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IAMFES

Announcement **Developing Scientist Awards Competitions** (Supported by Sustaining Members)

This year IAMFES is pleased to announce extension of its program to encourage and recognize the work of students in the field of food safety research. In addition to the Oral Developing Scientist Award Competition, IAMFES introduces a Poster Presentation Award Competition.

Purpose

1. To encourage graduate and undergraduate students to present their original research at the IAMFES meeting.
2. To foster professionalism in students through contact with peers and professional members of IAMFES.
3. To encourage participation by students in IAMFES and its annual meeting.

Developing Scientist Oral Competition:

The Oral Competition is open to GRADUATE students enrolled in M.S. or Ph.D. programs at accredited universities or colleges whose research deals with problems related to environmental, food and/or dairy sanitation, protection and safety. Candidates cannot have graduated more than one (1) year prior to the deadline for submitting abstracts.

This year the Oral Competition will be limited to ten finalists and awards will be given to the top five presenters. The papers should be approximately fifteen (15) minutes, including a 2-4 minute discussion.

Awards: First Place: \$500 and an Award Plaque; Second Place: \$400 and a certificate of merit; Third Place: \$300 and a certificate of merit; Fourth Place: \$200 and a certificate of merit; Fifth Place: \$100 and a certificate of merit. All of the winners will receive a one year membership including both *Dairy, Food and Environmental Sanitation* and the *Journal of Food Protection*.

Developing Scientist Poster Competition:

The Poster Competition is open to UNDERGRADUATE and GRADUATE students enrolled at accredited universities or colleges whose research deals with problems related to environmental, food and/or dairy sanitation, protection and safety. Candidates cannot have graduated more than one (1) year prior to the deadline for submitting abstracts.

Ten finalists will be selected for the Poster Competition. The presentation must be mounted on a 8' by 4' display board (provided at the meeting) for the entire duration of the Poster Session at the Annual Meeting. The presenter must be present at their poster for a specific time, approximately two hours during the session.

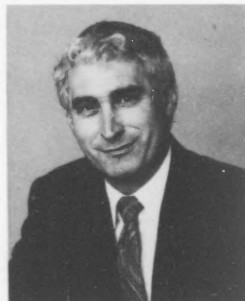
Award: The winner of the Poster Session Competition will receive \$300 and a one year membership including both *Dairy, Food and Environmental Sanitation* and the *Journal of Food Protection*.

Instructions to Developing Scientist Awards Competitions Entrants (Oral and Poster):

* **Note:** Both a short abstract and an extended abstract must be submitted to the IAMFES office no later than December 15, 1992. No forms will be sent to entrants. Enclose two self-addressed, stamped postcards with your submitted abstracts.

1. An original short abstract of the paper must be submitted on the blue abstract form from the September and October issues of IAMFES' journals. Indicate on the short abstract form whether the presentation is submitted for the Oral or Poster Competition.
2. One original and four copies of an extended abstract MUST BE SUBMITTED with the short abstract. Instructions for preparing the extended abstract follow on page 698. Attach one copy of the short abstract to each copy of the extended abstract and submit together with the original short abstract.
3. The presentation and the student must be recommended and approved for the Competition by the Major Professor or Department Head, who must sign both the short and the extended abstracts.
4. The work must represent original research done by the student and must be presented by the student.
5. Each student may enter only one (1) paper in either the Oral or Poster Competition.
6. All students will receive confirmation of acceptance of their presentations along with guidelines for preparing their Oral or Poster Presentations.
7. All students with accepted abstracts will receive a complimentary membership which includes their choice of *Dairy, Food, and Environmental Sanitation* or the *Journal of Food Protection*.
8. Winners are announced at the Annual Awards Banquet. The ten finalists for the Oral Competition and the Poster Competition will receive complimentary tickets and are expected to be present at the Banquet.

Thoughts From The President . . .



By
Michael P. Doyle
IAMFES President

An Industry Award for Commitment to Food Safety

Assuring product safety is a top priority of the food industry, yet seldom does a company receive recognition for its commitment to and investment in enhancing the safety of the foods we eat. Rather, consumers take for granted the safety of foods and many are quick to litigate if a food is associated with illness even though the company may not be responsible. Consider the billions of pounds of food many companies process annually and the relatively small number of reported cases of food-related illness associated with processed foods. It is time that companies be recognized for their contributions to assuring the safety of foods.

IAMFES is preparing to address this matter through the generosity of one of our members. Mr. Wilbur Feagan of F and H Food Equipment Company is the brainchild and benefactor of a new award to recognize the contribution companies engaged in the production, processing and marketing of foods have made to the health and well-being of the consumer. The award will be given annually and will recognize a company that has demonstrated unprecedented and unparalleled commitments to food safety. The first award will be presented at the 1994 IAMFES Annual Meeting.

The award is intended to be the most prestigious a company can receive for its involvement in food protection. The following criteria will be used as the basis for selecting the recipient:

- Contributions to public health principles and food safety
- Promotion of food safety education activities
- Support of the goals and objectives of IAMFES
- Promotion of ethical and fair business practices
- Demonstration of long-term commitment to high quality and safe products and services benefiting food protection

More information will be available in the coming months; however, it is not too early to begin accumulating the information your company will need to enter the competition. Start planning today, it will be an award your company will covet.

On My Mind . . .



By
Steven K. Halstead, CAE
IAMFES
Executive Manager

. . . is the need for you to attend the 1993 IAMFES annual meeting

As I write this, I am sitting in the gate area at O'Hare International Airport in Chicago. I am on my way to Atlanta to attend the annual meeting of the American Society of Association Executives (ASAE). ASAE is my professional association.

To become a member of ASAE, one must be engaged in the management of an association. I really don't know how far they push that idea (in the first place, I don't know why anyone outside of association management would want to be a member!), but that is the rule. At one time, to join the Iowa chapter, you had to be a least half time—we have many associations in Iowa which simply cannot afford full time staff. I think that we removed that barrier when we realized that those part-timers and in turn their associations and ultimately the profession, had the most to gain through their membership in ISAE.

I had originally decided that I would skip the annual meeting this year but attend and present a paper at ASAE's Management Conference (which I have never attended). After spending some eighteen weeks mentoring a class of "wannabe" certified association executives, and seeing the educational programming lined up for the annual meeting, I decided to attend. I also looked at it as an opportunity to learn more about the host city of our 1993 annual meeting.

Much of the programming dealt with Total Quality Management—as applied to associations, of course. It was very interesting to me to sit and listen to the presenters describe the TQM systems they had imple-

mented in their associations. Much of the jargon was exactly the same as I hear you people using as you describe your quality assurance programs. The sad thing is that associations don't know anything about HACCP, let alone how to apply the principals of HACCP to association TQM. Aha, perhaps an area where I can share an idea or two with my colleagues.

As I thought about it, I discovered that in many respects, this meeting is not all that different from ours. About 20% of our membership attend our meeting; about 10% of ASAE's attends. Those attending our meeting do not represent the "rank and file" membership, but rather the upper echelons of management. So too with ASAE. A goodly portion of both groups attend the meetings year after year for a variety of reasons. Similarly, there is another group of folks who attend the meeting because it is "local", i.e., in this case in Georgia or in our case, in Toronto.

While ASAE is able to attract some really big names—Disney's Michael Eisner and Dr. Stephen Covey (author of *The 7 Habits of Highly Effective People*), the real value of the meeting comes in being able to discuss these speakers and the many others with colleagues from around the country. It doesn't take long to find someone who has experienced and solved some of the very problems you are facing. It also doesn't take long to find someone whose problems are worse than yours. In all, it's a great way to learn!

Now, in case you missed the point of all this...make your plans now (for whatever reasons) to attend the 1993 IAMFES Annual Meeting (August 1-4) in Atlanta. I guarantee that you won't be sorry.

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Tests for Food Spoilage

George H. Reed, Jr., MPH, University of Massachusetts/Amherst, Amherst, MA 01003

There is no simple test known for determining when a food has spoiled and/or has been contaminated. The ability to touch, smell, taste, and observe texture and appearance changes (organoleptic changes) have been used to detect spoilage, which is damage to the quality of food. Contamination, the unintended presence of harmful agents in food, will probably not be visible and may not be detected through organoleptic means. Even an extensive laboratory analysis of a food item may not establish the degree of spoilage or the possibility of it causing illness. Even though the food supply comes through a network of inspection and regulatory protocols, the foodservice manager (or designee) has the responsibility for the sanitary quality of the food used in the establishment. REMEMBER, the thermometer is a most useful instrument in checking foods that are received cold or frozen; one must be available and used properly. However, it should be of some help to the manager to know that there are signs indicative of spoilage for certain foods. These may be used to help in judging if a food order should be rejected or a food item discarded.

Meats

Discoloration. Brown, green or purple blotches indicate microbial attack; black, white, and green spots may indicate mold.

Off-odor, especially sour smell (except aged beef).

Slimy to touch; occurs under high temperature and humidity conditions.

Beef usually spoils on the surface. Pork spoils first at meeting point of bone and flesh in the inner portions. To test for spoiled pork use a pointed knife to reach the interior of the meat. An off-odor on the knife means spoilage.

Poultry

Soft, flabby flesh usually means an inferior product.

Discoloration. Purple or green cast or green around neck opening may imply staleness or improper handling.

Other spoilage signs: abnormal odor, stickiness under wings and around joints, and darkening of wing tips.

It is now recommended NOT to wash poultry as pathogenic agents may be spread into the kitchen area; cook thoroughly to destroy pathogens; prevent cross-contamination of food-contact surfaces.

Eggs

Shells should not be cracked or dirty.

Freshness: if white clings to the yolk, and the yolk is firm, high, and does not break easily, the egg is acceptable;

off-odor, off-flavor are unacceptable; should be delivered in refrigerated vehicles.

Dehydrated, liquid, and frozen eggs must be checked for use-by dates.

Seafoods

Fresh fish: flesh softens, may have strong or off-odor, and is easily pulled away from bones; sunken eyes if head intact; finger nail indentation remains in flesh; gray or greenish gills; advanced deterioration gives ammonia odor.

Frozen fish: if thawed and refrozen may have a sour odor and an off-color.

Shellfish: abnormal appearance, sour odor, flavor or other off-odor; they should be purchased from certified shippers/dealers on the current FDA list.

Frozen Foods

Incoming product inspection should be for signs of thawing and refreezing and other indications of deterioration by mishandling practices; these include fluid or frozen liquids at the bottom of the container and/or presence of large ice crystals in a product; storage temperature should be below 0 F (-17.7 C), but may be accepted at delivery between 6-10 F (-14.4 to -12.2 C).

Do not refreeze any thawed food. Many foods may be refrozen if the partially thawed food still contains ice crystals.

Canned Foods

External damage, including swelled top or bottom, leakage, extensive rust, flawed seals, and large dents, indicates possible contamination.

Other signs: Abnormal odor, color or texture; foamy or milky liquid which is not natural for product; never taste-test any abnormal looking food.

Home canned food prohibited from use in a food establishment.

Milk and Dairy Products

Fluid milk: souring is rare if proper temperature maintained; psychrophilic bacteria may cause bitterness, proteolysis; off-flavors from some feeds or abnormal conditions at the farm.

Fermented milks: mold growth; off-flavor; separation of product.

Dry milk: stale odor, flavor; possible mold growth.

Butter: should have a sweet taste, uniform color and be firm; if rancid or has absorbed foreign odors, unacceptable.

Soft cheeses: mold growth; off-odor; sliminess; gas production.

Fresh Produce

All produce must be washed before being served or cooked to remove organisms and possible pesticide chemical residue.

Much reliance is placed on appearance, but this is not always dependable. Tasting of fruit is a good test of quality. Blemishes can be present in produce of good quality and flavor. Produce shows spoilage in a number of ways and the manager must know the signs in the common vegetables and fruits.

Salads, Prepared Meats, and Pastries

Meat, poultry, seafood, and potato/pasta salads, most cold cuts and custard-filled pastries can spoil quickly because of handling and must be kept cold continuously; start preparation with cold ingredients; off-odor, best spoilage indicator.

Mayonnaise and salad dressings do not readily support bacterial growth (low pH), but they may when combined with salad mixings. Keep salads cold.

Cereal/Dry Pasta

Products deteriorate over time in storage with loss of quality.

Favorite target of stored-products insects (pests) and can become moldy or musty.

New Generation (Convenience) Refrigerated Foods

Fresh pasta, vegetable salads, meat items, etc. may not show typical spoilage characteristics; factors such as partial (minimal) processing (which reduces the "normal" flora of the product), temperature abuse, and exceeding the shelf life of the food can facilitate the growth of hazardous microorganisms. It is best to store these foods at 40 F (4.4 C) or below.

Caution

It is not always possible to identify food spoilage by appearance, smell or taste. Many foods appear to be safe and wholesome, even when containing high levels of pathogens. Therefore, it is necessary to observe good food protection and sanitation practices in purchasing (receiving), preparing, storing, and serving (handling) foods. Leftovers: cool quickly below 45 F (might need pre-cooling by ice or cold water), store in shallow pans and use within 48 hours or freeze.

IF IN DOUBT THROW IT OUT

BIBLIOGRAPHY

1. Educational Foundation of the National Restaurant Association. 1992. *Applied Foodservice Sanitation* (4th ed.), John Wiley & Sons, New York.
2. Longree, K. and G. Armbruster. 1987. *Quantity Food Sanitation* (4th ed.), John Wiley & Sons, New York.
3. Longree, K. and G.G. Blaker. 1982. *Sanitary Techniques in Foodservice* (2nd ed.), John Wiley & Sons, New York.

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Nutrient Composition of Eight California Milk Products Based on Analysis Conducted in 1990-91

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Abstract

California fluid milk standards require significantly higher solids-not-fat (SNF) than current federal standards (8.25%). Low fat milks are available with up to 11% SNF. This increased SNF translates into increased nutritional value of the California milk products as compared to similar products formulated with only 8.25% SNF. The compositional values presented in the USDA Handbook for high solids milks were obtained by extrapolation from values on lower solid milks. This study was undertaken to generate actual data on the nutritional value of California milks and compare to the USDA Handbook 8-1 values for these milk products. Ten samples each of whole milk, 2% lowfat milk, 1% lowfat milk, nonfat milk, 2% lowfat milk with *L. acidophilus* culture added, buttermilk, chocolate milk with 3.25% fat, and lowfat (1.0 - 2.1% fat) chocolate milk were obtained from California milk processing plants. Samples were analyzed for weight, fat, total solids, protein, lactose, sucrose, glucose, fructose, cholesterol, calcium, chromium, copper, iron, magnesium, manganese, phosphorus, potassium, sodium, and zinc. It was found that the USDA Handbook values were mostly comparable to California higher SNF milks.

Introduction

Composition standards for California fluid milks are substantially higher than those for milks processed under Federal standards. The nutrient content of milk products for nutritional declarations has traditionally been derived from USDA Handbook 8-1⁽¹⁾. The validity of these values for California milk products is questionable since the analytical methodology used to establish the data in the USDA Handbook is over 15 years old. Furthermore, since the data listed in the Handbook for high-solids products was obtained by extrapolation and not direct analyses, its true validity was unknown. Therefore, a project was initiated by the California

Milk Advisory Board in April 1990 in cooperation with the California Department of Food and Agriculture to analyze the nutritional content of representative samples of fluid milk products currently marketed in California.

Materials and Methods

Over a period of a year, a total of 80 samples were collected from major milk processing plants in California, 10 samples each of the following market milk products: whole milk, 2% lowfat milk, 1% lowfat milk with 11% solids-not-fat (Extra Light Milk, ELM), nonfat milk, 2% lowfat milk containing *Lactobacillus acidophilus*, cultured buttermilk, chocolate milk, and chocolate lowfat milk. Five collections of 16 fluid milk samples representing the production from 10 different processing plants were analyzed in April, July, September, and November, 1990, and January, 1991. Each collection consisted of eight samples representing one of each type of fluid milk product to be studied collected from a Southern California milk processing plant and a Northern California milk processing plant to comprise each group of 16. In cases where one of the eight classes of fluid milk products were not processed by the plants selected for the sampling, missing product samples were collected from another milk processing facility within close proximity. Each group of samples was collected from the pre-selected processing plants by Milk and Dairy Foods Control Branch Dairy Foods Specialists on Monday, stored on ice and shipped to arrive at the Sacramento Laboratory by 9:00 a.m. Tuesday morning. Each sample was mixed thoroughly upon receipt and representative aliquots were dispensed in appropriate containers for analysis and refrigerated at 35°F, (2°C).

Each sample was analyzed for the following nutritional components: fat, total solids, protein, sugars (lactose, sucrose, glucose, fructose), cholesterol, and minerals (calcium, chromium, copper, iron, magnesium, manganese, phosphorus, potassium, sodium, zinc). Weight per serving was also determined. The AOAC Methods⁽²⁾ were used for the analysis of: fat (Modified Mojonnier); total solids (Direct Forced

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Air Oven); protein (Kjeldahl); and lactose (Polarimetric in non-flavored milk). Cholesterol was determined using the USDA gas liquid chromatographic procedure (R. Thompson, submitted for publication); sugars in flavored milk were assayed using high pressure liquid chromatography^(3,4); and mineral content was determined by inductive coupled plasma spectrometry^(5,6,7). The primary standards were NBS 1549 for protein and lactose and NBS 1563 for cholesterol. Evaporated milk of the same lot number, diluted 50:50 with water, was used as a secondary standard.

All analyses were performed in duplicate at the Department of Food and Agriculture Chemistry Laboratory where official regulatory analysis for compliance to composition standards is routinely conducted. The minerals were analyzed at Hazelton Laboratories America Inc., Madison, Wisconsin, according to quality control parameters established by the Department's protocol for credibility of data.

Results and Discussion

California fluid milk standards⁽⁸⁾ require significantly higher SNF than current Federal standards of identity⁽⁹⁾. Milk products sold in California are routinely sampled and analyzed by the Department's Milk and Dairy Foods Control Branch for compliance to California standards. Products failing to comply with California composition standards are removed from sale through administrative procedures taken by the Branch. A comparison of Federal and California State standards and a summary of the results of the study of the composition of the eight milks for fat, protein, lactose, SNF and cholesterol are listed in Table 1. Fat and SNF are the two compositional standards established by the California Food and Agriculture Code. All eight market milk products sampled were consistent in meeting State Code standards. There were only minor differences in the fat, protein, lactose, SNF, cholesterol and mineral compositional values with the USDA Handbook, Table 4. The California nonfat, ELM, lowfat, and whole milks have higher nutritional values than milks complying with Federal Standards because of the higher SNF content. Federal minimum standards for milk SNF are 8.25%. The average composition of field run raw milk received at milk processing plants is usually about 8.6 - 8.8% SNF. The USDA Handbook recognizes and lists the typical SNF value for fluid milk at 8.7%. In nearly all instances, milk would have to be diluted in order to reach the minimum Federal standards of 8.25% SNF.

Protein fortified 2% lowfat milk was the only lowfat milk marketed in California since 1962 until ELM was introduced in 1990. ELM is a protein fortified 1% lowfat milk with a minimum of 11% SNF. With the increased SNF, ELM has a higher nutritional value than the other seven milk products studied but is not referenced in USDA Handbook 8-1. Comparisons of the nutritional values of these products is found in Table 5. Protein fortified 2% lowfat milk also has a higher nutritional value due the 10% minimum SNF requirement when compared to unfortified 2% lowfat milk. With the exception of the addition of beneficial bacteria,

lowfat unfermented acidophilus milk had similar nutritional characteristics to protein fortified 2% lowfat milk.

California standards for flavored milks require chocolate milk to contain a minimum of 3.25% milk fat, chocolate low-fat milk to contain not less than 1.0% milk fat but not more than 2.1% milk fat, and chocolate nonfat milk not to contain more than 0.50% milk fat. All flavored milks shall meet the SNF standard established for milk, low-fat milk and nonfat milk, respectively. Administrative policy interprets the standard to require the minimum SNF standard prior to the addition of sweeteners and flavoring as calculated on a dry basis only. Therefore, incidental additions of water in liquid sweeteners, for example, must be compensated by addition of nonfat milk solids.

There are no standards governing the amount of sweeteners that may be added to flavored milk. As a result there is a wide range in the composition of flavored milk total solids not fat with sugar or sweeteners as the principle variable. This is apparent in Table 3 with a range of total sugars in the two milks from 5.98 to 13.74 percent. Using lactose as an indicator of milk SNF in California lowfat milk in Table 1 (5.52%), the lowfat chocolate milk would have a range of California milk SNF of 4.70 to 11.60 percent. There is a similar range in whole chocolate milk. This would indicate a variable nutritional quality.

The mineral composition of the eight milks is listed in Table 2. The main nutritional mineral emphasis has been on calcium. ELM, for example, contains significant nutritional levels of six minerals (Table 5)⁽¹⁰⁾.

Emphasis is placed on receiving adequate amounts of calcium through the growth years and into adulthood since this mineral contributes to bone strength and the prevention of osteoporosis. One serving of ELM milk provides 39% of the RDI for calcium. Less emphasis is placed on milk as a source of phosphorus, a significant mineral in bone, because phosphorus is readily available from other foods, such as grains.

Milk is frequently referred to as a high sodium food. However, the sodium content of a serving of milk is only 5.5% of the Daily Reference Values. More emphasis should be placed on milk as a source of potassium, which is an essential mineral in the electrolyte balance of the cells. The recommended ratio of sodium to potassium is 1:4⁽¹¹⁾ in people aged 6 years to adult. Milk has a favorable sodium to potassium ratio of 1:3.6.

Table 1 also shows that the California nonfat and whole milk studied averaged SNF of 9.5% and 8.8% respectively and therefore have higher nutritional values than nonfat and whole milk at Federal minimum standards of 8.25% SNF.

California standards for buttermilk or cultured milk require a minimum of 8.0% total solids. Consistent with Federal labeling requirements, the fat content of buttermilk must be declared in 0.5% increments. Table 1 indicates a wide range in the nutritional components in these milk products. The fat range is from 0.25% to 1.9% fat and the SNF varied from 7.4% to 11.37%. These products contained the highest sodium content per serving of any of the milk products studied, 215 mg per serving.

Table 3.

Nutritional Evaluation of California Dairy Products: Sugar

Variable	N	Low	High	Mean	Std Dev
Chocolate, Whole					
Lactose	10	2.65 %	5.20 %	3.77 %	1.11
Sucrose	9	3.09	6.62	4.56	1.14
Fructose	2	2.41	3.24	2.82	0.59
Glucose	2	1.58	2.65	2.12	0.76
Total Sugar	10	7.23	12.66	8.86	1.97
Fat	10	3.25	3.79	3.48	0.17
Solids-not-fat	10	12.83	16.16	15.36	0.64
Chocolate, Lowfat					
Lactose	27	2.59	6.42	4.43	0.93
Sucrose	15	0.15	6.42	2.84	1.93
Fructose	21	1.01	3.69	2.34	0.80
Glucose	21	0.89	4.33	2.70	0.92
Total Sugar	27	5.98	13.74	9.93	1.86
Fat	27	0.77	2.71	1.39	0.51
Solids-not-fat	27	12.64	18.19	15.28	1.62
Chocolate, Nonfat					
Lactose	14	3.74	5.41	4.68	0.47
Sucrose	14	0.00	4.32	1.15	1.52
Fructose	14	0.28	3.46	1.83	1.13
Glucose	14	0.42	4.37	2.31	1.26
Total Sugar	14	8.36	12.64	9.97	1.20
Fat	14	0.08	0.32	0.15	0.08
Solids-not-fat	14	12.63	17.02	14.32	1.32

Table 5

Nutritional comparison of Extra Light Milk (11% solids-not-fat) with Federal lowfat milk (8.25% solids-not-fat) and Handbook Lowfat Milk (8.81% solids-not-fat). Values extrapolated from handbook unless otherwise noted.

Nutritional Information Per Serving

	Fortified (Calif.)	Unfortified (Handbook)	Unfortified (Fed.)
Serving Size:	1 Cup	1 Cup	1 Cup
Servings Per Container:	1	1	1
Calories:	120	102	95
Protein:	10g	8g	8g
Carbohydrate:	15g	12g	11g
Fat:	2g	2g	2g
Sodium:	131mg	123mg	115mg

Percentage of Recommended Daily Intake (10)

	Fortified (Calif.)	Unfortified (Handbook)	Unfortified (Fed.)
Protein	20 ^a	16	15
Retinol Equivalents	10 ^b	10 ^b	10
Vitamin C	6	4	4
Thiamine	9	8	7
Riboflavin	35	29	27
Niacin	0	0	0
Calcium	39 ^a	33	31
Iron	0 ^a	0	0
Vitamin D	25 ^b	25 ^b	25
Vitamin B 6	8	7	6
Vitamin B 12	52	45	42
Phosphorus	32 ^a	26	24
Potassium	14 ^{a,c}	11	10
Magnesium	11	11	11
Zinc	9	7	7
Pantothenic Acid	17	14	13

a Analytical Values for ELM

b Supplemental Values

c Daily Reference Value

Table 4 California VS. USDA Handbook Values for 8 Oz. Serving of Milks

Milk Product:	Weight		SNF		Calories		Fat		Protein		Carbo- hydrates		Calcium		Sodium		Potassium		Sodium: Potassium	Cholesterol	
	g	(Ca.) (Fed.)	%	(Ca.) (Fed.)	KCal	(Ca.) (Fed.)	g	(Ca.) (Fed.)	g	(Ca.) (Fed.)	g	(Ca.) (Fed.)	mg	(Ca.) (Fed.)	mg	(Ca.) (Fed.)	mg	(Ca.) (Fed.)	Ratio ^a	mg	(Ca.) (Fed.)
Whole Milk	245	244	8.8	8.7	152	150	8.3	8.2	7.8	8.0	12.7	11.9	275	291	101	120	417	447	1: 3.6	28	33
Lowfat Milk	246	246	10.1	10.3	132	137	4.8	4.9	8.9	9.7	13.6	13.5	299	352	113	145	475	444	1: 3.6	20	19
Extra Light Milk	247	247	11.3	10.3	120	119	2.0	2.9	10	9.7	15	13.6	352	349	131	143	474	381	1: 3.6	13	10
Nonfat Milk	246	245	9.5	9.0	87	86	2.4	4.4	8.3	8.4	12.7	11.9	299	302	101	126	404	406	1: 3.6	8	5
Chocolate, Whole	250	250	15.4	14.3	196	208	8.7	8.5	7.9	7.9	22.2	25.9	262	280	146	149	387	417	1: 2.6	26	30
Chocolate, Lowfat	250	250	15.9	16.4	162	179	3.6	5.0	8.3	8.0	24.5	26	295	284	195	150	431	422	1: 2.2	14	17
Acidophilus Lowfat	246	246	10.1	10.3	135	137	4.9	4.9	9.2	9.7	13.5	13.5	322	352	119	115	431	447	1: 3.6	20	19
Buttermilk	246	245	9.3	9.0	102	199	2.7	2.2	8.8	8.1	10.2	11.7	305	285	215	257	410	371	1: 1.9	9	9

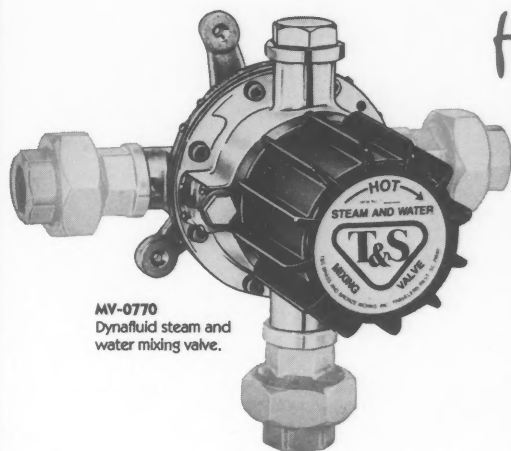
a Derived from California values

Conclusions

The results of these analyses confirm that the values for fat, solids, protein, different sugars, cholesterol and minerals contained in a variety of milk products (including high solids, low fat milks) currently sold in the California market are accurately reflected in the USDA Handbook. These results suggest that the extrapolation methods used to determine the Handbook values are accurate. These results also confirm that high solids milk products have substantially improved nutritional benefits over milk that meets minimum

federal standards. Fortification of milk with higher solids (at least 10%) also generates a reduced fat product with an improved mouth feel and better taste.

These results also point to the diversity in buttermilk products that are currently available. More uniformity, and therefore better consumer satisfaction, could be obtained if standards for buttermilk were developed. These should include minimum standards for fat, SNF, and acidity. The sodium:potassium ratio could be improved in these products by adding a potassium salt.



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Finally, since school children are the main consumers of chocolate milk, the nutritional quality of this product should be consistent. A minimum milk SNF of 10% and a maximum sweetness standard would improve this product greatly.

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REFERENCES

1. U.S.D.A. Handbook 8-1. 1976. Composition of Foods, Dairy and Egg Products, Raw, Processed, Prepared.
2. Official Methods of Analysis, 1990, Association of Official Analytical Chemists, Vol. 2. Fat 989.05; Solids, 925.23; Protein 920.65; Lactose 896.01.
3. Li, B. W., P. Schumann, and W. R. Wolf. 1985. Chromatographic determination of sugars and starch in a diet. Composite reference material. J. Agric. Food Chem. 33:531-536.
4. Pirisino, J. F. 1983. High performance liquid chromatography determination of lactose, glucose, and galactose in lactose reduced milk. J. Food Sci. 48:742-744.
5. Dahlquist, R. L. and J. W. Knoll. 1978. Inductively coupled plasma-automatic emission spectrometry analysis of biological materials and soils for major trace and ultra-trace elements. Appl. Spectroscopy 32:1-29.
6. Association of Official Analytical Chemists. 1984. Official Methods of Analysis, 14th ed., 43.292-43.296.
7. Association of Official Analytical Chemists. Official Methods of Analysis, 1st supplement, 14th ed., 1985, 3.A01-3.A04.
8. State of California Food and Agricultural Code: Production and Processing of Milk and Dairy Products.
9. Code of Federal Regulations, 1989, Title 21, Food and Drugs, Parts 100-169.
10. Anonymous. 1990. Food Chem. News 32:15-17.
11. Recommended Dietary Allowances. 1989. National Academy Press, Washington, D.C.
12. Bruhn, J. C. and A. A. Franke. 1988. Protein and major cations in California market milk. J. Dairy Sci. 71:917-924.
13. Eppard, P. J., D. E. Bauman, J. Bitman, L. D. Wood, R. M. Akers, and W. A. House. 1985. Effect of dose of bovine growth hormone on milk composition: α -lactalbumin, fatty acids, and mineral elements. J. Dairy Sci. 68:3047-3054.
14. Pennington, J. A. T., D. B. Wilson, B. E. Young, R. D. Johnson, and J. E. Vanderveen. 1987. Mineral content of market samples of fluid whole milk. J. Amer. Dietetic Assn. 87:1036-1042.

Preparing For a Disaster Before and After

An Action Plan for Food Operations

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DISASTER PREPAREDNESS ACTION PLAN

Introduction

When a disaster strikes your area, it affects your employees and their families, your friends, your neighbors, your customers, and your business. In short, disaster affects your entire community and everyone in it. In the time of disaster, we need to respond to the community's needs quickly when and where appropriate and practical.

This plan was developed to provide management personnel with a concise summary of "what to do" before and after a disaster strikes. By reading this plan, one should have the necessary information to plan and survive a disaster with few complications. Familiarity with "what to do" during a disaster is not only comforting, but will give management confidence in addressing the situation.

This plan will address "Natural Disasters," including tornados, floods, hurricanes, earthquakes, fires, explosion, and the resulting damage from these disasters. In addition, information is provided on "Mechanical Emergencies" including power failure, loss of water pressure, sewage backup, and resulting damage.

The purpose of this plan is to provide a procedure which can be systematically followed by management and other personnel prior to, during, and after an emergency or disastrous occurrence; to ensure that everything that can be done to reduce or prevent the occurrence of additional hazardous conditions or incidents has been accomplished to the best of your knowledge and abilities. Furthermore, it is essential that we reduce the potential for additional losses in the areas of personal injury, physical plant, and product.

Community Involvement

When a major disaster strikes and your business can render effective assistance, assess the situation and determine how you might best help your neighbors. Contact the Red Cross or other relief agencies and determine what would help. Contact law enforcement officials and find out where your operation could come to your community's rescue.

Complimentary hot coffee and food could be delivered to road crews clearing streets. You could stay open later to serve rescue workers and volunteers. Hot coffee and soup

could be transported to first-aid stations in carry-out containers. Your employees could assist in the serving or distribution of these items. Food could be donated rather than thrown away in a power failure. You could offer lobbies for pick up points of needed supplies. You could invite neighbors without water to bring containers to be filled at your operation if you maintained a safe water supply.

The action to be taken will be determined by the seriousness of the disaster, the needs of your community, and your ability to help.

When there are logical ways you can help, be sure to keep the offer genuine and non-promotional. Offering a two-for-one hurricane special to homeless families could be seen as tasteless and too gimmicky for a serious situation. It could result in negative rather than positive public relations. In the long run, you want to be remembered for your generosity at the time of the disaster. Do not be labeled as a company which attempted to profit from a community's misfortune.

Above all, **make no commitment** to your community that you cannot live up to.

Getting the Word Out

Once your plan to help has been approved, you need to let the community know.

Contact television, newspapers, and radio station newsrooms and ask them to make an announcement of your offer in print or over the air. If media are on the scene giving live coverage, send a note to the reporter, or ask to make the announcement yourself over the air.

Call the police, fire department, Red Cross, or other appropriate organizations involved in the situation and ask them to relay your offer to the victimized.

During a disaster, news reporters are anxious for any angles on involvement from business in the community, particularly during live coverage.

Being Prepared

The old saying of "an ounce of prevention is worth a pound of cure" is the guiding light when it comes to disaster planning. Prevention or good planning is the key to success in surviving any disaster. Knowing what to anticipate and the proper alternatives to pursue will give anyone a comfort-

ing command of the situation. Remember those two words, "planning" and "command" - if you have accomplished the former and have the proper tools to attack the latter, you will succeed.

In addition to reading this plan, three essential items to have on hand during a Natural Disaster are:

1. A flashlight - Without a good flashlight (with working batteries, of course) one is lost during darkness. When the power fails, a flashlight is necessary to move about to accomplish necessary tasks. One may even need the flashlight to refer to this plan. Each operation should be equipped with a two or three cell D-size battery flashlight. Equip the flashlight with alkaline batteries since they have twice the life of regular carbon/zinc batteries. Once a month, check the flashlight for brightness. At least every six months replace the batteries in the flashlight regardless of previous use or brightness.
2. Pen and paper - Throughout a disaster it is necessary to record events or make notes. Noting telephone numbers, product temperatures, names of individuals to contact, times, destroyed product, etc. are only some of the many things a manager will record. So, add to your disaster kit, to accompany the flashlight, a 3 x 5 spiral notepad and pen.
3. Battery-powered radio - During a Natural Disaster, it is important to know what is happening or is about to happen, so stay tuned to local radio stations for details. Up-to-date information will enable management to make more accurate decisions. Do **not** listen to rumors since people often exaggerate the situation to make it more interesting to talk about. The battery-powered radio should be equipped with alkaline batteries, checked regularly, and batteries replaced every six months.

While there are numerous other things that could be suggested for a disaster kit, such as first aid supplies, blanket, or even tape for windows, items such as a flashlight, pen, paper, and radio are essential. These four items will aid management in preparing for and addressing a Natural Disaster.

Initial Action

Being prepared is management's first responsibility during a Natural Disaster. If a disaster is apparent or weather conditions are conducive for a potential threat, monitor local radio stations immediately. At the same time, check flashlights and other emergency equipment to ensure they are in good working order.

The safety of your customers and your employees **always** comes first. In case of an unexpected disaster (fire, explosion, etc.) evacuate the building as quickly and orderly as possible. **Do not panic.** Have larger employees physically carry out children, handicapped, or elderly persons. Since employees are more familiar with the operation they can quickly move toward exits even under heavy smoke conditions. Other employees may be needed to lead out customers by hand if necessary. If smoke is extremely dense, crawling on one's hands and knees near the floor will provide the best visibility.

If it is apparent that a disaster will strike shortly

(tornado, hurricane, etc.), contact your headquarters' office for closing advice and scheduling. When the directions for closing are issued, you should then evacuate and close the operation. Immediately begin to make necessary preparations, as discussed later in the plan, for the specific disaster. Remember, your employees will be concerned about their own homes and families, so do not be surprised if you are the only one left behind to do all the preparation. After completing the necessary disaster preparation, and if time permits, lock and leave the building. If you have prepared properly, there is nothing you can do to stop the disaster from striking the building. Go home to your family — they will need your support, too. After the disaster is over, return to the operation as soon as possible to assess damage and make emergency repairs.

Physical Plant

The physical plant includes the roof, roof-mounted equipment, and all related utilities, i.e., water, gas, and electricity. If, in the event an incident should occur which appreciably affects the unit, such as may occur with high winds, water, etc., then the following actions should be initiated:

A. Utilities - If gas is provided to any equipment in the area affected by the incident, then action must be taken to **shut off** the gas supply to all equipment.

B. Power Failure

1. In the event an incident should occur which causes a power failure which is predicted to be of a long duration, then immediate action must be taken to provide for backup refrigeration equipment. If refrigeration equipment is unavailable, then the acquisition of dry ice or portable generators would be the alternative. Further details are given later in the plan on refrigeration procedures.

If any situation or incident is forecast or predicted to occur which could cause power loss, then this action should be initiated immediately.

NOTE: The prediction or forecast may prove to be inaccurate. However, the cost incurred for the action taken will be minimal in relation to possible losses if no action was taken and forecasts were accurate.

2. When a total loss of power is experienced due to a disaster, it is very likely that when power is restored the voltage will be less than normal (such as would occur during a brown-out). Therefore, when a power outage of this nature occurs, all disconnects should be placed in the OFF position. This action will eliminate damage to electrical equipment due to low voltage. The voltage should be tested by an electrician prior to operating the equipment to ensure the voltage is sufficient for safe operations.

C. Roof

1. Roof-mounted equipment must be inspected for loose-fitting or missing panels as this will allow for water leakage into the unit.
2. Gas equipment with pilot lights should be checked before and after the gas supply is restored to the equipment. Remember, if the gas is interrupted then the

pilots must be relighted.

3. Drains and down spouts should be cleared of any debris to ensure proper roof drainage. The roof should be cleared of any debris which may interrupt the draining of roof water.

D. Water Supply - Should the water supply be temporarily interrupted or a break occur in the main water line, a sampling of the water should be taken for microbial testing. The local health department will, in most cases, be able to give the quickest information on whether or not operation may continue. Under no circumstances should food processing or serving be conducted while a potable water supply is not available. Turn off all water faucets/outlets if the water supply is restored.

E. Drain Backup or Sewage - Normal drain backup during floods, fires, hurricanes, etc., should constitute action to assure food products are off the floor. Any food products coming in contact with sewage or drain backup effluent should be destroyed. Prior to resuming operation after backup through floor drains, floors should be scrubbed with soap and sanitized with bleach.

F. Sewage Treatment Plants - Any break in service of the sewage treatment plant should require immediate notification to the operator for restart or any other steps needed.

G. Emergency Lighting - The normal length of operation of an emergency lighting system is 2-3 hours. Each unit should be equipped with a flashlight or portable battery-operated unit for periods after the emergency system is extinguished. Candles should not be used for this type of occurrence because of possible explosion due to broken gas lines.

H. Sign Posting - During shutdown periods, a "closed" sign should be posted on the front door to eliminate the entrance of customers or **interference** with other people working to correct problems. This will keep out undue traffic and minimize the chance for liability claims.

I. Sanitizing - Prior to resuming operation, all food contact surfaces and utensils should be sanitized to prevent the introduction of disease agents into the food supply.

J. Garbage Removal - During periods of non-operation, all garbage should be removed from the building as soon as possible. This will minimize the chance of off odors and vermin infestation. Consideration should be given to whether or not pesticides should be employed or treatment requested.

K. Reporting Damage - Should damage occur to the building structure or equipment, efforts to communicate these should be conducted as soon as possible to appropriate company personnel.

Refrigeration

If the emergency includes a loss of power, the length of estimated power loss should be determined. If the estimated loss will be greater than 24 hours, arrangements should be started to obtain an outside frozen storage facility/freezer truck, etc. for the frozen food to be stored. Monitor food temperatures and initiate steps to assure frozen foods do not reach levels higher than 20° F through making available a truck trailer designed for frozen food use. Local dairies, freezer warehouses, or local Ryder truck rental

services are all possibilities to use. It should be noted, however, that during emergency situations the availability of this equipment is hard to attain and should be addressed by management prior to actual emergency conditions.

Temporarily frozen food can be kept solid using dry ice. Dry ice can be purchased locally from ice cream manufacturers, Carbona distributors, etc. Check the Yellow Pages for its availability. A 10 ft. x 10 ft. freezer would require about 200 lbs. of dry ice. Using gloves, place dry ice as high as possible in freezer on shelving. Do not place dry ice directly on food. Close the freezer door. When reopening the freezer door, allow the door to stand open for 15-20 minutes before entering. Dry ice evaporates into carbon dioxide and will cause unconsciousness to anyone entering prematurely. After using dry ice, never enter a freezer without telling someone where you are.

Food products requiring holding temperatures of 34-45° F should also be monitored and documented. As the food products move into the danger zone, above 45° F, efforts should be immediately made to keep foods cold through the use of ice in walk-in coolers or portable refrigeration containers such as truck trailers designed for this temperature range. If neither of these items are accessible for holding products requiring the 34-45° F range, an understanding by management should exist whereby after a given period of time, these products will be discarded to eliminate the potential for foodborne illness and spoilage.

Keeping gaskets on all refrigerators and freezers in good repair will aid in maintaining temperatures for the longest possible time. In addition, keeping doors closed on refrigerators will keep the warmer room temperature air out and preserve the cold air inside. Accurate external thermometers will assist in monitoring temperatures without having to open the refrigerator door.

Dry ingredients will **not** be affected by a loss of power or water. However, if flooding should occur, all dry goods, ingredients/paper supplies, etc., should be stored as far from floor level as possible.

Reuse of Food

After a Natural Disaster, power outage, etc., all food must be examined closely prior to reuse. Use of a potentially hazardous product is not worth the resultant damage to your public image if a foodborne illness should occur. Health Department personnel should be contacted to provide the store with evaluation of questionable food products.

Generally, fire and smoke damage cause the greatest product destruction. Smoke odors seem to penetrate almost any type of container with the exception of canned goods. However, canned goods are generally destroyed by the heat of the fire. If a fire occurs, one can generally consider total product loss.

In case of food items subjected to floodwaters, the following apply:

A. Milk - Milk in any type of container must be discarded.

B. Canned Goods

1. Check closely, and discard all bulging or leaking cans, or cans that are dented in any way. Do not take a chance with dented cans, even though you

may not be able to find a leak — bacteria can get into a hole too small for liquids to leak out!

2. Discard all food items that are not in solid, sealed cans, such as items with caps on them (for example, soft drinks, ketchup, beer, mustard, etc.), or dry goods such as breading, flour, sugar, mix, etc.
3. For food items in solid, sealed cans, before you use them write the contents on the lid with a waterproof marker, remove all paper labeling, wash the cans thoroughly in hot soapy water, rinse, then submerge them in chlorine solution for five minutes.

C. Frozen Foods

1. If the freezer has been covered with floodwaters the food within has probably been damaged by seepage. The food should be **DISCARDED**.
2. If the electricity has been cut off and no **floodwater** has entered the freezer the amount of food in the box will determine keeping qualities. A fairly full freezer box will come through a one-or-two day period without much loss of quality and flavor. Keep the door shut to retain cold.
3. **Partially-thawed** meat can be refrozen without much loss in quality.
4. **Completely-thawed** meat can be cooked and refrozen provided it has not reached temperatures above 45° F.
5. Fish, shellfish (clams, oysters, etc.), and frozen cooked goods that have been thawed should be **DISCARDED**.
6. The flavor and texture of vegetables and fruits are impaired upon thawing and refreezing. You may as well **DISCARD** these items.
7. Solid frozen foods are safe, unless exposed to floodwaters.

When there are any questions regarding the quality or integrity of food contact the local health department for assistance.

Accidental Disasters

Unlike Natural Disasters, there are disasters caused by accidents as well. These Accidental Disasters could be accidental release of poisonous chemicals into the area or radiation leaks. Since these disasters vary depending upon the agent involved, and generally require specialized technical evaluation they will not be discussed in this plan. If these occur, immediately contact your headquarters' office, or local health department for assistance.

Summary

Once again we would like to stress your commitment to offer community assistance quickly, where and when possible, and practical. But first during a disaster, your concern must be your neighbors, employees, their families, and your customers.

Definitions

The following are the definitions of related words for your information:

TORNADOS:

Tornado watch - Indicates there is a chance of dangerous weather, followed by damaging winds.

Tornado warning - Indicates a tornado has been sighted nearby.

Danger signs - Severe thunderstorms, hail, roaring noise, funnel.

General statement: Tornadoes have two seasons: May through August is when most tornadoes occur, however, the most devastating occur in December through April.

Tornadoes are more unpredictable than hurricanes because you do not have ample warning to take action before they hit.

A tornado watch can cover an area of 140 miles wide by 200 miles long. It does not mean that severe weather cannot occur, even outside this area. So pinpointing, so much desired by everyone, is not possible.

It is nearly impossible to issue warnings with any accuracy before a tornado is sighted or indicated by radar.

During a watch, keep a battery-operated radio nearby and listen for weather advisories.

If a tornado hits:

1. Check again to be sure all electric power is off.
2. If the operation is occupied when a tornado is approaching, all occupants should seek protection along inside walls of building or walk-in boxes, leaving doors of boxes open.
3. Notify Police or Sheriff's Department, and Fire Department.
4. Do not physically move anyone who may be injured or in shock until examined by a paramedic or technician from the rescue squad, nurse, or others from the medical profession.
5. Assign a staff member to keep record of identification of persons moved from the unit and their destination.
6. Uninjured persons should be gathered together in a safe area of the building to await removal to another designated area or to their homes.

HURRICANES:

When your area is covered by a hurricane watch:

1. A hurricane watch means possible danger within 24 hours. If the danger materializes a hurricane warning will be issued. Meanwhile, keep alert and ignore rumors.
2. Continue normal activities but stay tuned to radio or television for all weather bureau advisories.

When a hurricane warning is issued:

1. A hurricane warning means that a hurricane is expected to strike an area within 24 hours.
2. Plan your time carefully to avoid last-minute preparation which may leave you unprotected or unprepared.
3. Board up windows or protect them with storm shutters or tape. Small windows are generally broken by wind-driven debris. Large windows may be broken by wind pressure.
4. Secure outdoor objects that might be blown away or uprooted. Anchor them or store them inside.

5. In the event a decision is made to close the operation, you should cut off the gas supply. Anchor outside propane and butane tanks. It may also be necessary to shut off electrical power if there appears to be a danger of flooding or moisture inside the unit.
6. Keep your auto fueled. Service stations may be inoperable for several days after the storm strikes.
7. Draw curtains, shades, or blinds to protect from breaking glass.

After the storm:

1. Avoid broken or long dangling power lines as well as objects which may be in contact with them. Notify Police or utility companies of dangling or broken wires.
2. Listen to your radio for instructions from local authorities. Drinking water may have to be sterilized. You can do this by boiling water vigorously for two minutes, using water purification tablets available at drugstores, or adding household chlorine bleach, stirring well and allowing it to sit 30 minutes before using. Two drops of bleach per quart should be added to clear water and four drops per quart for cloudy water.
3. If power has failed, do not open freezers unless necessary for inspection until power is restored or until you can obtain dry ice. See Refrigeration Section.
4. Report broken sewer and water mains to the water department.
5. Make whatever repairs are necessary to protect your unit from further damage by wind and rain. Board up windows or cover with canvas, and cover holes in roof or siding with temporary materials.

FIRE:

In the event of a fire, the main power switch should be turned off to prevent spread through electrical wiring or shock from melted conduit. All food product must be examined for smoke or water damage prior to reopening or use.

DISASTER CHECKLIST

EVACUATION

- _____ Keep all exits clear.
- _____ Are alternate exits available?
- _____ Calmly and orderly evacuate building.
- _____ (check rest rooms).
- _____ Call for assistance.

SUPPLIES

- _____ Working flashlight.
- _____ Pen and paper.
- _____ Battery-powered radio.
- _____ First aid supplies.
- _____ Emergency telephone numbers.

UTILITIES

- _____ Shut off electric power at main breaker.
- _____ Shut off individual equipment or unplug.
- _____ Turn off all water faucets/outlets.
- _____ Shut off gas supply at main valve.

ACTIONS

- _____ Secure all compressed air cylinders with chains or by strapping tape in upright position.
- _____ Secure hanging signs and exterior accessories.
- _____ Secure or anchor all objects that could become airborne (knives, cutting boards, pans, etc.).
- _____ Make arrangements to secure a refrigerated truck or a freezer truck.
- _____ Order dry ice.
- _____ Check and record refrigeration/freezer temperatures, compare actual interior temperature with exterior gauge and record variance.
- _____ Call Headquarters' Office for other directions.
- _____ Lock up and go home.
- _____ Have car filled with gasoline.

EMERGENCY NUMBERS

COMPANY

- Regional Director _____
- Area Supervisor _____
- Quality Assurance Dept. _____
- Engineering or Facilities Dept. _____
- Food Storage Warehouse _____

LOCAL

- Police _____
- Fire _____
- Red Cross _____
- Civil Defense _____
- Electric Utility _____
- Gas Utility _____
- Water Department _____
- Sewer Department _____
- Electrician _____
- Plumber _____
- Equipment Rental _____
- Dry Ice _____
- Generators _____
- Refrigeration Trucks _____

OTHER

Biological Effects of ^{137}Cs Uptake in Carp (*Cyprinus Carpio* L.)

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Abstract

An experiment was conducted in a fresh-water fish, *Cyprinus carpio* cultured in small water tanks, artificially contaminated with ^{137}Cs (1,500 and 3,000 Bq L⁻¹), to determine the uptake of ^{137}Cs and its physiological and histological effects in different fish organs. The fish were killed every 2 weeks and the whole experiment lasted 6 months.

It was found that the presence of ^{137}Cs in all organs tested caused a gradual hydrophobic degeneration. In high doses, up to 3,000 Bq L⁻¹ hyperemia in all organs and secondly hydropsy and enlarged or ruptured urinary bladder were very common. Allergic or toxic effects of ^{137}Cs may cause hyperemia with focal hemorrhages in musculature tissue, a final stage movement-nucleus of kidney cells and fatty degeneration of hepatic cells. Morphological changes were not found.

Introduction

The principal source of artificially produced radioactivity in estuaries will be radioactive wastes from nuclear power plants. Although radionuclides in estuaries do not occur in sufficient quantities to damage fishery resources, they could, if permitted to increase without adequate surveillance and discharge limitations, become a threat to fisheries and to man (Rice et al. 1972).

Interactions between radionuclides and organisms vary with concentrations, chemical states and species of nuclides as well as organisms, concentration capabilities, transmission pathways and often other factors. Following uptake, biological effects will depend on the nuclides half-life and emission type as well as location within organisms and concentrations or dilution tendencies in food chains (Osterberg et al. 1964).

This program is part of a general study directed toward determining the levels of radionuclides in marine organisms which are food to man. To make analytical data relevant to the problem of radioactivity in the food chain leading to man, it is important to understand the pathway for radionuclides through the trophic level (Halver 1972).

The ^{137}Cs may reach the marine organisms by three pathways: 1) by fallout or rainout of airborne particles and gasses from the troposphere, 2) by erosion and redistribution of marine material by tidal action, 3) by sediment transport from rivers into the lake or estuary (Halver 1972).

This work represents the progress made and the results accumulated during the first year of study. The amount of ^{137}Cs lethal to carp (*Cyprinus carpio*) was unknown and therefore carried out preliminary toxicity determination of ^{137}Cs on carp (Vosniakos et al. 1989).

The specific purpose of these experiments was: 1) to determine the approximate dose of ^{137}Cs that is crucial to carp and 2) to find the pathological changes and the gross distribution of ^{137}Cs in the fish.

Methods and Materials

Two experiments were conducted in the fresh-water fish, carp (*Cyprinus carpio*) cultured in small water tanks artificially contaminated with radioactive ^{137}Cs .

The fish *Cyprinus carpio* L., weighing 25-30g were collected from their natural environment 2 d before the experiment. They were kept in a 200 L aquarium provided with good aeration and a continuous throughflow of tap water dechlorinated by active carbon. All experiments were conducted under fully aerated conditions. The fish acclimated well to the aquarium conditions, behaved well and no disease occurred. The phytoplankton produced in the aquarium was used as food by the carp.

The fish were sacrificed every two weeks, weighed, their length was measured and the overall condition of the fish was compared with the control. Visual observations were recorded and the radioactivity of a few organs was measured. The samples of the organs were fixed with 10 percent formalin, embedded in paraffin and sections of 5-10 μ thickness stained with Erlich's hematoxylin-eosin.

Results and Discussion

No changes, visual or microscopic were noticed in the control carp. Behavioral changes were not observed. The fish kept their balance and respiration was normal.

The visual and histopathological observations on carp are the following in doses of ^{137}Cs up to $1,500 \text{ Bq L}^{-1}$: Visually all organs showed a gradual hypertrophic degeneration (Mazzi 1982; Ghittino 1982).

Gills: Degeneration of epithelial cells and consequent fusion of lamellae final stages.

Musculature tissue: Primary stage of hyperemia with focal hemorrhages and final stage of degeneration of muscle fibers.

Liver: Hyperemia and hydropic degeneration and final stage of fatty degeneration of hepatic cells that may be due to toxic effects of ^{137}Cs .

Kidney: Gradual degeneration of kidney parenchymal cells and final stage of movement - nucleus of kidney cells.

Heart: Hydropy with degeneration of heart fibers.

Brain: Diffuse hyperemia and in certain areas degeneration of nerve cells.

In higher concentrations of ^{137}Cs ($3,000 \text{ Bq L}^{-1}$) the visual and histopathological observations are as follows: Visually all organs showed hyperemia, hydropsy and gradual degeneration with strong signs of anaemia (Mazzi 1982; Ghittino 1982).

Musculature tissue: Initial and final stage of moderate degeneration of muscle fibers. Hyperemia with focal hemorrhages and strong inflammation of muscle fibers, probably due to allergic effects of ^{137}Cs (Dougherty and Ng 1982; Hunt et al. 1982).

Liver: Diastole of liver blood-vessel with hyperemia and fatty degeneration probably due to toxic effects of ^{137}Cs (Dougherty and Ng 1982; Hunt et al. 1982).

Kidney: Gradual degeneration of kidney parenchymal cells. Diastole of glomerulus and vessel. Final stages movement - nucleus of kidney cells.

Brain: Diffuse hyperemia and final stages of degeneration of nerve cells.

Spleen: Hyperemia and degeneration of parenchymal cells.

Gills: Degeneration and proliferation of epithelial cells and consequent fusion of lamellae. In some cases dilatation of lumen of the capillaries in lamellae.

Heart: Hydropsy, myocarditis (degeneration of cells) and pericarditis.

Tables 1 and 2 showed the changes in size and weight of carp living in two concentrations of ^{137}Cs . The decrease in size and weight was indicative of the toxic effects of ^{137}Cs .

Conclusions

The long-term chronic exposure of carp (*Cyprinus carpio*) to ^{137}Cs in two different concentrations, caused allergic and toxic effects to fish. We concluded though that carp is quite resistant in the presence of ^{137}Cs at the levels tested.

References

- Dougherty, G., Ng, C. E. ^{137}Cs and ^{40}K levels in marine species caught in Malaysian Waters. *Health Phys.* 43(6):915-919. 1982.
 Ghittino, P. Technology and Pathology in Aquaculture. Vol. 2, Pathology, E., Bovo, Torino, p. 444. 1985.

Table 1. Toxicity of ^{137}Cs ($1,500 \text{ Bq L}^{-1}$) to *Cyprinus carpio*.

Fish no	Length (cm)	Weight (g)	Time of killing (d)
1	12.5	47.3	5
2	12.6	46.2	5
3	11.4	31.3	15
4	11.8	29.6	15
5	11.6	36.4	28
6	11.7	35.2	28
7	12.2	55.0	45
8	13.5	53.3	45
9	11.6	43.7	60
10	11.9	42.4	60
11	9.7	41.3	75
12	10.2	40.0	75
13	9.2	24.0	90
14	9.8	22.5	90
15	11.0	31.1	105
16	11.6	29.5	105
17	10.7	32.3	120
18	11.0	31.2	120

Table 2. Toxicity of ^{137}Cs ($3,000 \text{ Bq L}^{-1}$) to *Cyprinus carpio*.

Fish no	Length (cm)	Weight (g)	Time of killing (d)
1	9.6	29.0	5
2	9.7	28.5	5
3	10.2	30.0	15
4	10.5	28.6	15
5	10.0	30.2	30
6	10.9	28.0	30
7	11.5	41.5	47
8	11.5	39.0	47
9	12.7	61.0	60
10	13.0	60.0	60
11	12.3	50.9	75
12	12.8	48.3	75
13	14.0	56.3	90
14	14.2	55.0	90
15	11.5	46.8	105
16	12.4	45.7	105
17	12.5	53.1	120
18	12.8	51.6	120
19	9.3	30.1	135
20	10.0	29.0	135
21	10.5	34.3	150
22	11.6	32.7	150
23	9.0	19.0	165
24	9.6	17.3	165
25	9.8	25.5	180
26	10.6	25.0	180

- Halver, J. E. Fish nutrition. New York. Academic Press, 1972.
 Hunt, G. J., Hewett, C. J., Shepherd, J. G. The identification of critical groups and its application to fish and shellfish consumers in the coastal area of the Northeast Irish sea. *Health Phys.* 43(6):875-889. 1982.
 Mazzi, V. Manual of Hystology and Hystochemistry Techniques, Piccin Editors, Padova, p. 248. 1982.
 Osterberg, C., Pearcy, W. J., Curl, H., Jr. Radioactivity and its relationship to oceanic food chains. *J. Mar. Res.* 22(1):2-12. 1964.
 Rice, T. R., Baptist, J. P., Cross, F. A., Duke, T. W. Potential hazards from radioactive pollution of the estuary. *Marine Pollution and Sea Life*, Fishing News (Books) L.T.D. Surrey, England, 1972.
 Vosniakos, Fl, Kesidou, A., Kalfa, A., Moutzsis, A., Karakoltzidis, P. Uptake of ^{137}Cs in cultured fresh-water fish (*Cyprinus carpio*): Physiological and histological affects. In: Environmental Pollution and its Impact on Life in the Mediterranean Region, proceedings of the Fifth International Symposium, M.E.S.A.E.P., Blanes, Spain, October 2nd to 6th, 1989.

The Seminar Division of European Packaging Newsletter and World Report announces its Fall 1992 seminar schedule

European Packaging Waste Legislation and its Effects of American Exports
Chicago, Illinois, November 7, 1992
1:00 - 6:00 p.m.

Our founding editor, Pierre J. Louis, has scheduled and programmed this seminar for the convenience and economy of staff who will be in Chicago to attend PACK EXPO. He has agreed to present an up-to-the-minute situation report on the packaging implications of the all important January 1, 1993 date for the implementation of mandatory legislation rulings that every American company must face.

The mass market of 400 million European customers is more available every day — but the ground rules for a consortium Europe are stringent and will influence every aspect of product development — packaging and movement. It's been a changing and emerging situation and has moved far beyond the well covered environmental characteristics. Specifications for sale packaging, transport packaging, and intermediate containers are all specified in new laws and mandatory promulgatory regulations.

It's a brand new ball game and Pierre Louis is arguably the best informed person in the world to discuss these matters. He has followed the legislative development in each EEC country and the published procedures and directives with which the American exporter must comply. His 40-year background in every segment of the packaging world offers unparalleled in-depth knowledge to the American manufacturer and exporter interested in the European market now and in the future.

Full details and preliminary program may be obtained by contacting Marilyn Berry at (703)519-3907 or by writing to European Packaging Newsletter and World Report, Seminar Division, 669 S. Washington Street, Alexandria, VA, 22314-4109 USA.

1991 Dry Milk Census Results and 1991 Whey Products Survey Results Now Available

The American Dairy Products Institute, national trade association of the processed dairy products indus-

try, is pleased to announce the availability of its annual publications "1991 Dry Milk Products Utilization & Production Trends" and "Whey Products, 1991 Utilization & Production Trends." Copies of these publications may be purchased from the Institute.

"1991 Dry Milk Products Utilization & Production Trends" contains comprehensive industry data and reliably reflects domestic sales and specific markets of utilization for nonfat dry milk, dry whole milk, and dry buttermilk. Data on the utilization of concentrated forms of these milk products also are presented. The survey included American Dairy Products Institute members, other cooperating processors, and resellers, and reflects approximately 91% of the total domestic dry milk distribution.

Data assembled and presented in "Whey Products, 1991 Utilization & Production Trends" reflect the results of the Institute's seventeenth industry-wide survey of end-uses for whey products. The survey included American Dairy Products Institute members, other cooperating processors, and resellers, and reflects approximately 86% of the USDA-reported whey solids processed during 1991.

Additional information of interest to condensed and dry milk processors, whey processors, marketers/distributions and users has been included in these 1991 publications. The inclusion of such information presents a more complete picture of the manufactured milk products industry and whey products industry by providing cognizance of supply-demand patterns and their relationship to overall marketing. Continued market research and the development of new uses for the various condensed and dry milk products and whey products are necessary for continuing expansion of this segment of the dairy industry. To that end the American Dairy Products Institute was founded and is dedicated.

For further information about these publications, contact the American Dairy Products Institute, 130 North Franklin Street, Chicago, IL 60606. Telephone: (312)782-4888/5455, FAX (312)782-5299.

New Brochure from International Paper Provides Guidelines for Implementing School Milk Carton Recycling Programs

International Paper, the world's leading supplier of gabletop paperboard milk and juice containers, has published a brochure outlining the steps for implementing a school milk carton recycling program.

The fold-out pamphlet, which is itself printed on recycled paper incorporating repulped milk cartons,

describes the benefits of recycling, shows what happens to the reclaimed materials and discusses economic feasibility. It includes a checklist of actionable items, a flow chart and sources for further information.

For more information contact Janet Peterson or Henry P. Feintuch, KCS&A Public Relations, 820 Second Avenue, New York, NY 10017, (212)682-6565, ext. 228/211, FAX (212)697-0910.

Seminar to Update Bakery Maintenance Engineers

A seminar to arm frontline maintenance supervisors in food plants with the knowledge to maintain a smooth-running and efficient operation has been scheduled by the American Institute of Baking.

Maintenance Management will be offered in Manhattan, Kansas, November 16-20, and will feature key industrial speakers as well as the Institute's professional staff. Topics covered will include employee management, working with unions, controlling maintenance costs, energy analysis and use, budgeting, and evaluating the maintenance staff.

The seminar will also stress the elements of a successful maintenance program, how to write and implement it, and proven evaluation procedures.

"The course will be particularly valuable to management personnel in plants that are moving into or expanding the computerization of maintenance operations and recordkeeping or those planning to expand production or

distribution systems," explained Scott Casey, director of bakery maintenance engineering at AIB.

Plant managers, engineers, supervisors, foremen, or any professional responsible for successful and efficient equipment operation in a modern bakery will find this seminar worthwhile. It is also part of the sequence of courses leading to recognition as an AIB Certified Bakery Maintenance Engineer.

Tuition fees for the seminar are \$650 per participant for representatives of member companies of the Institute and \$750 for non-members. For further information write to the Registrar, American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502 or call (913)537-4750 or (800)633-5137.

Gillette Dairy Wins Gingrich Award for Production Excellence

Quality Chekd Dairy Products Association has named Brown Swiss Gillette Dairy winner of its 1992 Gingrich Award for production excellence.

The Gingrich Award recognizes the best single production plant in the Quality Chekd organization, and signifies the highest standards of quality in both freshness and cleanliness. This is the second time in several years Gillette has won the annual award.

Headquartered in Rapid City, SD, Brown Swiss Gillette provides dairy products to consumers in Nebraska, South Dakota, and Wyoming.

For more information contact Les Chaffin (402)371-3660 or Wendy L. Flanagan (812)426-7720.

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Updates . . .

Twelfth - Food Microbiology Symposium and Workshop at the University of Wisconsin - River Falls

The University of Wisconsin-River Falls will hold a symposium entitled "Current Concepts in Foodborne Pathogens and Automated Methods in Food Microbiology." The program is scheduled for October 22-23, 1992. A Rapid Methods in Food Microbiology workshop designed to provide practical demonstrations and discussion of various tests and instruments available for rapid detection, isolation and characterization of foodborne pathogens and toxins as well as prediction of shelf-life and checking hygiene and sanitation in food processing facilities is also scheduled. Registration for symposium and workshop is \$175 (\$200 after October 1, 1992).

For additional information contact Dr. Purnendu C. Vasavada, Animal and Food Science Department, University of Wisconsin-River Falls, River Falls, WI 54022, Phone: (715)425-3150, FAX: (715)425-3785.

IAMFES Has Moved

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CALL FOR PAPERS FOR THE 80TH IAMFES ANNUAL MEETING

**Waverly Stouffer Hotel
Atlanta, Georgia
August 1-4, 1993**

This is an invitation to all IAMFES Members to submit a paper for presentation at the 80th IAMFES Annual Meeting, to be held at the Waverly Stouffer Hotel, in Atlanta, Georgia, August 1-4, 1993. Abstract forms are published on pages 695-698 of this issue of *Dairy, Food and Environmental Sanitation*.

To receive more information on submitting a paper for presentation at the 80th IAMFES Annual Meeting, contact IAMFES at (800)369-6337 (U.S.) or (800)284-6336 (Canada) or (515)276-3344, or write IAMFES, 200W Merle Hay Centre, 6200 Aurora Avenue, Des Moines, IA 50322.

**Deadline for Submission of Abstracts:
DECEMBER 15, 1992**

Authors Wanted

Dairy, Food and Environmental Sanitation is looking for individuals interested in writing articles for our journal.

If you are interested, please contact IAMFES for more information.

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Federal Register

Environmental Protection Agency

***Pseudomonas fluorescens* A506, *Pseudomonas fluorescens* 1629RS, and *Pseudomonas syringae* 742RS; Exemptions From the Requirement of a Tolerance**

Agency: Environmental Protection Agency (EPA)

Action: Final Rule

Summary: This rule establishes an exemption from the requirement for a tolerance for residues of the biological pesticides *Pseudomonas fluorescens* strain A506, *Pseudomonas fluorescens* strain 1629RS, and *Pseudomonas syringae* strain 742RS in or on all agricultural commodities when applied as a frost protection agent or biological control agent to growing agricultural crops in accordance with good agricultural practices. This exemption was requested by the Frost Technology Corp.

Effective Date: This regulation becomes effective September 16, 1992.

Addresses: Written objections, identified by the document control number, (PP 1F4015/R1160), may be submitted to: Hearing Clerk (A-110), Environmental Protection Agency, Rm. M3708, 401 M St., SW, Washington, DC 20460.

For Further Information Contact: By mail: Susan T. Lewis, Product Manager (PM) 21, Registration Division (H7505C), Environmental Protection Agency, 401 M St., SW, Washington, DC 20460. Office location and telephone number: Rm. 227, CM #2, 1921 Jefferson Davis Highway, Arlington, VA 22202, (703)557-1900.

Supplementary Information: In the Federal Register of July 15, 1992 (57 FR 31371), EPA issued a notice that the Frost Technology Corp., 6701 San Pablo Ave., Oakland, CA 94608-1239, had submitted pesticide petition (PP) 1F4015 to EPA proposing to amend 40 CFR part 180 by establishing a regulation pursuant to section 408 of the Federal Food, Drug, and Cosmetic Act, 21 U.S.C. 346a, to exempt from the requirement of a tolerance the residues of the biological pesticides *Pseudomonas fluorescens* and *Pseudomonas syringae* in or on all raw agricultural commodities when applied as a frost prevention or biological control agent to growing crops in accordance with good agricultural practices.

There were no comments or requests for referral to an advisory committee received in response to the notice.

These bacteria are naturally occurring isolates selected for their ability to compete with and reduce populations of ice-nucleating bacteria on plant surfaces. Reduction of

numbers of ice-nucleating bacteria may result in the prevention of frost damage to plants. The bacteria will also aid in the control of fire blight of apples and pears. *Pseudomonas fluorescens* is ubiquitous in the environment and is a natural component of the microbial flora of soil, water, and plants. *Pseudomonas syringae* is similarly widespread and may commonly be found on the majority of plant surfaces and less commonly in soil and water. These bacteria are not generally regarded as human or animal pathogens.

The data submitted in the petition and all other relevant material have been evaluated. The toxicological data considered in support of the exemption from the requirement of a tolerance include an acute oral toxicity/pathogenicity study in the rat and an acute intraperitoneal injection study in the mouse, using a combination of *Pseudomonas fluorescens* strains A506 and 1629RS and *Pseudomonas syringae* strain 742RS. The results of these studies indicated that these organisms were not toxic or pathogenic to rats by the oral route of exposure and not lethal or significantly toxic to mice by intraperitoneal injection. Testing of various *Pseudomonas* strains closely related to those considered in the petition was conducted. Acute oral and acute inhalation toxicity tests indicated that the strains tested were not lethal or toxic to rats. Primary eye and primary dermal studies in rabbits using closely related strains showed no significant irritation effects. The toxicology data provided are sufficient to demonstrate that there are no foreseeable human health hazards likely to arise from the uses of *Pseudomonas fluorescens* strain A506, *Pseudomonas fluorescens* strain 1629RS and *Pseudomonas syringae* strain 742RS.

The petition which was submitted requested a generic exemption for the bacterial species *Pseudomonas fluorescens* and *Pseudomonas syringae*. It was concluded that at the present time there is insufficient data available to support an exemption from tolerance requirements for all strains of these very common and widespread bacteria. The data, however, are sufficient to support an exemption for the specific strains listed above.

Acceptable Daily Intake (ADI) and maximum permissible intake (MPI) considerations are not relevant to this petition because the data submitted demonstrate that these biological control agents are not toxic to humans. No enforcement actions are expected. Therefore, the requirement for an analytical method for enforcement purposes is not applicable to this exemption request. This is the first exemption from the requirement of a tolerance for these strains of *Pseudomonas*.

Pseudomonas fluorescens strain A506, *Pseudomonas fluorescens* strain 1629RS, and *Pseudomonas syringae* strain 742RS are considered useful for the purpose for which the exemption from the requirement of a tolerance is sought. Based on the information considered, the Agency concludes that establishment of the exemption will protect the public health. Therefore, the regulation is established as set forth below.

(cont. on p. 704)

Food and Environmental Hazards to Health

Suction-Drain Injury in a Public Wading Pool—North Carolina, 1991

On June 16, 1991, a 3-year-old girl playing in a public wading pool sat on the pool's uncapped suction drain. The child appeared to be stuck on the drain, and the pool attendant quickly turned off the pool's suction pump. As a consequence of sitting on the drain, the child sustained severe internal injuries requiring surgical repair. This report summarizes the investigation of this incident by the North Carolina Department of Environment, Health, and Natural Resources (DENHR) and describes safe measures to prevent injuries among children caused by pool suction drains.

Following the episode at the wading pool, the child was examined at a hospital and had perianal bruising and prolapse of the rectal mucosa. The prolapse was manually reduced, and a pelvic computerized tomography scan showed no evidence of a rectal leak; however, by June 17, she had evidence of localized peritonitis. An exploratory laparotomy revealed a long anterior laceration of the seromuscular layer of the rectosigmoid colon; the mucosal tube was intact but ischemic and was separated circumferentially from the outer layers of the bowel wall. The laceration was repaired and a sigmoid colostomy performed.

The investigation by the DEHNR revealed that the wading pool where this injury occurred had a three-quarter-horsepower suction pump that was not linked to the adjacent adult pool or any other outlet. At the time of the injury, the antivortex drain cover that had previously covered the drain had been removed. Since the incident, the antivortex drain cover has been secured to the drain to prevent further suction injuries.

Editorial Note: The findings in this investigation are consistent with those from previous reports of abdominal injuries among children who sit directly on uncovered openings or vents capable of forming a strong vacuum when covered. When a child sits on an unprotected suction-drain vent, the child's perineum can form a firm seal that creates a vacuum capable of relaxing the anal sphincter. This negative pressure on the exposed rectal walls can result in prolapse or intussusception; this, in turn, usually produces a full-thickness anterior bowel tear, creating the potential for evisceration of the mobile small intestine through the laceration and the anal canal. Damage to the mesentery can produce extensive irreversible small bowel ischemia requiring resection.

Since May 1, 1991, North Carolina has required all newly constructed public wading pools to be equipped with a surface skimmer and with interconnected double drains to prevent suction-drain injuries. However, pools constructed before May 1, 1991, have been allowed to continue operating with a single drain. The public pool involved in this incident was built before the standards became effective; however, the pool had been inspected 12 months before the

injury occurred and had had an antisuction cover in place over the drain opening at that time.

Because a child may be injured within seconds of sitting on a drain, adult supervision alone does not effectively prevent suction-drain injuries. Suction-drain injuries can be prevented through interventions that prevent vacuums from forming when the vents are covered. Existing pools that may have a single suction-drain or multiple suction-drains that can be isolated by valves should be equipped with antivortex covers or with grates at least 12 inches by 12 inches over the drains to prevent the possibility of a vacuum forming if a child sits on a suction-drain opening. In addition, standards of the American National Standards Institute/National Spa and Pool Institute and the American Public Health Association specify that drain covers be secured in a way to prevent removal without special tools. Also, maintenance personnel should routinely inspect pool drains to ensure covers remain secure. Pools should not be operated if a suction-drain cover is missing, broken, or inadequately secured.

For new pools, water circulation systems should be constructed so that suction pumps are linked with more than one drain outlet; for example, the pump may draw water from two drains in the deepest part of the pool or from one drain and a surface skimmer, thus preventing a tight seal from forming if one drain is covered. In addition to these barriers, water-safety instruction courses should include specific instructions on the prevention of injuries involving pool equipment.

MMWR 5/15/92

Outbreak of *Salmonella enteritidis* Infection Associated with Consumption of Raw Shell Eggs, 1991

Salmonella enteritidis (SE) is the most frequently reported *Salmonella* serotype in the United States. From January through December 1991, state health departments reported 66 outbreaks of SE in the United States to CDC. This report describes an SE outbreak associated with consumption of raw shell eggs and underscores the necessity of adequately cooking shell eggs.

During October 1991, 15 persons who ate at a restaurant during a 9-day period developed gastroenteritis. Predominant symptoms were diarrhea (100%), fever (92%), abdominal cramping (92%), nausea (83%), and chills (75%). The median incubation period was 24 hours (range: 12-48 hours); median duration of illness was 7 days (range: 4-10 days). Thirteen ill patrons sought medical care, eight required intravenous rehydration, and six were hospitalized. *Salmonella* group D was isolated from stool of all 13 ill patrons who submitted specimens; all of the eight isolates further

typed were identified as SE. Fourteen of the 15 ill patrons and none of 11 well patrons interviewed had eaten Caesar salad. Illness was not associated with consumption of any of the restaurant's other uncooked egg dishes.

During the outbreak, 23 (29%) of the restaurant's 78 employees had onset of gastroenteritis. Predominant symptoms were diarrhea (100%), abdominal cramps (70%), chills (61%), nausea (57%), and fever (52%). Median duration of illness was 5 days. Two employees sought medical care; neither was hospitalized. Of the 66 employees for whom cultures were obtained, SE was isolated from stool samples of 15 (68%) of the 22 ill employees and six (14%) of 44 asymptomatic employees. Stool specimens from all three employees who reported eating Caesar salad during the outbreak were culture-positive for SE; however, most (18 [86%] of 21) culture-positive employees did not report eating this food. Confirmed SE infection among employees was associated with exposure to raw eggs at the restaurant through consumption or handling. Employees with confirmed SE infection were more likely than those not confirmed (i.e., culture-negative or not cultured) to have eaten the restaurant's raw egg dishes (six [50%] of 12 versus seven [18%] of 40; odds ratio [OR] = 4.7; 95% confidence interval [CI] = 1.0-24.2), or to have handled raw eggs in the restaurant kitchen (seven [54%] of 13 versus five [17%] of 38; OR = 7.7; 95% CI = 1.5-42.8).

The Caesar salad dressing was prepared early in the morning by combining 36 yolks from hand-cracked eggs with olive oil, anchovies, garlic, and warm water. Neither lemon juice nor vinegar were included in the recipe. Batches of Caesar dressing were prepared daily except for one 3-day period when a single batch was used. The dressing was refrigerated until the restaurant opened, when it was placed in a chilled compartment in the salad preparation area for approximately 8-12 hours until the restaurant closed. By the time a restaurant inspection was conducted, the restaurant had eliminated Caesar salad from the menu. However, at the time of the inspection, the temperature of other salad dressings present in this compartment was 60 F (15.6 C). The restaurant obtained eggs from a single supplier twice weekly and stored them in a walk-in refrigerator until use. No eggs from the shipment implicated in the outbreak were available for testing at the time of the restaurant inspection, but three cases of eggs from a different shipment from the same supplier were available. Two pools of 10 eggs each from each of the three cases were sampled and submitted for culture. SE was isolated from one of the six pools. Phage typing of the SE isolate from the eggs and of one from an ill employee revealed that both were phage type 8. A traceback by the SE Task Force, U.S. Department of Agriculture (USDA), determined that the source flock for eggs used during the outbreak was the same flock from which the SE-positive eggs were obtained. The flock had been destroyed before recognition of the outbreak.

Editorial Note: From 1976 through 1990, isolation rates for SE increased in the United States. In 1990, the 8591 SE isolates reported through CDC's *Salmonella* Surveillance System represented 21% of all reported *Salmonella* isolates,

surpassing *S. typhimurium* to become the most frequently reported serotype.

During 1985-1991, state and territorial health departments reported 375 SE outbreaks, which accounted for 12,784 cases of illness, 1508 hospitalizations, and 49 deaths. Most SE outbreaks have historically occurred in the New England and mid-Atlantic states; however, in 1991, 39 (59%) of the 66 reported outbreaks occurred outside these areas.

An estimated 0.01% of all shell eggs contain SE; however, this percentage may be higher in the northeastern United States. Consequently, foods containing raw or undercooked eggs (e.g., homemade eggnog or ice cream, hollandaise sauce, and Caesar salad dressing) pose a small risk for infection with SE. Because most serious illnesses or deaths associated with these infections occur among infants, the elderly, or immunocompromised persons, special attention should be directed to the diets of these persons to prevent the consumption of foods containing raw or undercooked eggs. In contrast, commercial eggnog is made with pasteurized eggs and is safe.

Most cases of SE infection occur as sporadic cases or in limited family outbreaks, rather than as part of large common-source outbreaks. Many sporadic cases are caused by the same phage types as egg-associated outbreaks and are likely to have the same source. However, when commercial kitchens serve foods made with contaminated eggs that have not been sufficiently cooked to kill *Salmonella*, large numbers of persons may potentially become infected. The outbreak described in this report may be the first time SE infection has been documented as a potential occupational hazard for employees preparing raw egg dishes in restaurants. Commercial food-service establishments can reduce the risk for outbreaks and infections among employees by using pasteurized egg products or eliminating eggs in such recipes. Infections acquired by eating foods prepared in the kitchens of private homes can be reduced through improved education of consumers regarding the risks for eating raw or undercooked eggs and through increased availability of pasteurized eggs in the retail marketplace.

To address concerns regarding the SE infection issue and consumption of contaminated shell eggs, both USDA and the Food and Drug Administration have implemented a series of control measures. Beginning in February 1990, USDA began investigating egg-laying flocks whose eggs are epidemiologically implicated in human SE outbreaks. Eggs from flocks infected with SE (by culture of the flock environment and internal organs of hens) are diverted to pasteurization or the flocks are voluntarily destroyed. In 1991, Congress enacted legislation that mandates refrigeration of eggs during interstate shipping. These efforts are part of the concerted effort needed to ensure safe eggs for consumers. Commercial food-service establishments can reduce the risk for foodborne SE illness if they substitute pasteurized eggs for pooled eggs whenever possible, serve pooled egg dishes immediately after cooking, and do not serve foods containing raw or undercooked eggs.

MMWR 5/29/92

Derived Overall Microbiological Standards for Chilled Food Processes

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St. Paul, MN 55114

Today, the government has no HACCP-based total systems approach to chilled food processes. The following, then, are standards based on existing research data, to be used by people who wish to ensure zero food safety defects in their pasteurized-chilled foods.

Food Handlers Contamination

One in fifty people shed high levels (greater than 10^9 per gram) of pathogens in fecal material. It can be assumed that at least 0.01 gram of feces gets on fingertips and under fingernails when one uses toilet paper. If the fingers are to be safe, the pathogens contained in this quantity of material must be reduced to 10 on the fingers, as measured by a test such as the glove-juice test. These pathogens can be reduced by using the correct double hand wash procedure, which utilizes a fingernail brush.

Raw Food Area

Raw food handling areas will typically have the same contamination on the floor as the raw food. For example, chicken typically has 1,000,000 to 5,000,000 organisms per square centimeter of chicken skin. The best approach to quality and safety control is to use detergent and hot water every four hours to clean food contact surfaces, and to clean the entire area thoroughly each day with detergent and hot water, and sanitize. In addition, no one who has walked through this area will be allowed into the pasteurized food area without washing and dressing properly.

Pasteurized Food Area

Pasteurized food areas pose a more difficult problem. If food is being pasteurized, unpackaged, cooled, manipulated, and finally packaged, there should be **no pathogens** in a 50-square-centimeter swab of either floors, walls, ceilings, or food contact surfaces. No one should be allowed in the area without putting on a clean uniform, hair restraint, face mask, gloves, and sanitized footwear. On the other hand, if the food is packaged, then cooked, and packing seals are verified as adequate, then the finished products area can be treated like a standard kitchen area, which is kept clean but is not pathogen free, and where typical kitchen worker hygiene is practiced.

Number of Spoilage Microorganisms on Food Contact Surfaces

Spoilage microorganisms will build up on food contact surfaces in the pasteurized food area. If the standards as shown in the table, **Number of Spoilage Microorganisms on Food Contact Surfaces**, are followed, excellent quality food will be produced.

NUMBER OF SPOILAGE MICROORGANISMS ON FOOD CONTACT SURFACES

Number of Spoilage Microorganisms	Rating
< 1 /cm ² or < 1 /ml of rinse solution	Excellent
2 - 10 /cm ²	Good
11 - 100 /cm ²	Clean-up time
101 - > 1,000 /cm ²	Out of control, shut down and find the problem.

Expected Pathogen Contamination on Raw Food

The U.S. government has no microbiological standards for raw food. The only government standard that currently exists is for prepared entrees, whereby a product must be negative for *Salmonella* spp. in a 25-gram sample, for which the sample lot size is undefined. In the last few years, *Listeria monocytogenes* has also been informally included. Again, the standard is negative for a 25-gram sample from an undefined lot size. Other nations, generally under the umbrella of the International Commission on Microbiological Specifications for Foods (ICMSF), have developed standards. For the most complete recent listing, see Shapton and Shapton (1991).

Since it is not yet realistic, and may never be, to establish microbiological standards for every food found in retail food operations, the starting point for HACCP is to set general standards for pathogens and spoilage microorganisms that can be used in process development. It is economically unrealistic to expect a user to check for pathogens on incoming food. However, it is very reasonable to have suppliers provide microbiological contamination information simply as part of their HACCP-based TQM programs.

The expected pathogen contamination on raw food is shown in the table, **Assumed Microbiological Standards**

for Chilled Food Processes. Recall that the government normally specifies at least a 10⁷D for *Salmonella* spp., which will also give a 10⁴D for *Listeria monocytogenes* (USDA-FSIS, January 31, 1990). Since there are typically only approximately 10 *Salmonella* spp. per gram of product, there is a large safety factor in the USDA pasteurization requirement. This has been necessary in the past because there was no focus on accurate control of the process. HACCP provides that focus.

These contamination levels, again, relate to the ease of pasteurizing food, but also indicate the importance of pur-

**ASSUMED MICROBIOLOGICAL STANDARDS FOR FOOD
IN CHILLED FOOD PROCESSES**

EXPECTED PATHOGEN CONTAMINATION ON RAW FOOD

Microorganism(s)	Meat & poultry	Fish & shellfish	Fruits & vegetables	Starches
	(Number of Pathogens per Gram of Food)			
<i>Salmonella</i> spp., <i>Vibrio</i> , Hepatitis A, <i>Shigella</i> spp., <i>E. coli</i> , <i>L. monocytogenes</i>	10	10	10	10
<i>Campylobacter jejuni</i>	1,000	-	-	-
<i>Clostridium botulinum</i>	0.01	0.01	0.01	0.01
<i>Clostridium perfringens</i>	100	10	-	-
<i>Bacillus cereus</i>	100	-	100	100
Mold Toxins	- Below government tolerances			
Chemicals & Poisons	- Below government tolerances			

MICROBIAL STANDARDS FOR FOOD QUALITY

Number of Spoilage Microorganisms Aerobic Plate Count at 70°F (21.1°C)	Rating
< 10,000 / gram	Good
10,000 to 5,000,000 / gram	Average
5,000,000 to 50,000,000 / gram	Poor
> 50,000,000 / gram	Spoiled

chasing food which is specified by the government as being safe in terms of mold toxins, chemicals, and poisons, since these hazards cannot be controlled by the retail food process.

Microbial Standards for Food Quality

Aerobic microbiological plate count standards for various kinds of prepared food are shown in the table, **Assumed Microbiological Standards for Chilled Food Processes**. An aerobic plate count of less than 10,000 per gram of food indicates a good product. A plate count of greater than 50,000,000 per gram indicates a spoiled food product. This does not mean that the food is unsafe. A pathogen must be shown to be present, or there is no hazard. It merely indicates that the food will have to receive a greater heat treatment to reduce the spoilage microorganisms to a level that will guarantee an acceptable storage life.

Safe Food for Immune-Compromised People

The safe microbiological contamination level for immune-compromised people is no *Salmonella* spp. or *Listeria* spp. in one 25-gram sample from a lot. Again, the lot size is undefined. This standard is easy to achieve with cooked food. However, it is essentially impossible to attain with foods such as salads, for which the only control is to wash the raw vegetable ingredients. Washing vegetables gives at best about 100:1 reduction of microorganisms. This seems to be adequate for safety, however.

References

- USDA-FSIS. adopted January 31, 1990. Recommendations of the national advisory committee on microbiological criteria for foods for refrigerated foods containing cooked, uncured meat or poultry products that are packaged for extended refrigerated shelf life and that are ready-to-eat or prepared with little or no additional heat treatment. Washington, D.C.
- Shapton, D.A., and Shapton, N.F. 1991. Principles and practices for the safe processing of foods. Butterworth-Heinemann. Oxford, England. 377-444.

Sanitary Design



A Mind Set

Donald J. Graham
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CHECKLIST - PART 2

Part 2 of the checklist examines the overall plant design. It provides a sanitary design overview of the entire structure and helps the manager evaluate where the plant fits in the pattern of sanitary design. The list hits the highlights and does not go into great detail. It provides the basis for further investigation by intensive sanitation audits performed either internally or by an outside resource.

1. Are critical areas of the plant maintained under positive air pressure to help prevent contaminants, including insects, from entering the plant?

Positive air pressure in a food processing area is often overlooked. The importance of adequate air handling and the maintenance of the filter systems often falls to the axe of budget restrictions. That is a shortsighted view as air contamination of food products in a processing plant has been described by FDA as a prime source of contamination by yeasts, molds and bacterial spores. Positive air pressure, along with good filtration, serves as an internal barrier for the prevention of contamination (adulteration) by airborne contaminants.

The highest air pressure should be in the processing room where the product is being packaged, that is, at the spot in the process where the product is last exposed to the environment. From that point, the pressure can be reduced slightly as the process backs up toward raw material handling. The raw material or receiving area is usually at ambient pressure. Some argue that high dust areas should have a negative air pressure to prevent dust from spreading to other parts of the facility. A well-designed dust collection system contains the dust and still allows a positive air pressure in the room.

Good sanitary design also dictates that the restrooms maintain a *negative* air pressure. Negative air pressure

created by ducting exhaust fans directly to the outside minimizes the potential for yeasts, molds, pathogenic and other bacteria from escaping into the process areas of the plant and contaminating the food products.

Air pressure differentials need not be large. A pressure differential of .05 to .08 inches of water column is usually sufficient between the highest pressure area and the area of next highest pressure.

The number of air turns per hour and the filtration level are inherent in the evaluation of air pressure differentials between process areas. USDA requires a minimum of six complete air turns per hour. The agency does not, however, require the air changes to be made up entirely of outside air. The air can be recirculated. Air recirculated through an adequate filter can satisfy the air turn requirement. Usually, air exchanges in more modern plants constructed without windows exceed twelve per hour and appear to be adequate for removing odors and steam and keeping the micro counts down to a reasonable level. Worker comfort and the sensitivity of the product or ingredients to contamination dictate the final design of the air handling and reconditioning systems.

2. Are raw materials kept sufficiently isolated from processed products to prevent cross-contamination?

The Food and Drug Regulations GMPs specify that there be a physical barrier between process areas for food products and non-food products. Many inspectors write you up if they perceive your unpackaged finished product can be contaminated by raw materials or ingredients that are too close in the process room. It is recommended that product flow not double back, preventing partially finished or finished product from coming into the same area where raw materials are being prepared.

3. Is the plant designed to restrict access of nonessential personnel to the processing and packaging areas?

Having people work on the line in a non or semi-automated food processing plant is a necessity. However, people are one of the biggest contributors to product contamination. People continually shed skin cells, hair, moisture and microorganisms from their face, hair and fingers (from under fingernails especially) into the surrounding environment. Personnel essential in a processing area should be well aware of the rules and requirements concerning their dress, head coverings, hand washing and other sanitation procedures. However, non-essential people that continually pass through the processing area bring in, and leave, contamination. Truck drivers, contractors, workers from other parts of the plant or warehouse and other visitors should be discouraged or prevented from entering the process areas unless they have a specific need to be there. A well-designed plant has provisions for access to other parts of the plant or warehouse without passing through the food processing areas.

4. Are personnel areas and restrooms located so they do not open directly into the processing areas?

Sanitary design of employee facilities such as restrooms and locker rooms locates them so they do not open directly onto the processing floor. If, however, the facilities are already positioned near the processing area, consideration should be given to moving them so that they open onto a hallway or other area removed from processing. An additional suggestion is to remodel the existing facilities so there is a vestibule area between the restroom and the processing area. As stated earlier, a negative air pressure in the restroom is mandatory for good sanitary design.

5. Is the ventilation adequate for promptly removing excess steam and odors from the process area?

The myth exists that high ceilings in the process area adequately take care of any steam generated by the process. Not true. Good ventilation is required to remove any steam generated. If there are only high ceilings, the steam condenses on the ceiling, the interior structural members and everything else overhead. If the condensate drops back into the product or onto product contact surfaces, the spot it drops from becomes a product contact surface under the definition in 21 CFR part 110 of the Food and Drug Regulations. However, the more serious problem occurs when the condensing surface becomes a growth area for mold. Once established the mold is extremely difficult to remove and is considered a product contaminant.

Depending on the source of the steam, the control of where it goes can be addressed. If it is very local, then it might be controlled by a stack arrangement vented directly to the outside from the single piece of equipment originating it. If the steam comes from

multiple sources, then a hood arrangement may be the answer. No matter what configuration is used, a condensate problem must be addressed. If a stack arrangement is designed into the equipment, then it should have a condensate trap which drains to the floor or the nearest floor drain. If a hood is used, it should be constructed with a condensate trough around the inside to catch any water running back down and drain it to either the floor or the nearest floor drain.

6. Are ceiling areas designed to prevent the accumulation of dirt and debris which could contaminate your food products during processing?

Ceilings are one of the most difficult areas to keep clean in a food plant. Many plants are constructed with open trusses, I-beam and all kinds of flat surfaces that serve as collection points for dust, debris, and mold growth. They also make nice runways for rodents to travel around the plant. These ceilings are especially troublesome when they are located directly over food being processed and/or food contact surfaces. One of the best ceiling designs is the solid walk-in type with all the utility runs above it and penetrations to allow vertical drops to the equipment below in the process room. All the roof support members are then isolated from the process room. With a positive air flow, the area can be kept free of outside infestations and dirt infiltration.

Overhead open trusses used for roof support are a cleaning nightmare. There are all kinds of angles and flat surfaces that collect dirt and are just about impossible to adequately clean. Sanitary ceiling design presents a challenge to the designing engineer but is a necessity in the food plant of today and tomorrow.

7. Is your plant constructed to minimize the entry of insects, birds and rodents and to facilitate the control and elimination of those that do gain entry?

Keeping in mind the rule of thumb that a mouse needs only a 1/4-inch opening to gain entry in to a food plant (or anywhere else) when touring a plant usually reveals all kinds of opportunities for redesign, renovation and/or repair of a number of areas. Overhead doors that do not completely close, penetrations through outside walls that have not been sealed, personnel doors without self-closing mechanisms or that are propped open, truck dock doors that are unattended and have been left open, dock levelers that have rubber seals instead of brush seals (rodents apparently do not like brush seals and will chew right through rubber seals) and any other opening that they can squeeze through is fair game. The largest rat can penetrate an opening of only 1/2 inch, and they are excellent climbers, jumpers, swimmers. Rats chew through materials such as asphalt, aluminum, wood, fiberglass, plastic and PVC to name a few. The dentine on their teeth is reported to be five times harder than the dentine of human teeth, and they must continually gnaw to keep their evergrowing teeth at a controllable length.

To state the obvious, insects are also always a problem since they are drawn to the warmth, food and moisture present in most food processing operations. The best way to keep them out is to have a plant facility without windows, kept under a positive air pressure, with all outside doors closed when not in use and equipped with correctly designed air curtains when in use. As with rodent proofing, all penetrations through the outside walls should be sealed. If there are windows in the plant that can be opened, they should be adequately screened with a fine mesh screen that cannot be easily removed.

Birds are another problem in and around the food plants. A bird will occasionally enter even the most modern food plants through open truck dock doors. However, if the problem is chronic then there are a number of areas that should be investigated. Some of those are nesting sites around the plant. Are there birds nesting and roosting in the truck dock canopy, or on or

under outside ledges on the plant building itself? If the plant has aluminum walls and soffets, then there is a good chance these birds have found their way into and are nesting inside the soffets around the roof line. From there they can sometimes work their way into the plant and become a real nuisance. The fecal material they leave around these nesting sites can become a source of in-plant bacterial contamination through the air inside the facility.

Even with the best sanitary design these pests sometimes gain entry into a facility and become a problem. If a control program is in place, then the ones that do gain entry can be dealt with effectively and quickly. The secret is to design the facility to minimize the entry, so that few get in and can be eliminated before they cause problems and contaminate and adulterate the food products.

Checklist - Part 2 will be further developed in next month's column.

IAMFES Has Moved!!

Our New Address is:

**200W Merle Hay Centre
6200 Aurora Avenue
Des Moines, IA 50322**

New Phone: (515)276-3344

New FAX: (515)276-8655

**Our Toll-Free Numbers
Remain the Same:**

1-800-369-6337 (US)

1-800-284-6336 (Canada)

New IAMFES Members

California

Dr. Ata Baroudi
The Vons Co., Inc.
Los Angeles

Stuart Hall
Nevada Co. Enviro. Health Dept.
Nevada City

Sue Leslie
Kelco Div. of Merck & Co.
San Diego

Nancy Scholl
California Dept. of Food & Agriculture
Corte Madera

John F. Sheehan
Hanford

Colorado

Delbert Swanson
Schamrock Food
Commerce City

Michael P. Tierney
US Army Veterinary Service
APO

Connecticut

J. Larry Cohoon
Environetics, Incorporated
Branford

Delaware

Ramney Koul
Dupont ConAgra Vision, Inc.
Wilmington

Georgia

Huda Lillard
USDA, ARS
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Bill Snidow
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Iowa

Jan Wilson
Gestalt, Inc.
Nevada

Kansas

Thipparedoi Harshavardhan
Kansas State University
Manhattan

Kentucky

Gary L. Morgan
Kentucky Division of Water
Paducah

Maine

Larry Chaney
IDEXX Laboratories
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Maryland & Virginia Milk Producers
Laurel

Chen-Jang Liu
University of Maryland
Adelphi

Massachusetts

Joe Hansberry
The Partlow Corp.
Scituate

Dr. Michael G. Pappos
Advanced Instruments
Needham

Merle Weber
Advanced Instruments
Needham

Minnesota

Dee Benesh
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Ed Goss
3M
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Ginny Huber
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St. Paul

James K. Jackson
US Public Health Service
Bemidji

Patrick Mach
3M
St. Paul

Rich Matner
3M
St. Paul

Kevin Vought
Land O'Lake
Minneapolis

Bob Young
3M
St. Paul

Mississippi

Sergio Cogo Feijoo
Mississippi State University
Mississippi State

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Mississippi State Dept. of Health
Magnolia

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Dominican Republic

Angel Barón
Junta Agroempresarial Dominicana
Santo Domingo

Mexico

Martha Elvia Diaz-Cinco
CIAD
Hermosillo, Sonora

Taiwan

Hung-Tsung Tsai
Department of Health
Taipei

New IAMFES Sustaining Members

ABELL Pest Control
246 Attwell Drive
Etobicoke, Ontario, Canada M9W 5B4
(416)675-6060

Gardex Chemicals, Ltd.
246 Attwell Drive
Etobicoke, Ontario, Canada M9W 5B4
(416)675-6727

Dairy, Food and Environmental Sanitation Instructions for Authors

Nature of the Magazine

Dairy, Food and Environmental Sanitation is a monthly publication of the International Association of Milk, Food and Environmental Sanitarians, Inc. (IAMFES). It is targeted for persons working in industry, regulatory agencies, or teaching in milk, food and environmental protection.

The major emphases include: 1) practical articles in milk, food and environmental protection, 2) new product information, 3) news of activities and individuals in the field, 4) news of IAMFES affiliate groups and their members, 5) 3-A and E-3-A Sanitary Standards, amendments, and lists of symbol holders, 6) excerpts of articles and information from other publications of interest to the readership.

Anyone with questions about the suitability of material for publication should contact the editor.

Submitting Articles

All manuscripts and letters should be submitted to the Editor, Margie Marble, 200W Merle Hay Centre, 6200 Aurora Avenue, Des Moines, 50322.

Articles are reviewed by two members of the editorial board. After review, the article is generally returned to the author for revision in accordance with reviewer's suggestions. Authors can hasten publication of their articles by revising and returning them promptly. With authors' cooperation articles are usually published within three to six months after they are received and may appear sooner.

Membership in IAMFES is not a prerequisite for acceptance of an article.

Articles, when accepted, become the copyright property of *Dairy, Food and Environmental Sanitation* and its sponsoring association. Reprinting of any material from *Dairy, Food and Environmental Sanitation* or republishing of any papers or portions of them is prohibited unless permission to do so is granted by the editor.

Reprints

Reprints of an article may be ordered by the author. An order form for reprints will be sent to you. Reprints may be ordered with or without covers, in multiples of 100. Reprint costs vary according to the number of printed pages in the article. Reprints cannot be provided free of charge.

Types of Articles

Dairy, Food and Environmental Sanitation readers include persons working as sanitarians, fieldmen or quality control persons for industry, regulatory agencies, or in education. *Dairy, Food and Environmental Sanitation* serves this readership by publishing a variety of papers of interest and usefulness to these persons. The following types of articles and information are acceptable for publication in *Dairy, Food and Environmental Sanitation*.

General Interest

Dairy, Food and Environmental Sanitation regularly publishes non-technical articles as a service to those readers who are not involved in the technical aspects of milk, food and environmental protection. These articles deal with such topics as the organization and application of a milk

or food control program or quality control program, ways of solving a particular problem in the field, organization and application of an educational program, management skills, use of visual aids, and similar subjects. Often talks and presentations given at meetings of affiliate groups and other gatherings can be modified sufficiently to make them appropriate for publication. Authors planning to prepare general interest nontechnical articles are invited to correspond with the editor if they have questions about the suitability of their material.

Book Reviews

Authors and publishers of books in the fields covered by *Dairy, Food and Environmental Sanitation* are invited to submit their books to the editor. Books will then be reviewed and the review will be published in an issue of *Dairy, Food and Environmental Sanitation*.

Preparation of Articles

All manuscripts should be typed, double-spaced, on 8-1/2 by 11 inch paper. Side margins should be one inch wide.

The title of the article should appear at the top of the first page. It should be as brief as possible and contain no abbreviations.

Names of authors and their professions should follow under the title. If an author has changed location since the article was completed, his new address should be given in a footnote.

Illustrations, Photographs, Figures

Wherever possible, submission of photographs, graphics, or drawings to illustrate the article will help the article. The nature of *Dairy, Food and Environmental Sanitation* allows liberal use of such illustrations, and interesting photographs or drawings often increase the number of persons who are attracted to and read the article.

Photographs which are submitted should have sharp images, with good contrast.

Examples of Proper Bibliographic Citations

Paper in a journal

Alderman, G. G. and E. H. Marth. 1974. Experimental production of aflatoxin in citrus juice and peel. *J. Milk Food Technol.* 37:308-313.

Paper in a book

Marth, E. H. 1974. Fermentations. pp. 771-882. In B. H. Webb, A. H. Johnson, and J. A. Alford (eds.), *Fundamentals of dairy chemistry* (2nd ed.), AVI Publishing Co., Westport, CT.

Book

Fennema, O. R., W. D. Powrie, and E. H. Marth. 1973. *Low-temperature preservation of foods and living matter*. Marcel Dekker, Inc., New York. 598 p.

Patent

Hussong, R. V., E. H. Marth, and D. G. Vakaleris. 1964. Manufacture of cottage cheese. U. S. Pat. 3,117,870. Jan. 14.

CALL FOR PAPERS

IAMFES 80th Annual Meeting

August 1-4, 1993
Atlanta, Georgia

Instructions to Prepare Abstracts

Procedure

- Use the printed Abstract form that appears on the other side of this page.
- Type in the title, Capitalize the first letter of the first word and proper nouns.
- List the names of authors and institution(s). Capitalize first letters and initials.
- Give the name, title, mailing address and the office telephone number of the author who will present the paper.
- If the paper is to be presented by a student entered in the Developing Scientist Awards Competitions, check the box to indicate this and have the form signed by your Major Professor or Department Head.
- Check the most appropriate box to indicate the general subject area of the paper. Indicate subject if checking other.

Type the abstract *double-spaced*, in the space provided on the abstract form.

Mail two copies of the abstract before December 15, 1992 to:

Steven K. Halstead, CAE
Executive Manager, IAMFES
200W Merle Hay Centre
6200 Aurora Avenue
Des Moines, IA 50322

Enclose *two* stamped, self-addressed post cards. Two cards must be included with *each* abstract that is submitted. One will be returned to acknowledge receipt of the abstract and the other to notify the presenter of the time the paper is to be presented.

Content of the Abstract

The abstract should describe briefly: (a) the problem studied, (b) methods applied, (c) essential results, and (d) conclusions.

Presentations Format:

Papers may be presented orally or by poster format at the discretion of the Program Committee. Oral presentations will be scheduled so a speaker has a maximum of 15 minutes, including a 2-4 minute discussion. Carousel projectors for 35 mm slides will be available. **Overhead projectors are not to be used and none will be available.**

Subject Matter for Papers

Papers should report the results of applied research on: food, dairy, and environmental sanitation; foodborne pathogens; food and dairy microbiology; food and dairy engineering; food and dairy chemistry; food additives and residues; food and dairy technology; food service and food administration; quality assurance/control; mastitis; environmental health; waste management and water quality.

Developing Scientist Awards Competitions

The **Oral Competition** is open to GRADUATE students enrolled at accredited universities or colleges whose research deals with problems related to environmental, food and/or dairy sanitation, protection and safety. Candidates cannot have graduated more than one (1) year prior to the deadline for submitting abstracts.

This year the Oral Competition will be limited to ten finalists and awards will be given to the top five presenters. The papers should be approximately fifteen (15) minutes, including a 2-4 minute discussion.

The **Poster Competition** is open to UNDERGRADUATE and GRADUATE students enrolled at accredited universities or colleges whose research deals with problems related to environmental, food and/or dairy sanitation, protection and safety. Candidates cannot have graduated more than one (1) year prior to the deadline for submitting abstracts.

Ten finalists will be selected for the Poster Competition. The presentation must be mounted on a 8' by 4' display board (provided at the meeting) for the entire duration of the Poster Session at the Annual Meeting. The presenter must be present at their poster for a specific time, approximately two hours during the session. (For more information on the Developing Scientist Awards Competitions, see page 661 of *Dairy, Food and Environmental Sanitation*, October Issue and the following blue pages.)

All winners are presented and honored at the annual Awards Banquet. The ten finalists will receive complimentary tickets and are expected to be present at the Banquet.

Additional Abstract Forms

Extra copies of the abstract forms may be obtained from Steven K. Halstead, Executive Manager, or you may photo copy this one.

Membership in IAMFES

Membership in IAMFES is NOT a requirement for presenting a paper at the IAMFES Annual Meeting

(OVER)

IAMFES Abstract Form

DEADLINE: DECEMBER 15, 1992

Title of Paper _____

Authors _____

Name and Title of Presenter _____

Institution and Address of Presenter _____

Office Phone Number (____)____-_____

General Subject Area	
<input type="checkbox"/> Quality Assurance/Control	<input type="checkbox"/> Food Service
<input type="checkbox"/> Food Microbiology	<input type="checkbox"/> Sanitation
<input type="checkbox"/> Dairy Microbiology	<input type="checkbox"/> Food Safety
<input type="checkbox"/> Waste Management	<input type="checkbox"/> Processing
<input type="checkbox"/> Lab Methods	<input type="checkbox"/> Epidemiology
<input type="checkbox"/> Foodborne Pathogens	<input type="checkbox"/> Other _____
<input type="checkbox"/> Chemical Residues	
<input type="checkbox"/> Environmental Health	

Check the presentation format you prefer.	
<input type="checkbox"/> Oral	<input type="checkbox"/> Poster
<input type="checkbox"/> Video Theater	<input type="checkbox"/> No Preference

Developing Scientist Awards Competition Yes Oral Poster

Major Professor/Department Head approval (signature & date) _____

Please type abstract, double-spaced, in the space provided here.

Selected presentations, with permission, will be recorded (audio or video).

I authorize IAMFES to record my presentation.

Signature _____ Date: _____

I do not wish to be recorded.

Signature _____ Date: _____

Judging Criteria for Developing Scientist Awards Competitions

Judging

The abstracts and presentations will be evaluated by an independent panel of judges. Selection of ten finalists for both the Oral and Poster Competitions will be based on evaluations of the abstracts and the scientific quality of the work (see judging criteria). All entrants in the Developing Scientist Awards Competitions will be advised of the judges' decisions by March 31, 1993.

Only the ten finalists in each category will be judged upon their final presentations at the Annual Meeting and will be eligible for the final awards. All other entrants who submitted papers accepted by the IAMFES Program Committee will be expected to present their papers/posters as part of the regular Annual Meeting program.

Judging Criteria

ABSTRACTS

Short abstract: clarity, comprehensiveness, conciseness;
Extended abstract: technical merit, organization, completeness;

SCIENTIFIC QUALITY

Adequacy of experimental design;
Extent objectives were met;
Difficulty of research, depth;
Validity of conclusions based upon data;
Technical merit, contribution to science;

ORAL PRESENTATION or POSTER PRESENTATION

Organization: clarity of introduction, objectives, methods, results and conclusions;
Quality of visuals;
Quality and poise of presentation and in answering questions;

*** Note: Both a short abstract and an extended abstract must be submitted to the IAMFES office no later than December 15, 1992. No forms will be sent to entrants. Enclose two self-addressed, stamped postcards with your submitted abstracts.**

Instructions for Preparation of Extended Abstract:

Type your abstract, single-spaced, using elite (12 pitch) letter-quality type, on 8.5" x 11" pages. The margins should be as follows: Top: 1"; Bottom: 0.75"; Left: 1"; Right: 1". Do not exceed 3 pages, and DO NOT attach additional tables or graphs.

A. The first section should occupy the first fifth of the first page and read as follows:

First 3 lines or less, type:

TITLE: Capitalize only the first letter of the title and first letters of proper nouns.

Leave a blank line, then in the next 2 lines or less, type:

AUTHORS: Capitalize name of **SPEAKER ONLY**.

Leave a blank line then in the next 4 lines or less, type:

AFFILIATIONS: Name and complete mailing address of Affiliation.

Leave a blank line then on the next line, type:

Developing Scientist Awards Competition: Oral or Poster.

Leave a blank line then type:

Professor (or Department Head): Have your Professor or Department Head sign here.

B. Leave two blank lines then state briefly (8 lines or less):

"OBJECTIVES"

Indent the first line 5 spaces.

Leave a blank line, then describe:

"METHODS"

This should take up a maximum of three-quarters of a page; continue on page 2 if necessary. Include sufficient detail to indicate the adequacy of the experimental design and difficulty of research.

Leave a blank line then describe:

"RESULTS AND DISCUSSION"

This should take up a maximum length equivalent to 1 page; continue on page 3 if necessary. This section should indicate the extent to which objectives were met and validity of conclusions based upon data.

Leave a blank line then describe:

"SIGNIFICANT FINDINGS, CONCLUSIONS AND IMPLICATIONS"

This section should take up a maximum of 15 lines and should indicate the technical merit and contribution to science of the work.

Leave a blank line then list:

"REFERENCES":

List a maximum of four significant references. At the end of this section you will probably be close to the bottom of page 3.

Affiliate News

TAMFES Annual Meeting Report

The 10th Annual Meeting of the Texas Association of Milk, Food and Environmental Sanitarians was held June 2 and 3, 1992 at the Howard Johnson South Plaza Hotel in Austin, Texas.

312 persons registered for the event. Special guest was Mr. Steven Halstead of IAMFES.

A golf tournament was held June 1. A plaque was later awarded to Mike Littlefield for his hole-in-one during the tournament.

An overflow crowd attended the laboratory session presided over by Mr. Joe Bare. Topics for the session were: "Beta-Lactams-What are They?" by Tom Fuhrmann D.V.M., "Drug Residue Monitoring and Certification" by Dr. Larry Maturin, FDA Center for Food Safety, and "Complying with Drug Residue Regulations" by Mr. James Fraley, Texas Department of Health.

On Tuesday, June 2, 1992 the first general session started with opening remarks and awards. Mr. Wayne Weatherford was awarded a plaque for outstanding service to the Texas Association of Milk, Food and Environmental Sanitarians. Certificates were awarded to the Association's past 10 presidents.

Featured speakers for the afternoon session were: Tom Fuhrmann, D.V.M., "Farm Sanitation"; Mr. John Farquhar, Food Marketing Institute, "Food and Marketing Trends for the Year 2000"; and Mr. Larry Maturin, FDA for Food Service and Mr. John Adams, Milk Regulatory & Animal Health Affairs, speaking on "Antibiotic Residues and the Dairy Farm."

On Wednesday morning, June 3, 1992 session speakers and their topics were: Mr. Bob McCullough, H.E.B. Grocery Co., "Applying Total Quality Management to the Dairy Industry"; Dr. Richard Rowe, University of Texas at San Antonio, "Impact of Waste, Air and Water Quality"; and Dr. Auturo, Director R&D Tec-Lac Consultants, Mexico, "Free Trade Agreement-One Year Later from the Mexican Perspective." Other activities included a country-western dance and barbecue held at the Manchaca fire department.

Also TAMFES wishes to extend its thanks for the generous contributions of their sustaining members, for their hospitality and to all of the companies who set up display booths.



Five Past Presidents attended the BBQ (l to r): Claire Gothard, James Roberson, Joe Goddard, Al Wagner and Kenneth Seaman

Upcoming IAMFES Affiliate Meetings

1993

MARCH

•18-19, Florida Association of Milk, Food and Environmental Sanitarians Annual Meeting in conjunction with Suppliers Night at the Marriott on International Drive. For more information, please contact Bill Thornhill, 3023 Lake Alfred Road, Winter Haven, FL 33881, (813)299-6555.

Wyoming Department of Agriculture Changes

The last six months the Wyoming Department of Agriculture along with all other state agencies have felt the impact of strict budget restraints. The department has had to do some drastic changes in how operations are handled, additional cuts, however, were not taken in the recent legislature because they realize what a detriment it would have on Wyoming's food safety.

The Food & Drug section, which is managed by John Misock has made several changes in the last year that have made these restraints not as harmful to the inspection process and services provided. This section has 12 field inspectors located throughout the state and 3 lead inspectors. Each inspector has a laptop computer/printer that is linked to the main computer in Cheyenne. The computer has a program to do inspections, E-mail, word processor and Lotus program, this has drastically lowered mailing and telephone costs.

The inspection process has changed with the times. The department is in full agreement with the HACCP type inspection process. Over the last two years each establishment has been risk assessed according to food preparation. Example: Deli is risk 1 and is inspected every 3 months, as a bakery is a 3 and every 6 months and the grocery area a 4, once a year. This has cut down on areas that are not at a high risk and the ones that are can be concentrated on. Along with the risk assessment every department with a risk of 1 has had a HACCP study. This has been a real eye opener, as to what is really going on. The department has also benefited from the positive exposure these HACCPs have created by improving communication and compliance. The FDA and other states have been interested in our program and are wanting to know more about it.

Recently, the department changed in the sense of making the establishment more responsible for their sanitation, rather than using the inspector as their quality control person. This is being done in the Wyoming meat inspection program, in that the establishment signs an agreement with the inspector in charge and must comply with the stipulations that are tailored to that establishment. The intent is also to do this in the retail and food processing plants. The first

step has been taken for example in a deli by using charts for cooking/cooling and testing sanitizing solutions.

The consensus of WDA inspectors is that we have become more like consultants since the HACCP studies, due to the establishments calling us for more advice and wanting to comply. We still use the 44 point inspection without scores and designate critical and non-critical items. It is felt that most establishments only look at the score and if it is 90 or better (regardless of criticals) don't try to comply with the violations in hand. By doing away with the score we can concentrate on the criticals and get compliance. The ultimate goal is to do a HACCP inspection by checking mainly the critical items in a department and getting away from the floors, walls, and ceiling inspections that is created by using the 44 point system. In return we will not have to be in establishments that don't have many problems and be able to concentrate on the ones that do.

The department has also been active with the Wyoming Environmental Health Association. The Association in the last year has had 8 food seminars throughout the state. After doing the HACCPs these establishments have seen a need for proper training and thus there has been good attendance at the seminars. Along these lines the University of Wyoming, Dept. of Agric., Dept. of Health and Wyoming Restaurant Association, applied for a grant to present the WEHA food program in Wyoming via the University of Wyoming video teaching systems.

A Brief Historical and Current Overview of Applied Epidemiology Training in Florida

June 17, 1992

Wiley Hart,

Course Director, State of Florida,

Department of Health and Rehabilitative Services,
Tampa, FL 33614-9990

Epidemiology has been accurately described as the glue that holds public health programs together. Applied Epidemiology is an eight day training course originally developed and provided by the Centers for Disease Control (CDC). Participants obtain comprehensive training in the critical elements of the epidemiological process. This includes disease surveillance and data collection, outbreak recognition, reporting, evaluation, intervention, and activity summarization. The course utilizes the Criterion Referenced Instruction methodology which is self paced, challenging, and maximizes the students involvement and "hands on" experience. A considerable amount of reference material is provided for students to keep and use upon their return to their place of employment. In addition, students develop a communication network with the course managers and other participants which can serve as a valuable information resource. Each student is required to evaluate the course presenters and materials so that improvements can be made wherever possible.

This course is currently being provided to public health professionals in the state of Florida by the Department of Health and Rehabilitative Services (HRS), District VI Health Program Office. It is rapidly becoming one of the most sought-after training opportunities for public health staff in the state.

The most recent Florida initiative started in January, 1988, under the leadership of the assistant state epidemiologist at that time. The expense involved and the difficulty in obtaining out-of-state-travel approval had been identified as two formidable barriers to staff wishing to attend the course in Atlanta. The decision was made to provide this valuable training using HRS health staff who were CDC certified and offering the course at numerous sites throughout Florida. This would make attendance more economically feasible for local health unit personnel.

Several HRS staff who had successfully completed the CDC Principles of Epidemiology Home Study Course (3030G), and all 13 modules of the CDC Allied Epidemiology Course (4440G), received training in Tampa to become course managers. This training was provided by CDC staff and all those attending received course completion certificates.

In May, 1988, this newly trained group offered it's first Florida Applied Epidemiology Course. It was then the course managers began to discover all the things that course manager training didn't prepare them for. However, even with all the problems identified by the course presenters in this first offering, the participants still ranked the training as some of the most valuable they had ever received.

The course director and course managers immediately began implementing improvements. They met routinely between and during courses in a continuous effort to eliminate barriers to the participants' learning experience. Some examples of course fine tuning included the following:

- Site selection is a critical factor in success of this course. Initially, a questionnaire was developed and circulated to all HRS county and district health program offices. This data collection instrument was designed to help determine where the need for and the interest in the course was greatest. Initial, and some subsequent site selections were made based on this data.

It was immediately determined that offering the course in a health department or other building where participants routinely work is a mistake. In these situations, participants are more likely to try to do at least part of their regular work and are more likely to be interrupted by their supervisors, staff and secretaries.

If the course directors are not familiar with the building in which the course is to be provided, one of them travels to the site to help ensure that adequate, comfortable space is available for the general study and sign-off areas, that adequate, acceptable chairs, tables, etc. can be provided, and that acceptable lodging is available nearby. This extra effort has paid off more than once.

- The course has consistently had more applicants than could be managed in a single course presentation. Although the names of candidates are submitted by their immediate supervisors or the unit director, final selection of participants is made by the course director. Selection is made only after

a personal interview has been conducted with each candidate to determine his or her motivation, to discover those with the greatest immediate need for the training, and those who would derive prompt benefit from receiving it. A standardized interview format was developed and is used to screen each candidate. This process also helps to provide a sense of accomplishment to those selected. Although this methodology has been challenged occasionally by supervisors whose staff were not selected to attend, acceptable justification for current procedures has always been provided to these individuals.

- Each participant is required to take the Principles of Epidemiology Home Study Course (3030G) as a prerequisite. This helps familiarize students with basic terminology and calculations. Applicants are advised to begin the home study course before they are formally accepted to the applied epidemiology course. By doing this, it is believed that some will finish the home study course even if they are not selected for the applied course. Supervisors are encouraged to allow candidates to complete the 3030G course on "company time", and candidates are encouraged to form study groups.

- A great deal of emphasis is placed on course quality and improvement. A student course evaluation form has been developed which is user friendly. Although they can do so anonymously, each participant is required to complete an evaluation prior to receiving a course completion certificate. A Florida course completion certificate has been developed.

- With each course having limited enrollment, a conscious effort is made to select a group of participants with both geographic and programmatic diversity. Experience has taught that routine review of course materials in small groups (two or three students) enhances discussions. When these discussion groups are composed of a good mixture of individuals from large and small health units and from different programmatic disciplines (i.e., nurses, environmentalists, epi staff, etc.), this further broadens the learning experience. Therefore, care is taken to obtain a good balance of programmatic disciplines and to not select more than two individuals from any one health unit.

- Members of the staff of the HRS Epidemiology Program Office are invited to participate in each course. They provide excellent insight to current activities in their office to course participants by means of a two hour presentation approximately half way through the course. This gives students a break from the routine course material, gives them a chance to meet some of the state health program leaders, and provides a valuable opportunity for interaction.

- After each course is completed, the director produces a written summary. Both positive and negative aspects of each course presentation are critiqued and carefully summarized. Copies of the course summary and other pertinent information are shared with key health program administrators.

As a result of these and many other initiatives, although mistakes have been made, they are rarely repeated.

In late 1989 the CDC stopped providing 4440G and shipped the course materials on hand to approximately five states who planned to continue providing this training "in house." The impact of this was felt almost immediately in

Florida. Obtaining the resources to produce consistent high quality printing of the course materials continues to be an area of concern.

A goal was established to provide the Florida Applied Epidemiology Course three times per year for three years at various locations throughout the state. This would allow all county health units reasonable access to this training without requiring extensive travel on the part of students. Training needs were then to be reevaluated and course frequency was to be adjusted accordingly.

The first 6 times the course was presented, funding for the trainers' travel and per diem was provided by the HRS Epidemiology Program Office and no tuition was assessed for attendance. The course director's and manager's time was provided by their respective units.

In mid 1990, state revenue shortfalls forced travel restrictions which made it necessary to cancel all scheduled courses.

In late 1990, further budget restrictions eliminated the travel, printing and other resources which had been provided by the HRS Epidemiology Program Office. For over a year and a half, alternate means were sought to continue providing the epidemiology course. Finally in October, 1991, one of the HRS county health units agreed to pay travel expenses and printing costs for a course to be provided to their staff. For the first time, participants were assessed a small tuition.

About the same time, a previous Florida course graduate was promoted to a high level position with the state restaurant program. This individual now had a training budget and wanted her supervisory staff to receive the epidemiology training. An informal agreement was developed in which travel and housing expenses for the course managers, and printing costs would be paid by the HRS Office of Restaurant Programs. Ten restaurant program supervisors would receive training and the remaining 10 slots for a total of 20 students in the course) would be offered state wide to other public health staff. The response was gratifying with over 50 staff applying for the 10 available slots.

This training course has been provided 8 times since May, 1988, and 135 health staff have successfully completed it. Students have included physicians, environmentalists, nurses, and STD, TB and epidemiology program staff. Participant evaluations have been overwhelmingly supportive and complementary. Informal feedback from supervisors of course participants indicates that at least some implementation of improved surveillance techniques is occurring. A more formalized follow-up methodology is being developed to more thoroughly determine how students are using, or not using, this training. Based on a recent cost analysis, over \$120,000 has been saved by providing this course in Florida.

A training proposal has been submitted to Florida's State Health Officer, which has received conceptual approval. In this proposal, unique and highly regarded training courses would be offered state wide through the HRS District VI Health Program Office in Tampa. Participants would eventually be charged a tuition based on the actual cost of providing the course. This tuition would cover the cost of the course materials and the salaries and benefits of

the trainers. The applied epidemiological course is the corner stone of this proposal. Ties are currently being developed with the University of South Florida, School of Public Health and private sector businesses, including representatives from Thornton Laboratories and Walt Disney World. We believe interaction between the public, academic and private sectors will help us to provide a more comprehensive approach to our training initiative.

In addition, Florida is one of the states selected to help

field test the recently revised CDC home study course, Principles of Epidemiology (3030G). This provides an excellent opportunity for Florida health staff to not only take this new course, but to help shape future training provided by the CDC.

Throughout this training initiative, staff interest has remained high. This is reflected in the number of applications. Student course evaluations have been extremely supportive and complementary.

Federal Register, *cont. from p. 684*

Any person adversely affected by this regulation may, within 30 days after publication of this document in the **Federal Register**, file written objections with the Hearing Clerk, at the address given above (40 CFR 178.25). Each objection must be accompanied by the fee prescribed by 40 CFR 180.33(i). If a hearing is requested, the objections must include a statement of the factual issue(s) on which a hearing is requested, the requestor's contentions on such issues, and a summary of any evidence relied upon by the objector (40 CFR 178.27). A request for a hearing will be granted if the Administrator determines that the material submitted shows the following: There is a genuine and substantial issue of a fact; there is a reasonable possibility that available evidence identified by the requestor would, if established, resolve one or more of such issues in favor of the requestor, taking into account uncontested claims or facts to the contrary; and resolution of the factual issue(s) in the manner sought by the requestor would be adequate to justify the action requested (40 CFR 178.32).

The Office of Management and Budget has exempted this rule from the requirements of section 33 of Executive Order 12291.

Pursuant to the requirements of the Regulatory Flexibility Act (Pub. L. 96-354 Stat. 1164, 5 U.S.C. 601-612), the Administrator has determined that regulations establishing new tolerances or raising tolerance levels or establishing exemptions from tolerance requirements do not have a significant economic impact on a substantial number of small entities. A certification statement to this effect was published in the **Federal Register** of May 4, 1981 (46 FR 249550).

List of Subjects in 40 CFR Part 180

Administrative practice and procedure, Agricultural commodities, Pesticides and pests, Reporting and recordkeeping requirements.

Dated: September 1, 1992.

Douglas D. Campt,
Director, Office of Pesticide Programs.

Therefore, 40 CFR part 180 is amended as follows:

PART 180 — [AMENDED]

1. The authority citation for part 180 continues to read as follows:

Authority: 21 U. S. C. 3446a and 371.

2. By adding new § 180.1114, to read as follows:

§180.1114 *Pseudomonas fluorescens* A506, *Pseudomonas fluorescens* 1629RS, and *Pseudomonas syringae* 742RS; exemptions from the requirement of a tolerance.

The biological pesticides *Pseudomonas fluorescens* A506, *Pseudomonas fluorescens* 1629RS, and *Pseudomonas syringae* 742RS are exempted from the requirement of a tolerance in or on all raw agricultural commodities when applied as a frost protection agent or biological control agent to growing agricultural crops in accordance with good agricultural practices

(FR Doc. 92-22253 Filed 9-15-92; 8:45 am)

Abstracts of Papers Presented at the Seventy-Ninth Annual Meeting of IAMFES

Toronto, Ontario, Canada, July 26-29, 1992

Abstracts of most papers submitted for presentation at the 79th Annual Meeting of the IAMFES appear on this and the following pages. The complete text of some of the papers will appear in future issues of the *Journal of Food Protection or Dairy, Food and Environmental Sanitation*.

IVAN PARKIN LECTURE

GLOBAL ISSUES IN FOOD SAFETY

J. B. Morrissey, Assistant Deputy Minister, Agriculture Canada, 930 Carling Ave., Ottawa, Ontario, Canada K1A 0C5

In normal circumstances, marketing of a product such as food is done based on the "marketing mix." This was defined by McCarthy as the most attractive mix of:

- price,
- product,
- place,
- promotion.

The expectation was that the buyer purchase the food which provided the best combination of these four items from the buyer's point of view.

In my opinion, the model holds true for the international market for food. Particular emphasis has to be placed on the attributes of the "product." If the food is not perceived to be safe, it will not be "marketable." This means, any combination of the other three items in the marketing mix will probably be useless if the safety of food is not assured as the first attribute of the product. This concept is often expressed in the term "marketable." In other words, a food is not "marketable" at any price, in any place, and with any amount of promotion, unless it is perceived to be safe.

It is for this reason, that food safety and the related issues of "food wholesomeness" have become matters of importance. In historic times, the public concept of food safety may have been limited to whether the food looked and smelled safe. Over the last century, the public's concerns about food safety have moved from visible, to invisible issues. The public is afraid of the "unknown." They wish to be protected from threats to their health caused by physical, chemical, or biological dangers associated with food which cannot be detected organoleptically. Two important messages result from this shift:

1. The public's position is associated with "fear of the unknown."
2. The public looks to government to:
 - provide it with information on food safety which is not available from other sources; and,
 - provide a service associated with food safety which is of benefit to society as a whole and which the private sector may not be able to provide.

The provision of information about food safety and the objective guarantee of food safety will be described by political scientists as falling within the classical definition of the role of the state. Consequently, it is not surprising that governments around the world have become involved in assuring food safety both for food produced within their own countries and entering their countries from other nations. Food safety has become one of the classic examples in inspection theory of the principle that food safety is built into the product, not tested into it.

In conclusion, food safety appears to be such an overriding attribute of the marketing mix, that it might well be described as a prerequisite, without which, the product is unmarketable.

DAIRY MICROBIOLOGY

DETECTION OF LATENT COLIFORMS IN PASTEURIZED MILK

R. A. Ledford, E. T. Wolff, and K. T. Scofield, Comell University, Richard A. Holley*, Microbiologist, John Labatt Limited, 150 Simcoe Street, London, Ontario, Canada N6A 4M3

During tests conducted Jan.-Sept. 91 by Comell at 45 plants, 40% of 424 samples were coliform negative throughout refrigerated shelf-life. However, another 41% which were coliform negative the day of pasteurization, became coliform positive during 7-14 days refrigerated storage. The Comell pre-incubation test for coliforms (milk is held at 37°C for 6 hours prior to plating on VRB) has been used with some success since 1983 to accelerate coliform detection presumably by providing an opportunity for their recovery from injuries. To facilitate injury recovery, pyruvate was added to pre-incubated milk and pyruvate and/or catalase was added to VRB prior to plating. As currently used the test allows prediction with 82-85% certainty that milk contains viable coliforms. Since coliforms grow at refrigerator temperature in pasteurized milk, the value of the VRB test for compliance monitoring of samples is limited to fresh samples.

IDENTIFICATION OF MILK ENZYMES FOR MONITORING HEAT-TREATMENTS APPLIED TO MILK

Yolanda Hurvi*, and M. W. Griffiths, Department of Food Science, University of Guelph, Guelph, Ontario, Canada N1G 2W1

Experimenters have sought milk enzymes, other than alkaline phosphatase, that can be used as indicators of the heat treatment applied to milk. As milk used for cheese manufacture in Canada is generally heated at sub-pasteurization temperatures, an enzyme(s) that can be used in the range 60 to 70°C is desirable.

Earlier work suggested that catalase could be used as an indicator of heat treatment given to milk in the range 65-70°C. Differential Scanning Calorimetry has confirmed that the denaturation temperature of bovine catalase is 64.5°C and closely correlates with the inactivation temperature. This procedure measures conformational changes in proteins by measuring the energy necessary to disrupt the native structure of the protein. It is, therefore, a useful tool to identify the thermal stability of milk enzymes. Other enzymes of potential for predicting heat treatments given to milk have been identified.

ADAPTATION TO ACID PROMOTES SURVIVAL OF *SALMONELLA* IN CHEESE

Greg J. Leyer*, Research Assistant, and Eric A. Johnson, University of Wisconsin-Madison, Food Research Institute, 1925 Willow Drive, Madison, WI 53706

Salmonella has been implicated as the causative agent of foodborne illness in several dairy foods including cheese, and continues to pose a concern to the dairy industry. Rapid acid production by starter bacteria is important for the control of *Salmonella* and other pathogens in cheese. Since *Salmonella* has an adaptive response to acid, we investigated if acid adaptation influenced resistance of *S. typhimurium* to organic acids and survival during dairy fermentations. Recovery of acid-injured cells was enhanced ~10,000-fold by 0.1% pyruvate supplementation in tryptose phosphate agar. Acid-adapted cells were more resistant to inactivation by lactic, propionic, and acetic acids. The acid-adapted cells also survived better than non-adapted cells during milk fermentation with *Streptococcus salivarius* subsp. *thermophilus* and *Lactobacillus helveticus* (used in Swiss cheese fermentation). Acid-adapted salmonellae persisted much better than unadapted salmonellae when surface inoculated onto commercial cheeses (Cheddar, Mozzarella and Swiss) which were incubated at 4-6°C. Acid adaptation also was observed in other species of salmonellae including *Salmonella enteritidis*, *Salmonella heidelberg*, and *Salmonella javiana*. The results of this study suggest that acid adaptation is an important survival mechanism enabling *Salmonella* to persist in fermented dairy products.

MICROBIOLOGICAL SAFETY OF BLUE AND CHEDDAR CHEESES CONTAINING NATURALLY MODIFIED MILK FAT

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Blue and stirred curd Cheddar cheeses (two trials) were made from milk obtained from cows fed normal, soyabean oil and sunflower oil rations. Cheese was made from milk standardized to 3.6% milk fat, pasteurized and inoculated with *Listeria monocytogenes* (Scott A and V7) and *Salmonella typhimurium* and *S. senftenberg*. Listeriae and salmonellae populations were monitored on oxford and xylose lysine deoxycholate agars, respectively, during manufacture and aging (up to 120 days). With 10^3 /ml in milk, *L. monocytogenes* reached 1×10^4 /g in all fresh Cheddar or Blue cheeses regardless of milk fat composition. Listeriae decreased to < 100 /g after 120 days in Cheddar, and in Blue cheeses to < 1 /g after 60 days. With 10^3 /ml in milk, salmonellae reached 10^3 - 10^4 /g in fresh Cheddar and 10^2 - 10^4 /g in Blue cheeses and decreased to 1 /g after 90 days in all Cheddar and after 30 days in all Blue cheeses regardless of milk fat composition. Thus, Cheddar and Blue cheeses made from milk of naturally modified milk fat present no unusual or enhanced risk from Listeriae or salmonellae.

BEHAVIOR OF LISTERIA MONOCYTOGENES IN COLDPACK CHEESE CONTAINING NISIN DURING STORAGE

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The effect of nisin on the survival of *Listeria monocytogenes* in cold-pack cheese was examined. Two batches of cold-pack cheeses were prepared with 40 and 50% moisture respectively. Cheddar cheese containing a known concentration of nisin was blended with an appropriate amount of Colby cheese. The resulting cheese samples contained nisin ranging from 50 to 800 international units nisin (IU)/g. Samples were inoculated with *Listeria monocytogenes* at a level of ca 5×10^3 colony forming units (CFU)/g, and stored at 7, 21 and 32°C. Samples were evaluated every 2d during the first two weeks of storage, then every 5d thereafter for a period of 5 weeks. *L. monocytogenes* populations were enumerated by surface plating on Oxford Listeria Agar, and incubating at 30°C for 24-48 hrs. *Listeria* populations decreased in cheese containing nisin at 21 and 32°C. At 19d *Listeria* were not recovered in these samples. At 7°C *Listeria* populations remained constant. These results, suggested that the use of nisin-containing cheese in the manufacture of cold-pack cheese could be an effective method for controlling *Listeria* outgrowth.

EXTENSION OF SHELF-LIFE OF COTTAGE CHEESE USING MONOLAURIN

Derrick Bautista*, M. Durisin, and M. W. Griffiths, Department of Food Science, University of Guelph, Guelph, Ontario, Canada N1E 2W1

Shelf-life problems due to contamination of cottage cheese result in approximately 5% return of product to the manufacturer each year. Whereas preservatives are not permitted, it may be possible to use naturally-occurring compounds to extend the storage life of cottage cheese. The monoglyceride, monolaurin has been shown to possess anti-microbial properties as well as being an emulsifying agent. Incorporation of monolaurin into cottage cheese at levels of 250 and 500 p.p.m. resulted in inhibition of both *Pseudomonas* spp. (enumerated by plate counts on *Pseudomonas* Selective Agar) and coliforms (enumerated using Violet Red Bile Agar) during storage at 6, 15 and 21°C. There was also an inhibition of growth of yeasts and moulds in the presence of monolaurin as evidenced by reductions in counts on Potato Dextrose Agar. These results suggest that the use of monolaurin as an emulsifying agent in cottage cheese will also have beneficial effects on shelf-life.

THE USE OF EPIFLUORESCENT AND PHASE MICROSCOPY IN EVALUATING MIXED BIOFILMS

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Listeria spp. may be involved in the formation of biofilms on food processing equipment and processing plant environments. The ability of *Listeria* spp. to survive the sanitizing processes could be responsible for contamination of final product. *Listeria monocytogenes* and *Pseudomonas fragi* attachment to glass cover slips (GCS) grown in tryptic soy broth at 22°C, separately and in combination, were studied. Two systems were used: a continuous flow slide chamber (CFSC) and submersion in an agitated vessel. After 24 hr, epifluorescent and phase microscopy, as well as a modified Gram stain procedure, were used to evaluate attachment. Attachment of *Listeria monocytogenes* to GCS in these dynamic environments was not successful. The microorganisms either attached as single cells without further division or the cells desorbed. However, combined with *Pseudomonas fragi*, attachment of *L. monocytogenes* and subsequent microcolony formation were enhanced. *P. fragi* may act as a primary colonizer attracting and entrapping *L. monocytogenes* within its acidic mucopolysaccharides. Image analysis could be used to differentiate and quantify gram-positive and gram-negative cells within a biofilm.

ELIMINATION OF SURFACE-ATTACHED BACTERIA BY DETERGENT WASHING AND CHEMICAL SANITATION IN A DYNAMIC FLOW SYSTEM

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Recent reports have suggested that sanitizers are ineffective in killing surface-attached bacteria. However, sanitizers should be applied only as part of a total cleaning process, i.e., detergent washing followed by chemical sanitation. A study, therefore, was conducted showing the results of the total cleaning process. Stainless steel surfaces, contaminated with *Pseudomonas fluorescens*, were water rinsed, washed (Cl-alkaline, alkaline, and acid detergents) at 24 and 63°C and/or sanitized (NaOCl, acid anionic, iodophor, and peracetic acid) in a tubular flow system utilizing CIP protocols. Detergent washing resulted in at least 99% reduction of viable surface-attached bacteria. When followed by chemical sanitizers, the total cleaning process resulted in a 4 log or greater reduction, in most cases. Sanitizers applied to the non-washed surfaces reduced viable bacteria only 1 to 2.5 log. These results indicate that the total cleaning process is effective in giving surfaces that are bacteriologically clean, thus reducing food-contaminating problems caused by surface-attached bacteria.

EFFECT OF COLD TEMPERATURE ON GERMICIDAL EFFICACY OF QUATERNARY AMMONIUM COMPOUND, IODOPHOR AND CHLORINE ON LISTERIA

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The effect of cold temperature (between 2°C and 25°C) on the germicidal efficacy of quaternary ammonium compound (25 to 200 ppm), iodophor (12.5 to 50 ppm), and chlorine (25 to 200 ppm) on *Listeria* (a pool of two *L. monocytogenes* strains, *L. ivanovii* and *L. innocua*) was studied by using the suspension test method. At 30 sec exposure time, the efficacy of the quaternary ammonium compound (QAC) and iodophor decreased as the temperature decreased. The magnitude of the effect of the temperature was dependent on the concentrations of the sanitizers. In fact, the temperature showed an effect only at 50 ppm and lower QAC concentrations. The lower the concentrations of the sanitizers were, the greater the effect of the temperature. However, the effect of the temperature was reversible by increasing the exposure time. On the other hand, temperature did not show an effect on the efficacy of chlorine.

ASSESSMENT OF HANDLING CONDITIONS AND QUALITY OF MILK IN OREGON PUBLIC SCHOOLS

Floyd W. Bodyfelt*, Professor of Food Science, and A. J. Gatherum, Oregon State University, Department of Food Science and Technology, Corvallis, OR 97331-6602

A survey and audit of 11 Oregon milk plants was conducted to evaluate the processing and delivery systems for fluid milk to public schools. The shelf life potential of 1/2 pint size milk, lowfat milk and chocolate milks, were determined by the Mosley Test; 14% of the samples

were found unsatisfactory. The food service administrators of 17 school districts were interviewed about "school milk" service and products performance. Observations of milk handling practices and product temperatures were undertaken in 71 schools. Not one school monitored milk temperature at time of delivery, in storage or at the point of serving. Nearly 40% of all milk products were stored in excess of 4.2°C and 29% of the products were observed to be held non-refrigerated for periods exceeding 30 min. It was concluded that dairy processors need to focus attention on problems such as soiled milk cases and cartons, leaker cartons, product rotation, frozen milk, and warm milk (greater than 7.2°C).

A COMPARISON OF COMMERCIALY PROCESSED FLUID MILKS HELD AT 7.2°C (45°F) FOR 10, 12, AND 14 DAYS

S. E. Barnard*, Professor of Food Science, and R. A. Smeltz, Penn State University, University Park, PA 16802

Fluid milk samples were obtained from the 38 fluid milk dealer processors in Pennsylvania on more than 100 occasions during the past 18 months. These samples represented all fillers except dispensers and all products processed by each plant. They were selected from conveyors or cold rooms and held for 10, 12 or 14 days at 7.2°C (45°F) prior to testing and tasting. Initial studies showed that about 90% of samples remained of acceptable flavor for 10 days, but that only 62% of samples were acceptable after 14 days. Following education programs and individual assistance, holding times were set for 12 days at 7.2°C (45°F). Following two rounds of samples from the 38 plants which demonstrated that 96% of samples remained acceptable, the Pennsylvania open dating regulation was extended to 12 days. Monitoring shows about 90% compliance. Bacterial results showed that about 40% of samples had bacterial counts of less than one coliform, and less than 20,000 SPC per ml. at the end of the 12-day holding. Dairy processors have requested that educational, testing, and tasting programs continue. The goal will be to demonstrate that fluid milk can be processed and packaged which will be of acceptable flavor after 14 days. If product temperatures do not exceed 7.2°C (45°F), the 14-day open date would still represent the actual keeping quality which consumers can expect.

MILK QUALITY

RATIONAL ANTIBIOTIC THERAPY FOR MASTITIS - A RESIDUE AVOIDANCE PERSPECTIVE

Ron Erskine, DVM, Ph.D., Department Large Animal Clinical Sciences, Michigan State University, East Lansing, MI 48824

Public concern over residues in milk has brought about regulatory changes in the storage and use of therapeutic drugs on dairy farms. As a result of frequent use of antibiotics as a treatment, mastitis is the disease most frequently associated with drug residues in milk. Extra-label use of antibiotics is commonly employed in the therapy of mastitis, thus increasing the risk of residue contamination. This risk may be unwarranted as the efficacy and cost-effectiveness of many antibiotic treatments is unknown. Thus, a rational approach for antibiotic use in the treatment of mastitis needs to be developed.

FACTORS ASSOCIATED WITH INHIBITOR VIOLATIONS ON ONTARIO DAIRY FARMS

S. A. McEwen, Assistant Professor, Food Safety and Public Health, Department of Population Medicine, University of Guelph, Guelph, Ontario, Canada

Dairy farmers were surveyed to determine how the use of on-farm drug residue prevention methods and various farm management practices were associated with altered risk of antibiotic residues (inhibitors) in bulk milk samples. The risk of residues in milk was observed to decrease with the following factors: use of on-farm antibiotic residue test kits, use of teat dips, use of separate equipment to milk treated cows and a belief on the part of the farmer that an increase in the dose of antibiotic administered to a lactating cow would require an increase in the withholding time of milk from that animal. Risk was increased with the frequent use of part-time assistance in milking of cows, and with the use of parlor milking systems.

COWSIDE ANTIBIOTIC RESIDUE TESTS: CURRENT STATUS ON AVAILABILITY, USE AND INTERPRETATION

William M. Sischo, Assistant Professor and Extension Veterinarian, Penn State University, Department of Veterinary Science, 115 Henning Bldg., University Park, PA 16802

Consumer concerns, increased surveillance and improved sensitivity for detecting antibiotic residues in milk have made the cowside screening test an important tool for the dairy producer and veterinarian. In recent years, cowside test kits have become more available and easier to use. There are a variety of technologies involved in these tests with the most common assays measuring the effect that a suspect milk sample has on bacterial growth. Other methods used in these tests involve antibiotic-binding proteins adhered to membrane systems and immunologically-based techniques. Although, these systems have been adapted to farm use they are not fool proof and need to be carefully monitored for reliable results. Since none of the cowside tests have perfect sensitivity or specificity, it is necessary to use information of the cow's medical and treatment history to adequately interpret test results.

VEROTOXIGENIC *E. COLI* CONTAMINATION OF MILK AND ASSOCIATED RISK FACTORS

S. A. McEwen, R. C. Clarke, and J. B. Wilson*, Department of Population Medicine, University of Guelph, Guelph, Ontario, Canada N1G 2W1

Infection with verocytotoxigenic *E. coli* (VTEC) has been linked to a number of serious human illnesses including bloody diarrhea and the hemolytic uremic syndrome, a leading cause of childhood kidney failure. In outbreak investigations, VTEC infection has been linked to the consumption of beef. VTEC infection has also been linked to the consumption of unpasteurized milk. In 1986 a group of kindergarten children developed VTEC infection after drinking raw milk during a visit to a dairy farm near Samia, Ontario. VTEC were also found in a 1989 survey of milk filters from Ontario dairy farms and have been found to be common in the feces of dairy cattle in several studies, including a recent large scale study conducted in Ontario. Interestingly, however, many of the VTEC serotypes isolated from cattle have never been found in humans, suggesting that not all VTEC found in cattle are capable of causing human illness. Our current research addresses this question by focusing on the potential for bovine VTEC strains to infect and cause disease in dairy farm families.

MILK QUALITY IMPROVEMENT INITIATIVES FOR THE ONTARIO DAIRY INDUSTRY

M. Ann Godkin, Ontario Ministry of Agriculture, Animal Industry Branch, Fergus, Ontario, Canada

Milk quality regulation changes in Ontario, implemented January 1, 1992, have signaled the dairy industry's intention to reduce somatic cell counts and inhibitor violations. Producers affected by these changes require diagnostic, technical and corrective advisory services to remedy herd problems. The Ontario Udder Health Improvement Program has been developed to facilitate producers contact with readily available expertise.

The Ontario Udder Health Improvement Program has three components. These are an on-farm program, an extension program and a monitoring program. The program initially targets producers with high bulk tank SCCs who are in imminent danger of shut-off or penalties but will be extended to all producers seeking aid.

The three components and the "team" approach to mastitis control will be discussed in detail during the presentation.

THE DYNAMICS AND TREND ANALYSIS OF BULK MILK AND QUALITY DATA

Ken E. Leslie*, Associate Professor, and Y. H. Schukken, Department of Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, Ontario, Canada N1G 2W1

The Ontario Somatic Cell Count (SCC) Penalty Program, has caused a significant reduction in the mean bulk milk SCC. A drop of at least 60,000 cells/ml can be attributed to this program. Bulk milk SCC has a definite seasonal fluctuation, with a peak in August and the lowest counts in April. The presence of inhibitors, high plate loop counts, and added

water violations are all strongly associated with SCC. Improvements in the provincial SCC average are driven by farms with mid-range SCC values (300,000-600,000) moving down. The main reason for increases in the provincial SCC is the mobility of low SCC herds (<150,000) to remain low. These findings suggest that an incentive program may be useful to keep herds in the low SCC range. The overall contribution of cells to the total Ontario milk supply was calculated for each farm. Herds with the highest SCC contribution did not necessarily have SCC penalties. Extension education resources should be directed at herds with a high SCC contribution.

RELATIONSHIP OF MILKING MACHINE DESIGN AND FUNCTION TO MILK QUALITY

Stephen B. Spencer, Professor of Dairy Science, Department of Dairy and Animal Science, The Pennsylvania State University, University Park, PA 16802.

The influence of the milking machine to milk quality has long been debated. Cleanability and basic design are frequently approached as subjective opinions. Controlled studies to evaluate design would improve design criteria. In addition to the basic cleaning requirements of time, temperature, and concentration of the cleaning solution, a major factor of solution contact to milk surfaces is frequently inadequate, especially with large diameter pipelines. Proper pipeline configuration and location, size, and operation of air injectors are essential elements of achieving plug flow conditions of solutions for satisfactory cleaning. Large systems are also plagued by uneven distribution of solutions among units. Milking machines are often cited as a leading cause of mastitis and hence related to high somatic cell counts. This is seldom the case since mastitis is a multifactorial disease. A review of literature does show, however, a consistent relationship to increasing new infection rates when pulsation failure is present and when numerous teat end impacts are experienced. Most studies indicate that less than 10 percent of infections are machine related.

AUTOMATION IN DAIRY PROCESS CONTROL SYMPOSIUM

PROCESS DESIGN AND EXTENDED SHELF LIFE OF DAIRY PRODUCTS

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During the past decade a number of new fluid milk plants have been designed and constructed, and existing facilities have been renovated, to meet the objective of processing and packaging a fluid milk product having an extended shelf life. These facilities use conventional pasteurization, and also package the product in traditional containers.

The "extended shelf life" capability is the result of the application of design and operating concepts which maximize the efficiency and control of the cleaning and sanitizing procedures, and minimize human involvement in the cleaning process. Flexibility is provided via the application of U-Bend transfer panels as an improved means of handling the required physical separation of Grade A and non-Grade A products, and the separation of all products from flush, wash and rinse solutions. The Process/CIP system and control system design often makes it possible to clean, or requires the cleaning of all pasteurized side equipment in a single operation, thereby subjecting all interconnecting pasteurized piping and equipment to an identical, controlled cleaning procedure.

DOCUMENTATION OF AUTOMATED PROCESSES

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A highly automated, CIP cleaned dairy processing piping system provides many opportunities for improper function and/or performance not easily detected by operating, management or regulatory personnel. The complex *Automated Process* is best maintained and evaluated on the basis of concise and complete documentation, available to all concerned operating, maintenance and management personnel, and on file with the responsible Public Health Regulatory Agency.

This documentation should include (a) a building and equipment arrangement drawing, (b) a Schematic Flow Diagram, (c) easily inter-

preted CIP Circuit Schematics, (d) CIP program sequences and operating parameters, (e) a narrative description of processing and CIP operations and (f) a full definition of the control logic, related sensors, output devices, and interlocks. Special consideration must be given to the description of the interface of required legal controls to the Programmable Logic Controller or computer based control system.

AUTOMATIC CLEANING AND SANITATION IN THE 90'S

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The most common methods of automatic cleaning and sanitation in the dairy industry are found in the internal surfaces of piping, tanks and processing equipment.

This area of production, has been subjected to very extensive research of new, better and more efficient cleaning and sanitation methods under the C.I.P. (Cleaning-in-Place) umbrella.

The main parameters of internal sanitation and state-of-the-art knowledge are being revisited in some detail, with emphasis in automatic verification and environmental impact.

Current techniques and future developments in automatic sanitation of external surfaces and plant environment sanitation in food plants will be discussed.

A NEW DISTRIBUTED VALVE CONTROL SYSTEM

Keith Hammer, G & H Products, Inc., Kenosha, WI.

SattTop is a new I/O system for simplified control of pneumatic process valves and digital control of motors, switches and sensors. And it reduces the need for complex cabling considerably!

A SattTop system configured for valve control uses only *one* cable and *one* air hose for *all* valves, in contrast to a conventional system that requires several cables and a hose for each valve.

Communication is based on the high-speed, heavy-duty and sturdy SattBus field bus. A single SattTop trunk cable up to 1,000 metres long contains lines for power and communication, and supports as many as 120 process valves or I/O units.

SattTop means fewer cables, fewer I/O channels and fewer air hoses. And it also means simpler, less expensive installation, service and maintenance!

The compact local unit (SattTop EU) enables vital control functions to be positioned locally at individual objects in a process. Via the SattBus field bus, the local units communicate with the SattBus OP operator unit, which in turn is linked to the control system.

SattTop delivers decisive benefits in comparison with a conventional system where each object has its own separate link to the control system.

In the SattTop system, a single bus cable supports a total of 120 SattTop local units, each with two digital inputs and two digital outputs. The bus cable contains lines for communication and power supply. In large installations, multiple SattTop systems can be installed in parallel. In comparison with a conventional system for valve control, SattTop reduces the need for cabling by up to 75%.

SattTop Makes Valves Intelligent

In a SattTop system configured for pneumatic process valves, the EU is combined with the valve top - to create the intelligent valve! The valve top unit houses solenoids that are activated by the two output signals, as well as sensors for feedback signals.

Everything Gets on the Bus

The SattTop system has been developed as an integrated segment of the SattControl product range, so that it uses the high-speed heavy-duty sturdy SattBus for communication. The big benefit is that the bus can be used simultaneously by PLC systems, operator systems, distributed I/O units and instrumentation.

Profile of SattTop

SattTop EU: A compact electronic unit with two digital outputs and two digital inputs with LED's. The fully encapsulated electronics include programs for feedback, error calculations, addresses, variables and parameters.

Valve Top Unit: Mounted on Alfa-Laval pneumatic valves, contains a SattTop EU, one or two solenoid valves and two sensors.

SattTop VB: The VB (valve box) is designed for use with pneumatic valves from other manufacturers. It contains a SattTop EU, one or two solenoids and two inputs for external sensors.

SattTop I/O: For distributed control of motors, switches and sensors. Contains a SattTop EU, two 250V AC/DC and 110 or 220V AC for external sourcing. A SattTop system consisting solely of SattTop I/O can thus handle up to 480 I/O signals.

SattBus OP: The OP (operator panel) is the link between the control system and the SattTop system. With a keyboard and a 4-line display, it provides communication and operator functions. The SattBus OP is used for startup, service and manual operation of the system.

REGULATORY ASPECTS/INSPECTION OF PASTEURIZERS

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In 1986 the Dairy Processing Branch, Alberta Agriculture, initiated and legislated the Pasteurizer Testing Program. As well, the Dairy Industry Act required all Pasteurizer Operators to become licensed. Alberta is the only province in Canada requiring Pasteurizer Operators to be licensed.

The regulatory aspects/inspections of pasteurizers presentation at the 1992 IAMFES Annual Meeting will highlight the old and comparative new pasteurization component technologies implemented in the dairy industry to ensure greater food processing efficiencies and safety. As well, the Alberta government's regulatory testing program accepted by Agriculture Canada utilizes the Pasteurized Milk Ordinance developed in the USA, with exception to the holding time determinations. The department's program, its differences to PMO and today's concerns regarding pasteurizer systems will be discussed and undoubtedly be thought provoking. The success of the regulatory Pasteurizer Testing Program in Alberta is due to the unique working relationship between industry and government in this province. This joint effort has maintained out common interest - food safety in the dairy industry.

DAIRY SYMPOSIUM

PSYCHROTROPHIC *BACILLUS* SPP. — MORE THAN JUST SPOILAGE ORGANISMS?

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Psychrotrophic *Bacillus* spp. can be isolated from about 25% of raw milks and about 70% of pasteurized samples. Spores of these organisms can survive pasteurization and, indeed, can even be activated under these conditions. Several psychrotrophic strains have been identified but the most common are *B. cereus* and related strains. These can grow at 6°C with generation times of about 17 to 22 hours, but some species, such as *B. circulans*, can grow at temperatures of 2°C. Several isolates of psychrotrophic *Bacillus* spp. obtained from raw and pasteurized milk are capable of producing diarrhoegenic and cytotoxins. About 70% of strains were shown to produce diarrhoegenic toxin by an immunological test, and further analysis showed that these strains were capable of producing toxin in milk at 6°C when cell numbers reached about 1×10^7 cfu/ml. The factors affecting growth and toxin production have been determined and predictive equations describing these events have been derived. Detection of these organisms is time consuming and laborious, but new technologies such as low MW RNA typing and PCR may present opportunities. Control of growth of these bacteria is also difficult once they have contaminated the milk supply, but effective control of the cold chain is the best approach. By far the best alternative is prevention of contamination of the milk supply at source.

BIOLUMINESCENCE: AN ENLIGHTENING TECHNOLOGY

Mansel W. Griffiths, Chair Dairy Microbiology, Department of Food Science, University of Guelph, Guelph, Ontario, Canada N1G 2W1

Of all the newer technologies available to the food microbiologist, arguably the most useful as real time monitor of quality is bioluminescence. Tests based on ATP bioluminescence for the enumeration of micro-organisms in milk have been available for several years, but recent

innovations have resulted in assays capable of detecting microbial loads as low as 10^3 cfu/ml in milk in 5 to 10 minutes. In combination with pre-incubation procedures, these tests allow shelf-life testing of pasteurized products and sterility testing of UHT processes. Other applications of ATP bioluminescence include a 5 minute hygiene monitoring assay that enables effective regulation of HACCP programs. An exciting area of development is the use of bioluminescence to detect specific groups of bacteria in milk products. The genes responsible for bacterial bioluminescence can be cloned into host specific phages. On infection, the host cells become luminescent and can easily be detected at levels of about 10^2 cfu/ml within 60 minutes. The emergence of this technology will provide the microbiologist with a powerful tool for assessing quality and safety of dairy products.

BIFIDOBACTERIA IN DAIRY PRODUCTS

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Bifidobacteria are gram-positive, non-motile, non-spore formers of variable morphology. They are anaerobic but may grow in the presence of oxygen if carbon dioxide is present. In new-born infants bifidobacteria may account for more than 25% of the intestinal flora. The most common species are *B. infantis*, *B. breve*, and *B. longum*. Bifidobacteria population decreases with age and consists primarily of *B. adolescentis*, and *B. longum*. Bifidobacteria produce lactic and acetic acids. Consequently, they suppress pathogens via pH control. Bifidobacteria are also believed to possess therapeutic effects such as anticarcinogenic and cholesterol properties. They also produce bacteriocins, which are useful in suppressing bacterial growth. As a result, there has been wide-spread interest in manufacturing dairy products containing bifidobacteria. Many products are now commercially available especially in Europe and Japan. These products include primarily yogurts, but infant formula containing bifidobacteria have also been developed. Other products such as frozen desserts and fluid milks have been evaluated as well. The primary problem in manufacture of bifidobacteria containing products is that of viability of cells. To fully realize the potential benefits of these bacteria the current challenge is to produce fermented and non-fermented products in which bifidobacteria are viable for the entire shelf-life of the product.

BIOFILMS - A CLEANING AND SANITIZING PERSPECTIVE

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Biofilms, adherent macrocolonies of bacteria, have been implicated as the cause of microbiological-related quality problems. There is also considerable evidence that their presence in food processing environments presents a potential risk in terms of food safety. The mechanism of bacterial attachment, as well as the sequence of events leading to biofilm development, has been the subject of numerous investigations. The types of bacteria which are prone to develop biofilms or mixed biofilms have also been extensively studied.

Bacteria which are present in biofilms are more tolerant to the action of antimicrobial agents than the same bacteria in the suspended state. In some cases, the biocide must be used at 10-100X normal use levels to achieve the same degree of inactivation. Sanitizers also vary considerably in their activity against biofilms. The degree of attachment and also the extent of antimicrobial activity is also a function of the chemistry and physical nature of the attachment surface. While normal cleaning and sanitizing regimens appear to be adequate in terms of removal and inactivation, careful selection and control of time, temperature, and concentration are essential to assure complete control.

LABORATORY MANAGEMENT SYSTEM (MICROBIOLOGY)

Michael Lammers, Marketing Technical Manager, Diversey Corporation, 12025 Tech Center Drive, Livonia, MI 48150

Computer based laboratory management systems. IBM PC compatible programs for record keeping of microbiologic data in fluid milk processing operations. Demonstrations will include a currently available program.

FOODBORNE PATHOGENS

ISOLATION OF *SALMONELLA ENTERITIDIS* FROM POOLED EGG SAMPLES AS A SCREENING METHOD FOR DETECTING INFECTED LAYING HENS

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The association of human *Salmonella enteritidis* (SE) outbreaks with the consumption of eggs has necessitated the implementation of programs to identify SE-infected flocks of laying hens. These programs have generally applied serological and bacteriological tests to samples from hens and poultry houses. Sampling eggs for SE would provide a much more direct assessment of the risk to public health posed by particular flocks, but contaminated eggs are evidently produced infrequently and often contain very small numbers of SE.

The present study sought to evaluate the effectiveness of sampling pools of fresh eggs for detecting SE-infected flocks of laying hens. Artificially contaminated eggs were used to examine methods for sampling egg pools of various sizes. A method involving incubation of homogenized pools of egg contents before culturing was found to be capable of recovering the small numbers of SE likely to be encountered in naturally contaminated eggs. When such a method was applied to eggs from experimentally infected laying hens, egg sampling was at least as effective as serological testing or bacteriological sampling of voided fecal material for detecting infected hens.

SURVIVAL OF *LISTERIA MONOCYTOGENES* ON THE SURFACE OF EGG SHELLS AND DURING FRYING OF WHOLE AND SCRAMBLED EGGS

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The survival of *Listeria monocytogenes* on shell eggs and after cooking raw whole and scrambled eggs by frying was determined. Samples were inoculated with low or high populations of a five strain mixture of *L. monocytogenes*. Survival of the organism on shells of unbroken eggs was monitored over a 6-week storage period at 5° and 20°C. Presence and populations of *L. monocytogenes* were determined using enrichment in tryptic soy broth and/or plating on Lee Modified Oxford (MOX) agar. Both low (10² cfu/egg) and high (10⁴ cfu/egg) populations of *L. monocytogenes* on the surface of egg shells decreased to < 10 cfu/egg after 6 days of storage at 5° and 20°C. Frying whole eggs reduced both low (10² cfu/g) and high (10⁵ cfu/g) populations of *L. monocytogenes* by only about 0.4 log₁₀ cfu/g. In contrast, frying 1 or 3 scrambled eggs reduced low (10² cfu/g) populations of *L. monocytogenes* to undetectable and < 10² cfu/g, respectively. Frying 3 scrambled eggs containing high (10⁵ cfu/g) populations caused a reduction of about 3 log₁₀. Frying 1 scrambled egg containing a high population resulted in < 10² cfu/g populations. Both low (10² cfu/g) and high (10⁵ cfu/g) populations of *L. monocytogenes* remained unchanged or decreased slightly where raw slightly beaten whole eggs were allowed to stand for up to 3 h at 20°C.

HEAT STABILITY OF *LISTERIA MONOCYTOGENES* IN LIQUID EGG

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Pasteurized liquid egg products have become increasingly popular with the food industry, especially the hotel-restaurant-institutional (HRI) sector because of their convenience and versatility. The current pasteurization procedures were developed primarily for the destruction of *Salmonella*, however, there is now concern about their effectiveness in controlling *Listeria monocytogenes*. In this study the heat resistance of three strains of *L. monocytogenes* was determined in liquid whole egg and liquid yolk, with and without added NaCl or sucrose. Decimal reduction times (D-values) were determined for each strain at temperatures from 60° to 70°C. The results showed that *L. monocytogenes*, especially the Scott A strain, could survive the typical pasteurization treatment of 60°C for 3.5 min. in whole egg. The addition of 10% (w/w) NaCl to the whole egg and the yolk dramatically increased this pathogen's heat resistance with D-values in

excess of 20 minutes at 63°C. It was concluded that existing egg pasteurization treatments are not sufficient to ensure that such products will be free of *Listeria*.

HEALTH RISK ASSESSMENT OF UNDRAWN (NEW YORK DRESSED) POULTRY IN ONTARIO

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Undrawn or New York Dressed (NYD) poultry is exempt from inspection in Ontario, but has traditionally been graded by Federal graders. Change to Federal legislation prohibits grading of uninspected product, thereby prohibiting sale since provincial legislation requires grading before sale. This study was developed to assess the health risks associated with this product and to determine the feasibility of an inspection system based on on-farm, antemortem and external inspections with in-plant sampling for post-mortem inspection. Five plants participated in the study, which involved collection of on-farm flock history from producers. Following antemortem inspection all NYD-processed birds were inspected externally. A sample ranging from 3-10% depending on volume was randomly selected for post-mortem inspection. Microbiological sampling was conducted on five each of Control (eviscerated), NYD, NYD with feet removed, NYD with head removed, for aerobic plate count, coliform/*E. coli*, *Campylobacter jejuni* and *Salmonella*; each plant was visited three times. Bird types included ducks, fowl, capons, broiler chickens and roasting chickens. Differences in microbiological profile were more strongly related to plants, growers and bird types than to process. External inspection resulted in few condemnations; condemnation rates based on external inspection were strongly correlated with bird type. Post-mortem condemnation rates were related more to bird type than to process. This study has allowed the development of inspection standards for processing of NYD poultry.

A COMPARISON OF ANTILISTERIAL ACTIVITY OF TWO LACTIC STARTER CULTURES IN CHICKEN SUMMER SAUSAGES

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Chicken summer sausages (100% hand-deboned chicken meat) were manufactured with a bacteriocinogenic (Bac⁺) or a bacteriocin-negative (Bac⁻) *Pediococcus acidilactici* starter culture and challenged with a five-strain mixture (10⁷ CFU/g) of *Listeria monocytogenes* (Lm). Fermentation was conducted at 37°C (85% R.H.) until pH 5.0 was attained (ca. 11 h). Sausages were cooked to an internal chub temperature of 66.6°C for 45 min and cold-showered (5 min). Although sausages were similar in a_w (0.96) and titratable acidity (0.7%), about a 1 log₁₀ reduction of listeriae was observed over the fermentation period in sausages prepared with the Bac⁻ starter, whereas about a 3 log₁₀ reduction of Lm occurred in sausages fermented with the Bac⁺ *pediococci*. No listeriae were recovered from cooked sausages following storage at 4°C for 6 days. Thus, Bac⁺ starter cultures may afford an additional measure of safety in products that are either improperly heated or not cooked.

CONTROL OF *ESCHERICHIA COLI* O157:H7 BY FERMENTATION

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Escherichia coli O157:H7 has been implicated in outbreaks and sporadic cases of foodborne diseases causing hemorrhagic colitis, a bloody type of diarrhea, followed by hemolytic uremic syndrome (HUS) and renal failure, especially in children. One major vehicle of transmission of this pathogen is fresh ground meat. *E. coli* O157:H7 grows well in the temperature range (from 30 to 44.5 C) often applied when making fermented sausages, which usually do not undergo any further heat treatment prior to consumption. We studied the interaction of ten strains of *E. coli* with two starter cultures in a laboratory medium and in salami to ascertain the control of the pathogen by fermentation. *E. coli* were inoculated at levels of log₁₀ 3-4 (low) and log₁₀ 6-7 (high) CFU/ml or g, into

the laboratory medium or salami with starter cultures (*Pediococcus* sp. or *P. acidilactici* incubated at 32 or 40 C, respectively). Viable cell counts and pH were determined during the process. Within 24 h, the final pH of the laboratory medium and salami was as low as 4.75. *E. coli* O157:H7 was not destroyed in the laboratory medium, but its number was remarkably reduced in the high inoculum salami. However, in the low inoculum salami, the pathogen was totally destroyed (non-detectable level) by fermentation with starter cultures at both incubation temperatures.

THERMAL DESTRUCTION OF *LISTERIA MONOCYTOGENES* IN REDUCED SALT UNCURED-RESTRUCTURED MEAT PRODUCT

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Heat treatment is a critical control point for controlling *Listeria monocytogenes* in restructured meat products. Elevation of heat resistance of *L. monocytogenes* when heated slowly was reported. F values of the product were calculated using 160°F and 9.3 as the reference temperature and Z value. The purpose of this study was to evaluate destruction of *L. monocytogenes* under conditions simulating commercial processing. Beef clod muscles were trimmed, chunked, mixed with tetra sodium pyrophosphate (0.5%) and held at 32°F for 12 h. The preblend was mixed with NaCl (0.2% and 2.0%) and the cell suspension of *L. monocytogenes* to give a concentration of ca. \log_{10} 7.6 CFU/g in the mix. Meat was manually stuffed into water-proof casing, and the product was heated in a waterbath to simulate smokehouse heating schedule. Results are reported as mean of two replicates for each treatment.

Heating the product to 130, 140, 150, and 160°F resulted in \log_{10} reductions of 0.8, 3.3, 2.6, and 3.3 in low salt and \log_{10} reduction 1.4, 3.6, 3.5, and 4.0 in high salt product. Heating to 160°F resulted in an F value of 26 min. For all endpoint temperatures, heating high salt product resulted in significantly greater destruction ($p < 0.05$) of *L. monocytogenes* compared to low salt product.

BACTERIAL GROWTH AND SURVIVAL IN VACUUM PACKAGED BEEF DURING EXTENDED REFRIGERATED STORAGE

Reneé A. Hart*, Research Assistant, P. B. Kenney, G. Jordan, H. Thippareddi, K. Kone, R. E. Campbell, C. L. Kastner, and D. Y. C. Fung, Kansas State University, Department of Animal Science and Industry, Call Hall, Manhattan, KS 66506-1600

Lactic acid (3.0%) and chlorine (200 ppm) were applied to intact sides of beef following rail inspection and then immediately after 8 h of spray chilling. After 4 days of storage at 4°C, these sides were then divided into 6 subprimals, and the subprimals were subdivided into 8 pieces prior to random treatment with either chlorine spray (200 ppm) or microwave irradiation. These pieces were sampled at day 4, 10, 15, 20, 30, 60, 90, and 120 of vacuum storage at 1°C. One half of the subprimals was inoculated with a combination of *Listeria monocytogenes*-Scott A, *Salmonella enteritidis*, *Yersinia enterocolitica*, and *Escherichia coli* O157:H7 in order to evaluate the fate of these pathogens in vacuum packaged cuts with and without sanitizing treatment. Total plate counts, *L. monocytogenes*-Scott A, *S. enteritidis*, *Y. enterocolitica*, and *E. coli* O157:H7 were enumerated.

Reductions in total counts were observed for the treatment with lactic acid and chlorine at the carcass level. However, the same effect was not observed at the subprimal stage. With the exception of microwave treatment, *Listeria* counts declined; *Salmonella* did not proliferate; *E. coli* and *Yersinia* proliferated throughout the storage period.

EFFECT OF GROWTH NUTRIENTS ON ATTACHMENT OF *LISTERIA MONOCYTOGENES* TO STAINLESS STEEL

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The objective of this study was to determine the effect of growth nutrients on attachment of *Listeria monocytogenes* to stainless steel. Cells were grown in chemically defined medium (D10) and tryptic soy broth (TSB) at 21°C. After 4 h exposure of stainless steel surfaces to each standardized cell suspension, the numbers of attached cells were com-

pared. Cells that were grown in D10 showed 50 times higher attachment than those grown in TSB. Addition of nitrogen, carbon, and phosphate sources did not increase the attachment in TSB. Also, reduction of component concentrations in D10 medium did not result in a significant decrease of attachment ability. The replacement of nitrogen sources in D10 with tryptone resulted in a decrease in attachment equivalent to that observed with TSB. Growth on trehalose, fructose, cellobiose, and mannose instead of glucose did not affect attachment ability of standardized cell suspension. Different levels of tryptone, ammonium chloride, phosphate, and glucose in D10 did not affect the attachment ability of *L. monocytogenes*.

SIMULTANEOUS GROWTH OF *LISTERIA MONOCYTOGENES* AND *LISTERIA INNOCUA* IN PURE CULTURE AND FOOD SYSTEMS

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Listeria spp. have been isolated from a wide variety of sources, and in many situations *L. innocua* is more commonly found than *L. monocytogenes*. Previous work indicated that there was no significant difference between growth rates of *L. monocytogenes* and *L. innocua* strains in TSB-YE pure culture. Three *L. monocytogenes* and three *L. innocua* strains were selected to evaluate competition between the two organisms when inoculated simultaneously into cultural media and food systems. Fraser broth (FB), TSB-YE, UVM, and foods were inoculated (at ca. 10^7 /ml) and incubated at 35°C. Strains were selected to allow use of carbohydrate fermentation patterns to distinguish strains on purple agar base with added rhamnose. In FB, UVM, and TSB-YE, *L. innocua* populations were higher than *L. monocytogenes* by 1.1, 1.0, and 0.5 logs respectively. This occurred when media were inoculated individually or simultaneously. *L. innocua* populations were also higher in foods though differences were not as dramatic. This may explain in part why *L. innocua* is isolated more frequently than *L. monocytogenes*.

ACCELERATED GROWTH OF *LISTERIA MONOCYTOGENES* BY MOULDS

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The identification of soft cheeses as vectors for transmission of listeriosis has prompted examination of cheese making and ripening processes. Of particular interest is the accelerated growth of *L. monocytogenes* reported in whey previously cultured with *Penicillium camemberti*. This phenomenon has been confirmed using cell-free supernatants of *Penicillium candidum* grown on a variety of media. These supernatants were prepared by centrifugation followed by filtration. The enhancement in growth of *Listeria monocytogenes* is:

- i) dependent on the medium used to grow *P. candidum*.
- ii) does not involve the production of proteases as reported for a similar effect observed between *Pseudomonas* spp. and listeriae.
- iii) not solely due to pH effects.

THE 1991 CHOLERA EPIDEMIC IN LATIN AMERICA AND THE FDA ACTIONS IN RESPONSE

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Beginning in January, 1991, illnesses attributable to *Vibrio cholerae* O1, El Tor, Inaba began to be reported from Peru. The numbers of cases and resulting deaths rapidly grew. The epidemic spread geographically across South America, to Central America and Mexico. A few cases were reported in the U.S. Many federal agencies joined forces in response to the epidemic. FDA played a leading role by: coordinating various activities, conducting sampling and microbiological testing of foods imported from affected countries, searching for possible means of *Vibrio cholerae* organisms contaminating American shellfish growing waters, and developing new and perfecting existing methodologies for isolation and identification of the causative organism.

UPDATE ON FOODBORNE PATHOGENS

CHOLERA IN THE AMERICAS: A FOOD BORNE HAZARD?

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Vibrio cholerae serogroup 1, the etiologic agent of cholera, is endemic along the United States Gulf coast. Over a hundred serotypes of *V. cholerae* exist, but so far only toxigenic strains of the O1 serogroup have been found to cause epidemics. The first case of naturally acquired cholera in the Americas since 1911 occurred in 1973 in Port Lavaca, Texas, and sporadic cases and outbreaks in Texas and Louisiana traced to seafood from these two states have been reported since then. A single case was also traced to Cancun, Mexico in 1983. In January 1991 a cholera epidemic started in Peru, and continues to spread throughout most of Latin America. The cumulative case totals reported to the Pan American Health Organization, as of January 8th, 1992 are 391,955 cases and 3,986 deaths in the Western hemisphere. Untreated drinking water is a dominant risk factor, but the organism has also been isolated from fish and seawater. Therefore, marine food might be an important vehicle for transmission, and several cases of cholera in the USA during 1991 were epidemiologically linked to seafood either consumed in or imported from Latin America. We have used molecular techniques to document cases of cholera, and to indicate transmission through food. Genetic analysis has revealed that strains isolated from the outbreak in Latin America are similar to the pandemic isolates from Asia and Africa, and clearly distinguishable from the strains isolated from sporadic cases of cholera along the Gulf coast of USA during the last 20 years.

LISTERIA MONOCYTOGENES - CURRENT ISSUES IN PERSPECTIVE

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Although the hysteria surrounding *Listeria monocytogenes* has diminished over the last few years, there are still major concerns which will continue to need addressing both from a regulatory and from a research standpoint. Some of the current issues surrounding *L. monocytogenes* which will be discussed include methods, regulatory aspects and control.

In the methods area, conventional as well as some of the newer rapid methods for detecting *L. monocytogenes* will be discussed, summarizing the most salient points. In terms of regulatory aspects, compliance policies in Canada, the USA and the EEC will be examined, including recent discussions regarding proposed tolerance limits for *L. monocytogenes* in foods.

Some of the newer developments in controlling the presence of *L. monocytogenes* in foods, such as the use of starter cultures and clean rooms, will be examined. The continuing importance of the use of HACCP as a total quality control system will be emphasized.

ISOLATION OF VEROCYTOTOXIN-PRODUCING ESCHERICHIA COLI FROM ANIMALS AND FOOD PRODUCTS

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Since their discovery in 1977, the Verocytotoxin-producing *Escherichia coli* (VTEC), have evolved from a laboratory curiosity to one of the most important and complex group of bacterial pathogens affecting human and animal health. VTEC have been associated with a wide spectrum of disease in humans, ranging from asymptomatic carriers to hemorrhagic colitis and the hemolytic uremic syndrome. In animals, depending on the host target system affected, a variety of clinical syndromes are produced, from edema disease in swine to hemorrhagic colitis in calves. Epidemiological investigations have implicated food as an important vehicle for transmission from animal reservoirs to humans. In Canada, as in other countries, we have conducted numerous surveys which have shown that cattle are an important reservoir of VTEC serotypes associated with human disease. VTEC are commonly isolated from asymptomatic calves and are widespread throughout the cattle population. Contamination of raw beef products during processing is a major factor in the spread of

VTEC into the food chain. Methodology to determine which animal VTEC strains are potential human pathogens may be based on detection of specific adhesion mechanisms. The true prevalence of these organisms has been underestimated due to the inadequacies of the laborious tissue culture techniques that until recently were the only reliable means for isolation. The advent of immunological and molecular based detection systems will greatly enhance isolation and facilitate efforts to control these pathogens.

FOODBORNE TOXOPLASMOSIS

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Toxoplasmosis, a disease of mammals and birds, is caused by the obligate intracellular protozoan parasite, *Toxoplasma gondii*. In the U.S., 30-50% of the population demonstrate a positive serological reaction to the organism. The parasite is usually foodborne and enters the human body via ingestion of raw or undercooked meats from infected animals. Meat animals may be infected when they eat feed contaminated by feces from infected cats. Infection in immunocompetent humans seldom leads to clinical symptoms and foodborne outbreaks are rarely recognized. In immunocompromised individuals, a new infection or reactivation of a previous one can lead to severe and often fatal disease. Congenital infection with devastating complications to the fetus may occur if the mother becomes infected by *T. gondii* during pregnancy. Chemotherapy for toxoplasmosis has limited usefulness and a vaccine is not yet available. The foodborne aspect of *T. gondii* infection will be discussed in detail.

SALMONELLA CONTROL IN CANADA

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Foodborne Salmonellosis continues to be a major public health problem worldwide. Recently, public interest has been focused on *Salmonella enteritidis* and its association with eggs as a cause of foodborne illness. Since 1987, many countries including the United Kingdom and the United States have experienced marked increases in the number of foodborne outbreaks associated with *Salmonella enteritidis*.

In response to the rising international concern over *Salmonella enteritidis*, the Food Production and Inspection Branch of Agriculture Canada has implemented a control program for *Salmonella* within the Canadian poultry industry. This program is designed to be implemented over a 10 year period and is comprised of six main steps to control the bacteria within 17 defined sectors of the Canadian poultry industry. One of the steps is described as the problem definition phase. National surveys were conducted during the problem definition phase to establish the baseline prevalence of *salmonella* among the Canadian commercial egg, broiler and turkey industries. The results of several of these surveys will be presented.

UPDATE ON THE STATUS OF SALMONELLA ENTERITIDIS IN THE UNITED STATES

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The current status of the USDA Salmonella Control program is reviewed. The sharp rise in the mid 1980's of salmonellosis, caused presumably by *Salmonella enteritidis* in fresh shell eggs, and concentrated in the Northeastern quadrant of the U.S. resulted in a program which was started in February 1990, designed to trace back from human egg-implicated SE outbreaks to the egg-layer flocks of origin, with testing of the flocks and diversion of the eggs to pasteurization plants if the flocks were positive for SE. During a 2-year period (through April 20, 1992) 139 outbreaks were reported, of which 39 were considered egg-related. Tracebacks led to 25 flocks of origin, with some 10 million birds. Some 1.1 billion eggs from these flocks were sent to pasteurization plants. There was no apparent decrease in SE during this period (67 outbreaks in 1990 and 67 in 1991). A spent hen survey of egg-layer chickens from 406 houses in 37 different states indicated that 27% were positive for SE, with 45% positive in the Northeastern quadrant. Since the outbreak traceback program by itself did not promise to lower the SE rate in humans

significantly, a voluntary SE control program was organized in Pennsylvania, and started in April, 1992. The project is a cooperative effort between egg producers and State and Federal Agencies, and is organized to test the environments of hen houses for SE, then test eggs from these houses, and have the eggs diverted for pasteurization if positive for SE. At the same time, a variety of control procedures (SE-free feed, SE free pullets, biosecurity, rodent control, cleaning and disinfection, and use of an SE bacterin) will be evaluated to determine which are effective, singly or in combination, in preventing or eliminating SE in egg-layer flocks.

LABORATORY METHODS

EFFECTIVE METHOD FOR DRY INOCULATION OF *SALMONELLA* CULTURES

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An effective way of inoculating bacteria into dry foods/ingredients and achieving a uniform mixture was developed. Chalk tubes were weighed and soaked in a *Salmonella typhimurium* broth and allowed to dry back to their original weight in a 37°C incubator for approximately 72 hours. The dried chalk was stomached into a powder form, and a viable cell count of this incubated chalk, using a selective media for *S. typhimurium*, showed that the organisms survived the drying while entrapped in the chalk with no loss of viability. The "charged" chalk was used in an experiment as a dry inoculant where it was mixed in with a low-moisture poultry feed. In comparison to a liquid inoculant, the "charged" chalk was a superior way of inoculating into the dry particles because it created a more homogenous mixture with the feed without altering any properties of the feed itself.

EVALUATION OF ENRICHMENT AND PLATING MEDIA FOR ISOLATION OF VIRULENT *YERSINIA ENTEROCOLITICA* FROM GROUND MEAT

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Yersinia enterocolitica is becoming increasingly recognized as an emerging human enteropathogen. Over the years, several procedures are available to detect and isolate this pathogen. The efficacy of newly developed *Y. enterocolitica* isolation media by Schiemann (1979,1982), Fukushima (1987), Wauters et al. (1988), and Riley and Toma (1989) was tested with naturally contaminated pork and artificially inoculated beef samples. *Y. enterocolitica* (serotypes 0:3 or 0:8) (10^6 - 10^8 CFU/g) were inoculated into ground meat and recovered in three enrichment broths at 22°C for 2 days followed by surface plating onto three selective agar media with 24 h of incubation at 32°C or 36°C to determine the most effective combinations. Greatest recoveries of *Y. enterocolitica* were obtained using sorbitol bile broth (SBB) and yeast extract-rose bengal-bile oxalate sorbose (YER-BOS) broth, followed by isolation on virulent *Y. enterocolitica* (VYE) agar or Congo red-magnesium oxalate (CRMOX) agar. However, irgasan-ticarcillin-potassium chlorate (ITC) broth and cefsulodin-irgasan-novobiocin (CIN) agar were less satisfactory than other combinations to give quantitative recovery of test strains. While three plating media resulted in similar counts of *Y. enterocolitica* from the same enrichment broth, a significant variation in the recovery of this organism was noted with different broths.

COMPARISON OF 25G AND 375G COMPOSITE SAMPLES FOR DETECTION OF *LISTERIA*

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A two part study was conducted 1) to determine the detectable level of *Listeria* in 25g samples of meat and poultry products using the USDA procedure and 2) to investigate the efficacy of compositing in the recovery of *Listeria* in meat and poultry foods.

Part 1 consisted of inoculation of hot dogs with five strains of *Listeria* at levels of 0.1 cells/25g to 275 cells/25g. Ten samples at each of 4 levels for each strain were analyzed (200 samples). It was determined

that the minimum detection level was strain specific and ranged from 0.1/25g to 0.6/25g.

Part 2 consisted of inoculation of 6 food products. Fifteen 25g samples from 2 inoculation levels and 15-25g control samples were analyzed. Duplicate analyses were performed in two of three Silliker Labs participating. The results indicate that analysis of 15-25g composited samples was comparable to individual analyses.

DEVELOPMENT OF CULTURE MEDIA FOR THE RAPID DETECTION OF *LACTOBACILLUS* SPECIES IN HIGH ACID FOODS USING IMPEDANCE MICROBIOLOGY

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Impedance culture media have been developed for use in the Bactometer Microbial Monitoring System which allow for the detection of *Lactobacillus* sp. in high acid food products. Both the Capacitance and Conductance components of the impedance equation were monitored. The Capacitance signal provided the greater percent change and earlier detection times than Conductance.

Products successfully tested for low level *Lactobacillus* sp. contamination included condiments, salad dressings, tomato based products, juice beverages, and fruit juices. Six homo fermentative and hetero fermentative strains of *Lactobacillus* sp. of food and beverage origin were tested, including *L. fermentum*, *L. buchneri*, *L. plantarum*, and three strains of *Lactobacillus* sp.

The detection limit of seeded samples was 1 CFU/gm for food products and less than 10 CFU/250 ml for juices and juice beverages. After a preincubation of 24 hours, the majority of Bactometer detections occurred in less than 24 hours, providing a savings of one to two days over the standard plate count method. In seeded samples, growth of six strains of *Bacillus* sp., common non-spoilage flora present in high acid foods and beverages, was inhibited by the impedance media, offering an additional advantage for the selective detection of *Lactobacillus* sp.

EFFECTIVE RECOVERY OF *CAMPYLOBACTER* IN THE PRESENCE OF MIXED CULTURE

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The importance of *Campylobacter jejuni* as a food pathogen is well established. Detection of this organism is time consuming and laborious, and requires anaerobic cultivation system. An enrichment medium was developed to determine growth behavior and recovery of *Campylobacter* in the presence of mixed microflora under normal atmospheric condition. This enrichment consisted of brucella broth (75 ml in Klett flask), hematin solution (0.3ml) FBP supplement (0.3 ml), Skirrow antibiotic (0.3 ml), and Oxyrase enzyme (1.5 ml). Pure culture of *C. jejuni* and *C. coli* at level of 1 cell/ml to 10^8 cells/ml and an inoculum of mixed microflora (*S. aureus*, *Salmonella*, *Pseudomonas* and *E. coli*) at level of 10^6 - 10^7 were inoculated into this medium. Flasks were incubated at 42°C water bath shaker (90 rpm) for 24h. Serial dilutions were made and plated on CVA blood agar plates and on plate count agar medium at 16 and 24 h. CVA plates were incubated in gas pak anaerobic jar at 37°C for 48h, and typical colonies of *Campylobacter* were counted and checked under phase contrast microscope. PCA plates were incubated at 37°C incubator for 24h and colonies were counted. In our new medium with Oxyrase and culture condition we were able to recover *Campylobacter* from as low as 1 cell/ml, in the presence of high number of competitors (10^6 - 10^7 cells/ml) in 16h of incubation under normal atmospheric condition.

RECOVERY OF *CAMPYLOBACTER* SPP. FROM POULTRY THROUGH ENRICHMENT IN 10 ML OR 100 ML VOLUMES

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Recovery of *Campylobacter* spp. from poultry is greatly enhanced through enrichment culture. Procedures had been developed to assess samples for the presence of the organism using 100 ml volumes. Culture vessels are typically placed in a shaker water bath to maintain a high

degree of temperature control and agitation. Consequently, the numbers of samples are limited by the availability of space within the shaker water bath. Equal volumes of carcass rinse were inoculated to enrichment cultures of 100 ml (Hi V) and 10 ml volumes (Lo V). After overnight enrichment, the cultures, and a 1:100 dilution of these cultures were streaked to Campy-Cefex agar. Results indicated that the Hi V yielded *Campylobacter* spp. in 22 of 40 samples, while the Lo V yielded the organism in 16 of 40 samples. Three of the Lo V tests detected the organism in which the Hi V did not, while the Hi V detected 7 positive carcasses when the Lo V did not. Although sensitivity was sacrificed with the Lo V, far more sample numbers can be assayed using test tube culture vessels as compared with the Hi V, and this could be useful when water bath capacity is limited relative to sample numbers.

RAPID METHOD FOR ASSESSING MICROBIOLOGICAL QUALITY OF EGG WASHWATER USING RESAZURIN

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The need exists for a rapid and economical method to monitor the microbiological quality of the recycled washwater used to clean shell eggs at egg processing facilities. In this study a modification of the Resazurin Reduction Test used for milk has been developed and applied to the estimation of bacterial numbers in egg washwater. This test is based on the irreversible reduction of resazurin (blue-purple colour) by bacterial reductases to resorufin (pink colour), with reduction time being proportional to the number of viable bacteria present. The bacterial numbers in 40 egg washwater samples from local egg processing plants were determined by the standard plate count method and the corresponding reduction times measured. Washwater (10mL), adjusted to pH 6.6, was added to 1 mL of the reaction mixture: 0.3% tryptic soy broth, 0.06% yeast extract, ascorbic acid (1mg/mL) and resazurin (8mg/L). A high correlation was found between bacterial numbers and reduction times. Washwater samples with unacceptably high bacterial counts (i.e. > 10⁵ CFU/mL) could be identified in less than one hour at 37°C using this method.

RAPID FLUOROMETRIC ANALYSIS OF ACID PHOSPHATASE ACTIVITY IN COOKED POULTRY MEAT

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Poultry muscle acid phosphatase (ACP) activity at five end-point temperatures (EPT) was measured by a quantitative fluorometric assay. Ground turkey breast and dark meat and broiler breast meat (16 g), both, nonfrozen (NFZ) and frozen (FRZ) packed in a glass tube (25x150 mm) were heated to 62.8, 65.6, 68.3, 71.1, and 73.9 C in a water bath, set 1.5 C above target EPT; removed and immediately chilled (0-2 C). A 75 µl aliquot of an aqueous meat extract (1 meat:2 H₂O) was added to 2.0 mL ACP substrate and kinetic increase in fluorescence monitored at 38 C. The experiment was replicated three times. A curvilinear decrease in mean (N=12) ACP activity occurred within each muscle type. Freezing lowered ACP activity. EPT means (N=12) and standard error for ACP activity (mU/Kg) between 68.3 and 71.1 C differed within broiler breast NFZ and FRZ and turkey breast and dark meat NFZ and FRZ as follows: 11900±338 and 7305±118; 8823±506 and 5149±118; 9727±444 and 7966±475; 8940±794 and 5713±310; 6543±420 and 4296±238; 4479±245 and 2998±118, respectively. This procedure provides a rapid (3 min instrument time), sensitive analytical method for quality assurance process control technicians or regulatory analysts to monitor EPT in cooked poultry.

FLUOROMETRIC ANALYSIS OF ALKALINE PHOSPHATASE INACTIVATION CORRELATED TO SALMONELLA AND LISTERIA INACTIVATION

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Fresh, raw milk was inoculated with *Listeria monocytogenes* Scott A and *Salmonella senftenberg* 775W at levels of 10,000 to 10,000,000 colony forming units per gram milk. The milk was heat-treated at target temperature of 63° ± 0.5°C, 65° ± 0.5°C, 67° ± 0.5°C, 68° ± 0.5°C, or 71°

± 0.5°C in five trials. The D-values calculated for *Salmonella senftenberg* 775W ranged from 4.6 at 63°C to 0.17 at 71°C. The z-value was 5.0-6.7

The D-values calculated for *L. monocytogenes* Scott A ranged from 8.4 at 63°C to 0.19 at 71°C. The z-value was 4.8-6.1. Concomitantly, alkaline phosphatase inactivation was monitored using a fluorometric assay. The inactivation rate of the test microbes was greater than that of alkaline phosphatase over the temperature range tested and up to 81°-86°C using extrapolation. The fluorometric assay exhibited excellent accuracy, precision, reproducibility, and repeatability under the test conditions. Viable test pathogens were isolated for milk samples with alkaline phosphatase levels corresponding to legal pasteurization requirements of 1.0 µg phenol/mL/15 min (=500 mU/L ALP activity assayed fluorometrically) when inoculated at high (log 5-6) levels.

SHELF LIFE PREDICTION OF PASTEURIZED FLUID MILK USING THE CHARM II SYSTEM

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A new rapid assay (10 minute) for active bacteria (Charm ABC) was used to predict the shelf life of pasteurized milk using an accelerated incubation of 21 °C. The procedure evaluates and predicts bacterial growth rate under storage conditions ranging from 2°C - 7°C. The assay measures ATP, a common compound of all active bacteria, and uses a stabilized luciferin-luciferase reagent, tableted in a dry formula for individual testing.

Pasteurized fluid milk was obtained from local dairies within 24 hours of processing. Each milk lot was preincubated at various temperatures (4°C - 21°C) in duplicates. The ABC test and a standard plate count were performed on each sample. Samples kept refrigerated at 4°C to 7°C were monitored to determine expiration date. Expiration was determined by odor/visual inspection, standard plate counts (samples with bacterial counts higher than 5-10x10⁵/ml were considered expired), and ATP.

A prediction formula was generated to correlate accelerated bacterial growth rate at elevated temperature and growth at storage temperature. The predictive regression equations were evaluated with regard to shelf life of pasteurized fluid milk

The results indicate that potential shelf life of pasteurized milk can be predicted to within 2 days for storage conditions when temperature is controlled within 1°C. The preincubation temperature and time are critical and are set according to the intended shelf life. Preincubation at 21°C can be set between 16 hours to 36 hours for prediction of shelf life at 6°C - 7°C for 10 to 30 days.

FOODBORNE MICROBIOLOGY

PREDICTIVE MODELING OF PSYCHROTROPHIC *BACILLUS CEREUS*

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Bacillus cereus is the causative organism in many outbreaks of foodborne illness. The foods identified as vectors include dairy products, rice, and meat products. Many strains are capable of growth at refrigeration temperatures, and toxin production in milk at low temperatures (6°C) has been demonstrated. There is little information on the factors affecting toxin production by psychrotrophic *B. cereus*. This study was designed to determine the effects of a number of environmental conditions (e.g. a_w, pH, temperature, aeration and starch concentration) on growth and toxin production by strains of psychrotrophic *Bacillus* spp. using multivariate analysis. Using BHI broth as basal medium, growth was measured by monitoring optical density and plate counts. Toxin production was assayed by an immunological method and cytotoxicity with Vero and Hep-2 cells. Predictive equations for growth and toxin production show that the factors having the greatest influence on both growth and toxicity were water activity and temperature.

MICROBIAL ECOLOGY OF MODIFIED ATMOSPHERE PACKAGED PORK

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The dominant bacteria on fresh pork packaged in a modified atmosphere with elevated CO₂ in 2 packaging films of different oxygen permeability at 3 storage temperatures were determined by selection of representative colonies from the greatest dilution of the meat samples. Strains were classified and those identified as lactic acid bacteria (LAB) were screened for production of inhibitory substances. The types of bacteria isolated from samples stored in the 2 packaging films were similar. However, storage temperature influenced the type of bacteria that dominated the microbial population. At 10°C the dominant microflora consisted of aeromonads, Enterobacteriaceae and LAB but at 4 and -1°C, aeromonads, *B. thermosphacta* and LAB dominated. Listeriae were found as part of the dominant microflora on samples stored at -1°C but not on samples stored at 4 or 10°C. Species of LAB dominating the microflora were influenced by isolation media. The majority of isolates taken from Plate Count Agar were carnobacteria whereas those from Lactobacilli MRS agar were homofermentative LAB. Of the 538 LAB isolates screened for production of inhibitory substances, 179 strains showed deferred inhibition toward a range of LAB and non-LAB indicator strains.

METHOD FOR CLASSIFYING FOODS WITH A SIMILAR MICROBIOLOGICAL RISK

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As part of a Michigan safe food handling study, a method was devised to classify foods into categories which have a similar degree of microbiological risk. Similar schemes (CDC and NYS), which track epidemiologic patterns of foodborne illness outbreaks, were used as bases for development of the classification method. Revisions were made to these schemes to enable a higher degree of specificity for coding study data. The classification method contained 14 food categories — dairy, eggs, fruit, legumes, nuts, seeds, meat, mixed dishes, mushrooms, other, salads, salad dressings, seafood, starchy foods, vegetables, and water. Each food category was divided into two or more subcategories. High risk, brown bag lunch foods identified by coding 24 hour dietary recalls of 6,000 Michigan children were used to develop food safety hypermedia software for use by 8 to 10 year old children in Michigan schools. An enlarged version of this method is being considered for use by the Michigan Department of Public Health to analyze foodborne illness outbreak data at the state level.

PROCESSING AND FERMENTATION OF SOY YOGURT MADE FROM RAPID HYDRATION HYDROTHERMAL COOKED SOY MILK

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An efficient rapid hydration hydrothermal (RHHTC) process has been used for making a 11% solids sterile soy milk for production of high quality soy yogurt with low beany flavor. The soy milk is fermented to soy yogurt with a mixed culture of *Lactobacillus bulgaricus* and *Streptococcus thermophilus*, at 44°C, for 4 hours. Soy milk was produced at operating temperatures and heating times from 220 to 314°F and 20 to 120 seconds, respectively. There were no bacterial survivors when the soy slurry was heated at higher than 270°F, for 29 sec or longer. At 220-260 °F with resident time of 20-29 sec., *Bacillus* sp. spores, originally present in soy flour, can survive, while *Pseudomonas* sp., *Enterobacter gergoviae*, *E. cloacae*, *Serratia rubidaea*, *S. liquefaciens*, are all destroyed. The respective concentrations of sucrose, raffinose, and stachyose are in the range of 0.355, 0.118, and 0.456 g/L in soy milk, and 0.08, 0.09, and 0.351 in yogurt. Soy yogurt made from soy milk produced at 305°F has the pH, acidity, and viscosity of 4.6, 0.8% (as lactic acid), and 260 cp, respectively. It has the highest flatulent sugar reduction, 23%. The soy yogurt has high acidity, acceptable pH, and smooth texture characteristics.

MICROBIOLOGY HACCP DETERMINATION AT A POULTRY PROCESSING PLANT

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Improvements in food safety will be necessary in developing consumer confidence in poultry products. The main concerns will be microbial contamination of raw and cooked poultry. In this study, microbial indicators including aerobic plate counts, lactics, *E. coli*, coliforms, *S. aureus* and pseudomonads are used to determine potential critical control points (CCP's). Pathogen tests including *salmonella*, *listeria*, *campylobacter*, *yersinia*, and aeromonads are used to determine CCP's in evisceration and further processed poultry products. Results indicate that the most significant positive control points in evisceration are the final rinse for *salmonella* and *listeria*, while the scalding and chiller were most important in *campylobacter* reduction. *Listeria* control was the most significant challenge in packaging.

COMBINED EFFECTS OF GLYCEROL MONOLAUROATE, ETHANOL AND LACTIC ACID AGAINST *LISTERIA MONOCYTOGENES*

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The minimal inhibitory concentrations (MIC) of glycerol monolaurate (GML), ethanol (EtOH), and lactic acid (LA) either alone or in combination were determined against *Listeria monocytogenes* in tryptic soy broth. The effect of the antimicrobial agents on growth of *L. monocytogenes* was also investigated. MIC values were determined using a checkboard method and growth was monitored using the standard plate count method. The MIC of GML, EtOH, and LA were 0.001%, 5%, and 0.5% respectively when used alone at pH 7.0 and 35°C for 24 h. Sublethal combinations of 2.5% EtOH with 0.0005% GML or 2.5% EtOH with 0.25% LA were not different than the most active single compound alone, but a sublethal combination of 0.0005% GML with 0.25% LA was more active than the most active single compound alone. These interactions may be of importance when designing novel preservation or sanitation systems.

LETHAL EFFECT OF DIMETHYL DICARBONATE ON *LISTERIA* AND *SALMONELLA*, AND ITS POTENTIAL FOR USE IN THE TREATMENT OF FRESH PRODUCE

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The concern associated with minimally processed fruits and vegetables as vehicles of foodborne disease has increased recently as outbreaks of shigellosis and salmonellosis have been linked to lettuce, and to tomatoes and cantaloupe. Fresh vegetables have also been implicated in several listeriosis outbreaks. This study was done to determine if dimethyl dicarbonate (DMDC), a yeast inhibitor approved for use in wine, had a biocidal effect on *salmonella* and *Lm* that could be used to decontaminate fresh produce.

Suspensions of *S. agona* and *S. newport*, and *Lm* strains Scott A and V7, prepared in phosphate buffer (pH 6.5) at cell concentrations of 10⁹/ml, were treated with DMDC at 50, 100, and 200 ppm for 5, 10, 20, 30, 40, and 50 mins. Inoculated produce samples, e.g. radishes and potatoes (*Lm*), and cantaloupe and lettuce (*salmonella*), were treated with the DMDC (250 ppm) for 3, 5, 10, and 15 mins. The 2 *salmonella* strains tested were more sensitive to DMDC dropping 3+4 logs in 5 mins, and 5+6 logs in 10 mins, at 50+100 ppm, respectively. The *Lm* strains were reduced by 3+4 logs, at 50+100 ppm, and 6 logs at 200 ppm in 10 mins. With produce the drop ranged from 3-5 logs on *salmonella*, and 2-4 logs on *Lm*, depending on exposure time (3-10 mins) and product nature. DMDC does appear to have potential as pathogen decontaminant of fresh produce.

SIMULTANEOUS PRODUCTION OF YEAST POLY-GALACTURONASE AND LACTATE DEHYDROGENASE FROM SAUERKRAUT BRINE

Jurgen G. Schwarz*, Graduate Research Assistant, and Y. D. Hang, Cornell University, Department of Food Science and Technology, Geneva, NY 14456

Large quantities of waste brines are generated in the manufacture of sauerkraut. The brines have high BOD (biochemical oxygen demand), high acidity expressed as lactic acid, and high salt content, and therefore present a serious environmental problem. The objective of this investiga-

tion was to evaluate the feasibility of using sauerkraut brine as a substrate for the production of polygalacturonase (EC 3.2.1.15) and lactate dehydrogenase (EC 1.1.2.3) by *Kluyveromyces marxianus*. Biochemical changes during growth in shake flasks under various conditions were determined. Of the six strains examined, *K. marxianus* var. *marxianus* NRRL Y-1109 was found to be a better enzyme producer. The yeast gave the highest yields of polygalacturonase (350 units/L) and lactate dehydrogenase (245 units/L) when cultivated at 30°C for 36 hr. The results of this study thus indicate that growing *K. marxianus* in sauerkraut brine might have value in BOD reduction and in the production of yeast enzymes.

ACTIVITIES OF THE NATIONAL ADVISORY COMMITTEE ON MICROBIOLOGICAL CRITERIA FOR FOODS SYMPOSIUM

INTRODUCTORY REMARKS - ACTIVITIES OF THE NATIONAL ADVISORY COMMITTEE ON MICROBIOLOGICAL CRITERIA FOR FOODS

Fred Shank, Director, Center for Food Safety and Nutrition, Food and Drug Administration, Washington, DC 20204

The National Advisory Committee on Microbiological Criteria for Foods was established in 1988. During its short existence the Committee has provided recommendations to its Federal sponsors—the U. S. Departments of Agriculture (USDA), Health and Human Services (HHS), Defense and Commerce on a wide range of microbiological food safety issues. In addition to the following topics, the Committee has prepared recommendations on new generation refrigerated foods, raw molluscan shellfish, and cooked ready-to-eat shrimp and crabmeat. The work of the Committee has been particularly helpful to the Federal agencies as they move forward with Hazard Analysis and Critical Control Point (HACCP) programs.

LISTERIA

John Kvenberg, Director, Division of Cooperative Programs, FDA, Washington, DC

In the last decade, listeriosis has been recognized as an important foodborne illness. Considerable research has attempted to characterize the organism, define the magnitude of the problem, identify the risk factors associated with disease, and devise appropriate control strategies.

Because of the need to develop national control strategy, the National Advisory Committee on Microbiological Criteria for Foods has developed recommendations for *Listeria monocytogenes*.

This document includes summaries and recommendations in individual papers on foodborne listeriosis, ecology of *L. monocytogenes*, pathogenesis, infectious dose, prevalence in foods, control measures in food production, and specific information targeted to food processors, retailers, food service employees, regulators, and consumers.

FRESH MEAT AND POULTRY

David Theno, Theno & Associates, Modesto, CA

The control of food-borne pathogens in raw meat and poultry is a continuing concern for microbiologists, the general public and regulatory agencies. The National Advisory Committee on Microbiological Criteria for Foods (NAMCF) recommends that Hazard Analysis and Critical Control Point (HACCP) principles be applied as a method of controlling the level of enteric pathogens in fresh meats. Flow diagrams with generic identified critical control points have been developed. Specific control strategies and suggested system management formats are identified in the HACCP plans. A summarization of recommended critical control points, significant new technologies and long-term microbiological improvement in fresh meats will be presented.

HAZARD ANALYSIS AND CRITICAL CONTROL POINTS

Merle D. Pierson, Professor of Food Science and Technology, Food Science and Technology, Virginia Tech, Blacksburg, VA

The National Advisory Committee on Microbiological Criteria for Foods (NAMCF) reconvened a Hazard Analysis Critical Control Point (HACCP) Subcommittee in July 1991. The purpose was to review the

Committee's November 1989 HACCP document comparing it with a draft report prepared by a HACCP Working Group of the Codex Committee on Food Hygiene. The Subcommittee revised the seven HACCP principles and expanded upon its initial report by emphasizing the concept of prevention, incorporating a decision tree for identification of Critical Control Points, and outlining the steps in developing a HACCP plan. The Subcommittee again endorsed HACCP as an effective and rational means of assuring food safety. In keeping with the NAMCF's charge of providing recommendations to its sponsoring agencies regarding microbiological food safety issues, the HACCP document focuses on the development of systems to prevent and control pathogenic microorganisms or their toxins. The Subcommittee, however, recognized that properly designed HACCP plans must also consider chemical and physical contaminants.

CAMPYLOBACTER

Robert B. Gravani, Professor, Cornell University, Department of Food Science, 8A Stocking Hall, Ithaca, NY 14853

The *Campylobacter* Working Group of the National Advisory Committee for the Microbiological Criteria for Foods includes members from the public health community, food industry, consulting laboratories, regulatory agencies, and academia. This multidisciplinary group is currently developing a report on the status of *Campylobacter jejuni* as a foodborne pathogen, its significance in causing foodborne illness and strategies to control the organism in the production, processing, and handling of meat and poultry products.

Sections of the report will include discussions on:

- Epidemiology
- Ecology
- Pathogenesis
- Control strategies
- Research needs
- Recommendations

Highlights of the report will be presented in this paper.

FOOD HANDLING PRACTICES — BASIC HACCP FOR THE CONSUMER

Martha Roberts, Deputy Commissioner for Food Safety, Florida Department of Agriculture, Tallahassee, FL

The concept of Hazard Analysis Critical Control Points and this program's implications for the improvement of food safety and ultimately public health and welfare have been far-reaching. Implementation of HACCP programs within various segments of the food industry has been slow since formulation of this brilliant control concept at the first Conference for Food Protection in Denver, Colorado in 1971 by Howard Bauman and others. Various revisions have been made by the National Advisory Committee on Microbiological Criteria for Foods and recently by Codex. HACCP however is not just for the industry and the regulators. HACCP is a major protective concept that can be of excellent public health protection and enhance food safety for the general public. Basic HACCP for the consumer and applications for food handling practices in all aspects of everyday life from shopping, storage, food preparation, serving and other points that may represent critical control points will be presented.

THE NATIONAL ADVISORY COMMITTEE ON MICROBIOLOGICAL CRITERIA FOR FOODS: FUTURE DIRECTIONS

H. Russell Cross, Administrator, Food Safety and Inspection Service, U. S. Department of Agriculture, Washington, DC 20250

The work of the National Advisory Committee on Microbiological Criteria for Foods is critical to improving the microbial safety of all foods. For the future, we intend to make full use of the committee's expertise as we strive to make food even safer.

One priority is to encourage all food manufacturing plants to adopt the prevention-oriented Hazard Analysis and Critical Control Point (HACCP) system, and for the Federal government to define the role of regulatory agencies within a HACCP system.

Another priority will be to ensure we have the microbiological data to make important regulatory decisions. No changes should be made

unless they can be justified in this manner.

A third priority will be to ensure we are placing our resources where the greatest risks to the public health may be found. This will involve assessing and managing food safety risks — a big challenge in itself.

The National Advisory Committee on Microbiological Criteria for Foods will play a major role in helping the Federal government meet these challenges.

INTERNATIONAL FOOD STANDARDS

THE INTERNATIONAL DAIRY FEDERATION - DEVELOPMENT OF IDF STANDARDS AND BULLETINS

Harold Wainess, Secretary U. S. National Committee of the IDF, Harold Wainess & Associates, 464 Central Avenue, Northfield, IL 60093

The International Dairy Federation (IDF) is an independent, scientific, non-political association with headquarters in Brussels, Belgium. Its aim is to promote scientific, technical and economic progress in the international dairy field through publications, seminars, symposiums, congresses and specialized meetings. Its regular publications on key subjects provides texts of technology, voluntary Standards on many topical subjects of interest to the dairy industry. It cooperates with national and international organizations and consults and advises such groups as FAO, WHO and CODEX. Through various specialized commissions, such as, production, hygiene and quality of raw milk; another on technology and engineering and one on analytical standards and laboratory techniques, over 272 technical bulletins and 152 Standards have been published.

Current publications of particular interest to IAMFES will be reviewed.

FOOD STANDARDS AND FOOD SAFETY IN JAPAN

Nobumasa Tanaka, Ph.D., President, US-Japan Science Consulting Services, Inc., 72 Paxwood Road, Delmar, NY 12054

As Japanese trade barriers are being lowered or removed, more food items are flowing into Japan. In fact, Japan imports more than one third of all the foods consumed there. An example of lowered barrier is labeling requirement change for "natural" food additives implemented at the beginning of 1991. As in any other countries, however, there are some food regulations which are different in Japan from those in the United States, and one has to be aware of such differences in order for one's product to go into Japan smoothly. A large portion of rejections at the port is caused by ignorance of exporters or importers. I will attempt to describe some of the Japanese regulations which are related to the importation of foods. Some relevant information which may be of use to food exporters will also be discussed.

INTERNATIONAL LABELING AND ADVERTISING REQUIREMENTS: THE EFFECT ON TRADE

Lester M. Crawford, D.V.M., Ph.D., Executive Vice President-Scientific Affairs, National Food Processors Association, 1401 New York Avenue, NW, Washington, DC 20005

The United States and the European Economic Community have joined the Nordic countries in fundamental reform of the food label. Of equal interest are current policies in the Pacific Rim. The role of advertising has likewise come under scrutiny. The impetus for change can be traced to global interest in nutrition, food safety and truth in labeling. Secondary issues include solid waste, international trade, and the metric system. Differences in labeling and advertising policies could conceivably result in barriers to trade. What will be the result of these new initiatives? How will the international scene affect the way in which you conduct business?

FOOD SAFETY ISSUES IN EUROPE — AN UPDATE

M. F. Stringer, Campden Food & Drink Research Association, Chipping Campden, Glos. GL55 6LD U.K.

With the introduction of highly processed and sophisticated convenience foods, microwave ovens and novel packaging techniques, the safety of food continues to be a major concern in the eyes of the

consumer. In addition to the issues associated with microbiological contamination, increasing attention is given to chemicals, pesticide residues, safety of salt, colours and additives, the nutritional merit of sugar and fat substitutes, foreign bodies and the safety implications of processes such as irradiation. This paper will, in relation to the wider European market:

1. Review the current issues of food safety concern.
2. Overview the current position with respect to European legislation and illustrate with reference to the UK, the requirements for harmonisation.
3. Consider the need for sophisticated analytical techniques to address the issues of contamination and authenticity.

SEAFOOD REGULATORY SYMPOSIUM

CANADA'S SEAFOOD INSPECTION SYSTEM

David C. Bevan, Director, Inspection Services Branch, Fisheries and Oceans, 200 Kent Street, Stn. 1102, Ottawa, Ontario, Canada K1A 0E6

Since its inception in 1914, as a program entirely focused on inspection of final products destined for export, Canada's seafood inspection system has evolved into a multifaceted program that recognizes and deals with risks at all points of production from harvest waters through to distribution. A description of the seafood inspection system in Canada is provided including the introduction on February 1, 1992, of the Hazard Analysis Critical Control Point based Quality Management Program which each company must have in effect as a condition of their federal registration.

SEAFOOD ISSUES WITHIN CODEX

E. Spencer Garrett, Laboratory Director, National Marine Fisheries Service, DOC/NOAA/NMFS, National Seafood Inspection Lab., P. O. Drawer 1207, Pascagoula, MS 39556-1207

The FAO/WHO Codex Alimentarius World Food Standards Programme is a global, intergovernmental body organized to set standards to help facilitate international trade in food commodities and protect consumers. The program is governed by the Codex Alimentarius Commission which authorizes and oversees a number of specific Commodity Committees such as Fish, Meats, Cereals and Oils, and subject matter Committees such as Food Hygiene, Food Additives and Contaminants, Pesticide Residues, etc. The actions of the Codex can greatly influence world food regulatory activity since such actions represent a consensus of opinion of the 137 member countries with 97% of the world's population. The paper will detail from the Food Hygiene Committee point of view, the process of the Codex, the principle fishery issues before it, and the manner in which HACCP is being introduced within the Codex framework.

VOLUNTARY RETAIL SEAFOOD PROGRAM WITHIN THE U.S. FDA

Lawrence C. Edwards, Assistant Director for Interagency Programs, Food and Drug Administration, 200 C Street, SW, Washington, DC 20204

FDA has entered into a voluntary seafood program with the National Oceanic and Atmospheric Administration (NOAA) for the purpose of improving the safety and wholesomeness of seafood and to prevent economic fraud practices from occurring. A segment of the comprehensive initiative involves the retail food protection area. The program administration design follows the lead of the established Interstate Milk Shippers Conference and Program, working through the state and local regulatory agencies. Progress to date has been impressive due to the cooperative format. A successful HACCP-based pilot that tested enhanced standards and involved 12 industry firms in 11 states has been completed. These and other program components will be discussed.

SEAFOOD ISSUES UPDATE

John Kvenberg, Ph.D., Director, Division of Cooperative Programs, Food and Drug Administration, 200 C Street, SW, Washington, DC 20204

The National Advisory Committee on Microbiological Criteria for Foods (the Committee) examined microbiological safety issues associated with vacuum or modified atmosphere packaging (VAC/MAP) of refriger-

ated raw fishery products.

The Committee found that the primary preventive measure against the *Clostridium botulinum* hazard in these products is the temperature control at or below 38°F (3.3°C) from packaging through preparation. Other microbiological concerns such as *Yersinia enterocolitica*, *Listeria monocytogenes*, and histamine production can also be effectively addressed by low temperature storage. Secondary preventive measures to further reduce hazards were also evaluated.

The Committee recommends that VAC/MAP technology be permitted for raw fishery products only when the following conditions are met:

- The products are packaged under an established Hazard Analysis Critical Control Point (HACCP) plan.
- Detectable spoilage and rejection by the consumer precedes the possibility of toxin production.
- High Quality raw fish is used.
- Packaged product is stored at or below 38°F (3.3°C).
- Product is adequately labeled for storage temperature, shelf life, and cooking requirements.

The Committee also recommends minimum conditions for VAC/MAP technology, including protocols for inoculated pack studies, needs for sensory and statistical evaluation, use of secondary preventive measures, and additional research priorities that will facilitate rational development and safe use of VAC/MAP technology.

ICMSF: UPDATE ON SEAFOOD ISSUES

Michael P. Doyle, University of Georgia, Food Safety and Quality Enhancement Laboratory, Georgia Station, Griffin, GA 30223

The International Commission on Microbiological Specifications for Foods (ICMSF) was formed in 1962 by the International Association of Microbiological Societies to appraise the public health aspects of the microbiological content of foods. Several aspects of seafood safety have been addressed by ICMSF, including the ecology of microbial pathogens associated with seafoods, sampling plans and microbiological criteria for fish and shellfish, and the application of the hazard analysis critical control point (HACCP) system to ensure the microbiological safety of seafoods. All of these topics have been addressed and detailed in reference books written and critically reviewed by a group of internationally-recognized food microbiologists. Soon to be published is a book on characteristics of microbial pathogens which summarizes factors affecting the inhibition, death, survival, growth, and toxin production of harmful bacteria, including those associated with seafoods. This information will aid in identifying conditions/treatments that can be applied at critical control points in a HACCP program.

CONSUMER'S AND SCIENTIST'S VIEWS ON IRRADIATION AND FOOD SAFETY SYMPOSIUM

THE CONSUMER'S VIEW OF FOOD SAFETY

Ruth Jackson, Vice-Chair, Food Committee, Consumers' Association of Canada, 145 Forest Hill Road, Kitchener, Ontario, Canada N2M 4G4

The Consumers' View of Food Safety will deal with the results of a survey of Consumers' Attitudes and Opinions on Food Safety in Canada carried out by the Consumers' Association of Canada and released in May, 1990. The survey measured attitudes and opinions and evaluated the awareness of the regulatory environment surrounding food. The sources of consumer information and the perceived reliability of these sources was measured as well as consumer response to perceived hazards.

FOOD SAFETY - AN EPIDEMIOLOGIST'S PERSPECTIVE

James C. Hockin, MD, MSc, Chief, Field Epidemiology Division, Laboratory Centre for Disease Control, Tunney's Pasture, Ottawa, Ontario, Canada K1A 0L2

Food safety is promoted by the reduction or elimination of risks to health in the food we eat. In the Health Protection Branch framework for risk determination, the epidemiologist plays a key role in the risk analysis process: hazard identification and risk estimation. Epidemiologists use surveillance, outbreak investigation and planned case-control or cohort studies to identify and analyze risks, drawing heavily on data provided by

others. The epidemiologist perceives risk statistically, through disease or mortality incidence, relative risks to health, or population attributable risk. The correct use and interpretation of the epidemiologic data are essential to selection of the best options for improving the safety of the food we eat. While the Branch is concerned with microbial and chemical hazards, most of the examples presented will deal with microbial hazards in food. The intent is to illustrate the way in which the epidemiological approach to risk complements activities and expertise of other professionals.

LIMITATIONS OF OUR CURRENT APPROACH FOR ASSESSING MICROBIOLOGICAL FOOD SAFETY

Robert L. Buchanan, Research Leader, USDA, ARS, ERRC, 600 E. Mermaid Lane, Philadelphia, PA 19118

Host epidemiological data related to foodborne disease is acquired through passive surveillance systems. A large percentage of cases of non-life threatening non-reportable foodborne diseases are likely to go unreported, particularly if not associated with a moderate to large outbreak. Likewise, the ability to analyze foods for pathogens is limited due to the number of potential pathogens and the cost and timeliness of the analyses. However, when available data are coupled with a firm understanding of the characteristics of both the food system evaluated and the microorganisms of concern, determinations of relative risks can be achieved. Microbiological profile assessments of this type are critical for establishing strong HACCP based systems for assuring the microbiological safety of foods.

SAFETY RAMIFICATIONS OF FOOD IRRADIATION

Joseph Borsa, Ph.D., AECL Research, Pinawa, Manitoba, Canada R0E 1L0

Consumers are increasingly conscious of safety issues related to food. Food scientists agree that while our food supply probably is safer than ever, there is need for improvement in certain aspects. Microbial pathogens represent the safety hazard of greatest concern. The situation is aggravated by changes in food production, preparation and distribution practices which impact on the food-microbe ecosystem and open up new niches for exploitation by appropriately adapted microorganisms. Several new food-borne microbial pathogens have emerged in recent years. Food irradiation has much to offer towards reducing the hazard of microbial pathogens in our food supply. Consumer acceptance of this technology, and its attendant benefits, requires confidence that the process itself does not introduce significant safety hazards into the treated food. In this presentation the basis for the claims of safety of food irradiation will be examined in some detail.

SEAFOOD SAFETY SYMPOSIUM

ENTERIC VIRUSES AND SEAFOOD SAFETY

Marilyn B. Kilgen, Distinguished Service Professor of Biological Sciences, Nicholls State University, Thibodaux, LA 70310

Although more than 100 human enteric viruses can be found in human feces, only a few of these have been documented by the Centers for Disease Control (CDC) and the Food and Drug Administration (FDA) to cause seafood-associated illness. These include mainly Norwalk and Norwalk-related viruses, hepatitis A virus (HAV), and very rarely, non-A non-B (NANB) enteral hepatitis. Norwalk-like gastroenteritis from consumption of raw molluscan shellfish contaminated by human feces in their growing waters was documented in the last 10 years as the most common cause of all seafood-related illness. However, approximately 76% of all shellfish-associated cases were reported to CDC and FDA in the years 1982, 1983 and 1984, and many were from imported hard clams. Norwalk and Norwalk-like gastroenteritis is a relatively mild 12-24 hour illness with no associated mortality. The more serious HAV is generally acquired from infected food handlers in retail and home preparation, and to a lesser extent from human fecal pollution of the harvest waters. To prevent potential enteric virus illness from seafoods, consumers, food processors and food handlers should be educated regarding proper sewage treatment and disposal, avoidance of recontamination of cooked or clean processed products by raw products or contaminated wash water, proper sanitation and good personal hygiene at the food service level.

BACTERIAL PATHOGENS ASSOCIATED WITH SEAFOOD

Cameron Hackney, Professor, Virginia Polytech Institute and State University, Department of Food Science and Technology, Blacksburg, VA 24061-0418

Bacterial pathogens associated with seafoods may originate in the marine environment and from human or animal contamination. Sometimes this distinction can be somewhat hazy. For example *Vibrio cholerae* O1 may be derived from both human feces and the marine environment. Bacteria of marine origin include several species and numerous biotypes and serovars of the genus *Vibrio*. *Plesiomonas shigelloides* and *Aeromonas hydrophilia* are also of marine origin. Bacteria associated with humans that have caused seafood borne illness, include *Shigella*, *Staphylococcus aureus*, pathogenic *Escherichia coli* (enterotoxigenic, enteroinvasive and enteropathogenic). Bacteria associated with animals that have caused seafood borne illness include *Salmonella*, *Campylobacter* and *Clostridium perfringens*. In addition, bacteria associated with soil such *Bacillus cereus* have caused limited outbreaks. Finally, *Clostridium botulinum* has caused several seafood outbreaks. Of course there are many other bacterial pathogens, often isolated from seafoods that have not been implicated in actual cases, including *Listeria monocytogenes*, *Yersinia enterocolitica* and many others. It is important to understand how these microorganisms may enter the seafood supply, so that outbreaks can be prevented. Raw molluscan shellfish present the greatest hazard. The presence of pathogens in other seafoods is often the result of cross contamination, such as could occur with any food item. As new preservation technologies are developed, possible microbial problems must be considered.

NEW INSIGHTS INTO SEAFOOD TOXIN RESEARCH

Ewen C. D. Todd, Head, Contaminated Foods Section, Bureau of Microbial Hazards, Sir Frederick G. Banting Research Centre, Tunney's Pasture, Ottawa, Ontario, Canada K1A 0L2

Seafood toxins are becoming an increasing concern around the world because there is more demand for seafood, more toxic sources are being identified, and some of these sources are spreading through human activity. For paralytic shellfish poison (PSP) the toxicity to scallops and surf clams on the Georges Bank has increased in the last few years, and lobster hepatopancreases, eaten as tomalley, is known to contain PSP toxins in certain parts of northeastern North America. Balfast water from cargo ships has transmitted dinoflagellate cysts responsible for PSP from endemic areas to other parts of the world, e.g., from Japan to Australia. Diarrhetic shellfish poisoning (DSP) has been reported for the first time in North America (Nova Scotia, 1990), although it is well documented in Japanese and European waters. The dose of DTX1 causing gastroenteritis in the Canadian episode was determined (1.4-3.0 ug/kg). For no known reason, some strains of *Dinophysis* produce okadaic acid, some DTX1, and some no toxin. The structure of ciguatoxin has been determined but there is no good method for detecting the toxin. A solid phase immunobead assay has been developed to detect polyethers including okadaic acid and ciguatoxin. Research on domoic acid, which caused the 1987 amnesic poisoning episode in eastern Canada, has revealed its biosynthetic pathway in *Nitzschia pungens multiseriis* and the conditions required by this diatom to produce the toxin. Domoic acid has been found in California anchovies, which when consumed by pelicans caused their deaths, and has also been linked to human cases who had eaten clams in Washington state. Domoic acid causes neurological damage as demonstrated by animal studies and human autopsied brains. Quantities of specific seafood toxins are required for standards to detect these in seafood or the source plankton. Until this happens and kits become available for industry personnel and government officials, illnesses from seafood toxins will continue to plague maritime parts of the world.

ASSESSING AND MANAGING RISKS ASSOCIATED WITH CONSUMPTION OF CHEMICALLY-CONTAMINATED SEAFOOD

Susan H. Rieth, M.P.H., and Joseph V. Rodricks*, Ph.D., Principal, ENVIRON Corp., 4350 North Fairfax Drive, Arlington, VA 22203

A method of scientific analysis called risk assessment has now assumed a central role in both industrial and governmental decision-making regarding permissible human exposures to chemicals present in

the environment, at least in the United States. Over the past 10 to 15 years, regulatory officials in the principal governmental agencies responsible for placing restrictions on chemical uses and exposure - the U. S. Food and Drug Administration, the Environmental Protection Agency, the Occupational Safety and Health Administration, and the Consumer Product Safety Commission - have gradually expanded the uses of risk assessment, so that now virtually no decision on limiting chemical uses and exposures is taken without considering the question of human health risks. In this paper we present a brief sketch of the risk assessment process, its relationship to food safety decision-making, and a glimpse of its possible utility in dealing with seafood safety issues. Our presentation is by no means an exhaustive treatment of the subject; rather, we have illustrated the application of risk assessment to food safety issues with two contaminants found in some seafood - methyl mercury and polychlorinated biphenyls (PCBs) - and show how information on seafood consumption and inherent toxicity of these contaminants can be integrated to establish tolerances for these contaminants in fish. We also suggest what needs to be done to better understand seafood health risks.

SEAFOOD HACCP PROGRAMS

Donn R. Ward, Ph.D., Associate Professor, Department of Food Science, North Carolina State University, Box 7624, Raleigh, NC 27695

Hazard Analysis Critical Control Point (HACCP) inspection is being introduced into the U. S. seafood industry. While many seafood processors are urging enhanced inspection by regulatory agencies, most are not adequately prepared for HACCP inspections. As a consequence, the National Fisheries Institute has developed a HACCP Training Program which can be used to prepare processors for HACCP-based inspections. The training program and HACCP will be addressed during this discussion.

FOOD IRRADIATION SYMPOSIUM

FOOD IRRADIATION: INTRODUCTORY OVERVIEW

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Food irradiation involves exposure of food to ionizing radiation to achieve some desired technical benefit. The simple fact that insects, bacteria and parasites are much more sensitive to radiation than are nutrients allows us, by judicious choice of treatment conditions, to obtain the desired benefit while avoiding unacceptable detriment. Insect disinfection, microbial decontamination, sprout inhibition, and other more esoteric effects of irradiation translate into improved safety, longer shelf-life and higher quality food for the consumer.

The process of food irradiation has been researched for more than 4 decades, with 1000s of published studies in the world literature, examining all aspects of the technology. Since the early 1980s great strides have been made in bringing this technology into ever increasing commercial use. In January of 1992 Vindicator, Inc., the first dedicated commercial food irradiation plant in the USA, opened its doors for business in Florida. The next few years will be crucial in the adoption of this technology by appropriate sectors of the food industry.

SAFETY AND WHOLESOMENESS OF IRRADIATED FOODS

Donald W. Thayer, Research Leader for Food Safety, Eastern Regional Research Center, Agricultural Research Service, USDA, 600 East Mermaid Lane, Philadelphia, PA 19118

Treatment of foods with ionizing radiation is an effective technique with many possible benefits. The safety and wholesomeness of several classes of irradiated foods have been tested extensively. The safety and wholesomeness evaluations of each of the classes of irradiated foods considered: the efficacy of the treatment, the effects of the treatment on the nutritional quality of the food, the absence of viable pathogens or their toxins, and the absence of potentially harmful products resulting from the treatment process. Several short and long term animal feeding studies have been conducted with irradiated foods without evidence of treatment related toxicological effects. The accumulated data support the safety and efficacy of properly conducted irradiation treatments of foods.

REDUCTION OF FOODBORNE DISEASE THROUGH THE USE OF RADIATION PROCESSING

Ronald E. Engel, DVM, Ph.D., International Scientific Liaison, International Programs, Food Safety & Inspection Service, U.S.D.A., Washington, DC 20250

Commercial radiation processing of food, especially food of animal origin, is closer to becoming a reality. There is at the present time no other technology available that will render food safe to handle or consume in the raw state. Microbial pathogens such as *Salmonella*, *E. coli*, *Campylobacter*, and *Listeria* are still implicated in outbreaks of illness caused by contaminated meat and poultry. These pathogenic bacteria are easily destroyed by ionizing radiation. Economic studies of the impact of food borne diseases from these microbial pathogens indicate very clearly the need to break the cycle of illnesses caused by foods of animal origin. Included in these studies, is the medical cost of some parasitic diseases caused by consumption of infected product. The discussion leads to a conclusion that radiation processing is cost effective in reducing food borne illnesses caused by microbial pathogens.

INTERNATIONAL REGULATORY STATUS AND HARMONIZATION OF FOOD IRRADIATION

Donald D. Derr, Deputy Director for Scientific Support, U. S. Department of Agriculture, Food Safety & Inspection Service, 300-12th Street, SW Room, Washington, DC 20250

U.S. regulatory officials and some industry representatives share the opinion that radiation processing may be a solution to food safety and agricultural protection problems that now exist throughout the world. The status of existing U.S. regulations and new regulations being developed by regulatory agencies and being petitioned by industry groups will be discussed and be compared with regulations in other countries. Renewed interest on the part of the U.S. Army in using irradiated foods in many of their rations will be reviewed. The status of demonstration irradiation facilities sponsored by the Department of Energy will be outlined. Comments on harmonization of radiation process controls, dosimetry standards, and other practices that are important aspects of international trade in irradiated foods will be provided.

PRACTICAL EXPERIENCE WITH A COMMERCIAL FOOD IRRADIATION PLANT

William P. Hargroves, Vindicator, Inc., 1801 Thonotosassa Rd., Plant City, FL 33566

Irradiation of food has recently gained world-wide attention because the first commercial-size food irradiator in the United States is now in operation. Over thirty countries are now routinely irradiating certain foods. The Vindicator plant will perhaps have the widest range of processed commodities of all.

There is strong demand for this service. Over two dozen agricultural commodity groups have been identified to potentially benefit from the irradiation process. Many applications have never before been considered for irradiation. The timing of the opening of the plant is coincident with several major events which will aid in the use of irradiation at the Mulberry plant.

STATUS ON UNITED STATES REGULATIONS FOR IRRADIATION AS A QUARANTINE TREATMENT

James F. Fons and Ralph T. Ross*, Associate Director, Science and Technology, USDA Animal and Plant Health Inspection Service, P.O. Box 96464, Washington, DC 20090

The U. S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) requirements for irradiation treatments are identical to those for all other treatments using chemicals, heat, or cold. They are based on the APHIS mission, which is to protect American agriculture from pests new to or not widely distributed in the United States. The standard are adequate to produce this result; they are not designed to address quality or preservation considerations. The only approved quarantine treatment using radiation is for control of fruit flies on Hawaiian papayas. USDA has also recommended a treatment for

Florida grapefruit for Caribbean fruit fly. There is no requirement for publication of this treatment for export or domestic uses. All USDA quarantine treatments using irradiation must be issued in conformity with the Food and Drug Administration rule permitting the radiation of food at rates up to 1 kilogray (1 KGY) for control of insects. USDA/APHIS approval for a quarantine treatment will be discussed along with the factors which may limit the use of radiation as a quarantine treatment.

COMPUTER/PREDICTIVE SYMPOSIUM

THE USE OF PROBABILITY MODELS IN ASSESSING THE SAFETY OF FOODS WITH RESPECT TO *CLOSTRIDIUM BOTULINUM*

Karen L. Dodds, A/Chief, Evaluation Division, Health Protection Branch, Health and Welfare Canada, Ottawa, Ontario, Canada K1A 0L2

The safety of foods with respect to *Clostridium botulinum* depends on the probability (P) of growth or of toxigenesis in a particular food. Traditionally, food microbiologists have used a limited approach, dealing with only one variable, such as temperature or pH, at a time, when, in fact, several factors affect microbial growth. Mathematical models describing microbial growth or toxin production in a food can include different independent variables and any interactive effects between them. P has been the dependent variable in several models. In our latest study, the effects of different initial atmospheres, irradiation dose and storage temperature on toxin production by *Clostridium botulinum* in inoculated fresh pork were examined using factorial design experiments. The results were then used to develop mathematical models relating these parameters. The development of these and other probability models will be discussed.

THE DEVELOPMENT AND VALIDATION FOR THE GROWTH OF FOODBORNE BACTERIA

Robert L. Buchanan, Research Leader, USDA, ARS, ERRC, 600 E. Mermaid Lane, Philadelphia, PA 19118

There has been a series of recent advances in the development of mathematical models that can be used to describe and predict the impact of various cultural and environmental variables on the growth kinetics of foodborne bacteria. This includes empirical approaches such as the Ratkowsky square root model or non-linear response surface techniques, as well as semi-mechanistic approaches such as linear and non-linear Arrhenius models. All of these approaches have been enhanced by the introduction of mathematical functions such as the logistics and Gompertz equations that can be used to mathematically describe bacterial growth curves. Integral to successful model development is a series of "validation loops." Initial models are used to predict behavior of a microorganism under conditions previously not tested. Experimentation is then conducted to compare observed vs. predicted values, with the new data subsequently incorporated into the next (hopefully more accurate) version of the model. Once generated, a similar validation protocol is necessary to establish the efficacy of the models in relation to applicability to specific food products.

MODELING BACTERIAL INACTIVATION/SURVIVAL

Marsha H. Golden, Benne S. Mamer, and Richard C. Whiting*, Research Food Technologist, USDA, ARS, ERRC, 600 E. Mermaid Lane, Philadelphia, PA 19118

Bacterial inactivation upon heating or survival during storage frequently do not exhibit classic logarithmic death. An equation was developed to describe declining populations that have an initial lag or shoulder period and a resistant subpopulation (tailing). To simulate uncooked fermented (Pepperoni, Lebanon bologna) and non-fermented (prosciutto) meat products, survival of *Listeria*, *Salmonella* and *Staphylococcus* was determined in BHI broths with controlled pH (lactic acid), and NaCl and NaNO₂ concentrations stored at various temperatures for up to 6 mo. Data were fitted to the equation and the resulting parameters then described by polynomial regression equations. These equations will estimate the survival of any pathogens from the raw materials during manufacture and storage of these products.

PREDICTING MICROBIAL BEHAVIOR UNDER CHANGING CONDITIONS

Carl S. Custer, USDA, FSIS, S&T, PPID, Room 2155, South Ag. Building, Washington, DC 20250

In the past few decades, microbiologists have developed several models for predicting microbial growth. These models use either stationary conditions or conditions that change at a steady rate. Yet, the conditions in food during processing often change both constantly and at a variable rate. To model microbial behavior under such changing conditions, FSIS uses a simple method to integrate time, microbial response functions, and the changing condition, e.g. temperature. The integration method is based on reciprocals of the microbial behavior function such as germination time or generations per hour. The reciprocals can be used with a simple spreadsheet program or published in tables for use by people unfamiliar with higher mathematics. The tables of reciprocals are also suitable for incorporating into food processing regulations.

THE APPLICATION OF MICROBIAL MODELING IN THE FOOD INDUSTRY — MODELING DAIRY PRODUCTS

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For the dairy microbiologist, the greatest impact of predictive microbiology has been in the determination of potential keeping quality of pasteurized products. Numerous tests have been documented for estimating shelf-life and these generally rely on pre-incubation under conditions that select for accelerated growth of Gram negative, psychrotrophic bacteria (the group of organisms primarily involved in spoilage). The effect of temperature on the growth of these organisms can be well described by the "square root" equation. Time/temperature integrators based on this equation with parameters determined for *Pseudomonas* spp. have been used to provide an indication of shelf-life potential of milks subjected to temperature abuse. However, most predictive microbiologists have been concerned with growth of pathogens and many of the models derived are applicable to dairy products. Amongst these models are equations describing growth of *Listeria monocytogenes* and psychrotrophic *Bacillus cereus*. The latter is of interest because of its role as a spoilage organism as well as potential pathogen. The use of these predictive models will become increasingly important as consumer demands for a greater variety of foods containing fewer preservatives increases.

SANITATION AND DISASTER CONTROL SYMPOSIUM

OH GOD, WE'RE GOING TO DIE — FOOD SAFETY AT DISASTER TIME

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While some natural disasters can be devastating to a community or business they may not have to be. Proper planning is the key to meet an oncoming disaster head-on and prompt execution of a disaster plan will minimize its impact. This paper lists a step-by-step process in planning for a disaster, what materials may be needed to recover quickly, and how to interface with the community. Food safety is critical during and after a disaster and is addressed in any retail or foodservice location. Food safety of the community can be ensured with proper disaster preparedness.

READY? OR SORRY!! THE NEED TO EXERCISE EMERGENCY PLANS

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Under Title III of the Superfund Amendments and Reauthorization Act (SARA-III) of 1986, local governments and jurisdictions are directed to undertake emergency planning. This requirement for the compilation of plans is specifically directed toward spills and releases of hazardous materials, but can also be used to protect citizens during natural events such as storms, floods, earthquakes, and the like.

However, there is often a tendency to write an emergency plan, then set it aside, only to be opened when an event occurs. At that point, even the authors of the plan may not be familiar with its contents. While some sections of the plan may work well during an event, other sections may range from "somewhat inadequate" to "completely unworkable."

This presentation discusses the need for familiarity with the plan, and consideration of it as a "working document", rather than an emergency "panacea". Hints and techniques for testing the plan on a routine basis are presented. The consequences of unfamiliarity with your own emergency plan are also discussed.

HURRICANE HUGO AND ITS AFTERMATH

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In the dark hours of September 21 and 22, 1989 Hurricane Hugo roared through South Carolina like a fast freight train looking for something to destroy. The gigantic force of a Class IV hurricane was not to be denied.

The presentation will discuss preparations made to prepare for this catastrophe and some of the lessons learned to better plan in the future.

EMERGENCY MANAGEMENT OF HEALTH AND SAFETY RISKS ASSOCIATED WITH MARKETED FOOD COMMODITIES IN CANADA

Hélène Quesnel, Acting Chief, Emergency Operations Division, Health Protection Branch, Health and Welfare Canada

In Canada, The Health Protection Branch of the Department of Health and Welfare is the government organization concerned with protecting Canadians from health hazards, including those associated with marketed foods. To manage these risks, HPB uses a decision making model comprised of a risk assessment and a risk management phase. Within this framework the Field Operations Directorate of HPB carries out a nationwide program of inspection, education and analytical data-gathering and takes a leading role in establishing and maintaining capability to manage emergency situations. In responding to emergencies FOD relies heavily on the expert advice of HPB scientific personnel and is also able to call on the support of a network of other governmental agencies, both at the federal and provincial level. In 1991-92 FOD coordinated 105 class I food product recalls, issued 16 public alerts on potentially hazardous foods, carried out 8600 analyses of food products and refused entry into Canada of 330 import shipments of foods. Introduction of new technologies, alternative approaches to enforcement and trends in Crown liability present challenges for the future.

SCIENTIFIC POSTER SESSION

THE GROWTH AND SURVIVAL OF *VIBRIO* SP. AS DETERMINED BY PH, ACIDULANT, TIME AND TEMPERATURE

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The growth and survival of 5 strains of *Vibrio cholera*, 2 strains of *Vibrio vulnificus*, and one strain of *Vibrio parahaemolyticus* was compared in marine broth. The effects of different acids, pH, incubation times, and incubation temperatures were studied. Hydrochloric acid (HCl), tartaric acid (TA), and lactic acid (LA) were used to acidify marine broth to pH values of 5.5, 4.5, 4.0, and concentrations of .02%, 0.03%, and 0.04%. Strains were incubated 24, 48, and 72 hours at 25°C and 37°C. High acidity and low incubation temperature appear to exhibit the greatest inhibition of *Vibrio* strains tested. Antimicrobial activity of LA at 37°C was greater than or equal to that of TA and HCl. Greatest antimicrobial activity was observed at 25°C. At all incubation times and temperatures, the relative antimicrobial activity of the acids was LA ≥ TA > HCl. The lowest pH where growth occurred in Marine broth was 5.00 adjusted with LA, 5.00 or 4.50 (strain-dependant) with TA, and 4.50 with HCl. All strains are capable of growth in media acidified with HCl at pH values lower than the minimum previously reported (pH 4.8).

RAPID ASSAY FOR *BACILLUS* PROTEINASES IN RAW MILK AS DETECTED BY A SIMPLE CASEIN DENATURATION METHOD

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A simple casein agar diffusion method was developed to detect and quantify proteinases produced by psychrotrophic *Bacillus* spp. found in Grade A raw milk. A heat treatment of 75°C for 20 min was found to be most effective for maximum recovery of surviving spores. A sporulation broth containing five minerals and 0.2% nonfat dry milk was used to optimize spore production in pre-incubated heat-treated milk samples. A β -casein based medium detected proteinase activity of bacilli in raw milk samples that ranged from 0.093 to 4.034 units/mg which corresponded to zones of casein precipitation of 5.0 and 15.00 mm, respectively. This assay correlated well with the fluorescein isothiocyanate casein-labeled assay ($r=0.995$). However, proteinase activity of 370 raw milk samples as determined by the β -casein agar diffusion test failed to correlate with fresh spore counts ($r=0.21$), post-heat treatment incubation counts ($r=0.03$), psychrotrophic sporeformer counts ($r=0.06$), or sensory evaluation results. Wide variation in the quantity of proteinase produced per bacilli cell may be responsible for the poor correlation of the results of these methods.

APPLICATION OF A RECORDING THERMOMETER TO MONITOR CLEANING AND SANITIZING PROCEDURES FOR FARM RAW MILK TRANSPORT LINES

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Previously reported studies have demonstrated that cleaning and sanitizing practices of farm pipeline milking systems are often inadequate and deficient. Bacteriological analyses, including SPC, coliform and laboratory pasteurized counts often do not reflect cleaning and sanitizing problems. Therefore, we evaluated the value of using recording thermometers to monitor on farm, milk pipeline cleaning and sanitizing procedures.

Twelve California dairy farms having near illegal bacteriological counts were selected for this evaluation. Two brands of continuous recording devices were studied. We determined that there were several appropriate locations to place the temperature probe connected to the recorder, including near the end of the CIP discharge piper, immediately downstream from the plate heat exchanger, and other sites. The recording devices worked well on all farms and identified clearly where lapses in cleaning and/or sanitizing procedures occurred that resulted in the high counts. This study indicated that a recording thermometer would markedly improve milk pipeline cleaning and sanitizing practices. We recommend that all dairy farms employ this management tool to insure the quality and safety of raw milk.

MICROBIAL AND CHEMICAL ANALYSIS OF MEXICAN WHITE SOFT CHEESE AND ITS RELATIONSHIP WITH THE CONTENT OF HISTAMINE AND TYRAMINE

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Mexican white soft cheese "Queso Regional" was collected in the cheese makers farm in Hermosillo, Mexico for immediate analysis of microbial quality, chemical composition and amines content. The methods used were according to Bacteriological Analytical methods (FDA, 1984), AOAC and Lovenburg, respectively. The remaining portion was cut in two parts for storage at 5 and 25°C and analyzed them again at 4, 8, and 12 days. The initial content of fat, protein, salt and moisture was 19.22%, 17.10%, 1.6%, and 57%, respectively. The a_w was 0.97 and pH 6.14. Protein and fat content were slightly low in reference to the National Standard for Cheeses. *Shigella* was isolated from 9.5% of samples. The microbiological counts were done on freshly made cheese and after 4, 8, and 12 days. The total counts were 9.7×10^7 , 4.5×10^8 , 8.9×10^8 , 1.1×10^9 . For *Enterococcus* 5.6×10^6 , 5.1×10^7 , 1.5×10^8 , 1.5×10^8 , *Staphylococcus aureus* 1.2×10^5 , 4.0×10^5 , 1.1×10^6 , 1.4×10^6 . Total coliforms 5.6×10^6 , 1.2×10^7 , 2.2×10^7 , 3.2×10^7 . Fecal coliforms 3.8×10^6 , 1.0×10^7 , 1.0×10^7 , 1.6×10^7 . *E. coli* 2.3×10^5 , 3.5×10^6 , $4.8 \times$

10^6 , 1.2×10^6 . The levels of amines were low, and it was not possible to correlate them to the other parameters.

SURVIVAL OF *SALMONELLA TYPHIMURIUM*, *ESCHERICHIA COLI*, O157:H7 AND *LISTERIA MONOCYTOGENES* SCOTT A DURING STORAGE ON BEEF SANITIZED WITH ORGANIC ACIDS

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Sterile beef tissue was inoculated with either *Salmonella typhimurium*, *Escherichia coli* O157:H7 or *Listeria monocytogenes* Scott A and washed with water, 1% lactic or acetic acid and then dry or spray chilled. Washed tissue was stored at 5°C for up to 21 days, and total bacterial and sublethally injured populations were determined. There was no apparent difference in injured or non-injured populations of *S. typhimurium* or *L. monocytogenes* on acid washed lean tissue after 3 days of storage, irrespective of chilling method. Spray chilling did result in slightly higher populations of both non-injured and injured *E. coli* after washing with acetic acid, although this effect was not as pronounced with lactic acid. These results indicate that although injury and recovery of pathogenic bacteria may occur as a result of organic acid carcass sanitizing treatments, there was no practical significance after 3 days of storage.

USE OF PHENOLS AND LIQUID SMOKE TO CONTROL *LISTERIA MONOCYTOGENES*

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The behavior of *Listeria monocytogenes* was monitored in Tryptose Broth (TB) and wiener exudate during storage at abuse (25°C or 37°C) temperatures in the presence of liquid smoke or phenolic compounds found in smoke. Of 11 individual phenols tested, only isoeugenol exhibited antilisterial activity in TB; lag phase increased from 3 h (control) to ca. 21 h (200 ppm isoeugenol). Moreover, growth of the pathogen was inhibited more in TB (with or without added phenols) adjusted to pH 5.8 compared to pH 7.0. When added to wiener exudate, isoeugenol (150 ppm) displayed either listericidal or listeristatic action depending on the batch of exudate. In contrast, CharSol Supreme exhibited bactericidal activity against a 3-strain mixture of *L. monocytogenes* in wiener exudate; D values were 36 and 4.5 h at 0.2 and 0.6% liquid smoke. These studies establish the listericidal action of CharSol Supreme in wiener exudate and demonstrate the potential of isoeugenol for controlling the growth of *L. monocytogenes* in certain processed meats.

FATE OF *LISTERIA MONOCYTOGENES* IN MODIFIED-ATMOSPHERE PACKAGED TURKEY ROLL

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Although modified-atmosphere packaged foods are becoming more popular in North America, research on the microbiological safety of these foods is still lacking. Thus, research was conducted to study the growth of *Listeria monocytogenes* on modified-atmosphere packaged turkey roll. *L. monocytogenes* strain Scott A was used to inoculate the surface of turkey roll with a final concentration of approximately 1 to 5×10^3 cells/gram. Turkey roll was placed in high barrier bags and stored at 4 or 10°C for up to 4 weeks in an atmosphere of either 50% CO₂, 60% N₂, 30% CO₂, 70% N₂, or air. At various time intervals, samples were stomached and then spread-plated onto LPM and Oxford media for *L. monocytogenes*, MRS agar for the lactobacilli and Cetrimide agar for the pseudomonads. In addition, gas atmospheres within the bags were analyzed by gas chromatography, and pH and water activity values were determined. After 4 weeks storage in the MAP meats kept at 4°C, pseudomonad counts were usually < 1000/g, lactobacilli counts > 10⁷/g, while *Listeria* counts increased approximately 2-3 logs in number. During air storage at 4°C, pseudomonad counts were usually > 10⁶/g, lactobacilli counts > 10⁷/g and *Listeria* counts increased approximately 3-4 logs in number. Similar trends were observed during storage at 10°C. Turkey rolls appeared organoleptically acceptable during MAP storage at 4 or 10°C for 1 month. This

demonstrates that during MAP storage of meats, the normal spoilage flora may be inhibited relative to growth in air, while *L. monocytogenes* is capable of growing in atmospheres containing CO₂ levels as high as 50%.

FATE OF *ESCHERICHIA COLI* O157:H7 IN FERMENTED, DRY SAUSAGE AND IN MODIFIED ATMOSPHERE PACKAGED BEEF

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The fate of *E. coli* O157:H7 was determined during the production and storage of dry, fermented sausage and in beef packaged under different combinations of a modified atmosphere. Sausage batter inoculated with *E. coli* O157:H7 was fermented to pH 4.8 (ca. 13-14 h), dried until the moisture:protein ratio was $\leq 1.9:1$ (ca. 18-21 d), and sausages were then vacuum packaged and stored at 4°C for 2 months. The organism did not grow during fermentation, drying or subsequent storage at 4°C, and decreased by about 2 log₁₀ CFU/g by the end of storage. *E. coli* O157:H7 populations decreased in beef roast packaged under vacuum, 20% CO₂/80% N₂ or 100% CO₂ and held at 8°C. In contrast, growth occurred in beef packaged under sterile, compressed air. The most effective treatment for reducing *E. coli* O157:H7 in beef was packaging under 20% CO₂/80% N₂. Greater than a 2 log₁₀ CFU/g reduction occurred in 4 to 7 d with this treatment, whereas a 3 log₁₀ CFU/g increase of *E. coli* O157:H7 occurred within 7 d in beef packaged under air.

FREQUENCY OF FALSE PRESUMPTIVE POSITIVE RESULTS OBTAINED USING A COMMERCIAL ELISA KIT TO SCREEN RETAIL GROUND BEEF FOR *ESCHERICHIA COLI* O157:H7

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During January - August, 1991, 74 retail ground beef samples were tested for the presence of *Escherichia coli* O157:H7 using a commercial (3M) ELISA kit, and for numbers of aerobic bacteria, coliforms, and proteolytic bacteria. A total of 17 samples were presumptively positive for *E. coli* O157:H7. Of 42 isolates taken from these samples, 30 were positive when retested with the ELISA. Only 15 of these 30 isolates were *E. coli*, six were identified as *Hafnia alvei*, and nine were not identifiable. None of the *E. coli* isolates were serotype O157:H7. No significant difference in mean log₁₀ CFU/g of aerobic bacteria, coliforms, or proteolytic bacteria was observed between samples testing presumptive positive for *E. coli* O157:H7 and samples testing negative. There were no significant differences in these microbiological parameters between cold weather (January - May) and warm weather (June - August) samples. These results show that the O157 polyclonal antibody used in this ELISA cross-reacts with non-O157:H7 *E. coli* and other species, necessitating thorough confirmatory testing.

INCIDENCE OF LOW LEVELS OF ENTEROTOXIN-PRODUCING *BACILLUS CEREUS* IN ROUTINE SURVEILLANCE FOOD SAMPLES

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Eleven hundred foods submitted for routine surveillance bacteriology were analyzed for the presence of *B. cereus* in numbers ≥ 100 per gram. *B. cereus* was found in 44 foods (4%) at levels from 100 to 5,000 per gram. Thirty-seven isolates from 37 foods were tested for *in vitro* enterotoxin production using a Fluorescent Immunodot assay. Four did not produce detectable enterotoxin. The remaining isolates produced varying levels of enterotoxin. Twenty-one foods were temperature abused (30°C for 24 hours). In four of these foods *B. cereus* reached levels normally found in foodborne disease ($\geq 10^5$ per gram). Foods with such levels of *B. cereus* may remain aesthetically acceptable for consumption as is evident from foodborne disease investigations. Results indicate that contamination of foods with even low numbers of *B. cereus* may present a potential for foodborne disease.

DIMORPHISM IN *SHIGELLA SONNEI* AS IT RELATES TO RETENTION OF BIOCHEMICAL AND SEROLOGICAL CHARACTERISTICS

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It has been reported that traditional culture methods for the isolation of *Shigella* organisms in foods are relatively insensitive. The colonial dimorphism associated with *Shigella* cultures results in smooth as well as rough colonies. This study determined (1) the optimal pH for the organism's growth, (2) the optimal storage condition with respect to retention of indigenous biochemical and serological characteristics, and (3) the effectiveness of the culture method recommended in FDA's *Bacteriological Analytical Manual* (BAM) for the recovery of *Shigella* from selected foods. Preliminary results with 2 strains of *S. sonnei* indicated no significant difference in growth at pH values ranging from 6.2 to 8.2. Evaluation of various storage conditions showed an increase in the percentage of rough colonies derived from cultures stored for prolonged periods. Although there were no major differences in the biochemical characteristics of smooth and rough variants, smooth variants agglutinated more readily in homologous antisera than did rough variants. With the BAM method, *S. sonnei* was recovered from ground beef and chicken salad only at levels of at least 10³ organisms per g.

ACCESSIBILITY TO CHLORINE OF BACTERIA ATTACHED TO OR ENTRAPPED IN POULTRY SKIN

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Salmonellae and other bacteria are attached to or entrapped in poultry skin. Bactericides such as Cl₂ and ClO₂ eliminate salmonellae in chill water, but effect only a reduction on the carcass. This study was to determine if the reduction of salmonellae on carcasses is due to direct contact of bactericide with bacteria or to the elimination of cross-contamination. Levels of aerobic bacteria and *Enterobacteriaceae* (which include salmonellae) were determined on broiler carcasses which were rinsed before and after 30 min agitation in water chlorinated to a free residual of 0.5 to 1 ppm. Only a small reduction occurred in bacterial levels on carcasses indicating that attached or entrapped bacteria are not readily accessible to bactericides in processing water.

LOW DOSE UV AND GAMMA RADIATION ON SHELF-LIFE OF PEACHES

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The effect of low dose UV light (254nm) and gamma rays, non chemical way to extend the shelf-life of peaches, was investigated. Peaches were irradiated once, twice or thrice with UV at 7.4x10⁶ erg/mm² (at 4 d interval) or with 0.1 KGy gamma rays, stored at 16°C for 21 d then examined. The results showed that the % rot was 51 for the control while it was 25 for both UV and gamma ray treated peaches. Fruit irradiated with UV more than once appeared firmer, acidity higher, and soluble solids and pH lower than the control. Comparison of UV and gamma radiation showed that there were no difference in pH, soluble solids, acidity, texture, but sugar content was higher, color greener and the weight loss greater for the gamma rays treated peaches. The results indicate that low dose UV and gamma ray treatment delayed the ripening of peaches.

INCIDENCE OF BACTERIA ON SMEAR-RIPENED CHEESES ABLE TO INHIBIT *LISTERIA MONOCYTOGENES*

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A newly developed hydrophobic grid-membrane filter method was used both with and without selective enrichment to screen retail French surface-ripened cheeses for coryneform bacteria, staphylococci and micro-

cocci capable of producing bacteriocin-like substances active against 14 *Listeria monocytogenes*, 2 *L. innocua*, 2 *L. ivanovii*, 1 *L. welshimeri*, and 2 *L. seeligeri* strains. Four of 50 (8.0%) cheeses examined after enrichment yielded inhibitory strains of *Enterococcus faecalis*, *Staphylococcus xylosum* and yellow coryneform bacteria; whereas 16 inhibitory strains (1 orange coryneform, 6 yellow coryneforms, 2 white coryneforms, 2 *S. xylosum*, 1 *S. warneri*, 2 *S. saprophyticus*, and 2 *E. faecalis*) were recovered from 13 of 55 (24.0%) cheeses without enrichment. All inhibitory cheese smear isolates showed varying degrees of inhibition towards 2 to all 14 strains of *L. monocytogenes* and 1 to all 7 strains belonging to other *Listeria* spp. Cheeses yielding inhibitory strains included Livarot, St. Paulin, Reblochon, Cantal, St. Neactaire, Pont L' Evêque, Munster, Raclette, Comté and one proprietary cheese.

EFFECTIVENESS OF A MODIFIED SALMONELLA-TEK™ ENZYME IMMUNOASSAY FOR THE RECOVERY OF SALMONELLA FROM SELECTED LOW-MOISTURE FOODS

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The Salmonella-Tek™ (Organon-Teknika Corporation, Durham, NC) method is a colorimetric monoclonal enzyme immunoassay (EIA) in test kit form for the rapid identification of *Salmonella* in foods. Since its approval by the Association of Official Analytical Chemists in 1990, the manufacturer has proposed the revision of the test kit procedure by (1) incubating the tetrathionate selective enrichment broth and the post enrichment M broth at 42°C rather than at 35°C and (2) adding novobiocin at 10 µg/ml to the M broth. A study was performed to compare the sensitivity of the original versus the modified procedures for the identification of *Salmonella* in selected foods. A dilution-to-extinction procedure, using serial 10-fold dilutions, was used to inoculate the incubated post-enrichment media. Approximately 10⁶ cells/mL were needed to give a positive assay response. Preliminary results indicated no significant difference between the original and modified Salmonella-Tek™ methods.

MICROBIAL GROWTH RATE OF TWO MINIMALLY PROCESSED VEGETABLES PACKAGED IN MODIFIED ATMOSPHERE PACKAGE

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Minimally processed vegetables, if packaged as MAP and kept at refrigerated temperature, still support rapid microbial growth. The growth rate can be an indicator for their shelf life. Rutabagas and squash were washed, rinsed in 200 ppm chlorine solution, and peeled in a clean-air room at 6°C. The vegetables were diced into cubes, packaged in a high barrier film and were stored at 2° and 6°C for up to 3 weeks. O₂, CO₂ and aerobic plate count at 37°C were monitored daily. The initial CFU's were around 3 logarithms for both vegetables. The lag phase lasted for 12 days for samples at 2°C and only 3 days at 6°C. Growth rate was not affected by the changing package atmosphere from high O₂/low CO₂ to low O₂/high CO₂ condition. CFU's increased quickly after the lag phase although no visible spoilage could be observed.

ULTRASONIC KILLING OF LISTERIA MONOCYTOGENES AND SALMONELLA TYPHIMURIUM IN MILK

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This study examined the lethal effect of indirect ultrasonication on two food-borne pathogens in skim or whole milk. Ten thousand bacteria were suspended in 1 ml samples of milk in test tubes and placed in a Branson ultrasonic cleaning water bath set at 22°, 40°, or 50°C. At timed intervals, viability was determined. *Salmonella typhimurium* was more susceptible to ultrasonic damage than *Listeria monocytogenes*. In skim milk, the population of *S. typhimurium* significantly decreased after 15 min of ultrasonication at 40° or 50°C. *L. monocytogenes* populations were unchanged at 15 min. At 22°C, there was little change in viability for either species with 30 min of ultrasonication. Both species were more susceptible to ultrasonic killing when suspended in skim milk than when suspended in whole milk. The data indicates that ultrasonic treatment of

sufficient duration at 50°C is a means of killing both *S. typhimurium* and *L. monocytogenes* in skim milk, but it is less effective against bacteria in whole milk.

EVALUATION OF PC BASED SOFTWARE IN THE DAIRY Q. C. LABORATORY

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Production of high quality dairy products is closely monitored by the Dairy Q.C. Laboratory. This vital data, due to its volume and nature is often not used effectively. Microbiological quality, safety and consumer shelf life data may require several days to obtain. Problem identification from this data is difficult at best with manual systems. PC based spreadsheet, data bases and laboratory information management system (LIMS) were adapted to the dairy laboratory and evaluated. Each application will be reviewed and the results discussed. All software systems can provide benefits through varied reports, allowing improved interpretation of data and quick identification and correction of product defects.

IMPROVEMENT OF LACTIC CULTURES THROUGH ORGANIC SOLVENT TREATMENT

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Proteolysis and acid production are important characteristics of a starter organism. These parameters are intimately involved with the utilization of the culture in the manufacture of a diversity of fermented dairy products. The microorganisms used in this study were *Lactococcus lactis* ssp. cremoris 352 (*L. cremoris* 352), *Lactococcus lactis* ssp. *lactis* H₇ (*L. lactis* H₇) and *Lactococcus lactis* ssp. *cremoris* R₁₁ (*L. cremoris* R₁₁), from the culture collection of the Department of Food Technology, UFV, MG, Brazil. The proteolytic (mg tyrosine/100 g) and acidolytic (titratable acidity expressed as % of lactic acid) activities of these cultures were determined before and after treatment with 20% ethanol, for 15 minutes. The experimentation was repeated at least three times in different occasions. Although the literature has indicated an increase in both proteolytic and acidolytic activities for two lactic cultures, in this work the proteolytic activity was not significantly different (P ≥ 0.05) in the treated/non treated cultures. The acidolytic activity of *L. lactis* H₇ was 2.1 times higher than the untreated culture. The other two cultures did not respond to the treatment. We conclude that lactic cultures could be improved through treatment with 20% ethanol. However, due to individual responses the result obtained with a strain of a species can not be extrapolated to the species.

VIRULENCE OF AN ESCHERICHIA COLI O157:H7 SORBITOL POSITIVE MUTANT

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Escherichia coli O157:H7 is an important cause of foodborne illness in the U.S., Canada and Europe. Dairy cattle are the principle reservoir for the organism and most outbreaks have been associated with eating undercooked ground beef or drinking raw milk. Unlike most strains of *E. coli*, *E. coli* O157:H7 isolates do not ferment sorbitol. Many assays developed for the detection of the organism incorporate the use of Sorbitol MacConkey agar (SMA) as an initial screening for the presence of the pathogen; however, there was no information about the importance of this phenotype in relation to virulence. A sorbitol positive mutant, strain A9121+, was produced by culturing at 37°C in Purple Broth Base containing 1% sorbitol and selecting sorbitol positive colonies on SMA. A comparison of the wild-type strain with the mutant showed that both induced an equivalent cytotoxic response in Vero cells. Both were similar by plasmid profile and SDS-PAGE analysis revealed that both had similar outer membrane protein and total cell extract protein profiles. They also adhered equally well to HEp-2 and INT 407 cells. Since it is possible to produce sorbitol positive mutants by growth in sorbitol-containing medium, assays which utilize SMA as an initial screening medium for *E. coli* O157:H7 may not be reliable particularly when foods that contain sorbitol as a cryoprotectant are tested.

QUANTITATIVE EFFECTS OF PH AND LACTIC ACID CONCENTRATION ON THE KINETICS OF *LISTERIA MONOCYTOGENES* INACTIVATION

R. L. Buchanan, R. C. Whiting, and Marsha H. Golden*, Microbiologist, USDA, ARS, ERRC, 600 East Mermaid Lane, Philadelphia, PA 19118

The effects of pH and lactic acid concentration on *Listeria monocytogenes* inactivation was studied in BHI broth using a three strain mixture (inoculum = 10^8 cfu/ml). Lactic acid concentrations of 0.0, 0.1, 0.5, 1.0, and 2.0 M were tested in conjunction with pH values of 4.0, 5.0, 6.0, and 7.0, with each pH/conc. combination incubated at 28°C for up to 60 days. Bacterial levels were determined periodically by plate counts. Survivor curves (log# vs time) were fitted using a linear model that incorporated a lag period, and used to calculate D-values and time to a 4-D inactivation. Time to a 4-D inactivation was directly related to pH and inversely related to lactic acid conc. At lactic/pH combinations that supported growth, the organism increased approximately 10-fold before declining. At higher lactic conc., inactivation was exponential after an initial lag period that varied according to the severity of the conditions. In lactate-containing cultures, 4-D inactivation times were related to the level of undissociated lactic acid. That relationship was described by the equation, $t = \exp(-0.179 \cdot \text{LA}^{0.5} + 6.452)$, where t is time (hr) to 4-D inactivation, and LA is mM undissociated lactic acid.

SURVEY OF SPOILAGE BACTERIA IN RAW MILK AT EGYPTIAN MARKETS AND FARMS

R. S. Hafez, and H. M. A. El-Hady*, Assistant Lecturer, Department of Food Hygiene, Faculty of Vet. Medicine, Cairo University, Giza, Egypt

One hundred and seventy-five (175) raw milk samples were obtained from street peddlers or dairy shops (150) and from dairy farms (25) and examined bacteriologically. All the samples contained lactic acid bacteria with numbers ranging from 1.6×10^2 to 9.0×10^{10} .

The coliform content (MPN/100 ml) in the peddlers and dairy shops milk samples exceeded lactic acid producing organisms, while the farm milk samples yielded coliform counts at a lower range, 2.3 to 2.4×10^6 with a mean value of $2.9 \times 10^5 \pm 1.3 \times 10^5$.

Clostridial organisms could be detected in 67 and 40% of examined markets and farm raw milk samples respectively. The significance and economical importance of acid producing organisms in dairy industry is discussed.

FATE OF ENTEROTOXIGENIC STAPHYLOCOCCI IN FISH SUBJECTED TO CURING

P. K. Surendran, and S. Sanjeev*, Scientist, Central Institute of Fisheries Technology, Matsyapuri, P. O., Cochin-682029-INDIA

Enterotoxin A, B, C, D and E producing strains of *Staphylococcus aureus* were inoculated into dressed fish - Barracuda (*Sphyraena* sp.) and arranged in a vat with Sodium chloride in 3:1 ratio for 48 h. The samples were then dried in open sun for 3 days. The total bacterial count increased from 3.2×10^4 to 1.7×10^5 /g, *Staph. aureus* count from 1.6×10^4 to 2.1×10^5 /g and the moisture content decreased from 70.4% to 49.7% after 48 h salt curing. The total bacterial load came down from 1.7×10^5 to 1.8×10^2 /g, moisture content from 49.7% to 27.7% and *Staph. aureus* could not be isolated after 3 days sun drying.

THE EFFECT OF ULTRAVIOLET LIGHT-C ON STORAGE ROTS AND RIPENING OF TOMATOES

J. Liu, V. A. Khan, J. Y Lu, C. L. Wilson, O. Adeyeye, M. K. Kabwa, L. Pusey, E. Chalutz and T. Sultana, and Clauzell Stevens*, Associate Research Professor, Dept. Agri. Sci., Room 207, Milbank Hall, Tuskegee University, Tuskegee, AL 36088

The application of hormetic low dose of ultraviolet light (UV-C, 254 nm) that induced stress on fruits and vegetables to stimulate beneficial responses in plants, is a new method for controlling storage rots and extending the shelf-life of fruits. The present study was aimed at treating tomatoes (*Lycopersicon esculentum*) at different UV-C dosages (1.3 to 40×10^4 ergs/mm²) to induce resistance to gray mold (*Botrytis cinerea*) and Rhizopus soft rot (*Rhizopus stolonifer*). Tomatoes artificially inoculated with *B. cinerea* and *R. stolonifer* following UV-C irradiation was effective in reducing gray mold and fungal soft rot at 7.5 and 3.6×10^4 ergs/mm², respectively. Treatment with UV-C decreased the ripening process as indicated by the ripening stages and fruit firmness. For example, the % ripeness of tomatoes (at orange to soft red stage of maturity) were 63 and 35% for the control and UV-C (3.6×10^4 ergs/mm²) treatment, respectively. Resistance to storage rots of tomatoes and slower ripening are probably related. For example, the % of Rhizopus soft rot decreased while firmness increased. Furthermore, induced resistance of tomatoes to UV-C treatment decreased with the degree of ripeness. In conclusion, our results appeared to indicate that the ripening process of tomatoes has been delayed which might contribute to the increased resistance of fruits to storage rots.

Industry Products



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Industry's need for cost-effective monitoring of pollutants in water continues to grow in importance as new legislation increases the potential costs to companies that do not monitor their impact on the environment.

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The need for calibration is kept to a minimum and the use of a (patent pending) calibration cup halves the time required. The integral stirrer ensures that a representative sample of water is monitored, and is microprocessor controlled with pulse options to reduce power requirements.

The use of a Pt100 for temperature measurement and compensation offers improved stability and accuracy over thermistors. A custom self-pressurizing double junction pH electrode is stable in both ultra pure water and leachate, even at 100 meters depth. User-specified ion selective electrodes can be fitted to monitor nitrates, fluorides, calcium/hardness and other pollutants, increasing the scope of measurement. A 4-ring conductivity electrode corrects for fouling, operating from 1 S/cm (ultra-pure water) to 50 ppt (seawater) with microprocessor controlled autoranging. The turbidity electrode operates from 0.3 to 4000 NTU, with 0.1 NTU resolution.

A snap-lock sensor shield and anti-fungal screen give added protection to the sensors. An optional weight bracket enables the Sonde to reach the necessary depth. For applications where it is not practical to lower the Sonde into the

water a flow-through cell is available, allowing extracted water to be passed over the sensors. Samples may be pumped up from groundwater wells or bled off from industrial flow lines.

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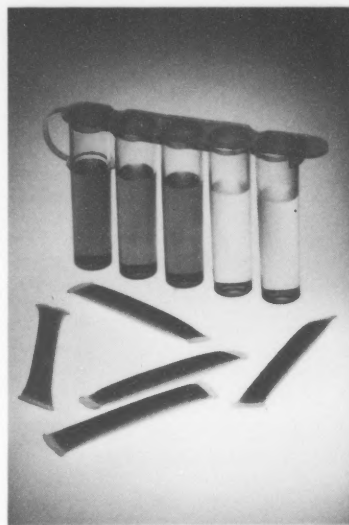
The generator is a complete system comprised of carefully matched components engineered for easy installation, operation and long term reliability. Standard features include: coalescing prefilters with automatic drains, proprietary gas separation systems, and a 0.01 μ m membrane final filter. Also included is a four year's supply of replacement filter elements.

Installation consists of connecting a standard compressed air line to the inlet, and connecting the outlet to the gas line.

Typical applications include: chemical and solvent blanketing, glove box purge, chemical and solvent evaporation, instrument purge and supply, evaporative light scattering detector (HPLC), and sparging.

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New ColiQuik Formula Improves Detection of Stressed E. coli

Hach's new ColiQuik formulation, an ONPG/MUG nutritive medium, improves recovery of stressed *E. coli*. Use ColiQuik to accurately test potable, waste, marine, and surface waters. In just 24 hours, ColiQuik gives you simultaneous, accurate results for total coliforms and *E. coli*. Inoculum from incubated ColiQuik tests can be used to further identify specific bacteria.

The formula contains ONPG and MUG reagents, which are activated by specific enzymes produced by total coliforms and *E. coli*. Coliforms react with ONPG to form a bright, yellow color. The yellow color change can be detected quickly and is easy to see. *E. coli* react with MUG to produce fluorescence under long-wave, ultraviolet light. Brighter fluorescence of *E. coli* is easy to detect. Confirmation of total coliforms and *E. coli* is not necessary.

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The new AROMATRON® test system is designed for those in the assessment of the effects of flavor, aroma and odor on packages and packaging materials. The AROMATRON transmission rate test system will quantitatively measure the loss or gain of expensive flavors and aromas from packages or packaging material. The system can test flat barrier materials or finished packages for organic gas permeation.

Now it is possible to determine the incoming permeation rate of unwanted odors such as solvents and perfumes into packages, or, to measure the loss of expensive flavors and aromas from packages. The AROMATRON can also perform statistically significant experiments on a variety of barrier packaging materials to determine the most cost effective material in given applications. The system can test with parts per billion sensitivity, provides semi-automatic calibration and includes two test cells for higher throughput.

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Buffered Listeria Enrichment Broth

A selective enrichment medium for the detection of *Listeria monocytogenes* has been introduced by Unipath. The Oxoid Buffered Listeria Enrichment Broth is intended for use with samples of fermented products, and as an alternate method for the enrichment of environmental samples. The addition of buffers (potassium dihydrogen orthophosphate & disodium hydrogen orthophosphate) enhances the enrichment of *Listeria* species when used with fermented products. The Buffered Listeria Enrichment Broth base is available in 500 gm containers and the Listeria Selective Enrichment Supplement package is sufficient to supplement 5 litres of medium.

Unipath Co., Oxoid Div. -
Ogdensburg, NY

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Protector® Stainless Steel Perchloric Acid Laboratory Hood is Designed For Safety and Durability

Labconco Corporation, Kansas City, Missouri, offers the Protector® Stainless Steel Perchloric Acid Laboratory Hood which is designed specifically for procedures involving the use of perchloric acid.

Available in 4, 5, and 6-foot widths, each Stainless Steel Perchloric Acid Hood is constructed of seamless, Type 316 stainless steel with integral work surface and drainage trough. The hood exterior is made of epoxy coated steel.

The Stainless Steel Perchloric Acid Hood features a vertical-rising counterbalanced clear safety glass sash which protects the operator and provides excellent visibility. A factory installed washdown system is manually operated by a control fixture on the front of the hood. This facilitates removal of hazardous perchlorates from ductwork and behind hood baffle. A duplex electrical receptacle, and factory wired lights and switches are also provided.

Each model includes four remotely controlled service fixtures for use with gas, vacuum, air or water. Fixtures are pre-plumbed and are provided with color-coded inlays for mounting on individual control knobs. Liftaway front panel and fixture panels enable easy access for servicing fixtures.

Labconco Corp. - Kansas City, MO

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Sparling Instrument's Pulse Batch Controller

Sparling Instruments Company of El Monte, California introduces a Digital Batch Controller. . . FLO-BATCHER Model 794.

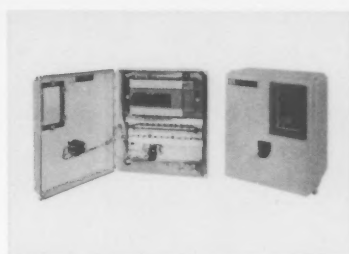
Microprocessor-based and suitable for panel-mounting - the Model 794 has two independently functioning counters. One counter will count up to a preset batch number entered by the user. The other counter reads total flow.

The unit can receive pulses from a variety of flowmeters and produces contact closures for controlling valves, pumps and alarms. Special features include: FS-232 computer interface; readout in engineering units; 16 button keypad; 12 VDC power supply, non-volatile memory (EE PROM), optional isolation, simultaneous inputs and high current relays.

Economically priced, the unit can be started and stopped by remote command and program changes can be made easily.

Sparling Instruments Co. -
El Monte, CA

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Custom Control Products Presents Enhanced FDVC

Custom Control Products, Inc., continues a tradition of innovation with the recent release of the enhanced SLC-500 programmable logic controller (PLC) for flow diversion valve controllers (FDVC). The advanced technology utilized in the SLC-500 renders it even more powerful than its predecessor, the SLC-100.

The upgraded FDVC eliminates separate relay interface panels previously required to integrate timing pumps, homogenizers, booster pumps, stuffing pumps, CIP pumps, divert valves, leak detect valves, and many more. Several important safety procedures are programmed into the new FDVC, including output and input signals that are isolated from their corresponding lights to prevent backfeed or accidental running of product.

The enhanced FDVC complies with PMO and FDA regulations for Grade "A" milk plant use, and is compatible with all flow diversion valves conforming with 3A/FDA regulations and guidelines.

Custom Control Products, Inc., provides exceptional quality control systems and auxiliary products, backed by personalized professional service to the dairy, food, beverage and pharmaceutical industries.

Custom Control Products, Inc. -
Racine, WI

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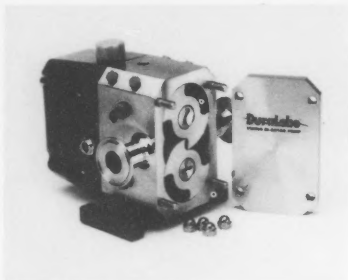
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With the WCR Exchange Program, regasketed/reconditioned plates are sent to the user ahead of need. New plates can be installed as the used plates are removed. Down-time is limited to change-out time. Used plates are returned to WCR and are reconditioned for the next customer. Returned plates are put through the rigorous WCR ten-step inspection, reconditioning, and regasketing process.

WCR regasketing services are more economical than comparable services offered by plate heat exchanger manufacturers. WCR regasketing is also more reliable than in-plant, do-it-yourself regasketing.

WCR - Dayton, OH

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Viking's DuraLobe™ Rotary Pump Meets 3-A Sanitary Standards

Viking Pump, Inc., has announced that its new DuraLobe™ bi-lobe rotary pumps meet 3-A sanitary standards and are now authorized to display the 3-A symbol.

Viking DuraLobe pumps feature a unique design allowing easy cleanability and maintenance while the pump remains in-line. The pump has been developed so that its entire "wet end" can be accessed by the simple removal of four nuts securing the pump head plate. With this plate removed, rotors and product seals are easily accessed and may be easily cleaned, inspected, removed and replaced without taking the pump off the line. In addition, the lobe design of the rotors has eliminated metal-to-metal contact within the pump chamber, significantly reducing the danger of contamination and allowing the pump to effectively handle shear-sensitive products. Viking offers tri-clamp and Acme thread port options that meet the 3-A standards, in addition to NPT and standard flange ports.

3-A standards are established and promoted by the 3-A Sanitary Standards Committee, comprised of representatives from the Dairy Industry Committee, Dairy and Food Industries Supply Association and U.S. Public Health Services. This national committee formulates industry standards and accepted practices used to process milk and milk products. For pumps, tanks, valves, fittings, packaging devices and other equipment for processing dairy foods, 3-A standards establish criteria for the design, fabrication and materials used in the construction of such equipment.

Standards for products such as the Viking DuraLobe pump are developed to ensure that design and manufacture facilitate cleanability, sanitation and inspection. While the standards demonstrate products' specific compatibility with the demands of dairy foods processing, industries such as chemicals and pharmaceutical have accepted 3-A compliance as an important attribute of products considered for use in their processes also.

The 3-A standards committee represents national sanitarians, equipment manufacturers and food processors. This nationally respected committee establishes and promotes the highest standards of industry quality and sanitation. Compliance with the standards adopted is voluntary, with participating manufacturers and processors self-certifying the compliance of their equipment, procedures and services with the exacting standards criteria.

Once manufacturers demonstrate that their products meet the exacting 3-A standards, they are authorized to display the registered 3-A symbol trademark on the qualifying products.

Viking manufactures an extensive line of rotary pumps. For 80 years, the company has been an innovator in the design and manufacture of internal gear pumps for thousands of applications. The Cedar Falls, Iowa-based company is marketing the new DuraLobe pumps throughout the United States, Canada and South America.

Viking Pump, Inc. - Cedar Falls, IA

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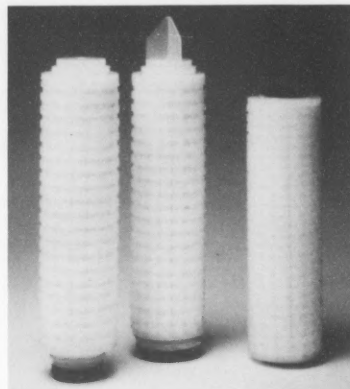
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STEEL IT Vinyl can be used in a variety of applications in tanks, ships and locks, as well as for food, chemical and drug processing. An 8 dry mil thick layer of multiple coats over well-sandblasted, primed steel provides excellent resistance to chemical fumes and spillage in severe environments. For marine immersion applications, a vinyl wash primer is required. Quick drying, the white primer can be recoated in three hours, and the stainless steel finish coat can be recoated in six hours. The stainless steel finish covers up to 272 sq. ft./gal. at a thickness of 1 dry mils.

Stainless Steel Coatings, Inc. -
So. Lancaster, MA

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The medium within a Profile Star filter is constructed using the Pall proprietary technique of varying fiber diameter to produce a constant density, high void volume, tapered pore filter medium. Therefore, when used for the filtration of viscous fluids, Profile Star filters can provide up to six times the service life versus both traditional pleated and depth filters.

Profile Star filters are available in absolute removal ratings from 3µm to 90µm, and in both an AB (single open ended) and Pall patented UNI LOC™ (double open ended) configuration. An AB style filter has a 2 3/4 inch outer diameter and is available in 10, 20, 30 or 40 inch lengths. A UNI LOC style filter has a 2 1/2 inch outer diameter and is available in 10 inch lengths. The individual 10" UNI LOC elements may be simply snapped together to form a 20, 30, or 40 inch cartridge filter.

Profile Star filters are constructed entirely of polypropylene which make them compatible with an extremely wide range of fluids. They are also available in a pharmaceutical "P" grade construction, which is optimized for pharmaceutical applications.

Profile Star filters are available from Pall Corporation, Fluid Processing Groups, which serve the chemical process, petrochemical, oil, gas, polymer film and fiber, photographic film, magnetic tape, surface coatings, compact and optical disc, electroplating, automotive paint, nuclear and fossil fuel, food and beverage, pharmaceutical, biological, bioprocessing, electronics and cosmetics industries.

Pall Corporation - East Hills, NY

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These three excellent manuals are based on epidemiologic principles and investigative techniques that have been found effective in determining causal factors of disease outbreaks. Used as a guide by Health Departments throughout North America.

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The Complete book of 3-A Dairy and E-3-A Sanitary Standards is available from the IAMFES Office. These standards detail the design, materials and fabrication of dairy and egg processing equipment to assure proper cleanability and sanitation.

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Procedures to Implement the Hazard Analysis Critical Control Point System (72 pp.)

This manual was developed for use by food safety/regulatory officials and food industry personnel charged with assuring food safety. The HACCP system is designed to ensure food safety by reducing the likelihood of foodborne illness. It accomplishes this goal by identifying the hazards and assessing the risks of contamination associated with food products as they pass through the phases from production to consumption.

The manual provides step-by-step instructions to develop, implement and refine the HACCP system in the food processing and foodservice sectors. These procedures include:

- Assignment of Responsibilities
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- Measurement of pH Level of Foods
- Collection of Samples
- Analyses of Measurements
- Determination of Critical Control Points
- Monitoring and Recording of Data at Critical Control Points
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- Measurement of Time-Temperature Exposures
- Testing of Samples for Pathogens
- Measurement of Water Activity (a_w)
- Flow Diagrams of Food Production Process
- Establishment of Control Criteria
- Verification of HACCP System's Effectiveness

The Procedures to Implement the Hazard Analysis Critical Control Point System manual is available exclusively from the International Association of Milk, Food and Environmental Sanitarians. To order, Contact IAMFES at 800-369-6337 (U.S.) or 800-284-6336 (Canada).

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Coming Events

1992

November

•**5, Food Industry Sanitation and Food Safety Workshop**, presented by the University of California Cooperative Extension, will be held at the Anaheim Plaza Resort Hotel, 1700 S. Harbor Blvd., Anaheim, CA. For more information contact Heidi Fisher, Food Science and Technology, University of California, Davis, CA 95616; (916)752-1478.

•**8-12, PACK EXPO 92, The World of Packaging Technology**, sponsored by Packaging Machinery Manufacturers Institute (PMMI), will be held at the McCormick Place, Chicago, IL. For more information contact Bonnie E. Kilduff, Exposition Manager, PMMI at (202)347-3838 or FAX (202)628-2471.

•**9-11, Quality Control and Stability Testing** will be held at Tragon Corporation, 365 Convention Way, Redwood City, CA 94063, (415)365-1833; FAX (415)365-3737.

•**9-13, Cookies and Crackers for Allied and Associated Personnel**, sponsored by the American Institute of Baking, Manhattan, KS. For more information contact AIB, 1213 Bakers Way, Manhattan, KS 66502, (913)537-4750, (800)633-5137, or FAX (913)537-1493.

•**12-13, Nondestructive Testing of Food Packages for Microbial Integrity**, presented by the Food Processors Institute to be held at the Chicago Hilton & Towers Hotel, Chicago, IL. For more information contact The Food Processors Institute, 1401 New York Avenue, NW, Suite 400, Washington, DC 20005.

•**10-13, Industrial Refrigeration Workshop** to be held at the University of California-Davis, Davis, CA. For more information or to enroll, call (800)752-0881. From outside California, call (916)757-8777.

•**16-17, Meeting the New Food Labeling Requirements Workshop**, sponsored by the Food Processors Institute, will be held at the Grand Hyatt Hotel, Washington, DC. For more information contact FPI, 1401 New York Avenue, NW, Suite 400, Washington, DC 20005; (202)393-0890.

December

•**1-2, ISO-9000 — The Impact on the Food Industry Seminar**, sponsored by the American Institute of Baking, will be held at the Embassy Suites, Airport O'Hare, Chicago, IL. Tuition fees are \$575 per participant. For further information write to the Registrar, American Institute of Baking, 1213 Bakers Way, Manhattan, Kansas 66502 or call (913)537-4750 or (800)633-5137.

•**7-9, Introduction to Food Processing Systems** to be held at the University of California-Davis, Davis, CA. For more information or to enroll, call (800)752-0881. From outside California, call (916)757-8777.

•**7-10, Better Process Control School** to be held at the University of California-Davis, Davis, CA. For more infor-

mation or to enroll, call (800)752-0881. From outside California, call (916)757-8777.

1993

January

•**4-8, 44th Annual Ice Cream Manufacturing Short Course** will be offered by the Department of Food Science, Cook College, Rutgers University. For more information contact the Offices of Short Courses and Conferences, Cook College, Rutgers University, P. O. Box 231, New Brunswick, NJ 08903, Telephone (908)932-9271.

•**13-15, FoodPack of the Americas '93 Exposition and Conference** to be held at the Coconut Grove Convention Center, Miami, FL. For more information contact FoodPack of the Americas, Inc., 200 N. Glebe Road, Suite 900, Arlington, VA 22203-3787; Telephone (703)527-3663; FAX (703)527-7750.

•**21, Surfactants in Foods (previously Emulsifiers in Foods)**, offered by the American Association of Cereal Chemists, will be held in Kansas City, MO. For more information, contact Marie McHenry, AACC Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097, USA. Telephone (612)454-7250; FAX (612)454-0766.

February

•**3-4, Food Processors Sanitation Workshop**, presented by the University of California Cooperative Extension, to be held at the Holiday Inn - Mission de Oro, Santa Nella, CA. For more information contact Heidi Fisher, Food Science and Technology, University of California, Davis, CA 95616, (916)752-1478.

•**15-18, Freezing Technology Short Course** to be held at the University of California-Davis, Davis, CA. For more information or to enroll, call (800)752-0881. From outside California, call (916)757-8777.

•**22-23, Dairy and Food Industry Conference; Focus on Food Ingredients** to be held at Ohio State University, Columbus, OH. For more information contact Dr. Ken Lee, Department of Food Science and Technology, 2121 Fyffe Road, Ohio State University, Columbus, OH 43210-1097 or call (614)292-6281; FAX (614)292-0218.

•**26, BISSC Annual Membership Meeting** will be held at the Chicago Marriott Hotel, Chicago, IL. For more information, contact the BISSC headquarters at 401 North Michigan Avenue, Chicago, IL 60611; (312)644-6610.

March

•**5-9, Statistical Quality Control** to be held at the University of California-Davis, Davis, CA. For more information or to enroll, call (800)752-0881. From outside California, call (916)757-8777.

•15-17, Food Product Development/Ingredient Technology to be held at the University of California-Davis, Davis, CA. For more information or to enroll, call (800)752-0881. From outside California, call (916)757-8777.

•15-18, Better Process Control School to be held at the University of California-Davis, Davis, CA. For more information or to enroll, call (800)752-0881. From outside California, call (916)757-8777.

•18-19, Florida Association of Milk, Food and Environmental Sanitarians Annual Meeting in conjunction with Suppliers Night at the Marriott on International Drive. For more information, please contact Bill Thornhill, 3023 Lake Alfred Road, Winter Haven, FL 33881, (813)299-6555.

•22-24, Introduction to Statistical Methods for Sensory Evaluation of Foods to be held at the University of California-Davis, Davis, CA. For more information or to enroll, call (800)752-0881. From outside California, call (916)757-8777.

•22-26, Midwest Workshop on Milk, Food and Environmental Sanitation to be held at Ohio State University, Columbus, OH. For more information contact Dr. Matrid Ndfie, Department of Food Science and Technology, 2121 Fyffe Road, Ohio State University, Columbus, OH 43210-1097 or call (614)292-3069; FAX (614)292-0218.

•22-26, Molds and Mycotoxins in Foods, offered by the American Association of Cereal Chemists, will be held in Lincoln, NE. For more information, contact Marie McHenry, AACC Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097, USA. Telephone (612)454-7250; FAX (612)454-0766.

•23-25, Food Extrusion, offered by the American Association of Cereal Chemists, will be held in Kansas City, MO. For more information, contact Marie McHenry, AACC Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097, USA. Telephone (612)454-7250; FAX (612)454-0766.

•26-28, Sensory Evaluation: Overview and Update to be held at the University of California-Davis, Davis, CA. For more information or to enroll, call (800)752-0881. From outside California, call (916)757-8777.

April

•20-22, NIR Spectroscopy, offered by the American Association of Cereal Chemists, will be held in Chicago, IL. For more information, contact Marie McHenry, AACC Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097, USA. Telephone (612)454-7250; FAX (612)454-0766.

May

•6-12, INTERPACK 93, 13th International Trade Fair for Packaging Machinery, Packaging Materials and Confectionery Machinery, will be held at the fairgrounds in Dusseldorf, Germany. For further information on exhibiting at or attending INTERPACK 93, contact Dusseldorf Trade Shows, Inc., 150 North Michigan Avenue, Suite 2920, Chicago, IL 60601, (312)781-5180; FAX (312)781-5188.

June

•15-17, Low Calorie Food Product Development (with IFT & CFDR), offered by the American Association of Cereal Chemists, will be held in Chipping, Campden, England. For more information, contact Marie McHenry, AACC Short Course Coordinator, 3340 Pilot Knob Road, St. Paul, MN 55121-2097, USA. Telephone (612)454-7250; FAX (612)454-0766.

August

•1-4, 80th Annual Meeting of the International Association of Milk, Food and Environmental Sanitarians, Inc. to be held at the Waverly Stouffer Hotel, Atlanta, GA. For more information please contact Julie Heim at (800)369-6337 (US) or (800)284-6336 (Canada).

To insure that your meeting time is published, send announcements at least 90 days in advance to: IAMFES, 200W Merle Hay Centre, 6200 Aurora Avenue, Des Moines, IA 50322.

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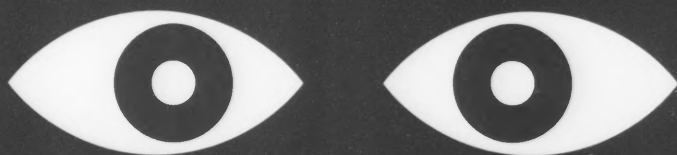
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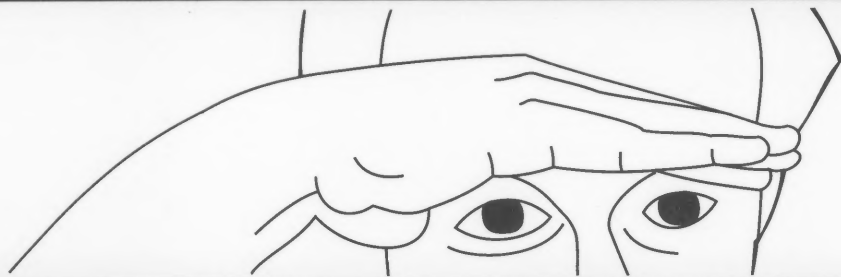
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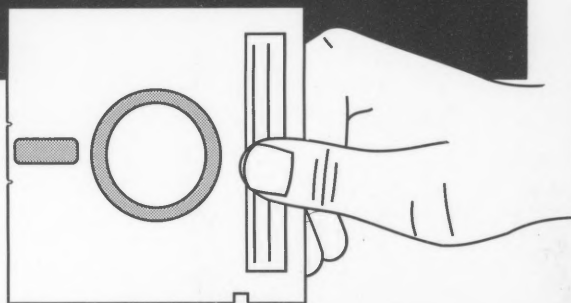
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