0 ± 2.61
Raw vs Flash > 71 C	21	5.3 ± 0.88	7.5 ± 1.73	11.1 ± 1.72
Raw vs Flash < 71 C	15	7.5 ± 1.68	10.5 ± 2.24	16.3 ± 2.79
		5.2 ± 1.18	7.4 ± 1.69	11.3 ± 2.38
		{7.6} ^a ± 1.93	11.2 ± 1.48	16.1 ± 2.06
		{6.7} ± 2.39	9.6 ± 2.37	13.8 ± 3.78

^aMeans enclosed in brackets indicate paired lots that are not significantly different. Differences between all other pairs are significant ($P < 0.05$).

spectively. Only the correlations at 6 and 12 months were significant ($P < 0.01$).

Moisture, acidity, and salt. Table 7 summarizes averages and standard deviations of percentages of moisture in cheese at paraffining and at 6 months.

Levels of moisture were normal for Cheddar cheese at both ages. Moisture at 6 months averaged as much as 2% lower than at paraffining in some groups, but this drop was normal for the shelf curing of waxed cheese at approximately 7 C and 65% relative humidity.

At paraffining, the raw-milk cheese in two series contained significantly less moisture ($P < 0.05$) than the comparable cheese from heated milk. This difference was 0.47% in the series with holder-pasteurized milk and 0.68% in the series with milk flash heated above 71 C. Such differences were great enough to have significant effects on yield; they decreased during the 6 months of shelf curing.

Measurements of pH of the cheese at paraffining, 3, 6, and 12 months are summarized in Table 8. All values were typical of well made Cheddar. With four exceptions, the raw-milk lots in paired series averaged slightly higher in pH ($P < 0.05$) than comparable lots made from heated milk; this was probably caused by slightly faster rates of syneresis in raw-milk curd and perhaps by slightly lower levels of moisture in the raw-milk cheese. Differences between the averages were usually less than 0.1 pH unit and were not large enough to explain differences in quality. The pH values of cheese made from milk heated to less than 71 C most closely approximated the acidity of comparable raw-milk lots. Variations of acidity were practically identical in each paired

series, as shown by the standard deviations of observations. Heat treatments of milk had no practical effects on pH values that could not be modified, if desired, by minor changes during manufacture.

Salt in the cheese was measured at 6 months of age. Table 9 shows means and standard deviations of percentages of salt in the cheese and salt in the moisture content of the cheese made from comparable lots of raw and heated milk. Averages of percentages of salt in the paired lots of cheese and in the moisture of the paired lots were practically identical. The only significant differences ($P < 0.05$) between pairs occurred, for some unknown reason, in the percentages of salt in the moisture of cheese made from raw-and holder-pasteurized milk.

TABLE 7. MEANS AND STANDARD DEVIATIONS OF PERCENTAGES OF MOISTURE IN CHEESE MADE FROM PAIRED LOTS OF RAW AND HEATED MILK

Paired treatments	No. of pairs	Raw	Heated
At paraffining			
Raw vs Holder ^a	16	36.01 ± 0.76	36.48 ± 0.91
Raw vs Flash 71 C	26	36.23 ± 0.82	36.40 ± 0.97
Raw vs Flash > 71 C ^a	21	36.37 ± 0.80	37.05 ± 0.90
Raw vs Flash < 71 C	15	36.27 ± 0.86	36.62 ± 0.68
At six months			
Raw vs Holder	16	34.56 ± 0.88	34.93 ± 1.33
Raw vs Flash 71 C	26	34.65 ± 1.09	34.77 ± 1.01
Raw vs Flash > 71 C	21	34.83 ± 0.79	35.13 ± 0.97
Raw vs Flash < 71 C	15	34.51 ± 0.83	34.76 ± 0.78

^aDifference between pairs is significant ($P < 0.05$). All other differences are not statistically significant.

TABLE 8. MEANS AND STANDARD DEVIATIONS OF pH VALUES IN CHEESE MADE FROM PAIRED LOTS OF RAW AND HEATED MILK.

Paired treatments	No. of pairs	Times of measurement			
		Paraffining	3 months	6 months	12 months
Raw vs Holder	16	5.17 ± 0.08	5.16 ± 0.11	5.17 ± 0.09	5.25 ± 0.08
Raw vs Flash 71 C	26	{5.14} ^a ± 0.10 {5.10} ± 0.11	5.15 ± 0.10	5.18 ± 0.09	5.27 ± 0.10
Raw vs Flash > 71 C	21	5.14 ± 0.10	5.16 ± 0.10	5.19 ± 0.10	5.28 ± 0.10
Raw vs Flash < 71 C	15	{5.10} ^a ± 0.09 {5.13} ± 0.13	{5.13} ^a ± 0.07 {5.10} ± 0.08	5.18 ± 0.08	{5.25} ^a ± 0.11 {5.22} ± 0.10

^aMeans enclosed in brackets are not statistically different. All other pairs of means are significantly different ($P < 0.05$).

DISCUSSION

The heat treatments of milk of manufacturing quality were varied widely without requiring extensive modifications during cheese manufacturing.

Cheese made from pasteurized milk was "Desirable" in grade and most stable during storage. It lacked the intense flavors of raw-milk cheese, but it continued to develop more characteristic flavor during 12 months of ripening. Cheese made from excessively over-heated milk was inferior to that made from pasteurized milk.

Cheese from milk given substandard pasteurizing treatments most closely resembled raw-milk cheese although it was somewhat superior to it in final grade for 6 months. Stability in storage of these two products was similar. Better quality in raw-milk cheese was associated with better quality in cheese from identical milk after heating.

Changes in protein during ripening were less extensive in cheese made from heated milk than in that from raw milk; these changes were greater in cheese of lower grades. Alterations in biological properties of milk during heating were undoubtedly responsible for differences in quality, rate of curing, and stability in storage. Differences of moisture, acidity, and salt in paired lots of raw-and heated-milk cheese were too small to cause such differences in quality, ripening, and stability.

There is an important market for Cheddar with the flavors and other attributes of raw-milk cheese, although it is somewhat smaller than that for Cheddar with milder flavor. The judges were fully aware of these facts as they graded the cheese during this study. Their standards were those used in evaluating cheese in scoring exhibitions and contests. Those who merchandise cheese with the intense flavors of

the raw-milk product do so usually for premium prices; they would not agree with the standards of the judges who downgraded the very pronounced flavors. For their purposes, such merchandisers might even choose to invert the scale used in grading cheese flavor, if it were assumed that all flavors in the raw-milk cheese were typical of those which might be expected from milk of superior quality.

Cheese made from raw milk and milk given substandard pasteurization must be cured for at least 60 days at not less than 35 F (1.7 C). Even so, that such a product might be the carrier of undesirable organisms or their toxins is always an unhappy possibility.

The decision to use heated, but not phosphatase-negative milk for cheese, must be made with due consideration of the quality of the milk supply, plant

TABLE 9. MEANS AND STANDARD DEVIATIONS OF SALT IN CHEESE MADE FROM PAIRED LOTS OF RAW AND HEATED MILK.

Paired treatments	No. of pairs	Raw	Heated
Salt in the cheese (%)			
Raw vs Holder	16	1.67 ± 0.11	1.59 ± 0.16
Raw vs Flash 71 C	26	1.63 ± 0.16	1.63 ± 0.14
Raw vs Flash > 71 C	21	1.60 ± 0.16	1.58 ± 0.13
Raw vs Flash < 71 C	15	1.62 ± 0.19	1.63 ± 0.19
Salt in the moisture (%)			
Raw vs Holder ^a	16	4.81 ± 0.41	4.59 ± 0.57
Raw vs Flash 71 C	26	4.69 ± 0.51	4.71 ± 0.49
Raw vs Flash > 71 C	21	4.57 ± 0.48	4.51 ± 0.38
Raw vs Flash < 71 C	15	4.72 ± 0.56	4.74 ± 0.58

^aDifference between pairs is significant ($P < 0.05$). All other differences are not statistically significant.

sanitation, manufacturing methods, the market for the cheese, and finally, the degree of risk which the manufacturer and distributor are willing to assume.

REFERENCES

1. Association of Official Agricultural Chemists. 1940. Official Methods of Analysis of the Association of Official Agricultural Chemists. A.O.A.C., Washington, D. C. 5th edition, pp. 382-383.
2. Benson, M. 1915. Manufacture of Cheddar cheese from "heated" milk. J. Soc. Chem. Ind. 34: 148.
3. Esselen, W. B., and A. S. Levine. 1957. Bacterial food poisoning and its control. A review. Univ. Mass., College of Agr. Bull. 493. 39 p.
4. Foley, A. R. 1932. Epidemic of typhoid fever in the Saint Maurice Valley. 11th Ann. Rept., Provincial Bur. of Health for the Province of Quebec. pp. 25-27.
5. Fox, P. F., and F. V. Kosikowski. 1962. Heat-treated and hydrogen peroxide-treated milks for Cheddar cheese. J. Dairy Sci. 45:648.
6. Franklin, J. G., and M. Elizabeth Sharpe. 1963. The incidence of bacteria in cheese milk and Cheddar cheese and their association with flavor. J. Dairy Res. 30:87-99.
7. Goepfert, J. M., N. F. Olson, and E. H. Marth. 1968. Behavior of *Salmonella typhimurium* during manufacture and curing of Cheddar cheese. Appl. Microbiol. 16:862-866.
8. Halverson, W. L. 1944. Preliminary report of typhoid fever due to unpasteurized cheese. California's Health, State Dept. of Public Health I (23):171.
9. Hanrahan, F. P., H. E. Walter, A. M. Sadler, and R. P. Tittsler. 1963. Modified equipment for pasteurizing and deodorizing market milk and for pasteurizing, deodorizing, and slightly concentrating cheese milk. J. Dairy Sci. 46:69-72.
10. Holland, R. F., and A. C. Dahlberg. 1940. The effect of the time and temperature of pasteurization upon some of the properties and constituents of milk. N. Y. (Geneva) Agr. Expt. Sta. Tech. Bull. 254. 55 pp.
11. Irvine, O. R., M. E. Reach, and K. A. Burnett. 1964. Report on a number of experiments on heat treating milk for cheese making. Can. Dairy Ice Cream J. 43 (10):22.
12. Kosikowski, F. V., and P. F. Fox. 1968. Low heat, hydrogen peroxide, and bacterofugation treatments of milk to control coliforms in Cheddar cheese. J. Dairy Sci. 51:1018-1022.
13. Kristoffersen, T., I. A. Gould, and G. A. Purvis. 1964. Cheddar cheese flavor. III. Active sulfhydryl group production during ripening. J. Dairy Sci. 47:599-603.
14. Lane, C. B., and B. W. Hammer. 1935. I. Effect of pasteurizing the milk on the nitrogenous decomposition in Cheddar cheese. Iowa Agr. Exp. Sta. Res. Bull. 183. pp. 355-373.
15. Marth, E. H. 1969. Salmonellae and salmonellosis associated with milk and milk products. A review. J. Dairy Sci. 52:283-315.
16. McGugan, W. A., and S. G. Howsam. 1964. Alkaline phosphatase in Cheddar cheese made from raw and heat-treated milk. J. Dairy Sci. 47:139-146.
17. Melachouris, N. P., and S. L. Tuckey. 1966. Changes of the proteins in Cheddar cheese made from milk heated at different temperatures. J. Dairy Sci. 49:800-805.
18. Moir, G. M. 1930. Pasteurized milk for Cheddar cheese making. J. Dairy Res. 1:149-167.
19. Marquardt, J. C., and A. C. Dahlberg. 1931. The creaming of milk pasteurized at high temperatures. N. Y. (Geneva) Agr. Exp. Sta. Tech. Bull. 180. 26 pp.
20. Ohren, J. A. 1966. The relation of flavor development in Cheddar cheese to chemical changes in the fat of the cheese. Diss. Abstracts 26:7252.
21. Phillips, C. A. 1928. The effect of flash pasteurization of milk upon the flavor and texture of Cheddar cheese. J. Dairy Sci. 11: 292-298.
22. Pimblett, Juliet. 1962. Factors influencing the quality of Cheddar cheese. Inter. Dairy Congr. B: 721-728.
23. Price, W. V. 1927. Cheddar cheese from pasteurized milk. J. Dairy Sci. 10: 155-168.
24. Price, W. V., and P. S. Prickett. 1928. A comparison of three methods of pasteurizing milk for Cheddar cheese making. J. Dairy Sci. 11: 69-78.
25. Rice, T. B. 1944. Typhoid epidemic in Northern Indiana. Ind. State Bd. of Health, Monthly Bull., Feb. 1944. pp. 29, 42.
26. Sammis, J. L., and A. T. Bruhn. 1912. The manufacture of Cheddar cheese from pasteurized milk. Univ. Wis. Agr. Exp. Sta. Res. Bull. 27. pp. 137-248.
27. Scarpallino, R. J., and F. V. Kosikowski. 1962. Evolution of volatile compounds in ripening raw and pasteurized milk Cheddar cheese observed by gas chromatography. J. Dairy Sci. 45:343-348.
28. Sherwood, I. R. 1936. Observations on the ripening of cheese made from raw and pasteurized milk. J. Dairy Res. 7:271-283.
29. Silverman, G. J., and F. V. Kosikowski. 1956. Amines in Cheddar cheese. J. Dairy Sci. 39:1134-1141.
30. Stevenson, C. 1923. Pasteurization of milk for Cheddar cheese making in New Zealand. Proc. World's Dairy Congr. Vol. I. pp. 306-308.
31. Tuckey, S. L., M. E. Stiles, Z. J. Ordal, and L. D. Witter. 1964. Relation of cheese-making operations to survival and growth of *Staphylococcus aureus* in different varieties of cheese. J. Dairy Sci. 47:604-611.
32. Van Slyke, L. L., and W. V. Price. 1949. Cheese. Revised. Orange Judd Publishing Co., New York, N. Y.
33. Walker, G. C., L. G. Harmon, and C. M. Stine. 1960. Survival of staphylococci in Colby cheese. J. Dairy Sci. 43:861.
34. Wilster, G. H., W. V. Price, A. J. Morris, E. F. Goss, and G. P. Sanders. 1937. Determination of fat, moisture, and salt in hard cheese. J. Dairy Sci. 20: 27-30.
35. Zehren, V. L., and Virginia F. Zehren. 1968. Examination of large quantities of cheese for staphylococcal enterotoxin A. J. Dairy Sci. 51: 635-644.
36. Zehren, V. L., and Virginia F. Zehren. 1968. Relation of acid development during cheese making to development of staphylococcal enterotoxin A. J. Dairy Sci. 51:645-649.
37. Zottola, E. A., A. N. Al-Dulaimi, and J. J. Jezeski. 1965. Heat resistance of *Staphylococcus aureus* isolated from milk and cheese. J. Dairy Sci. 48:774.
38. Zottola, E. A., and J. J. Jezeski. 1963. Effect of heat treatment on *Staphylococcus aureus* in milk and cheese during commercial manufacture. J. Dairy Sci. 46:600.

MANUFACTURE AND KEEPING QUALITY OF LOW FAT DAIRY SPREAD¹

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(Received for publication December 23, 1968)

ABSTRACT

Six lots of dairy spread containing 35 to 50% milk fat and 8 to 13% solids-not-fat (SNF) were prepared using the following stabilizers: (a) gelatin; (b) a propylene glycol alginate; (c) a product containing propylene glycol alginate, carrageenin, and an emulsifier; and (d) a product composed of carboxymethylcellulose, carrageenin, and locust bean gum. A portion of one lot of dairy spread was fortified with nisin in addition to stabilizer (d) above. Bacterial counts, syneresis measurements, and organoleptic evaluations were made on two lots, whereas the others were only subjected to body strength and syneresis measurements.

It was found that an increase in the fat to SNF ratio was accompanied by an increase in wheying-off; a decrease in body strength; and a deterioration of body, texture, and appearance of the dairy spread. In contrast to this, a decrease in the fat to SNF ratio was accompanied by improvements in body, texture and appearance, and by less wheying-off. However, reducing the fat to SNF ratio below 40:13 was detrimental to over-all quality, although wheying-off was significantly reduced. Choice of storage temperature (40 F instead of 45 F), stabilizer (carboxymethylcellulose-carrageenin-locust bean gum product used at a level of 0.18% yielded a superior product), as well as addition of nisin (1,465 ppm), were important in determining over-all product quality, and thus the shelf-life of dairy spread. A shelf-life of 5 to 6 weeks was obtained when the product was made from high quality ingredients, under sanitary conditions, and with the procedures outlined in this paper.

A low-fat dairy spread is generally defined as a product made from dairy ingredients, containing from 40 to 50% milk fat, and one which can be used in a manner similar to butter or cream cheese. In this paper the term "low-fat dairy spread" refers to a product which: (a) is spreadable at household refrigerator temperatures; (b) is made from milk, milk fat, and nonfat dry milk (NFDM); (c) contains 35 to 50% fat and 8 to 13% milk solids-not-fat (SNF); and (d) contains salt, lactic acid, and starter distillate to impart desired acidity and flavor characteristics. Vitamins also can be added to enrich its nutritive value and food colors to enhance its appearance. The product can be used as a spread on bread, crackers, and sandwiches. With some modification it can be used to garnish salads and hors d'oeuvres.

Low-fat dairy spread also can serve as a base to which other ingredients (e.g. pickle relish, fruits, herbs, vegetables, and flavors) can be added.

Although similar to butter in some physical properties, dairy spreads are distinctly different in others. They are not suitable for use in frying and are destabilized by freezing.

Interest in dairy spreads first developed during World War II when there was an acute shortage of butter for use by the civilian population. To meet this need for a low-fat dairy spread, Weckel (10, 11) developed a product which contained 28% milk fat and 19% SNF. Later, in 1947, he modified this product by increasing its fat content from 28 to 40-50% and reducing its SNF content from 19 to 9% (12). These changes resulted in a product with improved body, texture, and flavor characteristics and with a shelf-life which approximated that of Cottage cheese. Since then, investigators (5, 6, 9, 13, 14) have experimented with a variety of products made with different fat to SNF ratios.

Although the greatest defects of dairy spread are its tendency to whey-off and its short shelf-life, little attention has been devoted to the physical and bacteriological stability of this product when made by different procedures and stored under various conditions.

The present investigation was undertaken to determine: (a) if the tendency toward wheying-off by a dairy spread could be reduced by incorporating a stabilizer into the product, (b) the effect of storage temperatures on the keeping quality of dairy spread, with respect to its bacterial content and degree of syneresis, and (c) the effect of added nisin on the number of bacteria in the product at various intervals during storage.

MATERIALS AND METHODS

Production of dairy spread

Unsalted Wisconsin grade AA butter and pasteurized whole milk were obtained from the University of Wisconsin dairy plant. The NFDM was an extra-grade, spray-dried product supplied by the Bowman Dairy Co., Chicago, Ill. Each dairy ingredient was analyzed for its content of fat and total solids by the Mojonnier method (2). Various lots of dairy spread with the desired fat to SNF ratio were prepared as described

¹Published with the approval of the Director of the Wisconsin Agricultural Experiment Station.

TABLE I. INGREDIENTS USED TO PRODUCE SIX DIFFERENT 37.5-POUND LOTS OF DAIRY SPREAD.

Ingredients	Lot A	Lot B	Lot C	Lot D	Lot E	Lot F
Pasteurized whole milk (lb)	20.12 ^a	15.40 ^b	15.37 ^c	14.21 ^d	16.14 ^d	16.76 ^d
Unsalted butter (lb)	15.30 ^e	20.18 ^e	20.44 ^f	22.17 ^g	19.92 ^g	17.63 ^g
NFDM (lb)	2.07 ^h	1.91 ^h	1.59 ^h	1.11 ⁱ	1.42 ⁱ	3.10 ⁱ
Sodium chloride (g)	71.68	71.68	71.68	71.68	71.68	71.68
Stabilizer (%)	0.2, 0.18 ^j	0.2, 0.18 ^k	0.2 ^l	—	—	—
Starter distillate (ml)	54.26	54.26	54.26	54.26	54.26	54.26
Lactic acid (ml)	18.45	18.45	18.45	18.45	18.45	18.45
Nisin (g)	—	13.45	—	—	—	—
Fat:SNF	35:10	45:9	45:9	50:8	45:9	40:13

^a3.7% fat, 12.12% total solids (TS)

^b3.44% fat, 11.93% TS

^c3.57% fat, 12.12% TS

^d3.98% fat, 12.28% TS

^e80.9% fat, 81.60% TS

^f79.82% fat, 82.24% TS

^g81.42% fat, 84.83% TS

^h0.98% fat, 95.13% TS

ⁱ1.12% fat, 93.11% TS

^jStabilizers added separately to different portions of this product were: gelatin (0.2%), Kelcolloid DS (0.2%), and HG Special (0.18%).

^kStabilizers added separately to different portions of this product were: gelatin (0.2%) and HG Special (0.18%).

^lStabilizers added separately to different portions of this product were: Dricoid K, gelatin, Kelcolloid S, and Kelcolloid DS.

below. The detailed composition of these lots is given in Table 1.

The required quantities of butter, milk, and NFDM were transferred to a pasteurizing vat and mixed with a mechanical agitator fitted to the vat. With constant stirring, salt, stabilizer, and a mixture of starter distillate (obtained from Chr. Hansen's Laboratories, Milwaukee, Wis.) and 85% food grade lactic acid were added while the temperature of the mix was maintained between 80 and 90 F. The mix was then warmed to 150 F, held at that temperature for 30 min, and homogenized at pressures of 2,000 and 500 psi with a previously sanitized two-stage homogenizer. The first product discharged by the homogenizer was discarded and the remainder collected in 16 oz. plastic coated Cottage cheese cartons with tight fitting lids. After filling, cartons were closed immediately to prevent contamination, and the product was stored at 38 F where it was allowed to "set" or to develop firmness. After a desirable set was developed, generally within 24 hr, the product was transferred to experimental storage conditions. Six lots of dairy spread were prepared as described below.

Lot A. The product in this lot contained 35% fat and 10% SNF. The lot was subdivided into four portions of approximately 37.5 lb each. One portion, without stabilizer, served as the control; a different stabilizer was used in each of the other three portions. The stabilizers were gelatin (250 bloom strength), Kelcolloid DS (a propylene glycol alginate supplied by the Kelco Co., Chicago, Ill.), and HG Special (a mixture of carboxymethylcellulose, carrageenin, and locust bean gum supplied by Germantown Mfg. Co., Philadelphia, Pa.). After a desirable set was developed, each portion was subdivided into two groups, each weighing approximately 19 lb. Product in one group was stored at 40 F and that in the other at 45 F.

Lot B. The product in this lot was prepared in a manner similar to that of lot A except that it contained 45% milk fat and 9% SNF. The lot was again subdivided into four portions, one of which received no further treatment and served as a control. The other three portions were modified by adding gelatin (250 bloom strength), HG Special, or HG Special plus nisin. Nisin (supplied by Aplin and Barrett

Ltd., Yeovil Somerset, England) is a complex polypeptide produced by specific strains of *Streptococcus lactis*. This antibiotic is inhibitory to certain bacteria in the genera *Bacillus* and *Clostridium*, as well as a number of other microorganisms (1, 4).

Lots C, D, E, and F. The products in these lots were prepared as described above but contained varying amounts of fat (40 to 50%) and SNF (8 to 13%). Portions of lot C were modified by adding the stabilizers Dricoid K (propylene glycol alginate and carrageenin plus an emulsifier; supplied by the Kelco Co., Chicago, Ill.), gelatin, Kelcolloid S, and Kelcolloid DS. The last two stabilizers listed differ only in their dispersibility. Both are manufactured by the same company. Products in lots D, E, and F contained no stabilizers. See Table 1 for a complete description of these lots of dairy spread.

Examination of products. Products in lots A and B were examined weekly for wheying-off, numbers of bacteria, and organoleptic properties. Dairy spread in lots C to F was examined for body strength and wheying-off. Methods employed in testing products are described below.

Methods for physical and bacteriological evaluation of dairy spread

Body strength measurement. Body strength or tension in grams was determined by the curd tension meter according to the American Dairy Science Association method (3).

Determination of syneresis. Products in lots D, E, and F were tested by the drainage method. A measured quantity (150-200 g) of dairy spread was placed in a glass funnel which was suspended over a glass cylinder and allowed to drain for 6 hr at 45 F. Whey collected in the cylinder was measured. A plug of glass wool was placed in the bottom of the funnel to retain the dairy spread and permit drainage of whey.

This method failed to yield satisfactory results, and hence a procedure which employed centrifugation was adopted for testing lots A, B, and C. In this method, a weighed sample of dairy spread (40-50 g) to be tested was placed in the top of a specially prepared graduated centrifuge tube. A glass disc with a pore size of 40 μ was placed at the bottom of the enlarged top; this retained the dairy spread but permitted

TABLE 2. BODY STRENGTH OF DAIRY SPREADS WITH DIFFERENT COMPOSITIONS AND STABILIZERS.^a

Fat:SNF (%)	Lot	Stabilizer	Tension (g)
50:8	D	None	81
45:9	C	Dricoid K	102
45:9	E	None	115
45:9	C	Gelatin	158
45:9	C	Kelcoloid S	202
45:9	C	Kelcoloid DS	200
40:13	F	None	269

^aTension was measured after 'set' was developed and before the product was transferred to cold room storage.

liquid to enter the graduated portion of the centrifuge tube. The sample was centrifuged at 40 F in an International centrifuge operating at 2,000 rpm for 30 min. Liquid collected in the graduated portion of the tube was measured.

Bacterial content. Numbers of bacteria in samples of each subgroup were determined at weekly intervals using the Standard Plate Count procedure (7). Samples of products containing gelatin and HG Special plus nisin exhibited excessive turbidity in the dilution blanks. This was prevented by adding 2% sodium citrate to the initial phosphate buffered dilution water.

Organoleptic evaluation. The product (lots A and B) was evaluated weekly for flavor, body and texture, and wheying-off. An over-all final score was assigned by each member of a panel of four to seven judges selected from graduate students and faculty members of the Department of Food Science. At the time of judging, duplicate samples of each product to be evaluated were arranged at random in two groups according to their storage temperature. Judges evaluated the samples for each variable using the scale: 1 - excellent, 2 - good, 3 - fair, 4 - poor, and 5 - unacceptable. Results were analyzed using factorial and split plot designs. Those results found to be significant at the 5.0 and 1.0% level with the analysis of variance were further analyzed by Duncan's Multiple Range Test (DMRT) (8).

RESULTS AND DISCUSSION

Body strength

The body strength varied considerably, ranging from 81 to 269 g (Table 2), depending on the fat to SNF ratio of the dairy spread and the type of stabilizer used. A product high in fat but low in SNF had a lower tension than one high in SNF and low in fat. Presumably, this resulted from the greater water binding capacity of SNF constituents. Among those stabilizers tested, Kelcoloid S and Kelcoloid DS had a similar effect on body. This was expected since these products were chemically similar. Dricoid K was detrimental to the product. Dairy spread failed to solidify regardless of the homogenization pressures used when this stabilizer was added.

Body strength of dairy spread has a direct influence on its plasticity or spreadability. An increase in tension improved the appearance and texture of dairy spread but reduced its spreadability. How-

ever, an increase beyond the range listed in Table 2 will affect the product adversely. A recommended fat to SNF ratio is 45:9.

Wheying-off

It was found that the following factors significantly affected the tendency toward wheying-off (Tables 3 and 4).

Fat to SNF ratio. A decrease in the fat to SNF ratio of the dairy spread generally reduced the degree of wheying-off (Table 3), but a reduction in the fat to SNF ratio beyond 45:9 affected the product adversely in appearance, texture, and spreadability.

Stabilizers. Certain stabilizers considerably retarded wheying-off. For example, in lot A (Table 3) with a fat to SNF ratio of 35:10, gelatin was most beneficial in checking syneresis regardless of storage time and temperature. Next in order of effectiveness were HG Special and Kelcoloid DS.

Storage temperature. Products held at 40 F displayed less free whey than did those stored at 45 F (Tables 3 and 4).

Period of storage. A product with low SNF and high fat contents (lot D) tended toward more wheying-off with an increase in storage time, whereas the reverse was true when the product had high SNF

TABLE 3. WHEY (IN ML/100 G) OBTAINED FROM SAMPLES OF DAIRY SPREAD (LOT A) DURING STORAGE AT 40 AND 45 F.^a

Length of storage weeks	Stabilizer							
	Gelatin		Kelcoloid DS		HG Special		Control	
	40 F	45 F	40 F	45 F	40 F	45 F	40 F	45 F
0	0.51	0.51	2.09	2.09	0.92	0.92	2.86	2.86
1	0.45	0.53	2.05	1.55	1.17	0.93	2.82	2.27
2	0.48	0.54	1.34	1.84	0.98	0.77	1.97	1.97
3	0.74	1.06	1.23	1.71	0.91	1.22	1.70	2.00
4	0.69	0.38	1.25	2.04	1.47	1.13	2.13	2.15
5	0.49	0.76	0.93	—	—	0.91	1.73	1.76

^aCentrifugal method used for measuring whey.

TABLE 4. WHEY (IN ML/100 G) OBTAINED FROM SAMPLES OF DAIRY SPREAD (LOT B) DURING STORAGE AT 40 AND 45 F.^a

Length of storage (weeks)	Additive (s)							
	Gelatin		HG Special		HG Special plus nisin		Control	
	40 F	45 F	40 F	45 F	40 F	45 F	40 F	45 F
0	2.74	2.74	1.33	1.33	2.52	2.52	19.10	19.10
1	0.26	0.28	0.83	1.08	0.75	0.74	9.90	17.79
2	2.97	5.90	4.00	8.09	3.18	4.27	13.15	18.74
3	3.69	2.40	0.00	2.12	2.95	1.96	12.73	13.80
4	2.43	3.65	1.76	3.87	0.54	1.79	13.96	17.08
5	5.84	14.84	8.96	11.30	3.91	8.42	23.09	19.68
6	—	1.28	0.52	0.00	0.27	0.58	15.01	14.62

^aCentrifugal method used for measuring whey.

TABLE 5. NUMBERS OF BACTERIA PER GRAM OF DAIRY SPREAD (LOT A) STORED AT 40 AND 45 F.

Length of storage (weeks)	Stabilizer							
	Gelatin		Kelcoloid DS		HG Special		Control	
	40 F	45 F	40 F	45 F	40 F	45 F	40 F	45 F
0	19x10 ³	19x10 ³	52x10 ²	52x10 ²	17x10 ²	17x10 ²	21x10 ²	21x10 ²
1	4.1x10 ²	67x10 ³	69x10 ²	22x10 ⁵	42x10 ³	22x10 ⁵	42x10 ³	13x10 ⁴
2	4.6x10 ²	47x10 ³	12x10 ³	12x10 ⁵	21x10 ⁵	13x10 ⁵	41x10 ³	24x10 ⁵
3	12x10 ²	83x10 ⁴	10x10 ⁴	26x10 ⁵	32x10 ⁵	47x10 ⁶	49x10 ³	39x10 ⁶
4	5.9x10 ²	53x10 ⁴	5x10 ⁵	80x10 ⁶	51x10 ⁶	25x10 ⁶	24x10 ⁵	19x10 ⁷
5	3.5x10 ²	10x10 ⁵	13x10 ⁵	—	—	53x10 ⁶	19x10 ⁴	16x10 ⁶

TABLE 6. NUMBERS OF BACTERIA PER GRAM OF DAIRY SPREAD (LOT B) STORED AT 40 AND 45 F.

Length of storage (weeks)	Stabilizer							
	Gelatin		HG Special		HG Special plus nisin		Control	
	40 F	45 F	40 F	45 F	40 F	45 F	40 F	45 F
0	2x10 ⁴	2x10 ⁴	15x10 ⁴	15x10 ⁴	3.7x10 ²	3.7x10 ²	1x10 ⁴	1x10 ⁴
1	27x10 ⁴	81x10 ⁴	47x10 ⁴	41x10 ⁵	11x10 ³	17x10 ³	17x10 ³	11x10 ⁴
2	73x10 ⁴	74x10 ⁵	46x10 ⁴	51x10 ⁵	56x10 ²	27x10 ⁴	72x10 ³	74x10 ⁵
3	15x10 ⁵	56x10 ⁶	14x10 ⁵	39x10 ⁶	33x10 ³	26x10 ⁵	14x10 ⁴	69x10 ⁵
4	44x10 ⁵	76x10 ⁶	14x10 ⁶	93x10 ⁶	47x10 ⁴	32x10 ⁵	20x10 ⁵	12x10 ⁶
5	45x10 ⁶	13x10 ⁷	35x10 ⁶	13x10 ⁷	60x10 ⁴	73x10 ⁶	40x10 ⁵	41x10 ⁶
6	—	11x10 ⁷	41x10 ⁶	13x10 ⁶	14x10 ⁵	71x10 ⁶	36x10 ⁵	19x10 ⁶

TABLE 7. ANALYSIS OF VARIANCE OF DATA OBTAINED FROM EVALUATION OF DAIRY SPREAD (LOTS A AND B).

Source	Lot A				Lot B			
	Mean square for:				Mean square for:			
	Flavor	Body and texture	Wheying-off	Over-all score	Flavor	Body and texture	Wheying-off	Over-all score
Stabilizer	**b	**	**	**	NS	**	**	**
Temperature	NS ^c	NS	a	NS	NS	NS	**	**
Weeks	NS	**	**	NS	**	**	**	**
Judges	**	**	**	**	**	**	**	**
Stabilizer x temperature	NS	NS	NS	NS	NS	NS	**	NS
Stabilizer x week	NS	NS	**	NS	NS	**	**	**
Week x temperature	NS	NS	NS	NS	NS	NS	**	NS
Week x temp. x stabilizer	NS	NS	NS	NS	*	NS	**	NS
Experimental error	NS	NS	NS	NS	NS	NS	NS	NS
Sample error	NS	NS	NS	NS	NS	NS	NS	NS

*—Significant at 5% level.

**—Significant at 1% level.

^cNS—Not significant.

and low fat contents (lots A and F). There was no distinctive effect of storage time on products with a medium fat to SNF ratio (lots B, C, and E).

Bacteriological condition

It was observed that the temperature of storage and use of nisin had a direct effect on the number of bacteria in the dairy spread (Tables 5 and 6). Nisin at a concentration of 35.88 g per 54 lb of total

solids in dairy spread (1,465 ppm) and a holding temperature of 40 F appreciably reduced the number of bacteria which developed in the product during storage. However, increases in storage time and temperature (45 F instead of 40 F) were accompanied by higher bacterial populations. Nevertheless, after 6 weeks of storage, the duration of the experiment, the product did not show any signs of

bacterial spoilage even though the numbers of organisms in some products were appreciable at this time. These data suggest that dairy spread made from high quality ingredients and under proper sanitary conditions has a shelf-life of at least 6 weeks when held at 40 F. Addition of nisin may serve to insure attainment of this shelf-life and may actually aid to further increase the keeping quality of dairy spread.

Organoleptic evaluation

The main factors responsible for variation in flavor, body and texture, wheying-off, and over-all score of dairy spread were found to be the stabilizers used, temperature and time of storage, and the interactions between these factors (Table 7). Variation resulting from judges, although significant for all characteristics of dairy spread, was not considered since it was not a part of the study. Scores obtained in the

TABLE 8. DUNCAN'S MULTIPLE RANGE TEST APPLIED TO VARIOUS CHARACTERISTICS OF DAIRY SPREAD (LOT A).

Treatment	Flavor	Body and texture	Mean ^a response to:					Over-all score
			Wheying-off (weeks)					
			0	1	2	3	4	
Control	3.2 ^b -A	3.4	3.6-A	3.2	2.7	2.7-F	2.7-I	3.4
Gelatin added	2.7 -C	2.7	3.5-A	3.6	3.6	2.5-EF	2.2-HI	2.9-A
Kelcoloid DS added	3.0 -AB	2.1-A	3.6-A	2.5-B	1.6-C	1.9-DE	1.7-GH	2.8-AB
HG Special added	2.9 -BC	2.0-A	3.2-A	3.0-B	1.7-C	1.6-D	1.2-G	2.6-B

^aMeans with a common letter are not significantly different at the 5% level.

^b1 - excellent, 2 - good, 3 - fair, 4 - poor, 5 - unacceptable.

TABLE 9. DUNCAN'S MULTIPLE RANGE TEST APPLIED TO THE FLAVOR AND WHEYING-OFF CHARACTERISTICS OF DAIRY SPREAD (LOT B).

Treatment		Mean response ^a —Flavor					Mean response ^a —Wheying-off						
Stabilizer x temp. x week		Storage time (weeks)					Storage time (weeks)						
Stabilizer	Storage temperature (F)	0	1	2	3	4	5	0	1	2	3	4	5
None	40	3.0 ^b -A	2.5-B	2.7-C	2.7-D	2.4-E	2.8-FG	5.0-A	2.6-B	2.0-E	2.4-GH	3.6-N	3.1-Q
	45	3.0 -A	2.6-B	3.2-C	2.9-D	2.5-E	3.2-F	5.0-A	3.7-C	4.0-F	4.6	4.1-N	3.4-Q
Gelatin	40	3.0 -A	2.6-B	2.7-C	2.6-D	2.3-E	2.5-G	5.0-A	3.4-CD	3.9-F	2.6-H	2.5-M	3.7-Q
	45	3.0 -A	2.8-B	2.6-C	2.6-D	2.5-E	2.9-FG	5.0-A	3.9-C	4.1-F	3.7-J	2.4-LM	3.2-Q
HG Special	40	3.1 -A	2.6-B	2.6-C	2.5-D	2.3-E	2.7-FG	5.0-A	2.5-B	1.7-E	1.9-G	1.8-L	1.5-P
	45	3.1 -A	2.6-B	2.6-C	2.6-D	2.2-E	2.9-FG	5.0-A	3.8-C	3.6-F	3.3-IJ	2.3-LM	3.2-Q
HG Special plus nisin	40	3.0 -A	2.6-B	2.6-C	2.6-D	2.2-E	2.4-G	5.0-A	2.9-BD	1.8-E	1.0	1.2-K	1.0-P
	45	3.0 -A	2.6-B	2.7-C	2.5-D	2.3-E	2.9-FG	5.0-A	3.3-CD	3.8-F	2.8-HI	1.1-K	1.0-P

^aMeans with a common letter are not significantly different at 5.0% level.

^b1 - excellent, 2 - good, 3 - fair, 4 - poor, 5 - unacceptable.

TABLE 10. DUNCAN'S MULTIPLE RANGE TEST APPLIED TO THE BODY AND TEXTURE CHARACTERISTICS AND OVER-ALL SCORE OF DAIRY SPREAD (LOT B).

Treatment		Mean response ^a —Body and Texture					Mean response ^a —Over-all Score					
Stabilizer x week		Storage time (weeks)					Storage time (weeks)					
Stabilizer	0	1	2	3	4	5	0	1	2	3	4	5
None	3.6 ^b -A	3.9	4.2	3.6	4.0	4.0	3.8-A	3.5-B	3.9-E	3.6	3.9	4.0
Gelatin	3.1 -A	2.8-B	3.1-C	2.9-D	2.6	2.6	3.5-A	3.3-B	3.6-E	3.1-G	2.6	3.3
HG Special	3.1 -A	2.9-B	2.8-C	2.7-D	2.0-E	1.7-F	3.4-A	3.0-BC	3.0-D	2.8-FG	2.0-H	2.8-I
HG Special plus nisin	3.1 -A	2.6-B	2.9-C	2.5-D	1.9-E	1.8-F	3.4-A	2.9-C	2.9-D	2.5-F	1.9-H	2.5-I

^aMeans with a common letter are not significantly different at 5% level.

^b1 - excellent, 2 - good, 3 - fair, 4 - poor, 5 - unacceptable.

organoleptic examination of dairy spread (lots A and B) were analyzed statistically to determine the most desirable combination of stabilizer and storage conditions.

Flavor. The flavor of dairy spread in lot A was not affected by the temperatures or times of storage used in these tests (Table 7). Stabilizers had a significant effect even at the 1% level, and use of gelatin was associated with products having the most desirable flavor (Tables 7 and 8). In lot B, with a fat to SNF ratio of 45:9, only the period of storage and the interaction between stabilizer, temperature, and period of storage had a significant effect on the flavor of dairy spread (Tables 7 and 9). With DMRT analysis (Table 9) no flavor difference was noted after 0, 1, 2, 3, and 4 weeks of storage regardless of stabilizer or storage conditions employed. Limited flavor differences were detected after 5 weeks of storage with greatest deterioration observed in products held at 45 F. The score obtained when the product contained HG Special plus nisin was best although it was not significantly different from products made with other stabilizers and held at 40 or 45 F.

Body and texture. Body and texture of the dairy spread in lot A were significantly affected at the 1.0% level by stabilizers and period of storage (Table 7). Analysis by DMRT showed that the stabilizers HG Special and Kelcoloid DS were similar in their effect which was preferable to that of gelatin (Table 8). Although there was no difference noted in the body and texture of dairy spread initially and after 1 week of storage, slight but statistically significant deterioration occurred during the second, third, and fourth weeks of storage.

Products in lot B were affected by stabilizer, storage time, and the interaction between stabilizer and storage time (Table 7). Although no significant difference was initially observed between different portions, after 1 week of storage, products with stabilizers differed significantly from the control (Table 10). There was no appreciable difference among stabilizers until after the third week of storage when the product with gelatin became less acceptable in contrast to products with HG Special and HG Special plus nisin, which showed no marked variation at the end of the experiment (Table 10).

Wheying-off. Stabilizers, temperature, period of storage, and the interaction between stabilizer and period of storage had a significant effect on the tendency toward wheying-off exhibited by dairy spread in lot A (Table 7). Analysis by the DMRT showed that after the first week of storage, HG Special and Kelcoloid DS were more effective in reducing whey separation than was gelatin. By the third and fourth week of storage, differences between treatments dis-

appeared (Table 8). These results indicate that HG Special and Kelcoloid DS were consistent in their effects on wheying-off of dairy spread during the entire storage period. In contrast to this observation, gelatin-treated and control products improved with an increase in storage time.

Products in lot B were affected by all factors studied and by their interactions (Table 7). Use of HG Special, particularly when the product was held at 40 F, was found to be most beneficial in minimizing syneresis (Table 9).

Over-all score. Individual characteristics of dairy spread with a fat to SNF ratio of 35:10 (lot A) were affected by stabilizer, temperature, and period of storage; but the over-all score was only influenced by the stabilizers (Table 7). This demonstrates the importance of the stabilizer, as evaluated by organoleptic testing, in determining the over-all quality of dairy spread. The score obtained when HG Special was used was lowest and hence indicated the most desirable product (Table 8), although statistically it was not significantly different from the dairy spread which contained Kelcoloid DS.

In a product with a high fat to SNF ratio (lot B), the over-all score was affected by stabilizer, storage temperature, period of storage, and the interaction of stabilizers and storage period (Table 7). An increase in storage time was generally accompanied by improvement in the over-all score of the dairy spread with stabilizers, especially when the stabilizer was HG Special.

ACKNOWLEDGMENT

The authors thank Dr. W. C. Winder, Professor L. C. Thompson, Dr. W. D. Powrie, Dr. O. R. Fennema, Mr. Thomas McNurlin, Mrs. Charlotte Chang, and Mr. Robert Olson for their organoleptic evaluations of the dairy spread. Appreciation is expressed to the Germantown Manufacturing Company and to the Kelco Company for supplying stabilizers used in these studies. This research was supported, in part, by a grant from the Research Committee of the Graduate School, University of Wisconsin.

REFERENCES

1. Foster, E. M., F. E. Nelson, M. L. Speck, R. N. Doetsch, and J. C. Olson, Jr. 1957. Dairy Microbiology. Prentice-Hall, Inc., Englewood Cliffs, N. J.
2. Instruction Manual for Setting Up and Operating the Mojonner Milk Tester. Bull. 101. Mojonner Bros. Co., Chicago, Ill.
3. Laboratory Manual. 3rd ed. 1964. Milk Industry Foundation. Washington, D. C. pp. 430-432.
4. Marth, E. H. 1966. Antibiotics in foods—naturally occurring, developed, and added. In: Residue Reviews (vol. 13), F. A. Gunther, ed., Springer Verlag, Heidelberg, Germany. pp. 65-161.
5. Norman C. H., J. P. Malkames, and R. Fresnosa. 1957. Reconstituted butter-like spread. Milk Products J. 48(12): 55.

6. Roberts Dairy Company. 1957. Image of butter. *Milk Products J.* 48(6):35.
7. Standard Methods For the Examination of Dairy Products. 11th ed. 1960. American Public Health Association, Inc., New York.
8. Steel, R. G. D., and J. H. Torrie. 1960. Principles and Procedures of Statistics. McGraw-Hill Book Company, Inc., New York.
9. Tobias, J., and P. H. Tracy. 1958. Observations on low fat dairy spread. *J. Dairy Sci.* 41:1117-1120.
10. Weckel, K. G. 1943. New dairy spread developed. *Wis. Agr. Exp. Sta. Bull.* 461.
11. Weckel, K. G. 1946. A method for producing dairy spread. *Milk Plant Monthly* 35(9):24.
12. Weckel, K. G. 1947. Simplified method for producing dairy spread. *Wis. Agr. Exp. Sta. Bull.* 471.
13. Weckel, K. G. 1952. Dairy Spreads—their potential market and manufacture procedure. *Milk Plant Monthly* 41(6):24-28.
14. Weckel, K. G. 1965. Dairy spreads. *Manuf. Milk Products J.* 56(7):5-6.

REPORT OF COMMITTEE

(Continued from Page 300)

The committee was reappointed for the purpose of continuing its activities.

In the July 1967 publication, entitled "Procedures Governing the Cooperative State-Public Health Service Program for Certification of Interstate Milk Shippers 1967 Revision, PHS Publication No. 1046" Page 2, Sec. F. Single-Service Container and Closure Standards.

"1. Effective January 1, 1969, the procedures outlined in the guide for sanitation standards, 'Fabrication of Single-Service Containers and Closures for Milk and Milk Products,' shall be used to determine acceptable manufacturing plants and processors of single-service containers and closures."

The first meeting of the committee was held August 24, 1967. This committee is a cross section representing the milk control agencies, sanitation consultants, dairy plants, manufacturers of single-service containers, manufacturers of filling equipment, and suppliers of paper and plastic to the packaging industry. This committee was informed by Syracuse Research Corporation of Syracuse University that they had been given a Public Health Service grant to conduct seminars for the purpose of introducing fundamentals of the paper industry and the plastic industry to regulatory officials, believing that these regulatory people would sooner or later become these rating officers, and it would be through them that the listing would be made available to the Public Health Service.

Four seminars were planned: (1) St. Paul, Minnesota; (2) Philadelphia, Pennsylvania; (3) Dallas, Texas; (4) Sacramento, California.

The committee assumed the responsibility of getting good attendance at each of these seminars and suggested the material presented at each seminar.

The four seminars were held as scheduled, starting in November and ending the early part of March. The average attendance of the four seminars was 35 people; 9 members of the committee presented material at each one of these seminars.

The second meeting of the committee was held April 25, 1968. Reports of the seminars were given to the members of the committee. A discussion of the procedures to be followed when forwarding information to the Public Health Service so that it would assist in the publication of the January 1, 1969 listing.

In the publication of the Department of Health, Education, and Welfare, Public Health Service, Sanitation Compliance and Enforcement Ratings of Interstate Milk Shippers, dated January 1, 1969, the listing of the Certified Manufacturers of Single-Service Containers and Closures manufacturers included 106 certified plants.

The April 1 publication had more names added to it. This list is only a small portion of the total number of single-service container and closure plants in the United States. This is a voluntary program. Industry should request state regulatory agencies to make the necessary inspections.

The fourth meeting of the committee was held February 27, 1969 in New York City. At the meeting the point system for evaluating a plant was discussed, and it was decided not to establish a point system at this time. The Public Health Service is studying the necessary procedures for such a system. The Public Health Service has developed a special form for the certification of plants manufacturing single-service containers and closures.

The members of the committee are of the opinion that there should be more training courses by the PHS for rating officers, so that there will be a uniformity of certification programs throughout the United States.

The committee recommends to the conference that the committee be continued as presently constituted.

I want to take this opportunity of thanking the members of this committee for the co-operation they have given to me as its chairman.

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Dr. Paul Cundy, American Can Co., Marathon Ave., Neenah, Wisconsin.

F. DeSieghardt, Sealright Co., Kansas City, Missouri.

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(Continued on Page 333)

A Research Note

A COMPARISON OF THE OXIDASE TEST AND THE WISCONSIN MASTITIS TEST FOR THE DETECTION OF ABNORMAL MILK¹

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(Received for publication December 5, 1968)

ABSTRACT

An oxidase reaction with tetramethyl-*p*-phenylenediamine hydrochloride (TMPD) was carried out in 179 samples of raw milk. Results of the oxidase test were compared with those of the Wisconsin Mastitis Test (WMT). With an increase in the WMT value, particularly above 20, the percentage of samples with TMPD in the leuco form increased. With WMT values ranging from 25 to 35, this percentage ranged from 86 to 94.

For many years, microbiologists have used the oxidase test as a taxonomic tool to separate the oxidase-positive *Pseudomonadaceae* from the oxidase-negative *Enterobacteriaceae* (4, 7). The test is based on the ability of certain bacteria to oxidize compounds of the para-phenylenediamine series to colored products. Gordon and McLeod (3) determined the oxidase activities of colonies on agar plates by bringing them in contact with a 1% solution of dimethyl-*p*-phenylenediamine hydrochloride (DMPD) and subsequently exposing them to air. The dye is rapidly oxidized through a red to black color in 10-30 min. In subsequent studies Ellingsworth et al. (2) used tetramethyl-*p*-phenylenediamine hydrochloride (TMPD). This compound is less toxic than DMPD and is easily oxidized in the air to a blue-violet compound sometimes called "Wurster's Blue." This blue oxidation product, however, can be further oxidized to a colorless compound by bacteria, whereas the black product formed from DMPD does not undergo further changes (5). Recently Cullen (1) applied the oxidase test with TMPD to milk residue on membrane filters to screen milks for abnormal conditions. When TMPD was applied to the residue of mastitic milks it changed rapidly to a blue color. However, the filtration of milk through membranes is a laborious procedure. In a previous paper (9) on the relation of the oxidase reaction to flavor quality of pasteurized milk, Vanderzant and Nickelson described experiments in which the oxidase reaction was carried out in milk samples rather than on filtered products of the milk. One of the objectives of the

present study was to determine whether or not the oxidase test with TMPD in milk could be used to screen milks for mastitic conditions.

Mastitis is usually detected by indirect screening tests which estimate cell content of milk. The reaction involves the DNA of cells and therefore is a measure of the concentrations of entire cells entering the milk. This principle was first used in a test described by Whiteside (11) and later in the California Mastitis Test (CMT) and in the Wisconsin Mastitis Test (WMT). It is well known that many cells appear in milk which are not the result of an inflammatory or pathological process. With respect to the oxidase reaction of the various types of cells in milk, Cullen (1), Ronin (6) and Vosiltsov and Shimkevich (10) have shown that neutrophils, eosinophiles, polymorphs, and monocytes are oxidase-positive whereas lymphocytes and epithelial cells normally found in milk are not. In view of these observations, a comparison of the oxidase reaction and indirect screening tests based on total cell concentration seemed highly desirable.

EXPERIMENTAL METHODS

Raw milk samples were obtained from individual cows by quarter milker techniques and stored in the laboratory at 5-7 C. The oxidase reaction was determined as follows: to 5 ml of milk in screw-cap test tubes (145 X 15 mm) was added 0.5 ml of 1% aqueous TMPD solution. The tubes were inverted three times to mix milk and TMPD and were placed in a water bath at 30 C for 10 min. The water in the bath was about 2 inches above the contents of the tubes. Samples which showed a blue color (TMPD in oxidized state) were designated as positive; those which were white with or without a blue ring (2 mm) on top (TMPD in reduced or highly oxidized state) were called negative. This reaction had to be read in 5 to 10 min because further incubation resulted in the development of the blue color in all tubes. WMT values were obtained as described by Thompson and Postle (8). A WMT reading of 20 or above can be used to screen out milk supplies with 500,000 or more cells per ml.

RESULTS AND DISCUSSION

The results of WMT values and oxidase reactions of 179 samples of raw milk are presented in Fig. 1. The results show that with an increase in the WMT

¹Technical paper No. 7543 of the Texas Agricultural Experiment Station, College Station.

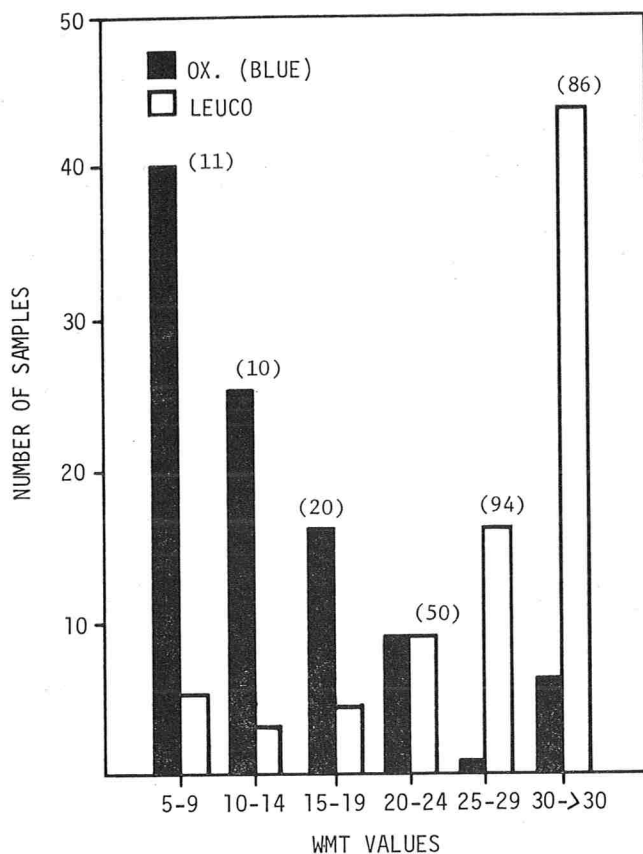


Figure 1. A comparison of the oxidase test and WMT values of 179 samples of raw milk (the numbers in parenthesis represent the number of samples with TMPD in the leuco form expressed as percent of the total number of samples).

value, particularly above 20, the percentage of samples with TMPD in the leuco form (open bars) increased. With WMT values of 25 and higher this percentage ranged from 86 to 94%. The chemical basis of the color changes is not definitely known. The blue color in the non-mastitic samples probably resulted from normal oxidation of the reagent TMPD by the environmental conditions in the milk particularly the dissolved O_2 . The change to the leuco form in the mastitic samples was probably caused by the highly oxidized state of the TMPD produced by the cytochrome oxidase of the leucocytes. Samples with high WMT values which turned blue with TMPD (solid bars) are possible indications of false

WMT values. The "false positives" in the oxidase test at the low WMT values (below 20) may have resulted from invading microorganisms which maintained the TMPD in a reduced state in the absence of large numbers of leucocytes. In a few samples in which large numbers of erythrocytes were present the sample with TMPD changed to a deep dark blue in a few minutes. This probably resulted from the iron porphyrins present in hemoglobin. Results of the present study do not justify any firm conclusion about the usefulness of the oxidase test as a screening test for mastitic milks. Further studies to determine the relation between the number of various types of body cells in milk, the total direct microscopic leucocyte count, and various indirect screening tests including the oxidase test seem highly desirable.

REFERENCES

1. Cullen, G. A. 1966. Direct milk test for mastitis. *Vet. Record* 78:297.
2. Ellingworth, S., J. W. McLeod, and J. Gordon. 1929. Further observations on the oxidation by bacteria of compounds of the para-phenylenediamine series. *J. Pathol. Bacteriol.* 32:173.
3. Gordon, J., and J. W. McLeod. 1928. The practical application of the direct oxidase reaction in bacteriology. *J. Pathol. Bacteriol.* 31:185.
4. Kovacs, N. 1956. Identification of *Pseudomonas pyocyanea* by the oxidase reaction. *Nature* 178:703.
5. Michaelis, L. 1931. A potentiometric study of Wurster's Red and Blue. *J. Amer. Chem. Soc.* 53:2953.
6. Ronin, V. S. 1967. Activity of succinate dehydrogenase, ubiquinone reductases, and cytochrome oxidase in peripheral blood leukocytes of healthy people. *Tsitologiya*, 9: 823. (Chem. Abs. 67:10814. 1967.)
7. Steel, K. J. 1961. The oxidase reaction as a taxonomic tool. *J. Gen. Microbiol.* 25:297.
8. Thompson, D. I., and D. S. Postle. 1964. The Wisconsin Mastitis Test—An indirect estimation of leucocytes in milk. *J. Milk Food Technol.* 27:271.
9. Vanderzant, C., and R. Nickelson. 1968. The oxidase reaction in relation to flavor quality of Grade A pasteurized milk. *J. Milk Food Technol.* 31:278.
10. Vosiltsov, M. K., and L. L. Shimkevich. 1964. Histochemical study of oxidative enzymes under conditions of aseptic inflammation. *Tr. Nauchn. Konf. Aspirantov i Ordinators, 1-yi (Pervyi) Mosk. Med. Inst. Moscow.* 1964: 18. (Chem. Abs. 64:16442. 1966).
11. Whiteside, W. H. 1939. Observations on a new test for presence of mastitis in milk. *Can. Pub. Health. J.* 30: 44.

IMITATION AND FILLED DAIRY PRODUCTS PRODUCTION AND PROCESSING STANDARDS¹

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No food product has received more free publicity during the past year than filled and imitation milks. This publicity has resulted because of a misunderstanding, lack of information, and the public's almost fanatical interest in anything "new and different," even if it is only a substitute for something considered nearly perfect for hundreds of years.

For the purpose of this discussion, filled milk is defined as that product in which the butterfat has been replaced by vegetable fat, with fairly clear indication that in most instances this will be coconut fat.

Imitation products are those which are chemically combined to simulate dairy products, but using no direct dairy ingredients, with the exception of sodium caseinate which has been declared a manufactured product, rather than a dairy product.

NEED FOR STANDARDS

Much that has been written and spoken about these products has been related to economic impact, performance in the market place, legislation, etc. — and little or nothing detailed has been said until just recently, about the need for production and processing standards. It would seem rather clear that if these products are to be used interchangeably with milk, and our standards for milk are correct, then the imitation product should meet the same standards that are required for milk and milk products.

Some regulatory people justify a lack of regulation for these products by the fact that milk is more perishable, for milk is an animal product, etc. This, of course, is pure nonsense. Regulation is for public health protection, and has nothing to do with keeping qualities.

A batch of coconuts contaminated by unsanitary workers or premises, is just as capable of transmitting disease, as improperly handled milk. Inasmuch as the end product in both instances is pasteurized to destroy all the disease producing organisms, we really retain regulation prior to pasteurization in the interest of esthetics, or because we have always done it. If such regulations are justified for milk, they are

equally justified for ingredients used in imitation products.

It would seem incongruous to require Grade A nonfat dried milk to fortify 2% skim milk, and permit sale of a 2% imitation from the same showcase and in the same type of carton, that has been made from sodium caseinate or nonfat dried milk which are not subject to the same Grade A regulations.

It would seem to be impractical and unrealistic to supervise production of ingredients, such as coconuts in the South Seas—although when inspectors go from one state to inspect products already under inspection in another on the other side of the country, it is equally impractical, and just as unrealistic. Regulations for handling and transporting raw product should be equivalent to those required for nonfat dry milk. Boats delivering products to this country, should be as sanitary, free of insects and rodents, as is required of a rail car delivering milk powder. Products should be adequately packaged for handling, and not handled in bulk, or in any old burlap sack available.

STANDARDS OF IDENTITY

The Food and Drug Administration (FDA) published in the Federal Register of May 18, 1968, Standards of Identity and Quality for imitation milk and cream. These standards obviously expand the concept of equivalency, as they provide standards nutritionally, and compositionwise that are equivalent to milk.

However, these proposals do not include any specific sanitary standards, but would no doubt come under regular good manufacturing practices inspection, by FDA. These standards, of course, would not be applicable to filled milk, as these products are illegal under present Federal law.

There is some belief that FDA should not write standards for a product not yet developed. Such standards would certainly do much to legitimize the product if it could be developed. If good practice and public health require a given set of regulations for a glass of milk to be safe for consumption by a child, identical safeguards should be required for a glass of imitation milk to be consumed by that same child.

¹Presented at the 55th Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, Inc., St. Louis, Mo., August 18-22, 1968.

ENFORCEMENT

Further, I believe that regulatory people who enforce regulations on the dairy industry, should be equally diligent in enforcing regulations on a substitute. How many inspectors have established standards for imitations, conducted surveys of processing areas, and made laboratory analyses with the same frequency as they do for milk plants under their jurisdiction?

There is considerable effort being extended to insist that imitation products be given fanciful names, with no reference to dairy products. This is really academic since present Food and Drug law requires the name *imitation milk*, if the product is shipped interstate. Once such designations are established, there is no reason to suppose that requirements for production and processing will not be similar to milk as far as the FDA is concerned—but such will not be true as far as local and state regulations are concerned.

When these products are merchandised out of the dairy case, in Pure-Pak cartons and with good promotion, the consumer will quickly learn that they are substitutes for milk, and will use them as such. The dairy industry is left at a disadvantage—as a less nutritional product, handled under more economical conditions, and with very few regulations is competing directly with dairy products. We should be required to withstand competition, to be able to justify our continued existence—but we and the competition should both be required to play by the same set of rules.

GUIDELINES FOR PRODUCTION AND PROCESSING

In developing a set of guidelines for production and processing standards, we must make a few assumptions: (a) these products are going to be handled, sold, and used in a manner similar to the products they imitate, (b) these products are going to be used as a direct replacement for dairy products; this assumption may not be entirely true, as some people may be able or willing to use the substitutes who could not use the real product—cost, medical reasons, etc., and (c) there are regulations now in effect for dairy products, and we must assume that they are necessary to protect the public health.

I have a very uneasy feeling that a thorough, objective study of this last assumption would show it to be false. If we have unneeded regulations, I believe it is right and desirable to eliminate their use by the dairy industry, rather than saddle the competitor with the same set of useless regulations, in an

effort to be merely vindictive.

Since these products become interchangeable in the minds of the consumer, the consumer also takes it for granted that they are interchangeable as far as nutrition, composition, and sanitary standards are concerned. As these assumptions are not true, the consumer is being cheated.

I would like to outline some of the areas that should be considered in setting up regulations for production and processing of imitations and filled dairy products.

(a) Ingredients used in the manufacture of imitation or filled milk products, should be handled in a sanitary manner and be required to meet the same regulations as for dry milk to be added to a dairy product.

(b) Boats, trucks, trains, etc., carrying these ingredients for imitation products, should be inspected and judged in relation to requirements for nonfat dry milk.

(c) All handlers, brokers, etc., should be required to handle products in a sanitary manner—from debarkation or domestic production, to the first point of processing.

(d) Plants used to process ingredients for imitation or filled products, should meet construction and processing standards required of milk plants.

(e) Processing plants for production of finished products should be required to meet the same regulations and the same frequency of inspection as milk plants. Products should be handled, processed, pasteurized, filled and stored under the same requirements as milk and other dairy products.

It can be argued that these are different products than dairy products: therefore, they should not be required to meet dairy standards. There may be some merit in this argument, except that all people selling these products wish to make capital of the purity, wholesomeness, and nutritional value of milk, and imply that imitations also provide these qualities. When this is done, even if in a manner as subtle as similar packaging, locations, etc., every effort should be made to insure that there is no misunderstanding on the part of the consumer. If the consumer feels that the standards of imitations are similar to milk, then they should be similar, or the consumer should be told how they differ.

However, regulatory agencies should not be attempting to set standards of composition for non-existent products. Their function is to set standards for sanitary compliance and proper labeling and adherence to requirements of composition for defined products.

THE SPOKANE CITY HEALTH DEPARTMENT MASTITIS CONTROL PROGRAM¹

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Spokane, Washington*

ABSTRACT

The City of Spokane Health Department was asked by the U. S. Public Health Service to study and instigate a practical abnormal milk control program in 1962. From May until November 1962 composite bulk tank samples were tested using the Modified Whiteside Test. Some abnormal milk appeared in 42% of the bulk tank samples. With this information, a meeting was called which included personnel from the U. S. Public Health Service, State Department of Health, State Department of Agriculture, Idaho Health Department, Extension Service, Dairy Industry, the Dairy Science Departments of Washington State University and the University of Idaho. A program was started using five committees recommended by the National Mastitis Council and a steering committee. The Direct Microscopic Leucocyte Count (DMLC) was adopted for official use and an educational program was started.

In April 1965, it was agreed that enforcement was needed to bring the leucocyte level below 1,000,000 per ml. After a few suspensions, the results were amazing, dropping from 22% to 1% of the producers continually with over a million per ml of milk.

In April 1966, the City adopted the 1965 U. S. Public Health Service *Grade "A" Milk Ordinance* and included an Abnormal Milk Section with 800,000 leucocytes/ml as a limit and using the 3 out of 5 method of suspension. At present, the DMLC is the official method and the industry is using the Wisconsin Mastitis Test monthly on all their producers.

The program has been very successful because of the cooperation of the milk industry, machine installers, Extension Service, Dairy Science Departments and Health Departments. It will be possible in the future to meet the 500,000 leucocytes per ml limit.

Spokane is located in the northeast section of the State of Washington. The milk shed covers 5 counties in northern Idaho and 5 counties in northeastern Washington. The weather is quite different from that of the coast which most people regard as typical for the whole state. Winters are fairly severe with the ground frozen for several months, springs are cool, summers hot and falls are dry and bright.

The size of the dairy herds in this shed ranges from <20 to 400 with an average of about 60 cows. The dairymen generally raise their own hay, mostly alfalfa, which is fed with concentrates. One hundred percent of the farms have milking parlors with from 3 to 20 cows being milked at a time. Housing is

changing fast to free individual loose stalls with some open housing. The majority of the herds are Holstein. The consumer population is about 300,000 and at present, there are 442 producers shipping milk to this market.

In deciding if a program should be started in 1962, the department felt it had sufficient cause to start a mastitis control program and believed the following reasons warranted doing so to eliminate abnormal milk from the supply.

Food poisoning

The danger of food poisoning outbreaks, especially from milk produced by udders infected with pathogenic organisms was of concern to the department. On and off since the 1880's, a few outbreaks caused by staphylococcus organisms in dairy products have been reported including recent outbreaks associated with cheese. This organism is one of the most hazardous as its toxin is heat resistant and if left to grow in milk (pasteurization can not destroy the toxin) it could cause a food poisoning outbreak. Over a period of 3 years, 57% of the infected quarters of cows in this milk shed, tested by the State Department of Agriculture, showed a staphylococcus infection.

Nutrition

Milk, being one of the most nutritious foods known to man, is necessary for the health of children, oldsters and yes, people in between. It must be produced from healthy udders. Research has proven that the solids content of milk goes down as the leucocytes increase. With a leucocyte count of 1,500,000 per ml, it is possible to lose 1% or more of the solids in the milk. The undesirable chlorides go up and there is an increase in blood protein.

Quality

It takes a good wholesome raw milk to turn out a top quality pasteurized milk or milk product. Cottage cheese is tops in per person consumption in this northwest area and no doubt the program may have played a part in the increased consumption. Use of milk substitutes is discouraged with production of a better quality and flavored milk. Bulk tank milk drivers have reported less slime in the tanks after the decrease of infection in cows.

Economics

Research and, yes, the work of this department

¹Presented at the 55th Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, Inc., St. Louis, Missouri, August 18-22, 1968.

TABLE 1. POUNDS LOST MILK PRODUCTION¹

CMT reaction	No. of quarters	Per quarter per day	Total per day	All quarters per month (30 days)	Value per month @ \$5.19 per CWT.
		(lb.)	(lb.)	(lb.)	
Negative ²	57	None	None	None	
Trace ³	19	0.90	17.10	513	\$ 26.62
1 ⁴	62	2.10	130.20	3,906	202.72
2 ⁵	42	3.80	159.60	4,788	248.59
3 ⁶	60	5.14	308.40	9,252	480.18
Totals	240		615.30	18,459	\$958.11

¹Taken from "Mastitis and the Dairyman's Pocketbook" by the Washington State University.

²Negative is an average of 64,700 leucocytes per ml

³Trace is an average of 113,000 leucocytes per ml

⁴1 is an average of 394,000 leucocytes per ml

⁵2 is an average of 1,700,000 leucocytes per ml

⁶3 is an average of 7,000,000 leucocytes per ml

proves that if a herd with a real abnormal milk problem corrects its problem, it will produce more milk and increase the producer's income. It is an advantage to the producer, to the industry, and the public since a producer who has a just and reasonable income will continue to improve his quality program.

Humane treatment of animals

Another reason for the program was the humane treatment of the dairy animals. Many dairymen had very poor housing, bedding, very muddy barnyards, and the cows were in need of better care to safeguard their general health.

SPOKANE PROGRAM

The following steps were taken in the abnormal milk control program in the milk shed.

1. Survey, May 1–October, 1962.

2. Meeting of Industry, Dairy Science Departments of Washington State University and the University of Idaho, United States Public Health Service (USPHS), Washington State Departments of Health and Agriculture, Idaho Health Department, and the Spokane City Health Department.

3. Following committees formed: (a) steering committee, (b) education committee, (c) farm management committee, (d) milking machine equipment committee, (e) program development and evaluation committee, and (f) therapeutic and laboratory procedures committee.

The above 5 committees were made up of fieldmen, Extension Service personnel, equipment personnel, laboratory people, veterinarians, producers, and health department people. The Steering Committee was made up of 1 member from each milk plant and milk cooperative, 1 from Department of Agriculture, 1 from Idaho Health Department, 1 from Spokane City Health Department and 1 from the Extension Service. The Steering Committee went over all material before printing for distribution by the other committees to be sure the wording was right and would not misinform the producers or the consumer if, by chance, he should see a copy. The Steering Committee also directed the whole program.

4. Started using Direct Microscopic Leucocyte Count (DMLC)—producers were informed of 1,000,000 leucocyte limit to be established in the future.

5. Technical school held at Washington State University for training on milking equipment. The school was attended by fieldmen, sanitarians, Extension Service personnel of Idaho and Washington, and a few producers. This was one of the most valuable schools held as all of the local people received

TABLE 2. LEUCOCYTE COUNTS OF RAW MILK FROM A FARM BEFORE AND AFTER EQUIPMENT CORRECTION

Date	No. leucocytes per ml	Date	No. leucocytes per ml
12/23/63	1,200,000	7/17/66	1,000,000
1/13/64	760,000	8/14/66	980,000
2/ 3/64	620,000	9/19/66	1,000,000
2/13/64	660,000	10/16/66	1,100,000
3/16/64	700,000	10/27/66	550,000
4/27/64	1,300,000	11/12/66	540,000
6/ 8/64	1,200,000	12/ 8/66	320,000
6/16/64	1,700,000	1/16/67	400,000
7/20/64	1,200,000	2/13/67	300,000
8/17/64	840,000	3/20/67	250,000
9/ 7/64	510,000	4/17/67	420,000
9/14/64	760,000	5/14/67	330,000
9/22/64	450,000	6/19/67	320,000
11/ 9/64	480,000	7/17/67	300,000
1/11/65	440,000	8/15/67	530,000
3/ 9/65	360,000	11/20/67	420,000
5/17/65	820,000	12/17/67	350,000
7/12/65	880,000	1/15/68	420,000
9/ 7/65	820,000	2/ 7/68	400,000
11/ 1/65	820,000	3/ 6/68	300,000
11/11/65	330,000	4/ 3/68	400,000
12/20/65	300,000	4/16/68	380,000
1/16/66	300,000	5/23/68	300,000
3/21/66	300,000	6/ 6/68	300,000
4/18/66	310,000	7/10/68	300,000
6/13/66	760,000		

TABLE 3. LEUCOCYTE COUNTS OF SAME HERD BUT WITH 2 OWNERS AND NEW OWNER'S COUNTS BEFORE AND AFTER CORRECTIONS COMPLETED

Date	No. leucocytes per ml	Date	No. leucocytes per ml
Previous owner			
3/16/64	200,000	8/ 3/64	660,000
4/27/64	300,000	9/ 1/64	340,000
6/16/64	280,000		
New owner			
12/21/64	620,000		
5/17/65	520,000	1/15/67	700,000
7/12/65	500,000	1/17/67	720,000
9/ 7/65	1,800,000	2/13/67	640,000
11/11/65	550,000	3/13/67	540,000
12/20/65	400,000	3/20/67	500,000
1/16/66	820,000	4/17/67	360,000
3/21/66	550,000	5/16/67	1,000,000
4/19/66	1,200,000	6/19/67	480,000
5/22/66	1,200,000	7/17/67	400,000
6/13/66	1,100,000	8/13/67	600,000
7/ 5/66	840,000	9/18/67	760,000
7/16/66	1,400,000	11/20/67	800,000
8/14/66	1,500,000	12/17/67	540,000
8/28/66	1,400,000	2/ 7/68	1,300,000
9/19/66	1,600,000	3/ 6/68	900,000
9/30/66	1,900,000	3/15/68	530,000
10/16/66	1,700,000	3/26/68	720,000
11/12/66	1,600,000	5/23/68	600,000
12/18/66	1,100,000	6/ 6/68	460,000
1/ 5/67	500,000	7/10/68	500,000

a thorough knowledge of proper installation and operating of milking equipment.

6. Producer education: (a) Small group meetings were held in each valley or area, most of the time at a dairyman's farm to discuss methods and equipment and demonstrate the use of testing equipment for machines. (b) Meetings were conducted by equipment specialists using their brand of equipment for producers who were having high leucocyte counts. One company at a time made it easier and more understandable to the dairyman when they discussed and explained their brand of equipment. (c) Mass meetings were held with specialists in animal health, such as Dr. Kermit Peterson, Oregon State University; Dr. Roy Hostetler, Washington State University; and others. (d) Two meetings were conducted with large animal veterinarians, Dr. Hostetler, and this department. The veterinarians agreed with the program, but preferred not to take an active part. They were able to aid individual dairymen who needed help in the control program.

7. Education material distributed to producers: (a) introduction of testing and abnormal milk control program for the Spokane Milk Shed, (b) care of the milking machines, (c) good milking techniques, (d) a complete sanitation program, (e) providing loafing and bedding facilities, (f) the use of the California Mastitis Test and disposal of milk after treating with antibiotics, (g) barnyards, (h) evaluation reports for program progress, (i) after milking teat dips, (j) machine dealer's and company specialists' meetings, (k) other reports were made for timing, keeping records on milking operations, and obtaining farm history for use by sanitarians, fieldmen, and county

agents, (l) how to buy a cow, (m) fliers prepared by Roy I. Hostetler, DVM, Washington State University in cooperation with Washington State Mastitis Council including: *Treat Mastitis Promptly and Properly, Avoid Irritating the Udder During Milking, Prevent Minor Accidents, Test Cows for Mastitis Regularly, Keep Mastitis from Spreading, and Save \$30 per Cow.* (n) flier prepared by University of Idaho Agricultural Extension Service and the U. S. Department of Agriculture, *You Can Prevent Mastitis.* (o) flier prepared by Extension Service of Oregon, Idaho, and Washington, *You Can Prevent Mastitis.*

8. Enforcement. The enforcement portion of the program was put into effect in the spring of 1965. Twenty producers were suspended over a 10 week period. It was apparent, as statistics will show later in this paper, education aided correction, but enforcement was necessary in the final stages as a few producers would make corrections only when required. The methods of enforcement were to select a producer with a count continually over a million leucocytes per ml and make repeated farm inspections. If the dairyman had not corrected faulty machines, barnyards, poor bedding, and sanitation, he was asked not to ship milk to our market. This method corrected the majority of the high count producers within a very short time. Machines were repaired, cows with deep seated infections were culled, improved management techniques were instituted, and better housing and yards were maintained. During a suspended period, a dairyman was required to write a letter to the department asking for a hearing with the health department. He had to bring a California Mastitis Test (CMT) or other test records of his herd to the department during the suspension time or to the hearing. A dairyman who had been warned several times on high counts by this time would have had several tests on each cow from the fieldman and sometimes from the Dairy Herd Improvement As-

TABLE 4. LEUCOCYTE COUNTS INDICATING ABNORMAL MILK CORRECTION

Date	No. leucocytes per ml	Date	No. leucocytes per ml
12/23/63	1,400,000	8/15/66	350,000
2/ 3/64	1,000,000	9/18/66	430,000
2/17/64	580,000	10/16/66	550,000
3/16/64	620,000	11/14/66	540,000
4/27/64	1,200,000	12/19/66	520,000
5/15/64	560,000	1/16/67	550,000
7/20/64	620,000	2/13/67	600,000
8/18/64	1,300,000	3/19/67	660,000
9/11/64	980,000	4/17/67	540,000
11/ 9/64	980,000	5/14/67	400,000
1/11/65	720,000	6/19/67	520,000
3/ 8/65	1,100,000	7/17/67	580,000
5/17/65	1,100,000	8/14/67	400,000
7/12/65	800,000	9/18/67	620,000
9/ 7/65	1,200,000	11/20/67	500,000
11/ 1/65	1,200,000	12/17/67	490,000
11/11/65	500,000	2/ 6/68	400,000
12/20/65	160,000	3/ 7/68	330,000
1/17/66	960,000	4/ 3/68	500,000
3/20/66	210,000	4/16/68	280,000
4/17/66	400,000	5/23/68	330,000
6/16/66	140,000	6/ 6/68	400,000
7/18/66	230,000	7/10/68	200,000

TABLE 5. LEUCOCYTE COUNTS OF A PROPERLY MANAGED HERD

Date	No. leucocytes per ml	Date	No. leucocytes per ml
4/18/66	70,000	3/20/67	40,000
6/12/66	50,000	4/17/67	100,000
7/17/66	60,000	5/14/67	60,000
8/28/66	120,000	6/19/67	40,000
9/19/66	50,000	7/17/67	100,000
10/10/66	40,000	8/13/67	170,000
11/12/66	20,000	9/18/67	40,000
12/18/66	40,000	11/20/67	60,000
1/15/67	40,000	12/17/67	80,000
2/13/67	60,000		

sociation (DHIA). He could bring his veterinarian, the plant fieldman was always asked; sometimes the plant production manager was asked to attend the hearing with the Health Officer, Supervising Sanitarian, and the Sanitarian in the area. At this hearing, if some of these cows showed millions of leucocytes in the tests for a period of time, the dairyman was asked to sell the cows to the stockyard for slaughter purposes with a copy of the Bill of Sale submitted to this department. At the hearing, he would have to agree to keep milk from the cows he was treating out of the public supply. He also had to agree, if needed, to overhaul the milking machine, improve housing, yard, and remove junk or other items that might cause udder damage. After the above agreement was reached and he was allowed to come back on the market, the health department would sample the milk and in very few instances would there be trouble again at this dairy farm. As remembered, only 2 shippers quit dairying on account of the program. Many times a producer was called in for a hearing before he was suspended to discuss a plan for correction. This was often successful.

9. In 1965, the new *Grade "A" Pasteurized Milk Ordinance—1965 Recommendations of the USPHS* was passed by the Spokane City Council with the addition of a leucocyte limit. The leucocyte section being as follows: "Individual producer milk shall not exceed 800,000 leucocytes per ml. The leucocyte count limit will be lowered to 500,000 per ml when the Spokane City Health Officer and the local Mastitis Steering Committee have reason to believe the program has advanced to this degree. Commingled milk shall not exceed 800,000 leucocytes per ml."

10. Improvement as to per cent of producers in trouble: (a) 1962—42.3% over 1,000,000 leucocytes per ml, (b) 1963—30.0%, (c) April, 1964—22.0%, (d) 1964-1965—enforcement 1% over 1,000,000 leucocytes per ml, and (e) 1967—1.0% over 800,000—3 illegal out of 5 sample method.

11. Truck tankers of milk, in 1962, contained 2,000,000 to 4,000,000 leucocytes per ml.

RESULTS

The following are some tables of results of leucocyte counts on some of the producers.

Example No. 1 (See Table 2)

This is a producer with about 100 cows, fairly good housing, and yards. His milking machine had too low a vacuum, pulsation was varied and one person was milking with 4 units. He corrected the vacuum

and pulsators and is now using 2 milker units per man. In July, 1966, he bought another herd and had to start another culling program. He is now using Bovadine teat dip and is happy with his present production.

Example No. 2 (see Table 3)

This case is very interesting as the previous owner controlled the count by culling. His vacuum pump was too small and some other changes should have been made. The new owner, a young person—just starting, really in debt, could only cull to a certain extent as the sale contract held him to 52 cows. The new owner changed to another machine, but still many things needed changing, such as size of pump and lack of vacuum. The ends of the teats were very sore and damaged. Because the fellow was a new producer and young, we went along with him even though he had high counts. In November, 1966, we wrote to inform him if he did not get his counts down, we would suspend his permit. He then put in a complete new machine with the company helping him finance it. His counts immediately

TABLE 6. PRODUCTION RECORD AND LEUCOCYTE COUNTS OF A HIGH PRODUCING HERD

Production 1966	
Butterfat616 lb.
Milk15,024 lb.
Production 1967	
Butterfat605 lb.
Milk14,863 lb.
Leucocyte counts (no./ml)-1966	
	180,000
	160,000
	130,000
	60,000
	50,000
	140,000
	50,000
	80,000
	70,000
Leucocyte counts (no./ml)-1967	
	100,000
	140,000
	110,000
	160,000
	90,000
	190,000
	80,000
	150,000
	220,000
	100,000
	130,000

TABLE 7. LEUCOCYTE COUNTS OF A HIGHLY INFECTED HERD

Date	No. leucocytes per ml
6/20/63	3,000,000
5/18/63	2,000,000
6/17/63	3,600,000
8/18/63	1,800,000
10/ 4/63	2,100,000
11/12/63	4,900,000
12/30/63	2,700,000
1/10/64	2,600,000

went down and much faster than expected. He had a flareup in May, 1967 because a new milker worked for him while he was on a vacation. The milker had included milk from infected cows in the tank. This dairyman is paying his bills now and is very happy with his increased production. He also changed from loose housing to individual stalls and is teat dipping. His new heifers are clear of infection. He had a staphylococcus autogenous vaccine made and each animal was injected 3 times at proper intervals. He had a very bad staphylococcus infection, but we will never know if this vaccine did any good as other corrections were made at the same time. This producer is now one of the best boosters for our program and has gone to dairy meetings in other parts of the state recommending regulations on the control of abnormal milk.

Example No. 3 (see Table 4)

This dairyman, like the one in Table 3, was a very clean operator and had good yards and housing. He had a high line, poor vacuum, and left the machines on too long. A thorough survey of his operation was made with suggestions for corrections, i.e., getting machines on and off at the proper times, teat dipping after milking, and some equipment changes along with culling 9 cows of a 39 cow herd. Tests records showed these 9 cows were continually producing abnormal milk. He now is out of trouble and happy with more milk from less cows. The first calf heifers are also staying void of infection.

Example No. 4 (see Table 5)

This dairyman has good equipment, methods, yards, housing, and his tests, as can be seen, for 2 years indicate a well controlled herd as to abnormal milk.

Example No. 5 (see Table 6)

This is one of our top production herds and as the figures show, his leucocyte counts indicate a good milking program.

Example No. 6 (see Tables 7 and 8)

This dairyman was a very poor operator and did

TABLE 8. LEUCOCYTE COUNTS ON INDIVIDUAL COWS OF HERD OF TABLE 7

Cow no.	Leucocyte estimate	Causative organism present
	no./ml)	
20	—	—
60	—	—
29	5,000,000	Strep
3	1,000,000	Strep
80	2,500,000	Strep
18	3,000,000	Staph
4	Dense	Strep
31	—	—
64	Dense	Strep
7	5,000,000	Staph-Strep
57	—	—
21	Dense	Strep
73	Dense	Staph-Strep
67	—	—
28	—	—
50	—	—
26	Dense	Strep
23	—	—
71	—	—
33	—	—
1	—	—
58	3,000,000	Staph
42	5,000,000	Strep
42	5,000,000	Strep
8	—	—
55	5,000,000	Staph
62	2,000,000	Staph
66	4,000,000	Strep
10	1,500,000	Strep
5	—	—
32	Dense	Strep
65	Dense	Staph
17	Dense	Staph
75	Dense	Strep
45	Dense	Strep
3	2,000,000	Strep
14	500,000	Staph
22	—	—
12	—	—
2	—	—
25	Dense	Staph
19	Dense	Strep
39	Dense	Staph
70	Dense	Strep
78	500,000	Strep
33	Dense	Staph
69	Dense	Strep
79	—	—
74	—	—
56	500,000	Staph
77	—	—
40	—	—
40	—	—
63	—	—
34	500,000	Strep
66	4,000,000	Strep
9	Dense	Staph

not seem to want to change. Help was given him by such people as equipment manufacturers, fieldmen, veterinarians and Extension Service personnel without success. He had to be suspended. Later, he was permitted to ship with the promise that he would make certain corrections. He did not keep his promise and his permit finally had to be revoked. He not only was producing a very poor quality milk, but was in financial trouble. A detailed study of the herd is reported in Table 8. Most of his cows had infection.

Example No. 7 (see Table 9)

This table shows what can be accomplished by the cooperative action of management and fieldmen of a milk plant.

TABLE 9. RESULTS OF LEUCOCYTE COUNTS OF FARM BULK TANK MILK OF A PLANT WITH 118 PRODUCERS

	0- 500,000/ml	500,000- 800,000/ml	800,000- 1,000,000/ml	Over 1,000,000/ml
May, 1968	82.4%	11.7%	3.4%	2.5%
June, 1968	82.4%	5.9%	1.7%	0.0%
July, 1968	95.3%	4.7%	0.0%	0.0%

Basic reasons for improvement

1. Good machine operation. In the beginning of the program at least 90% of the machines were not functioning properly because of vacuum pumps and air lines that were too small; poor pulsation; low or uneven vacuum; old, outdated, inadequate equipment; mixed brands of equipment; and dealers were blamed when they were not responsible because brands were mixed.

2. Good milking practices.

3. Proper care—adequate housing (individual), yards, and bedding.

4. Teat dipping—pine oil. We have had many producers for years dipping the teats individually after milking in a pine oil solution—1 tablespoon of No. 6 pine oil to 1 qt. of water. This takes the last drop of milk off, gives some protection from flies for 1 to 2 hr and makes skin pliable. The new iodine products are also being used in this area for dipping. Bovadine is being used at a rate of 7500 ppm in the troublesome herds and it appears to help stop the

spread of staphylococci.

5. Enforcement. This is very necessary in the program. We now use 800,000 leucocytes per ml as the maximum and the 3 illegal out of 5 sample method.

6. Cooperation. We have been very fortunate in Spokane that we have had a Dairy Fieldmen's organization since 1948. This group meets once a month and discusses problems, programs, and other items of interest. It is made up of plant fieldmen, equipment dealers, Dairy Science Department professors, sanitarians, production men from milk plants, producers and Extension Service workers. This group kept the abnormal milk program going and steered it through all its original plan.

7. Culling.

Tests used

1. Modified Whiteside Test (MWT). We started with this test in our laboratory and made our original survey with it.

2. Direct Microscopic Leucocyte Count Test (DMLC). January 1, 1963, this department started to use this test following Standard Methods. It has been used in this laboratory and has also been used for enforcement.

3. California Mastitis Test (CMT)—Milk Quality Test (MQT). These tests have been used since January, 1963 as the cow side test. All the dairymen in this milk shed have been instructed to use one of these tests. The DHIA is using the CMT where the dairymen wish the service.

4. Wisconsin Mastitis Test (WMT). This test is conducted at least once a month by the milk plant on milk from each producer. It is quite close to the DMLC in its results if conducted properly. This department follows up with the DMLC on all industry sample results of 600,000 leucocytes per ml or over. The fieldmen, on checking a herd, will take the individual cow or quarter samples and transport them to their plant laboratory and conduct WMT as soon as possible. The WMT is preferred because it gives results as number of leucocytes and the producers understand it better than other methods of reporting abnormal milk. All samples are iced at sampling either from the cow or tank and tests conducted as soon as possible, preferably, the same day at the plant laboratory.

SANITATION IN THE SINGLE SERVICE CONTAINER AND CLOSURE INDUSTRY—A STATUS REPORT¹

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ABSTRACT

Single service containers and closures have a history of steady growth and widening use. The industry has had the guidance of public health authorities and the benefit of effective self-policing since its inception.

Manufacturing practices emphasizing good basic house-keeping, employee orientation, and process integrity contribute significantly to sanitary products. Increased automation, new materials, more refined equipment, and further study of public health aspects of the single service container are anticipated in the future.

The single service container is a phenomenon of the North American Continent, our attitudes on public health, our economy, and our unending search for convenience. It has been at once blamed for the solid waste problem of the United States and blessed for the help which its BTU content affords in incinerating wet garbage. It is of the imagination—adventurous, adaptable, whimsical. It has the heart of the American homemaker in its hip pocket; it is the supermarket's most aggressive salesman. It has taken areas traditionally held by other materials and concepts by storm. From humble birth as a paper cup it expanded to napkins, handkerchiefs, diapers, underwear and swimwear, medical accessories, home-decorating items, filtration media, laboratory ware, and the list is still growing. It is true-to-life science fiction.

If all this sends a small shudder of uneasiness up our spine, it is understandable. The restlessness of it all runs counter to our professional instincts as sanitarians. We would like to be able to lay the whole thing out, examine it, prove it, and then let it fly. This is the way we've done it for years with milk and food equipment, pharmaceuticals, vaccines, processes (like pasteurization), chemical food preservatives, etc. It is a good system and it has served the interests of public health, comfort, and well-being rather admirably.

The single service industry seems to have a streak of sacrilege about it. The rules we've come to respect don't appear to apply. The package in vogue today may be gone from the grocery shelf tomorrow.

The succession of shapes, materials, color combinations and pouring spouts is endless. We hardly learn how to open, close, dispense or discard by one set of instructions before we have a new package and it's a whole new ball game.

If I have successfully sold you the idea that this is how it is, I'd like to spend the next few minutes convincing you that it isn't this way at all. The industry actually has a good record of public health responsibility and an active self-policing program in manufacturing sanitation. It has a few problems, too. I'd like to tell you about them and the programs in force to solve them. Finally, I'd like to take a look ahead and make a few projections of things to come.

EARLY DEVELOPMENT

It would be an exaggeration to say that single service items have always been. They haven't of course, but there are precious few people who can remember back far enough to recall when there weren't any. In the normal affairs of society a situation like this creates what social scientists call a "generation gap."

Since we of the industry and you of the sanitarian's profession are going to be talking more—and more often—about matters of mutual concern perhaps it would be well if I tried to close the gap.

Motives for early containers

It may be a surprise to some of you to know that the ancient and honorable profit motive was not the seed for the first commercially offered single service container. The motive was public health. The item was the paper cup. The era was circa 1900 (give or take a few years). The case presented by Dr. Samuel Crumbine against the common cup so impressed two young men that they made their way to discuss the concept of the single service cup with the Doctor himself. The overriding goals of the project were so obvious that nobody seems to have investigated the fiber content of the paper, the possible migratory additives in the seam adhesive, or the bacteria count on the wrapping material. Public health had such a long way to go that a clean one-way cup, even one unrefined by today's standards, was a genuine blessing.

¹Presented at the 55th Annual Meeting of the International Association of Milk, Food, and Environmental Sanitarians, St. Louis, Missouri, August 18-22, 1968.

A long generation further down the road the first single service milk container was assembled and filled in a milk plant. Its purveyors alleged a number of advantages for it over traditional competition, the glass bottle. They offered light weight, no-return convenience, lots of advertising space on side panels, warehouse space savings, labor savings in handling and transportation, and the full assurance of a clean and sanitary container for milk. Documentation accompanied the promotional brochures. It included bacteria counts on finished containers, paper pulp, and other elements of broad furnish. It included excerpts from correspondence between the manufacturers and regulatory agencies. The information is impressive testimony. What is more, research and review going on at the time gave support to these claims.

Courts resolved some questions

But the people—in the person of their appointed representatives in public health—objected. This Johnny-Come-Lately could not have its way without their sanction and they proceeded to challenge it. The new concept did not enjoy free entry; it had to prove itself. In due course its case was laid before the courts. It is interesting that much more than the cleanliness of the container came under debate. The right of the governing body to regulate the sale of milk (and thereby, to define the containers in which it might be sold) and whether the single service container was a "standard milk bottle" were also focal points. The records show that the single service container actually lost! In the light of today's acceptance of it this may seem almost ludicrous, and maybe it is. Again, let me emphasize—this is not at issue. The single service milk container exists in today's economy and public health structure because it demonstrated its right to exist before the competent authorities into whose hands business and society have committed their destinies.

The 1939 USPHS Milk Ordinance and Code

I would be remiss in this recitation of history if I did not call your attention to the fact that the U. S. Public Health Service Milk Ordinance and Code was revised in 1939 to include reference to the sanitation of single service containers and closures. Milk bottle caps had been on the scene for years. Pre-formed paper milk bottles had been in traffic for at least 10 years and the first commercial exposure of in-plant forming and filling was on the record books prior to the 1939 revision of the code.

As interest in the single service concept increased, the Service obliged by issuing interpretations of the Ordinance provisions as situations warranted. The Service is probably still issuing them, because no

ordinance ever seems to embrace all possible situations in its wording.

Local and State authorities

Nor did the pronouncements end with U. S. Public Health Service. Local and state health authorities examined in detail such pertinent matters as the bacteria counts of preformed paper containers, the wrapping and casing of milk bottle closures and Cottage cheese containers, and the degree to which closure design afforded protection from pilfering. All this, mind you, was 30 and more years ago. It was all very real and assumed an importance which the record may not show to its fullest.

Unfortunately, not everybody thought alike. (We have had that problem in milk inspection, too, I seem to recall). Containers and closures which were acceptable in one area occasionally failed to make the grade in another. I know that you are aware that to an extent this still goes on today. Fortunately, it is less a problem than it was, and hopefully its decline will continue. But the rules of the game were not all laid down by public health agencies.

Industrial contributions

The containers and closure industry itself recognized the public health implications of its products pretty early in the day. It started a program of manufacturing sanitation and bacteriological testing over 20 years ago. Many existing standards, including—I believe—the 250 colony limit per gram of raw paper board and the single colony/ml maximum on finished containers were in routine use within the industry before they were written into the rule book. This is as it should be.

Manufacturing plants have had sanitation inspection services available—and in use—for years. The Syracuse University Research Corporation has been most active in this work; others, including our friend and professional conscience, Mr. Harold Wainess, are also known for their contribution to intelligent industry awareness of public health responsibilities.

So much for the influence of history. I guess I have talked about almost everyone concerned with the container and closure industry except the little old lady who breaks her fingernail trying to lift the tab of a stubborn bottle cap. I'll get to her in due time.

PRESENT INDUSTRIAL PRACTICES

Today, with 50 years' experience behind it in basic product sanitation, the industry has several things going for it. First is its solid background in public health. I've covered that before and I won't repeat myself.

Second are the materials of which single service

items are made. Paper and plastic are by nature austere substances, not particularly attractive media for the growth of organisms. Kept damp or otherwise contaminated they will sustain bacteriological life, but dampness and physical contamination introduce risks in handling, forming, and end-use performance. Normally, vegetative cells, the non-spore formers, just do not last on paper and plastic.

"Untouched by human hands?"

It might be worthwhile, digressing for a moment, to point out that we have just about come full circle in the matter of hand contact on single service items. Some years ago great stress was laid on the benefits in sanitation accruing to products which were "untouched by human hands." In certain converting plants white gloves were issued to production workers, packers and inspectors. They were changed daily and laundered before re-use. It looked like a winner! When the system was fully on stream, bacteria counts were taken on items subjected to bare-handed manipulation and those which received the white glove treatment. The verdict was overwhelmingly in favor of bare-handed methods! Postmortem showed that the properly trained production worker seldom varied his technique. His hands—gloved or not—were constantly operating in a very limited environment. He was putting product into the machine and receiving product from it. He was not sweeping the floor, oiling, repairing, etc. His bare hand was the captive of its trade. The gloved hand, equal captive though it was, perspired into the fabric of the glove. The dampened glove picked up paper fibers, transient dust, etc. some of which was inadvertently transferred to the product, hence the counts. We have abandoned the glove in favor of the bare hand. I know that plastic gloves, single service plastic gloves, at that, are available and these do not absorb sweat. Theoretically they are a good answer, except that (a) they leak, (b) they are difficult to ventilate well enough to prevent perspiration from pooling in them, (c) they are expensive, and (d) experience suggests that they are not necessary.

Incidentally, hand manipulation of product does have some serious disadvantages. It costs money for one thing. For another, it is difficult to find, train, and hold people who do it well. I think that you will find less of it as time goes on.

Suppliers

Finally among the things the industry has going for it is a responsible corps of suppliers. If it were left to the converting industry to check out the acceptability of given materials for food-contact the job would be endless, thankless, and uncertain. Fortunately, plastics, paper, ink, and adhesive manufacturers are pretty well abreast of the sanitary im-

plications of their products as well as the compatibility of their offerings with FDA requirements.

PRESENT PROBLEMS

Since we have so much going for us you may wonder what we do with our spare time. My supervisor has a way of asking the same question with the same directness; because of this I have developed some good answers. Here they are.

Day-to-day operating sanitation is a different ball game in our industry from that of the milk or food industry. It takes a complete re-assessment of the situation to get it in perspective. I know; I have had the adjustment to make personally. Let us spend a few minutes adjusting together.

Factories

Single service containers are made in factories. Some are as old as the industry itself. They are open beamed, austere, and frequently ventilated by open windows which may not always be screened. The equipment, especially for such items as plug caps and paper cups, may have a little age on it, too; say, 30 years or so. Not a nut, bolt or mandrel has a 3-A symbol on it. In a milk plant you expect to see an occasional leaky pipe coupling. It is something the industry fights every day. Single service container factories have the same campaign to wage against dust. It is an all-day, every-day campaign, since it is impossible to cut a piece of paper or cold blank a sheet of plastic without making dust. Floors in single service plants are usually concrete; in older buildings they may be wood. They probably don't have floor drains, and even if they did it wouldn't be a particularly good idea to flush some of the solvents, waxes and inks which are part of the business down the drains.

The printing presses, blanking equipment, and delivery conveyors would not react well to wet washing; they are usually not stainless steel. Sanitizing and general cleanup of such equipment is usually done with solvents. Conveyor belts may be canvas although in recent years the trend has been toward less porous materials.

Plastics operations are usually more refined. They are newer and more demanding. Air conditioning is not uncommon; positive pressure environments are frequent. Plastic forming is more reliable in a controlled operating situation. It will probably continue to be so.

Sanitation in converting plants

As unorthodox as all this may sound against the backdrop of milk and food plant design and conduct, it has been a successful formula. New construction invariably benefits from experience—good and bad—

accumulated in the past. But many of the operations built in another generation have years of production still ahead of them. If there are any secrets of success or earmarks of failure in converting plant sanitation they are, and always will be, quite simple. (a) Keep the paper (or plastic) clean. This means keeping the operating web off the floor, stripping the outer layers off before threading it into a machine, keeping the overhead essentially clean, trimming the edges of the roll to eliminate dirt and scuffs. (b) Keep insects at arm's length. Nobody likes a bug squashed in his coffee cup—even if it is encased in plastic. There is very little in the single service industry to attract insects except the things people might bring with them. So, we try to control lunches, candy wrappers, dirty clothes, coffee-break snacks. We use air curtains and insect attractant lamps to advantage in discouraging night fliers. (c) Use good judgement in housecleaning. This is economics, as much as it is public health. Piles of junk, waste paper, crowded roll stock and packing cases—all these create a disorder that can only grow if it is allowed to exist at all. Good general housekeeping keeps dust to a minimum, extends the life of bearings and motors and keep production scrap out of finished containers.

(d) Reckon with static electricity! It needs to be reckoned with! Winding and unwinding rolls of paper can build a powerful charge in the cooler low humidity months. The charge is a magnet for dust and an impediment to efficient through-put of finished goods. Dust can interrupt ink lay-down and make art work blotchy. Charged paper parts stick to conveyor belts, defy packers to stack, pack, or sort them. There are a variety of approaches to static control. In paper products it is usually bled off mechanically. Plastics may be surface treated with an inhibitor or, as is true of polyethylene, manufactured with an anti-static agent in them. Fortunately, some FDA complying anti-stat additives are now available and there will probably be more in the future. (e) Teach people common sense. No cynicism is intended. Good work habits, like industrial safety, are a day-in, day-out challenge to operating management. Things like clean hands, clean clothes, hand washing after toilet, keeping open wounds properly protected, these are all part of the human equation. They can never be explained too often or too clearly.

(f) Keep the process, whatever it is, on stream. The fact is that there is no greater contributor to public health, in my opinion, than a container that performs its desired function for the customer. If it is automatically dispensed and capped at the dairy or food plant it should work every time. Jams, irregularities, process adjustments at the filling line,

all add people, hands and the opportunity for contamination. This is so simple a concept it hardly seems worthy of mention. Yet it is basic and important.

Now all this is no mean trick. For better or worse, paper making and plastic fabrication are still much more an art form than a science. Paper has a "grain"; plastics takes an orientation. Paper grows in a humid environment. Plastic shrinks under certain process and storage conditions. Despite all these limitations both must be handled on milk and food plant equipment built to tolerances of less than .001 inch. It is a real challenge. By now you may have made a mental note that in addition to the walls, floors, people, and processes of our industry you must now consider monitoring the dimensions of our products. You can forget that idea! Our customers beat you to it. They are aware of the problems which may be created by container and closure failures, of the bacteria counts they invite, and of the product waste the often effect. Customers expect performance, and it is well that they do.

THE FUTURE

That is the contemporary view, painted with a very wide brush. I have tried to be candid, because I think you want it that way. Now for a few thoughts on the long road ahead. As all adventurers in prognostications do, I will expect you to tolerate poetic license of a sort.

First, I expect more process automation. There is nothing very startling about this. It is something that has been gaining momentum for years. It will mean fewer people handling products, but I hardly think it will affect bacteria counts or basic product sanitation. This is good right now. What it will do is increase process reliability and predictability. The main beneficial fallout of this will be increased respect of the industries we serve and more economical operation for us.

Second, I expect the evolution of a program similar to 3-A in our process equipment. It is natural, and it will provide insights and improvements not foreseen in earlier designs—improvements which will benefit the container industry and its customers.

Third, I expect new materials, some of which we haven't even thought about. It is a long way from the celluloid collar to the polyethylene milk jug, but I think I am more than safe in saying that this is only the beginning.

Fourth, I expect some real in-depth study—by different people in different places for different reasons—of the true and compelling public health implications of single service container and closure manufacture. Today we are trying to apply the sense of

good public health principle to our trade. Every index seems to say we have succeeded, but times, materials, and practices change. Questions which have not been asked so far will need answers. Side by side with this effort to know will come more dialogue between regulatory people and the industry. A lot of information has to be exchanged so that we develop a common language and a total rapport we

have not needed or known in the past. It will be a good adventure!

With this statement, I think I have gone far enough. I hope that my projections for the years ahead sound inviting and realistic and I hope I have helped make the industry as it is today more real and approachable. The mechanics of how things happen we can go over at machine-side with you.

REPORT OF COMMITTEE

(Continued from Page 318)

K. L. Pike, International Paper Co. 220 East 42nd Street, N. Y. C.

Donald H. Race, Dairymen's League Coop, Assn., 402 Park St., Syracuse, N. Y.

Dr. Ralph Russell, Syracuse University Research Corp., Merrill Lane, University Heights, Syracuse, N. Y.

Harold Thompson, Jr., U.S.U.H.S., 222 East Central Parkway, Cincinnati, Ohio.

Harold Wainess, N. 510 Dearborn St., Chicago, Illinois.

REPORT OF THE COMMITTEE ON ABNORMAL MILK CONTROL NATIONAL CONFERENCE ON INTERSTATE MILK SHIPMENTS

The IMS Committee on Abnormal Milk Control held meetings in Chicago on February 14, 1968, and in St. Louis on August 19, 1968. In these meetings and in correspondence the Committee reviewed the status of the abnormal milk program with respect to the Conference action at Miami in April 1967. This included a comprehensive review of the Public Health Service "Guidelines for the Control of Abnormal Milk" published in May 1968. The views of official agencies, educational institutions, and industry were considered.

The Committee recommends that the National Conference on Interstate Milk Shipments adopt section IV of the Public Health Service Guidelines and recommends that the Public Health Service make certain revisions in paragraphs "B" and "C". The revised section IV would read as follows:

IV Mastitic Milk

"The health authority requires such additional tests for the detection of abnormal milk as he deems necessary." The tests include, but are not limited to, tests indicating udder inflammation—namely, excessive somatic cells. Tests for somatic cells are found in PHS publication No. 1306, *Screening Tests for the Detection of Abnormal Milk*. Four indirect tests are used for screening raw milk samples and the results indicate a range of somatic cell levels. These are the California Mastitis Test, the Catalase Test, the Modified Whiteside Test, and the Wisconsin Mastitis Test. The fifth test, the Direct Microscopic Leucocyte Count, measures somatic cells directly and current research indicates that this test should properly be called the Direct Microscopic Somatic Cell Count. (DMSCC) A more precise test than the DMSCC procedure that was developed after publication of PHS No. 1306, is the Electronic Method of counting somatic cells.

After July 1, 1967, required laboratory examination for the presence of unwholesome, altered mammary secretions—

whether of an inflammatory, infectious, physiological, or environmental origin—shall be made on all raw milk samples at the same frequency as that specified for bacterial count samples in Section 6—The Examination of Milk and Milk Products, *Grade "A" Pasteurized Milk Ordinance*. Samples shall be analyzed at an official laboratory or an officially designated laboratory approved by the State milk laboratory certifying agency for the indirect or direct tests specified. Those tests listed in PHS publication No. 1306, *Screening Tests for the Detection of Abnormal Milk*, and the Electronic Method shall satisfy this requirement. For purposes of uniformity, a screening test that may be read objectively is highly desirable. The results of these tests shall be recorded by the regulatory agency on the official records for each dairy farm.

It is necessary that mastitis control programs be organized to assist the interested dairyman in controlling mastitis. This program should involve all resources which may be of assistance. The National Mastitis Council, Inc. has published a guideline for the establishment of such a control program which is available from the National Mastitis Council, Inc., 910 17th Street, NW, Washington, D. C. 20006.

After July 1, 1968, when a herd milk sample exceeds any of the following screening test results:

California Mastitis Test	Weak positive (CMT 1 +)
Catalase Test	30% oxygen
Modified Whiteside Test	Positive (1 +)
Wisconsin Mastitis Test	WMT value of 28

a confirmatory count, using the Direct Microscopic Somatic Cell Count or the Electronic Method shall be made on that sample and the result of this count shall be the official result.

Whenever the confirmatory count indicates the presence of greater than 1,500,000 somatic cells per ml., the following procedure shall be followed:

A. A notice shall be sent to the producer warning him of the excessive somatic cell count. The notice should also list the more likely causes of high somatic cell counts.

B. Following the second confirmatory count of greater than 1,500,000 somatic cells per ml. within any consecutive 6 months, an inspection shall be made by the regulatory agency or by certified personnel as specified in Section 5 of the *Grade "A" Pasteurized Milk Ordinance*. This inspection should be made at milking time to be most effective.

C. A third milk sample shall be taken after a lapse of three days and within 14 days of the inspection required under "B" above. If three of the last five samples within any consecutive 6 months indicate a count greater than 1,500,000 somatic cells per ml., the milk regulatory agency shall proceed with its responsibility to suspend the dairyman's permit for violation of item 1r or other applicable requirements of the *Grade "A" Pasteurized Milk Ordinance*.

Upon written application by the dairyman stating that the

(Continued on Page 337)

NEWS AND EVENTS

EGG INDUSTRY FINALIZES FOUR SANITARY STANDARDS

The initial efforts of the 3-A Sanitary Standards Committees for the Egg Industry, patterned on the very successful 25-year-old 3-A Sanitary Standards Committees for the Dairy Industry, have resulted in the completion and official signing, June 23, of four new E-3-A Sanitary Standards for egg equipment. The E-3-A Standards are for pumps, homogenizers, sifters and thermometer fittings respectively, for processing egg products. This accomplishment is the beginning of a bold, new program to establish guidelines for sanitation and cleanability of equipment design in an entirely new food industry area.

The 3-A Sanitary Standards Committees are made up of representatives from the International Association of Milk, Food and Environmental Sanitarians; U. S. Public Health Service; U. S. Department of Agriculture; Institute of American Poultry Industries and the Dairy and Food Industries Supply Association. The Committees thus represent a voluntary cooperative effort by processors, fabricators and the regulatory-sanitation community.

Generally speaking, 3-A standards and practices are acceptable in public health jurisdictions in nearly every town, city and state in the United States, and are cited in various regulatory and health ordinances.

Publication of the new egg equipment standards will take place in the Journal of Milk and Food Technology toward the end of the year, and will become effective June 23, 1970. E-3-A Standards will be distributed as reprints from the Journal. Copies will be available from the Journal offices, Box 437, Shelbyville, Indiana 46176, at a nominal cost.

FDA CLEARANCE FOR PYRETHRINS ON MEAT AND MILK ANIMALS

Tolerances for residues of pyrethrins in milk fat have been set at 0.5 part per million, "reflecting negligible residue in milk," the Food and Drug Administration reports in the May 3, 1969 issue of the Federal Register. Similarly, tolerances of 0.1 part per million ("negligible residue") have been established for meat, fat and meat by-products of cattle, goats, hogs, horses and sheep.

The Secretary of Agriculture has certified that this pesticide chemical is useful for the purpose for which the tolerances are established, "the Register reports. "Based on consideration given the data submitted

... and other relevant material, the Commissioner of Food and Drugs concludes that the tolerances established by this order will protect the public health." These tolerances were reported in Volume 34, No. 85, (p. 7279) in the May 3, 1969 issue of the Register. The new tolerances are added to the lengthy list of agricultural commodities already established. The previous lists also appear in this issue. Reprints of the page are available from Pyrethrum Information Center, Suite 423, 744 Broad Street, Newark, N. J. 07102.

ILLINOIS COMPLETES TWO POULTRY INSPECTION AGREEMENTS WITH USDA

The U. S. Department of Agriculture has announced that it has completed two cooperative agreements with Illinois which will provide the basis for establishing a strong Federal-State poultry inspection program in the State. The agreements, signed by both Illinois and USDA's Consumer and Marketing Service, will help the State in implementing inspection programs under the Wholesale Poultry Products Act and the Talmadge-Aiken Act. Under the Wholesale Poultry Products Act agreement, Illinois is eligible for Federal funds covering up to 50 percent of the cost of developing and operating the State's inspection program. Illinois is also eligible for technical assistance provided by C&MS inspection personnel. Plants slaughtering and processing poultry products for sale across State lines or in foreign commerce will continue to be Federally inspected.

The Wholesome Poultry Products Act applies a uniform standard of wholesomeness to all poultry, whether State or Federally inspected. Each state has until August 1970 or August 1971, if significant progress is being made, to establish a poultry inspection program at least equal to the Federal program.

Before the agreement was completed, Illinois' inspection procedures and poultry plants were surveyed by joint Federal-State survey teams to determine the extent of the State's program, any needed improvements and estimated costs for improving it. Illinois provided C&MS with plans detailing how the State intends to improve its inspection programs.

The Talmadge-Aiken agreement provides for licensing State poultry inspectors to conduct Federal inspection in approved poultry packing and processing plants. USDA and Illinois will share the cost of the program.

Before being granted inspection, each individual plant must be surveyed and approved jointly by Federal and State officials. Plants inspected under the Talmadge-Aiken agreement will be eligible to ship across State lines.

Besides Illinois, eight other States have completed Wholesome Poultry Products Act agreements. Illinois is the seventh State to complete the Talmadge-Aiken poultry agreement with USDA.

AUTOMOBILE EXHAUST GAS ANALYZER TO HELP CONTROL AIR POLLUTION

A major step forward in the program to regulate air pollution has been taken with the introduction of a Carbon Monoxide Analyzer by Marquette Corporation, St. Paul, Minnesota. The unit will make possible periodic testing of the amount of the deadly gas present in automobile exhaust emissions.

The unit was unveiled for the first time on June 12 before the Technical Advisory Committee of the State of California Air Resources Board, and it will be marketed nationally beginning in September. Its price will be within the range of every service station, and it can be easily operated by any station employee.

Federal regulations specify the maximum amount of carbon monoxide that may be emitted into the air, however, there is no practical way of determining if a car is meeting regulations. Present methods of testing carbon monoxide content of exhaust gases requires a complicated instrument costing many thousand dollars and taking several hours to test. Thus, it has been impractical and far too costly for periodic measurement of carbon monoxide.

DFISA TO PROVIDE STAFF SERVICES TO NAFDEM

John E. Greb, President of the National Association of Food and Dairy Equipment Manufacturers, has announced signing an agreement under which the Dairy and Food Industries Supply Association will provide specified staff services to NAFDEM members when John Marshall, who has served as NAFDEM Executive Vice President for 18 years, retires on September 30. Mr. and Mrs. Marshall will continue to reside at 5304 Albermarle Street N.W., Washington, D.C.

Under the new arrangement, monthly statistical reports and annual meeting planning are two of the services that the DFISA staff will provide. NAFDEM will retain its identity and autonomy. It will continue to have its own Board of Directors and officers, and to establish its own programs. The DFISA staff will merely perform the functions requested

by the NAFDEM officials. The new NAFDEM address will be 1145 Nineteenth Street N.W., Washington, D.C. 20036. Telephone: 202-338-6470.

NAFDEM members manufacture food processing equipment, with special interest in dairy items. All but three of the current NAFDEM members are also members of the Dairy and Food Industries Supply Association, which includes not only equipment manufacturers in its membership, but also manufacturers of all other items required in the processing of food.

Transfer of records and services will be made during the weeks preceding Mr. Marshall's retirement so that the DFISA staff will be performing all functions by October 1. By that date the monthly statistical reports will be published from the DFISA office and the DFISA staff will handle final details in connection with the NAFDEM meeting scheduled for Lake Lawn Lodge, Delavan, Wisconsin, October 7, 8, and 9.

BOOK REVIEW

Agricultural Sciences and the World Food Supply

The Agricultural University of Wageningen in the Netherlands commemorated the fiftieth anniversary of its founding by sponsoring an international symposium on "Agricultural Sciences and the World Food Supply." Proceedings of the symposium, which was held March 4 to 6, 1968, have recently appeared in the form of a book containing 111 pages and bearing the name of the symposium.

Five papers given at the symposium make up most of the book. The remainder of the volume consists of a preface, the opening address, and discussion which followed presentation of each paper. The papers are: "World Population, Food Demand, and Agricultural Sciences During the Last Fifty Years" by E. DeVries, University of Pittsburgh; "Plant Production" by C. T. DeWit, Agricultural University, Wageningen; "Animal Production" by H. P. Donald, Animal Breeding Research Organization, Edinburgh; "Conservation and Technological Production" by H. A. B. Parpia, Central Food Technological Research Institute, Mysore; and "The Future of Farming and Food" by P. L. Yates, FAO-UN, Geneva.

Although some of the information given in this volume has been said by others, most of the papers address themselves to some problems which are often overlooked when world food needs are considered.

Food scientists and others who are concerned with providing an adequate diet for the underfed and undernourished populations in some parts of the world will find the book to be useful. Persons interested

in obtaining a copy should request it from: Dr. S. J. Wellensiek, The Agricultural University of Wageningen, Wageningen, The Netherlands.

E. H. MARTH

CONDITIONING AND ANTI-STALING COMBINED IN NEW PRODUCT FOR BAKING INDUSTRY

A new product for the baking industry that combines both dough conditioning and anti-staling properties is now being introduced by Atlas Chemical Industries, Inc. Trademarked TANDEM 8, it is permitted in bread under the Federal standards of identity, and its components conform to Food Chemicals Codex specifications. The baker now gets all the dough conditioning and softness retention he needs with a single product. Bakers can now save as much as 20% to 30% on their costs of buying a dough conditioner and an antistalant separately. They'll also save on handling and storage because there is only one product to handle instead of two. Other benefits claimed for TANDEM 8 include less proof time, greater through-put with less electrical power consumption, better oven-spring, and improved machinability with faster cleanup.

USDA MAN SEES TREND TOWARD COST SHARING BY WASTE DISCHARGER

The costs of combating pollutants affecting water quality of streams and lakes may have to be paid by waste dischargers themselves in the future, according to a U. S. Department of Agriculture engineer at the national convention of the American Society of Agricultural Engineers at Purdue University.

Paul E. Schleusener, who is on leave from the USDA's Cooperative State Research Service as acting assistant research director of the N. Y. State College of Agriculture, Cornell, predicted that certain segments of the agricultural industry may be among the first to be expected to pay such costs.

Pointing to the trend toward the possibility of levying what he called "effluent charges" on agricultural production and food processing industries, the USDA engineer said that such charges may be made on the basis of the volume of waste water discharged and the amount of specific pollutants such as nitrogen and phosphorous, among other contaminants. He cited Long Island as a good example. Duck growers there are organized in such a way that they all share in the cost of a water quality measurement laboratory in close cooperation with government regulatory agencies. This combined effort appears to be the beginning of many more such cooperative efforts. Other portions of our agricultural industry in

various parts of the nation must work together in a similar manner. Schleusener pointed out that national policy has made a significant change "from how much waste we can discharge into a stream to how much waste we can keep out of the stream."

"Thus the burden of pollution control or waste quality control is being placed on the discharger," he noted. "The emphasis is on the source of the problem rather than the problem after it has developed."

Discussing a whole range of pollutants including radioactive materials, microorganisms, and heat from nuclear power plants, the speaker said that standards for water quality are extremely difficult to establish and enforce because each user of water affected has different quality requirements.

"Water quality management increases in complexity for a given source of water because multiple uses are made of water," he pointed out. "Many of these uses are conflicting from the standpoint of water quality." In many states, water quality standards have already been established without giving full consideration to the costs involved in pollution abatement. Some forms of pollution present such complex problems that it may not be possible for the industries affected to comply with the established standards.

Both the social costs and benefits of pollution abatement need to be taken into consideration when water quality standards are being developed. If it is not economical for persons or businesses to comply with the standards, either the standards must be modified or special institutional arrangements must be created.

COURSE IN LABORATORY ANALYSIS OF MILK AND MILK PRODUCTS October 20-24, 1969

This course is designed to provide laboratory training for technicians engaged in evaluating the sanitary quality of milk or milk products.

Emphasis will be placed on laboratory technique in carrying out the microbiological and chemical tests outlined in *Standard Methods for the Examination of Dairy Products*. The principles underlying the methodology will be presented in lectures which, with the laboratory work, will provide the trainee with a thorough understanding of the procedures routinely employed in the laboratory. Special emphasis will be given to the proper interpretation of data.

Subjects include: Sampling procedures, Standard plate count on fluid and dry milk, Enumeration and detection of coliforms, Plate loop count, Screening tests for abnormal milk, Direct microscopic somatic

cell count, Detection of inhibitors, Suitability of distilled water, Bacteriological examination of equipment. Theory and application of the phosphatase test including reactivation, Split sample analysis and statistical interpretation. Mail applications to: Chief, Milk & Food Protection Training, Training Institute, Food & Drug Administration, 550 Main Street, Cincinnati, Ohio 45202.

COURSE IN ADMINISTRATION IN COMMUNICABLE DISEASE CONTROL

The National Communicable Disease Center announces the presentation of Course No. 3240-G, *Administration in Communicable Disease Control*, at Atlanta, Georgia, November 17-21, 1969. This course is intended for public health personnel who either have administrative responsibilities or expect to undertake such responsibilities.

The purpose of this course is to provide enrollees with immediately useful information and practice in administrative functions basic to planning, staffing, managing and evaluating health department programs for the control of communicable disease.

For further information write: Director, Training Program, National Communicable Disease Center, Public Health Service, Atlanta, Georgia 30333.

DAIRY PROCESSORS CONFERENCE

The Department of Dairy Science will offer a one week conference for milk processors for October 6-10, 1969. This is a *REPEAT* of one given in February at which pre-registration exceeded the available facilities. This course will be given at Borland Laboratory, University Park, Pennsylvania. The agenda will cover the following: 1. Processing and marketing trends; 2. Processing fluid milk products; 3. Cleaning and sanitizing dairy equipment; 4. Factors affecting the quality and shelf life of fluid milk products; 5. Off flavors of fluid milk products and 6. A field trip to nearby fluid milk plants. This conference is specifically designed for dairy plant processing personnel. The fee for the conference will be \$20.

SHORT COURSE IN PRINCIPLES OF ACCIDENTAL INJURY CONTROL

The Training Institute, Environmental Control Administration, Consumer Protection and Environmental Health Service, Public Health Service, Department of Health, Education, and Welfare and the Injury Control Branch, Bureau of Community Environmental Management is presenting the short course entitled "Principles of Accidental Injury Control." The

course location is Reno, Nevada, October 20-24, 1969.

Applications for the course may be forwarded to the Injury Control Representative, Public Health Service, Regional Offices VIII and IX, Denver, Colorado and San Francisco, California respectively. Applications may also be forwarded to the Director, Training Institute, Environmental Control Administration, Cincinnati, Ohio 45202.

The course is designed to furnish the public health educator, officer, nurse, sanitarian and other interested persons the basic concepts relating to the accidental injury problem in general. Combined with this the trainee becomes aware of appropriate administrative and program planning techniques which may be utilized to achieve predetermined objectives.

A diverse array of subject matter is included on the course agenda. These include the epidemiological aspects, human behavioral relationships, the safe practices concerning electricity and fire, recreational safety, and the safety problems associated with various types of power and equipment.

Further, information relating to the safety in hospitals, nursing homes and schools is to be covered. The subjects of program planning and development, community resources and relationships between local, state and federal governments are explored. Techniques used for generating community support are to be included as well.

A particular feature is the solution of a course problem.

The course offers "hands-on" experiences for the trainees. This is provided by assigning trainees to develop a scheme for initiating injury control activities within the program of an existing agency. This will be done as sub-group projects. Added to this is the opportunity to develop basic skills in the use of the electric shock and burn demonstration kits. These devices have proven to be very popular training devices.

REPORT OF COMMITTEE

(Continued from Page 333)

cause(s) for the abnormal milk has been corrected, within one week an inspection shall be made and a sample collected. If the results of the farm inspection and the sample analysis indicate that there is no longer a violation of item 1r, the permit shall be reinstated.

The above material is the recommended revision of section IV of the Public Health Service "Guidelines for the Control of Abnormal Milk." When the revised paragraphs "B" and "C" become effective, references to the dates July 1, 1967, and July 1, 1968, will no longer be significant and should be deleted.

Acceptance of the Public Health Service Guidelines as modified by the IMS Committee on Abnormal Milk Control will result in the following changes in the program approved by the IMS Conference at Miami in April 1967:

Phase I—No change except the requirement that the milk producer shall be notified of all test results has been omitted in the Guidelines.

Phase II—The farm inspection requirement after the second consecutive high count has been changed to a farm inspection after the second high count within any consecutive 6 months.

The PHS Guidelines require a confirmatory count in Phase II when the screening test indicates a count in excess of 1,500,000 cells per ml. The program approved at the Miami IMS Conference required the confirmatory count only in Phase III.

Specific requirements have been omitted with reference to the advice the milk producer is to obtain in the event of high counts. The Miami agreement calls for analysis by a milking equipment serviceman and herd examination by a veterinarian. The Guidelines call for the dairyman to obtain expert advice for the correction of his problem.

Phase III—The Guidelines do not require punitive action at this time. The proposed revision is a recommendation to the Public Health Service on the additions needed to provide for suspension and reinstatement of permits.

Committee on Abnormal Milk Control

J. C. Flake, Chairman, William L. Arledge, A. Richard Brazis, W. I. Carr, John W. Dean, Carrol E. Despain, David A. Hill, Richard M. Hoyt, D. E. Jasper, William L. Lovell, Carl D. Olsen, Roy T. Olson, H. E. Randolph, R. B. Read, Jr., W. D. Schultze.

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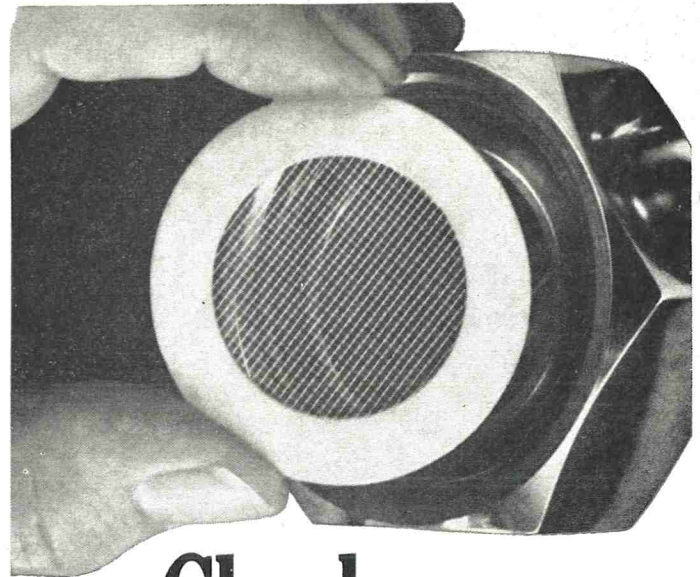
Single Service milk sample tubes. For further information and a catalogue please write, Dairy Technology Inc., P.O. Box 101, Eugene, Oregon 97401.

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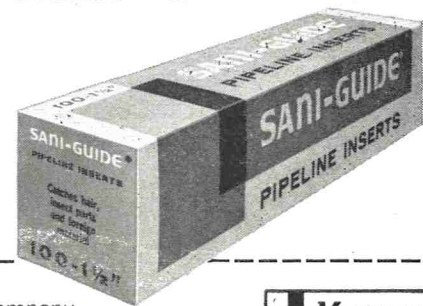
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 Difco Laboratories ----- Inside Front Cover
 IAMFES, Inc. ----- II, IV
 Pennwalt Corporation ----- Inside Back Cover
 The Haynes Mfg. Co. ----- I
 The Kendall Co. ----- Page 338



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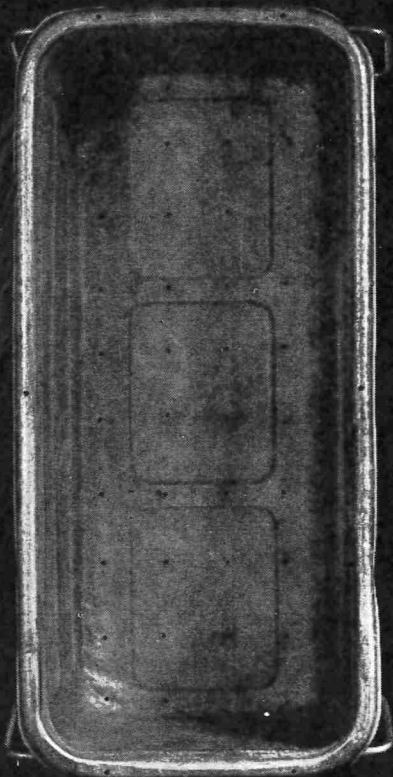
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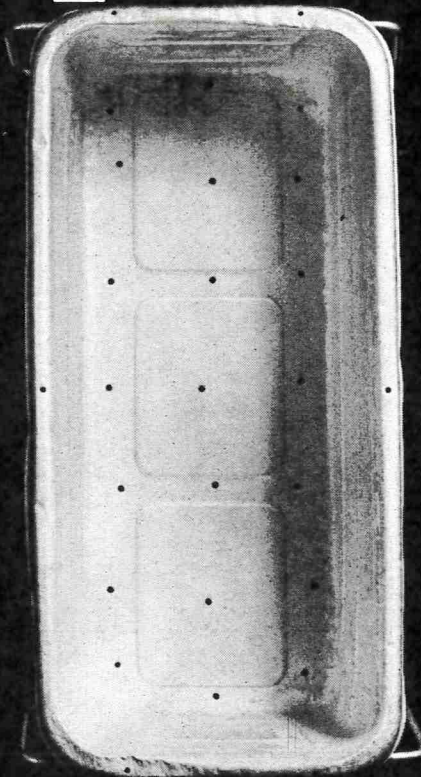
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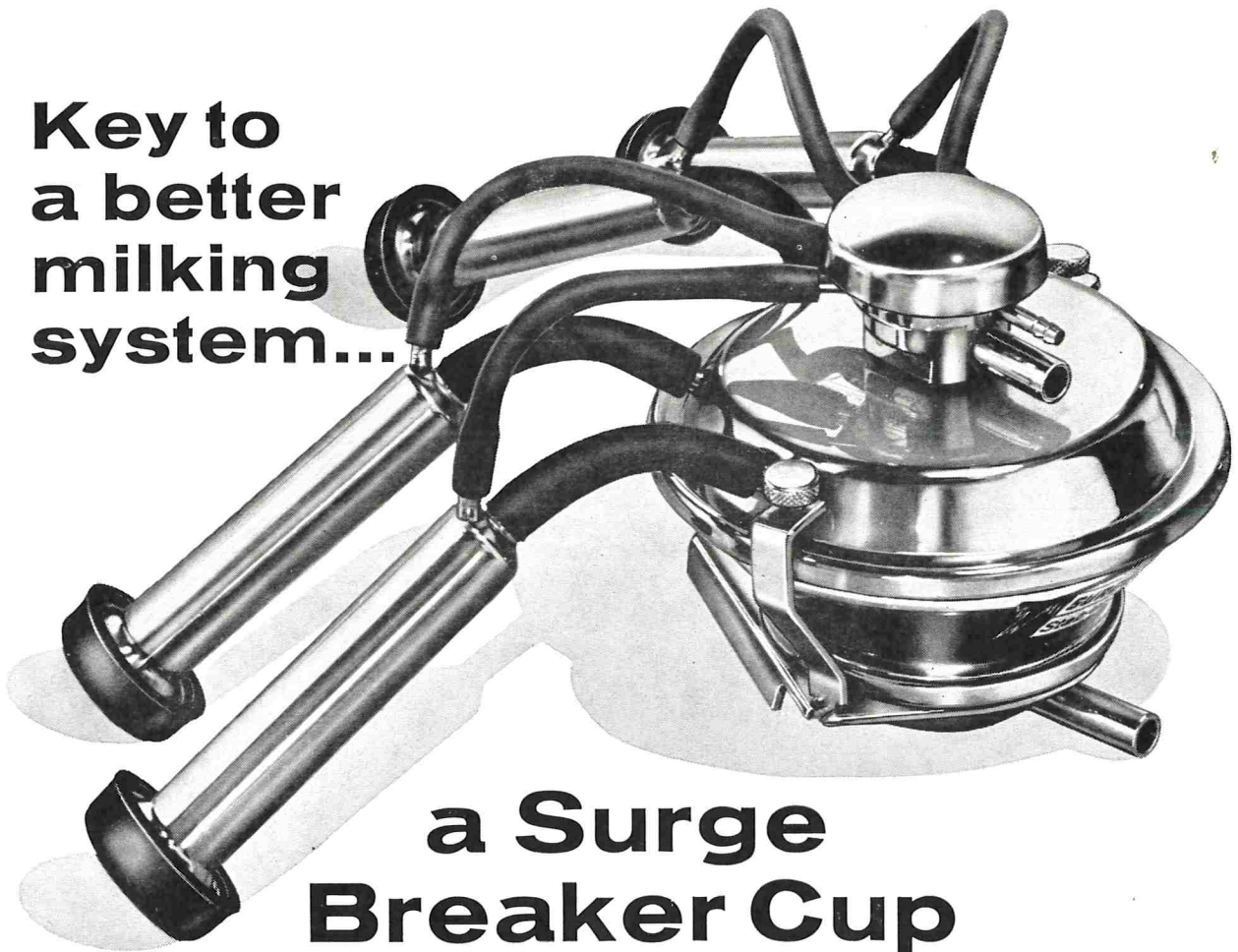
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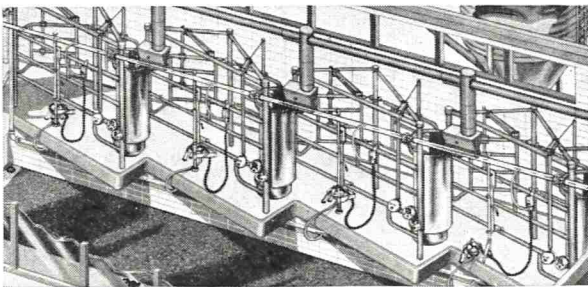


a Surge Breaker Cup

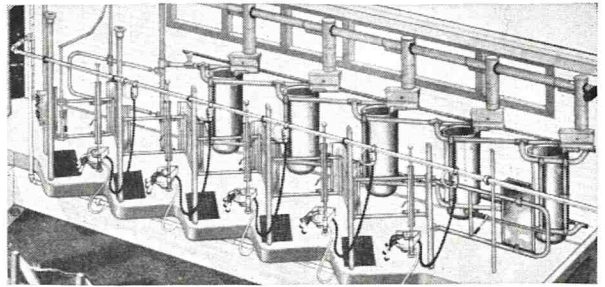
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