

June, 1981
Vol. 1, No. 6
Pages 225-268
ISSN: 0273-2866
Box 701
Ames, Iowa 50010

University Microfilms, Inc.
300 N. Zeeb Road
Ann Arbor, MI 48106

Dairy and Food Sanitation

A Publication for Sanitarians and Fieldmen

- A Local Community's Approach to Inland Shellfish Sanitation
- Microbiological Tests for Evaluation of Dairy Products
- Prevention of Contamination in Cheese Bulk Cultures
- Getting Good Preliminary Incubation Counts
- Danger Lurks Among the Molds



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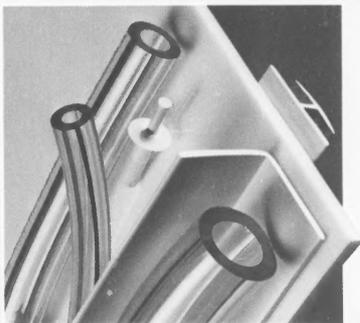
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Dairy and Food Sanitation is issued monthly and published by the International Association of Milk, Food and Environmental Sanitarians, Inc., executive offices at 413 Kellogg, PO Box 701, Ames, IA 50010. Printed by Heuse Printing and Signs, Inc, 911 Second St, Ames, IA 50010.

Manuscripts: Correspondence regarding manuscripts and other reading material should be addressed to Jan Richards, PO Box 701, Ames, IA 50010, 515-232-6699. "Instructions to Contributors" can be obtained from the editor.

Orders for Reprints: All orders should be sent to

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Business Matters: Correspondence regarding business matters should be addressed to Earl O. Wright, IAMFES, PO Box 701, Ames, IA 50010.

Subscription Rates: \$50.00 per volume, one volume per year, January through December. Single copies \$4.50 each.

Membership Dues: Membership in the Association is available to individuals only. Direct dues are \$25.00 per year and include a subscription to either **Dairy and**

Food Sanitation or the **Journal of Food Protection**. Direct dues and both journals are \$40.00. Affiliate membership are \$22.00 per year, plus state dues, and include a subscription, also. Affiliate dues and both journals are \$37.00, plus state dues. Student membership is \$7.50 per year, with verification of student status, and includes one journal.

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Shellfish are a unique food item in the American society because they are usually eaten raw or partially cooked, and the entire animal, including the gastrointestinal tract, is consumed.

The inland consumer of shellfish may not be aware that the nation's shellfish industries estimated value of oysters, clams and mussels, before reaching the retailer, is several hundred million dollars a year.

Although the nation's shellfish supply is rigorously monitored, additional safeguards for the sanitation and safe consumption of shellfish shipped inland are needed.

The information herein has been extracted from the Shellfish Sanitation Program of Springfield, Missouri, during its continuing efforts to establish sound criteria for the development of sanitation requirements and inspection procedures for an effective Inland Shellfish Sanitation Program.

"Shellfish." It's a term that implies a wide variety of marine species, and includes any edible, commercially distributed member of the animal kingdom classed under mollusks. This paper will limit the definitions to those bivalved mollusks that are filter feeders and are commonly eaten whole in the living state, such as oysters, mussels and clams.

Shellfish shipped inland to Springfield, Missouri have primarily been flown to restaurants and retail grocery stores. Seafood trucks also began transporting frozen seafoods and some fresh oysters to the area from the Gulf Coast about five or six years ago. Many of these outlets also sell shrimp, crab, lobster and fish.

Organoleptic methods are commonly used to deter-

A LOCAL COMMUNITY'S APPROACH TO INLAND SHELLFISH SANITATION

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mine the freshness or composition of fresh or frozen fish products. However, because of the biology and ecology of shellfish and the practice of eating them raw, particularly the oysters, sanitary controls over production and processing are necessary to ensure that the products will be safe.

Due to the possible risks involved with consumption of shellfish, this article, although it will not exclude crustacea and fish, will primarily deal with the Springfield Health Department's criteria for regulating shellfish shipped inland, and more specifically, storage and handling of oysters.

FOODBORNE ILLNESS ATTRIBUTED TO SHELLFISH

In order to develop sound rationale for a shellfish sanitation program and sanitation inspection procedures, it is important to know the biological and

ecological characteristics of shellfish, as well as the potential health hazards associated with these characteristics.

Shellfish are bivalve mollusks, filter feeders which obtain nourishment from microorganisms living in the water. They do this by pumping large volumes of water across their gills each day. Depending upon the species, this may be as much as 210 to 300 gallons of water per day². A number of species of bivalves, including the sea clam and sea mussels, live in shallow, brackish water along coastal areas. The Eastern oyster thrives best in sea water where water is diluted by fresh water streams. These streams may be contaminated with sewage, agricultural run-offs, municipal discharges, and suburban home drainage.

Unable to distinguish between pathogens and non-pathogens, oysters may concentrate pathogenic organisms in higher levels than are found in surrounding waters. Thus, without rigorous monitoring of waters where shellfish feed, or through improper handling and storage after harvesting and shipping inland, there are potential hazards of foodborne illness and other diseases. Thus, to prevent shellfish-borne illness, control agencies must classify and monitor shellfish growing areas and apply strict sanitary controls on harvesting, processing and shipping procedures.

Shellfish are a unique food item in society in that the whole animal, including the gastrointestinal tract, is often consumed raw or partially cooked. There are a number of infectious diseases and biointoxications transmitted by the raw or improperly cooked shellfish. For example, paralytic shellfish poison is heat stable and will not be destroyed by the usual cooking procedures.

These diseases and biointoxications are divided into two general categories. The first includes infectious diseases caused by a large variety of bacteria, viral, protozoan, and multi-cellular parasitic agents with the etiological agent being human and lower animal fecal wastes.

There are three diseases associated with the first group, which are infectious hepatitis, salmonellosis (including typhoid and paratyphoid fever) and gastroenteritis of unknown etiology. These diseases account for most of the shellfish associated outbreaks of enteric disease in the United States. Typhoid and paratyphoid fever were the most commonly reported shellfish associated diseases in the United States during the first four decades of this century.³ Another enterovirus which has been known to be transmitted by shellfish is the polio virus.²

In the 1950's consumption of raw shellfish was first known to be a route for transmission for infectious hepatitis, and there were about 17 outbreaks involving some 1,339 persons in the United States.³

In a recent outbreak of some 268 cases, the oysters involved were traced to an approved harvest area in Louisiana, which earlier in the year had been closed due to pollution associated with a massive fresh water

run-off, where there were unacceptably high fecal coliform densities and low salinities.³

There have been at least 1,800 cases of gastroenteritis of unknown etiology associated with the consumption of shellfish, and no reported shellfish associated outbreaks of disease referable to the culturable enteroviruses.³

The second category of diseases or biointoxications transmitted by shellfish is responsible for the production of potent toxins. Included in this group are diseases caused by the bacteria *Vibrio parahemolyticus* and *Clostridium botulinum* and a group called "Red Tide" algae. These are largely associated with bivalved mollusks, commonly associated with crustaceae (shrimp and crabs) in the US, and cephalopods such as cuttlefish in Japan. These are not discernable by organoleptic analysis, nor will cooking destroy the poisonous toxins. *Clostridium botulinum* is more closely associated with problems in food preparation than with the marine environment.³

V. parahemolyticus resembles Salmonellosis with vomiting, abdominal cramps, diarrhea and fever. It was first described in Japan, and *V. parahemolyticus* infections accounted for most of the shellfish associated disease outbreaks from 1974 to 1978, with the exception of gastroenteritis of unknown etiology.³ Consumption of shellfish and fin fish is the only route of transmission of this disease.³ Laboratory testing for *V. parahemolyticus* is not a common occurrence and it has been suggested that this particular bacteria be considered during lab analysis of the shellfish.²

Paralytic shellfish poisoning is caused by the consumption of shellfish which have ingested "red tide" dinoflagellates. However, cases in recent years have occurred with much less frequency,³ although in 1980 there were 16 cases in New England and Michigan, and two deaths which occurred in California.

The second category of shellfish-borne diseases includes bacterial and algal agents which can be considered aquatic because they multiply in the marine environment. This differentiates them from the first category. Evidence offers little indication that the agents in the first group multiply significantly in the marine environment. This is particularly significant when considering laboratory analysis of the aquatic environment and product sampling as related to sources and transmission of disease. Thus, appropriate fecal indicators can index risk of disease for the first group, but are of little value for the second group.³

DEVELOPMENT OF SANITATION REQUIREMENTS AND INSPECTIONS PROCEDURES

The Springfield, Missouri Health Department has developed sanitation requirements and inspection procedures to regulate the storage and handling of the shellfish, and more specifically, the oyster. The rationale for the sanitation requirements and inspection procedures are based on the prevention of shellfish-borne

illness and disease. By regulating the handling and storage of shellfish when they reach the Springfield, Missouri area, a regulative extension from the coastal to the inland areas can be established to further assure safe consumption by prevention of shellfish borne illness.

SANITATION REQUIREMENTS AND INSPECTION PROCEDURES WHEN FRESH OYSTERS ARE TRANSPORTED TO A RETAIL OUTLET

Common retail outlets which handle and store shellfish in order to sell to the consumer are restaurants, grocery stores, seafood trucks, and most recently a retail seafood store was opened in the Springfield, Missouri area. All of the above mentioned retail outlets handle fresh oysters, crustaceans, fish (freshwater and marine), and other seafood products. Usually the trucks do not transport oysters inland due to the financial problems related to their short shelf life, and due to the necessity of having a separate refrigeration compartment from the freezer area.

Shucked shellfish, shellfish which have been removed from their shells, are usually flown into restaurants and grocery stores during the latter part of October or the first part of November and during the holiday season in the Springfield area.

No matter the mode of transportation inland, it is required that oysters be stored in crushed ice during shipment and when on display, and that ice be up to the level of the oysters.

Since oysters' shelf life is ten to twelve days from the day they are shucked, only five to seven days shelf life is allowed upon arrival of the oysters once the transit time is accounted for.

Oysters may not be held by the retail outlet and frozen for later sales after the shelf life has expired. Repacking is not allowed except for over-the-counter sales.

Oysters must remain in the original shipping container with the Interstate Shippers number until sold. (This number is on a list developed and sent out by the Shellfish Sanitation Branch of the United States Public Health Service, FDA, which is responsible for developing the shellfish sanitation standards. Not all states cooperate in this program.) Sometimes the oysters are shipped in consumer packs, which can be sold in a display case.

When the oysters are shipped in one container, a sanitized ladle is to be stored in the container and oysters are then sold over the counter, which does not require individually labeled containers.

When oysters are flown in, they are usually packed in gallon containers which are shipped in a cooler filled with ice.

SANITATION REQUIREMENTS AND INSPECTION PROCEDURES OF SEAFOOD TRUCKS

As previously discussed, oysters are not usually found

as one of the food items sold by seafood trucks, as they are cost prohibitive. Frozen seafood items and crustaceans are the most commonly sold products.

Owners of the seafood trucks are required to notify the Springfield Health Department when the truck is to arrive and where the operation is to be conducted.

Upon inspection, a check is made for correct temperatures. 0-5° F is preferred for a frozen product, although the Health Department will accept the product if it appears frozen and there is no evidence of ice crystallization to indicate thawing and refreezing practices. In addition, to insure proper temperature maintenance, no product may be on display, and everything must be packaged.

The product must be delivered to the customer at a proper temperature. Therefore, two practices presently being used have been accepted: (1) the product may be handed to the customer through a small door in the truck, or (2) a canvas or screen may be located between the storage area and the doors to help maintain temperatures when truck doors are being opened and closed. The doors must be closed each time a product is taken from the truck.

A great variety in structure and organization is found with the seafood trucks, but by and large most of them use freezer units, with the entire truck bed made into a total freezer unit or with individual freezer units placed inside an enclosed truck bed.

LABORATORY ANALYSIS, METHODOLOGY, AND PRODUCT SAMPLING

In the early 1970's the Springfield Health Department began participating with the FDA as an interstate shellfish receiver agency. This was for the purpose of finding out if seafood could be shipped this far inland and still be safe for consumption. At one time the Springfield, Missouri laboratory was the only certified inland laboratory.

This program was implemented after completing standardization by Shellfish Sanitation Program, FDA, Washington, D.C.

Since that time, the Shellfish Sanitation Branch has been incorporated into the New Division of Milk, Shellfish, and Foodservice where there are 3 branches: 1) Milk Safety, 2) Shellfish Sanitation, and 3) Retail Food Protection. Although these branches exist as before, they are now under a common division.

The standardization of the Springfield program involved inspection procedures, product sampling, and laboratory analytical methodology.

Results of laboratory analysis of the product sampling are forwarded to: FDA regional office in Kansas City, Missouri, FDA Shellfish Sanitation Branch, Washington, D.C., the State Regulatory Agency having jurisdiction over the origin of the product, and the plant shipping the product as identified by the Interstate

Shellfish Shipper plant identification code number. This code number originated in the Certified Shellfish shipper's list published by FDA to advise wholesale buyers of certified interstate shippers. This list goes to approximately 6,000 markets and food control officials every month and includes 1,200 to 1,500 certified shippers depending on the season.⁵ It is an essential tool for the Springfield Health Department during inspections of shellfish shipments.

If a laboratory sample is not acceptable, then a second laboratory sample is taken to see if there is a chronic occurrence or a sporadic situation. Consequently, if the laboratory sample is unacceptable a second time, the firm is notified and if a third sample is high, then the particular product shipped from this packer or repacker is not accepted into the area until the problem is solved. At that point, the state and industry get together and in some cases, the transit company is included.

The laboratory analyses that are performed on the shellfish samples when brought into the laboratory are (1) Standard Plate Count. An acceptable count is up to 500,000/gram. (2) Fecal coliform. An acceptable count is up to 230/000 grams, and (3) pH. It is found that 6.1 to 5.6 indicates fresh to stale, and 5.3 to 4.9 indicates stale to sour. Anything below 5 ph indicates advanced decomposition.¹

In the beginning it was suspected that the midwest might be a dumping ground for unacceptable oysters, but it was hoped that the development of an inland shellfish receipt and monitoring program in the area might halt such a practice.

Now that the laboratory has had the opportunity and experience in testing product samples, very few problems are being found with the fresh oyster shipments, but there are some people who feel that because of the existence of the Springfield laboratory and established requirements and inspection procedures, public awareness of necessary safeguards have been encouraged. As a result, most shellfish shipped into the area are acceptable shipments.

It has been shown that shellfish can be shipped inland and still be a safe product for consumption. However, it has been found that most of those product samples not found acceptable had not been properly iced while in transit or on display. This seems to be the major problem in inland shipment of oysters.

Regularly planned product sampling usually begins with the holiday season as more demand for inland shellfish shipments increase. Once the product sample reaches the laboratory it takes at least 5 days for the appropriate laboratory tests and results to be completed. This means that any particular oyster shipment found to be unacceptable is usually sold before the public health department can act to remove the shipment from the market. However, enforcement procedures, as described above, do go into effect immediately, so that efforts can be made to identify the source and location of the problem. With proper identification and notification,

unacceptable shipments in the future can be halted. The delay between product sampling and the laboratory's completed analysis points out a weakness in the program.

FINAL WORD

In considering laboratory analysis of product sampling and the author's research, one recommendation could be made to increase the frequency of tests for *V. parahemolyticus*. This is because *V. parahemolyticus* is a strict intestinal pathogen, which grows well in salt water, and has been widely implicated in intestinal infections.²

Basically, organoleptic methods for crustaceans and fish, are considered to be reliable indicators. However, FDA continues to search for more scientific means to detect decomposition in seafoods and reliable analytical chemical methods to supplement the organoleptic methods.⁴

The Springfield, Missouri Health Department is maintaining a direction of continued cooperation with FDA's Division of Milk, Shellfish and Food Service, as well as industry. There are presently no plans to change the inspection procedures outlined, but there is a strong awareness of the need to change and update the procedures as advances occur.

In the meantime, laboratory analyses in Springfield suggest that the locally developed criteria for Inland Shellfish Sanitation Program has been sound and relatively successful in presenting proper safeguards to assist in the safe consumption of shellfish and frozen seafood products.

ACKNOWLEDGMENT

This is in special acknowledgment of Harold Bengsch, Chief of Environmental Hygiene, George Robert Gregory, Environmental Control Specialist III, Ron Lawson, Larry Gibson, Loring Bullard, and Jim Fry, Food Control Specialists II and Larry Lambeth, Chief of Environmental Laboratories of the Springfield, Missouri Health Department, for their help and assistance in contributing to the information included in this paper.

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Insuring Food Quality by Tamper-Proof Packaging

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During the 1977 annual meeting of the American Public Health Association (APHA), the Governing Council adopted a position paper on "Tamper-Proofing Food Containers To Prevent Pre-Purchase Contamination". (1). The paper was presented by the APHA Environmental Section's Committee on Food Protection. The purpose of the paper was to encourage federal agencies, such as the USDA and FDA, to become more concerned with tamper-proofing of containers and to be more explicit in the terminology of existing regulations. This paper outlines the development and application of tamper-proofing legislation to protect the health and welfare of consumers.

It is generally agreed that the primary sources of major food poisoning bacteria, the staphylococci, streptococci, and salmonellae, are the nose, mouth, skin and feces of man and animals. It is also conceded by experts that the most common food spoilage organisms and many of the clostridia are primarily soil origin which find their way into food products via fruits, vegetables, water and dust. The food industry has the knowledge and technology to process and package food so that these pathogenic and spoilage organisms are destroyed.

Nevertheless, we must be ever aware of the fact that the majority of bacteria, molds and yeasts will multiply in an environment where adequate or optimum nutrients, moisture, pH and temperature are provided. Most of our packaged foodstuffs supply these environmental conditions. Nearly all of the food sold today, regardless of how it has been originally processed, may be subjected to post-processed contamination upon opening of the package and may support very rapid growth of airborne spoilage or human pathogenic organisms.

Food on the supermarket shelf is vulnerable to many forms of contamination from inconsiderate shoppers. The ease of opening a bottle, jar or tub is appalling. Most containers lack a tamper-proof seal or a visible indicator of tampering. Filth, foreign matter and microorganisms can readily be exposed and introduced to the pure contents. A vacuum packed product, once opened for inspection and returned to the shelf, becomes a deteriorating and possibly disease carrying foodstuff for the unwary customer. By their very nature, cultured cheese products and fresh seafoods packed in tubs deteriorate rapidly when exposed. This tampering and the resulting contamination, if allowed to continue, will escalate to dangerous proportions. Tamper-proofing is the logical extension to complete a food package and safeguard the consumer.

Tamper-proofing does not appear to be beyond present technology. Today's creativity and innovation in container design is unlimited. There are pop-top cans, squeeze bottles, tubs, tubes, blister packs, mesh bags, jars, bottles, boxes, cartons, cups,

**From paper presented at the Food Quality and Family Health Session, 107th Annual Meeting, American Public Health Association, New York, New York, November 6, 1979.*



"I wonder if this tastes better than Ragu."

and a host of other packages which transport, identify and promote a cornucopia of foodstuffs and other products. Unfortunately, too few of these containers do an adequate job of protecting their contents.

Many containers spring leaks from rough handling in transit. Others invite in-store tampering by sniffers and tasters who open a container, smell or sample the contents, then close and return the package to the shelf. Once these containers are closed it is very difficult to distinguish the jar that has been opened from the jar that has not.

Cap switching is another problem that will continue to plague us, especially during economic recession and runaway inflation. Lids from different price products are exchanged by the shopper, who gets "fancy" for the price of "plain" at the checkout counter. These incidents add up to an "epidemic" of contamination, spoilage and loss, all of which could be avoided with the use of secondary seals on food containers.

There are many ways to tamper-proof food containers: pressure-

sensitive tapes, wet bands, dry bands, aluminum twist-off caps, metal caps with tamper-proof indicators, metal lids with plastic skirts, and other film, foil, and paper closures.

An example of the later, the "innerseal", is either applied by adhesive or heat to the top of the jar or bottle when the cap is applied. Its most common use is in the instant coffee and tea industry where it has become somewhat of a standard. The consumer is so conditioned to finding an "innerseal" that it is doubtful he or she would accept a package where the seal was broken or missing. This type of seal, like others listed, indicates to the consumer that the product has not been touched since it left the packer.

The unit cost of secondary closures is often minimal! At as little as two-tenths of a cent per container, the secondary closure is a very small price to pay for reducing potential losses due to leakage, tampering, and decreased shelf life. It certainly is not too high a price to pay for consumer safety when one considers the number and variety of diseases which can be transmitted by post

processed contaminated food. This problem was made part of the Congressional Record a few years ago when a distinguished midwestern senator admonished his colleagues that laws covering interstate food shipments needed modifications to insure against tampering. His wife had purchased peanut butter at a Washington, D.C. market and found on opening it, that someone had already sampled the product. The impetus for change at that time, however, was lost with Watergate.

Precedent has already been set for federal involvement in related matters of public health. For example:

(a) The Federal Government has had food labeling standards for more than a decade. Every state in the country has its own statutes requiring that labels state clearly the amount and contents of the containers.

(b) The "Poison Prevention Packaging Act of 1970" also illustrates the initiative government will take, given the prior incentive. This Act requires that children under five years of age be protected from ingestion of many products con-

sidered hazardous to them. Among the products covered by law are aspirin and products containing aspirin, methyl salicylate, liquid furniture polish, as well as many other household products, petroleum distillates and drugs. (2)

The government is becoming increasingly involved in the purity of food products. The most significant activities here include a USDA regulation, effective December 10, 1977, which requires that "vacuum

Consumers Union in 1975 stirred more interest (5). Although the project centered around analysis of the nutritional contents of baby food, Consumers Union also reported its findings on presence of extraneous matter. Insects, insect parts, or rodent hairs were found in ten of the forty-six infant foods tested. Consumers Union suggested that insect filth may have wound up in the tested foods because of a package design deficiency: "Foreign matter

"Food on the supermarket shelf is vulnerable to many forms of contamination from inconsiderate shoppers. The ease of opening a bottle, jar or tub is appalling."

packed containers sealed with quick-twist, screw-on or snap-on lids (or closures) shall not have an annular space between the linear edge of the lid's rim (lip or skirt) and the container itself, or shall have such a space sealed in a manner that will make it inaccessible to filth and insect" (3). The regulation applies to all meat and poultry products amenable under the Meat Inspection Act and the Poultry Products Inspection Act (4). Generally, poultry products containing two percent cooked poultry meat and meat products containing three percent raw meat are considered answerable under these Acts. Although many food products are affected, including spaghetti sauce, cocktail franks, liver pate and meat noodle selections, the major product category challenged is baby food.

Work on the USDA regulation began in 1973 following publication of a consumer's alleged discovery of fly larvae in a popular baby food product. It was hypothesized that insects entered the annular space between the lid and the jar during shipping. When the lid was unscrewed and the vacuum seal broken, the larvae were sucked into the jar's contents. Consumerists' alarm led to government action. A study by the

tends to collect in this breach (the visible gap between the sides of the lid and the glass) and is sucked into the jar when the vacuum seal is broken".

The breadth of the USDA regulation appears to be bogged down in vague terminology. A full understanding of the Agency's intent can hardly be obtained from the phrase, "...and thereby prevent the products in the containers from becoming adulterated". A stronger position is necessary. A concise definition is required.

Adequate seals on containers after packing should be required by the ultimate regulations. Tamper-proofing with secondary seals could provide the necessary protection against seal breakage during shipping, and could prevent shoppers from opening containers in stores. Some foods, such as shellfish, are particularly susceptible to the effects of air and contaminants; it is crucial that containers of these foods remain tightly sealed prior to purchase.

Many industries are starting to police themselves to maintain product purity through tamper-proof closures:

The beverage industry uses aluminum twist-off caps which contain a

tamper-proof metal ring. Some of these beverage closures leave the tamper-proof band on the neck of the bottle. A more recent variation has light vertical scores in the band which break upon twisting and provide evidence of tampering. No skirt or ring remains on the bottle in this package design.

The liquor and wine industries completely shroud the necks of the bottles with various paper or foil closures to discourage tasters.

Some companies in the dairy industry use tamper-proof plastic caps with rip-away skirts on their 1/2 gallon milk bottles.

Certain divisions of the snack food industry use pressure-sensitive tapes, wet bands, and dry bands on containers of peanuts, candies, and other products.

The baby food industry has incorporated a "freshness indicator" on its cap lids. A special embossed seal in the center of the lid is concave when the jar is tightly sealed and the contents are in a vacuum. If the seal is broken, the lid pops up and appears convex. Watchful stockboys and consumers can determine immediately if the jar has been opened and the contents exposed to potential contaminants.

A new "Pie Taping" machine has recently been evaluated in the baking industry. The machine was designed to apply Secur-A-Seal tape onto pie domes at the rate of 30 units per minute. Basically, the pies enter the machine with domes in place in three separate lines. The leading pie in each line is placed into the taping station by a star wheel. While in the taping station, the pie is rotated about its own axis and tape applied onto the outside edge of the dome. Following this, the pies pass through a heat tunnel where the tape is shrunk securely into place.

The recognition and resolve by others in the food industry to solve these problems are remote. Management efforts toward maximizing profits should include packaging that protects the consumer. Unfor-

tunately, the added cost of such packaging means it has been met with great resistance from within the industry. External pressure is warranted and federal intervention inevitable.

Our objective is to provide stronger consumer protection through clearer recognition by the USDA and FDA of their roles in tamper-proofing. It is also imperative that these agencies become fully involved once they begin to regulate industries.

We as public health oriented personnel and consumers should (a) become actively involved in supporting the development and application of tamper-proofing legislation to protect the health and welfare of consumers of processed packaged food and (b) take a leadership role in supporting specific changes in Federal Register regulations written for

meat, poultry and shellfish by the USDA and the FDA.

Who knows, the next jar of food you buy (and consider commercially sterile) may have been "opened for inspection" in the supermarket. It may be supporting the growth of microorganisms which originated

 "Many industries are starting to police themselves to maintain product purity through tamper-proof closures."

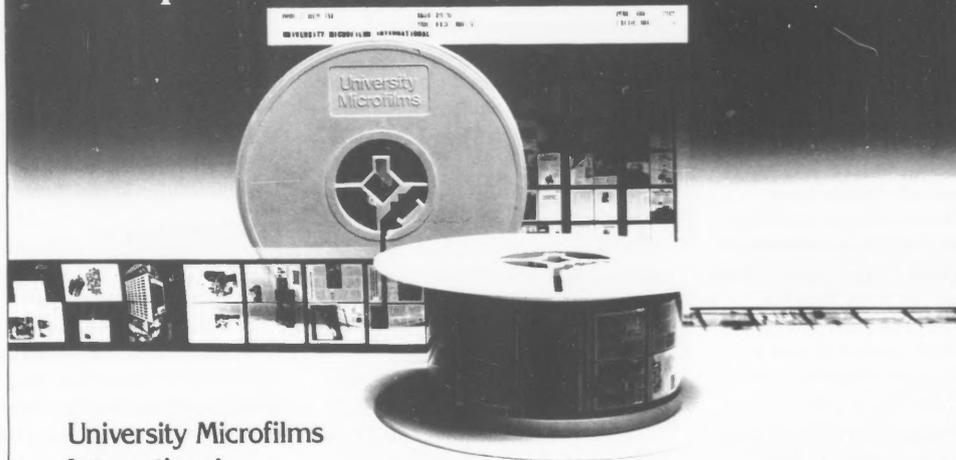
from a cough, sneeze, dirty fingers, skin or hair shedding or from airborne dust particles. It's time the consumer — you and I — is protected from the acts of the inconsiderate few. Tamper-proof devices on food containers is the most efficient, effective way to accomplish

this. The technology of tamper-proofing does not have to be developed — it's here. A little prodding from consumer groups, local and state health departments and federal regulatory agencies is needed to overcome the resistance of major food producers.

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Prevention of Contamination in Cheese Bulk Cultures¹

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Cultures produced with pH control and nutrient exhaustion can be stored for intervals that were previously not possible.

Bulk lactic cultures are still used in cheesemaking at some plants. Careful control of quality is important in use of the cultures, however, because contamination of the culture can result in many problems. Good sanitation practices become even more important when the bulk cultures are to be stored any length of time. A variety of controls and procedures to follow to insure the integrity of the culture are discussed.

Economic advantages have caused some cheese makers to continue the traditional method of producing bulk lactic cultures at the cheese plant. Newer techniques, however, assure greater numbers of cells and better control of acid production. Cultures produced with pH control and nutrient exhaustion can be stored for intervals that were previously not possible (1). Any tendency for the culture maker to

become lax in sanitation practices can cause contamination of a culture with many associated problems. Some of the essential sanitation steps necessary to assure contaminant-free strains of lactic culture for cheese manufacture are outlined here. These are of prime importance where bulk cultures are stored for any significant periods prior to use.

REFRIGERATED STORAGE

Lactic cultures can be held for several days in refrigerated storage with very little activity loss if they have been prepared with pH control (1,4,5). However, post-processing contaminant growth has been demonstrated in several plants (5). If a culture is to be stored after being transferred from the production bulk tank, temperatures at or below 5 C are essential. Thomas (5) found that one coliform strain could grow from 10⁴ to 10⁸ during storage at 10 C. This was in "spent" media, in which the lactic organisms had reached 10¹⁰ prior to transfer into storage tanks. All pumps, hoses and containers used to transfer a culture

must be cleaned and either chlorinated or steamed prior to contact with that culture. The storage tank must be clean and sanitized. Samples of culture should be removed following transfer and stored at 30 C to encourage contaminant growth and detection. These samples should be plated on coliform media to note the build up of non-lactic colonies. Such colonies would suggest a reevaluation of the steps used in culture medium preparation and culture handling techniques.

PSYCHROTROPHIC SPOREFORMERS

The temperature of stored bulk cultures has been kept in some plants at 21C since no cooling was provided for the storage system. Lactic culture activity was rapidly dissipated at this temperature, while any contaminant present that could obtain energy from the spent medium, would grow. These include the sporeformers, which survive the 95 C for 45 min heat treatment traditionally used in preparing phage-inhibitory media. Such organisms are few and have no time

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to grow in the presence of active lactic cultures and "sour" substrate. When the medium is sweet and temperatures and times are sufficient, however, they have produced ropy, off-odor cultures with markedly lower than normal culture activity. A good quality assurance check involves aseptic removal of a sample of heat-treated, cooled bulk culture substrate prior to inoculation. The sample is incubated at 30 C for 48 hours and a plate count taken. Growth of colony forming units suggests the need for additional heat treatment of the medium. If refrigerated storage is used, then a heat treatment of 95 C for two to three hours is suggested during the preparation of the substrate.

CONTAMINATION DURING INCUBATION

Recent research has demonstrated the inability of *Staphylococcus* and *Salmonella sp.* to compete with lactic cultures, even when pH is controlled (2,3,5). Thomas demonstrated however, that coliforms could compete well during culture incubation (5). One *E. coli* strain grew from 10^4 to 10^7 during culture preparation while the pH was controlled. The numbers remained stable throughout an eight day storage period at either 5 or 10 C. Similar growth was observed during preparation of conventional cultures, but the numbers declined rapidly during storage of the acid culture. The count was 10^3 after four days at 10 C and 10^4 after eight days at 5 C. Some coliforms produce no observable change in culture activity. Most problems with these organisms are solved with proper sanitation. Significant coliform contamination has been associated, however, with

the neutralizer injection systems in some operations.

Ammonia gas is a preferred neutralizer because it is more concentrated and easy to handle in the gas cylinders or larger storage tanks. However, hundreds of volumes of ammonia can be absorbed into one volume of water. Thus when the injection system is shut off, the culture medium is drawn into the injection tube. A check valve has been used to minimize this problem, but some back up still occurs. Some plants use small-diameter injection tubes. These are difficult to clean and inspect. An unclean tube soon harbors coliforms, which eventually produce high coliform counts in the culture. The most effective method of preventing this contamination has been applied by Alberta dairy processors. A flexible tube with a quick connect fitting was installed just above the check valve outside the culture tank. The fitting was alternatively connected to the ammonia feed line and the tank CIP system. The operator who forgot to change the fitting as needed was reminded by a spray of cleaning solution on the wall or an ammonia gas attack! No further contaminant problem was reported upon application of this simple modification.

A second technique for avoiding contamination problems involves pumping liquid ammonium hydroxide to an inlet at the top of the culture tank, where it is allowed to drop into the medium. There is thus no opportunity for culture media to be drawn into the feed line. Larger volumes of neutralizer are needed, but there is less need for culture cooling. This is preferred by some plants where the economics associated with handling liquid

neutralizer are favorable.

EQUIPMENT

Many bulk culture contamination problems observed have been caused by the use of poor equipment. Unless culture tanks are properly protected, well built and maintained, storage of liquid culture concentrate should not be attempted. Neither, for that matter, should the production of lactic culture in the first place! Newer culture tanks have been designed so that phage contamination is not possible except perhaps at the time of inoculation. If phage cannot enter then neither can bacterial contaminants. The use of modern equipment and filtration facilities and the careful application of sound sanitation principles will allow production of contaminant-free culture which can be stored for days.

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MICROBIOLOGICAL TESTS

FOR EVALUATION OF DAIRY PRODUCTS —

TODAY AND TOMORROW

CHARLES H. WHITE¹

The largest microbiological problem facing the dairy foods industry is caused by psychrotrophic bacteria. A larger problem can be anticipated with thermophilic psychrotrophs as ultra high temperature processing (UHT) and aseptic packaging of milk become more common. Advances in the microbiological evaluation of milk are discussed, including test kits, enumeration methods, coliform tests, swab tests, HPLC and GCHS, and computer concepts. The application of these advances to raw milk, pasteurized milk, UHT processed and aseptically packaged milk is discussed.

It is important to determine the microbiological quality of milk and milk products today, and where the dairy industry will be in this regard in the 1980's.

An important part of these assessments is the understanding of tests that are used and will be used, along with interpretations of the results these tests produce. When "microbiological tests" are discussed, what's being talked about is tests designed to detect, identify or enumerate microorganisms present in milk. In addition, terms are used broadly to indicate the methods for detection of bacterial metabolites or enzymes liberated in the milk and milk products. It is these metabolites and enzymes which may cause product degradation following processing and packaging.

The biggest microbiological problem facing the dairy foods industry is caused by psychrotrophic bacteria. Psychrotrophs will continue to be a problem into the 1980's. A larger problem can be expected with thermophilic psychrotrophs as ultra high temperature

(UHT) processing and aseptic packaging of milk becomes more common. Many of the current tests and those used during the next ten years will be based on a need to detect these Gram negative rods. Luck (4) indicated that there is not a "best test" for the evaluation of the microbial quality of milk and milk products. The industry is almost always looking for more than one type of bacterium and is dealing with different milk supplies and/or different products. Therefore, one or more "better" tests which fit in with a particular operation (depending on type of product, company size, centralized vs decentralized laboratory testing, critical levels used as standards, and so on) should be adopted and faithfully followed.

The increased age of the raw milk supply prior to processing has greatly increased the percentage of the total microbial population which is made up of psychrotrophs. In having microbiological tests which are useful indicators of quality milk production and shelf-life, fairly rapid methods must be available if they are to be of any value. Shelf-life testing of greater than 72 h will be of little value other than "fingerprinting" in coming years. Tests, now available, for detecting metabolites and enzymes give the following results with regard to time value:

1. Relatively certain within 24 h
2. More certain within 48 h
3. Almost completely certain with 72 h

Thus, correlation studies are in order to help establish these tests with accepted tests such as the Moseley Keeping Quality Test, where incubation of fresh product for 5-7 d at 7C (45F) is followed by SPC and flavoring.

In addition, look at the goals which help determine the level of microbiological criteria or standards in the first place.

Among the goals of setting microbiological criteria are to protect public health; ensure hygienic food; and to assure acceptable storage life without spoilage.

Tests to assure acceptable storage life are vital, financially, to the food processor. While questions regarding microbiological standards for foods such as

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meats are still in their infancy and even yet to be established, milk standards, have been well-entrenched for some time. Perhaps these standards should be changed to delete tests of questionable value, such as the standard plate count (SPC), on fresh milk products and instead include measurement of psychrotrophs. Perhaps tests specifically designed for fecal coliforms and other enterics will replace the standard coliform tests (for *Escherichia coli* and *Enterobacter aerogenes*).

New advances in microbiological tests include test kits available for the ready identification of microorganisms. Names and stated uses of some of these methods are shown in Table 1. While most of these methods were originally designed for clinical lab purposes such as in identifying human pathogens, application is being made to dairy microbiology. A few kits are available for

identification of yeasts as well as bacteria. This is of great value in quality control work. Such kits show good correlation with standard laboratory procedures and agreement normally exceeds 95%. Two or three of these methods are routinely used at Dean Foods to identify bacteria causing problems in different areas. The procedure includes:

Gram reaction

a. If Gram + \longrightarrow Spore Stain and identify based on biochemical function

b. If Gram - \longrightarrow Oxidase Test

(1) Oxidase + \longrightarrow Kit for pseudomonads

(2) Oxidase - \longrightarrow Kit for enterics

Incubation temperatures are conducted at 32C and 21C.

Methods currently available for the enumeration of bacteria in milk and milk products are shown in Table 2.

TABLE 1. Test kits available for identification of microorganisms.

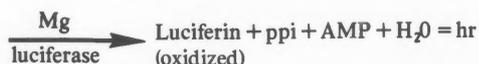
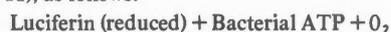
Test	Enterics	Other Gram Negatives	Anaerobes	Yeasts
Analytab API 20 E	x	x	x	x
BBL Minitek	x	x	x	x
Corning r/b	x	x	x	
General Diagnostics Micro-ID (Enzymatic)	x	x		
Inolox Enteric 20	x			
Roche Diagnostics En- terotube & Oxi Ferm Tube	x	x		
AMS AutoMicrobic System	x			
Aminopetidase Profiles (Not a kit--J. Food Sci., 1978, 43:1853-1856)	x			

While most are familiar with the limitations of the older test methods, the newer test methods may require some explanation.

The Bactec (trade names are used only as a means of identification) instrument is based on the release of C^{14} labelled CO_2 by the metabolizing bacteria present in the sample. The greater the number of bacteria present, the shorter the time required to make the final estimation. The instrument is relatively simple to run and is safer as spent samples may be discarded in the drain.

The Vitatetect photometers follow the principles of chemiluminescence, bioluminescence, and fluorescence for quantitative detection of bacteria present in fluids and degraded solids. A rapid detection time is advertised and was recognized. The time required for enumeration of samples even at concentrations of 10^6 and higher was 6-10 h. Correlation and standardization with standard plating procedures failed to yield useable results.

The luciferin-luciferase reaction is more accurately referred to as the ATPase photometric method. The principle involves the release of light by the firefly enzyme, luciferase, as luciferin is oxidized. Bacteria supply the ATP that provides energy for the reaction (2, 6, 11), as follows:



The method for milk is based on concentration of bacteria on a filter. The fat and casein interfere with the filtration.

The manufacturers of the Bactometer have gone out of business, but, the principle involved in the instrument's operation should be noted. The Bactomatic method is based on changes in electrical impedance as bacteria grow in milk or another suitable medium. The

instrument was evaluated and found to be easy to use with fair correlation to standard procedures.

A final, newer procedure is based on membrane filtration and epifluorescent microscopy (1, 9). The technique is designed to filter raw milk which has been treated with trypsin and Triton X-100 to lyse somatic cells, stain it with acridine orange, and count fluorescent bacterial clumps under U.V. light. A correlation with SPC of .91 was reported on this procedure which takes approximately 20-25 min. The results from five samples held up to 4 d at 5C are indicated in the relationship between the membrane and plate counts (Fig. 2, in Ref. 1). The procedure is suitable for milks containing between 5×10^3 and 5×10^8 bacteria per ml and is reported to be both sufficiently rapid for monitoring silo and "accommodation" milk and at the same time, sensitive enough for grading from milk on the basis of hygienic quality. Corroborative studies are presently underway.

Coliform tests other than the standard VRB-24 h test which show promise are the Hydrophobic Grid-Membrane Filter (HGMF) Method (12) and the Seven Hour Fecal Coliform Test (10). Both tests will be frequently used in the future, particularly as more requirements are developed for coliform determination.

One newer swab test, the Con-Tact-It System (Birko Chemical) works very well and aids greatly in rapidly pinpointing trouble areas. Other swab systems are available and work. Swabbing or rinsing, followed by rapid counting and a computer hookup provides continuous monitoring of dairy processing equipment during cleaning and sanitizing.

Special mention should be made of two procedures presently used in analytical chemistry laboratories. There are several potential uses for High Performance Liquid Chromatography (HPLC) and Gas Chromatography

TABLE 2. *Methods available for enumeration of bacteria in milk and milk products.*

<i>Test</i>	<i>Principle</i>
I. <i>Older Test Methods</i>	
Standard Plate Count	Viable bacteria
Direct Microscopic Count	Both live & dead cells
Dye Reduction Tests	Time required to reduce dye
II. <i>New Test Methods</i> (Normally must have initial population of at least 10^5 /ml)	
Bactec	Radiometric ($C^{14}O_2$)
Vitatetect Surface Reaction Photometers	Chemiluminescence
Luciferin-Luciferase	Bioluminescence for ATP quantitation
Bactometer (no longer in business)	Changes in impedance
Membrane Filtration & Epifluorescent Microscopy (Acridine Orange--U.V. light)	
III. <i>Other Coliform Tests</i>	
Hydrophobic Grid--Membrane Filter Method (Appl. & Env. Microb., 1979, 38:431-435)	
Seven-Hour Fecal Coliform Test (Appl. & Env. Microb., 1979, 38:229-236)	
IV. <i>Swab Kits</i>	
Con-Tact-It System (Birko Chemical) (Food Processing, Dec., 1976)	

Head Space Analyzer (GCHS) methodology for microbiological studies of dairy food. Among them are evaluation of commercial starter cultures; culturing conditions and potential additives for fermented dairy foods; and detection of metabolites and intermediate compounds in psychrotrophic bacteria studies with possible correlation on the extent of contamination. Quality functions of the HPLC-GCHS methodology are: determining purity of incoming liquid ingredients to provide a product profile, checking quality of skim milk powders and quality of corn syrup (yeast contamination → ETOH), and determining reasons for product spoilage.

Analysis of organic acids in milk and milk products provides valuable information on process control parameters and flavor indicators. Thus, uses of these procedures in control of cultured and fermented dairy foods, as well as in shelf-life and spoilage studies are imminent. The setting of quality control standards for incoming ingredients and for solving problem areas are just two of the major areas in which HPLC and GCHS have application.

There are advantages and disadvantages which accompany HPLC and GCHS. Advantages of HPLC, for example, are that it is rapid, sensitive, and specific, suffering from less interference than colorimetric procedures. The main disadvantage of HPLC is its cost, about \$15,000. It is also prone to downtime and failure problems, and requires a relatively skilled operator. GCHS advantages are the same as HPLC, plus it is relatively trouble-free and can be operated by a trained although inexperienced technician. The GCHS has tremendous versatility and is a useful identification aid. Its main disadvantage is its cost, \$22,000. It also needs more correlation studies with conventional methods. It should be noted, however, that the price of HPLC and GCHS equipment is not much greater than that of widely accepted milkfat testing equipment. The advantages of both procedures are obvious in that they are rapid, sensitive and specific. The GCHS system would be the author's choice if he could have only one or the other.

The use of computers has expanded greatly in the dairy industry in every area except the laboratory.

Computers can be used in the microbiological area of the dairy food industry. For example, information systems can be used in labs in areas such as inventories, media selection and sampling size, dilutions, and bacterial identification. The use of distributed data processing helps solve microbiological problems while the use of application generators helps solve computer problems. All of the mentioned uses are helpful in accumulating quality data for plant evaluations.

Information systems are available but biological applications have not been given to the computers. Immediate use of these systems in any raw milk quality control program could be realized, such as in coding

individual producers' test results and automatically sending warning notes, as needed. Coupling use of the computer with sample processing through one or more of these newer microbiological methods could provide the manager a continuous pattern of product/machine/vat or tank/code date to ensure valid shelf-life predictions. This could also result in prompt attention to trouble areas prior to product release.

Tests which will be used during the 1980's for assessing microbial quality of raw milk include:

Preliminary Incubation of sample, plus SPC
Microscopic Colony Count

Heat Resistant Psychrotrophs (particularly useful for raw milk to be processed under UHT conditions)

Detection of psychrotrophic metabolites, determination of change in pyruvate concentration (less expensive method which is rapid and can be tied in with microprocessor to furnish treatment of data is needed)

Acridine Orange---UV Colony Counting Method---
membrane filtration and epifluorescent microscopy

A period of preliminary incubation (PI) followed by a plating procedure gives a fair estimate of the number of psychrotrophs present in the raw supply. Since these cause problems due to the liberation of heat stable enzymes, in long code dated products, such as cottage cheese, there will be a continued emphasis on psychrotrophs, even in raw milk. A typical PI of 13C-18 h will give a clear picture of the raw milk received.

The microscopic colony count (MCC), as perfected by Juffs & Babel (3) is a rapid means of estimating raw milk counts. Simply, the method involves mixing an equal amount of milk and agar together on a glass slide, incubating overnight at 20C, drying, staining and counting microcolonies under low power (10X) magnification.

Heat resistant psychrotrophs, especially sporeformers, will play larger roles as "spoilors" in the raw supply, due to the advent of ultra high temperature processed (UHT) milk. Therefore, heating milk at 80C-10 min, or a similar treatment, followed by a plate count involving skimmilk agar (Plate Count Agar + 10% MSNF) will give an estimate of the number of proteolytic, heat-stable psychrotrophs present in the milk supply. Spore stains can also be routinely run to monitor percentage increases of sporeformers in the entire microbial population.

The detection of bacterial metabolites will be a very useful tool in the control of the raw milk supply. The pyruvate difference test (7) is a good example of this and will be a useful tool as soon as it is economically feasible.

The MF-Epifluorescent (Acridine Orange) procedure will, in all likelihood, be used by many labs as an automated method of estimating bacterial numbers on tanker loads and on individual producers.

TABLE 3. Recommended microbiological tests for raw milk and finished products.

I. Raw Products	
A.	Standard Plate Count or Plate Loop Count on each tanker - review at 24 hours for possible high load.
B.	Preliminary Incubation (7C - 48 hr) followed by SPC. Range should be:
1.	<100,000/ml - Normally would indicate no major problem with psychrotrophs in raw supply
2.	100,000-300,000/ml - Significant problem emerging
3.	>300,000/ml - Big problem
C.	Microscopic Colony Count - Could be used in place of PBC on each load as a rapid screening tool for detecting potential psychrotrophic problems.
D.	Pyruvate Determination - Should be used in conjunction with autoanalyzer.
II. Finished Products	
A.	SPC or PLC on fresh products - of questionable value other than to satisfy legality.
B.	Coliform on fresh products.
C.	Moseley Keeping Quality Test - 6 days at 7C (45F).
D.	Pyruvate Determination on Fresh Products - use of pyruvate difference test (after 24 hours incubation at either 15 or 20C) to predict shelf-life.

The Hull Test (as a measurement of the extent of protein hydrolysis) has proven valuable in trouble-shooting. This is of particular value when incoming loads of raw milk are suspect. The DMC can be used as effective screening tool for over-the road tankers.

Tables 3 and 4 depict a microbiological quality control program for a dairy foods company. While this shows the tests being used today, the emphasis should be noted on the interpretation of the PI results:

- <100,000/ml - normally no problem
- 100,000-300,000/ml - significant problem emerging
- >300,000/ml - big problem already existing

The range established for the Moseley Keeping Quality Test (7C-5 d - flavor + SPC) is <10,000/ml and >30,000/ml. When samples continually are in excess of 30,000/ml after this incubation period, shelf-life problems undoubtedly abound with the product.

Some promising tests which will be used for predicting dairy product shelf-life in the 1980's are shown in Table 5. The Moseley KQ Test is considered the standard, along with the actual shelf-life of the product, by which newer tests are compared.

The pre-incubated CVT count involves plating a pre-incubated (21C-16 h) resazurin-milk mixture, which is then incubated at room temperature for 48 h with color change noted. A rating system can easily be established from the results to predict the actual shelf-life. Recent studies at Mississippi State University and at Dean

Foods labs have borne out the fact that this test and others shown have good potential.

The Hull Test, mentioned previously, when run on samples incubated under different time-temperature conditions and followed by solving a regression equation where values obtained in results are plugged in, predicted shelf-life within hours for the products examined.

The Nacconal-TTC test involved a color change in hours which can be correlated with shelf-life in days. This is more of a gross estimation, but it can be of value in forecasting the big trouble areas.

The proteolytic count and the Gram Negative Agar Counts, when both follow incubation of the pasteurized milk sample at 13C-18 h, result in a fairly accurate estimation of shelf-life. These tests are based on the fact that the biggest deterrent to long shelf-life of dairy products is the proteolytic psychrotroph.

Incubation of pour plates at 21C-25 h correlates well with the standard 10 d psychrotrophic count. This modified psychrotrophic count was reported by Oliveria & Parmelee (8).

Finally, indicators of bacterial metabolites have proven useful in predicting shelf-life. The same type of test described for raw milk can be used with pasteurized products. Marshall & Harmon indicated that daily tests of pyruvate content could be fed into a computer which would collate the data and present it in a useable form. From these data, they indicated that management could make decisions regarding time and temperature constraints on distribution and on the sanitary status of fillers, lines, vats, valves and other equipment. It should again be stated, however, that no matter how elaborate the test, test results will have to be fully understood, and clear-cut guidelines be established, corrections in cleaning practices established and good followup accomplished before the desired, long shelf-life is realized.

Microbiological quality control testing of UHT products will soon be a necessity. Tests now being used in Europe, as well as in the U.S. (primarily for high fat products) are shown in Table 6. A pre-incubation period of the aseptically packaged product is generally acknowledged as being critical to accurate assessment of the product quality. Pre-incubation periods of 30C for 7-9 d and 55C for 3-7 d have been advocated, the former being preferable if only one is to be run. Some combination of both might be run as the latter reflects the incidence of thermophilic spoilers. Lück, Mostert and Husman (5) have indicated that titratable acidity, alcohol stability and organoleptic evaluations are all useful indicators of spoilage.

Test kits in conjunction with the Gram reaction and oxidase test can be effectively used to identify contamination in U.H.T. milk as well as conventionally

TABLE 4. Laboratory testing of raw milk and finished products for psychrotrophs

I. Raw Milk	
A. Sample incubated at 45F - 48 hr, then SPC	
B. Guidelines	
<u>100,000-300,000</u>	>300,000
Card sent out	Degrade as for SPC
Approx. 8% (Range 2-18%)	Approx. 5% (Range 0-13%)
Roughly 85% of the raw milk received would average approximately 60,000 psychrotrophs/ml. A few high samples have increased the overall average at one plant for last 4 months to 175,000/ml.	
II. Finished Products	
A. Sample incubated 45F - 6 days, then SPC, and flavor tests	
B. Guidelines	
<u><10,000</u>	>30,000
Approx. 82% Milk	Approx. 11% Milk
Approx. 61% Chocolate	Approx. 28% Chocolate
Approx. 75% Mix, Half & Half	Approx. 15% Mix, Half & Half

pasteurized milk products. This way the source can be traced and eliminated. The Hull Test again appears to be useful as a screening tool for detecting poor quality incoming milk or cream.

UHT milk is rapidly catching on in parts of Europe. In West Germany, for example, UHT milk is almost 50% of the total consumed.

Processing and distribution advantages of UHT processed milk include that non-refrigerated transportation and storage reduces cost through use of less expensive vehicles, reduced fuel consumption, use of larger vehicles, and rescheduling routes. Production scheduling may also be improved, resulting in lower production costs.

Disadvantages of UHT are that processing and packaging equipment is more expensive than the equivalent equipment for pasteurized milk; container and energy costs are higher; and equipment and the process are more sophisticated, more complicated. Other disadvantages are that economies of scale exist in processing and unit costs are higher for small plants; more storage space may be required; and plant and delivery schedules must be revised.

There are retailing advantages of UHT milk. For example, retail store costs are lower for non-refrigerated or dry grocery items. Savings include lower investment costs, reduced energy consumption, and more efficient use of labor. Retail store margins and profitability are small for refrigerated fluid milk items. Long life of the product is an advantage in certain specialty markets and price premiums or cost savings are likely.

But there are also retailing disadvantages of UHT. There is uncertainty about consumer acceptance of the product, particularly regarding flavor, package, and price. There is also a lack of a marketing strategy. Specialty products represent added lines in retail stores in the absence of high volume UHT products, and some

TABLE 5. Promising shelf-life predicting tests for fluid milk products.

Test	Principle-Procedure
1. Moseley KQ Test	1. 5-7 day - 7C --- flavor, SPC
2. Pre-incubated CVT Count	2. Plate pre-incubated (16 hr-21C) resazurin--milk mixture, incubate ambient-48 hr. Develop rating system.
3. Hull Test--PI at different temperatures	3. Measures degree of proteolysis.
4. Nacconol--TTC Test	4. Color change in hours correlated with approximate shelf-life in days.
5. PI--Proteolytic Count	5. PI (13C - 18 hr) followed by plating on PCA + 10% MSNF and incubation at 32C - 48 hr.
6. PI--Gram Negative Agar	6. PI (13C - 18 hr) followed by plating on gram negative agar (PCA + Penicillin G at 10IU/ml agar).
7. Metabolite indicators, Pyruvate	7. Change in pyruvate, P (20C- -24 hr). Suggest fresh products incubated at different temps., evaluated, fed into computer, results evaluated and trouble spots pinpointed (Marshall & Harmon, <i>J. Food Prot.</i> , 1978, 41:168-177).
8. Modified Psychrotrophic Count	8. Incubation of pour plates at 21C for 25 hr (Oliveria & Parmelee, <i>J. Milk & Food Technol.</i> , 1976, 39:269).

reorganization or additional investment may be required. It definitely appears that there will be UHT milk in the

TABLE 6. *Microbiological testing of ultra-high-temperature (UHT) and aseptically packaged milk.*

<u>Test</u>
1. Pre-incubation at 30C for 7-9 days (Langeveld & Bolle, <i>Neth. Milk & Dairy J.</i> , 1979, 33:172-18).
2. Pre-incubation at 55C for 3-7 days (Lück, Mostert, and Husman, <i>S. Afr. J. Dairy Technol.</i> , 1978, 10:83-85). Would suggest combination of 30C for 7 days and 55C for 5 days.
3. Titratable acidity, alcohol stability, and organoleptic evaluation are all useful as detectors of spoilage in the pre-incubated samples.
4. Bacteriological test kits (Oxiferm Tubes, etc.) in conjunction with Gram reaction and oxidase test can be effectively used to identify contaminants in UHT milk as well as conventionally pasteurized milk products; thus, source can be traced and eliminated.
5. Hull test for protein degradation - Effective in screening high count (or suspected high count) milk and heat-treated products for enzymatic problems with heat-stable protease from psychrotrophs.

TABLE 7. *A summary of the microbiological tests used to control milk and other dairy foods in the 1980's.*

I. Raw Milk
A. Detection of metabolites and interfacing results with computer so as to correlate with known base.
B. Checks for thermophilic psychrotrophs and mesophilic and thermophilic sporeformers.
C. Estimation of psychrotrophic population.
D. Control of lactic acid producing bacteria when added to raw storage tanks.
II. Processed Milk
A. Pre-incubation followed by estimation of psychrotrophic population by differential media or metabolite determination.
B. For larger plants, identification of metabolites, measurement of enzymatic activity and identification work via GCHS.
C. Other shelf-life tests correlated with Moseley KQ Tests.

U.S. in the 1980's, even if it is only on a modified scale. While there are no apparent major cost savings with existing refrigeration and transportation systems in the U.S., both commercially and at home, perhaps the energy situation will change this picture sufficiently to the point that large processing plants will manufacture both UHT and conventionally pasteurized milk. In order to get the three to six month shelf-life which will be required for a "sterile" nonrefrigerated product, the quality of the raw supply will become even more critical as to the type of bacteria present, even to include presence of heat-stable enzymes which can chemically modify the product.

Quality control, "checking to see if we are doing things right," or quality assurance, "checking to see if we are doing the right things," will have some type of Hazard Analysis Critical Control Point system for each plant.

The first step in establishing critical control points in the plants is through use of a flow diagram. Each point is detailed, potential hazards are identified, the control necessary, and the person at lowest level to whom responsibility is affixed, and the frequency of the control measure and location is noted of any records or data which are generated by the control measure. It is easy to see that microbiological tests which are the right ones to use can be more accurately determined by knowing this information. Statistical quality control will also play a bigger role. The question of whether to use centralized or decentralized QC (microbiological) labs will dictate the types of microbiological tests that can be used. It can be seen---there is no "best" test for all products under all conditions.

A summary of the microbiological tests used to control milk and milk products in the 1980's is shown in Table 7. While this "pie in the sky" look at the tests of today and the future may not turn out to be accurate, hopefully it will prompt ideas which can produce the best tests. This will result in fulfilling the purpose of the symposium to improve the ability to accurately assess the microbiological quality of the milk in the 1980's.

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Danger Lurks Among the MOLDS

Benjamin Franklin said that house-guests and fish begin to smell after 3 days. Often true. Foods don't always give off bad odors from being around too long, but most do develop molds that make them both unpleasant to look at and unwelcome to the tongue and GI tract. Molds can also develop, as this article notes, under climatic conditions favorable to their growth. Whatever their cause, molds can be unhealthy.

Molds tell us better than words can that the food on which they appear has been around too long. Moldiness, more often than not, is mute evidence that somebody was less than diligent in harvesting, handling, processing, or storing. No matter how the mold got there or who's to blame, offering moldy food products in interstate commerce violates the Food, Drug, and Cosmetic Act, which protects the buyer from cheating, exposure to unnecessary health hazards, and unbargained-for offenses to the nose, the eyes, and the palate—not to mention the gastrointestinal tract.

Molds are living, ugly symbols of spoilage and decay. To the farmer, the housewife, the food processor, and others, molds are ancient and wily adversaries that work so quickly and quietly that some ingenuity is needed to dispose of foodstuffs before the molds do. Once established in a food product under conditions suitable for growth, molds will,

if not checked, spread rapidly throughout, making the food a total loss. Often by the time their insidious presence is discovered, it's already too late to save the food.

Even when the food producer, owner, or handler follows the practices laid down to protect his product from these hairy invaders, the molds can take advantage of circumstances and nature's caprices to dash the best of precautions. When conditions are ideal for molds, the spoilage of food is about as certain as death and taxes. If the conditions are not controlled—and sometimes they can't be—the food will soon be covered by a blanket of blue, or green, or a conglomerate of filaments and hues too revolting to contemplate. The ideal condition for growth of most molds is a combination of warmth and humidity. "Musty" was originally spelled "moisty."

Molds are no respecters of size. They will penetrate and cover a shipment of brazil nuts or peanuts, a barge or bin or elevator filled with wheat, a carload or truckload of vegetables, or a field of unharvested corn as quickly as they envelop a loaf of bread, single peach or tomato, a table leftover, or a piece of cheese. So they are not only the bane of the pantry and kitchen, but also of the field, the factory, the warehouse, and the store. A bumper food crop that overflows handling and storage facilities, a period of warmth and humidity as crops reach maturity, a

cargo ship's stormy ocean crossing, transportation tie-ups, a fruit-pickers' strike, or any appropriate combination of events and the elements may give the molds their toehold. The result can be sizable losses and sometimes disaster for the producer, the processor, or the distributor. There are times when a crop of an entire region may be devastated as weather and other conditions create a favorable environment for molds to work. In some tropical countries mold on food crops is almost a way of life—and death.

Drastic damage to or large scale destruction of foodstuffs by molds introduces a dilemma. On the one hand a product rendered unfit to eat represents waste of what would otherwise have been perfectly good food, as well as a loss to the producer, processor, or retailer. Extensive losses can create shortages of a commodity and drive up its price. On the other hand, the consumer is entitled to a wholesome food product, one that will not endanger his health or offend his sensibilities. FDA is bound by both law and conscience to side with the consumer every time, even when there is an inevitable loss in food resources.

This dilemma has become even more pronounced in just the past two decades with the discovery that eating large amounts of certain mold metabolites (byproducts of the mold's growth or metabolism) in food is acutely toxic to animals and

humans, and that smaller amounts cause cancer in some test animals and are presumed to do so in humans.

Such toxins produced by molds are called mycotoxins. The most completely known of the mycotoxins is aflatoxin, a word derived from *Aspergillus flavus*, the name of the mold that produces it. *A. flavus* is found most often on tree nuts and ground nuts (peanuts); cereal grains, such as corn and wheat; and oilseeds, such as cottonseed. It cannot be destroyed by heat or effectively removed by other food processing, and so may remain intact in finished products, such as peanut butter or bread.

Aflatoxin is a naturally occurring food contaminant; that is, it is not added to food in production or processing. FDA takes spot samples of susceptible and suspected raw materials and finished foods and tests them for aflatoxin content. FDA will act to remove a product from the market if it contains aflatoxin above a specified amount, this tiny amount, in parts per billion, being the lowest that can now be detected in the food.

Molds may cause illness, not only by producing toxic metabolites, but by their growth in or on the body. The types of molds that cause infections are seldom the same as those that produce toxins. So far, there is no direct evidence that internal mold infections have been caused from eating molds in food, although moldy food and food crates have been implicated as a cause of skin infections in food handlers. FDA is currently looking into the possibility that disease may result from the growth of fungi eaten in food.

Molds are members of a group of so-called primitive, plant-like organisms called fungi, which also includes mushrooms and puffballs,

mildews, yeasts, water molds and slime molds, rusts, and smuts. There are over 400,000 known species. The fungi depend for their food on living or dead organic matter. Being nonmotile (motile = moving), molds must take up residence or establish themselves on material to survive. Therefore, they are mainly associated with decay and disintegration. Metabolites from certain fungi are toxic to man, some extremely so. Of these, the poisonous mushrooms are perhaps the best known.

Many fungi can cause disease or allergic reactions if spores are inhaled. Some produce skin allergies. A crippling disease prevalent in the Middle Ages, ergotism (or St. Anthony's Fire), resulted from eating bread made of rye that had been infected in the field by a fungus, *Claviceps purpurea*. Epidemics of human and animal diseases and deaths occurred in Russia in the 1940's from eating moldy millet and other small grains that had not been promptly harvested. These are now believed to have been caused by a mycotoxin produced by several mold species of the genus *Fusarium*. Some Japanese liver disease outbreaks in the 1950's are thought to have been caused from eating moldy rice contaminated with several *Penicillium* mold species.

But some fungi are also useful to man in various ways. The fruiting bodies of certain of the mushrooms are edible and some are considered great delicacies; truffles are another fungal fruiting body esteemed by gourmets world-wide. The fermenting properties of yeasts make them useful in baking and in the processing of such products as wine and beer, vinegar and sauerkraut, buttermilk, yogurt, cheese, and other dairy goods. Some fungi produce a number of enzymes and organic acids useful in industry or in the home.

Some molds are useful by themselves. These include molds that are cultured for use in the manufacture of Roquefort, Stilton, veined Cheshire, and other "blue" cheeses—the bluish or greenish veins or streaks in the cheese representing mold. The metabolites of some molds are also a major source of antibiotics, such as penicillin and streptomycin.

Molds require free oxygen for growth and therefore will not survive in vacuum-sealed containers of food. Some molds occupy only living host-plant or animal; others survive only in nonliving organic matter.

Some molds may grow on either living or dead matter. Some will grow only on a specific host, such as lettuce or grapes. Unlike more advanced plants, molds have no vascular (sap flow) systems and produce no chlorophyll. The exposed parts of molds—those that we usually see when we look at mold on food—represent the "tip of the iceberg"; that is, the "fruiting" or sporebearing reproductive parts. The parts that aren't normally seen are the basic, threadlike units of structure, called the hyphae. The hyphae penetrate and spread rampantly beneath the surface of the food or other occupied material and are roughly equivalent to the roots, stems, and foliage (or vegetative), parts of higher plants.

Detection of molds on food can be done by examination with the unaided eye whenever the mold growth is advanced enough to be visible or by examination of the food with a hand lens or dissecting microscope. In more difficult cases, diluted mixtures of the food, or whole pieces of it—such as beans or cereal grains—are cultured to produce growths or colonies of molds that may be present.

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A 40-year-old test to determine raw milk quality is finally in wide use. A Preliminary Incubation [PI] Count provides a good indication of milk production methods and the potential shelf life of raw milk. The procedure involves incubating samples of raw milk from individual farms at 55° F for 18 hours. Results can be expected to be as low as those for the Standard Plate Count (SPC). The experience of many supplies indicates that PO bacterial counts below 100,000 per ml. are acceptable. Initially counts of milk from some farms may exceed 1,000,000 per ml. Causes of high PI counts include dirty cows, poor udder washing practices, slow cooling or temperatures being held above 40° F., failure to thoroughly clean equipment twice each day, neglecting to sanitize equipment prior to use and a contaminated water supply. A list of causes of high PI counts and recommended corrective measures are provided.

Presented at the 66th Annual Meeting of the International Association of Milk, Food and Environmental Sanitarians, Inc.

A 40-year-old test to determine raw milk quality is being widely used throughout the dairy industry. In Pennsylvania at least two cooperatives and many dealers are performing Preliminary Incubation (PI) Counts. One has made monthly tests of each producer for about 10 years.

The PI Count was developed by Dr. C. K. Johns. His goal was to find a laboratory procedure which would provide a better indication of raw milk production practices. The results of Standard Plate Counts (SPC) do not correlate well with sanitary conditions on farms.

The PI Count procedure involves incubating samples of raw milk from individual farms at 55° F. for 18 hours. Plating is done by the same procedures and in the same dilutions as for the SPC. Some people have objected to the elevated temperature because it is not normal for milk, while others have found it difficult to find a refrigerated box which could be set at 55° F. One alternative is to hold samples at 45° F. for 48 hours after collection before

testing. Bacterial results will be similar.

A PI Count procedure should be included in all quality control programs. Results of PI Counts correlate well with equipment sanitation and milking practices on farms. Most industry and regulatory sanitarians have little difficulty in finding the cause of high PI Counts. Identification of the high count cause, frequently does require farm visits at milking time.

Efforts to convince federal and state regulatory agencies to accept the PI Count in lieu of the SPC should be increased. The PI Count is not advocated as a regulatory test, but rather as a quality control tool.

There is no doubt that the bacterial quality of raw milk has improved greatly in supplies where PI Counts are performed regularly. Previously, bacteria counts increased many times over when milk was held raw for two or three days, awaiting processing.

Bacterial results for the PI Count can be expected to be as low as those for the SPC. The experience of many supplies

GETTING GOOD PRELIMINARY INCUBATION COUNTS

There is no doubt that the bacterial quality of raw milk has improved greatly in supplies where P.I. counts are performed regularly.

indicates that PI Counts below 100,000 per ml. are acceptable. A few dairies have used a 50,000 standard for notifying a farmer he has sanitation problems, or as a basis for a farm visit.

Some industry fieldmen are very discouraged when PI Counts results of their supply first arrive. Initially, counts from some farms may exceed 1,000,000 per ml. and 30% or even 50% of the counts may be over 100,000 per ml.

Adopting a PI Count program requires time, patience and some changes in farm sanitation practices. There is no doubt that with such adoption, time and expense of field work will increase sharply for a few months.

Causes of high PI Counts include dirty cows, poor udder washing practices, slow cooling or temperatures of milk being above 40° F., failure to thoroughly clean equipment twice each day, neglecting to sanitize equipment prior to use, and a contaminated water supply.

When a PI Count program is started, information should be provided to dairy

farmers. This information should include the purpose of the program and a list of causes of high PI Counts. Here is a list of corrective measures of causes of high PI Counts.

1. Clip hair from udder and flanks of cows. Keep them reasonably clean.
2. Use a sanitizer solution for washing cows' udders. The iodine compounds provide a color indicator at the proper strength of 25 ppm. Use individual towels or cow cloths, not a sponge, to wash and dry the lower udder and teats.
3. Wash all milk handling equipment after each use. Disassemble and clean valve, covers, bridge and agitator of the bulk tank each time after milk is picked up. Clean milker units, transfer system or pipeline *twice* each day using dairy detergents and a recommended procedure.
4. Sanitize all milk contact surfaces with a chlorine or iodine sanitizer solution. Proper strengths are 200

ppm chlorine or 25 ppm iodine. Do this just before using the equipment, not after cleaning.

5. Cool milk to 40° F. or below within two hours after finishing milking. Blend temperatures should not exceed 50° F. during the second and subsequent milkings.
6. Check the bacterial count of the water supply to be sure that it contains no coliforms or spoilage bacteria.

Adopting a PI Count program for raw milk supply will do much to improve bacterial quality. Test samples from each farm at least monthly, but check samples of each load every day it is received. Cooperatives with their own laboratory can provide a picture of their entire raw milk supply every day, rather than once a month. Use 100,000 per ml. as an actionable level and urge regulatory agencies to accept PI Counts in place of SPC's, though not as a part of regulatory requirements.

“Causes of high PI Counts include dirty cows, poor udder washing practices, slow cooling or temperatures of milk being above 40°F., failure to thoroughly clean equipment twice each day, neglecting to sanitize equipment prior to use, and a contaminated water supply.”

Dairy and Food Sanitation

The new IAMFES magazine, *Dairy and Food Sanitation* addresses many of the same concerns as does the *Journal of Food Protection*. *Dairy and Food Sanitation*, however, provides articles of immediate interest and application to the work of the practicing sanitarian, fieldman, and quality control person.

As such, it complements the scientific *Journal of Food Protection*, which continues to offer the latest research in milk and food sanitation and technology.

In addition to articles, *Dairy and Food Sanitation* contains departments formerly included in the *Journal*, but they're expanded in the new magazine to offer readers more complete information about news, events, and others in the field. Among the expanded departments are news about IAMFES affiliate members, meetings, and events; Association events; new product news; excerpts from such publications as the Center for Disease Control's "Morbidity and Mortality Weekly Report," and the Federal Register. New 3A and E-3A Sanitary Standards and amendments to existing standards are also included in *Dairy and Food Sanitation*.

Regular publication of *Dairy and Food Sanitation* began this January. Give the portion below to a colleague who might like to receive *Dairy and Food Sanitation*, or to request additional information about IAMFES and the *Journal of Food Protection*.

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New Product News



• *The versatile Halldé Model RG-6 food cutter features a stainless steel surface in its cutting chamber. Its micro safety switch has been changed and relocated for increased safety to the operator and improved sanitation. The machine is corrosion resistant and has a minimum of moving parts for reliability, easy maintenance and long life. Contact Halldé, Inc., 37-06 61st Street, PO Box 729, Woodside, NY 11377, 212-424-6000 for more information.*

• *To expand their distribution network, Ladish Co., Tri-Clover Division recently opened a new distribution center at 4313 Air Trans Road in Memphis, Tennessee. Ladish Co., Tri-Clover Division is a major manufacturer of sanitary flow control systems and components (fittings, pumps and valves).*

• *Other distribution centers are located in Robbinsville, NJ, Hayward, CA, and Kenosha, WI. For additional details contact Ladish Co., Tri-Clover Division, Kenosha, WI. Ask for Distribution Center Bulletin.*

• *Sample identification is easier with new Write-On Whirl-Pak Bags from Nasco, Fort Atkinson, WI. Ordinary Whirl-Pak Bags have been redesigned with white write-on strips. Ordinary ball-point pens can be used on the new bags for more legible writing and easier identification. Available in 1 ounce, 2 ounce, 6 ounce, and 18 ounce sizes, the bags are made of heavy, transparent polyethylene, and are good for milk, water, and food sampling for testing, analysis, and storage. The top of the white strip serves as each bag's fill line. For more information, contact: Nasco, 901 Janesville Avenue, Ft. Atkinson, WI 53538, 414-563-2446.*

• *A manufacturer of industrial air compressors offers air-cooled units on a rental basis to industrial plants in water-short areas of the country so water can be saved during the current water shortage crisis. Atlas Copco, headquartered in Wayne, NJ, ordinarily rents air-cooled air compressors to companies in emergency situations when plants experience breakdowns in their regular air compressor systems. The air-cooled rental machines available are in the company's ZT-line of rotary screw self-contained stationary pack units and PTS-line of wheel mounted portable units, both providing oil-free air for process industries, ranging in air capacity from 650 cfm to 1500 cfm. For more information, contact: Atlas Copco North America Inc., 70 Demarest Dr., Wayne, NJ 07470, 201-696-0554.*



• *A new series of general purpose Column Heaters is available from Eldex Laboratories. The units support either one or two columns within a thermally insulated aluminum block. Precision inserts accommodate most standard columns. A unique feature is the option of having the injector valve incorporated within the heating block. The Eldex Column Heaters are particularly applicable for HPLC, where a precisely controlled temperature environment is vital. For further information contact Stephen Amendola, Eldex Laboratories, 3551 Haven Avenue, Menlo Park, CA 94025, 415-364-8159.*

• *A full range of TFE butterfly valves in sizes from 2" thru 42" for leakproof control of virtually any fluid is described in a new bulletin published by Garlock Inc, Valves and Industrial Plastics. Bulletin 792 gives full details and specifications on Gar-Seal 100 Series butterfly valves. Copies of Bulletin 792 are available upon request from Garlock Inc, Valves and Industrial Plastics, 602 N. 10th St., Camden, NJ 08101, 609-964-0370.*



• *New Brunswick Scientific Co., Inc. now offers a no-risk thirty-day trial of up to three different instruments for automated microbiology. Included in this offer are: the PourMatic dish filler that can pour as many as 320 agar plates automatically in 20" of bench space; the BioTran III, a video-scanning colony/particle counter that enumerates and sizes particles automatically in less than a second; or the Programmable Dispensing Pump with microprocessor memory, that allows the operator to dial liquid volume directly while the pump controls and counts dispensing cycles. For complete details of the NBS 30 Day Equipment Evaluation Offer, contact Ezra Weisman, New Brunswick Scientific Company, Inc., P.O. Box 986, 44 Talmadge Road, Edison, NJ 08817, 201-287-1200.*

• *A new brochure discusses how homogenization affects emulsions and dispersions processing and describes the full line of Gaulin high-pressure Homogenizers and Pumps, low-energy Hydroshear Systems, high-capacity, positive-displacement pumps and Gaulin's Customer Product Testing Lab services. Bulletin #250.81 is available from Gaulin Corporation, Garden Street, Everett, MA 02149.*

ADVANCE
SELECTION GUIDE
Water, Wastewater Treatment and Process Equipment

SECTION I **MANUAL GAS FEED**

<p>DIRECT CYLINDER MOUNTED GAS CHLORINATOR</p> <p>Using flexible connectors from outside source. Maximum capacity of 100 P.P.D. (2000 gms/hr) for use in remote measuring.</p> <p>MODEL 201</p> <p>REFERENCE BULLETIN 100</p>	<p>DIRECT TON CONTAINER MOUNTED GAS CHLORINATOR</p> <p>For remote remote measuring with maximum capacity of 1000 P.P.D. (20000 gms/hr) for use in remote measuring.</p> <p>MODEL 202</p> <p>NOTE: See Bulletin 100 for details.</p> <p>REFERENCE BULLETIN 100</p>
<p>WALL MANIFOLD MOUNTED GAS CHLORINATOR</p> <p>Using flexible connectors from outside source. Maximum capacity of 100 P.P.D. (2000 gms/hr) for use in remote measuring.</p> <p>MODEL 203</p> <p>REFERENCE BULLETIN 100</p>	<p>FLOOR CABINET MOUNTED GAS CHLORINATOR</p> <p>Manual chlorine gas flow rate adjusting valve with maximum capacity of 1000 P.P.D. (20000 gms/hr) for use in remote measuring.</p> <p>MODEL 204</p> <p>NOTE: See Bulletin 100 for details.</p> <p>REFERENCE BULLETIN 100</p>
<p>WALL MANIFOLD MOUNTED GAS CHLORINATOR</p> <p>Using flexible connectors from outside source. Maximum capacity of 100 P.P.D. (2000 gms/hr) for use in remote measuring.</p> <p>MODEL 205</p> <p>REFERENCE BULLETIN 100</p>	<p>WALL MOUNTED GAS CHLORINATOR</p> <p>Manual chlorine gas flow rate adjusting valve. Maximum capacity of 1000 P.P.D. (20000 gms/hr) for use in remote measuring.</p> <p>MODEL 206</p> <p>NOTE: See Bulletin 100 for details.</p> <p>REFERENCE BULLETIN 100</p>

• **Capital Controls Company**, a Colmar, PA-based manufacturer of chlorination equipment and related products, has published an updated selection guide to its products. The guide highlights Capital's gas chlorinator lines, both manual and automatic; instruments and controls, including systems for chlorine gas detection, analysis, and switch-over; and medium-duty liquid feed pumps. The *Advance Selection Guide* also cross references each individual product bulletin. For a copy of the guide, Bulletin A1.1001.6, write: Capital Controls Company, 201 Advance Lane, PO Box 211, Colmar, PA 18915.

• A new antimicrobial agent called **Proxel® GXL** has been cleared for use in pesticide flowables. Clearance by the Environmental Protection Agency for the active ingredient, 1, 2-benzisothiazolin-3-one, Proxel GXL is the latest in the line of biocides marketed by the Wilmington, Delaware-based chemical firm. It has been shown to be particularly effective against a wide spectrum of spoilage organisms. Bulletin Z10-15 contains complete information about Proxel GXL and is available from Specialty Chemicals Division, ICI Americas Inc., Wilmington, DE 19897.

• A small hand-held instrument from Beckman Instruments, Inc. enables food distributors, processors and storekeepers of moisture-sensitive products to test or adjust environmental conditions in storage areas for proper relative humidity levels. For more information, contact Beckman Instruments, Inc., Cedar Grove Operations, 89 Commerce Road, Cedar Grove, NJ 07009.

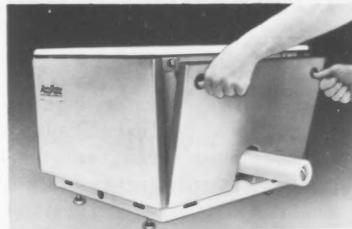
• **Stal Refrigeration Corporation** has announced the introduction of **Stalelectronic® 300**, a new control system for refrigeration systems. A major feature of this modular system is a special sequence regulator that controls multiple compressor systems at optimum energy levels. The Stalelectronic 300 can read the demand curve slope and determine precisely when to start the next compressor in the system. For complete technical data on Stalelectronic Controls for Refrigeration Systems, contact Hal Beumer, sales manager, Stal Refrigeration Corporation, 1746P Winchester Road, Bensalem, PA 19020, 215-638-7330.



• The new **DU® -5 UV-Visible/NIR Computing Spectrophotometer** from Beckman Instruments, Inc., automates procedures in analyzing aerosols, polymers, paints, food, drugs, water and biologicals. The DU-5 Spectrophotometer provides instant setup, analysis, calculation and hardcopy printout of final answers in units specified by the user. The Tabletop instrument includes a Spectrophotometer, microcomputer and printer in one unit and software memory storage modules. For more information, contact Beckman Instruments, Inc., Scientific Instruments Division, Box C-19600, Campus Drive at Jamboree Boulevard, Irvine, CA 92713, 714-833-0751.

• A new **double-headed filler** for packaging aseptically processed liquids and semi-liquids in bag-in-box has been introduced by Liqui-Box Corporation of Worthington, OH. The filler has a capacity of six to 10 bags per minute in sizes of four to 20 liters.

The machine maintains asepsis of both the product and pre-sterilized, pre-capped bags. It has a control system for steam sterilizing prior to start-up as well as maintenance of sterilization during operation. Filling head chambers are slightly pressurized with hot, sanitized air including chlorine spray fogging of the chamber interiors.



• A newly designed sanitary screw-type volumetric feeder, introduced by Accu-Rate, incorporates significant design changes to provide more accurate measurement and delivery of dry materials. Designated as the Model 612 Accu-Rate Sanitary Dry Feeder, the new model utilizes a smooth flexible vinyl hopper, as have the previous models. However, the new hopper is flexed by a dual paddle mechanism on both sides of the hopper's exterior. Pressing against the sides the paddles keep the hopper in motion, slowly undulating and preventing formation of bridges or funnel holes in the material being fed. Because the flexing mechanism is on the outside of the hopper, cleaning and servicing is easier, and the possibility of having to empty the hopper for maintenance is minimized. For more information, contact: Accu-Rate Division, Moksnes Manufacturing Company, White-water, WI 53190.



• A new **milk-hose support arm** for claw-type milkers has been introduced by Babson Bros. Co., builder of Surge Dairy Farm Equipment. The new support arm features a hook-end enclosure to help prevent injuries to the cow while a unique glass-impregnated, nylon ball joint provides firm, sure positioning for the milk-hose arm. The arm hook itself is made of galvanized steel. For more information, contact your Surge dealer, or write: Babson Bros. Co., 2100 S. York Road, Oak Brook, IL 60521.

• A new catalog describing the line of custom and specialty catalysts is available from the Calsicat catalyst division of Mallinckrodt, Inc. Calsicat is a part of the chemical group of Mallinckrodt. For further information or for a copy of the catalog, write Calsicat, 1707 Gaskell Avenue, Erie, PA 16503.

News and Events

Angevine Award Winners Announced

Winners of the Neil C. Angevine Superior Quality Award were announced at the March 23 - 25, 1981 ACDPI Kutures and Kurds Klinik in San Antonio, TX.

This award-consisting of an engraved plaque and revolving trophy - is given to the dairy plant with the highest cumulative score for buttermilk, sour cream, yogurt, and cottage cheese submitted for evaluations by experts at the annual national judging contest held in conjunction with the Klinik.

First place Angevine Award recipient was Purity Dairies, Inc. Second place finisher in the overall products competition was Smith Dairy Products, Orrville, OH. Third place was captured by H. E. Butt Grocery Co.



Pictured (L to R) are: Dr. Ron Richter (Judging Contest Coordinator), Texas A & M University, College Station, TX; Maurice Rouchon, H. E. Butt Grocery Co., San Antonio, TX; F. Bryan Black (ACDPI President), Borden Inc., Columbus, OH; David Walker and Sam Morrison, H. E. Butt Grocery Co.; Ray Rottero, Purity Dairies, Inc., Nashville, TN; Earl Connolly (Assoc. Judging Contest Coordinator); Fantasy Flowers, Inc., Wheaton, IL; Rob Mayfield (ACDPI Vice President), Mayfield Dairy Farms, Inc., Athens, TN; Dr. C. Bronson Lane (ACDPI Secretary), Dairy and Food Nutrition Council, Orlando, FL.

HIEFSS Grants Clock Hours for NIFI Course

The Hospital, Institution and Educational Food Service Society (HIEFSS) will grant clock hour credit to certified members who successfully complete home study courses of the National Institute for the Foodservice Industry, (NIFI) offered in cooperation with Purdue University.

HIEFSS, which confirmed its prior approval of the courses, is a professional organization for dietetic assistants and dietetic technicians. NIFI is the industry's not-for-profit foundation, established to upgrade foodservice management through education.

Any individual successfully completing any one or all of the four courses described below will earn continuing education units (CEU's), as indicated.

Foodservice: A Managerial Approach, focuses on the how's and why's of both executive and operations management. Through functional analysis, it presents techniques of running institutional foodservices, employee feeding operations, restaurants and other establishments that make up the foodservice industry (40 contact hours - 4 CEU's)

Applied Foodservice Sanitation, an operations-centered course, focusing on essential principles and practices of safe food handling (20 contact hours - 2 CEU's)

Management by Menu, a course which depicts the menu as the manager's working plan and blueprint for

the entire operation--front and back of the house (30 contact hours - 3 CEU's)

The Financial Ingredient in Foodservice Management, a course which takes the student through general areas of accounting procedures into specific concepts dealing with foodservice costs and cost controls, as a basis for decision-making. It will assist the owner/manager in communicating effectively with his accountant (30 contact hours - 3 CEU's)

For further information, contact Department of Instructional Planning, NIFI, 20 N. Wacker Drive, Suite 2620, Chicago, IL 60606, 312-782-1703.

"Federal Food Standards" Available

"Federal Food Standards" -- a fact sheet which briefly describes the various kinds of food standards set by the Federal Government -- has been revised. Those standards developed by the U.S. Department of Agriculture, the U.S. Department of Commerce, the Food and Drug Administration (Department of Health and Human Services), and the Codex Alimentarius Commission are included. A free copy of "Federal Food Standards," FSQS-19, is available from: Midwest Information Office, USDA, 536 South Clark Street, Room 635, Chicago, IL 60605.

AFFI Urges Awareness of Potential PCB Liability

The American Frozen Food Institute (AFFI) has urged frozen food processors to be aware of potential liability should an accident involving polychlorinated biphenyls (PCBs) occur at their plants.

PCBs, dielectric fluids used in electrical transformers and capacitors, are under study as possible hazards to human health, and will, as of May 11, be regulated by the Environmental Protection Agency (EPA) under an eighteen-month Interim Measures Program.

"The hazard to human health caused by exposure to PCBs is unclear, as is the regulatory climate that will prevail following the Interim Measures Program. In addition to exercising the utmost caution where PCBs are in use, processors should make sure that they are adequately insured to cover any liabilities that might result from the exposure of employees or consumers to PCBs," Thomas House, President of the American Frozen Food Institute, said.

Under the Interim Measures Program, food processors must implement inspection and maintenance procedures to guard against PCB contamination.

The program, announced in the March 10 Federal

Register, requires weekly visual inspections of electrical transformers that contain fifty parts per million (ppm) or more of PCBs, and that pose risk of exposure to food or feed products. Other transformers in storage or those not posing a risk or exposure to food or feed products must be inspected at least once every three months.

Users of PCB transformers who do not own the units are required to comply with the requirements of the Interim Measures Act until they notify the transformer's owner that it poses a risk of exposure to food or feed products.

Processors who have equipment containing PCBs should contact the EPA for a copy of the regulations of the Interim Measures Program, as well as a description of how the program came about.

For further information contact:

John B. Ritch, Jr.
Industry Assistance Program
Office of Pesticides and Toxic Substances
Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

The toll free number is (800) 424-9065.

GB Fermentation Announces Two Promotions

Dr. Louis I. Feldman has been named Vice President of Scientific Affairs for GB Fermentation Industries Inc. (GBFI), Des Plaines, IL. Leon D. Gustafson has been named North Central Territory Sales Manager for GBFI dairy products.

GBFI produces and markets products for a wide variety of food, beverage, pharmaceutical and industrial manufacturers and processors. It is the U.S. Subsidiary of Gist-Brocades, Delft, Holland.

In his new position, Dr. Feldman will be responsible for directing GBFI's activities in research and development, regulatory affairs, patents and trademarks. He will also work in close cooperation with the R & D Departments of other Gist-Brocades companies internationally.

Prior to joining GBFI in 1977, Dr. Feldman was



Louis I. Feldman



Leon D. Gustafson

Director of Research for the Wallerstein Company. He is a member of the American Society for Microbiology.

He earned his Ph.D. at Indiana University, is author of numerous technical articles and holds over 25 patents.

Gustafson will be responsible for sales of GBFI products to the dairy industry in Minnesota, North and South Dakota and Wisconsin. He will also provide technical support for GBFI's dairy products throughout the U.S. and Canada.

Prior to joining GBFI, Gustafson was a cheese production specialist for a major dairy corporation. He is also a licensed cheesemaker and grader and has experience in dairy plant management.

Sign up a new member
TODAY!

Contact IAMFES, P.O. Box 701, Ames, IA 50010

515-232-6699 for details.

Frozen Foods Code of Practices is Revised

"The Code of Practices for the Proper Handling of Frozen Foods" has been revised and is currently undergoing final editing in preparation for its spring publication.

Renamed "The Code of Practices for the Proper Handling and Merchandising of Frozen Foods," the recent revisions to the code were approved March 25 in Washington, D.C., at a meeting of the Frozen Food Roundtable, an industry task force made up of organizations concerned with the processing, distribution and sale of frozen food.

The industry has long subscribed to the industry-wide Code of Practices which covers the basic principles to be observed in freezing, packaging, storage and distribution.

The Frozen Food Roundtable decided that a fresh look

at the Code was due, and the draft developed encompasses changes in practice and technology. The Code of Practices was last revised in 1975.

One of the changes is the updating and clarification of the need for appropriate equipment for freezing and the desirability that the product pass quickly through the temperature range of maximum crystallization.

Another change to the Code is a list of suitable thawing methods that has been added to the foodservice section.

A new case code program, designed to make proper rotation of the product easier, has also been added to the Code. By applying an industry-wide rotation symbol and a code to the outer shipping cases containing the product, processors can help ensure that their product is handled properly, and those selling the food can help ensure its maximum quality.



Thomas E. Stender



Larry Graves

Norton Names Stender Industrial Product Manager

Garrett R. Miller, Director of Sales and Marketing for the Norton Company, Plastics and Synthetics Division, recently announced the appointment of Thomas E. Stender to the position of Product Manager. Stender will be responsible for product support for all divisional industrial products.

A fourteen-year employee of the company, Stender served the Division in various capacities, including the position of Sales Representative for the North Eastern Region and for Medical Operations. He also served as staff researcher at Norton's research and development center located in Stow, OH.

Graves to Cover Walker Midwest Area

Walker Stainless Equipment Company has appointed Larry Graves as a direct sales representative. His primary responsibility will be coverage of Pennsylvania and the midwest area.

Graves has almost two decades of experience with transportation and process equipment for the dairy, food and chemical industries. He will coordinate all Walker services in his area....new equipment sales, service, repair and replacement.

He has been active in the dairy industry, holding offices as the President of the Michigan Dairy Booster's Association, Vice-President of the Kentucky Association, Member of the Board of Directors of the Ohio Association, and Past President of the Indiana and Illinois Dairy Booster's Association.

Do you have your IAMFES hat yet?
Like one?
Send me _____ hats at \$4.00 each.

Name _____

Address _____

Return to: IAMFES, PO Box 701, Ames, IA 50010

Minnesota Offers Independent Study Course

A correspondence course exploring food technology is now available through the Department of Independent Study at the University of Minnesota.

"Technology of Food Processing" (FScN 1102) covers the techniques used in processing and distributing food. Course topics include food safety, additives, and regulations, food-borne illnesses, spoilage, processing meat, milk, cereal grains, fruits, and vegetables, wastewater management, and cleaning and sanitation. The course provides an introduction to the food processing industry.

The course instructor is Edmund A. Zottola, Ph.D. A professor of food microbiology at the U of M, he is the author of many scientific articles and more than 20 extension bulletins on food safety and processing. The study guide Zottola wrote for "Technology of Food Processing" provides detailed study notes on the course topics and information on course procedures and assignments.

Because Independent Study has no admission requirements, this course is open to everyone. Interested persons can enroll in this four-credit course at any time and take up to a year to complete it. Tuition is \$86.

Registrations are accepted in person or by mail at 45 Webbrook Hall, 77 Pleasant St. SE, Minneapolis, MN 55455. Call (612) 373-3256 to request more information about this course or registration materials.

NIFI Offers Course on Quantity Production

Handling large-scale food production effectively is detailed step-by-step in *Managing Quantity Food Production*, a new course released by the National Institute for the Foodservice Industry (NIFI), Chicago.

NIFI, the not-for-profit educational foundation established by the foodservice industry for the advancement of professionalism in the industry, announced that the new course is available for use in home study and in industry training programs.

The course is based on *Quantity Food Production Planning and Management*, a textbook written by John B. Knight and Lendal H. Kotschevar, well-known foodservice educators. Directed at the foodservice manager, who must coordinate all the activities in a foodservice operation, the 590-page textbook covers all aspects of food production planning and management.

Four courses published earlier by NIFI are *Applied*

Harper Retires from Ohio State



W. James Harper, Professor of Food Science, has retired from the Ohio State University and the Ohio Agricultural Research and Development Center effective March 31, after nearly 32 years of service. He has accepted a 3-year appointment with the New Zealand Dairy Research Institute to head a research team in whey utilization.

Dr. Harper, a native of Lafayette, IN, received his B.S. degree in dairy technology from Purdue University in 1946, and his M.S. and Ph.D. degrees from the University of Wisconsin, the latter in 1949. He joined the Ohio State Department of Dairy Technology the fall of 1949 as an Assistant Professor. He was promoted to Associate Professor in 1958 and to full Professor in 1961. Since 1967 he also held an appointment as Professor in the Department of Biochemistry.

At Ohio State, Dr. Harper has been involved in both teaching and research. He taught dairy technology courses dealing with market milk, proteins, refrigeration and plant layout and design. When the Department became Food Science and Nutrition, in 1971, he developed and taught courses in fluid foods, technical problem solving, food additives, food fermentations, food plant wastes and waste treatment, and research methods.

His membership in professional societies includes International Association of Milk Food and Environmental Sanitarians, American Dairy Science Association, Institute of Food Technologists, American Association for Advancement of Science, and the American Chemical Society.

Foodservice Sanitation, Management By Menu, The Financial Ingredient in Foodservice Management, and Foodservice: A Managerial Approach.

Managing Quantity Food Production was published with the support of the Consolidated Foods Corporation, Chicago.

The course is available from NIFI, 20 North Wacker Drive, Suite 2620, Chicago, Illinois 60606. Home study course enrollment fee is \$87.50.

Specialist Cautions Against Excess Iodine in Rations

Don't feed excess iodine in dairy cattle rations, advises Jeff Reneau, dairy specialist with the University of Minnesota's Agricultural Extension Service.

Iodine, and particularly EDDI, should not be added to feeds in amounts greater than the minimum nutritional requirement of 10 milligrams per day for the adult dairy cow. "This is a very small amount," Reneau emphasizes.

On a total ration basis, it amounts to .5 parts per million (ppm) or .00005 percent iodine. A daily dose is only 1/326 of a teaspoon of potassium iodine. Growing young stock need only about one-half that amount.

Recent research evidence suggests that excessive iodine in the diet is detrimental rather than beneficial to cow health, reproductive efficiency and milk production.

Present levels of iodine in milk have not yet resulted in human health problems, Reneau says. "That's because the cow is a pretty good filter. Only 7-10 percent of the cow's dietary iodine is secreted in milk."

However, the medical profession and human nutritionists are concerned about the gradual increase of iodine in the human diet, Reneau says. Recent surveys of

the average American's diet show that over 50 percent of the dietary iodine in adults and young children and 80 percent of that in infant diets comes from milk and dairy products.

"Removing excess iodine from dairy cattle feeds would solve the problem of excess iodine in milk quickly," Reneau says. "Farmers need to check supplement labels carefully for iodine content," he advises. "Be careful not to add excessive iodine levels by combining protein, mineral and trace mineral salt supplements that all have iodine in them."

Feed manufacturers need to remove iodine "medicated" supplements from the market, Reneau adds.

The following table is a practical guide to iodine concentration in the dairy ration. It gives the iodine concentrations that will meet the National Research Council's minimum nutritional requirements. The table is constructed so that any one of the ration items listed supplying the only source of iodine equals 10 milligrams per day, the suggested feeding level.

	% of diet	Iodine %	Iodine mg/kg	Daily intake mg
Total daily dry matter	100	.00005	.5	10
Concentrate ration	30 to 50	.0001	1.0	10
Protein supplement	10 to 15	.0004 to .0005	4 to 5	10
Mineral supplement	.3 to .5	.007 to .01	70 -100	10
Salt, iodized	.3 to .5	.007 to .01	70 -100	10

New Cheese Ripening Process Developed

A new cheese ripening process developed by University of Wisconsin-Madison food scientists should save cheesemakers time, energy and money.

The process involves enclosing cheese ripening enzymes and the milk components they act upon in tiny milkfat capsules. The capsules are added to pasteurized milk prior to cheesemaking.

"Microencapsulation" reduces cheese ripening time and gives cheesemakers more control over cheese flavors, according to Norman F. Olson, leader of the research team that developed the process. Olson is director of the Cheese Research Institute in the UW-Madison College of Agricultural and Life Sciences.

Cheesemakers now rely on special bacteria for ripening cheese. The bacteria added at the start of the cheesemaking process, produce enzymes while they grow.

The enzymes break down certain milk constituents, creating cheese flavors.

The new process uses the same bacterial enzymes, but instead of being produced in the cheese by living bacteria, the enzymes are added in the capsules.

Olson says encapsulated enzymes will not replace bacteria in cheesemaking. Rather, the two ripening agents will most likely be used together.

Encapsulated enzymes reduce cheese ripening time because they speed up flavor development. Olson predicts that aged cheddar made with the new process could be ready for market in two or three months instead of the eight or nine months now required.

Cheese must be refrigerated during ripening, so shorter ripening time would mean reduced energy

Computerized Systems Offer Better Records Control

Dairy farmers will be able to "computerize" their cows to record daily milk production, grain consumption and possibly to detect heat and subclinical mastitis.

Some of these programs may be available in some areas within the next two or three years, says Bob Appleman, dairy specialist with the University of Minnesota's Agricultural Extension Service.

On-farm mini computers can be linked to mechanical systems in milking parlors of large dairy operations. Records and data can be collected in the milking parlor, then transmitted to a large centralized computer at a regional Dairy Herd Improvement Association (DHIA) center.

"Such systems are being used in some large California herds on a limited basis," Appleman says. The system's \$40,000 cost can be easily justified in large dairies with at least 500 cows. "Eventually we think a computerized system like this would be profitable for herds in the 150 to 200 cow range," Appleman says.

Appleman is a member of a national DHIA committee that's studying on-farm computers linked to mechanical systems in the milking parlor. Through measuring devices, the computers collect data like daily milk production and grain consumption. The on-farm

computer is linked to a central DHIA computer.

The national DHIA committee is composed of dairy farmers, university extension dairy specialists and national DHIA people. "The committee is working closely with about 15 agricultural business companies that are developing the technology for these systems," Appleman says.

Committee objectives are to:

- Maintain a national data base for sire proving and cow evaluations.
- Develop a national cooperative DHIA program that's flexible enough for appropriately monitored production data from on-farm computer programs.
- Assist manufacturers to design systems to standardize input and output of on-farm computer programs.
- Assist equipment suppliers and dairy farmers with continuity so that data input is up-to-date.
- Inform dairy farmers of the latest developments and their practicality.

Appleman says Minnesota farmers are already using computerized devices to read milk weights and each cow's daily grain allotment and refusal, although the devices are not yet tied into a central computer.

Microencapsulation, *con't. from p. 258*

requirements for production. Olson estimated that savings will be about two cents per pound for each month cheese must now be refrigerated.

The microencapsulation process makes low-fat cheese more flavorful. Most low-fat cheese made by conventional processes is mildly flavored. In a diet-conscious country, the availability of tastier low-fat cheeses could boost cheese sales, Olson says.

Using microencapsulation, the cheesemaker will be able to control the flavor of his product by selecting particular enzymes, amount of substrates and perhaps other flavor-affecting ingredients to be encapsulated, Olson says.

The researchers make the capsules by first preparing an emulsion of enzymes and appropriate substrates in milk fat. They spray the emulsion into cool skim milk, where the fat hardens to form the capsule coat. Emulsifiers added to the milk fat aid in coat formation. Temperature and pressure must be carefully controlled for the procedure to work properly.

"The milk fat capsules are similar to liquid vitamin capsules," Olson explains. "But they are much smaller--less than ten-thousandth of an inch--and milk fat is softer, so the capsules are unnoticeable in cheese."

Olson says he and others have attempted to control cheese flavor formation by adding bacterial enzymes directly to milk. But the attempts met with little success because most of the enzymes ended up in the whey instead of in the curd.

Microencapsulated enzymes remain with the curd to a much greater extent, the food scientist says.

In preliminary tests, the researchers found that one kind of cheese had eight times more of the substances responsible for flavor when made with microencapsulated enzymes than when made with enzymes added directly to milk.

Olson says the new process probably will not be used widely for at least five years. "We have to learn how to put all the right enzymes and their substrates in the capsules," he says. "Then both cheesemakers and consumers will benefit."

Options Offered for Better Supply — Demand Balance

As national milk production increases and consumers switch their consumption of milk and milk products to other protein sources, an imbalance in supply and demand is taking place.

According to Mike Hutjens, University of Illinois extension dairy specialist, it's up to dairy producers to bring milk supply into balance with demand. If producers don't act now, Hutjens warns that Congress may move to alter the dairy price-support program.

The national dairy herd produced 3 percent more milk in 1980 than it did the year before, notes Hutjens. Meanwhile, as consumer buying patterns change, cheese consumption - which has been increasing over the last several years - has dropped 1 percent, and that reflects decreased milk utilization.

The milk surplus of about 10 billion pounds that the government has purchased over a two-year period looms over markets and threatens the current price-support program, explains Hutjens. The accompanying table gives an overview of the current market situation:

Hutjens says dairymen have several options to help ease the supply-demand imbalance. He offers these suggestions:

- Cull marginal cows today. Poor producers and

problem cows don't return a profit, but they continue to contribute to the surplus milk supply. Include on a cull list cows that have chronic mastitis, long-calving intervals, poor dispositions and those that are susceptible to disease.

- Review feeding programs and feed costs. Profit margins shrink as the feed-to-milk ratio narrows. It's better to feed high-producing cows well, rather than feeding all cows marginally.

- Consider expansion plans carefully. Dairymen shouldn't speculate on higher milk prices and lower feed costs.

- Increase support of milk and dairy product promotion. Western U.S. dairy producers have proven that promotion pays off with greater consumer consumption.

- Dairymen should put their herds on a Dairy Herd Improvement test program to determine which cows aren't paying their way and should be culled.

Hutjens says that unless dairymen demonstrate their willingness to help balance production with demand, a solution to the over-supply program may be taken out of their hands.

Reprinted from "Professional Fieldman," Nov.-Dec. 1980 issue, published by Klenszade Products.

Milk Production, Utilization and Removals

item	1977-78	1978-79	1979-80	1980-81
Total supply (billion pounds)	127.2	127.7	133.2	134.6
Total utilization (billion pounds)	124.0	126.6	125.0	127.1
Government purchases (billion pounds)	3.2	1.1	8.2	7.5
Government expenditures (billion pounds)	413	230	1,300	1,255
Number of cows (millions)	10.9	10.7	10.8	10.8
Milk per cow (pounds)	11,207	11,371	11,745	11,900
All milk price (dollar/cwt)	10.73	11.74	12.75	14.35

Sire Selection Could Offer Genetic Mastitis Resistance

WITHIN the next decade, dairymen might be able to select sires that transmit more genetic resistance to mastitis.

University of Wisconsin researchers have found somatic cell counts (SCC) are about as heritable as milk yield. These findings could be a step toward improving genetic resistance to the costly disease.

Dairy scientist G. E. Shook says the next step is to determine if sires' genetic ability to lower somatic cell counts also reduces the incidence of mastitis.

If certain sires do transmit more genetic resistance to mastitis, dairymen could use sire evaluations in their battle against mastitis much as they have used sire evaluations to increase milk yields.

Shook and research assistant Ahmed Ali analyzed 22,000 individual somatic cell count tests from more than 3,000 cows from 722 sires.

Flexibility in Delaney Clause Urged

A strict Congressional ban on any food additives shown to cause cancer in people or laboratory animals "had better be made more flexible before it shatters," said former Food and Drug Commissioner Donald Kennedy.

Kennedy, now president of Stanford University, said the Delaney clause of the Food, Drug, and Cosmetic Act should be modified to allow food additive manufacturers to show that "in the concentration found, the chemical under test presents no human hazard."

His suggestion was made at Cornell University in Ithaca, NY, where he delivered the endowed Hiram J. Messenger lecture series.

The Delaney clause "has been blamed for a great deal more than it has ever accomplished, which amounts to the banning of three minor food additives in its 18 years of existence," he said.

But the clause "blocks any recourse to a scientifically based argument that some very small amount of a particular cancer causing substance might be too little to worry about," he added.

As analytical methods for detecting chemical hazards continue to improve, mass spectroscopy could become a weapon of corporate competition, he suggested.

"Will company A's packaging material be disqualified on the basis of a tip to the FDA from company B's spectroscopist that it leaches a picogram of plastic per year into the bacon? It would not take very much of that sort of thing to make the Delaney clause, and quite possibly the rest of health and safety regulation, appear ridiculous."

Changing the clause from an outright ban to a rebuttable presumption "would put the incentive where it belongs and would make policy more hospitable to new information," he suggested.

"Strict application of the Delaney clause in the case of lead would clearly require the immediate banning of all 'tin' cans, since small amounts of lead leach into the food from the solder in the seams and contribute significantly to the part of the human body burden of lead resulting from food ingestion.

"FDA is already seeking to reduce by half the 14 percent of total human lead intake that comes from this source. Meanwhile, the Environmental Protection Agency is proposing new emission standards to limit amounts of atmospheric lead.

"Since these more significant nonfood sources of human lead exposure are not subject to zero-tolerance provisions like the Delaney clause, it would seem unreasonable to demand the reduction of food sources take place through the kind of economic dislocation-with

other possible health consequences-that would result from instant application of the Delaney clause to tin cans.

"According to the Department of Justice, the Delaney clause could not even be applied to such a situation by 'phasing in' a ban. A perfectly reasonable proposal to do exactly that was made by FDA in the case of nitrites in cured meats, when it appeared that a study showed them to be carcinogenic. In that case, the Attorney General took the position that when Congress said 'ban' it meant 'ban right away.'

"The lesson of lead, perhaps, is that the Delaney clause at least needs modification by allowing manufacturers to demonstrate that for a particular test, a given animal species may be inappropriate.

"Provisions should also be made for agency discretion in the timing of bans upon already used food additives, especially where a significant proportion of the nation's food supply depends upon them, or when abrupt removal would generate a new set of health risks."

"These infirmities of legal structure are directly traceable to differences in the rate of scientific progress between analytical chemistry and toxicology."

con't. p. 262

Sires, *con't. from p. 260*

Sires were found to have a significant effect on daughters' somatic cell counts. Using the average of several somatic cell counts increases heritability in much the same way as repeatability increases when more daughters are used in sire proofs, says Shook. This is largely because somatic cell counts vary from test to test due to environmental factors.

For example, heritability increased from 0.20 when one SCC test was used to more than 0.30 when the average of 10 tests was used in the calculations. Heritability of milk yield is about 0.25.

"Heritability of average somatic cell counts is sufficient to be used in selecting for lowered counts although it may not be the best trait to select for resistance to mastitis," the researchers report.

Shook notes it would be relatively easy to use somatic cell counts in sire evaluations if research confirms counts do affect incidence of mastitis. Depending on additional research findings, results could be used in sire evaluations in as few as five years.

Reprinted from "Professional Fieldman," Nov.-Dec. 1980 issue, published by Klenzude Products.

ADA, HIEFSS, Ohio Approve '81 IAMFES Meeting for CEU's

The American Dietetics Association (ADA), Hospital, Institution and Educational Food Service Society (HIEFSS) and the State of Ohio will grant continuing education credits for attendance at the 1981 IAMFES Annual Meeting.

HIEFSS recently indicated it will grant 10 continuing education hours to its members who attend the meeting, scheduled for Aug. 9-13 in Spokane, WA. Registered Sanitarians from Ohio can earn 14 continuing education

clock hour credits for attendance at the meeting, according to the State Board of Sanitarian Registration for the State of Ohio.

ADA has not yet indicated the number of hours it will approve for the meeting, but that information should be received soon. For more information contact the IAMFES office, 515-232-6699. Registration forms for the IAMFES meeting may be found at the beginning of this issue.

Delaney Clause, *con't. from p. 261*

Thirty years ago, tests for detecting the presence of synthetic organic compounds at low concentrations in the human body or the environment seldom exceeded the parts-per-million level.

In the 1960s, new techniques-chromatographic separation and mass spectroscopy-pushed the detection limit to parts-per-billion in most cases.

In the 1970s, "newer chromatographic techniques, high resolution mass spectroscopy, and radioimmunoassay have made it possible to go to parts-per-trillion," Kennedy said.

What is generally possible in "state of the art" settings, like a university laboratory, may be 10-fold better than what can be used for everyday regulatory purposes, he added.

"Our ability to detect chemical hazards by analytical methods-whether in drinking water, in food, or in the environment generally-is superb, and getting better all the time.

"We can estimate, though not nearly so accurately, the human exposure to such chemicals that results from location and eating habits.

"But our capacity to estimate the actual health consequences of these exposures by direct, epidemiological assessment is poor, because of the lack of an adequate data base and the inherent insensitivity of the methods employed.

"For that reason, we must routinely turn to toxicological experiment for risk estimation. This requires a number of assumptions about which there is some scientific uncertainty and a great deal more public skepticism.

"The science of risk assessment, then, is much weaker than we would like it to be. . .

"Epidemiology has until very recently been the victim of poor government support. It has been hampered by

privacy legislation and consequent lack of access to health record.

"Toxicology has been neglected by its parent disciplines of biochemistry and pharmacology, probably because it bears the stigma of being an applied science."

Around 1950, retrospective epidemiological studies demonstrated the cancer risks associated with cigarette smoking. Now careful prospective studies show that males aged 35 to 84 who are lifetime smokers are nearly 10 times as likely to get lung cancer as those who don't smoke. Moreover, the mortality ratio rises with the average number of cigarettes smoked per day.

"No more convincing demonstration of risk could be found," Kennedy said. "Yet with a strong habit and powerful economic interests at stake, it took literally dozens of research groups over 10 years to provide any significant impact on the policy process."

Toxicological studies depend on the chronic toxicity of a test compound fed to experimental laboratory animals. "The substitution of animals for humans introduces a whole new set of assumptions," Kennedy noted. "So, too, does the necessity to deliver large doses of the suspect compound.

"Although both these aspects of animal testing invite public disbelief, they are based on perfectly sound scientific rationale." In effect, 100 laboratory animals stand in for 230 million Americans and may be exposed to the equivalent of 800 cans of diet soda per day, since higher concentrations of the suspect compounds may be used to compensate for the smaller numbers in the test population.

In summary, he concluded: "risk assessment is a science beset with uncertainties and deficiencies. It rests heavily on two disciplines that are relatively immature and upon a national data base that is uncertain and difficult to get at.

"As a result, public confidence in both the process of assessment and the (risk) management policies that result is lower than one would like."

Calendar

June 24-26---**FOOD MICROBIOLOGY SHORT COURSE.** Sponsored by Center for Professional Advancement. Puerto Rico location, \$565 fee. Contact Rosanne Razzano, Dept. NR, Center for Professional Advancement, PO Box H, East Brunswick, NJ 08816, 201-249-1400.

June 29-July 1---**WATER POLLUTION CONTROL TECHNOLOGY.** Short course sponsored by Center for Professional Advancement. Course to be held in Chicago, \$590 fee. Contact: Rosanne Razzano, Center for Professional Advancement, 201-249-1400 for more details.

Aug. 9-12---**IAMFES ANNUAL MEETING.** Sheraton-Spokane, Spokane, WA. Contact: IAMFES, PO Box 701, Ames, IA 50010, 515-232-6699.

Aug. 16-20---**HOSPITAL, INSTITUTION & EDUCATIONAL FOOD SERVICE SOCIETY (HIEFSS), 21st ANNUAL MEETING.** Hyatt Regency Houston Hotel, Houston, TX. Contact: Carolyn Isch, HIEFSS, 4410 West Roosevelt Road, Hillside, IL 60162, 312-449-2770.

Aug. 17-21---**FOOD PROCESSORS ADVANCED MICROBIOLOGY SHORT COURSE.** University of California, Davis. Contact: John C. Bruhn, Food Technologist, or Shirley Rexroat, Program Assistant, Dept. of Food Science & Technology, University of California, Davis, CA 95616, 916-752-2192.

Aug. 17-21---**21st ANNUAL MEETING, HOSPITAL, INSTITUTION & EDUCATIONAL FOOD SERVICE SOCIETY.** Houston, TX. Contact: HIEFSS, 4410 West Roosevelt Road, Hillside, IL 60162.

Aug. 30-Sept. 4---**WORLD ASSOCIATION OF VETERINARY FOOD HYGIENISTS, Eighth Symposium.** Theme: "Animal Health, Food Safety and the Consumer." Dublin, Ireland. Contact: The Secretariat, 8th WAVFH Symposium, 44 Northumberland Road, Ballsbridge, Dublin 4, Republic of Ireland.

Sept. 14-16---**PESTICIDE RECERTIFICATION.** Chicago, IL. Course sponsored by American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502.

Sept. 15-17---**"SIGNIFICANCE OF INDICATOR ORGANISMS,"** Symposium sponsored by Food Microbiology Section, Netherlands Society for Microbiology. The Hague, Netherlands. Contact: H. J. Beckers, Meeting Secretary, Rijksinstituut voor de Volksgezondheid, Postbus 1, 3720 BA Bilthoven, The Netherlands.



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Case Studies in Sanitation

This and future Case Studies in Sanitation are written by Frank Raffaele, Vice President of Regulatory Compliance, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502.

Case #13 - Mold

The management at Cannon's Bakery in Minnesota, were quite solemn on the afternoon of August 24, 1979 for several reasons. The chief reason for their somberness was that the bakery had just lost a very prestigious account that morning because their muffins were becoming moldy in 48 hours, in spite of an all-out campaign.

In a long and emotional meeting, sales manager Vince Spagal had broken the news that the account had been lost and literally thousands of dollars in anticipated income would not be forthcoming. This unexpected development would mean that production employees could anticipate layoffs until such a time as the account could, if at all possible, be regained.

For sanitarian Bill Schaffer, the news was even less appealing since it would undoubtedly be the sanitation department that would eventually be blamed for loss of the account. While Bill was feeling personally responsible, he feared his services would soon be terminated.

As the hours dragged by, Bill Schaffer recounted all the effort and time spent in trying to reverse the problem over the past eight weeks, and concluded that he really didn't know that much about mold and was not experienced with its elimination. Furthermore, six weeks previously, when he suggested to management that they seek technical assistance from an outside firm, he was immediately rebuked and reminded of the company's precarious financial condition.

In his own mind, Bill began to think that even if he were fired, it might be a blessing in disguise because in the four years that he had been with Cannon's, no effort had been made by the management to expand his personal technical knowledge. Time and time again during that period, Bill had asked for permission to attend various technical seminars and every time his request met with failure.

By Friday, August 28, another unexpected event took place. Cannon's President announced that Mike DeBarron, Plant Manager of over 12 years, had submitted his resignation. Could it be Mike was going to be the scape goat? The inter-office memo also stated that the company had hired John White as a replacement and that he would start his assignment in ten days. Who was John White, and what changes would be forthcoming, was a subject on the minds of everyone as the weekend approached.

At age 47, John White had seen numerous management positions within the industry since he first started as a depanner at age 16 during high school. John was proud of the fact that he had worked his way up through the ranks in departments which included sanitation, production and quality control in top-notch organizations - those that produced quality products and appeared to truly care about their people. John had accepted the job at Cannon's as a challenge, knowing full well that unless he could correct the mold problem, he too would have to find another job.

John's first day in the plant was packed with meetings and lengthy discussions with key department personnel. On the second day, however, John assembled the department heads from Maintenance, Sanitation and Quality Control and immediately set about on an all-day sanitation inspection followed by a lengthy critique of their findings.

The specific observations made during that inspection were as follows:

1. The fiberglass roll screen filters on the roof air intake units were heavily soiled and had not been changed in some time.
2. Stagnant water was noted on specific areas of the roof.
3. Mold development was noted in the upper section of the bulk flour silo located outside the production building proper.
4. Visual mold (black and green) was noted growing on the outside of the overhead piping in the mixing room and several other areas including the wrapping room.
5. Heavy dust was noted on obsolete equipment stored at the north end of the production room.
6. Overhead duct vents were noted, showing heavy filth directly over product zones.
7. Visual mold was noted inside the muffin proofer and was especially heavy along the ceiling.
8. Heavy mold and slime was noted inside the humidifier unit of the muffin proofer.
9. The compressed air feeding the wrapping machine was not properly filtered.
10. Visual mold was noted on wooden racks used to store packaging off the floor in the wrapping room.
11. Obsolete packaging material and numerous old office files were stored in a mezzanine above and to the north of the muffin production area. Said material was heavily dust laden.

Among improvements needed were:

1. Fiberglass filters in air units must be changed as needed. This usually is once each month but it depends on the soil load in the air around the plant.

JFP Abstracts

Abstracts of papers in the June Journal of Food Protection

Effects of Sodium nitrite, Sodium Nitrate and DL, Alpha-Tocopherol on Properties of Irradiated Frankfurters, R. N. Terrell, F. Heiligman, G. C. Smith, E. Wierbicki, and Z. L. Carpenter, Meats and Muscle Biology Section, Department of Animal Science, Texas A & M University, College Station, Texas 77843 and Food Engineering Laboratory, U. S. Army Natick Research and Development Command, Natick, Massachusetts

J. Food Prot. 44:414-417

Frankfurters were manufactured to contain certain combinations of curing ingredients (sodium nitrite, sodium nitrate and DL, alpha-tocopherol). Some frankfurters were made to contain in the finished product 0% added moisture, others were made to contain 10% added moisture, some frankfurters were not irradiated (0-megarad), others were irradiated with either 0.8 or 3.2 megarads (Cobalt-60 radiation source). Use of DL, alpha-tocopherol (at a level of 206 ppm) was associated with greater processing shrinkage, more off-flavor and less overall palatability ($P < 0.05$). The most desirable external and internal cured color and firmest texture was in frankfurters made with 50 ppm of NO_2 or with 100 ppm of NO_2 , irrespective of irradiation level. Use of irradiation (0.8 or 3.2 megarads) on frankfurters made without nitrite or nitrate did not improve visually determined cured color but did improve this color when determined spectrophotometrically; nevertheless, cured color of irradiated frankfurters made without use of nitrite or nitrate was not comparable to that of non-irradiated or irradiated frankfurters made with 100 ppm NO_2 . Irrespective of added moisture or curing ingredient combinations, significant differences ($P < 0.05$) in palatability traits were associated with increasing irradiation levels (0, 0.8 or 3.2 megarads). Off-flavor increased, texture was less firm and overall palatability was less desirable as irradiation level increased. Low-dose irradiation (≤ 1 megarad) may be feasible for enhancing the palatability traits of frankfurters containing lower levels of nitrite (lower than 156 ppm) but it appears that the correct irradiation level would be lower than the 0.8 megarad used in this study.

Growth of *Salmonella typhimurium* and *Staphylococcus aureus* in Retail Pumpkin Pies, C. Jane Wyatt and V. H. Guy, Department of Food Science and Technology, Oregon State University, Corvallis, Oregon 97331 and Schwans Sales Enterprises, Inc., 115 W. College Drive, Marshall, Minnesota 56258

J. Food Prot. 44:418-421

The ability of pumpkin pies as prepared and distributed in the food distribution system to support growth of selected food pathogens was studied. Products were purchased from a

cross-section of retail outlets. Microbial quality of the products was determined. One of four samples contained high levels of coliforms and *Staphylococcus aureus*. *Salmonella* was not detected in any of the samples. Samples were inoculated with *Salmonella typhimurium* and *S. aureus* and incubated at 4, 25 and 35 C. Water activity (a_w), pH and *S. aureus* enterotoxin were measured. Pumpkin pies supported growth of the pathogens at 25 and 35 C. Data revealed if contaminated and held at room temperature, pumpkin pies could present a public health hazard. Growth of pathogens is inhibited at refrigeration temperatures. Enterotoxin was present in samples containing *S. aureus*. Potassium sorbate (0.25%) inhibited growth of *S. typhimurium* but not *S. aureus*. Refrigeration is recommended for pumpkin pies to eliminate the possible health hazard.

Incidence and Growth of *Bacillus cereus* in Retail Pumpkin Pies, C. Jane Wyatt and V. H. Guy, Department of Food Science and Technology, Oregon State University, Corvallis, Oregon 97331 and Schwans Sales Enterprise, 115 W. College Drive, Marshall, Minnesota 56258

J. Food Prot. 44:422-424

Pumpkin pies were sampled and screened for presence of *Bacillus cereus*. Pies were obtained from a cross-section of distribution outlets including: two major chain supermarkets, an independently owned supermarket with in-store bakery and a major chain supermarket that distributes products baked at a central distribution center. Water activity (a_w) and pH were determined on each sample. *B. cereus* was isolated on KG agar incubated at 30 C for 24 h. Intraperitoneal injections in mice were used to determine pathogenicity of the isolates. Pumpkin pies inoculated with *B. cereus* were incubated at 4, 25 or 35 C. *B. cereus* grew well at 25 C. D-values in minutes for *B. cereus* in pumpkin pie were 40 at 100 C, 10.5 at 108 C, and 7 at 124 C. Under normal baking conditions, the internal temperature of the pie reaches 108 C for approximately 1 min. Therefore it appears that the spores would survive baking. Potassium sorbate (0.25%) or refrigeration temperature inhibited growth of *B. cereus*.

Effect of Comminution Method and Pressure on Restructured Beef Steaks, W. J. Costello, S. C. Seideman, J. D. Michels and N. M. Quenzer, Departments of Animal Science and Nutrition-Food Science, South Dakota Agricultural Experiment Station, South Dakota State University, Brookings, South Dakota 57007

J. Food Prot. 44:425-429

Restructured steaks were made using six methods of meat comminution: (a) sliced parallel, (b) sliced perpendicular to muscle fibers (2-mm thick slice), (c) flaked at -5 C, (d) flaked at

-2.2 C, (e) flaked at 2.2 C and (f) ground through a 3.2-mm plate. Meat used was from cow inside rounds. After comminution, meat was stuffed into casings and pressed under pressure (200, 600 or 1,000 psi). The "logs" were then frozen, cut into steaks and evaluated for cooking characteristics and sensory attributes. Intact round steaks were used for controls. The amount of pressure used to form the restructured steaks had no effect ($P>.05$) on any of the cooking characteristics or sensory properties. Particle production method had no effect ($P>.05$) on cooking characteristics; however, tenderness, texture description and flavor desirability ratings were higher ($P>.05$) for flaked steaks as compared to the sliced or intact steaks.

Food Poisoning Potential of Artificially Contaminated Vacuum Packaged Sliced Ham in Sandwiches, James E. Steele and Michael E. Stiles, Faculty of Home Economics and Department of Microbiology, The University of Alberta, Edmonton, Alberta, Canada T6G 2M8

J. Food Prot. 44:430-434

Ham sandwiches inoculated with a mixture of five enteropathogenic bacteria, *Bacillus cereus*, *Clostridium perfringens*, *Escherichia coli*, *Salmonella typhimurium* and *Staphylococcus aureus*, were held at 30, 21 and 4 C for up to 24 h. Food poisoning potential was judged by the growth and survival of the inoculated pathogens. Major differences were observed between new and old (30 days of storage at 4 C) ham samples. On new ham, all enteropathogens were able to grow except *C. perfringens*, whereas on old ham, with high microbial competition, the pathogens survived but did not grow. Severe storage temperature abuse was necessary to develop a food poisoning potential in new ham samples. The safety of old ham was attributed to the competitive microflora that grew in the ham during storage at 4 C for 30 days. Infective pathogens, *E. coli* and *S. typhimurium*, either survived or increased in numbers under all test conditions. The safety of vacuum packaged sliced ham for use in sandwiches, in its present market form, was indicated by these studies.

Microbial Quality of Vacuum Packaged Sliced Ham, James E. Steele and Michael E. Stiles, Faculty of Home Economics and Department of Microbiology, The University of Alberta, Edmonton, Alberta, Canada T6G 2M8

J. Food Prot. 44:435-439

A total of 60 paired samples of vacuum packaged sliced ham was purchased at retail stores and analyzed for microbial quality as new (less than 10 days from manufacture) and old product (held to manufacturer's pull date at 4 C). Microbial counts of new product were variable, but at the product pull date, counts reached 10^8 per g. Differences in microbial load were noted between manufacturers. Although it might be expected that lactic acid bacteria would make up the predominant part of the microflora, this was not confirmed by the *Lactobacillus* count or pH drop. Lactobacilli formed a

variable component of, and seldom predominated, the total population. The pH did not drop markedly as product aged, and pH change differed between products from several manufacturers. A protective effect could not be predicted from pH of these ham samples. Other bacteria, including *Microbacterium thermosphactum*, micrococci and group D streptococci were of minor importance, and potential pathogens were absent in these samples, at their respective minimum detectable levels. The vacuum packaged sliced ham obtained for analysis from retail stores for this study was of sound microbial quality.

Minimizing Salmonella Contamination on Broiler Carcasses with Poly [Hexamethylenebiguanide Hydrochloride], J. E. Thomson, N. A. Cox, J. S. Bailey and M. N. Islam, Richard R. Russell Agricultural Research Center, SEA, U.S. Department of Agriculture, P.O. Box 5677, Athens, Georgia 30613 and Department of Food Science and Human Nutrition, University of Delaware, Newark, Delaware 19711

J. Food Prot. 44:440-441

Broiler carcasses, each inoculated with 30 cells of marker *Salmonella heidelberg*, were prechilled and chilled together with uninoculated carcasses in a simulated commercial chilling system. When either 10 or 25 ppm of PHMB [poly(hexamethylenebiguanide hydrochloride)] was added to the prechill water, cross-contamination (uninoculated carcasses showing contamination with marker *Salmonella* after chilling) was prevented, and no viable *Salmonella* were found on the inoculated carcasses. When carcasses, each inoculated with 60,000 cells of marker *Salmonella*, were similarly chilled, and 10 ppm of PHMB was added to the prechill water, cross-contamination was not prevented, and viable *Salmonella* were found on the inoculated carcasses. With 60,000 cells, and 25 ppm PHMB, cross-contamination was prevented, but viable *Salmonella* remained on the inoculated carcasses.

Comparison of Micro-ID and Minitek-Serology Systems for Rapid Identification of Salmonella, N. A. Cox, J. S. Bailey and J. E. Thomson, Richard R. Russell Agricultural Research Center, SEA, U.S. Department of Agriculture, P.O. Box 5677, Athens, Georgia 30613

J. Food Prot. 44:442-444

A 4-h biochemical identification system (Micro-ID) and a rapid confirmation 24-h biochemical and serological procedure (RC) involving the Minitek system were compared for accuracy of *Salmonella* identification. Of 144 known *Salmonella* stock cultures, RC correctly classified all, and Micro-ID correctly classified 141. Both systems correctly classified all the *Salmonella* isolates obtained from four artificially inoculated broiler carcasses. When 113 suspect-*Salmonella* isolates from naturally contaminated samples were examined, RC correctly classified all, and Micro-ID correctly classified all except one.

Minitek Inoculum Broth for Testing Indole Production by *Enterobacteriaceae*, N. A. Cox, J. E. Thomson and J. S. Bailey, Richard B. Russell Agricultural Research Center, SEA, U.S. Department of Agriculture, P.O. Box 5677, Athens, Georgia 30613

J. Food Prot. 44:445-446

With 73 members of the *Enterobacteriaceae* family, detection of indole production with Minitek inoculum broth (MIB) correlated more closely with the results of the conventional method than did detection with the Minitek H₂S/indole disk.

Bacteriology, Water Activity and Moisture/Salt Ratio of Six Brands of Precooked Canned Bacon, Edmund M. Powers, Daniel Berkowitz and George C. Walker, Food Sciences and Food Engineering Laboratories, U.S. Army Natick Research and Development Command, Natick, Massachusetts 01760

J. Food Prot. 44:447-449

Six commercial brands of precooked canned bacon, comprising 101 cans, were examined to determine if they complied with military specifications for a moisture-to-salt (M/S) ratio (percent moisture divided by percent salt) of ≤ 9.0 . Three brands were found in compliance with expected lot average values (ELAV) for M/S ratio of 4.70, 5.58 and 6.10. Water activity ELAVs of samples from these three brands were 0.82, 0.89 and 0.91; aerobic plates counts (APCs) ranged from <100 (64%) to 1500/g. Brands not in compliance had M/S ratio ELAVs of 11.24, 12.00 and 12.83; water activity ELAVs of 0.93, 0.97 and 0.99; and APCs as high as 1.7×10^7 /g.

Influence of Potassium Sorbate and Sodium Benzoate of Heat Inactivation of *Aspergillus flavus*, *Penicillium puberulum* and *Geotrichum candidum*, L. R. Beuchat, Department of Food Science, University of Georgia Agricultural Experiment Station, Experiment, Georgia 30212

J. Food Prot. 44:450-454

Experiments were conducted to determine if two preservatives, potassium sorbate and sodium benzoate, had a synergistic effect with heat on inactivation of conidia of *Aspergillus flavus* and *Penicillium puberulum* and vegetative cells of *Geotrichum candidum*. A second objective was to determine if heated conidia had increased sensitivity to preservatives in a recovery medium. As the pH of heating menstrua was decreased from 7.0 to 2.5, the rates of inactivation of molds were increased. Conidia were not as adversely affected by acid pH as were vegetative cells. At 50 ppm, potassium sorbate caused a significant ($P \leq 0.05$) increase in the rate of thermal inactivation of *A. flavus* and *G. candidum*; 100 ppm had a significant effect on *P. puberulum*.

Sodium benzoate caused significant decreases in decimal reduction times of *A. flavus* and *P. puberulum* when present at a concentration of 50 ppm in heating media. Viable heated conidia of *A. flavus* and *P. puberulum* had increased sensitivity to potassium sorbate and sodium benzoate, indicating heat injury. However, the relative effects of the two preservatives on colony formation in recovery agar were reversed from those noted in heating media, i.e., at comparable concentrations, potassium sorbate was more effective than was sodium benzoate for inhibiting colony formation.

Effects of Package Temperature and Days of Storage on the Flavor Score of Processed Milk, J. J. Janzen, A. B. Bodine and J. R. Bishop, Department of Dairy Science, Clemson University, Clemson, South Carolina 29631

J. Food Prot. 44:455-458

Shelf-life studies were made on commercially pasteurized milk packaged in fiberboard and blow-mold plastic containers, using two temperatures of storage (4.5 and 7 C) and 0, 7 and 14 days of storage. Quality parameters evaluated were flavor, Standard Plate Count, coliform count, oxidase-positive bacteria count and acid degree value. The data suggest a shelf-life (flavor score ≥ 36.0) of 2-3 days at 7 C and 7 days at 4.5 C. No significant ($P > .01$) differences, in the parameters measured, were noted between milk packaged in fiberboard and plastic jugs which were not exposed to fluorescent light. A second phase of this study examined the shelf-life of commercially pasteurized milk packaged in fiberboard containers only. The milks were tested at 0, 3, 5, 7, 9, 11 and 13 days of storage, using the same parameters noted above. The results suggested a satisfactory shelf-life of 11 and 9 days, respectively, for storage temperatures of 4.5 and 7.0 C.

Detoxification of Rapeseed Products, P. N. Maheshwari, D. W. Stanley and J. I. Gray, Department of Food Science, University of Guelph, Guelph, Ontario N1G2W1, Canada, and Department of Food Science and Human Nutrition, Michigan State University, East Lansing, Michigan 48824

J. Food Prot. 44:459-470

The full potential of rapeseed products has not yet been realized because of the presence of certain toxic compounds. This paper reviews development of low erucic acid rapeseed, and the extensive experimental scrutiny to which this oil has been subjected. The significance of the presence of glucosinolates as well as their decomposition products (isothiocyanates and oxazolidinethiones) in rapeseed meal is also discussed. Various methods for removing these toxic constituents from the meal are reviewed.

Microbiological Problems in Dairy Foods in the 1980s, Ron Richter, Department of Animal Science, Texas A & M University, College Station, Texas 77843

J. Food Prot. 44:471-475

Microorganisms are important to the dairy industry. Some bacteria and molds are used to manufacture dairy products while others cause spoilage or are potential health hazards. Many of the microbiological problems challenging the dairy industry in the 1980s will not be new. Psychrotrophic bacteria will continue to be a problem, but more effort will be directed toward elucidating their effect on processing properties of milk and the significance of enzymes produced by them. Heat-stable enzymes that cause quality problems will become more important as efforts to achieve a longer shelf-life for products are realized. Acceptance of reverse osmosis and ultrafiltration for concentrating milk and whey might increase if energy costs continue to rise or if economic advantages such as increased cheese yield can be accomplished. Microbiological problems associated with the product processed, processing parameters and sanitary design of this equipment will emerge if greater use of the technology is implemented. Microbial production of toxic metabolites and biologically active chemicals such as mycotoxins and amines will emerge as primary factors in the public health area as the research in food toxicology expand.

Milk Iodine Content as Influenced by Feed Sources and Sanitizer Residues, R. W. Hemken, J. D. Fox and C. L. Hicks, Department of Animal Sciences, University of Kentucky, Lexington, Kentucky 40546

J. Food Prot. 44:476-479

Human consumption of iodine has increased to amounts which are about equal to the upper safe level as set by the National Research Council. One of the major sources for the greater iodine consumption is an increase in the amount

reported in milk and other dairy products. The mammary gland does not limit the amount of iodine secreted in milk as it does with many other elements. Increased use of organic iodine in feed has resulted in high levels in milk in some dairy herds. Most of the herds with levels above 1,000 µg/liter were fed organic iodine above recommended levels as a prevention for foot rot. Iodine teat dips and udder washes can contribute additional iodine to the milk. In a few instances, the misuse of iodine sanitizers in the dairy industry has also contributed to increased milk iodine. If milk iodine levels are to be held at the present level or decreased, iodine feed supplementation and sanitizers must be used as currently recommended.

Campylobacter fetus subsp. jejuni: An Old Pathogen of New Concern, M. P. Doyle, The Food Research Institute, University of Wisconsin-Madison, 1925 Willow Drive, Madison, Wisconsin 53706

J. Food Prot. 44:480-488

For over 60 years subspecies of *Campylobacter fetus* (formerly *Vibrio fetus*) have been recognized as agents responsible for a variety of veterinary diseases. Such diseases range from abortion in cattle and sheep to hepatitis in poultry to dysentery in cattle. In rare instances, they have also been known to cause disease in humans. However, within the last 3 years, with the advent of microbiological methods that can selectively isolate campylobacters from human fecal specimens, *C. fetus* subsp. *jejuni* has become a disease-agent of serious concern. Clinical laboratories from throughout the world are now reporting that *C. fetus* subsp. *jejuni* is one of the most common bacterial causes of acute gastroenteritis in both children and adults. Its frequency of isolation is comparable to and in many studies exceeds that at which *Salmonella* is isolated from diarrheal stools of hospitalized patients. Although the source of the organism could not be identified for many of these cases, food and water have been implicated as being important vehicles for transmitting campylobacters to susceptible individuals.

Case Studies in Sanitation, *con't. from p. 264*

- Soiled filters will breed mold spores.
2. Stagnant water in roof areas must be eliminated if mold development is to be curtailed. The use of pitch and gravel must be applied to pooling areas.
3. Flour silos will develop mold at the top as a result of condensation which develops from temperature differentials. All flour silos should be dry cleaned once every three weeks to one month and any mold development removed.
4. Visual mold on overhead pipes can be viewed by regulatory officials as "insanitary conditions." In most cases, old pipe insulation will have to be removed in favor of sanitary plastic, which can be washed and sanitized if necessary.
5. Dust on old packaging material and obsolete equipment will breed mold. Obsolete equipment must be stored away from the production zones and in an area where air currents will not cross into production facilities.
6. Visual mold inside the muffin proofer must be physically removed and the entire interior sanitized with a food grade sanitizer such as a quaternary ammonia.
7. The humidifier unit on the proofer must be cleaned and sanitized on a weekly basis.
8. More frequent cleaning of the wooden racks holding packaging material should be undertaken until the wooden racks can be replaced with steel.
9. Micro filters should be installed in the compressed air system at the bagger and other equipment that is used to convey or otherwise carry the product. Compressed air systems breed mold since condensation is almost always present.
10. It is strongly recommended that the sanitarian, Bill Schaffer be sent to several of the many courses offered in the area of sanitation to broaden his technical knowledge.

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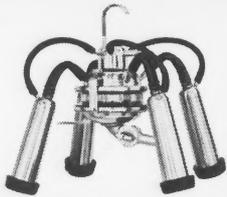
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