Agricultural Extension Service University of California

INFORMATION APPLICATION

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DAIRY INDUSTRY CONVEYOR

No. 6 March 1970

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INTRODUCTION

This newsletter is particularly prepared for the California dairy processing industry by John C. Bruhn, Extension Food Technologist (Dairy Products). It is sent to you as a service of the Agricultural Extension Service, an educational agency of the University of California and the United States Department of Agriculture. Also working with the California food processing industry, we have Extension Food Technologists: A. W. Brant (Animal Products); Robert C. Pearl (Plant Products); and George K. York (Microbiology, Sanitation & Waste Disposal). They are also located with the Department of Food Science and Technology, Davis. Please feel free to call on us. Agricultural Extension Service representatives stationed in 56 counties of California are known as farm and home advisors. Their offices are usually located in the county seat. They will be happy to provide you with information in their fields.

1970 DAIRY INDUSTRY CONFERENCE

Mark your calendar and plan to attend the 50th California Dairy Industry Conference, March 24, 25, and 26, 1970, University of California, Davis campus. An outstanding array of speakers has been lined up and there should be something for everyone in the dairy and food industries. The program is presented on the last two pages. We'll see you in Davis at the Conference.

CONTINUOUS DRYING OF WHOLE MILK SCALED FOR COMMERCIAL USE

A plant designed to produce 15 million quart-equivalent of a dried whole milk powder per year has been reported by USDA workers.

This new process consists of evaporating pasteurized whole milk (butterfat, 3.37%; solids-not-fat, 8.75%; total solids, 12.12%) to a concentrate, dispersing nitrogen gas into it and drying it continuously as a foam in a vacuum chamber. The product will reconstitute to one quart of milk containing 3.25% butterfat, 8.45% solids-not-fat and 11.70% total solids. The reconstituted product has excellent flavor, ready dispersibility in cold

water, and long storage life under refrigeration.

In the process, milk is pasteurized by the usual HTST method, except that it is done in two stages. After cooling, the pasteurized milk is raised to 135°F in a preheater and concentrated under vacuum to 45% solids in a mechanically agitated thin-film evaporator. After cooling the concentrate to about 55°F, a metered quantity of nitrogen gas, about 20% of the fluid volume, is added and dispersed into the concentrate as fine bubbles by means of a scraped surface gas dispersing unit.

After reduction of temperature to 32°-48°F, the product is dried at a pressure of 19mm mercury absolute to about 4% moisture.

The product is collected in receivers maintained at the same pressure as the drier. When one receiver is full, product collection is switched to a second receiver. The filled receiver is then brought up to atmospheric pressure by nitrogen gas and the product drops through a valve in the bottom onto a screw conveyor which transfers it to storage hoppers.

In the canning operation, empty cans and lids are fed into the canning line enclosure through a system of feed chutes which are also purged of air. Powder is fed from the hoppers to the enclosed canning line, where it is filled in No. 10 cans and sealed. Filled cans go out through an air lock to refrigerated storage.

Before beginning a day's run, the conveying system, hoppers and the enclosed canning line are purged with carbon dioxide and then with nitrogen to remove all oxygen. The powder will develop an oxidized flavor if exposed to oxygen.

A list of the equipment required and its cost, the estimated capital investment required and estimated manufacturing costs are given.*

*Turkot, V. A., N. C. Aceto, E. F. Schoppet and J. C. Craig, Jr. Food Engineering, Vol. 41, Aug., 1969, p. 59.

ULTRA-HIGH-TEMPERATURE MILK PROCESSING

In 1968, the U.S. Public Health Service established standards for ultra-high temperature (UHT) pasteurized milk in which the minimum heating conditions between 191°F for 1 second and 212°F for 0.01 seconds were established.

In California, no holding time is required in the pasteurization of milk or milk products if the temperature of pasteurization in approved high-temperature short-time equipment is at least 192°F and 194° for the vacreator. Milk and milk products pasteurized by the Roswell process shall be heated to 200°F and held at that temperature for a minimum of three seconds.

In Ohio the following times and temperatures have been approved for UHT pasteurization (Lindamood):

191°F - for 1.0 seconds
194°F - for 0.5 seconds
201°F - for 0.1 seconds
204°F - for 0.05 seconds
212°F - for 0.01 seconds

A safety factor has been built into the pasteurized standards. For example, a temperature of 191°F for 1.0 seconds is equivalent to 161°F for about 1,000 seconds, as compared to the minimum requirement for milk of 161°F for 15 seconds.

These minimum UHT conditions will not result in a sterile product. However, UHT processing in the United States when a commercially sterile product is desired undoubtedly means that a processing temperature between 266°F and 300°F with a holding time at least 1 second will be used, followed by aseptically putting the product into its package.

In Europe, UHT processing of milk is aimed at producing a commercially sterile product by heating it to at least 266°F with at least 1 to 2 seconds holding time.

For the remainder of this review, UHT processing implies a processing temperature between 266-300°F with a holding

time of at least one second. The milk so produced is then aseptically filled with no further in-container sterilization.

Types of Heat Exchangers

The heat exchangers are of two basic types: direct and indirect heating. With the direct heat process the milk is usually first heated indirectly with a plate or tubular heat exchanger and then is mixed with saturated steam under pressure. Steam may be either injected into the milk or the milk may be sprayed into an atmosphere of steam. In either case, the milk is cooled after a short steam exposure by injection into a vacuum system.

The vacuum is controlled so that water added to the milk during the steam injection phase is removed as vapor in the vacuum system. During the evaporation of the vapor, the milk is cooled rapidly to a temperature near that which it had before mixing with steam. The steam which is to be mixed with the milk must be of high quality - culinary steam - and contain no compounds resulting from the boiler feedwater treatment.

With indirect heated system, the milk is heated via a stainless steel barrier which separates the milk from the heating medium. The heat exchange surface may be a corrugated plate, as in many HTST systems, or a tubular system, or a scraped-surface type in which the product flows through an ice cream-like cylinder. The cylinder is heated externally by steam, and the inside wall of the cylinder is scraped by continuously rotating blades. This latter scraped surface system is used primarily for relatively viscous products where turbulence would be hard to obtain.

Bacteriological Effects

All vegetative organisms will be destroyed by the UHT heat treatment as well as the less heat-resistant spores, such as those of most strains of Bacillus cereus. Only the heat-resistant spores of bacteria such as Bacillus subtilis and Bacillus stearothermophilus are of concern in UHT processed milk. Generally, there are only a few of these resistant spores present in the raw milk.

The heat-shock given the spores during UHT treatment may activate them. If so, the spores will germinate more readily in UHT treated products than in products which have received a regular pasteurization treatment. Recent findings have shown that some sporeforming bacteria in raw milk are psychrophilic and will grow at refrigerator temperatures. Thus, some sporeforming bacteria may present a potential problem to the keeping properties of UHT treated products.

Chemical and Biochemical Effects

Vitamins. UHT processing has little effect on the fat-soluble Vitamins A, D and carotene. Pantothenic acid, nicotinic acid and biotin also are not affected by UHT processing followed by storage up to 180 days at room temperature. Some loss (up to 20%) is reported in thiamin content after UHT treatment of the milk. Riboflavin (B_2) proved to be very stable to the heat treatment with less than 10% loss reported by several researchers. Generally, negligible losses in Vitamin B_6 have been reported but some variable loss results in storage. Considerable variation in results are reported for ascorbic acid (C), folic acid and Vitamin B_{12}. The situation is further complicated by the influence of changes in ascorbic acid on the losses of the latter two vitamins.

Mineral availability. There appears to be no loss in the nutritional availability of calcium of milk after processing by UHT.

Proteins and nutritive value. Considerable denaturation of the serum proteins of milk results from the UHT treatment. One research group found between 55 to 70% denaturation of the serum proteins at 275°F. The β-lactoglobulin was particularly affected, being about 90% denatured. Direct heating systems tend to give slightly less serum denaturation (60-70%) than indirect systems (75-80%). Some modification of the casein also appears to occur.

Changes in the amino acid content seem to be negligible. The availability of the essential acids was not significantly altered by UHT processing.

Feeding experiments with rats showed negligible effects on their growth rate and reproductive performance when UHT processed milk was used in their diets. Further reports indicate that the biological value and true digestibility of the milk proteins were unaffected by the heat treatment.

It is, therefore, very unlikely that the denaturation of the serum proteins is important in human infant nutrition, and UHT processed milk has been used for infant diets in Europe with satisfactory results.

Phosphatase Reactivation. UHT treatment of fluid milk products will expose active sulfur (sulfhydryl) compounds in the products, which may cause the reactivation of the phosphatase enzyme during subsequent storage of the products. To insure a reliable phosphatase test, the following precautions of sampling and sample handling should be taken: (a) products for testing should be obtained directly from the processing line and not from stored products, (b) the product should be cooled to and maintained at 40°F or below until tested, and (c) the test should be completed within 24 hours after sampling.

A test, which utilizes the increased sensitivity of reactivatable phosphatase to magnesium, has been developed to differentiate between the native phosphatase in improperly pasteurized products and the reactivated phosphatase in properly heat-treated UHT pasteurized products.

Change in Freezing Point Depression. Indirect UHT treatment causes no effect on the freezing point of milk. However, an increase has been noted by researchers after vacuum pasteurization and after Uperisation at 302°F. Removal of the dissolved gases by these processes may influence the freezing point.

Homogenization effect. UHT heating methods reduce the fat globule size and cause homogenization effect.

Organoleptic Properties

Color. UHT milk has been observed to be whiter than the corresponding raw milk, due to the heat denaturation of the soluble proteins.

Texture. UHT milk seems to have a chalky texture which has been attributed to fat-casein complexing, but could be alleviated by homogenization after heat treatment.

Flavor. The flavor of UHT milk is sometimes considered poor the first day or two after processing but it improves to an optimum between one and two weeks. After this stage there appears to be a slow decline in flavor quality which is more pronounced at higher storage temperatures.

UHT milk is sensitive to the presence of oxygen, which can result in oxidative deterioration. Aluminum lined containers help alleviate this problem by keeping oxygen away from the milk.

Sources:

Burton, H. 1969. Ultra-High-Temperature Processed Milk. Dairy Science Abstr. 31:287-297.

Lindamood, J. B. 1969. Ultra-High-Temperature Pasteurization. Timely Tips, March, 1969.

NEW BOOKS

Microbiological Procedures for the Diagnosis of Bovine Mastitis. National Mastitis Council, Inc., 1969.

Recognizing the need for more uniform procedures for the microbiological diagnosis of bovine mastitis, the officers of the National Mastitis Council, through its Research Committee sponsored the preparation of this manual. The methods recommended are intended primarily for use in mastitis-control programs and represent current procedures available for the detection of various types of bovine mastitis pathogens. The manual covers the procedures for collection of milk samples, general cultural procedures and procedures for the identification of specific groups or species of mastitis microorganisms.

The manual is available at a nominal cost from the National Mastitis Council, Inc., 910 Seventeenth Street, N.W., Washington, D.C. 20006.

1968 Annual Compilation of Selected United States Government Publications.

This is available from: Documents Index, Box 195, McLean, Virginia 22101. This compilation gives all of the biweekly Government Printing Office announcements of new and popular U.S. Government publications. The volume contains an agency index, a title index to both individual and series publications, and a detailed subject index.

Packaging Wastes Conference Proceedings.

Published proceedings of the first national Conference of Packaging Wastes have just become available from The Packaging Program, Food Protection and Toxicology Center, University of California, Davis, California 95616. The conference was held in San Francisco, on September 22-24. The price of the proceedings is $5.00. Checks may be made payable to: The Regents, University of California.

New Book on Milk and Other Proteins.

A new book that devotes several chapters to milk proteins has been published by two members of the Department of Food Science and Technology, University of California at Davis. The book is "Evolutionary Biochemistry of Proteins. Homologous and Analogous Proteins from Avian Egg Whites, Blood Sera, Milk, and Other Substances.", published by Inter-science Wiley (1969). Professor Robert E. Feeney and Dr. Richard G. Allison, former graduate student in the department, are the authors.

This book traces and discusses the interesting and unique relationships between the proteins of mammalian milk, blood serum, and avian egg white. In the preface, the authors write the following: "An additional hope is that the molecular interrelationships described in this book will help to show the interrelationships between different scientific disciplines and between organizational units of the scientific community. Perhaps we can help those in Medical, Agricultural, and Liberal Arts Schools to see the common interests and goals in their respective scientific departments."

WHAT'S BEING PUBLISHED

Interested in keeping informed about recent and new books published for the dairy and food industries? The publishers listed are only four of a number that would send you a list of their books.

Academic Press
111 Fifth Avenue
New York, New York 10003

Dairy Training and Merchandising Institute
910 Seventeenth Street, N.W.
Washington, D.C. 20006

AVI Publishing Company
P.O. Box 670
Westport, Connecticut 06880

Miller Publishing Company
P.O. Box 67
Minneapolis, Minnesota 55440

FOOD ENZYME SHORT COURSE

John R. Whitaker, Professor in the Department of Food Science and Technology, will be the instructor for a 10 day short course scheduled for June 15-19, June 22-26. This course, aimed at food industry personnel, will cover the fundamentals of enzymology and the enzymology of foods.

The mornings will be devoted to lectures and discussions, while in the afternoon students will have the chance to explore the concepts of enzymology in the laboratory. The course will include: introduction and history of enzymology; structure of proteins; physical chemistry of enzymes; nature and role of cofactors; enzyme inhibitors; classification of enzymes; and hydrolytic and oxidative enzymes.

For further information write to Dr. J.R. Whitaker, or to Dr. G.K. York, Department of Food Science and Technology, Cruess Hall, University of California, Davis, California 95616. Enrollment is limited and applications should be in early.

Prepared by: John C. Bruhn, Extension Food Technologist, Department of Food Science & Technology, Roadhouse Hall, University of California, Davis, California 95616.

1970 UNIVERSITY OF CALIFORNIA
DAIRY INDUSTRY CONFERENCE
DAVIS CAMPUS

MARCH 24-26, 1970

TUESDAY MORNING
Freeborn Hall
10-12AM

Opening Session

Welcoming Remarks - W. L. Dunkley

Fifty Years in Fifty Minutes - E. L. Jack

The Changing Agricultural Science - C. O. McCorkle

WEDNESDAY MORNING
106 Wellman Hall
9-12AM

Milk Quality

University of California Milk Quality Program - G. S. Goble

Recent Developments in Oxidized Flavor Research - W. L. Dunkley

Psychrophilic Sporeformers and Shelf Life - T. E. Shehata

Mastitis and Milk Quality in California- R. B. Bushnell

TUESDAY AFTERNOON
Freeborn Hall
2-4PM

General Session

Impact of Change on the Dairy Industry - Dee M. Graham

Potential Impact of Intentional Additives - Gaylord P. Whitlock

Impact of Present and Contemplated Pollution Legislation - J. B. Gilbert

WEDNESDAY MORNING
126 Wellman Hall
9-12AM

Economics

Growth in Capital Requirement for Dairy Enterprises - George DeMedeiros

Projections of California Agriculture: The Impact of the San Joaquin West Side Project - Gerald W. Dean

A Critical Look at California's Milk Pooling Program - Jed A. Adams

WEDNESDAY AFTERNOON
106 Wellman Hall
2-5PM

Pollution and Management of Waste Materials

Public Health Aspects of Animal Waste Disposal - W. F. Jopling

Dairy Waste Management: Farm to Home - S. A. Hart

Treatment of Liquid Wastes - E. D. Schroeder

Treatment of Dairy Products Processing Wastes - G. K. York

THURSDAY MORNING
106 Wellman Hall
9-12AM

Dairy Food Nutrition

Nutrition and You - D. Fisk

Symposium - Tailored Food Products

Panel Members: Dee M. Graham
J. L. Breeling
W. E. Speckmann
D. Fisk

WEDNESDAY AFTERNOON
126 Wellman Hall
2-5PM

Marketing Growth and Development

The European Economic Community: Is It Becoming a Closed Market? - T. Oyleo

Competition from Milk Substitutes: A Progress Report - Alex F. McCalla and Ralph Hanan

Milk Products: Their Place in Feeding the Undernourished - Gaylord P. Whitlock

Goals and Method of Implementation of California's Dairy Products Promotion Program - John M. Shea

THURSDAY MORNING
126 Wellman Hall
9-12AM

Instrumentation and the Dairy Industry

Instrumentation: An Overview - W. L. Dunkley

A Fully Automated System for Milk Analysis - Fred A. Potoff and Frank LaPerch

The Infrared Milk Analyzer - Stan Salsbury

Description of Status of the Milko Tester - R. J. Rutgerson

Recent Advances in Automated Detection of Microorganisms - R. C. Wade

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CONFERENCE NOTES

In conjunction with the University Conference, the California Dairy Industries Association milk and ice cream judging activity is scheduled for the afternoon of March 24. There will also be luncheons on Tuesday and Wednesday with a Dairy Industry Banquet scheduled for the evening of March 25. Printed programs will be available at the registration desks. Registration is $7.00. No pre-registration necessary.