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FOOD PROTECTION TRENDS

SCIENCE AND NEWS

FROM THE
INTERNATIONAL ASSOCIATION
FOR FOOD PROTECTION

APRIL 2005



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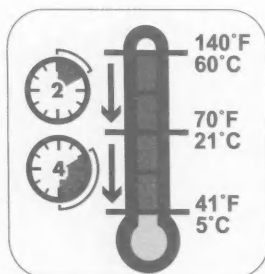
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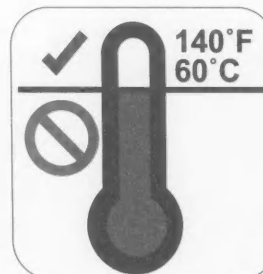
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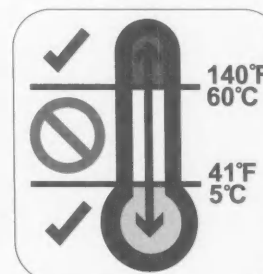
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"The mission of the Association is to provide food safety professionals worldwide with a forum to exchange information on protecting the food supply."



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"A VIEW FROM WISCONSIN"

For those of you who do not know my background, I was a high school biology teacher for four years before I became a university researcher. I have to admit that even though I changed careers, there will always be a "teacher" in me. As a research scientist at UW-Madison, I train laboratory workers, supervise independent study undergraduate students, and guest lecture in food safety or HACCP workshops and classes. As a volunteer, I have the opportunity to teach basic food safety principles and hand-washing in local elementary and middle school science programs. It gives me great satisfaction to assist in the education of individuals, whether they are children or adults. Given my academic background, it is no wonder that the Outreach and Education theme of the IAFP Strategic Plan is an area to which I feel particularly committed.

The Executive Board has agreed to move forward in the area of Outreach and Education on several fronts. As a leader in food safety, IAFP is developing a procedure to host "rapid response" conferences when significant food safety issues arise, such as would have been appropriate when the first BSE cases were detected in North American cattle. In order to be able to react quickly to critical events, the Board will appoint a special committee to be alert to developing food safety concerns. This committee will be charged with identifying and mobilizing a team of researchers, regulators, and concerned industry members to come together to address the problem, discuss the state of the knowledge base, and develop a coordinated, scientific response. The



By **KATHLEEN A. GLASS**
PRESIDENT

***"While we might
not all be teachers,
we are all stakeholders
in the education
of our students
and colleagues"***

IAFP staff will assist by identifying suitable meeting venues and developing procedures to handle meeting promotion and registration. By developing this rapid response approach for food safety meetings, we will be able to promptly address crucial issues as they arise rather than wait for "hot-topic" symposia at our annual meeting.

We also recognize that our future successes depend on well-trained students and young profes-

sionals. Therefore, the next two objectives under our Outreach and Education theme revolve around developing our student membership base. As I reported in February, IAFP and the Foundation Fund have initiated a Travel Scholarship Program to support students to attend the IAFP Annual Meeting. Our student members responded enthusiastically to the program announcement, with many worthy applications received by the March 15 deadline. The selection committee will have a difficult choice selecting the two recipients for this year's award from among all those who demonstrate potential to contribute to the field of food safety. As the Foundation Fund grows, we plan to accordingly increase the number of travel grants to assist more students and young professionals, especially from developing countries where resources are particularly limited. Your financial contributions to this program through the IAFP Foundation Fund will be instrumental in ensuring we are able to provide opportunities for students and young researchers to develop essential professional skills.

Another action item is to expand our Executive Board Speaker Program, previously limited to affiliate meetings, to provide a resource to universities. Through this program, faculty will be able to invite Executive Board members to deliver guest lectures to food science or food microbiology classes, seminars, or clubs. The purpose of the expansion to universities is two-fold. First, this program will expose undergraduate and graduate students studying in our field to professionals with experience in the field of food safety. Secondly, it will increase the visibil-

ity of IAFP, and the value of membership, among food science faculty and students, and will encourage their participation in our Association. In the initial stages of this program, we will limit requests for speakers to the first 4-6 requests for a calendar year. Ideally, we would like to coordinate board member travel to affiliate meetings with visits to nearby universities. This could be a great opportunity for faculty to be-

come more engaged with their local affiliate and foster a cooperative relationship between the two entities. You can see photos from the first presentation to Texas A&M students on page 241. If your university is interested in the Speaker Program for this fall, contact Lucia McPhedran at the IAFP office for more details.

While we might not all be teachers, we are all stakeholders in the education of our students and col-

leagues. We all can contribute to that education in some way, whether it is in the form of financial support for travel funds or mentoring a student from a local university. I encourage you to volunteer your time and talents to help fulfill our mission.

As always, I welcome your comments and questions. Please feel free to email me at kglass@wisc.edu and let me know your view.



Golf Tournament

Waverly Woods Golf Club
Saturday, August 13
8:45 a.m. - 4:00 p.m.

Orioles Baseball Game

Saturday, August 13
3:30 p.m. - 7:30 p.m.

Welcome to Washington Tour

Saturday, August 13
9:00 a.m. - 5:00 p.m.

Visit the Web site at www.foodprotection.org to sign up.

“COMMENTARY” FROM THE EXECUTIVE DIRECTOR

There are two topics that I want to review with you this month and both have a direct impact on the IAFP Annual Meeting. First, I will cover the topic of recording symposia and technical sessions during the Annual Meeting. And secondly, I want to review a meeting that was held to inspire growth in the IAFP Foundation Fund.

Over the years, there has been a lot of interest in IAFP recording sessions at the Annual Meeting. We even surveyed attendees at IAFP 2004 to find their interest in obtaining such recordings and asked whether attendees would be interested if the recordings were provided free (to attendees) or at a cost. We found that there was substantial interest in this endeavor. Unfortunately we also found that there was a lot of concern about recording sessions limiting the candid discussions that take place at IAFP symposia and technical sessions. Therefore, the IAFP Executive Board decided that at the present time, we will not record sessions at the IAFP Annual Meeting.

The undertaking of recording sessions at the IAFP Annual Meeting would be a huge project in itself and one that would stretch both our staff and symposia convenors. This aside, the IAFP Executive Board, acting on the advice received from our Program Committee made a decision that we would not record sessions at IAFP Annual Meetings. The main consideration in arriving at this decision was that it was felt that the presenters would be limited in their ability to deliver their presentation openly and frankly. In some cases it was even felt that the



By **DAVID W. THARP, CAE**
EXECUTIVE DIRECTOR

“As this year progresses, watch for further information about how you can help the Foundation grow to meet its goal of \$1 million by 2010.”

presenter may have to “read from a script” rather than delivering their presentation “from memory” or talking with the audience.

In addition to limiting the presenter, it was felt that questions from audience members may be restricted knowing that the audience member was being recorded. The Program Committee and the Executive Board discussed this topic at length during their meeting in late January. They could see the potential advantages to providing recordings, but they saw the factor of limiting open and honest discussion as an overriding factor.

The Board did agree to look at this situation down the road. It is just that the sessions will not be recorded this year (2005) and most likely in 2006. After that, we will take another look to see if the situation has changed.

Now let's review the Foundation Fund meeting report. Last October, the Foundation Fund Committee met via teleconference. Many topics were discussed, but one in particular was to establish a sub-committee to work towards developing a DVD presentation and supporting print materials. Due to the generosity of Frank Yiannas and Walt Disney World, the sub-committee met at the end of February at Disney World. Frank provided a communications professional and a production company professional to assist the sub-committee in their developmental process.

Progress was made in refining the mission statement for the IAFP Foundation and in developing an overall “marketing plan” for the Foundation. The group spent many hours discussing who the target audience will be, how to best present the Foundation's message and on a developmental timeline. The biggest hurdle to producing this DVD is that relevant video footage needs to be generated and the best place to do this is at an IAFP Annual Meeting. This pushed our timeline for completing the DVD project to after IAFP 2005.

Even at that, there was a great deal of enthusiasm for the project. Once the DVD project is completed, a marketing effort will take place to generate interest in providing support to the IAFP Foundation. Foundation Fund Committee Members

will make personal visits to potential contributing companies to solicit donations. Contribution requests will continue to be made to IAFP Members who have provided a great deal of support over the years.

We want to thank Gale Prince, Paul Hall, Susan Sumner, Stan Bailey and Frank Yiannas for taking time from their schedules to meet on this extremely meaningful project. We view this as a long-term endeavor

and one that we have just begun to fabricate the building blocks. As this year progresses, watch for further information about how you can help the Foundation grow to meet its goal of \$1 million by 2010. With your help, it can be done!

IAFP University Speaker Program

Disney Food Safety Leader Speaks to Large Crowd at Texas A&M University



Frank Yiannas, Vice President of IAFP and Director of Safety and Health at Walt Disney World, gave a seminar presentation entitled "Food Safety is Magical, But It Doesn't Magically Happen" to a capacity crowd of 100+ Texas A&M University students and faculty at the Kleberg Animal and Food Sciences Center in College Station, Texas. Frank was introduced by Gary Acuff, Professor and Interim Head for the Department of Animal Science and current IAFP Secretary. The program was co-sponsored by the Texas A&M University Intercollegiate Faculty of Food Science. Texas A&M

University has an Intercollegiate Graduate Program in Food Science with collaborating faculty from multiple colleges and departments. Food safety programs weave throughout the program, so there was great interest in Frank's presentation. Frank answered numerous questions from the crowd and stayed long after the seminar was over answering additional questions. It was a great success and a fine kick-off to the IAFP University Speaker Program.



On March 4, Frank Yiannas kicked off the IAFP University Speaker Program.



Contact the IAFP office for program details.

Prevalence Studies on *Escherichia coli* O157:H7, *Salmonella* spp. and Indicator Bacteria in Raw Ground Beef Produced at Federally Registered Establishments in Canada

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SUMMARY

A study was carried out to examine the microbiological quality of raw ground beef produced at 52 Canadian federally registered establishments. Raw ground beef samples were analyzed for total aerobic counts (TAC), total generic *E. coli* counts (EC), *E. coli* O157 and *Salmonella*. Overall, a total of 1,396 samples of raw ground beef were taken from three categories of establishments with significantly different production volumes: large, medium and small. Mean \log_{10} TAC counts/g ranged from 3.0 to 6.4, while mean \log_{10} generic *E. coli* counts/100g ranged from 2.7 to 3.5. No significant difference was demonstrated with regard to mean \log_{10} generic *E. coli* counts between different sizes of establishments, although significant differences were noted for mean \log_{10} TAC counts between small and large or medium-size establishments. A seasonal variation was noticed during the months of June and August for mean \log_{10} TAC counts; however, no obvious seasonal variation was observed for mean \log_{10} *E. coli* counts. In total, for large, medium and small-size establishments, 0.74, 2.1 and 0.25% of samples, respectively, were positive for *E. coli* O157, while 0.87, 1.06 and 0.5% of samples, respectively, were positive for *Salmonella* spp.

A peer-reviewed article

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INTRODUCTION

Foodborne disease of microbiological origin presents a significant health risk for Canadians. It is estimated that more than one million illnesses, with about 30 deaths, occur each year in Canada (7). Although most of these illnesses are acute, they can be life-threatening, especially for the young, old and immunocompromised. A number of the cases in which source has been determined can be traced to contaminated meat and poultry. The microbial pathogens found in meat and poultry that have the greatest impact on human health are *Campylobacter*, *Salmonella* and verotoxigenic *Escherichia coli* (VTEC). These pathogens are frequently found in the feces of animals. Raw meat and raw poultry can be contaminated directly, through contact with feces, or indirectly, through the handling and processing practices of workers and equipment at the slaughterhouse, processing and retail levels.

Countries such as Ireland, the United Kingdom, the United States and Australia have also tested beef carcasses and/or beef products for either total aerobic counts (TAC), generic *E. coli* counts, *E. coli* O157 and/or *Salmonella* (1, 4, 5, 6, 8). In addition, a study carried out by Gill and McGinnis (3) assessed the total bacterial count, coliform and *E. coli* count in beef trimmings collected at the slaughter plant at processing and ground beef at retail. In light of these studies, it seemed important to conduct a survey of federally registered establishments in Canada in order to assess the microbial quality of raw ground beef produced for human consumption. The objectives of this study were to assess the prevalence and distribution of certain foodborne pathogens and indicator organisms in raw ground beef produced in Canadian federally registered slaughter establishments. Total aerobic counts (TAC) and total generic *E. coli* counts (EC) were determined for most of the samples. Samples were also screened for *E. coli* O157 and *Salmonella*.

MATERIALS AND METHODS

Sample collection

Each sample consisted of one unit (700 g) of ground beef. The sample collection schedule put into place by the inspection staff specified that samples were to be taken only on Mondays and Tuesdays, that samples were to be collected immediately after the first grinding and that they were to be shipped to the closest CFIA

laboratory for analysis. For the first grind of the day, the inspector selected the combination of beef trim to be ground, and, following the grind, took at least 140-g of ground beef from five different locations in the lot and combined them into one 700-g sample. For this study, a "lot" was defined as any ground beef produced between one cleanup and sanitation and the next cleanup and sanitation. Establishments were divided into three categories: large, medium and small. Large establishments had ground beef production volumes $> 5 \times 10^6$ kg per week, while medium and small establishments had production volumes of 0.5 to 4.9×10^6 kg and 5 to 499×10^3 kg per week, respectively. Large establishments were sampled twice per week, medium establishments twice per month and small establishments once a month. The geographical location of the various plants is shown in Table 1. This project lasted for one year, from March 2001 to February 2002.

Sample procedures

The samples were collected by use of aseptic techniques and procedures utilizing sterile gloves and sterile packaging bags. All samples were shipped refrigerated; temperatures did not exceed 10°C upon arrival at the laboratory. Industry detained all ground beef from any sampled lot, pending the laboratory results for *E. coli* O157. The samples collected were sent to the laboratory of destination by overnight courier with a guaranteed morning delivery. The testing began as soon as the sample was received at the laboratory. The CFIA laboratory communicated negative results to the inspector in charge within 24 h.

Laboratory procedures

The following tests were performed on each sample: Total Aerobic Counts (TAC; MFHPB-33) (11), generic *E. coli* counts (EC; MFHPB-34) (11), *Salmonella* spp. (MFHPB-20) (2) and *E. coli* O157 (MFLP-87) (11). The labs used the recommended sample size for MFHPB-33 and MFHPB-34. For MFHPB-20 and MFLP-87, a sample size of 125 g was used for each test.

RESULTS AND DISCUSSION

Overall, a total of 1,370 samples of raw ground beef were taken from Canadian federally registered establish-

ments in order to estimate the prevalence and distribution of certain foodborne pathogens such as *E. coli* O157 and *Salmonella*, in addition to indicator organisms such as those included in total aerobic counts (TAC) and total generic *E. coli* counts (EC) (Table 1).

The microbiological status of ground beef produced at federally registered slaughter establishments is summarized in Table 1. Nationwide, mean \log_{10} TAC counts/g ranged from 3.0 to 6.4, while mean \log_{10} generic *E. coli* counts/100g ranged from 2.7 to 3.5.

In large-size establishments, mean \log_{10} TAC counts/g were from 3.0 to 4.6 (both in Ontario), while mean \log_{10} *E. coli* counts/100g were 2.8 in Alberta and 3.1 in Ontario and British Columbia (Table 1). In medium-size establishments, mean \log_{10} TAC counts/g ranged from 3.7 in Alberta to 5.8 in Quebec, while mean \log_{10} *E. coli* counts/100g ranged from 2.9 to 3.5, both in Quebec (Table 1). Although the average number of samples collected at each establishment dropped from 90 in large to 21 in medium to 11 in small, the range in mean counts was greatest in small establishments. Mean \log_{10} TAC counts/g ranged from 3.2 in British Columbia to 6.4 in Quebec, while mean \log_{10} *E. coli* counts/100g varied between 2.7 and 3.5 (Table 1).

The mean \log_{10} TAC counts/g and mean \log_{10} *E. coli* counts/100g for each month were determined by using the data collected nationwide (Table 2). The highest TAC, observed in June and August, were significantly different ($P < 0.01$) from the lowest counts, which were obtained from December to March (Table 2). In contrast, the seasonal variation in mean \log_{10} *E. coli* counts was less marked, although *E. coli* levels were highest in March and lowest in January and February.

The range in individual TAC and *E. coli* counts was narrowest in large establishments. The \log_{10} TAC counts/g ranged from 2.5 (est. A) to 5.5 (est. G), whereas \log_{10} generic *E. coli* counts/100g ranged from 2.7 (est. A-D) to 4.0 (est. A). The 806 samples of raw ground beef taken from large-size establishments across Canada represents approximately 58% of the total samples taken. Four (0.5%) samples taken from the same establishment in the summer months had a \log_{10} TAC count/g of 5.0 or greater, while three (0.4%) samples taken in the spring at the same establishment had \log_{10} *E. coli* counts/100g of 4.0 or greater. Six samples tested positive for *E. coli* O157 during this one-year study, either in June (est. B),

TABLE 1. Mean total aerobic counts (TAC) and mean generic *E. coli* counts (EC) in raw ground beef produced in federally registered establishments in Canada

Size of Est.	Province	n	Mean log ₁₀ TAC ^a count/g	SD ^b	n	Mean log ₁₀ <i>E. coli</i> count/100g	SD ^b
Large A	Ontario	94	4.6	1.3	94	3.1	0.4
	B Ontario	94	3.7	0.6	94	3.1	0.3
	C Ontario	91	3.6	0.8	91	3.1	0.4
	D Ontario	89	3.6	1	89	3.1	0.3
	E Alberta	77	3.5	0.4	77	2.9	0.3
	F Alberta	90	3.3	0.4	90	2.9	0.4
	G Alberta	90	3.3	0.2	91	2.8	0.3
	H British Columbia	89	3.2	1	89	3.1	0.6
	I Ontario	92	3	0.8	92	3	0.2
Medium A	Quebec	19	5.8	0.8	19	3.5	0.8
	B Quebec	19	4.9	1.2	19	2.9	0.4
	C Ontario	24	4.6	1.1	24	3.2	0.4
	D British Columbia	20	4.6	0.9	20	3.3	0.8
	E Quebec	20	4.2	1.3	20	3	0.5
	F Alberta	24	4.1	1	24	3	0.6
	G New Brunswick	23	4.1	1.2	23	3	0.6
	H Ontario	16	3.8	1.3	16	3.1	0.5
	I Alberta	23	3.7	0.6	23	3.4	0.9
Small (Western) A	Alberta	12	5.8	0.9	12	2.8	0.3
	B Alberta	11	5.6	1.3	11	2.8	0.3
	C Sask. & Manitoba	12	5.1	1.3	12	3.1	0.6
	D Alberta	12	4.9	1.2	12	2.7	0.1
	E Alberta	12	4.4	1.4	11	2.7	0.1
	F Sask. & Manitoba	12	4.3	0.8	12	2.7	0.1
	G Sask. & Manitoba	10	4.3	0.8	10	2.8	0.2
	H Alberta	12	4.2	0.9	12	2.9	0.4
	I British Columbia	11	3.8	1.2	11	3.3	0.8
	J Alberta	12	3.7	0.5	12	2.7	0
	K Sask. & Manitoba	12	3.7	0.4	12	3	0.5
	L British Columbia	11	3.6	0.5	11	3	0.5
	M Alberta	12	3.3	0.2	12	2.8	0.3
	N British Columbia	11	3.2	0.7	11	3.2	0.7
Small (Central) A	Quebec	11	6.4	0.6	11	2.7	1.1
	B Ontario	12	6	0.5	12	3.3	0.9
	C Quebec	10	5.9	0.5	10	3.3	0.7
	D Quebec	11	5.8	0.8	11	3.5	1.3
	E Quebec	9	5.2	1	9	3	0.6
	F Quebec	11	5.2	0.9	11	2.8	0.2
	G Quebec	10	4.8	0.7	10	2.7	0
	H Ontario	11	4.4	1.2	11	3.5	0.6
	I Quebec	9	4.4	0.5	9	2.7	0
	J Quebec	9	4.3	1.3	9	2.8	0.4

TABLE 1. (continued) Mean total aerobic counts (TAC) and mean generic *E. coli* counts (EC) in raw ground beef produced in federally registered establishments in Canada

Size of Est.	Province	n	Mean log ₁₀ TAC ^a count/g	SD ^b	n	Mean log ₁₀ <i>E. coli</i> count/100g	SD ^b
K	Ontario	10	4	0.9	10	3.2	0.4
L	Ontario	11	3.9	0.7	11	3.1	0.2
M	Quebec	9	3.9	0.9	9	3	0.6
N	Quebec	10	3.9	0.8	10	2.8	0.2
O	Quebec	12	3.5	0.5	12	2.9	0.3
P	Quebec	11	3.4	0.4	11	2.7	0
Small (Eastern)	A Prince Edward Island	9	6.3	0.4	9	2.9	0.3
B	Nova Scotia	15	5.5	0.9	15	3.4	0.8
C	Nova Scotia	12	4.9	1.1	12	2.9	0.3
D	Newfoundland	12	3.9	0.7	12	3.1	0.4

^aTAC; Total aerobic counts

^bSD; Standard deviation

TABLE 2. Monthly mean log₁₀ TAC counts/g and mean log₁₀ *E. coli* counts/100g

Month	TAC		Month	<i>E. coli</i>	
	Mean log ₁₀ count/g	SD ^e		Mean log ₁₀ count/100g	SD ^e
August	4.2 ^a	1.2	March	3.1 ^a	0.5
June	4.2 ^{ab}	1.2	May	3.1 ^{ab}	0.5
September	4.0 ^{abc}	1.1	December	3.1 ^{ab}	0.6
May	4.0 ^{bcd}	1.2	April	3.1 ^{abc}	0.5
November	4.0 ^{bcd}	1.1	June	3.0 ^{abc}	0.5
July	3.9 ^{cd}	1.0	August	3.0 ^{abc}	0.4
October	3.9 ^{cd}	1.2	July	3.0 ^{abc}	0.4
April	3.9 ^{cd}	1.1	November	3.0 ^{abc}	0.4
December	3.8 ^{cd}	1.0	October	3.0 ^{bc}	0.4
February	3.8 ^d	1.2	September	3.0 ^c	0.4
January	3.7 ^d	1.1	January	2.9 ^c	0.4
March	3.7 ^d	1.0	February	2.9 ^c	0.4

^{a,b,c,d}Means with the same letter are not significantly different ($P > 0.01$)

^eSD; Standard deviation of mean log₁₀ count

FIGURE 1. Scatter plot representing the monthly prevalence of total aerobic bacteria per gram of ground beef in each medium-size establishment.

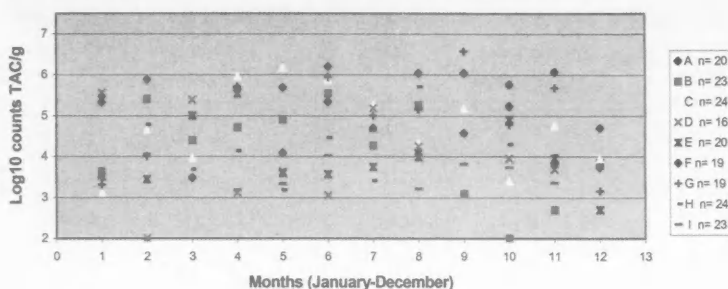


FIGURE 2. Scatter plot representing the monthly prevalence of generic *E. coli* bacteria per 100 grams of ground beef in each medium-size establishment. *E. coli* O157:H7 positive samples were obtained in August (C), October (C), May (E) and July (H). *Salmonella* spp. positive samples were observed in March (B) and July (C).

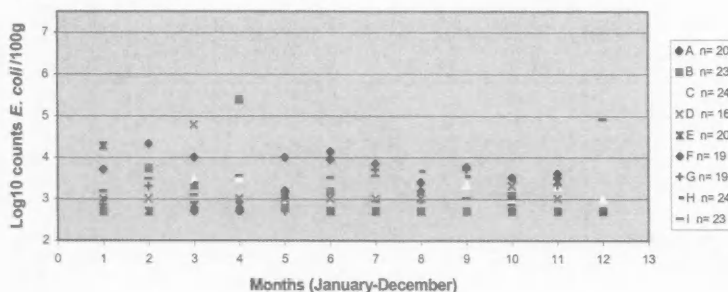


FIGURE 3. Scatter plot representing the monthly prevalence of total aerobic bacteria per gram of ground beef in each small-size establishment in Western Canada.

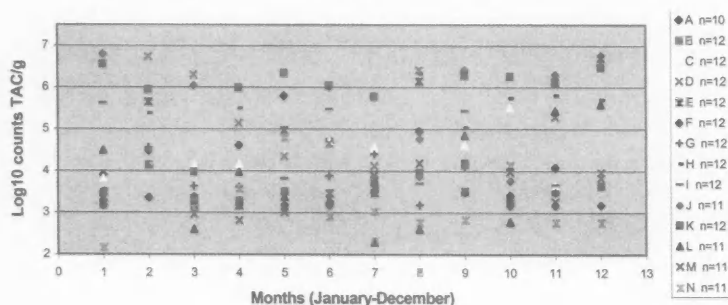
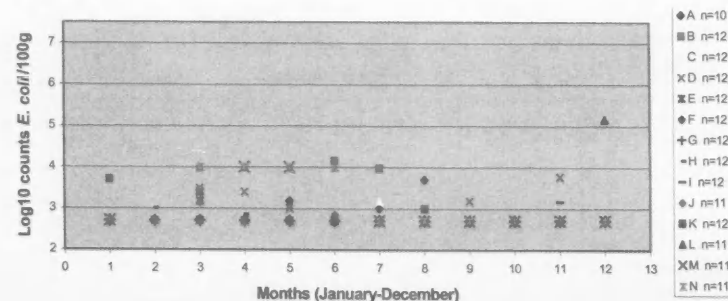


FIGURE 4. Scatter plot representing the monthly prevalence of generic *E. coli* bacteria per 100 grams of ground beef in each small-size establishment in Western Canada.



March and August (est. C), April (est. D and H), November (est. G), or while seven samples tested positive for *Salmonella* spp., either in August (est. B), September (est. D), May (est. F), June (est. G), July (est. G), May or August (est. I).

For medium-size establishments, the \log_{10} TAC counts/g ranged from 2.0 (est. B) to 6.6 (est. G) (Fig. 1), whereas the \log_{10} generic *E. coli* counts/100g ranged from 2.7 (est. A, B, E-I) to 5.4 (est. B) (Fig. 2). The 188 samples of raw ground beef taken from medium-size slaughter establishments across Canada represented approximately 13% of the total samples taken. Thirty (16%) samples had \log_{10} TAC counts/g of 5.0 or greater, and 8 (4.2%) had \log_{10} *E. coli* counts/100g of 4.0 or greater. Four samples taken from the medium-size establishments tested positive for *E. coli* O157 during the one-year study, either in August and October (est. C), May (est. E) or July (est. H). In addition, two samples tested positive for *Salmonella* spp., either in March (est. B) or July (est. C) (Table 3).

To better present and make comparisons in the large amount of information obtained from small-size establishments, they were separated into three geographic regions: Western, Central and Eastern Canada. The 379 samples of raw ground beef taken from small-size slaughter establishments across Canada represented approximately 29% of the total samples taken. When the data obtained from small-size establishments in Western Canada were evaluated, the \log_{10} TAC counts/g ranged from 2.2 (est. N) to 6.8 (est. J) (Fig. 3), whereas the \log_{10} generic *E. coli* counts/100g ranged from 2.7 (est. A-N) to 5.1 (est. L) (Fig. 4). Thirty-eight of 163 samples (23%) had \log_{10} TAC counts/g of 5.0 or greater, while 10 of 161 samples (6.2%) had \log_{10} *E. coli* counts/100g of 4.0 or greater. No positive samples were detected for *E. coli* O157 or *Salmonella* spp. In Central Canada, the \log_{10} TAC counts/g ranged from 2.7 (est. C, K) to 7.0 (est. J) (Fig. 5), whereas the mean \log_{10} generic *E. coli* counts/100g ranged from 2.7 (est. A-P) to 6.0 (est. A) (Fig. 6). Fifty-three of 168 samples (32%) had \log_{10} TAC counts/g of 5.0 or greater and 11 of 168 (6.5%) had mean \log_{10} *E. coli* counts/100g of 4.0 or greater. One sample tested positive for *E. coli* O157 (November; est. D) and two samples tested positive for *Salmonella* spp., one in November (est. K) and one in September (est. N). Lastly, in Eastern Canada, the mean \log_{10} TAC counts/g ranged from 2.5 (est. B) to 6.9 (est. D) (Fig. 7), whereas the mean \log_{10} generic *E. coli* counts/100g ranged from 2.7 (est.

TABLE 3. Mean log₁₀ aerobic counts (TAC) and generic *E. coli* counts (EC) in raw ground beef found to contain *E. coli* O157:H7 or *Salmonella* spp.

Size of Est.	Est.	Date	TAC ^a mean log ₁₀ count	<i>E. coli</i> mean log ₁₀ count	Pathogen detected
Large	D	April	3.3	0.7	<i>E. coli</i> O157
	D	September	3.2	0.7	<i>Salmonella</i>
	C	March	3.2	1.0	<i>E. coli</i> O157
	C	August	3.4	1.7	<i>E. coli</i> O157
	H	April	3.4	1.0	<i>E. coli</i> O157
	G	June	5.6	1.4	<i>Salmonella</i>
	G	July	3.3	1.0	<i>Salmonella</i>
	G	November	4.1	1.0	<i>E. coli</i> O157
	I	May	3.3	1.0	<i>Salmonella</i>
	I	August	4.1	1.0	<i>Salmonella</i>
	B	June	3.2	0.7	<i>E. coli</i> O157
	B	August	3.2	0.7	<i>Salmonella</i>
	F	May	4.1	1.0	<i>Salmonella</i>
	Medium	B	March	5.6	2.0
H		July	3.6	1.2	<i>E. coli</i> O157
C		July	5.3	1.0	<i>Salmonella</i>
C		August	3.8	1.0	<i>E. coli</i> O157
C		October	5.4	1.0	<i>E. coli</i> O157
E		May	4.5	1.5	<i>E. coli</i> O157
Small ^b	D	November	4.4	0.7	<i>E. coli</i> O157
	N	September	6.4	4.0	<i>Salmonella</i>
	K	November	4.9	0.7	<i>Salmonella</i>
Average mean log ₁₀ CFU/g			5.3	2.7	
Standard deviation of mean log ₁₀ count			1.0	0.7	

^aTAC; Total aerobic counts

^bSmall; all establishments in Central Canada

A-D) to 5.8 (est. C) (Fig. 8). Twenty-one of 48 (44%) samples had log₁₀ TAC counts/g count of 5.0 or greater and 3 of 48 (6.2%) had log₁₀ *E. coli* counts/100g of 4.0 or greater. No samples were positive for *E. coli* O157 or *Salmonella* spp.

In total, 0.74, 2.1 and 0.25% of samples obtained from large, medium and small-size establishments, respectively, were positive for *E. coli* O157, while 0.87, 1.06 and 0.5% of samples, respectively, were positive for *Salmonella* spp.

Although a weak seasonal variation was noted for generic *E. coli*, no strong seasonal variation was noted for *E. coli* O157 in raw ground beef produced from federally registered establishments across Canada, as approximately 55% (6/11) of

positive samples were obtained between May and October (Table 3). Chapman et al. (1), however, demonstrated a seasonal variation for *E. coli* O157 obtained from meat samples collected between May and September. In contrast, a seasonal variation was noted for *Salmonella* spp. in raw ground beef samples taken throughout our one-year study, with 82% (9/11) of the positives occurring between May and September. McEvoy et al. (4) also found seasonal variation in that *Salmonella* was more frequently isolated from bovine carcasses from August to October. In the present study, none of the samples tested positive for either foodborne pathogen during the months of December, January or February.

Table 4 provides a summary of the mean log₁₀ TAC counts/g and mean log₁₀ *E. coli* counts /100g for establishments of different sizes, comparing all samples and specifically those found positive for *Salmonella* or *E. coli* O157:H7. It is clear that the larger establishments have better control over total aerobic counts, although this does not seem to be true for *E. coli* (Table 4). Although there is an indication that plants that test positive for a pathogen have higher total counts and higher *E. coli* counts in their ground beef, the number of positive samples was too low to allow any definitive conclusions to be drawn.

FIGURE 5. Scatter plot representing the monthly prevalence of total aerobic bacteria per gram of ground beef in each small-size establishment in Central Canada.

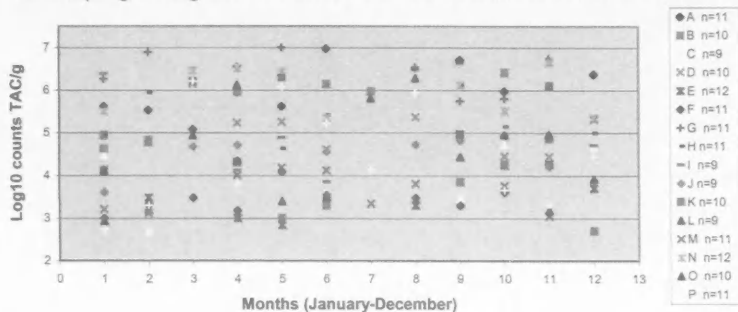


FIGURE 6. Scatter plot representing the monthly prevalence of generic *E. coli* bacteria per 100 grams of ground beef in each small-size establishment in Central Canada. *E. coli* O157:H7 positive samples were obtained in November (D). *Salmonella* spp. positive samples were observed in November (K) and September (N).

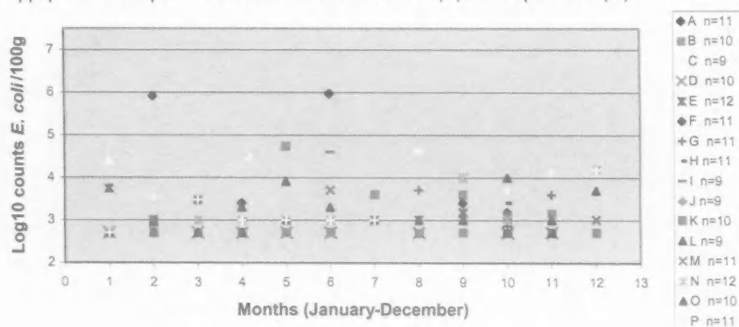


FIGURE 7. Scatter plot representing the monthly prevalence of total aerobic bacteria per gram of ground beef in each small-size establishment in Eastern Canada.

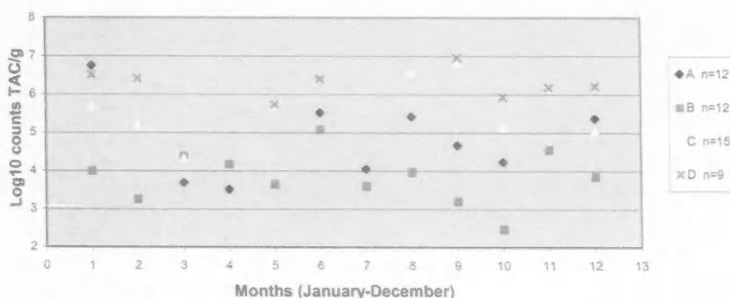
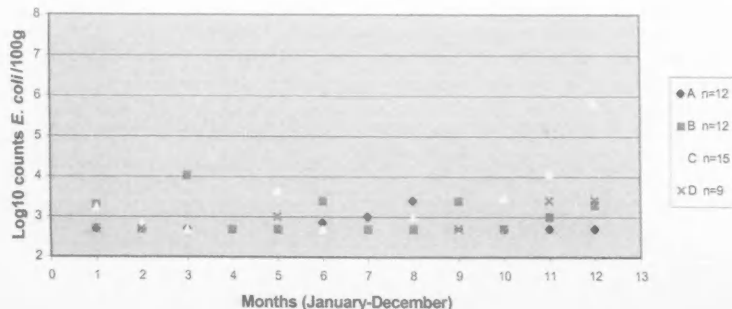


FIGURE 8. Scatter plot representing the monthly prevalence of generic *E. coli* bacteria per 100 grams of ground beef in each small-size establishment in Eastern Canada.



The present study shows that the microbial level of ground beef is better controlled in large than in small federally-registered plants. This may be due to better control over suppliers or to better sanitation in these establishments. However, even though these large plants may have better controls in place, this does not appear to reduce the risk of pathogen contamination, as 58% of the samples and 59% of the samples positive for pathogens were recovered from large plants, whereas 28% of the samples and only 14% of the positives came from small establishments. Further in-depth testing and analysis will be required to verify some of the apparent trends observed in the present study.

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TABLE 4. Summary of mean log₁₀ counts for different establishment sizes comparing all samples vs only samples found positive for *Salmonella* or *E. coli* O157:H7

Size of est.	Number of samples	TAC ^a mean log ₁₀ count/g	SD ^b	Number of samples	<i>E. coli</i> mean log ₁₀ count/100g	SD ^b
All samples from each size of establishment						
Large	806	3.5 ^c	0.9	807	3.0 ^c	0.4
Medium	188	4.4 ^c	1.2	188	3.1 ^c	0.6
Small West	163	4.3 ^c	1.2	161	2.9 ^c	0.04
Small Central	168	4.7 ^c	1.2	168	3.0 ^c	0.06
Small East	48	5.1 ^d	1.2	48	3.1 ^c	0.06
Only samples positive for <i>Salmonella</i> or <i>E. coli</i> O157:H7						
Large	13	3.6	1.0	13	3.1	0.3
Medium	6	4.7	0.8	6	3.3	0.4
Small	3	5.2	1.0	3	3.2	0.3

^aTAC: Total aerobic counts

^bSD: Standard deviation of mean log₁₀ count

^{c,d}Means with the same letter are not significantly different ($P > 0.01$)

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Knowledge, Attitudes and Behaviors Concerning “Mad Cow Disease” among Physicians in Lebanon

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SUMMARY

Our study group consisted of 142 physicians belonging to three hospitals in the Greater Beirut area: the American University of Beirut's Medical Center (A.U.B.-M.C.), the St. Georges Hospital and the Sacré Coeur Hospital. The objective of this study, which was conducted in 2002, was to assess in physicians in the Greater Beirut area in Lebanon, knowledge, attitude and behavioral changes related to “Mad Cow Disease” (MCD). A high percentage of practitioners knew the correct answers to questions related to the causative agent (98%), the concentration of agent in the central nervous system (96%), fatality (94%) associated with the disease, treatment (86%), similarity between nvCJD and BSE (82%) and existence of a diagnostic test (72%). However, less than one-fifth of the physicians answered correctly to questions on the possibility of transmission among humans by blood transfusions (10%), solution to skin contamination (9%), concentration of agent in all three systems concerned (5%) or solution surface contamination (3%). Age had no significant impact on the level of knowledge about MCD. Regarding sources of information about MCD, the press and radio were the most important private sources of information affecting the level of knowledge. Also, television (TV) had a negative impact on knowledge, whereas all formal channels positively affected it. The majority of our study group seemed not to be concerned about the disease. Fifty-seven percent did not consider themselves at risk of contracting MCD, and only 22% thought that the chance of contracting the disease through the intake of contaminated food products is high. Regarding behavioral changes, 79% had decreased or completely stopped their consumption of beef. Age, gender, level of knowledge and attitudes were not significant determinants in changing behavior, although they did affect it. The results provide information regarding knowledge, attitude and behavior of Greater Beirut physicians towards “Mad Cow Disease.” This is the first study in Lebanon that involves assessing knowledge and behavioral changes concerning MCD in physicians as perceived reliable sources of information.

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INTRODUCTION

After having been considered a problem exclusive to the United Kingdom, Bovine Spongiform Encephalopathy (BSE), or Mad Cow Disease (MCD), a fatal neurodegenerative disease in cows, has caused major worldwide fear in both the public and the scientific community now that many countries thought to be "BSE free" have found cases (13). In fact, while BSE cases in the United Kingdom have been declining since 1992, many other countries are now reporting cases (19). In attempts to control and eradicate this disease, many important agricultural sectors have been impaired and millions of cows slaughtered, leading to major economic loss (11). The economic impact on the global livestock industry has been affected further by people significantly reducing their beef intake.

This public and scientific reaction resulted from the discovery, in 1996, by scientists in the United Kingdom, of a possible link between BSE and a new variant of Creutzfeldt-Jakob Disease (nvCJD), a fatal neurodegenerative human disease (1). Ingestion of infected meat had, in many cases, led to the transmission of the disease to humans in the form of nvCJD (14). According to the Center for Disease Control, 156 cases of nvCJD had been reported worldwide as of February 2004 (7).

BSE belongs to a family of diseases known as transmissible spongiform encephalopathies (TSEs). These diseases, which cause vacuolations in the central nervous system (CNS) and are fatal, also include scrapie in sheep and goats, feline spongiform encephalopathy in cats, chronic wasting disease in elk and deer, transmissible mink encephalopathy and exotic ungulate encephalopathy. Five TSEs that have been identified in humans, are CJD, Gerstmann-Straussler-Scheinker Syndrome (GSS), fatal familial insomnia, Kuru, and atypical prion disease (12). Dr. Stanley B. Prusiner, the first to identify the "unusual" causative agent of these diseases in 1982, coined the term "Prion" (16) to denote small proteins void of nucleic acid. We all have cellular prion protein named, (PrP^c), but the infectious particle is a misfolded form of the normal protein (18) that consists of an abnormal, disease-causing form named (PrP^{sc}). It was originally thought that prion diseases such as scrapie did not jump species and thus did not affect humans (5). However, bovine PrP was found to be closer to the prion protein of humans than to that of

sheep, and the probability of transmission of PrP^{sc} to humans from cows is therefore higher than the probability of the original transmission that caused BSE from cows to sheep (6). Recently, results of studies on transgenic mice have also indicated the absence of an interspecies barrier to BSE infection (7, 8).

The BSE prion resulted from changes in cattle feed that occurred around 1980. At this time, cattle feed included as protein sources meat and bone meals (MBM) obtained from dead animals. However, the preparation of cattle feed at this time also involved the use of a hydrocarbon solvent extraction step. In the later 1980s, this step was discontinued because it was costly. Scientists believe that elimination of the solvent treatment led to an increase in the fat content of MBM and thus to the survival of BSE prion (2) and the appearance of nvCJD in humans (17). Scientists are also studying the relation between the presence of inhibitors of the proteasome, the cellular machinery responsible for the degradation of misfolded proteins, and the neurotoxicity of the prion protein causing MCD (15).

Today, prions remain a biological mystery that threatens the health of the world community. It is true that the risk of MCD transmission is being reduced in many ways (9) and that there are hopes for pre-clinical detection of the disease as opposed to a simple post-mortem diagnosis (10), but secondary transmissions by means such as blood transfusions or other routes are still a real concern (9).

Physicians have an important role to play in educating the public about the sources, transmission and prevention of all diseases. To fulfill this role, they must be knowledgeable themselves. The objectives of this study, conducted in 2002, included assessing knowledge, attitude and behavior (KAB) of physicians in Beirut, Lebanon toward mad cow disease, as well as the relationship of this KAB to demographic characteristics of physicians and to their sources of information.

MATERIALS AND METHODS

Study group

One hundred forty-two physicians from three hospitals were included in this survey. The hospitals, which were all in the Greater Beirut area, were the American University of Beirut Medical Center (A.U.B-M.C.), the Saint Georges Hospital and the Sacré Cœur Hospital, which are among the top rated in Lebanon.

Survey and survey administration

The survey includes 38 questions, mostly closed-ended, related to knowledge of MCD, sources of information about MCD, perceived attitudes toward the disease and response by the government, changes in nutritional behaviors related to the disease, and demographic information. The survey, which was pilot tested and modified prior to use, was delivered to physicians by mail or in person. Physicians then completed the survey anonymously and in privacy. Participation was voluntary and confidentiality was assured by assigning numbers to received questionnaires, with no names included. Letters were sent to 200 randomly selected physicians. Of these, 142 replied, for a response rate of 71%.

Data analysis

Data analysis was completed by use of SPSS 11 statistical software. Univariate frequencies were conducted on all variables. Bivariate analysis investigated the influence of demographic and background variables, such as age, gender and hospital, on knowledge, attitude and behavior. A summary variable was created from all knowledge questions. Physicians were categorized as follows: highly knowledgeable if they scored 61% or greater on the summary variable; of average knowledge if they scored 51%-60% of the summary variable, and poorly knowledgeable if they scored 50% or less on the summary variable. Chi-square analysis also investigated the influence of sources of information on knowledge; of knowledge on attitude and behavior; and of attitude on behavior.

RESULTS

Seventy-four percent of the 142 physicians were males. Forty percent were 20 to 29 years old, 21% were 30 to 39 years old, 18% were 40 to 49 years old and 21% were 50 years or above in age. The percentages coming from different hospitals were as follows: 57% were from the A.U.B-M.C., 26% from the Sacré Cœur and 17% from the Saint Georges.

General knowledge related to the disease was adequate. Of all respondents, 82% stated that the histological basis of nvCJD is similar to that of BSE. Almost all (98%) knew that prions are the causative agent of the disease. Ninety-six percent responded that beef could be involved in transmitting the agent to humans, 32% also implicated gelatin and only 30% reported

TABLE 1. Percentages of physicians answering correctly on clinical aspects of the disease

Questions	Frequencies (%)
Existence of definitive diagnostic test	71.8
Nature of definitive diagnostic test	55.6
Early symptoms of nvCJD	53.5
Late symptoms of nvCJD	79.6
NvCJD transmission among humans	38.0
NvCJD transmission by blood transfusions	9.9
NvCJD transmission by organ transplantations	34.5
Existence of treatment for nvCJD	85.9
Terminal nature of nvCJD	93.7
Number of survival years after diagnosis of nvCJD	32.4
Incubation period in humans	43.7

that the transmission is by both. Moreover, 45% knew that eating animals fed on diets containing offals could be dangerous. Eighty-five percent of respondents agreed that it is difficult to destroy the agent. Concerning the systems and organs in which the agent is mostly present, 97% cited the central nervous system, 16% the lymphatic system and 13% the peripheral nervous system. Only 5% of the respondents identified all three of the systems.

Table 1 indicates level of knowledge related to the clinical aspects of disease. Although clinical knowledge was generally high, only 56% of those who indicated a definitive test for nvCJD identified necropsy as the appropriate test. In addition, only 38% percent stated that nvCJD could be transmitted among humans; of those, 35% reported that the disease could be transmitted by organ transplant. It was interesting to note that only 10% identified blood transfusion as a possible route of transmission. Finally, only 44% of respondents knew that the incubation period for the disease was ten years or more. At the time, the understanding was indeed that the incubation period of the disease was 10 years or longer. Since then, the World Health Organization has indicated that the incubation period ranges from 5 to 10 years. However, this is highly controversial, as it is very hard to pinpoint the moment at which a person has been exposed to Mad Cow Disease.

Questions regarding the number of cases worldwide were answered in the following way: 22% of responding physicians were not sure of the number, while 8% thought that 2,000 cases had been reported. Only 38% knew that there were "less than a hundred cases", which was considered the right answer at the time this survey was conducted. With respect to the countries with reported cases of nvCJD, 94% cited the UK, 82% stated France, 42% cited Ireland and a substantial 34% knew that MCD cases had been reported in all three of these countries. Concerning nvCJD reported cases in Lebanon, 20% believed that there are fewer than 10 cases and 20% were not sure of the answer. Still, only 58% stated correctly that there have been no reported cases in Lebanon.

The final set of knowledge questions was related to preventive measures to eradicate the causative agent. Because Mad Cow Disease cannot be detected except upon the demise of the patient and a follow-up biopsy, a question about proper disinfection of instruments was asked for the purpose of finding out how nurses and doctors could take proactive measures to disinfect instruments to protect other patients from prion diseases rather than how they could deal with instruments that are unquestionably contaminated. In this matter, 49% of the participants knew that instruments had to be autoclaved at 132°C for one hour, whereas

only 9% answered correctly when asked about the solution needed for treatment of contaminated skin and only 3% knew that a 1:10 dilution of 5% household chlorine bleach was needed to inactivate the agent.

Chi-square analysis showed that age, gender, and hospital were not significantly related to knowledge (Table 2). However, trends seem to suggest that younger people (20 to 39 years old) may be more knowledgeable than older ones (40 years old and above) about the disease; females were more knowledgeable than males, and A.U.B.M.C. had the highest percentage of practitioners with "high knowledge."

As far as attitude and behavior are concerned, only 22% believed that their chance of contracting the disease as the result of consuming contaminated food products is high, 46% considered such a chance moderately to relatively high, and the rest (32%) thought it was negligible. In addition, 57% stated that they were at no risk of contracting the disease in general. Table 3 indicates the dietary changes made by physicians in response to the disease. Despite the small perceived risk voiced by physicians, most have changed their nutritional behavior. Consumption of beef and beef products has decreased, with an increase in consumption of other forms of meat such as chicken. Among those who modified their dietary behavior, 66% considered their "new" diet to be healthful, while 17% viewed it as unhealthful and 17% were not sure. Regarding the preventative safety measures taken by the government, only 8% thought that those measures were adequate; 84% did not and 8% were not sure.

With respect to bivariate analyses, age had no significant effect on perceived risk of contracting the disease ($P = 0.080$). This risk was more or less equally perceived among people in the age group 20 to 49 years old (risk perception varied between 46 to 55% in these age categories) while only 23% of physicians above 50 years perceived a personal risk in contracting the disease. Also, age did not significantly affect beef consumption ($P = 0.109$). Still, beef consumption decreased most within the age group 40 to 49 years. The effect of the hospital on perceived risk was not significant ($P = 0.643$) as was its effect on beef consumption ($P = 0.125$). As for gender, it did not have a significant effect on risk perception ($P = 0.669$) but it did have a significant effect on beef consumption ($P = 0.040$), with 84% of males, versus 68% of females, decreasing or eliminating beef from their diet.

TABLE 2. Relationship between knowledge and age, gender and hospital

		High knowledge %	Average knowledge %	Low knowledge %	P-value
Age	20 – 39	29	34	37	0.065
	40 and above	12	45	43	
Gender	Female	24	38	38	0.949
	Male	40	38	22	
Hospital	AUB-MC	26	38	36	0.506
	Sacré Coeur	22	40	38	
	St Georges	23	38	39	

TABLE 3. Modification of diets as a result of MCD

	Increased (%)	Did not change (%)	Decreased/ Stopped (%)
Beef	0.7	20	79.3
Veal	7	23.4	69.5
Sheep	33.3	48.8	17.9
Goat	28.1	58.3	13.5
Pork /Ham	14.3	71.4	14.3
Chicken	52.8	45.1	2.1
Fish	46.8	52.5	0.7
Eggs	17.3	80.5	2.3
Dairy products	10.6	83.7	5.7
Vegetables and fruits	26.1	73.2	0.7
Legumes	26.8	71.8	1.4
Cereals	26.1	69.8	0.6

Physicians used one or more sources of information, whether formal or private. Regarding formal sources of information, as many as 52% used published research as a mean of information whereas 25% made use of World Health Organization resources and 13% of the Ministry of Health's materials. Seminars seemed to attract as few as 9% of the population and the Order of Phy-

sicians came well behind, with only 7% making use of it. As for private sources of information, the most consulted sources were the Internet (54%) and television (51%). Finally, only 33% of physicians relied on newspapers and 16% on the radio.

Concerning the number of channels used to seek information, only 15% of physicians used more than one formal

channel. This number went up to 37% of subjects using more than one private channel. Merging the formal with the private, it is seen that the majority of practitioners (80%) used one to three channels of information.

The relationship between source of information and knowledge was not significant, except for radio and newspapers (Table 4). Individuals who used the radio and newspapers as sources of information were significantly more knowledgeable than those who did not.

There was also no significant difference between physicians who used more than two channels and those who restricted themselves to only one or two ($P = 0.091$).

Regarding the effect of knowledge on attitude, knowledge did not significantly affect attitude based on risk perception. For instance, 59% of those who had low knowledge felt they were not at risk of contracting the disease, as compared to 62% among highly knowledgeable subjects ($P = 0.0587$). Interestingly, knowledge influenced beef consumption in a negative way. The results showed that 83% of people in the low knowledge group, but only 77% in the high knowledge group, decreased their beef consumption. This difference was not significant ($P = 0.747$). On the other hand, knowledge correlated positively but not significantly ($P = 0.768$) with answers about chances of contracting disease from contaminated food; 26% of highly knowledgeable people perceived the chance as high whereas only 19% of low knowledgeable physicians felt the same way.

TABLE 4. Relationship between knowledge and sources of information

		High knowledge %	Average knowledge %	Low knowledge %	P-value
W.H.O.	Yes	31	33	36	0.408
	No	20	39	41	
Ministry of Health	Yes	32	47	21	0.204
	No	21	37	42	
Research	Yes	24	33	43	0.357
	No	21	44	35	
Seminars & Order of Physicians	Yes	39	39	22	0.063
	No	19	38	43	
Internet	Yes	29	34	37	0.143
	No	15	42	43	
T.V.	Yes	19	42	39	0.506
	No	26	33	41	
Radio & Newspapers	Yes	23	53	26	0.013
	No	24	29	47	

With regard to the effect of attitude on behavior, beef consumption decreased in 91% of those who believed the chance of contracting the disease from contaminated food is high, while this number falls to 79% among those who considered the chance negligible. This difference related to attitude remains non-significant ($P = 0.214$). Also, 85% of subjects who had any risk perception decreased beef intake, while only 76% of practitioners in the "no risk" group took such a measure ($P = 0.243$).

DISCUSSION

Among our study population, answers to knowledge-based questions reflected relatively good awareness concerning nvCJD. Around three-quarters of the group answered half the questions right. This is probably due to the extensive media coverage associated with MCD. For an extensive period of time, MCD was discussed daily on television, in newspapers, on talk shows, and at meetings; a great deal of information was posted on the Internet. As for the impor-

tance of blood transfusion as a possible vehicle for transmission of the disease, very few (10%) thought it was possible. This might be due to the fact that such information became available only recently and, therefore has not been discussed in the media.

On the other hand, the extensive publicity that MCD has received may have misled persons regarding the number of cases worldwide. Only 38% reported the number of cases worldwide correctly. Additionally, 59% of our respondents incorrectly thought that there were reported cases in Lebanon. This is somewhat surprising. Even though there had been a rumor that a possible case of nvCJD had been found in A.U.B-M.C., many of the respondents had worked at the medical center in question and nevertheless obviously believed the rumor. A successful awareness campaign must not only try to prevent rumors from spreading, but also try to control their effect when they are spread.

Knowledge related to protective and preventive measures was low. Only a small proportion of practitioners actually

knew how to treat contaminated skin (9%) or surfaces (3%). This may be due to the lack of concern among practitioners about getting infected surfaces cleaned in the workplace. In turn, this lack of concern probably emanates from an inaccurate risk perception of work hazards.

Age and gender did not affect knowledge significantly, the results were not significant, although the results seem to indicate that younger people are more knowledgeable than older ones and that female doctors are more knowledgeable than male doctors. This may be because young physicians are more motivated to research, read and learn more than older practitioners feel inclined to. Female doctors also tend to be more concerned about their overall well-being than males are (3, 4).

Most physicians who responded to the survey seem to perceive a relatively low risk of contracting the disease. Still, most have changed their nutritional behaviors. Here, although the difference is not significant, males seem to be more worried about MCD than females are. This was indicated by higher rates of decreased beef consumption. Regarding sources of

information, all participants who got their information from formal, reliable sources were more knowledgeable than those who did not. TV alone did not provide a very good source of information, and those who rely only on TV did not do well in the knowledge-related questions. Consequently, TV can be considered a less reliable source of information than other private channels. This may be due to the fact that TV is a medium that commonly exaggerates rumors and dispenses away somewhat amplified information that might bias the actual scientific reality necessary to understand a disease as complex as MCD. The best sources of information related to high knowledge in our sample were the press and the radio. Indeed, these two sources together had a significant and positive effect on the knowledge of our respondents. This may be because the press and radio usually relate events and numbers quite objectively and also because written material sometimes allows the reader to better grasp and retain information, particularly in dealing with scientific data.

Limitations

Conclusions to be drawn from this study are subject to several limitations. The sample was selected based on convenience; participation was voluntary; and all hospitals were in Greater Beirut. Results could therefore represent the responses of a select group of physicians who are motivated and willing to respond to questions related to MCD, and for this reason cannot necessarily be generalizable to all physicians in Lebanon. The survey was also self-administered, with all the advantages and disadvantages inherent in this method of survey administration. Some of the attitude questions were scales in a dichotomous yes/no format rather than a Likert format, which could have affected validity of responses. Finally, the number of participants was relatively small, and the trends suggest that with an increased number of survey respondents, many more associations might have been statistically significant.

CONCLUSION

Although knowledge was relatively high, several areas of information clearly need emphasis with respect to physician awareness of nvCJD and MCD. Educational campaigns, created with a focus on these areas, should be designed specifically for physicians. For example, it is very

important that hospitals provide their personnel with practical day-to-day information updating that can help them efficiently protect their patients and themselves from contamination. Physicians could unknowingly be exposed to materials contaminated with nvCJD at any time. It is crucial to keep them updated about this disease in order to enable them to pass this information to their staff and provide their patients with maximum protection.

Perceived risk was relatively low, but behavior change relatively high for this group of physicians. This serves as an interesting contrast to the concept of a tenuous link between attitudes and behavior. Despite low levels of risk perception, the disease is probably perceived to be serious enough that behavior change is thought to be a matter of "better safe than sorry".

To our knowledge, this is the first study to investigate the links between physicians' knowledge, attitudes, behaviors, and sources of information related to MCD. Because physicians are primary gateways to knowledge, attitudes, and behaviors of the general public, understanding the links investigated in this study is a critical component of a comprehensive strategy of public health prevention and control.

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New England Consumers' Willingness to Pay for Fresh Fruits and Vegetables Grown on GAP-certified Farms

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SUMMARY

A consumer survey was distributed throughout the New England states to evaluate consumers' food safety concerns and purchasing profiles regarding fresh produce and their preferences for produce grown by farms with Good Agricultural Practices (GAP). Of 3,000 surveys, 24% were returned. Respondents were slightly older, had higher median income and were more educated than the averages indicated by 2000 Census data for the New England region. Consumers expressed preference for locally grown produce and considered produce from a roadside stand or farmer's market safer to eat than produce from a supermarket. Only 22% of respondents were completely confident in the safety of produce in the United States and 64% indicated that produce would become contaminated prior to retail: on the farm (23%), in the warehouse (21%) or during transport (20%). Few considered handling at home or in roadside stands to be a significant source of pathogenic contamination. Although 84% and 71% of the respondents indicated that they would pay a 0.50 and \$1.00 premium, respectively, for a produce basket from a GAP-certified farm, economic regression modelling showed no statistical characteristic that could be used as an explanation. However, when the extremes of the distribution were compared to those not willing to pay anything for safety assurances, slightly younger, highly educated, female and larger household size were found to be significant descriptors.

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INTRODUCTION

The microbial safety issues associated with fresh produce have been well documented (3). During the past two decades, the consumption of fresh fruits and vegetables has increased in the United States. Along with this increase in consumption (up 27% between 1970 and 1993), public health officials have documented an increase in produce-related foodborne illnesses (25). A variety of fresh produce has been implicated in these outbreaks, with causes attributed to many different bacteria, viruses and protozoa (25). Since fresh produce does not undergo a "kill" step to remove pathogens, these agricultural commodities must now be thought of as "ready-to-eat" foods. Prevention practices must be implemented at every step of the food distribution chain, starting at the very beginning—food safety basics at the farm (12). The FDA and USDA have developed guidelines that outline good agricultural practices (GAP) for growers/producers. These strategies were designed to minimize the microbial safety hazards associated with fresh and minimally processed fruits and vegetables. In October, 1998, *The Guidance for Industry: Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables* (10) was published by the FDA/CFSAN and USDA partnership in an effort to improve agricultural practices in the United States and upgrade monitoring systems. The guidance document addresses factors commonly associated with the production of fruits and vegetables—water, manure/biosolids, field/worker hygiene/sanitation and transportation—from harvesting to packing. This document was developed as guidance and not regulation. It is now hoped that, through education and outreach programs along with continued efforts in research, that the agricultural community—both large and small producers will embrace these guidelines. This "voluntary" compliance should be initiated by the industry without the weight of regulatory authority, if for no other reason than to reduce liability or satisfy buyer specifications (26).

Traditionally, fruits and vegetables have been regarded as microbiologically safer compared with other unprocessed foods, including meat, milk, eggs, poultry and seafood. During the past decade, outbreaks of human gastroenteritis have been linked to the consumption of a variety of contaminated fruits and vegetables in the United States and overseas. It is estimated that in the 1990s, at least 12% of foodborne outbreaks were linked to

fresh produce (9, 11), raising public health concerns about the safety of fresh fruits and vegetables in the United States. The reported foodborne outbreaks and illnesses in the United States associated with the consumption of fresh produce had increased from 2% in 1973–1987 to 8% in 1988–1991 (25). Fruits and vegetables are exposed to soil, water, and different environmental conditions to a greater degree than animal-derived foods. Microbial hazards associated with fresh fruits and vegetables revealed *Escherichia coli* O157:H7, *Salmonella* spp., *L. monocytogenes*, and *Cryptosporidium* pathogens of significant concern to the safety of fresh produce (4, 5, 16, 17, 19).

Providing additional food safety controls would continue to increase food costs to the consumer. In addition, industry may be willing to supply safety only up to the level that consumers are willing to value it (21). In today's marketplace, consumers often use labels and information on the food packaging as a guide to evaluate its attributes. The price of the item may heavily influence the perceived quality of the product. Inspections for safety, quality and production methods, may also affect consumer choices. For most decisions that involve risk, perceptions of risk stem from a broad range of personal experiences and related knowledge (24, 27, 29). Studies have shown that in some cases consumers are willing to pay for certain aspects of food safety (14, 18). Alternatively, in a study done by Bagnara (2), when pesticide branding guarantees for IPM (Integrated Pest Management) techniques, consumers were unwilling to pay more but the branded guarantee helped keep market share. While consumers have, in part, been the driving force for many of the current food safety initiatives, a GAP program could be seen as responding to food safety issues and concerns. However, these consumer perceptions and preferences have not been evaluated. The goal of this study was to evaluate New England consumers' perceptions of food safety as it relates to fresh fruits and vegetables, preference locations for purchasing and potential willingness to purchase, and preference for fruits and vegetables produced under GAP procedures and practices.

METHODS

This research used methods commonly applied to determining consumer preferences for attributes of product, where those attributes do not currently exist. This methodology is referred to as

contingent choice and has been used in many studies of consumer demand for attributes of food products (1, 6, 13, 15, 28). The contingent choice format uses surveys to ask respondents to make a discrete choice between multiple product alternatives. By analyzing preferences for a variety of potential options or products (differing according to a chosen set of variables), researchers can estimate the relative importance of particular variables in determining respondents' choices.

Attributes of products include price. Contingent valuation allows us to determine a consumer's willingness to pay (WTP) for a product with particular attributes and derive the willingness to pay for the attributes into willingness to pay for the product.

Sampling data

Following the model of Salant and Dillman (22), a total of 3,000 surveys were mailed to randomly selected households throughout the six New England states in two complete mailings. The randomized mailing lists, weighted as to state population, and labels were purchased from New Am-Pro Mailing List Company, Danvers, MA. The first and second mailings generated 60% and 40% of all responses received, respectively. One-hundred eighty-nine surveys were returned as "undeliverable." Of the 790 consumers who responded, surveys of 48 were discarded because of unanswered questions. Therefore, 742, or 24%, completed questionnaires were used in the analysis.

The questionnaire, cover letter, postage-paid return envelope and two recipe cards were mailed to each household. The questionnaire was anonymous. The complete survey was mailed a second time, without recipes, and with instructions to those who had already filled out the first solicitation to disregard the second. The initial mailing was completed in June 2001 with the second done two weeks later.

Data analysis

An economic regression analysis was performed by use of the SAS statistical program, version 8.0 (23). Descriptive analysis (frequencies, distributions) were computed for all variables by use of Microsoft Excel, and t-tests were performed to determined statistical significance of differences between means. Significant differences were reported at $P < 0.05$.

Questionnaire

The questionnaire was divided into four parts: demographics, purchasing behavior, food safety perceptions and willingness to pay. Survey questions reflected consumers' fruit and vegetable purchasing habits and perception of food safety hazards, with a focus on origin of the product, i.e., locally grown, imported, supermarkets and roadside stands. Some question sets were answered with specific choices (e.g., daily, twice a week, etc.); other sets used "agree", "not important to me," "disagree" and "don't know" or "completely confident", "somewhat confident", "somewhat doubtful" and "very doubtful." Following a brief description of the voluntary GAP program, the next section asked about a consumer's willingness to pay increased prices for produce grown on a GAP-certified farm. Survey respondents were asked to choose the maximum amount that they would be willing to pay for a \$5.00 basket of fruits or vegetables if the produce had been grown by a certified farmer. Choices ranged from \$5.00 (purchased from an uncertified farmer) up to a total of \$8.00/basket from a certified source with increases of .50 cent increments. The final section contained demographic questions concerning income, education, residence, gender and household size/age of occupants. Respondents had to be at least 18 years old to participate. The protocol and questionnaire were approved by the University of Rhode Island Institutional Subjects Review Board.

The surveys were reviewed for content validity and clarity by the food safety experts from the other New England State/Land-Grant Universities. All suggested changes were considered and the questionnaire was revised based on these recommendations.

RESULTS AND DISCUSSION

Demographics

Where possible, demographic information obtained from the six states was compared to the 2000 year census data for the New England six-state region (Table 1). The distribution of respondents by state compared favorably with the population distribution for the New England state census data (CT - 18%; MA - 45%; ME - 9%; NH - 13%; RI - 9% and VT - 5%). The final demographic data indicated that the respondents were slightly older, with 70% of the respondents, 45 or older (26%, 45-54), of higher income

households, with a median income of \$50,000-75,000 (50%, \$50,000 or greater;) and more highly educated (48% had college degrees or more). This data was significantly different ($P < 0.05$) from the 2000 Census data (8), which indicated that only 49% of the NE state population was over 45, the median income range for the states was \$37,240 - 53,935, and only 27% had a college degree or higher. Overall, 37% of the participants were male, and 61% were female; 2% did not answer the question about gender. Where applicable, the data results are reported based on states' population that reflects residents of more than 18 years old. The bias toward female respondents may have resulted from the screening question in the survey asking that the principal shopper of the household fill out the survey. The average household size for the states was 2.5, with 40% of the respondents having two household members and 16% and 15% having three and four members respectively. This number agrees favorably with the census average. Finally, this group had an interest in growing fruits and vegetables, with an average of 35% and 9% home growing vegetables and fruit and 5% either working on a farm or growing produce commercially.

Purchasing patterns

Table 2 and Figure 1 illustrate the purchasing behavior and preferences of consumers in the six-state New England region. The vast majority of the respondents (87%) shopped for fresh fruits and vegetables 1 or 2 times/week. Consumers expressed a preference for locally grown produce whenever it was available and considered produce purchased at a farmer's market or roadside stand to taste better and be fresher than produce from a supermarket. However, this preference was offset by a perception of higher price, less variety and less convenient locations of the markets and roadside stands.

Food safety

Responses to questions regarding food safety are illustrated in Table 3 and Figures 2-4. Consumers were asked to indicate the top five (5) food items that they thought posed the highest risk of causing an illness (other than allergies) when eaten. Relative to other food items (Table 3) the respondents considered fresh fruits and vegetables of lower risk for foodborne illness. Consumers ranked raw shellfish (93%), chicken (66%), fish (56%), beef (47%) and pork (44%) as the top five

commodities that could cause illness, whereas only 11-13% of the respondents felt that fresh fruits and vegetables fell in the top five. It was interesting to note that canned and frozen fruit and vegetable products were rated even lower than fresh. This would indicate that the consumers who responded to this questionnaire appeared to be aware that heat processing or frozen storage had a positive impact on the safety of food.

While the majority of the respondents indicated that bacterial contamination was the primary source of foodborne illness from fresh fruits and vegetables (Table 3), over 40% of those surveyed either did not know or disagreed with the statement. Generally, New England consumers felt that domestically grown produce (64%) was safer than imported and only 4 out of 10 respondents indicated that there was a safety difference between locally grown and US grown. However, when asked about the origin of the fresh products they thought were safer, over half (55%) of the survey participants considered fruits and vegetables from a roadside stand/farmer's market safer to eat than those found in a supermarket (Fig. 3). Because roadside stands would usually have only locally grown produce, the reason behind the differences in responses is unclear. However, the latter question forced the participant to either select one of the two choices or not answer. A third option, such as no difference, would have allowed the consumer the opportunity to select a better response.

Finally, when asked about the overall safety of fresh produce (Fig. 4), only 22% of the respondents indicated that they were completely confident in the safety of the fruits and vegetables in the United States while 63% and 14% were only somewhat confident or somewhat doubtful, and very doubtful respectively. When asked where they thought produce most often became contaminated (Fig. 5), 64% indicated that it would be prior to retail - on farm (23%), in the warehouse (21%), and/or during transport (20%). Very few considered home handling or roadside stands to be a significant source of pathogenic contamination. The view that home handling does not contribute to foodborne illness is common; most consumers believe that foodborne illness is caused by food prepared somewhere other than the home (7). Consumers consider restaurants and cafeterias to contribute most frequently to outbreaks even though illness from foodborne disease relating to food consumed in homes is three times more frequent (20). However, perceptions of

TABLE 1. Demographic results of survey respondents for the six New England states and comparison against the 2000 Census data for New England

Demographic ^a Characteristic	N	State's Average (%) ^b	Census Average (%)
Population Distribution	742		
CT		18	24
MA		45	46
ME		9	9
NH		9	9
RI		8	9
VT		4	5
Age^c	617		
18-24		2	12
25-34		9	18
35-44		19	22
45-54		26	19
55-64		17	12
65-74		14	9
75+		13	9
Education Level^c	742		
< High School		2	29 ^d
High School		20	28
Some College		23	18
Tech. Degree		6	—
College Degree		29	19
Graduate Degree		19	8
Household Income	742		
< \$25,000		14	27
25,000-50,000		26	29
50,000-75,000		21	21
75,000-100,000		12	11
>100,000		17	13
No answer		10	
Median Income ^c		\$50,000 – \$75,000	\$37,240 – 53,935
Gender	726		
Male		37	48
Female		61	52
No answer		2	
Household size (persons)	742		
1		21	27
2		40	34
3		16	16
4		15	15
5		6	6
6+		2	3

^aPercentages based on New England population for > 18 years wherever appropriate

^bTotals may not add to 100% because of rounding to the nearest whole number

^cSignificance at $P < 0.05$

^dCensus data based on education of population 25 years or older

FIGURE 1. Respondents' preferences for purchase site of fresh fruits and vegetables

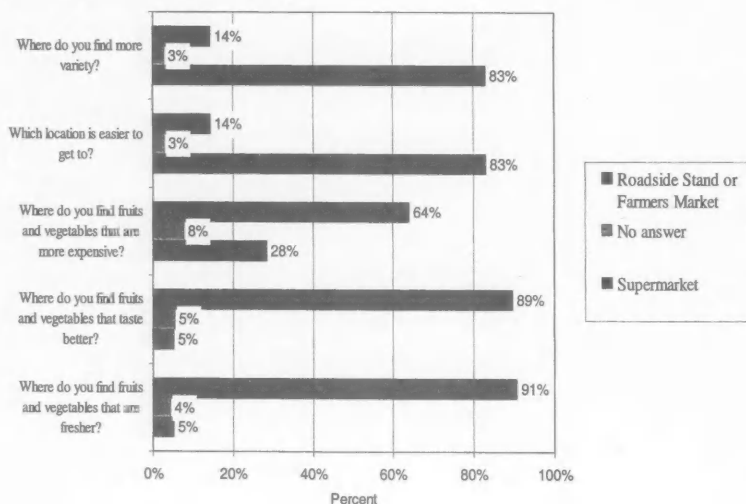


TABLE 2. Purchasing profile of consumers in New England for fresh fruits and vegetables

Characteristic	Percent (%)
Shopping frequency	
Daily	5
Twice/week	40
Weekly	47
Once/2 weeks	7
Once/month	1
< once/month	1
Shopping location	
Summer	
Supermarket	58
Neighborhood market	14
Farmer's market or Roadside stand	27
Winter	
Supermarket	88
Neighborhood market	10
Farmer's market or Roadside stand	2
Whenever available, I prefer to buy locally grown produce	
Agree	81
Disagree	0
Not important	18
Don't Know	1

consumers are powerful. Many of the survey respondents' food safety concerns relating to produce were in those areas that on-farm Good Agricultural Practices (GAP) and programs would impact. Of those surveyed, 37% indicated that they had heard of these terms prior to administration of the survey. This was higher than anticipated, but there was no follow-up question that addressed the source (s) of their information. Once the GAP concept was introduced on the questionnaire just prior to the questions addressing willingness to pay (WTP), responses to questions on certification agencies indicated that the ones that the respondents trusted most were the FDA or USDA (25 and 32%), and independent third party (22%) or State Department of Agriculture (17%). The respondents did not trust industry groups to provide certification for consumers (1%).

Willingness to pay for GAP certification

Figure 6 illustrates the degree to which consumers were willing to pay above a "normal" cost – in this case \$5.00/basket for fruits and vegetables – from a GAP-certified farm. While 16% were unwilling to pay any extra, 84% of the respondents were willing to pay up to \$0.50 and 71% were willing to pay a premium of \$1.00. Up to 43% of those surveyed stated that they would be willing to pay up to \$1.50. While the WTP (the amount that these consumers claim they were willing to pay for produce from a GAP-certified farm) was high, the results would suggest that consumers are inclined to pay some additional amount for this produce.

The economic regression model showed no statistical predictor that could be used to explain WTP for any of the variables (income, education, age, etc.) measured in the questionnaire. There was no significant factor(s), when regressed against WTP, that would explain a consumer's willingness to pay a premium for produce grown on a GAP-certified farm. It appeared that the desire for some certification of food safety for fresh fruits and vegetables was shared among all New England consumers. However, when the extremes of the bimodal distribution, those willing to pay \$2.00 or more (26%) and those not willing to pay anything (16%), were examined, certain elements or descriptors were found statistically significant and could be used to describe those who were really concerned about the food safety of produce and those who were

FIGURE 2. Respondents' list of food items that cause illness: Percentage of respondents listing items among the top five that cause illness

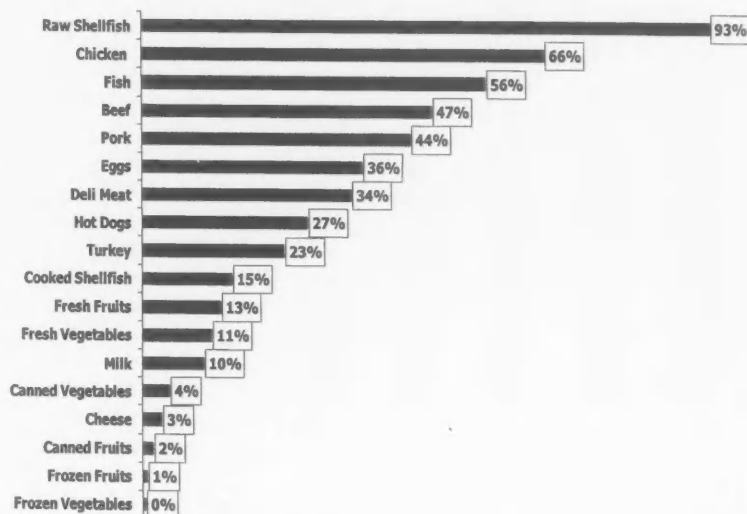
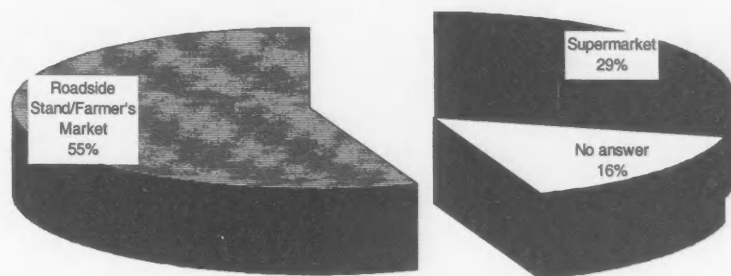


FIGURE 3. Comparing supermarkets and roadside stands: Where do you find fruits and vegetables that are safer to eat?



not. The results could be indicative of consumers' preferences and likelihood to pay something extra for the products.

Table 4 shows the profile of a consumer who might be willing to pay a premium of more than \$2.00 for produce grown on a GAP-certified farm. The willingness to pay varied slightly across the New England states and was highest in New Hampshire and Vermont. The group of respondents with a higher willingness to pay ($P < 0.05$) consisted of a slightly younger population, had a higher education level and was predominantly female. Those willing to pay were less than 55 years old, 54% had college degrees ver-

sus 45% of those not willing, and 66% were females. While income was not significant, there was a smaller percentage in the low income brackets and a higher percentage in high income of those who were willing to pay more for fruits and vegetables from GAP-certified farms. Household size was also a significant characteristic ($P < 0.05$) that could be used to predict purchasing choices. Those households that had more than 2 occupants were more willing to pay a premium to help ensure the safety of the produce that they consumed. In addition, 75% of all households with three or more members had a least one household member

younger than 18 years. The presence of children may have an impact on the respondent's desire for produce from a GAP-certified farm that decreased safety risks by using practices that minimize microbial hazards. This group also had a higher preference for locally grown produce when available, and thought that roadside stands or farmers' markets provided produce that was fresher and tasted better.

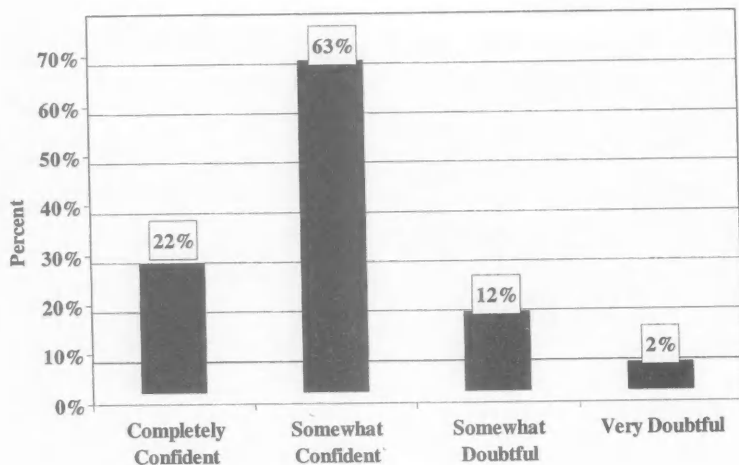
Existing awareness and concern about food safety may influence the respondent's willingness to pay for fruits and vegetables from a GAP-certified farm. The group of respondents with a high willingness to pay was more doubtful about the safety of fruits and vegetables sold in the US and considered imported produce to be less safe than US-grown products ($P < 0.05$). Of those not willing to pay extra, 39% were completely confident that the fresh fruits and vegetables were safe, versus 19% of those willing to pay a premium. The respondents willing to pay also indicated that there was a difference in safety between locally grown and US-grown produce and considered produce at a roadside stand safer to eat than produce in a supermarket ($P < 0.05$). Those who were willing to pay also agreed that contamination with harmful microorganisms was the primary reason that people became ill from eating fresh fruits and vegetables and felt that fruits and vegetables most often become contaminated with harmful bacteria during transport or at a warehouse ($P < 0.05$).

CONCLUSION

Although fresh fruits and vegetables may pose a lower health risk than meat, seafood and poultry, consumers are still not completely confident in the safety of the produce supply. There is clearly a perception that produce purchased from a roadside stand or a farmer's market is of better quality and is safer than products obtained from a supermarket, and few considered handling in the home or in roadside stands to be a significant source of pathogenic contamination. When the Good Agricultural Practices Program was described, a large majority of consumers responding to this questionnaire indicated that they were receptive to some increase in price for produce grown on a GAP-certified farm, regardless of income, education, household status, etc. It was not possible, in this study, to specifically identify those consumer characteristics that could be used to predict a willingness to pay in the general population. A desire

TABLE 3. New England consumer attitudes concerning the safety of fresh fruits and vegetables

Question	Agree (%)	Disagree (%)	Don't Know (%)	Not Important (%)
Bacterial contamination is the primary reason people become ill from eating fresh fruits and vegetables	57	10	32	1
US-grown fresh fruits and vegetables are safer to eat than imported fresh fruits and vegetables	64	8	23	5
There is no safety difference between US-grown and locally grown fresh fruits and vegetables	24	38	32	6

FIGURE 4. Respondents' confidence in the safety of fruits and vegetables sold in the United States

for increased food safety "guarantees" was shared by most of the respondents. The quantitative results of this study that seem to indicate a group of buyers that are willing to pay 50% or higher for a basket of fresh fruits and vegetables should be regarded with caution. However, these results do describe attributes of consumers that are potentially willing to pay a premium for produce from GAP-certified farms. Finally, results from this study indicate that consumer education with regard to both GAP and general food safety

issues (e.g., impact of home handling, role of bacteria in foodborne disease) could increase consumer awareness on the benefits of produce from a GAP-certified farm.

ACKNOWLEDGMENTS

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FIGURE 5. Respondents' answers with regard to where they thought fruits and vegetables most often become contaminated with harmful bacteria

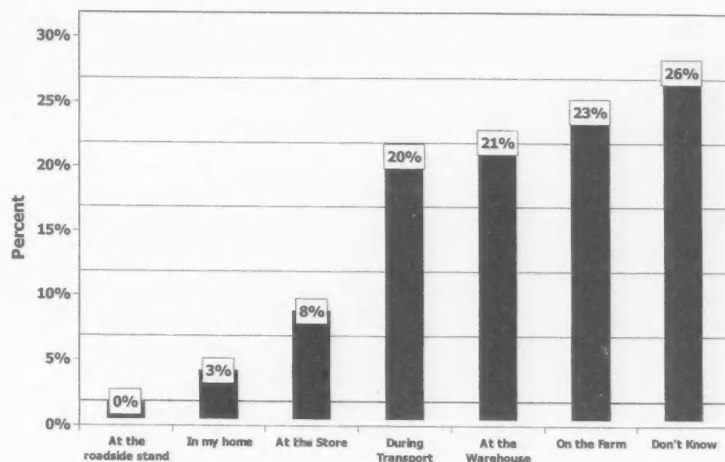
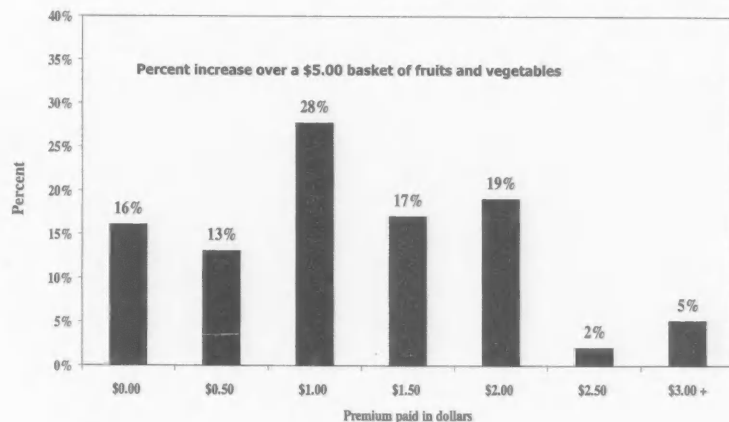


FIGURE 6. Respondents' willingness to pay a premium for fruits and vegetables from GAP-certified farms: percent increase over a \$5.00 basket of fruits and vegetables



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TABLE 4. Profile of consumers' willingness to pay an additional \$2.00 or more for a \$5.00 basket of produce from a GAP-certified farm

Characteristic	Willingness to Pay (WTP) an additional \$2.00 or more		Significance P < 0.05
	No WTP (%)	WTP (%)	
State affiliation		Higher NH, VT	No
Age^a			
20 – 54	51*	64*	Yes
55 – 75+	49*	36*	
Education			Yes
< High school	0	3	
High school	25	10	
Some college	22	26	
Technical	8	8	
College	46*	54*	
Gender			Yes
Female	55*	66*	
Male	44*	34*	
Income			No
< 25,000	20	11	
25,000 – 50,000	27	29	
50,000 – 75,000	23	25	
75,000 – 100,000	13	14	
>100,000	16	22	
Household size			Yes
1 – 2 persons	63*	48*	
3 – 6+ persons	37*	52*	
Seasonal purchasing			Winter – No Summer – Yes
Supermarket			
Winter	83	87	
Summer	63	53	
Neighborhood market			
Winter	12	11	
Summer	13	16	
Farmer's market/Roadside			
Winter	4	2	
Summer	24*	38*	
Home gardening			No
Fruits	8	8	
Vegetables	33	34	
Working on farm	5	5	
Prefer local produce			Yes
Agree	63*	89*	
Not important	34*	11*	
Disagree	1	0	
Don't know	3	1	

(continued) TABLE 4. Profile of consumers' willingness to pay an additional \$2.00 or more for a \$5.00 basket of produce from a GAP-certified farm

Characteristic	Willingness to Pay (WTP) an additional \$2.00 or more		Significance <i>P</i> < 0.05
	No WTP (%)	WTP (%)	
Fresher produce			
Supermarkets	5	3	Yes
Farmer's market/Roadside	88*	95*	
No answer	7	2	
Tastier produce			
Supermarkets	3	5	Yes
Farmer's market/Roadside	85*	92*	
No answer	12	3	
More expense			
Supermarkets	24	28	No
Farmer's market/Roadside	65	67	
No answer	11	5	
Local purchase more important then price			
Agree	29*	66*	Yes
Not important	28*	20*	
Disagree	39*	11*	
Don't know	3	3	
Confidence in safety of US produce			
Completely confident	39*	19*	Yes
Somewhat confident	54*	62*	
Somewhat doubtful	7	16	
Very doubtful	1	3	
US products safer than imports			
Agree	54*	64*	Yes
Not important	8*	4*	
Disagree	13*	10*	
Don't know	25	22	
No difference in US grown and locally grown produce			
Agree	54*	20*	Yes
Not important	8	6	
Disagree	13*	44*	
Don't know	25	30	
Safety of farmer's market and roadside vs. supermarket			
Supermarket	29	25	Yes
Farmer's market/Roadside	50*	60*	
No answer	22	15	
Bacteria cause illness in fruits and vegetables			
Agree	43*	63*	Yes
Not important	5	1	
Disagree	13	7	
Don't know	39*	27*	

(continued) TABLE 4. Profile of consumers' willingness to pay an additional \$2.00 or more for a \$5.00 basket of produce from a GAP-certified farm

Characteristic	Willingness to Pay (WTP) an additional \$2.00 or more		Significance P < 0.05
	No WTP (%)	WTP (%)	
Produce most often becomes contaminated			Yes
On the farm	28	29	
At the store	8	7	
During transport	16*	20*	
At the warehouse	15*	24*	
In my house	3	3	
At the roadside stand	0	0	
Don't know	30*	17*	

*Percentage adjusted for those respondents who did not answer, 20% in the No WTP and 13% in the WTP (see Table 1)

*Significant difference between No WTP and WTP for specific characteristic at P < 0.05

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Highlights of the Executive Board Meeting

Following is an unofficial summary of actions from the Executive Board Meeting held at the Baltimore Marriott Waterfront Hotel on January 23–24, 2005:

Approved the following:

- Minutes of November 15, 2004 Executive Board Meeting teleconference
- Minutes of November 15, 2004 Executive Board Meeting Executive Session teleconference
- To withhold providing recording services at Annual Meeting presentations so as to encourage honest and open discussion
- Co-sponsorship of ILSI Europe's workshop on "Using Microbial Risk Assessment in Food Safety Management"
- Holding a one-day IAFP symposium in conjunction with ILSI Europe's workshop
- Mentors for Student Travel Scholarship program
- IAFP Expert Panel papers
- IAFP University Speaker Program
- Dues restructuring
- Membership Committee ideas
- Sustaining Membership – new ideas
- Possible new Affiliates
- Non-compliant Affiliates
- Food Research Coalition
- Selection Criteria for Symposium
- Membership renewal and *JFP* Online
- Pamphlet Sales records and posting information Online
- Speaker Travel Fund update
- Governor's Conference on Public Health
- IAFP 2008 contract status
- 3-A Sanitary Standards, Inc.

Discussed the following:

- E-mail votes taken since the last meeting
- Committee Member appointments for 2005–2006
- Suggested change in scope for *Journal of Food Protection*
- Foodborne Illness Booklet revision
- Results of the Program Committee meeting
- Revision of Tuesday and Wednesday afternoon's schedules for IAFP 2005
- Workshop offerings for IAFP 2005
- IAFP 2005 Local Arrangements Committee
- IAFP 2005 Ivan Parkin Lecturer
- John H. Silliker Lecturer for IAFP 2005
- Foundation Fund Investment Policy
- Foundation Fund promotional materials
- Student Travel Scholarship program

Reports received:

- *Food Protection Trends*
- *Journal of Food Protection*
- IAFP Web Site
- Membership update
- Advertising update
- Financial statements for period ending November 30, 2004
- Board Members attending Affiliate meetings
- Affiliate Newsletter
- Future Annual Meeting schedule
- Exhibiting (IAFP On the Road)
- Future Board meeting dates

Next Executive Board meeting: April 18, 2005

FPT SPECIAL REPORT



MYCOBACTERIUM AVIUM SUBSP. PARATUBERCULOSIS (MAP) AND THE FOOD CHAIN

**BY GRAHAME GOULD
PETER FRANKEN
PHILIPP HAMMER
BERNARD MACKEY
FERGUS SHANAHAN**

REPORT

PREPARED UNDER THE RESPONSIBILITY OF THE ILSI EUROPE EMERGING PATHOGEN TASK FORCE

AUGUST 2004

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Scientific Reviewer: Donald Muir, Hannah Research Institute (UK)

Report Series Editor: Kevin Yates (UK)

EXECUTIVE SUMMARY

Mycobacterium avium subsp. paratuberculosis (MAP) is the causative agent of Johne's disease in cattle, sheep and goats, and occurs in some non-ruminants, including primates.

MAP is shed from infected animals, and so may contaminate pasture, water run-off, meat and milk. Most experimental work has been undertaken, and sound data derived, by research institutions and by the milk and dairy industries. However, other sources should not be discounted.

Programmes to improve preventive measures undertaken on the farm, in order to minimise transmission within and between herds and so reduce shedding into the environment, offer the most effective and confident means for better control in the future.

Heat treatment is the most effective measure to reduce MAP during the manufacture of milk and milk products, and of meat and products derived from meat. However, anomalously high heat tolerances of fractions of MAP populations have been reported, though not explained, and low level survival has been demonstrated in some surveys of commercially pasteurised milk. It is uncertain how effective processes, such as milk centrifugation and ultrafiltration, may be in helping to reduce residual contamination levels. MAP is relatively resistant to chlorination and other disinfection methods.

There have been reports of a potential association between MAP and Crohn's disease in humans. At present the complexity of the human disease is such that definitive answers cannot be given, though most recent research does not support a causal link. However, since different researchers have different opinions, the possibility should not be ignored. Issues that remain, therefore, include the possibility of an association of MAP with the disease and, should there prove to be an association, the dose response relationship that would allow a proper risk assessment to be undertaken, targeting all possible sources of MAP.

The report has identified a number of gaps in our understanding, particularly with respect to the heat tolerance of MAP, and to sources of MAP other than dairy, especially water and meat.

INTRODUCTION

Mycobacterium avium subsp. paratuberculosis (MAP) is a slow-growing, hydrophobic, acid fast, rod-shaped bacterium that is the causative agent of Johne's disease, or paratuberculosis, in ruminants, including cattle, sheep and goats. It also occurs in some non-ruminants - including primates. Johne's disease is a fatal, incurable, chronic inflammatory bowel disorder. It has been reported to contribute to large financial losses in the agriculture industry in some countries, e.g. the USA (see 'Occurrence and spread' below).

There have been reports of an association of MAP with Crohn's disease in humans, although evidence is currently insufficient to confirm or to disprove an aetiological or participatory role.

With regard to the possible exposure of humans to the organism via food, most studies have targeted milk. Consequently there are considerable milk-related data, though this should by no means indicate that milk is the only, or the main source for transmission. MAP may be present in the milk of animals that are infected symptomatically or asymptotically, derived from faecal contamination or directly from the udder.

Many laboratory studies suggest that standard milk pasteurisation times and temperatures of processing, by holder treatment and by high temperature short time (HTST) treatment, should satisfactorily eradicate MAP from milk. Other reports indicate low levels of survival, even after extension of HTST pasteurisation times from 15 to 25 sec at 72°C, and at temperatures as high as 90°C. Furthermore, survival of MAP has been reported in studies employing pilot plant and commercial pasteurisation units, and some surveys of retail pasteurised milk have detected surviving MAP. While such unexpected survival is not fully explained, it may be exacerbated by the strong tendency of the hydrophobic MAP cells to adhere to each other to form large clumps. The purpose of this review is to summarise and document up-to-date information about MAP, and to highlight its significance in the food chain by:

- reviewing the veterinary and human health implications of MAP
- reviewing the ecology of MAP in the food chain
- identifying farm and food safety management options which, in the short and in the longer term, will assist in better controlling MAP.

MAP IN VETERINARY HEALTH

Pathogenesis of Johne's disease

Paratuberculosis, or Johne's disease, is an infectious disease caused by MAP in cattle, goats, sheep, deer and South American camelids. Neonatal and juvenile animals are at highest risk of acquiring infection, through the faecal-oral route. MAP targets the mucosa-associated lymphoid tissues of the gastrointestinal tract. Survival within macrophages is characteristic of the organism. Cytokine production and the initiation of a cellular immune response causes the appearance of intestinal granuloma, and a cellular response is initiated in the nearby lymph nodes in an attempt to clear the infection (Harris & Barletta, 2001). The inflammatory process leads to the clinical manifestations of a corrugated intestinal epithelium and the corresponding characteristic malnutrition syndrome associated with the disease.

Occurrence and spread of Johne's disease

Johne's disease is common in dairy herds worldwide, where it causes significant losses through decreased milk production, animal deaths, low weight at slaughter and replacement costs. The disease has been spreading through domestic livestock for many years (Kennedy *et al.*, 2001). For example, it is estimated that about 22% of dairy and 8% of beef herds in the USA are infected, and 10% and 3% respectively in Belgium (Boelaert *et al.*, 2000). As a consequence, financial losses to the agriculture industry are substantial, for instance they are estimated at about \$1.5 billion annually in the USA (Stabel, 1998). The primary means of introduction of infection into a herd is through the acquisition of infected cattle. These may test negative at the time of purchase, but later shed the organism and spread the disease. Successful control of Johne's disease represents a particular challenge for a number of reasons. For example: infection may occur in the calf at an early age, but recognisable clinical disease occurs usually about two years later; MAP is able to survive well in the environment; the disease has a long incubation period; diagnostic tests have poor sensitivity during that period.

MAP IN HUMAN HEALTH

Pathogenesis of Crohn's disease

The pathogenesis of Crohn's disease is complex and does not appear to involve a simple cause and effect relationship. There are three major interacting elements: genetic susceptibility factors; immune-mediated tissue injury; and environmental modifiers, such as the enteric microbial flora. Intestinal inflammation seems to be due to unrestrained immune response to components of the intestinal bacterial flora in individuals who are genetically susceptible. The role of genetic factors is well established and the first susceptibility gene (CARD15, NOD2) has been identified. Mutations of CARD are associated with defective innate immune responses to bacterial components such as peptidoglycans. The contribution of intestinal bacteria is supported by several clinical observations in humans and by studies in genetically defined animal models (Shanahan, 2002). Genetic defects either at the level of mucosal barrier function or at the level of immunoregulation have been associated with diseases like Crohn's in animals, but colonisation with bacteria is necessary for disease development irrespective of the underlying genetic defect. Commensal microorganisms such as *Bacteroides* ssp. and other Gram-negative organisms, including those which are unculturable at present, that are part of the normal intestinal flora, rather than pathogenic infectious agents drive the inflammatory disease in these animal models (Shanahan, 2002). Hugot *et al.* (2003) have suggested that predominant use of refrigeration may have contributed by encouraging increased exposure to components of psychrotrophic bacteria that normally do not provoke the immune response.

The role of non-genetic (environmental) factors in Crohn's disease is shown by the incomplete concordance rate in monozygotic (identical) twins (<50%). In addition, an environmental influence is likely to account for the changing epidemiology of Crohn's disease. Increases in incidence and prevalence of Crohn's disease as countries become socio-economically developed have occurred over too short an interval to be explained by changes in population susceptibility genes (Ekbohm, 2003). However, the changing epidemiology of Crohn's disease within developed countries has been accompanied by increases in other inflammatory disorders that involve a disturbance in immunoregulation. These include asthma, insulin-dependent diabetes and multiple sclerosis (Bach, 2002). It is unlikely that each of these conditions is due to separate infectious agents targeting different end-organs. A more likely explanation is that environmental conditioning occurs at the level of immunoregulation. Changes in modern lifestyle and reduced microbial exposure have influenced mucosal immune development and may be a risk factor for inflammatory bowel disease. In addition, genes that once conferred resistance to infectious diseases in an unsanitary environment might become risk factors for excessive immunoinflammatory responses in the setting of a modern lifestyle and sanitised environment.

Possibility of MAP involvement

The discovery of a link between *Helicobacter pylori* and peptic ulcer disease helped to heighten awareness of the possibility that infectious agents might be the cause of other complex disorders like Crohn's disease. While various infectious agents have been proposed as possible causes of Crohn's disease, MAP is the most enduring candidate among the pathogens. In particular, studies of the occurrence of MAP in mucosal biopsy specimens from individuals with and without Crohn's disease have been claimed to be especially significant. For example, Bull *et al.* (2003) used culture methods and PCR techniques for MAP specific IS900 insertion sequences to detect MAP in 34 of 37 (92%) of such samples from patients with Crohn's disease, and in 9 of 34 (26%) of samples from control patients without Crohn's disease, but with non-inflammatory bowel disease. Sechi *et al.* (2004) found no MAP microscopically, but detected IS900 DNA in 69% of wax-embedded intestinal tissue samples from Crohn's disease patients. On the other hand, other studies have failed to find any correlation. For example, Bernstein *et al.* (2003) performed

colonoscopy and biopsy sampling of patients with Crohn's disease (n=24), patients with ulcerative colitis (n=28), unaffected siblings (n=9), and controls without inflammatory bowel disease (n=28). PCR testing for MAP in mucosal samples was positive for one patient with ulcerative colitis, but for no patients with Crohn's disease, nor for any of the siblings, whereas 6 of 19 healthy controls were MAP-positive. Baksh *et al.* (2004) found no IS900 DNA in granulomas from paraffin-embedded resection specimens of 18 patients with well-established Crohn's disease. Bernstein *et al.* (2004) found no differences in MAP seropositivity rate among Crohn's disease patients, ulcerative colitis patients, healthy controls, and unaffected siblings, in a Manitoba study. The data seemed to refute an association of MAP with Crohn's disease, but the high seroprevalence in Manitobans raised the possibility that the high rates of Crohn's disease in Manitoba could somehow be related to high exposure rates to MAP. While the occasional presence of MAP may be compatible with a participatory role, it may also be secondary in that its presence, and that of other bacteria within the mucosa, simply reflects opportunistic association, encouraged by defective immunity.

Representative arguments and counter-arguments (facts that have been presented against a relationship of MAP with Crohn's disease) for involvement of MAP, and explanatory comments, are summarised in Table 1.

Facts that have been proposed as counter-arguments include the following. Firstly, there is paucity of evidence for the horizontal or vertical transmission that one would expect from an infectious agent. Secondly, Crohn's disease is less common in rural areas and is not an occupational hazard of farming, where maximal exposure to MAP would be expected (Ekbohm, 2003). Thirdly, environmental conditions, such as poor sanitation, endemic parasitism and overcrowding, which should favour infectious transmission, actually appear to protect against Crohn's disease. Fourthly, there is no evidence for MAP in animal models of Crohn's disease. Fifthly, the most compelling clinical argument against persistent MAP or other infections as a cause of Crohn's disease is the clinical experience with anti-TNF- α (infliximab) therapy. Tumour necrosis factor (TNF) is a pivotal mediator of the inflammatory process in Crohn's disease. It is also required for activation of macrophages in defence against intracellular infections such as mycobacterial infections. Intravenous administration of the monoclonal antibody, infliximab, has been shown in well-conducted clinical trials to be therapeutically effective in Crohn's disease and has been approved for treatment of that condition in Europe and the United States. This anti-TNF therapy is not only effective in healing intestinal lesions but also has been shown to be effective in maintaining remission when repeated infusions are given at two-monthly intervals for up to a year. Therapeutic blockade of TNF- α creates sufficient immunosuppression to be a risk for disseminated tuberculosis caused by the closely-related *Mycobacterium tuberculosis* (Keane *et al.* 2001), but has not been associated with disseminated MAP in patients with Crohn's disease. It is difficult to understand why an infection putatively stimulating the intense inflammatory reaction characteristic of Crohn's disease should respond to long-term suppression of immune defences. While none of these arguments is necessarily convincing alone, together they cast considerable doubt on a causal role. In support of the counter-arguments for a role for MAP in Crohn's disease outlined in Table 1, there are specific clinical and epidemiological features of the disorder that are at odds with a putative transmissible agent as a direct cause.

It is noteworthy that only two case reports claiming chronic MAP infection in humans have been described (Hermon-Taylor *et al.*, 1998; Greenstein, 2003). The significance of the finding and relation to Crohn's disease in one case has been questioned (McDonald, 2001), and the other case in an immunodeficient individual highlights the extreme rarity of MAP, even in subjects with defective immune defences (McDonald, 2001). Van Kruiningen (1999) reported that MAP isolated from Crohn's patients were unable to infect ruminants. De Hertog and Geboes (2004) recently reviewed the complexity of the numerous proposed links between Crohn's disease and common gastrointestinal pathogens, some of which can cause infections that even mimic the disease.

Table 1. Potential role of MAP in Crohn's disease

Argument	Counter-argument	Comments
Crohn's resembles Johne's disease in animals, which is caused by MAP.	The similarity is superficial, with several points of dissimilarity.	Crohn's is spontaneously relapsing and remitting, whereas Johne's is progressive. Unlike Crohn's, Johne's is not associated with extraintestinal associated diseases. Crohn's responds to immunosuppressants and steroids, in contrast to Johne's.
Crohn's shares features with intestinal tuberculosis.	Unlike Crohn's disease, intestinal tuberculosis does not respond to immunosuppressants or steroids.	Tissues have limited response to insult and some similarity across different diseases is expected.
MAP infection in humans has been reported suggesting that it may be a zoonotic organism.	Only one or two reports implicate a linkage with Crohn's disease, but do not prove a cause-and-effect relationship.	The extreme paucity of reports suggests that this is a rarity, even in immunosuppressed patients.
MAP has been reported to be detectable by molecular methods in tissues from Crohn's disease.	Presence of MAP and other bacterial DNA within the mucosa probably reflects either defective innate immunity to enteric bacteria or may be secondary to disease-induced defects in barrier function and does not represent a specific infection.	Reports have been inconsistent or conflicting, but this might reflect variations in technique. Reports of MAP in controls and in ulcerative colitis cast doubt on the specificity and pathogenic significance.
MAP has been cultured from Crohn's disease tissue.	MAP is also isolated from healthy subjects and not from all patients with Crohn's disease.	Long-term culture is required, creating the risk of contamination artefacts. There is also a risk of contamination from faecal contents.
Seroreactivity to MAP in Crohn's disease has been reported by some investigators.	Seroreactivity is weak, inconsistent, and may be due to cross reactivity.	Cellular reactivity to MAP would be more relevant, but is weak or non-detectable in Crohn's disease. This is at variance with an infection putatively stimulating such an intense inflammation.
Responsiveness of Crohn's disease to anti-mycobacterial therapy.	Good responses are evident primarily with broad spectrum macrolides, suggesting non-specific antibiotic effect.	Some antibiotics that have been used have immunomodulatory properties which might influence disease activity without implying microbial involvement (e.g. metronidazole).

A recent report (Naser *et al.*, 2004) describes the detection of MAP DNA in peripheral blood of a subset of patients with Crohn's disease (40-50%). However, the finding lacks disease specificity because a similar proportion of patients with ulcerative colitis were also found with the same result. Indeed, the authors of the report also found MAP DNA in 20% of subjects without inflammatory bowel disease. This lack of disease specificity calls for caution in the interpretation of the tests results.

In conclusion, evidence for infection with MAP in humans is sparse. The case for MAP involvement in Crohn's disease is unproven. Most assessments suggest that it is unlikely to be a causative factor. Furthermore, the pathogenesis of Crohn's disease in humans can be explained without invoking an infectious agent, and animal models indicate that a Crohn's-like disease can occur without involving a pathogenic infection. Although the possibility that MAP might account for a subset of Crohn's disease or might have a modifying effect on established disease cannot be definitively excluded, MAP infection is unlikely to be a causative factor for the majority of cases of Crohn's disease.

ECOLOGY OF MAP

Animals

A major source of MAP in the environment is the excretion of large numbers of organisms in the faeces of infected animals. While domestic ruminants, especially cattle but also goat and sheep are important sources, MAP also contaminates a number of wild animals, including deer, rabbits, foxes, stoats, badgers and wood mice, and birds such as jackdaws and rooks (Beard *et al.*, 2001; Stehman *et al.*, 1996). A question remains as to whether there is transmission between these species, because there is no evidence of active disease in wild non-ruminants.

An important aspect of the ecology of MAP is that there will most likely be no further multiplication of the microorganisms after they have left the host, especially since specific growth factor requirements are unlikely to be satisfied in the wider environment. Consequently, along the food chain, a progressive dilution will occur. Excreted organisms may contaminate pastures, water run-off, meat and milk, or milk may be contaminated directly via the mammary gland (Sweeney *et al.*, 1992). Numbers in milk ranged from 2 to 8 cfu per 50ml in culture-positive samples. Positive samples ranged from 3 to 19% in light to heavy shedder cows (Sweeney *et al.*, 1992).

MAP may become widely distributed within the tissues of infected animals, so that its occasional presence in meat and meat products is likely. For example, examination of thin cows after slaughter in the USA yielded positive results for MAP in 11% of dairy cows and 0.7% of beef cows. Sampling sites were gut, liver and meat-associated lymph nodes (Rossiter & Henning, 2001). Ingestion is therefore possible, at least in raw or undercooked meat. It should also be considered that cow's meat in particular is often used to manufacture meat products such as sausages and ground or minced meats, which could lead to the contamination of larger lots of respective products. Furthermore, it could be important that dry-cured and fermented meat products are normally manufactured without heat treatment and then eaten without cooking, so that no MAP-lethal step occurs prior to ingestion, but there are no data on the incidence or the resistance of MAP in such foods.

Water and the environment

Since cattle with severe disease may shed more than 10^{12} organisms onto pastures daily (Chiodini *et al.*, 1984), there is the possibility of contamination of water supplies from run-off (Grant, 1997). MAP has been shown capable of remaining viable for at least 163 days in river water, at least 270 days in pond water, and at least 330 days in bovine faeces and soil (Chiodini *et al.*, 1984). Ward and Perez (2004) reported that MAP survival was enhanced in loamy soils with high contents of sand or silt. The possibility of MAP entering domestic water supplies has been suggested by studies in the USA demonstrating survival of other mycobacteria through municipal water treatment plants (Mishina *et al.*, 1996), and by the observation that MAP is relatively resistant to chlorination (Whan *et al.*, 2001).

A recent study from the Czech Republic showed that MAP may be present in the stems, leaves and fruits of tomatoes, radish and lettuce when grown on soil contaminated by the use of manure (Pavlik *et al.*, 2002). MAP survived in the soil, at $< 6^{\circ}\text{C}$, for at least 113 days, and contaminated the plants within four weeks of planting (Pavlik *et al.*, 2002).

INTERVENTION MEASURES

Farm

Control of Johne's disease within and between herds is considered to be feasible with existing technologies, but with considerable difficulties (Kennedy, 2001; Kennedy *et al.*, 2001), and with greater difficulty for large rather than for small sized herds (Groenendaal *et al.*, 2002). Progress is likely to be slow, and depends on strong commitment of and incentives for farmers. Key elements of control being pursued include:

- Improved calf hygiene to prevent infection (prevention of exposure to manure of adults)
- Identification and removal of infected animals
- Inspection and identification and removal of suspected animals
- Introduction of animals only from herds thought to be free of infection
- Protection of herds thought to be free of infection and regions by:
 - Maintenance of biosecurity and best hygiene practices
 - Regular monitoring of infection status
 - Assistance with control if infection/disease is detected

Farm hygiene

Since Johne's disease is very common within animal populations of domestic ruminants, management practices are considered to be the most important tools for controlling paratuberculosis in domestic livestock herds. For control and eradication programmes to be effective therefore, it is generally accepted that extensive husbandry measures should be undertaken along with intensive diagnostic testing. Husbandry measures have two main objectives: firstly to prevent the spread of a possible infection within a herd, and secondly to prevent introduction of infection into a disease-free herd. The most important management practices that have been identified are overall cleanliness of the farm, careful manure handling, hygienic calving procedures, newborn calf care, and restriction of contact between calves and mature animals (Goodger *et al.*, 1996). To prevent spread of the disease, prevention of infection of young, newborn animals is especially critical. It is important to ensure clean calving pens, separate housing of young and older animals and feeding of colostrum and milk only from non-infected mothers. Fischer *et al.* (2004) detected MAP in blowflies that had fed on infected cattle or waste, and suggested they should be targeted during herd sanitation procedures and in slaughterhouses.

Primary sourcing

To prevent the introduction of infection, it is important to maintain a closed herd. This includes not purchasing animals from farms with an unknown history of paratuberculosis, but also not spreading as fertiliser manure from other farms. Banning positive herds from trading will prevent spread while activation of test-and-cull programmes helps to eradicate the disease, with replacement stock then being purchased from certified free herds.

Transfer of animals of unknown disease status between herds is a major impediment to control, so that action to prevent acceptance of infected animals into herds, which depends on effective diagnosis of diseased animals, is fundamental. A critical management tool is therefore herd testing. However, diagnosis presents a major challenge, firstly because confident detection is difficult, and secondly because detection is unlikely before the animal has progressed to the later stages of the disease. During the early stages of the disease animals are clinically normal and current diagnostic methods are unable to detect an immune response or intermittent shedding of the organism. Because of the limited sensitivity of diagnostic tools with individual animals, herd testing gives a better performance.

Faecal culture and determination of antibody response by enzyme-linked immunosorbent assays (ELISAs) are the two major means of detecting Johne's disease in a herd. While faecal cultures are effective for the detection of cattle that are excreting MAP, a disadvantage is the slow growth of the organism in laboratory cultures. A polymerase chain reaction (PCR) can detect MAP within three days, but is expensive, and requires more skilled technicians than do culturing methods. Antibodies to MAP can be detected in the serum of infected animals (by complement fixation, agar gel immunodiffusion, and ELISAs), but the slow development of the disease delays detection until its later stages.

Economic losses from Johne's disease are primarily due to premature disposal of animals and reduced milk production (van Schaik *et al.*, 1996). A vaccine that prevents animals from becoming infected would therefore be particularly valuable. Live and heat-killed vaccines have been developed, and have been commercially available for many years. Both types are capable of eliciting both cellular and humoral immune responses, and provide partial protection, reducing faecal shedding in cattle, the number of clinically affected cows, and the number of animals testing positive bacteriologically or histologically. However, vaccines are not yet completely effective in preventing disease, and may allow continued shedding. A really effective vaccine would offer a viable option for control of the disease.

Presently there are no antibiotics that can be routinely used for the treatment of Johne's disease in livestock. Attempts to treat paratuberculosis with antimicrobial agents have been inconsistent or delivered only temporary results, and are expensive and unrewarding.

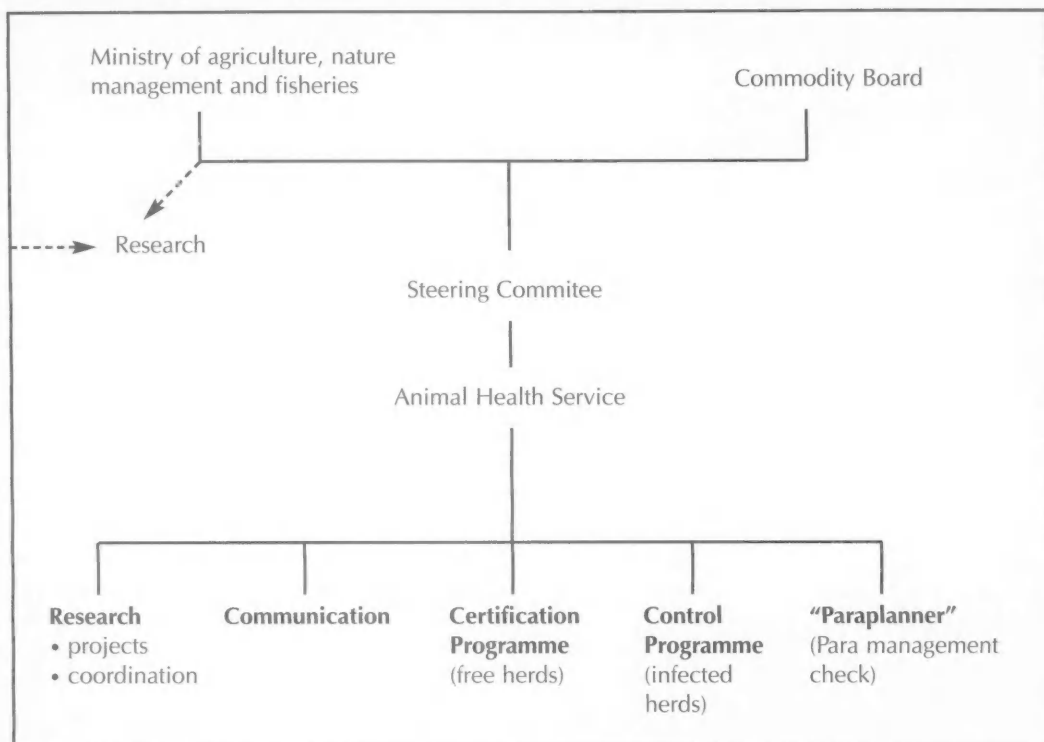
Without effective curative treatments or vaccination procedures, control methods are therefore primarily directed towards the introduction and maintenance of sound management techniques to clear herds of disease. Because single diagnostic tests detect less than half of infections, and only in older animals, long-term, dedicated efforts are required.

The critical importance of calf hygiene was highlighted by a modelling study of control programmes for MAP in mid-sized dairy herds in the USA (Groenendaal & Galligan, 2003). It was concluded that test-and-cull strategies alone do not reduce the prevalence of paratuberculosis in cattle, and they are costly for producers to pursue. Vaccination did not reduce prevalence although it was economically attractive. Improved calf hygiene strategies were found to be critically important and were also economically attractive.

Lack of compliance with herd management recommendations or insufficient time on a programme, hinders success.

Overall, therefore, because control of paratuberculosis is of interest not only to the individual farmer, programmes supported by the cattle industry and its partners and governments are necessary. The structure of such a programme is illustrated in Fig. 1 (Franken, 2002).

Figure 1. Proposed structure for paratuberculosis control programmes (from Franken (2002))



The steering committee in the structure should consist of representatives of the Ministries responsible for agriculture, nature management and the environment, human health, and include representatives of the cattle-related industries (farmers' organisations, the dairy industry, and the relevant animal health organisation). The animal health organisation should run the different activities of the programme. These are the overall management activities of the programme, and also include research projects, and the certification and control programmes.

As the most important preventive tool, the programme should ensure that the dairy herds apply preventive measures as stated in the relevant guidelines. Communication is an important issue and as such should have its own place and budget in the programme.

The costs of the programme for activities on farms, such as certification, control measures and management checks, should most logically be directly charged to the farmer. There is additional funding needed for programme management, communication and research (Franken, 2002).

The importance of costs was emphasised by Dufour *et al.* (2004) and by Pouillot *et al.* (2004). They undertook modelling and cost-benefit studies and concluded that herd-level certification procedures are not economically profitable at present in French cattle herds, but that this could change if certification costs decreased, for example if cheaper and effective diagnostic tests became available. The UK Department for Environmental and Rural Affairs has circulated similar draft guidelines for veterinarians and dairy farmers, aimed at reducing MAP levels in dairy herds and consequently in milk (DEFRA, 2004).

Food

Although it is possible that MAP may gain access to a number of types of food, by far the most attention has been given to milk.

MAP in retail pasteurised milk

Whatever the 'true' heat resistance of MAP cells in milk (see below), while some surveys of retail samples of pasteurised milk for MAP have been negative (e.g. all of 396 samples in a survey in the Republic of Ireland; O'Doherty *et al.*, 2002) others have identified the sporadic presence of viable cells (Grant *et al.*, 2001). Taken alone, such identification is not evidence of exceptional heat resistance. Failure in commercial processing may occur due to inadequate processing (inadequate holding times, leaks in valves, heat exchangers etc) or post-process contamination. Of course, definitive conclusions regarding survival after heat treatment can only be reached if it is also shown that pasteurisation was properly applied, and that no post heat-treatment contamination occurred, i.e. coliforms and other Gram-negative bacteria were absent from the milk after heat treatment. However, from the public health standpoint, the presence of MAP is important rather than the rationale for their occurrence.

Millar *et al.* (1996) reported the presence of MAP in retail pasteurised milk in England and Wales using PCR to detect the MAP-specific IS900 DNA sequence. Over an 18 month period, 7% of 312 samples were found to be positive, though not culturable, so that viability was not proven. Gao *et al.* (2002) found that 15% of retail milk samples from stores and dairy plants in south western Ontario were MAP-positive by PCR, but not by culture. Viability was proven, however, in a study of 827 raw and commercially pasteurised milk samples from 241 dairies in England, Wales, Northern Ireland and Scotland over a 17 month period (Grant *et al.*, 2000). Two percent of samples were culture positive for MAP, and of these, 70% were from samples processed at 72 to 75°C for 25 sec.

MAP was detected, but was not culturable, from one of 104 samples of raw sheep and goat's milk (Grant, 2002c), but Muehlherr *et al.* (2003) found 23.0% of raw goat's tank milk samples and 23.8% of raw ewe's tank milk samples in Switzerland to be PCR-positive for IS900, providing presumptive evidence of MAP.

MAP fate during cheese making

Little work has been done so far to determine the survival of MAP in dairy products other than pasteurised cow's milk. Donaghy, Totton & Rowe (2003) used an improved, laboratory-based method to contaminate 800g blocks of cheddar cheese. MAP survived the cheese making process. Syneresis of the curd caused a 1 log concentration of numbers of cfu of one strain of MAP, though not of another, from milk to cheese. Survival during subsequent storage was not tested. However, data were published by Sung & Collins (2000) about the survival of MAP in soft cheese (Hispanic style, 2% NaCl, pH 6.15). In cheese made from milk spiked with non-heated MAP at a level of 10^4 cfu ml⁻¹ a decimal reduction time of 59.9 days was estimated. Using sub-lethally injured cells (62°C for 240 sec) the decline was faster, resulting in an estimated D-value of 36.5 days. It is obvious that in such types of cheese, with high a_w -values, low contents of NaCl, and pH values close to neutrality, only moderate reductions of MAP can be expected.

Spahr & Schafroth (2001) used raw milk spiked at a level of 10^4 – 10^5 cfu ml⁻¹ (declumped cells) to manufacture hard cheese (Swiss Emmentaler) and semi-hard cheese (Swiss Tilsiter). Calculated D-values for the hard cheese were 27.8 days, for the semi-hard cheese 45.5 days. After 120 days of ripening, MAP at low levels were still detected. A probable 3–4 log reduction was estimated during ripening.

Processing options

Thermal inactivation of MAP

Although heating is the major process that will inactivate any MAP cells that gain entry to food, there remain difficulties in obtaining reliable heat resistance data.

Accurate counts of numbers of MAP cells surviving particular heat treatments have not been easy to obtain for three principal reasons: (i) the growth rate of the organism in media is very slow, so that incubation times up to as many as 20 weeks, or even up to one year, are necessary to record positive growth; (ii) hydrophobic mycobacterial cells tend to clump (Grange, 1996), so that groups of adhering organisms containing hundreds, thousands, or even millions of individuals may give rise to single colony forming units (cfu) and then greatly affect the outcome of experiments (Klijn *et al.*, 2001); (iii) hydrophobic cells congregate at liquid surfaces and in films on the sides of tubes and pipettes resulting in erratic transfer of cells down dilution series, with consequent inaccurate estimation of true viable numbers (Gould, personal communication).

A further difficulty in interpreting published data has been that different groups of workers have employed different heating and recovery techniques, so that laboratory-to-laboratory comparisons are sometimes difficult to make (Lund *et al.*, 2002). While this is of obvious importance, it is unfortunate that there is no single accepted protocol covering the recovery, culture and identification of MAP (consideration of conditions such as those summarised in Table 2 may help in the future). Nevertheless, a number of research groups have obtained MAP heat resistance data in the laboratory. Some of the most relevant log reductions reported following heating at 63°C for 30 min, or at 72°C for 15 sec, are summarised in Table 3. The results were obtained using cultured cells inoculated into raw milk or (Keswani & Frank, 1998) into UHT milk. Different methodologies employed are summarised in Table 3 (Lund *et al.*, 2002).

Table 2. Conditions for a uniform experimental design for heating experiments with milk¹.

Inoculum	Heating technique	Resuscitation	Decontamination	Incubation period
Type and origin of strains. Growth conditions ² . Homogenisation & sonication ³ .	Laboratory batch processes (capillaries, tubes, plastic bags etc). Commercial continuous processes ⁴ .	Heated MAP will be injured, so some form of resuscitation should be employed ⁵ .	If raw milk is used, overgrowth by components of the normal milk flora, particularly bacilli, can be expected. Chemical inhibitors may further injure MAP ⁶ .	Growth of non-injured MAP on standard media requires 8-12 weeks at 37°C. Reported incubation times range from 12 to 52 weeks ⁷ .

1 Considerations at the joint Federal Dairy Research Center/IDF Workshop, May 2003, Kiel, summarised by Hammer (personal communication). The proceedings of the workshop have been published in the IDF bulletin (IDF, 2004).

2 Resistance factors, such as acid tolerance can depend on growth conditions (Sung & Collins, 2003).

3 After disruption of clumps, survival is reduced. The mechanism of this phenomenon is not known, but is not a result of poor heat penetration into a clump, which is estimated to take 2-3 hundredths of a second (Davey, 1990).

4 Applicability of laboratory batch-derived D-values for the design of commercial processes may be questioned. Lethality in continuous processes is strongly dependent on uniform heating and turbulent flow. Knowledge of residence time distribution are necessary for full evaluation.

5 Grant *et al.* (2002b) allowed recovery at 4°C overnight before evaluating survival in heated milk samples.

6 Hammer *et al.* (2002) performed resuscitation in a modified Dubos medium for up to 6 months.

7 It is still under discussion which chemical agent is the most appropriate, and whether heat injured MAP might be further injured by its use (Grant *et al.*, 2002; Hammer *et al.*, 2002; Pearce *et al.*, 2001).

7 It is likely that the shorter the incubation time, the lower the probability of detecting surviving MAP cells.

Table 3. Laboratory determinations of MAP heat resistance

Heating at 63°C for 30 min			Heating at 72°C for 15 sec			Reference
Inoculum (cfu ml ⁻¹)	Decimal reduction	Methodology employed in MAP heat resistance studies	Inoculum (cfu ml ⁻¹)	Decimal reduction	Methodology employed in MAP heat resistance studies	
10 ⁴	<2	10ml volumes in tubes in a water bath	10 ⁴	<2	Double boiler with continuous mixing	Chiodini and Hermon-Taylor (1993)
10 ⁶⁻⁷	5-6	5ml volumes in stoppered tubes immersed in a water bath	10 ⁶⁻⁷	4.3-6	250 ml heated in a batch pasteurising unit	Grant <i>et al.</i> (1996)
10 ³⁻⁴	2-3.7		10 ³⁻⁴	2-3.7		
			10 ⁵⁻⁶	5.6-6	250 ml heated in a batch pasteurising unit	Grant <i>et al.</i> (1999)
			10 ⁵	5	Small scale flow-through pasteurising unit, laminar flow	Hope <i>et al.</i> (1996)
			10 ⁶⁻⁷	0.5-3	Small scale flow-through pasteurising unit, laminar flow	Stabel <i>et al.</i> (1997)
			10 ^{5.5-6}	>4.5-5	Small scale flow-through pasteurising unit, laminar flow	Stabel <i>et al.</i> (1997)
10 ⁵⁻⁶	>6	0.1 ml suspension added to 1.5 ml preheated milk in vials, sealed and immersed in water bath	10 ⁵⁻⁶	1-2	0.1ml suspension added to 1.5 ml preheated milk in vials, sealed and immersed in water bath	Sung and Collins (1998)
10 ⁶⁻⁷	>6	0.05 ml volumes in capillary tubes immersed in water bath	10 ⁵	4	0.05 ml volumes in capillary tubes immersed in water bath	Keswani and Frank (1998)
			10 ⁶	>6	Pilot scale flow-through pasteurising unit	Rademaker <i>et al.</i> (2002)

In addition, Gao *et al.* (2002) heated MAP at levels of 10³, 10⁵ and 10⁷ cfu ml⁻¹ in 2 ml samples of raw and UHT milk, in tubes in water baths, at 63°C for 30 min and at 72°C for 15 sec (Canadian Dairy Code). No survivors were detected from the batch treatment, but MAP was detected in two of 11 HTST simulations, from inocula of 10⁵ and 10⁷ cfu ml⁻¹.

Three of the reports summarised in Table 3 showed >10⁵ fold kills following heating at 63°C for 30 min, whereas two reports showed only <10² to 10^{3.7} fold kills. It is not clear why such small kills were recorded by Chiodini & Hermon-Taylor (1993). Technical problems are known often to result in erroneously high survivor estimations, sometimes enormously so (Donnelly *et al.*, 1987), particularly for hydrophobic cells. The low kill obtained from a small inoculum, but high kill obtained from a large inoculum (Grant *et al.*, 1996), are difficult to reconcile. Grant *et al.* (1996)

demonstrated severe 'tailing' of MAP survivor curves, with 1 in 10^6 or so cfu ml⁻¹ apparently hardly reducing between 10 and 30 min of heating time at 63.5°C. If such tailing were due to clumping, the same fraction of survivors would be expected from high and from low inocula.

In 6 of the 10 studies involving heating at 72°C for 15 sec, the process delivered >10⁴ fold reductions in MAP cfu, but in four of the studies reductions were only 10¹ to 10^{3.7} fold (Table 3). Stabel *et al.* (1997), recording low kills, used a laboratory scale flow-through pasteurising unit in which calculations by Hasting *et al.* (2001) concluded that laminar flow would occur such that the fastest moving particles would be at the desired target temperature for only 7.5 sec. Keswani & Frank (1998), obtaining a 10⁴ fold kill, heated 0.05 ml volumes in capillary tubes immersed in a water bath, which should have delivered rapid heat-up and satisfactory total treatment.

Stabel *et al.* (2001) summarised the various heating and culturing methodologies that have been employed, pointing out the difficulties in comparing data from different research groups and the sometimes questionable methods used, but concluded that overall the data suggested that HTST pasteurisation should result in a 5 to 6 log kill of MAP. However, this conclusion is not easily reconcilable with the reported survival of MAP in HTST pilot plant studies and its occurrence in retail pasteurised milk.

Several studies have evaluated the efficacy of pilot plant or commercial pasteurisers in the inactivation of MAP. The major elements of four key ones are summarised in Table 4.

The conclusions of the authors from the studies summarised in the table were:

- Properly maintained and operated equipment should ensure the absence of viable MAP in retail milk and other pasteurised dairy products. An additional safeguard is the widespread commercial practice of pasteurising 1.5°C to 2.0°C above 72°C (Pearce *et al.*, 2001).
- Pasteurisation conditions applied in the dairy industry seem sufficient to inactivate MAP (Rademaker *et al.*, 2002). Results support the conclusions of Pearce *et al.* (2001).
- Low level survival of MAP during conventional pasteurisation is possible (Hammer *et al.*, 2002).
- There is clear evidence that MAP bacteria in naturally infected milk are capable of surviving commercial high temperature, short time pasteurisation if they are present in raw milk in high numbers (Grant *et al.*, 2002a,c). Grant *et al.* claimed their study to be particularly significant because, in contrast to earlier inoculated milk studies, it was the first using naturally infected milk processed in a commercial-scale pasteuriser under confirmed turbulent flow conditions. The possibility of post process contamination was suggested by the occasional isolation of *E. coli*.

Taken altogether, the disparities between these various heat resistance studies is obvious. In some instances there are likely explanations. In other instances, reasons for the disparities are not clear. Overall, from the studies in which reductions of 10⁵ fold or more were obtained following heating at 72°C for 15 sec, a D-value of about 3 sec would be indicated if one assumes simple exponential kinetics over that part of the inactivation curve that is of relevance. But the well established examples of survival after heating for 25 sec, and even after heating at greatly raised temperatures (e.g. 90°C; Grant *et al.*, 1999; Rowe *et al.*, 2000; Hammer *et al.*, 2002) suggest that simple exponential kinetics are inadequate to explain the inactivation of MAP in milk.

Rationalisation of these disparities is urgently needed so that practical, sensible decisions can be made. To this end, an approach to develop guidelines for uniform experimental designs for heating experiments with milk were undertaken at a joint Federal Dairy Research Center/IDF workshop, May 2003 in Kiel.

MAP-specific items that should be considered in heating experiments are summarised in Table 2.

Table 4. Inactivation of MAP in pilot plant and commercial pasteurisers

Heating system	Inoculum	Process	Result	Reference
Pilot scale HTST pasteuriser.	Type strain & 3 bovine isolates (0.7-13 x10 ³ cfu ml ⁻¹). Clumps dispersed prior to heating. Faeces from "moderate shedder" cow (20-32 cfu ml ⁻¹).	15 sec at 63, 66, 69 & 72°C.	No survivors at 72°C. One strain survived 69°C. No survivors at 72°C. Low recovery (0.4 cfu ml ⁻¹) in 1 of 2 trials at 69°C.	Pearce et al. (2001)
Pilot scale HTST pasteuriser.	5 bovine isolates	18 sec at 68.1-79.1°C. 15-30 sec at 72-75°C ¹ 18-19 sec at 80-90°C. 40-60 sec at 72-90°C	Survivors in 77 of 282 trials. Survivors in all 45 trials Survivors in all 53 trials Survivors in all 48 trials. Low level survival in all trials, est. 4-6 log reductions ² .	Hammer et al. (2002)
Commercial scale pasteuriser.	Naturally MAP-infected milk.	15 or 25 sec at 73°C, +/- prior homogenisation	Viable cells cultured from 6.7% of 60 raw, and 6.9% of 144 pasteurised samples. On one occasion, high initial levels resulted in survival after all four processes ³ .	Grant et al. (2002b)
HTST pilot plant	Cultured cells. Raw & UHT milk inoculated with 10 ⁶ cfu ml ⁻¹	68, 72 & 78°C for 10, 20 & 30 sec	2 log kill (68°C 10 sec); 4 log kill (68°C 20 sec); No recovery from higher temperatures or longer times.	Rademaker et al. (2002)

1 German Milk Ordinance conditions (=72°C for 15 sec equal and above)

2 Cerf & Griffiths (2000) re-emphasised that, based on conventional microbial inactivation kinetics, it is always more efficient to increase temperature than time of heating, so that 90°C survival remains surprising.

3 It is significant that in some instances other supposedly heat-sensitive bacteria (*E. coli*) were detected as well.

A further problem is that, after heating, low numbers of surviving MAP cells must be expected. Any concentration step will enhance detection. The same effect can be expected with respect to the sample size processed. The most frequently applied concentration method is centrifugation. Grant *et al.* (2000) introduced immunomagnetic separation for concentration purposes. If centrifugation is used, it must be considered that it depends on the g value whether MAP may also be concentrated in the cream layer, and not only in the sediment.

The survival of MAP in pasteurised milk is clearly exacerbated by the high numbers of cells, many in clumps that may irregularly be present. Grant *et al.* (1996) had already reasoned that clumping played a key role in survival, and used a novel vital staining method to demonstrate viable cells in cell clumps, a conclusion supported by Sung & Collins (1998), Keswani & Frank (1998) and Hammer (2000). However, low numbers can, of course, be satisfactorily killed. This was demonstrated when the sensitivity of MAP detection in milk was greatly increased by the use of an immunomagnetic separation technique coupled to PCR (Grant *et al.*, 1998a,b; 2000), such as to detect the equivalent of about 20 cfu ml⁻¹. Use of this technique enabled the demonstration that levels of MAP <10 cfu ml⁻¹ were satisfactorily eradicated from milk during standard HTST pasteurisation processes.

Possible resistance mechanisms

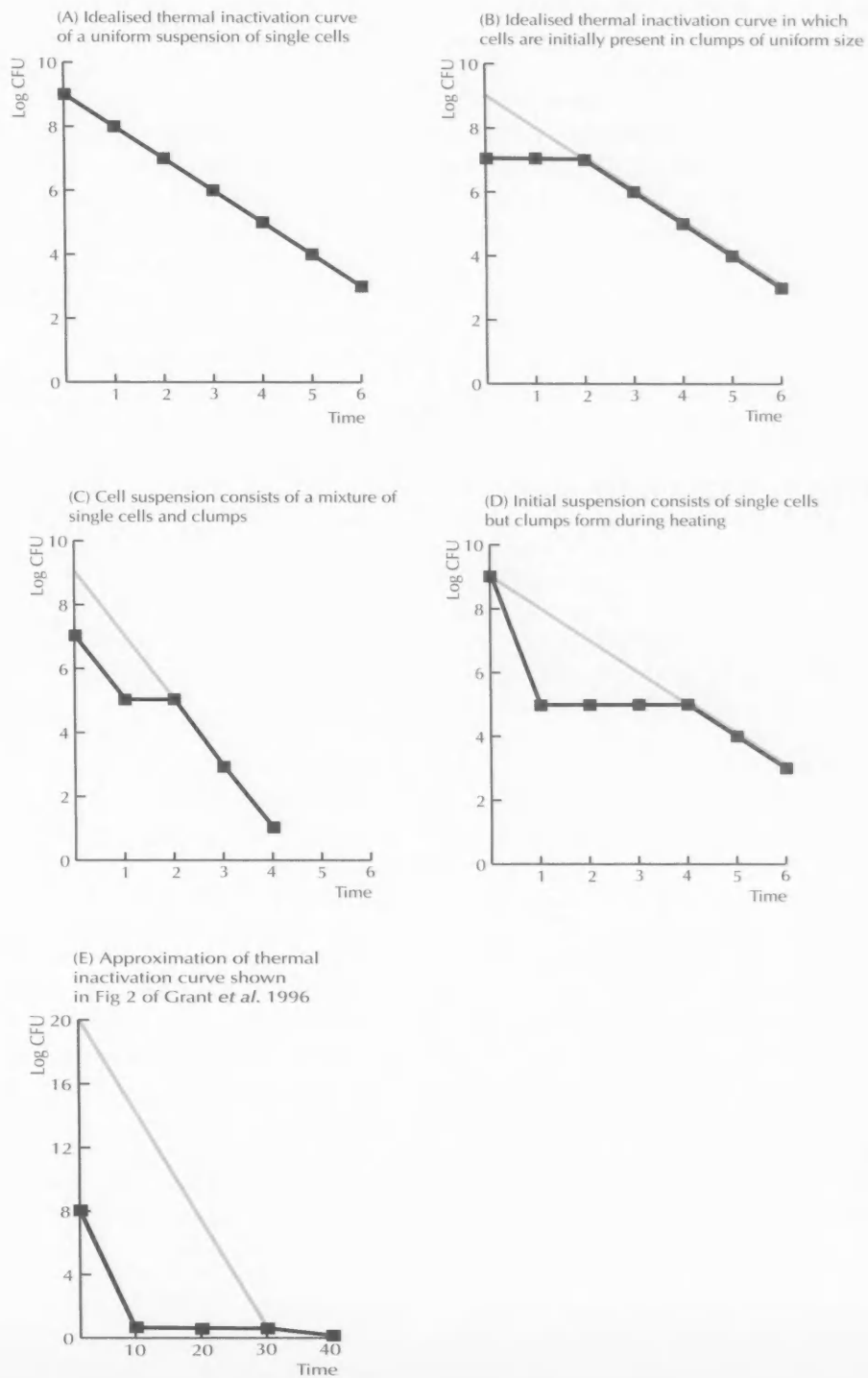
The unexpectedly high apparent heat resistance and irregular inactivation kinetics of MAP is often attributed to the presence of clumps in bacterial suspensions and/or to the acquisition of thermotolerance by a physiological adaptation mechanism. The presence of clumps of cells in a bacterial suspension can certainly give rise to deviations from the classic exponential order of death (Fig 2A) for purely statistical reasons arising from the discrepancy between the number of colony forming units and the actual number of viable bacteria present. A clump of bacteria gives rise to a single colony forming unit (CFU) but all cells within a clump have to be inactivated before a decrease in CFU occurs. Depending on the number of clumps and whether they are present initially or are formed during heating, this can give rise to 'shoulders', 'plateaus', or 'tails' on survival curves (Stumbo, 1965; Fig 2A-D).

It is notoriously difficult to obtain uniform suspensions of MAP, and large clumps in suspensions are readily visible under the microscope (Keswani & Frank, 1998; Sung & Collins, 1998). Grant *et al.* (1996) suggested that such clumps might explain the very long tails on survivor curves, and this idea was reinforced by the mathematical treatment of Klijn *et al.* (2001). However, the maximum length of tail that can occur during heating is dependent on the total number of cells initially present and the number and size of clumps; and the relationship between these variables places a limit on the length of tail that is possible in practice. With this in mind it can be concluded that the extreme case of tailing reported in Grant *et al.* (1996) would require an initial count of about 10¹⁹ cells per ml, which is impossible (Fig 2E).

Tails can also occur if clumping takes place during heating because, when cells aggregate into clumps, the colony count declines and the subsequent inactivation of bacteria in the clumps leads to a plateau or tail in the inactivation curve. For an appreciable tail to occur by this mechanism would require an increase in clump size of several orders of magnitude and a requirement that almost all single cells aggregate into clumps. If, for example, only 90% of single cells aggregated this would result in only a 1 log decrease in CFU and a rather short plateau on the survival curve (Fig 2D). It is thus unlikely that, even with substantial aggregation during heating, the purely statistical effects of clump formation are sufficient to explain extensive tailing, though non-statistical artefacts due to hydrophobic attachment of cells to tubes, pipettes etc. should not be ruled out. Three groups of workers found that disruption or removal of clumps by sonication,

Fig 2. Idealised thermal inactivation curves.

The solid line represents the number of colony forming units whereas the fainter line shows the estimated total viable number that would be obtained in the absence of any clumping effects.



repeated passage through a thin syringe needle or filtration did not have significant effects on the shape of survivor curves or estimates of D values (Keswani & Frank, 1998; Sung & Collins, 1998; Stabel *et al.*, 2001). Rowe *et al.* (2000) found that declumping cells by vortexing with glass beads reduced D values by a factor of two but survival curves were log-linear in both cases. MAP grown on different media by Sung *et al.* (2004) had different heat resistances, but all showed log-linear survival over at least 6 logs when heated at 65°C.

An alternative possibility is that cells within clumps undergo a physiological adaptation leading to an increase in heat resistance. Evidence that cells in a clump may be more resistant to heat than when present singly was obtained by using a novel double-staining procedure to identify metabolically active cells in heat-treated milk samples. When samples taken from the 'tail' region were examined by this method, metabolically active cells were always located within clumps (Grant *et al.*, 1997).

Stress response regulons affecting resistance to heat, acid, oxidative and osmotic stresses have been described in many species of bacteria (Yura *et al.*, 2000; Hengge-Aronis, 2000) and it is therefore likely that MAP has mechanisms for adapting to heat stress. Although ostensibly attractive, this explanation is very unlikely to account for the ability of cells to survive temperatures as high as 90°C (Hammer *et al.*, 2002) unless, somehow, induction of spore-like resistance can occur. Studies of the heat-shock response in a wide range of bacteria have shown that the increase in heat resistance, expressed in terms of D values, is typically two to five fold (Doyle & Mazzotta, 2000). To allow survival of MAP at 90°C would require an increase in its reported resistance (measured as D values) of at least a thousand fold and probably much more. None of the stress responses that have been characterised in other bacteria would result in resistance increases of this order and it is extremely unlikely that any physiological mechanism (apart from spore formation) could achieve this degree of stabilisation of cellular macromolecules. Growth on different media effected MAP heat resistance (Sung *et al.*, 2004), though not sufficiently to explain the extreme resistances that have been reported.

The importance of resuscitation and/or post pasteurisation holding on the recovery of MAP following heat treatment have been pointed out by Hammer *et al.* (2002) and Grant *et al.* (2002b). Whilst resuscitation is important to reduce experimental variation and improve recovery of injured cells, its use has never been reported to allow recovery of mesophilic vegetative cells exposed to heat treatments as high as 90°C. It is not a factor likely to explain the reported survival of MAP after extreme heat challenge (though, of course, inadequate resuscitation might explain failure to recover any MAP after treatment at 72°C for 15 sec).

In the absence of a physiological explanation, the only other obvious mechanism that could account for such extreme heat resistance would be a change in the physicochemical environment of the organisms. Vegetative bacteria are protected from heat when present in foods that are low in moisture or high in fat, and at low water activity, and under these conditions they can resist temperatures of 100°C or higher (Olsen & Nottingham, 1980). The protection afforded to bacteria present within lipid material is due to an increased solubility of water in the lipid phase as temperature rises and a consequent reduction in the local water activity (Senhaji, 1977; Senhaji & Loncin, 1977). For MAP to be protected by this mechanism would require the cells to be located within a fatty matrix and the amount of cellular water present not to exceed that necessary to saturate the lipid phase. If such mechanisms do not withstand experimental scrutiny we would be forced to reconsider the possibility that, despite the great care taken by experimentalists, there is some unknown property of MAP that prevents some cells receiving the intended heat treatment in pasteurisers or submerged ampoules.

Other options for control

In the evaluation of control options, the increased milk stream (quantities) from the collection at individual farm level, through collection centres and finally up to the processing facility needs to be considered. Taking this situation into account, the fate of MAP can be considered. On the one hand, milk originating from a single infected animal will be diluted all along the process flow by clean milk but on the other, this mixing process will lead to larger quantities of milk being contaminated with low levels of MAP.

Although the thermal tolerance data indicate that MAP is more thermoresistant than many other vegetative bacteria, during HTST treatment at even the lowest legally defined conditions (15 sec, 72°C) most studies have indicated that a 5 log reduction is achieved. Further reduction might be possible by application of other processing options, such as homogenisation or milk purification, bactofugation and filtration. Data on the efficacy of these processing options, besides heat treatment, are rare. Grant *et al.* (2002b) reported some evidence that homogenisation may enhance the lethality of the heating process during commercial-scale pasteurisation. In general during milk purification by centrifugation, 50-60% of the bacterial load attached to particles such as faeces or straw will be removed. More effective is centrifugation in a bactofuge. This process is capable of removing 90-95% of spores and vegetative bacteria. Microfiltration leads to a more than 99% reduction of bacterial load. It is likely that similar effects can be expected with respect to a reduction of MAP by application of these processes. However, more sound scientific data generation is desirable.

As proper UHT treatment inactivates most bacterial spores, survival of MAP would seem to be unlikely. In addition, often UHT treatment is a subsequent step after pasteurisation. However, in view of the uncertainties associated with survival of MAP after heating, with recovery even after treatment at 90°C, the behaviour of MAP during UHT treatment should not be assumed and would bear investigation.

Few data are reported on the effects of cheese ripening (see above), and covering only a very small segment of cheese manufacturing. However, a wide variety of cheeses are produced from heat treated milk, and bactofugation is already often used for cheese milk so that a cumulative reduction of MAP can be expected.

Further important processes in milk manufacturing include production of milk powders, butter, yoghurt and other fermented products, but for these no information on the behaviour of MAP is available. Whether reliable data can be generated here may be doubtful because new or improved methodology would be necessary to detect extremely low numbers. A considerable reduction should be expected by the heat treatment. Concentration of MAP in cream resulting from its hydrophobic character may be important, and needs further investigation. Fermentation processes generally commence after an initial pasteurisation. Surviving MAP may be affected by the decrease in pH during fermentation, but the high acid tolerance of the organism should be considered (Collins *et al.* 1984). Possible effects of starter cultures and their products are possible future research items.

Few data on the effects on MAP of processing of meat and meat products are available at present. It is likely that, comparable to milk, heating will be most effective in minimising survival.

CONCLUSIONS

MAP shed by infected cattle and other animals contaminates the environment and, whilst not multiplying there, gains irregular access to a number of foods, of which milk has received the most attention. Small fractions of populations of MAP cells appear, unexpectedly, to show greatly enhanced heat resistance, and MAP may occasionally be recoverable from pasteurised milk, though the reasons for this remain unknown. In contrast to the many studies of MAP contamination of milk that have been undertaken, other potential sources, especially water and meat, have so far received too little attention.

The public health importance of such survival of MAP depends on their possible involvement in human disease, in particular Crohn's disease. At the present time, despite substantial research (see reviews European Commission, 2000; Rubery, 2002) the possible involvement of MAP in human disease remains under discussion. Further studies are needed to clarify the issue.

RECOMMENDATIONS

While further studies are underway, it has been suggested that the food industry should adopt a precautionary approach (ACMSF, 2003; Greenstein, 2003) and support programmes and new initiatives aimed at reducing the chance of MAP contamination of foods so that more effective control measures can be developed. There is a need to learn more about MAP occurrence in meat and water.

The most effective and long lasting actions are likely to be the on-farm management programmes aimed at reducing infection in cattle. While food processing, predominantly by heating, is effective in reducing numbers of any contaminant MAP, normally by approximately 5 log, the occasional occurrence of survivors remains unexplained, and requires further research.

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APPENDIX – FACT SHEET

The organism

The mycobacterial species *M. avium* is subdivided into three subspecies: *M. avium* subsp. *avium*, *M. avium* subsp. *paratuberculosis* (MAP), and *M. avium* subsp. *silvaticum*. The subspecies designation of MAP is based on DNA-DNA hybridisation and numerical taxonomy. MAP can be differentiated phenotypically from *M. avium* and *M. silvaticum* by its dependence on mycobactin for growth. It can be differentiated genotypically by the presence of multiple copies in its genome of an insertion element, IS900.

Ecology – sources in the food chain

MAP may enter the food chain from a variety of sources. The organism, shed from cattle or from other animals, may contaminate pastures, and therefore water run-off. Faecal contamination may introduce MAP into raw meat and raw milk. Meat may also be contaminated endogenously in infected cattle. Milk may also be contaminated directly via the mammary gland. Contamination by animal effluent has been shown capable of introducing MAP onto food crops.

Disease in animals

MAP is the causative agent of Johne's disease in cattle, sheep and goats, where it causes a fatal chronic intestinal disorder. It occurs also in some non-ruminants.

It has been spreading through domestic livestock for many years, and is endemic in most countries. It is common in dairy herds, where it causes significant financial losses resulting from decreased milk production, animal deaths and replacement costs.

Links to Crohn's disease

The pathogenesis of Crohn's disease is complex and does not appear to involve a simple cause and effect relationship. There are three widely-accepted, well-researched, interacting elements: genetic susceptibility; immune-mediated tissue injury; and enteric environmental modifiers such as the intestinal microbial flora. However, there have been reports of a possible association of MAP with Crohn's disease in humans, though the current evidence is sparse, and it is insufficient thoroughly to confirm or disprove such an association. Different researchers have different opinions about the possibility of a link, so the possibility should not be ignored.

Food materials likely to be contaminated

By far the most studied food is raw milk and, since low level survival of pasteurisation has been demonstrated, there may be the possibility of contamination of products derived from it (pasteurised milk, butter, yoghurt, cheese and other fermented products). Other food materials that might be contaminated at some frequency have been much less studied. They include meat and products derived from it (burgers, sausages, dry-cured and fermented products), products that may become contaminated with cattle effluent (some crop plants) and water.

Survival of MAP in food

Whilst MAP is not expected to be able to multiply in foods, it is a good survivor. It is not inactivated by most food preservatives, and so low levels of contamination are likely to persist in the food chain.

Control in the food chain

Improved control will most likely derive from continuously upgraded intervention procedures on the farm, to reduce the chances of intra- and inter-herd transmission. In foods, heating remains the most effective eradication process, with additional improvements possible from techniques such as milk centrifugation and microfiltration.

Implications for the future

With respect to food, the major implications will derive from future work on the pathogenesis of Crohn's disease, and the availability of new evidence supporting or countering a participatory role for MAP. The complexity of the situation is such that this is not likely to be unambiguously resolved in the short term.

ABBREVIATIONS AND DEFINITIONS

D-value (Decimal reduction value): The time taken for a 90% decrease (10% survival) of numbers of viable cells in a bacterial population under a specified set of environmental conditions.

Cfu (colony forming units): A unit when attempting to estimate the numbers of microorganisms in a sample by inoculating into solid media and counting the numbers of colonies that appear after suitable incubation. Use of "cfu ml⁻¹" is preferable to "numbers of microorganisms ml⁻¹" since an individual colony may grow from a single bacterium or from a clump containing many.

Concordance rate: Level of agreement. In the context of Crohn's disease, if genetic factors alone are responsible one might expect monozygotic twins, who are genetically identical, to show a high level of concordance.

Infliximab: A monoclonal antibody against TNF (see below) that is therapeutically effective in Crohn's disease.

IS900: Insertion sequence. A specific base sequence of DNA that is present in the MAP chromosome in multiple copies. Its detection by PCR allows much faster detection of MAP than culture methods.

TNF: Tumour necrosis factor is the major mediator of the inflammatory process in Crohn's disease.

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NEW MEMBERS

CANADA

Melanie Gagnon
Universite Laval
Quebec, Quebec

Anthony Griffin
Northern Health Authority
Prince George, British Columbia

SOUTH AFRICA

Claire A. Christison
University of the Witwatersrand
Johannesburg, Gauteng, Witwatersrand

UNITED STATES

ARKANSAS

Sergio A. Quilo
University of Arkansas
Fayetteville

CALIFORNIA

Albert E. Middlebrook, III
Richmond

William R. Wiebe, Jr.
Foster Farms
Livingston

DELAWARE

Gary P. Richards
Delaware State University
Dover

FLORIDA

Rick A. Barney
Sweetbay Supermarket
Tampa

Kenny Chuang
Florida State University
Tallahassee

GEORGIA

Edith D. Akins
University of Georgia
Athens

ILLINOIS

Steven A. Sklare
Food Safety Academy
Evanston

Latricia L. Tolbert
Kraft Foods
Glenview

KANSAS

Erin J. Harvey
Kansas State University
Wamego

MARYLAND

Crystal McDade-Ngutter
National Institutes of Health
Bethesda

MASSACHUSETTS

Robert A. Brown
Shaw's Supermarkets Inc.
East Bridgewater

MICHIGAN

Susan B. Allen
Gerber Products Co.
Fremont

Lei Zhang
Michigan State University
East Lansing

NEW JERSEY

Maria Montoya
North Plainfield

OHIO

Daniel McElroy
Gojo Industries
Akron

SOUTH CAROLINA

Frank Wier
Amick Farms, Inc.
Batesburg-Leesville

TENNESSEE

Karen Sebby
S & W Laboratories, Inc.
Knoxville

TEXAS

Kirk Eggleston
Tyson Refrigerated Processed Meats,
Inc., Vernon

UTAH

Burke F. Stone
Stone Meats
Pleasantview

WASHINGTON

Wei-Yi W. Lu
Washington State University
Pullman

NEW SUSTAINING MEMBERS

Lyle W. Clem
ESC/Entegris
South Beloit, IL

Lori Grimes
VWR International
West Chester, PA

UPDATES

Kraft Names Corporate Nutrition Vice President

Richard Black has been named vice president of nutrition at Kraft Foods, a new position created by the company to oversee health and wellness issues.

Mr. Black will be responsible for developing and leading company-wide nutrition programs. In addition, he will support Kraft's Worldwide Health & Wellness Advisory Council of independent experts in key health and wellness disciplines.

Mr. Black was formerly executive director of the International Life Sciences Institute, North America, (ILSI, N.A.) in Washington, D.C.

Silliker, Inc. Names New Directors

Silliker, Inc. announces the appointment of Stephanie Campbell as laboratory director of its Modesto, CA, testing facility. She is responsible for managing scientific operations, quality systems, and staff to help food companies in northern California and the Pacific Northwest assure the safety and quality of their products.

Ms. Campbell most recently served as director at the company's Columbus, OH, lab. Prior to joining Silliker, she served as quality control supervisor at Stewart Sandwiches and Squire Foods, Inc.

Ms. Campbell holds a master's degree in bacteriology from the University of Wisconsin-Madison.

Dr. Amitha Miele has been named director of Columbus, OH, testing laboratory. She is responsible for managing scientific operations, quality systems, and staff to help food companies in the Mideast assure the safety and quality of their products.

A graduate of the Ohio State University, Dr. Miele joined the Columbus facility in 1998 as a microbiology technician. In quality assurance, supervisory and management roles, she implemented several quality systems improvements, administered staff training programs, and participated in validation studies on new testing methods. Most recently, Dr. Miele served as operations manager.

Steve Murphy Promoted to Senior Extension Associate

Steve Murphy has been an employee of Cornell University since October 1979. He began his "dairy career" working as a technician in the laboratory of Dr. Robert Zall, where work focused on milk quality, on-farm processing, cheese-making procedures, and evaluation and modification of laboratory methods. This position was considered part of the Milk Quality Improvement Program (MQIP), which was funded by NY State Dairy Farmers under the direction the NY State Milk Promotion Board/Order. After working with Dr. Zall, Steve furthered his laboratory research activities under the guidance of a number of professors and staff members including Richard Ledford, Gary Senyk, Frank Shipe and Dave Bandler, still under the MQIP umbrella. In 1991, when Gene Wolff, a long-time food science extension associate, retired, Steve assumed a position under Dave Bandler in the Dairy Extension Program. In this position, Steve had direct involvement with dairy plant and laboratory personnel through training, consultation, material development

and the activities of the MQIP's Voluntary Shelf-Life (VSL) Program. Steve continues to work under the MQIP.

Steve has a BS in microbiology (1979) and an MPS in food science (1997), both from Cornell University.

Gary Fread Named New President of Guelph Food Technology Centre (GFTC)

GFTC has announced the appointment of Gary Fread as its new president and CEO.

Mr. Fread's background is comprised of more than 25 years of experience in corporate management and management consulting, integrating supply chain management, sales, marketing, operations, and technical functions culminating in general management experience. Most recently, Gary has been president of Fread & Associates Ltd. Before that, he held a variety of senior positions, including vice president and general manager of Morrison Lamothe's Prepared Meals Division. At Campbell Soup, he was vice president and chief technical officer, after having begun his career at Procter & Gamble.

Mr. Fread holds a BA from the University of Kentucky and an MA from the University of Toronto.

Christian Nansen Joins Steritech Group as Technical Director

Christian Nansen, Ph.D., has been named technical director for The Steritech Group, Inc.

Dr. Nansen's duties in his new role will consist of overseeing all aspects of a technical nature in

UPDATES

Steritech's field operations, leading Steritech's Technical Committee and playing a critical role in the development of service protocols, including product usage choices, implementation of new technologies and company policy in regard to the Pest Prevention Division.

Previously, Dr. Nansen served as a researcher at Montana State University and Oklahoma State University, where he studied various measures to control agricultural and stored-product insect pests. In addition, Nansen has been published more than 20 times on various entomological subjects in periodicals such as the *Journal of Economic Entomology*, *Environmental Entomology*, *The Annals of the Entomological Society of America* and the *Journal of Stored Products Research*.

Dr. Nansen earned his doctoral degree in zoology from the Royal Veterinary and Agricultural University in Denmark. He resides in Charlotte, NC.

Executive Management Changes at Chr. Hansen

Chr. Hansen, Inc. announces the immediate appointment of David R. Carpenter as president and CEO for North America, following the resignation of Donald Combs.

Mr. Carpenter has been with Chr. Hansen since 1999 in various positions.

Mr. Carpenter was initially responsible for the sales activities of the dairy business, then for the entire Bio Ingredients business, and most recently as senior vice president of sales and marketing for North America. He has spent his entire career in the food ingredients business, which included vice president and global business unit manager at Degussa (formerly Sanofi Bio Industries), vice president of sales and marketing for Continental Colloids, vice president of sales and marketing for Ramsey/SIAS Laboratories (now ATYS), and 10 years at Sensient (Universal Flavors). He holds a BS in agriculture and an MBA.

Along with the change in the top management at Chr. Hansen-North America, the company also announces the promotion of Don Cox to senior vice president of sales and marketing. Effective immediately, Mr. Cox is responsible for the overall direction of the sales and marketing organization in North America including activities in Canada and Mexico.

Mr. Cox has been with Chr. Hansen for 11 years, and has held several positions in sales management, marketing and supply chain. He recently completed his MBA from Marquette University, Milwaukee, WI.

To put a greater focus on key industry segments, Chr. Hansen has reorganized the sales management team in North America. Tom Barry will continue in his role as vice president of sales for meat and prepared foods, allowing for greater strategic focus into this very large business segment, as measured by current and potential sales. Previously, he was also responsible for the overall direction of sales for the Food and Beverage industry.

Paul Duddleston is appointed to vice president of sales for food and beverage, and will be responsible for growing the sales of Chr. Hansen products in this industry. He previously was vice president of sales for dairy. Additionally, Ken Gawley is promoted to director of marketing for food and beverage.

Kristian Elsborg is promoted to vice president of sales for dairy. He has been with the company for 15 years and has held several positions, most recently as the director of sales for cheese ingredients.

Don Cox, senior vice president of sales and marketing, explains, "By focusing our efforts on these key industries, our customers can expect specialized expertise and true innovations."

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BSE Investigation on January 2 Case Concludes

The Canadian Food Inspection Agency in January announced the conclusion of its investigation into the case of bovine spongiform encephalopathy (BSE) detected on January 2, 2005. The investigation has fully traced the birth cohort, recently born offspring and feed to which the affected animal may have been exposed early in its life.

Nine animals from the birth cohort have tested negative for BSE. One other birth cohort animal had tested negative in November 2004. Most of the remaining animals have been confirmed to have previously died or been slaughtered.

According to Health Canada, the food safety risk associated with animals slaughtered before 2003 should be considered extremely remote. The prevalence of BSE in North America is low and the vast majority of cattle slaughtered in Canada are young cows, considerably less likely to develop infective levels of the disease. All cattle exhibiting symptoms consistent with BSE have been, and continue to be, diverted from the food system. In regards to birth cohort risk, international research shows that finding more than one case of BSE in a birth cohort is rare.

The offspring component of the investigation determined that all calves of interest had died of causes unrelated to BSE. The feed line of inquiry confirmed that the affected animal was exposed to feed containing ruminant meat and bone meal that was produced before the 1997 feed ban.

Canada's ability to quickly exhaust all lines of inquiry clearly demonstrates the effectiveness of the systems in place to respond to BSE. It also reflects the commitment to food safety stewardship and diligent record keeping of cattle producers and industry representatives that have assisted in this investigation.

The investigation into the January 11 case is ongoing. Test results on 33 of the birth cohort animals have been received and all were negative for BSE.

The Agency will be undertaking a review of the implementation of Canada's feed ban. This process is now underway and a report on the results was released the end of February.

Traceability of Food Products: New EU Guidelines to Facilitate Implementation

Guidelines have been agreed between the Commission and the Member States to facilitate the implementation of major requirements in the General Food Law (Regulation 178/2002) that entered into force on January 1, 2005. The Standing Committee on the Food Chain and Animal Health, consisting of representatives of the Member States, agreed on this common guidance document to make harmonized implementation in all Member States easier. The specific requirements covered in the guidance document include the traceability of food products, withdrawal of dangerous food products from the market, operator responsibilities and requirements applicable to imports and exports.

Markos Kyprianou, Commissioner for Health and Consumer Protection, said "The new requirements in the EU food law include important elements like rules on traceability and the withdrawal of dangerous food products from the market. Their effective implementation will benefit public health and make trade between EU Member States easier. The guidelines address many of the practical issues raised in recent months by food and feed business operators and will help both businesses and national authorities to implement the new requirements."

The new mandatory traceability requirement applies to all food, animal feed, food-producing animals and all types of food chain operators from the farming sector to processing, transport, storage, distribution and retail to the consumer. The guidance document lays down detailed implementing rules for operators.

Information on the name, address of producer, nature of products and date of transaction must be systematically registered within each operator's traceability system. This information must be kept for a period of 5 years and on request, it must immediately be made available to the competent authorities.

Common criteria triggering the withdrawal or recall of a dangerous product from the market are defined. Situations where operators are required to inform competent authorities of this withdrawal are specified.

All food and feed business operators are responsible for the safety of the food that they produce and put on the market. The guid-



ance document clarifies that operators are responsible for the activities under their control.

The extent to which traceability requirements apply to imported and exported food and feed products is clarified. The guidance document addresses concerns raised by third countries trading with the EU.

The guidance document is currently available in English on the website of DG Health and Consumer Protection: http://europa.eu.int/comm/food/food/foodlaw/guidance/index_en.htm.

Other language versions will be added as they become available.

Biosensors Can Help Stem Spread of Infectious Diseases after Disasters

Biosensors developed at the University of South Florida lab of Luis Garcia-Rubio, a chemical engineer at the university's College of Marine Science, can detect infectious diseases in blood and bodily fluids as well as identify pathogenic microorganisms in contaminated water. The new sensors could be our most effective future frontline defense against diseases emerging after disasters such as the recent tsunami, as well as help reduce the every day, annual rates of illness and deaths caused by contaminated water and unsanitary conditions worldwide.

"In the wake of the recent tsunami, it was anticipated that infectious diseases could increase dramatically in affected areas. Public health officials rightfully fear thousands more will die from infectious waterborne and water-related diseases after the tsunami. When people are forced to live in crowded refugee camps, they are more easily exposed to infectious diseases that spread quickly due to a

lack of clean drinking water and unsanitary conditions," Garcia-Rubio said.

The CMS research group, comprised of engineers, physicists microbiologists and chemists, is now testing portable, miniaturized biosensors that can – in real-time and continuously – monitor for a number of infectious diseases using as little as a single drop of blood. The sensors then wirelessly teleport data to a remote location for analysis.

"By optically identifying how an organism absorbs and scatters light, our new, minimally invasive technology identifies the light wave spectrum in a sample collected on-site. Because each organism absorbs and scatters light differently, we can analyze the light wave spectrum and scatter pattern and identify an organism in the sample by comparing those patterns with known, cataloged samples," explained Garcia-Rubio.

"Up to now," said Garcia-Rubio, "without expensive processes and highly trained personnel, there have been no portable instruments capable of detecting and classifying either microorganisms or cells in real time."

After patenting their technology, the research group has moved into field experiments with confidence that in the near future their advancement will be available to help public health officials rapidly detect not only infectious diseases, commonplace after natural disasters like the recent tsunami, but also waterborne pathogens that can occur in the drinking water of developed countries, including the United States.

According to Debra Huffman, a collaborator of Garcia-Rubio's lab, the new biosensors can detect malarial parasites, the dengue virus that causes dengue fever, *E. coli*,

Salmonella, *Shigella* and *Listeria* as well as causes of bacterial dysentery, such as *Cryptosporidium* (protozoan parasites). The sensors can also identify *Bacillus anthracis*, anthrax that can be weaponized by terrorists.

"Development and implementation of portable cost-effective technologies for the early and rapid diagnosis of pathogenic microorganisms and infectious diseases is the best way to stem the spread of disease following an environmental disaster," said Garcia-Rubio.

"However, the new technology can also help prevent the yearly illnesses and deaths resulting from contaminated water supplies both globally and here in the US. It doesn't take a tsunami to cause widespread illnesses resulting from contact with contaminated water."

"The World Health Organization reported in 2002 that there are nearly two million deaths annually related to unsafe water and poor sanitation and hygiene," pointed out Huffman. "The majority of those deaths are among children under five years of age." According to Huffman, diarrheal diseases account for one-third of illnesses globally and are the sixth leading cause of deaths worldwide. "Natural disasters notwithstanding, one-sixth of the world's population lacks good access to safe water," she said.

The new biosensors can help reduce those rates.

CFSAN 2004 Program Priorities Report Card

Dear Colleague, FDA Foods Community: I am pleased to provide you with the end-of-year report on our 2004 program priority accomplishments for FDA's foods program. We had an ambitious plan and we have met our goal of completing at least 90% of our "A" List goals. I am



proud of the Center's success rate. These results reflect a continued commitment to the management strategy of focusing our resources on where we provide the most benefit to American consumers and the continued dedication of the CFSAN workforce.

I would like to highlight a few program areas that have seen significant accomplishments this fiscal year. First, I have placed a renewed focus on the Nutrition program and we are starting to see the results of those efforts. In May, we completed consumer research on qualified health claim messages in the labeling of foods and dietary supplements. This research is aimed at ensuring the most effective wording of the qualified health claim to ensure the messages are not misleading to consumers. The Obesity Working Group completed its Working Group Report and Recommendations, Calories Count in February 2004 and we have begun to implement the recommendations of the report. We are working with a third-party facilitator to develop options for providing nutrition information at the point of purchase in a restaurant setting and to develop approaches, including partnerships for educating consumers, particularly adolescents about obesity. Our overarching goal is to make available more and better information about foods and dietary supplements, to help American consumers prevent diseases and improve their health by making sound dietary decisions.

I am also delighted that we have taken positive steps forward in the area of produce safety. Produce is recognized as an important component of a healthy diet and it can play an important role in weight management as well. Because most produce is grown in a natural environment, it is vulnerable to contamination with

pathogens. In September, we released our plan to minimize the incidence of foodborne illness associated with the consumption of fresh produce. The plan extends to all parts of the food chain from farm through retail or consumer preparation and consumption.

Let me address our commitment to protecting consumers from misleading claims and unsafe dietary supplements. This year, we published a final regulation declaring dietary supplements containing ephedrine alkaloids adulterated under the Federal Food, Drug and Cosmetic Act.

Dietary supplements containing ephedrine alkaloids present an unreasonable risk of illness or injury and the sale of these products is now prohibited.

Active steps also have been taken through the issuance of warning letters to cease the distribution of products sold as dietary supplements that contain androstenedione. We believe these products may increase the risk of serious health problems because they are converted in the body to testosterone which is an androgenic and anabolic steroid. We responded to 47 notifications for dietary supplements containing new dietary ingredients. The notifications were reviewed for science-based evidence of safety. We identified deficiencies in the information submitted or had safety concerns with 31 of the notifications. We are committed to working with all of our stakeholders and are seeking public comment on the type, quantity, and quality of evidence manufacturers should provide in a new dietary ingredient notification.

Finally, let me mention our efforts related to Food Defense formally referred to as Food Security. Following publication of the interim final rules for the Registration of Food Facilities and the Prior Notice of Imported Foods,

we have worked diligently to implement the information technology systems for these regulations. We have worked closely with our stakeholders to ensure these systems are functional and are user-friendly. The systems have been operational since December 2003. We have worked closely with Customs and Border Protection on the development of the prior notice systems and successfully implemented a phased-in approach to enforcement.

In closing, I would like to express my appreciation for the support I have received from our many stakeholders. Your reviews and perspectives are invaluable to me in establishing our program priorities. Working together we can improve public health. I look forward to working with you and continuing the tradition of building predictability, transparency and accountability into FDA's foods program.

Sincerely,

Robert E. Brackett, Ph.D.

Director, Center for Food Safety and Applied Nutrition

Complete document available from <http://www.cfsan.fda.gov/~dms/cfsan105.html>.

Feeding the World Requires More Than a Spoonful of Safety

While the United States battles an obesity epidemic, millions around the world are starving or malnourished – a population already at increased risk of foodborne disease. Fighting hunger goes hand in hand with the fight against foodborne disease, urges a Michigan State University researcher.

"When production of food goes up on a mass scale, something in the



food system – even the smallest problem – can exacerbate on a large scale and a large amount of people can be affected by foodborne disease,” says Ewen C.D. Todd, director of the National Food Safety & Toxicology Center at MSU.

Increased demand for food – and the whirlwind of trade to meet the demand for the export markets – carries an invisible price tag – in some cases, the loss of land to produce the food, and in other cases higher risk for food contamination for both local and exported foods.

“When we look at the question of feeding the world, we also have to take into account providing safe food,” Todd says. Among the concerns that affect food safety: storage, transportation, production, worker hygiene, trade and food laws, new pathogens, antibiotic resistance, natural disasters, vendor/retail sanitation among others.

Todd spoke at the American Association for the Advancement of Science annual meeting in Washington, D.C., in a symposium entitled “Can We Feed the World Without Poisoning the Earth?”

Todd spoke alongside Nobel Peace Prize winner Norman Borlaug and Charles Benbrook, who was an invited speaker at the First World Congress on Organic Food, organized by the National Food Safety & Toxicology Center at MSU this past March.

During his talk, Todd focused on microbial contamination of food in and from countries that face problems of hunger. Microbial hazards are not diminishing and food contamination is a problem in both developing and developed countries that needs more attention, he says.

“We need new approaches to food control, particularly centralized food safety policies that each

country understands and increased surveillance to track the source of the problems. The goal of fighting hunger and foodborne disease is achievable, but it will take planning and vision,” Todd says.

“Worldwide, approximately 1.5 billion episodes of diarrhea occur annually in children under the age of five, resulting in some 1.8 million deaths. Estimates are that up to 70 percent of diarrheal episodes may be caused by foodborne contaminants,” Todd says.

“There are examples of positive change,” says Todd, pointing to the food safety strategy of Ghana to control pathogens in fresh fruits and vegetables through the use of pre-cooling trucks to ship and store the food. He also points to the Codex Alimentarius Commission as a way of standardizing food safety standards through its international emphasis on encouraging fair international trade in food while promoting the health and economic interest of consumers. Todd is leading the only dedicated Food Safety Policy Center, which is examining US and international food safety policies and standards.

“One of the dilemmas facing food production is the increasing demand for stricter standards, which make it more difficult for developing countries to produce food for export. Food safety has become critical in international trade discussions following the establishment of the SPS (sanitary and phytosanitary) agreement in 1995. Since then, regulations in developed countries have become increasingly comprehensive and stringent, in some cases restricting trade or significantly increasing the costs of food exports from many developing countries,” Todd says.

Education is a major tool in the fight against foodborne disease, Todd urges, and he supports the

annual MSU International Short Course in Food Safety, a two-week course designed for working professionals in developing countries to learn how to apply food safety policies and technologies to their own countries from US experts and from fellow students.

In addition, five conferences organized by the National Food Safety & Toxicology Center have yielded valuable education and policy tools in the form of conference proceedings. All information is available online at www.foodsafe.msu.edu

A New Method for Early Detection of Disease Outbreaks

For disease outbreak detection, the public health community has historically relied on the watchful eyes of doctors, who have reported individual cases or clusters of cases of particular diseases to the authorities. But these days, the availability of electronic health-care data should facilitate more automated and earlier outbreak detection and intervention. Besides diagnoses of known diseases, other indicators – such as primary complaints of patients coming to the emergency room or calling a nurse hotline – are being collected in electronic formats and could be analyzed if suitable methods existed.

Martin Kulldorff and colleagues have developed and operated real-time disease surveillance systems based on electronic records. In an article published in the open-access medical journal *PLoS Medicine*, they now report a new and very flexible approach for early disease outbreak detection.

The method, called the “space time permutation scan statistic,” is an extension of a previous method



of detecting outbreaks called scan statistic. The problem with this previous method is that it works only under certain circumstances, for example if there is a uniform population at risk (with the same number of expected disease cases in every square kilometer), or if quite a bit is known about the variation in factors such as age and disease susceptibility that occurs in that population. The new method doesn't need any of that; it can detect disease outbreaks when only the number of cases is available.

In their article, Kulldorff and colleagues illustrate the utility of the new method by applying it to data

collected from hospital emergency departments in New York City. The researchers analyzed diarrhea records from 2002, and did both a "residential analysis" (based on the home address of the patients) and a "hospital analysis" (based on hospital locations). The former has more detailed geographical information; the latter may be better able to detect outbreaks not primarily related to place of residence but, for example, school or workplace. With their new "space time permutation scan statistic," they found four highly unusual clusters of diarrhea cases, three of which heralded citywide

gastrointestinal outbreaks due to rotavirus and norovirus. This suggests that their method can detect outbreaks early, and — equally important — it isn't prone to false alarms.

Since November 2003, the method has been integrated by the New York City Emergency Department in its syndromic surveillance system (this system for monitoring outbreaks was established in 1995 to detect outbreaks of waterborne, diarrheal illnesses). To make the method more widely accessible, it has been implemented as a feature of the freely available SaTScan software (www.satscan.org).

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INDUSTRY PRODUCTS



KD Scientific Inc.

New Compact Nanoliter Syringe Pump from KD Scientific

KD Scientific has released the Model KDS 310 Plus, a Nanoliter Syringe Pump augmenting their broad line. This new Nanoliter Pump works with syringes from 0.5 μ l up to 250 μ l with accurate "pulseless" flow delivery from 1nl/min to 363.7 μ l/h.

The KDS 310 features a unique remote injector which allows the user to deliver small volumes without wasting precious fluids in excessively long tubing. The compact remote injector has dimensions of 7 x 1.7 x 2 in (17.8 x 4.4 x 5.1 cm) and can be placed up to 6 ft from the controller.

Syringes fit snugly in a new mounting bracket design so the fluid is delivered precisely without movement of the syringe. The assembly will mount on a clamp for positioning on a frame.

The controller is set up in 3 easy steps. The user can set the flow rate, dispense volume and syringe diameter. The syringe table is preprogrammed with most popular syringes.

The KDS 310 is actually 2 pumps in one featuring a dispense/infuse mode and a withdraw mode. Loading the syringes with the fluid is easy using a fast forward or reverse mode.

Optionally, the KDS 310 can be triggered remotely by a foot pedal or remote switch. This will offer the user true versatility in using the unit in a "hands-free" mode.

Applications for the KDS 310 include: pharmaceutical, chemical, petrochemical, biotechnology, semiconductor, plastics, industrial, government, scientific research and development markets.

KD Scientific Inc.
Holliston, MA
508.429.6809
www.kdscientific.com

Thomas® Scientific Introduces Its New Line of Vortex Mixers

Thomas® Mini Vortex mixers are ideal for use with test tubes, flasks, beakers and a range of small containers. The Thomas® Touch vortex mixer is a one-touch unit with a fixed speed of 3200 rpm designed for high speed mixing of samples.

Thomas® Analog vortex mixers offer variable speed control from 100 to 3200 rpm for gentle or high speed mixing in continuous or touch mode operation.

A wide range of accessories is available to maximize the versatility of the mixers.

Thomas® Multi-Tube Vortexers provide hands-free vortexing of up to 50 tubes or three microassay plates. The multi-tube features variable speed control over a range of 1200 to 2400 cycles per minute. Its automatic timer is adjustable from one second to one minute or can be set for continuous operation. It easily adjusts to different height tubes and it can mix various tube sizes by changing the foam tube racks.

Thomas Scientific
Swedesboro, NJ
800.345.2100
www.thomassci.com

FKI Logistex Adds New Features to 24-Volt Accuzone Motorized Roller Accumulation and Transportation Conveyor

FKI Logistex® announces the incorporation of several design updates to its industry-leading Accuzone® 24-volt motorized roller accumulation and transportation conveyor. The fully modular, plug-and-play Accuzone offers true zero-pressure, zero-contact accumulation, and is available in straight, curve, merge, divert, belted, and right-angle transfer modules.

Changes to the Accuzone design include the standard control system, now a standalone and programmable DeviceNet networked controller. The DeviceNet control system enables completely modular wiring and eliminates more than 20 electrical connec-

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tions per 10-foot Accuzone section, allowing faster and easier assembly, troubleshooting, and interfacing with other equipment. The preexisting low-cost zone control wiring option will continue to be available for straight and curve modules.

Additional changes to Accuzone include the optimization of merge and divert module sizes for easier handling and configuration, and the addition of a cost-effective, aesthetically designed plastic side-frame cover to encase wiring and controls.

FKI Logistex also now offers Accuzone in a variety of belted configurations. These new modules enable improved package handling, particularly on inclines and declines, and provide seamless integration with roller conveyor.

Accuzone's existing benefits remain, including its modular, 24-volt-based design which reduces installation time and requires no high-voltage motor wiring or compressed air. The Accuzone system is also fully self-manageable and runs only when product is being conveyed, a feature that produces energy savings as high as 50 percent compared to traditional conveyor systems.

FKI Logistex
877.935.4564
St. Louis, MO
www.fkilogistex.com

Advanced Instruments, Inc. Introduces the SomaScope Analyzer

Advanced Instruments, Inc. announced the introduction of the SomaScope™ to the North American dairy market. The instrument provides a cost-effective way for dairy labs to

quantify somatic cells in unpasteurized milk and identify sub-clinical mastitis.

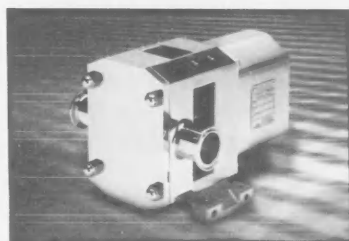
"The SomaScope analyzer features every benefit you look for in a test device," said Peter Costas, vice president, sales and marketing, Advanced Instruments. "It's accurate, very reliable, and comes at an affordable price. It's also one of the fastest instruments in its class, with integrated automation that maximizes the analyses of somatic cells in unpasteurized milk," he said.

Research has found that the quality of pasteurized milk and its shelf life decreases when milk with high somatic cell counts is used. In addition, higher cell counts reduce cheese yield, affect cheese curd firmness, increase whey proteins and decrease casein, and compromise dairy product sensory quality.

The instrument features fluorescence flow cytometry and high-throughput, dual photomultipliers for outstanding accuracy. The unit's modular construction, including open access to the sample preparation unit and other components, allows easy maintenance and parts replacement.

Accuracy and repeatability exceed industry standards for laboratory analyzers with a throughput rate of up to 400 samples an hour. A simple user interface makes it easy to operate and no external computer is required. A standard RS-232 enables data transmission to a central data management system and a printer output port allows local printing of results.

Advanced Instruments, Inc.
781.320.9000
Norwood, MA
www.advancedinstruments.com



Viking Pump

Viking Introduces a New Standard for Hygienic PD Pumps

Viking Pump announces the new SteriLobe® pump series, which sets a new standard in hygienic PD pumps for food, beverage and biopharm applications, with its exceptionally clean design and ease of maintenance. The pump conforms to relevant EHEDG and 3-A standards, and in the critical area of the mechanical seal, exceeds those design criteria to make the SteriLobe one of the cleanest standard-construction pumps available.

The pump's front-loading seal access makes seal removal easy, even for flushed and double-seal options, without removing the pump. The removable rotorcase and optional O-ring seal are ideal for COP (strip-clean) operations. For CIP or SIP cleaning, the pump comes standard with a hygienic mechanical seal. An optional DIN 24960 seal housing accepts many customer-specified seals.

The stainless steel gear case, with no breather plug or sight glass, ensures cleanliness and corrosion resistance, and prevents water spray infiltration. It even enables radial loads for belt-drive applications. Additional benefits of the new SteriLobe pump are its very smooth, standard internal surface fin-

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INDUSTRY PRODUCTS

ish of 0.6 μm RA, and a unique cover-joint profile that improves hygienic characteristics and self-draining capabilities to ensure rapid and thorough cleaning. Both Bi-Wing and Multi-Lobe rotors are available with clearances to 300°F (150°C), making them suitable for all CIP and SIP conditions. Universal mounting is available and all pumps may be fitted with front cover and rotor case jackets, or pressure relief valves, when required.

The new SteriLobe offers 8 frame sizes with 15 displacements, providing capacities from 2 to 870 GPM (0.5 to 230m³/h) and pressure capabilities to 220 PSI (15 bar). These type 316L Stainless Steel pumps will handle materials from ultrapure water to viscosities of more than one million cSt.

Viking Pump

319.266.1741

Cedar Falls, IA

www.vikingpump.com



Torrey Pines Scientific, Inc.

Torrey Pines Scientific Introduces the EchoTherm™ Model IC20, Compact Chilling/Heating Dry Bath

Torrey Pines Scientific announces its EchoTherm™ Model IC20, Peltier driven, compact Chilling/Heating Dry Bath with the broadest vari-

ety of precision-made aluminum sample blocks available anywhere.

The Model IC20 can freeze, chill or heat samples from -10°C to 100°C in assay plates, centrifuge tubes of all sizes, vials, and most any size test tube.

It is particularly well suited to the molecular biology lab for doing hybridizations, sample prep for PCR, ligations, enzyme reactions and much more.

The Model IC20 has digital display and control of temperature to 1°C; countdown timer in days, hours, minutes and seconds to 30 days; data logger; and RS232 interface to control the unit by computer or to record data.

The compact unit measures 6.5" (16.5 cm) wide by 8.75" (22.23 cm) deep by 3.5" (8.9 cm) tall. It comes complete with chiller/heater module, universal power supply, AC line cord, and instructions. Sample blocks are extra. The EchoTherm™ Model IC20 is UL, CSA, and CE certified.

Torrey Pines Scientific, Inc.

760.471.9100

San Marcos, CA

www.torreypinesscientific.com

Data-merging Option and Updated Database Now Available for DuPont Qualicon RiboPrinter® System

The RiboPrinter® Data Merging Workstation is a new option available from DuPont Qualicon for advanced microbial tracking. Customers who use several RiboPrinter® systems in their labs can now combine records from each system into one integrated database for comprehensive comparison, grouping and identi-

fication of unknown bacteria. For regulated industries, a data merging validation package of ready-made protocols is also available.

Additionally, DuPont Qualicon has released an update to the RiboPrinter® system identification database, adding over 400 new RiboPrint™ patterns of critical interest to the pharmaceutical industry.

The RiboPrinter® system uses powerful genetic information to provide an automated genetic snapshot, or RiboPrint™ pattern, of any bacterium in less than eight hours. With over 6,400 patterns in the identification database, electronic data security and characterization below the species level, the RiboPrinter® system surpasses US Food and Drug Association guidelines for preventing contamination and assuring consistency in aseptic processing.

In addition to the RiboPrinter® system, DuPont Qualicon markets the award-winning BAX® detection system, an innovative DNA-based technology for screening food and environmental samples for pathogens or other organisms. The BAX® detection system provides polymerase chain reaction (PCR) assays to screen food and other samples for *Salmonella*, *Listeria monocytogenes*, *Listeria* spp., *E. coli* O157:H7 and *Enterobacter sakazakii*.

Qualicon, Inc.

302.695.5300

Wilmington, DE

www.qualicon.com

NEOS Introduces the Industrial TPU Overshoe!

NEOS has announced the release of its newest product for the food and beverage processing market. Designed with an extra large gusset

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and high quality straps the NEOS overshoe is extremely easy to slip on and off over your favorite shoes. This exciting new product offers unmatched protection for your workers from slip hazards, and work-related strains associated with pulling on rubber overshoes.

In addition to comfort and protection, the NEOS overshoe has been clinically proven to reduce the introduction of *Listeria* and other pathogens into your food supply. The overshoe can easily be sanitized inside and out using most common cleaning solutions processes.

One of the real challenges facing safety managers today is compliance. In addition to providing 100% waterproof protection and unmatched slip resistance, the NEOS Industrial Overshoe offers supreme comfort by allowing your workers to wear their favorite footwear underneath their NEOS overshoes. Workers can now wear their own steel-toed work boots, sneakers or even custom prosthetics and still enjoy superior protection.

NEOS
888.530.6367
Burlington, VT
www.overshoe.com

Key Technology Presents G6, a New Modular Electro-optical Platform for Key's Family of Sorters

Key Technology presents G6, a new modular electro-optical foundation for Tegra® and Optyx® optical sorting systems, at Interpack Hall 4 / Stand D46. The G6 features an advanced, modular vision engine and an

array of new, high-performance monochromatic, color, and VIS/IR cameras.

The new G6 platform features proven, high-performance connectivity standards such as Camera Link, FireWire and Ethernet that maximize the underlying technology's flexibility. The open-source Linux Operating System offers inherent security and ensures long-term development and support. With greater operational versatility and reduced risk of obsolescence, Key's G6 sorters optimize sorting performance today and provide a foundation that prepares users for future improvements to enhance defect removal and recovery rates.

The modular design of Key's G6 platform allows customers using both current and legacy sorting systems to take advantage of technological advancements by upgrading the applicable module rather than forcing a redesign or replacement of the entire sorter. With Camera Link-compliance, G6 users can select from Key's existing array of high-performance color, IR, (infrared) and monochromatic G6 linear cameras today and later consider future camera and sensor technologies as they become available.

The new G6 Image Processing Module features Key's proprietary FPGA (field-programmable gate arrays) chipset technology, which puts the power of an entire electronic rack in a single chip. With twice the number of filter stages, G6 enables more subtle feature identification and more robust detection of defects. This programmable technology allows for simple future upgrades without mod-

ule replacement, offering greater opportunity for future performance enhancements and customization.

G6 features a powerful new programmable Ejector Controller Module that makes the adoption of new ejector operating characteristics or adding upgrades simple. Added power in the EC Module supports more complex ejection operations to generate more effective removal of defective product from the product stream.

Key designed the G6 platform with several features that improve reliability and reduce mean time to repair (MTTR). The intuitive graphical user interface (GUI) reduces operator training requirements, simplifies optimum operation of the sorter and provides a unique window into the highly, self-aware G6 architecture, ensuring rapid problem identification and resolution. The GUI can reside locally on the sorter and can be accessed remotely via network or Internet, enhancing the flexibility in the operating environment and easing access for remote factory troubleshooting and application assistance. The highly modular design of the G6 platform allows rapid module swapping and problem isolation. Simplified wiring eases maintenance and troubleshooting. Sophisticated real-time and on-demand diagnostics help avoid costly downtime and detect conditions that could compromise inspection.

Key Technology, Inc.
509.529.2161
Walla Walla, WA
www.key.net

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Juan Parkin Lecture

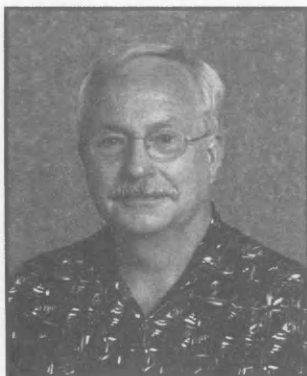
Sunday, August 14
7:00 p.m. – 8:00 p.m.

Food Safety 2005: Facts Come Easy – Answers are Elusive

Presented by

Douglas L. Archer, Ph.D.

Professor and Past Chair
Food Science and Human Nutrition Department
University of Florida
Gainesville, Florida, USA



Dr. Douglas L. Archer is a professor and Past Chair of the Food Science and Human Nutrition Department, Institute of Food and Agricultural Sciences at the University of Florida, Gainesville. He received a B.A. degree in Zoology

in 1968, a M.S. degree in Bacteriology in 1970 from the University of Maine and a Ph.D. degree in Microbiology in 1973 from the University of Maryland.

Dr. Archer served as Deputy Director, Center for Food Safety and Applied Nutrition, US Food and Drug Administration (FDA) in charge of research, regulatory and policy activities of programs including foods, food additives and food labeling; dietary supplements; seafood, cosmetics and colors. He was a Commissioned Officer in the United States Public

Health Service (USPHS) and was appointed Assistant Surgeon General in July 1990. He received numerous awards including five citations for excellence, three Meritorious Service Medals and the Distinguished Service Medal. Other awards included the 1988 Tanner Memorial Award from the Institute of Food Technologists and the J. C. Frazier Memorial Award from the University of Wisconsin in 1992. Dr. Archer retired from the USPHS on January 1, 1994.

Dr. Archer also served as Chairman of the FAO/WHO Codex Alimentarius Committee on Food Hygiene from 1984 to 1994. He is the past US Associate Editor for Food Control where he now serves on the Editorial Board, and since 1990 has been a member of the WHO Expert Advisory Panel on Food Safety.

Dr. Archer is a member of the International Association for Food Protection and the Institute of Food Technologists and also serves as an advisor to the FDA and the WHO. Dr. Archer has authored or co-authored more than 80 scientific publications and given hundreds of presentations to scientific organizations, trade organizations and consumer groups.



John H. Silliker Lecture

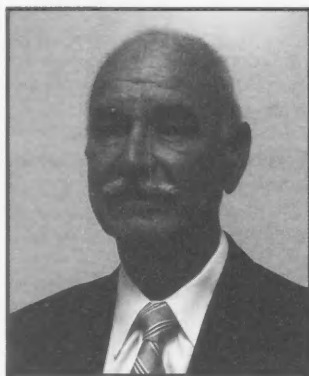
Wednesday, August 17
3:45 p.m. – 4:30 p.m.

Managing the Safety of Internationally Traded Food

Presented by

Michiel van Schothorst, Ph.D.

Retired Vice President, Food Safety Affairs
Nestlé
Vevey, Switzerland



Dr. Michiel van Schothorst studied Veterinary Medicine and obtained his Ph.D. at the University of Utrecht (NL). He began his career as a food microbiologist at the National Institute of Public Health in The Netherlands

where he became Head of the Laboratory for Zoonosis in 1975. From 1965 to 1980 Dr. Schothorst was Secretary-Treasurer of the World Association of Veterinary Food Hygienists (WAVFH).

In 1980, Dr. Schothorst continued his career at the Nestlé Head Office in Vevey, Switzerland where he was appointed Head of Quality Assurance in 1985. In 1992 he was nominated Vice President of Food Safety Affairs until he retired in 2002.

Dr. Schothorst was elected to become the first professor and European Chair in Food Safety Microbiology at the University of Wageningen (NL) in 1997. In addition he has been active in developing Quality Assurance and Food Safety programs and promoting the HACCP concept through textbooks, publications, lecturing and training.

Dr. Schothorst was a member of the Permanent Food Safety Advisory Panel of the World Health Organization from 1986-2002, participating in the Codex Food Hygiene Committee from 1968-2002. He was also a member of the International Commission on Microbiological Specifications for Foods (ICMSF) from 1973-2003 and Secretary from 1992-2003.

Dr. Schothorst participated in many FAO/WHO expert meetings on Food Safety and Public Health, and plays an active role in the WHO/ICD Food Safety training programs such as "Food Safety for Nutritionists and other Health Workers," "HACCP" and "Microbiological Risk Assessment". He is author or co-author of more than 140 scientific publications or chapters in scientific books.



IAFP 2005 Preliminary Program

SUNDAY, AUGUST 14

Opening Session – 7:00 p.m.

- Ivan Parkin Lecture – Food Safety 2005: Facts Come Easy – Answers are Elusive, Douglas L. Archer, Ph.D.

MONDAY, AUGUST 15

Morning – 8:30 a.m. – 12:00 p.m.

Symposium Topics

- Laboratory Response to Food Bioterrorism: How Prepared are We?
- Microbiological Predictive Models: Development, Use and Misuse
- Food Allergens: Concerns for the Packaged Food and Food Service Industries
- Global Water Quality Concerns
- Recent Regulatory Changes and Issues Affecting Your Dairy Operation

Technical Session

- Produce

Poster Session

- Pathogens

Afternoon – 1:30 p.m. – 5:00 p.m.

Symposium Topics

- Update on Foodborne Disease Outbreaks
- Safety Concerns of Food Chemical Contaminants
- Data for Decision Making
- Materials for Multi-Use Food Contact Surfaces: Characteristics, Fabrication, and Evaluation

Technical Session

- Foods of Animal Origin

Poster Session

- Risk Assessment and Antimicrobials

TUESDAY, AUGUST 16

Morning – 8:30 a.m. – 12:00 p.m.

Symposium Topics

- Foodborne Diseases: Discovery of Causes and Reduction Strategies
- Safety of Raw Milk Cheeses – A Global Perspective
- Yeast and Molds: When Fungi Go Bad, Who Do You Call?
- They Said What? – The Risky World of Risk Communication
- Pre-Harvest Issues Associated with the Transmission of Viruses and Parasitic Protozoa – The Problems and the Solutions

Technical Session

- Pathogens

Poster Session

- Produce and General Microbiology

Afternoon – 12:15 p.m. – 1:00 p.m.

- IAFP Business Meeting

Afternoon – 1:30 p.m. – 5:00 p.m.

Symposium Topics

- Managing the Risk of *Listeria monocytogenes* at Retail and Restaurants
- Risk and Control of *Salmonella* in Raw Nuts
- Oceans and Human Health: Trends and Practical Tools for Seafood Safety
- Risk Ranking for Foodborne Pathogens
- Enrichment Media and Sample Preparation: What's New?

Technical Session

- Antimicrobials

Poster Session

- Miscellaneous Food Commodities

WEDNESDAY, AUGUST 17

Morning – 8:30 a.m. – 12:00 p.m.

Symposium Topics

- A Behavioral Approach to Performance-based Food Safety Management – Theory, Practice and Outcome for Successful Retail Food Safety Programs
- Produce Packinghouse Sanitation: Designing and Implementing Effective Food Safety Programs
- International Food Safety Opportunities and Challenges in the Developing World
- Recent Advances in Intervention Strategies for Pathogen Control

Technical Session

- Risk Assessment
- Education

Poster Session

- Method Development for Pathogen Testing

Afternoon – 1:30 p.m. – 3:30 p.m.

Symposium Topics

- Microarray Technology: An Emerging Tool in the Food Microbiologists' Toolbox
- Pathogen Survival in Dried Fermented Meat and Partially Cooked Products
- Food Safety Objectives – Now We Have Decided to Have Them, How Do We Think They Will be Used in Food Safety Management?
- Current Practices and Innovations in Cold Chain Management for Food Products

Technical Session

- General Microbiology

Afternoon – 3:45 p.m. – 4:30 p.m.

- John H. Silliker Lecture – Managing the Safety of Internationally Traded Food, Michiel van Schothorst, Ph.D.

Subject to change



IAFP 2005

Networking Opportunities

IAFP FUNCTIONS

NEW MEMBER RECEPTION

Saturday, August 13, 2005 • 4:30 p.m. - 5:30 p.m.

If you recently joined the Association or if this is your first time attending an IAFP Annual Meeting, welcome! Attend this informal reception to learn how to get the most out of attending the Meeting and meet some of today's leaders.

AFFILIATE RECEPTION

Saturday, August 13, 2005 • 5:30 p.m. - 7:00 p.m.

Sponsored in part by Weber Scientific, Inc.

Affiliate Officers and Delegates plan to arrive in time to participate in this educational reception. Watch your mail for additional details.

COMMITTEE MEETINGS

Sunday, August 14, 2005 • 7:00 a.m. - 5:00 p.m.

Sponsored by Springer

Committees and Professional Development Groups (PDGs) plan, develop and institute many of the Association's projects, including workshops, publications, and educational sessions. Share your expertise by volunteering to serve on any number of committees or PDGs. Everyone is invited to attend.

STUDENT LUNCHEON

Sunday, August 14, 2005 • 12:00 p.m. - 1:30 p.m.

The mission of the Student PDG is to provide students of food safety with a platform to enrich their experience as Members of IAFP. Sign up for the luncheon to help start building your professional network.

OPENING SESSION AND IVAN PARKIN LECTURE

Sunday, August 14, 2005 • 7:00 p.m. - 8:00 p.m.

Join us to kick off IAFP 2005 at the Opening Session. Listen to the prestigious Ivan Parkin Lecture delivered by Douglas L. Archer, Ph.D., Professor and Past Chair, Food Science and Human Nutrition Department, University of Florida, Gainesville, Florida. He will deliver a presentation titled "Food Safety 2005: Facts Come Easy - Answers are Elusive."

CHEESE AND WINE RECEPTION

Sunday, August 14, 2005 • 8:00 p.m. - 10:00 p.m.

Sponsored by Kraft Foods, Inc.

An IAFP tradition for attendees and guests. The reception begins in the Exhibit Hall immediately following the Ivan Parkin Lecture on Sunday evening.

IAFP JOB FAIR

Sunday, August 14 through Wednesday, August 17, 2005

Employers, take advantage of recruiting the top food scientists in the world! Post your job announcements and interview candidates.

COMMITTEE AND PDG CHAIRPERSON BREAKFAST

(By invitation)

Monday, August 15, 2005 • 7:00 a.m. - 9:00 a.m.

Chairpersons and Vice Chairpersons are invited to attend this breakfast to report on the activities of your committees.

EXHIBIT HALL RECEPTION

Monday, August 15, 2005 • 5:00 p.m. - 6:15 p.m.

Sponsored by DuPont Qualicon and REMEL, Inc.

Join your colleagues in the Exhibit Hall to see the most up-to-date trends in food safety techniques and equipment. Discuss with exhibitors their latest products or use this time to view the poster presentations. Take advantage of this great networking reception.

BUSINESS MEETING

Tuesday, August 16, 2005 • 12:15 p.m. - 1:00 p.m.

You are encouraged to attend the Business Meeting to keep informed of the actions of YOUR Association.

PRESIDENT'S RECEPTION (By invitation)

Tuesday, August 16, 2005 • 5:30 p.m. - 6:30 p.m.

Sponsored by Fisher Scientific

This by invitation event is held each year to honor those who have contributed to the Association during the year.

PAST PRESIDENTS' DINNER (By invitation)

Tuesday, August 16, 2005 • 6:30 p.m. - 9:00 p.m.

Past Presidents and their guests are invited to this dinner to socialize and reminisce.

JOHN H. SILLIKER LECTURE

Wednesday, August 17, 2005 • 3:45 p.m. - 4:30 p.m.

Michiel van Schothorst, Ph.D., Retired Vice President, Food Safety Affairs, Nestlé, Vevey, Switzerland will deliver a presentation titled "Managing the Safety of Internationally Traded Food".

AWARDS BANQUET

Wednesday, August 17, 2005 • 7:00 p.m. - 9:30 p.m.

Bring IAFP 2005 to a close at the Awards Banquet. Award recipients will be recognized for their outstanding achievements and the gavel will be passed from Dr. Kathleen Glass to Incoming President Dr. Jeffrey Farber.



IAFP 2005 Event Information

EVENING EVENTS



Orioles Baseball Game

Saturday, August 13, 2005 • 3:30 p.m. - 7:30 p.m.

Play Ball! Join the fun as the Orioles take on the Toronto Blue Jays. Oriole Park at Camden Yards became the official home of the Orioles on April 6, 1992. The one-time railroad center is only 2 blocks from the birth-place of baseball's most legendary hero, George Herman "Babe" Ruth. Ruth's father operated Ruth's Cafe on the ground floor of the family residence, now center field at Oriole Park.

Oriole Park is state-of-the-art yet unique, traditional and intimate in design. It blends with the urban context of downtown Baltimore while taking its image from baseball parks built in the early 20th century. Ticket price includes admission to the game and transportation between the Baltimore Marriott Waterfront Hotel and Camden Yards.

Monday Night Social - Harbor Cruise

Monday, August 15, 2005 • 6:30 p.m. - 10:00 p.m.

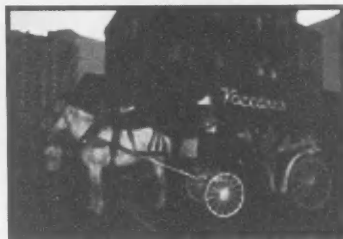


Let the good times float on a Harbor Cruise. After a short walk from the Baltimore Marriott Waterfront to the Pier, the Bay Lady will be waiting for you to come on board and enjoy the evening. The Bay Lady will take you across the harbor and along the Patapsco River, with the city skyline in view. Enjoy a fabulous spread of food within the enclosed air-conditioned deck or go up to the top deck for a refreshing breeze and the most gorgeous panoramic view of Baltimore's Historic Harbor. Get your ticket today to reserve your spot aboard the Bay Lady! Everyone is welcome.

Let the good times float on a Harbor Cruise. After a short walk from the Baltimore Marriott Waterfront to the Pier, the Bay Lady will be waiting for you to come on board and enjoy the

Little Italy Walking Tour and Dinner

Tuesday, August 16, 2005 • 6:30 p.m. - 10:30 p.m.



Take a guided walking tour through Little Italy, founded in 1849 and located in the heart of the downtown renaissance in Baltimore. Nestled between the Inner

Harbor and Historic Fells Point, the area boasts more than 20 of Maryland's best Italian restaurants and trattorias. It's so hard to pick just one of the fabulous restaurants - so tonight you'll try three! Appetizer, entrée and dessert are served in charming trattorias for which this neighborhood is known regionally. Limited tickets available.

GOLF TOURNAMENT

Golf Tournament

Saturday, August 13, 2005 • 8:45 a.m. - 4:00 p.m.



Begin IAFP 2005 with a relaxing round of golf with your friends. This year's tournament will be held at Waverly Woods Golf Club, which was recognized as the "2002 Maryland Course of the Year" for its unique design and playability. The appeal of this new but mature and lush course is its wide-landing areas for tee shots while much of the challenge comes from the small, undulating greens. Course designer Arthur Hills was selected by *Golf Digest* magazine as one of their "Top Five Favorite Present-Day Architects." Everyone is welcome to play in this fun best-ball tournament. Registration fee includes green fees, cart, range balls, transportation to and from the course, a box lunch and prizes!

DAYTIME TOURS

Welcome to Washington

Saturday, August 13, 2005 • 9:00 a.m. - 5:00 p.m.



Welcome to America's most unique city! One of the few capitals founded as a show-place and a seat of government, Washington is really several cities in one and you will get a chance to experience something of each.

This all-encompassing tour of Washington is designed to introduce you to the most magnificent monuments, memorials and architectural structures of the city. You will ride by the White House, Washington Monument, Capitol Building, Supreme Court, Library of Congress, Smithsonian Complex, as well as many other Washington attractions. You will stop at the Lincoln Memorial, World War II Monument, Vietnam Veterans Memorial, Korean War Veterans Memorial, and the Jefferson Memorial.

While visiting these sites, you will hear the story of Washington's unique city plan devised by the gifted architect, Pierre L'Enfant. L'Enfant was the master architect who envisioned placing broad avenues, dramatic vistas and plentiful parkland in what was then a swamp.

Lunch will be at Washington, D.C.'s historic Union Station, a Beaux Arts national landmark. After lunch, guests may enjoy over 100 stores in which to browse and window shop.

Baltimore City Tour by Land and by Sea

Sunday, August 14, 2005 • 10:00 a.m. - 2:00 p.m.



Guests will take a guided tour through the historic Mt. Vernon, Federal Hill and Fells Point neighborhoods. Once arriving in Fells Point, the original harbor of Baltimore, a costumed Living-History Narrator brings to life

Baltimore's colorful history with stories about real people. Lunch in an authentic Fells Point pub is also included.

Then sail aboard a blue and white Water Taxi out to the place where Francis Scott Key wrote our nation's anthem. From the water, you'll see where British ships fired on Fort McHenry in 1814.

From the fastest sailing vessels in the history of the Navy to the arrest of Southern sympathizers in City Hall at the beginning of the "War between the States", to the oldest continually working waterfront in the country, you'll take home a new opinion of Baltimore as a stalwart city of national importance.

Annapolis Past and Present

Monday, August 15, 2005 • 9:00 a.m. - 2:00 p.m.

The brick streets, the charming church, state circles around which colonial era homes and inns are built, and the history that breathes from every antique house all contribute to a fascinating day's adventure in Maryland's Capital, Annapolis.

You'll begin with a walking tour of the historic center of Annapolis. Led by costumed guides you will hear fascinating stories.



The State House, the oldest continually operating in the US, is another highlight of your visit. It is where George Washington resigned as Commander-in-Chief of the Continental Armies.

There's much more to this quaint seaport town, and as you continue your exploration, you'll walk through the US Naval Academy, with its stately brick campus, and passing Bancroft Hall Dormitory, where thousands of midshipmen are fed in a matter

of minutes; the famous Tecumseh statue, which serves as an Academy mascot; and stopping at the Chapel and at the dolphin-supported grave of Naval hero John Paul Jones.

Lunch will be served at the historic Maryland Inn. The Maryland Inn has a rich history - dating back to our country's revolutionary era.

PLEASE NOTE: Photo Identification is required for admittance to the US Naval Academy.

A Taste of Baltimore from the Inside

Tuesday, August 16, 2005 • 10:30 a.m. - 3:30 p.m.



Take a guided tour through the new world headquarters of Phillips Foods in Baltimore, where millions of crab cakes and seafood products are prepared for distribution across the country. Known for award-winning Mary-

land style crab cakes and simple dedication to quality, Phillips has served millions of seafood lovers from around the world.

Guests will see how Phillips produces more than 150 crab cakes per minute - 80,000 crab cakes a day - 20 million crab cakes per year! Then, get a true taste for blue crab with a Maryland crab cake sandwich.

Next, it's on to Clipper City Brewing Company. Clipper City is Baltimore's largest brewing facility producing hand-crafted draught and bottled beers. Enjoy complimentary samples after the tour featuring Baltimore's "best locally brewed beer."

Chesapeake Bay Cooking Class

Wednesday, August 17, 2005 • 10:00 a.m. - 1:00 p.m.



Executive Chef Jerry Pellegrino is fascinated by food and wine, and the way they work in harmony on the palate. His understanding of the two goes all the way to the molecular level, drawing on his advanced education in molecular biology. His cuisine is simple and surprising, pairing unexpected ingredients together

to work with wines from the US.

Participate and observe as the Chef prepares regional specialties step-by-step. You will dine on the chef's creations and learn about what makes a wine complement or clash with cuisine.

Each course will be served with Maryland wines - Cheers!



IMPORTANT! Please read this information before completing your registration form.

MEETING INFORMATION

Register to attend the world's leading food safety conference.

Full Registration includes:

- Technical Sessions
- Symposia
- Poster Presentations
- Ivan Parkin Lecture
- John H. Silliker Lecture
- Awards Banquet
- Exhibit Hall Admittance
- Cheese and Wine Reception
- Exhibit Hall Reception
- Program and Abstract Book

4 EASY WAYS TO REGISTER

Complete the Attendee Registration Form and submit it to the International Association for Food Protection by:



Online: www.foodprotection.org



Fax: 515.276.8655



Mail: 6200 Aurora Avenue, Suite 200W
Des Moines, IA 50322-2864, USA



Phone: 800.369.6337; 515.276.3344

The early registration deadline is July 13, 2005. After this date, late registration fees are in effect.

REFUND/CANCELLATION POLICY

Registration fees, less a \$50 administration fee and any applicable bank charges, will be refunded for written cancellations received by July 29, 2005. No refunds will be made after July 29, 2005; however, the registration may be transferred to a colleague with written notification. Refunds will be processed after August 22, 2005. Event and tour tickets purchased are nonrefundable.

STUDENT FUNDRAISER

Help support the students with their annual fund raiser. See page 318 to order T-shirts or polo shirts.



International Association for
Food Protection®

EXHIBIT HOURS

Sunday, August 14, 2005	8:00 p.m. - 10:00 p.m.
Monday, August 15, 2005	8:00 a.m. - 11:00 a.m. 1:00 p.m. - 6:15 p.m.
Tuesday, August 16, 2005	8:00 a.m. - 2:00 p.m.

DAYTIME TOURS - Lunch included

Saturday, August 13, 2005	9:00 a.m. - 5:00 p.m.
Welcome to Washington	
Sunday, August 14, 2005	10:00 a.m. - 2:00 p.m.
Baltimore City Tour by Land and by Sea	
Monday, August 15, 2005	9:00 a.m. - 2:00 p.m.
Annapolis Past and Present	
Tuesday, August 16, 2005	10:30 a.m. - 3:30 p.m.
A Taste of Baltimore from the Inside	
Wednesday, August 17, 2005	10:00 a.m. - 1:00 p.m.
Chesapeake Bay Cooking Class	

EVENING EVENTS

Saturday, August 13, 2005	3:30 p.m. - 7:30 p.m.
Orioles Baseball Game	
Sunday, August 14, 2005	7:00 p.m. - 8:00 p.m.
Opening Session	
Monday, August 15, 2005	8:00 p.m. - 10:00 p.m.
Cheese and Wine Reception <i>Sponsored by Kraft Foods North America</i>	
Monday, August 15, 2005	5:00 p.m. - 6:30 p.m.
Exhibit Hall Reception <i>Sponsored by DuPont Qualicon and REMEL, Inc.</i>	
Monday, August 15, 2005	6:30 p.m. - 10:00 p.m.
Monday Night Social - Harbor Cruise	
Tuesday, August 16, 2005	6:30 p.m. - 10:30 p.m.
Little Italy Walking Tour and Dinner	
Wednesday, August 17, 2005	6:00 p.m. - 7:00 p.m.
Awards Banquet Reception	
Wednesday, August 17, 2005	7:00 p.m. - 9:30 p.m.
Awards Banquet	

GOLF TOURNAMENT

Saturday, August 13, 2005	8:45 a.m. - 4:00 p.m.
Golf Tournament at Waverly Woods Golf Club	

HOTEL INFORMATION

For reservations, contact the hotel directly and identify yourself as an IAFP 2005 attendee to receive a special rate of \$149 per night, single/double or make your reservations online. This special rate is available only until July 13, 2005 or until sold out.

Baltimore Marriott Waterfront Hotel
700 Aliceanna St.
Baltimore, Maryland 21202
Phone: 800.228.9290 • 410.385.3000 • Fax: 410.895.1910
Web site: www.stayatmarriott.com/IAFP2005
(Group Code ialfa)

TRAVEL DISCOUNTS

Visit our Web site at www.foodprotection.org for air travel, Amtrak and rental car information.



Attendee Registration Form

Member Number: _____

First name (as it will appear on your badge) _____ Last name _____

Employer _____ Title _____

Mailing Address (Please specify: Home Work) _____

City _____ State/Province _____ Country _____ Postal/Zip Code _____

Telephone _____ Fax _____ E-mail _____

Regarding the ADA, please attach a brief description of special requirements you may have.

Member since: _____

IAFP occasionally provides Attendees' addresses (excluding phone and E-mail) to vendors and exhibitors supplying products and services for the food safety industry. If you prefer NOT to be included in these lists, please check the box.

PAYMENT MUST BE RECEIVED BY JULY 13, 2005 TO AVOID LATE REGISTRATION FEES

REGISTRATION FEES:

Registration _____
 Association Student Member _____
 Retired Association Member _____
 One Day Registration* Mon. Tues. Wed. _____
 Spouse/Companion* (Name): _____
 Children 15 & Over* (Names): _____
 Children 14 & Under* (Names): _____
 *Awards Banquet not included

MEMBERS	NONMEMBERS	TOTAL
\$ 385 (\$ 435 late)	\$ 583 (\$633 late)	_____
\$ 78 (\$ 88 late)	Not Available	_____
\$ 78 (\$ 88 late)	Not Available	_____
\$ 210 (\$235 late)	\$ 320 (\$345 late)	_____
\$ 55 (\$ 55 late)	\$ 55 (\$ 55 late)	_____
\$ 25 (\$ 25 late)	\$ 25 (\$ 25 late)	_____
FREE	FREE	_____

EVENING EVENTS:

Golf Tournament (Saturday, 8/13) _____
 Baseball Game (Saturday, 8/13 - 3:30 p.m. - 7:30 p.m.) _____
 Student Luncheon (Sunday, 8/14) _____
 Monday Night Social - Harbor Cruise (Monday, 8/15)
 Children 14 and under _____
 Tuesday Evening - Little Italy Walking Tour and Dinner (Tuesday, 8/16) _____
 Additional Awards Banquet Ticket (Wednesday, 8/17) _____

# OF TICKETS	TOTAL
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
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_____	_____
_____	_____
_____	_____
_____	_____

DAYTIME TOURS: (Lunch included in daytime tours)

Welcome to Washington (Saturday, 8/13) _____
 Baltimore City Tour by Land and by Sea (Sunday, 8/14) _____
 Annapolis Past and Present (Monday, 8/15) _____
 A Taste of Baltimore from the Inside (Tuesday, 8/16) _____
 Chesapeake Bay Cooking Class (Wednesday, 8/17) _____

# OF TICKETS	TOTAL
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

PAYMENT OPTIONS:

Check Enclosed
 Credit Card # _____
 Name on Card _____
 Signature _____

Check box if you are a technical, poster, or symposium speaker.

TOTAL AMOUNT ENCLOSED \$ _____
US FUNDS on US BANK

Expiration Date _____

JOIN TODAY AND SAVE!!!
(Attach a completed Membership application)



International Association for
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6200 Aurora Avenue, Suite 200W
 Des Moines, IA 50322-2864, USA
 Phone: 800.369.6337 • 515.276.3344
 Fax: 515.276.8655
 E-mail: info@foodprotection.org
 Web site: www.foodprotection.org

EXHIBITORS DO NOT USE THIS FORM

STUDENT FUNDRAISER!



Purchase an IAFP 2005 long-sleeve T-shirt or Polo Shirt from the Student PDG to help raise money in support of our Students. Pre-ordered T-shirts are \$18.00 and Polo shirts are \$25.00. Shirts will be available for pick-up from the SPDG booth throughout IAFP 2005. All order forms are due by July 13th. If you have any questions, contact Renee Raiden at rraiden@vt.edu.

IAFP SPDG Shirt Order Form

If you choose to pay by credit card, make sure you include the amount to be charged. If you are paying by check make checks payable to IAFP and enclose the check with your order form. Please mail order forms for receipt by July 13, 2005 for pre-orders.

Please return order form to the following address: Renee Raiden, Virginia Tech, 22 Food Science Bldg., Blacksburg, VA 24061-0418; Fax: 540.231.9293.

Name _____ Title _____

Mailing Address _____

City _____ State/Province _____ Country _____ Postal/Zip Code _____

Telephone _____ Fax _____ E-mail _____

Quantity _____ **T-shirts** S M L XL \$18.00
 (long-sleeve)

Polo Shirts S M L XL \$25.00

METHOD OF PAYMENT:   
 (Payable to IAFP)

TOTAL AMOUNT ENCLOSED \$ _____
US FUNDS on US BANK

Check or Money Order Enclosed

Credit Card # _____

Name on Card _____

Signature _____

Expiration Date _____

Contribute to the Eighth Annual Foundation Fund Silent Auction Today!



The Foundation of the International Association for Food Protection will hold its Annual Silent Auction during IAFP 2005, the Association's 92nd Annual Meeting in Baltimore, Maryland, August 14-17, 2005. The Foundation Fund supports:

- Ivan Parkin Lecture
- Travel support for exceptional speakers at the Annual Meeting
- Audiovisual Library
- Developing Scientist Competition
- Shipment of volumes of surplus *JFP* and *FPT* journals to developing countries through FAO in Rome

Support the Foundation by donating an item today. A sample of items donated last year included:

- Bausch & Lomb Student Microscope
- Brazil Cook's Tour
- Country Cured Ham
- Cultured Pearl Necklace
- The Food Safety Professional Guide Set
- Georgia Gift Basket
- International Food Safety Icons CD
- New York State Pure Maple Syrup
- Premium Export Brandy
- Wine

Complete the form and send it in today.



Description of Auction Items _____

Estimated Value _____

Name of Donor _____

Company (if relevant) _____

Mailing Address _____
(Please specify: Home Work)

City _____ State or Province _____

Postal Code/Zip + 4 _____ Country _____

Telephone # _____ Fax # _____

E-mail _____

Return to:

Donna Gronstal
International Association for Food Protection
6200 Aurora Avenue, Suite 200W
Des Moines, IA 50322-2864, USA
800.369.6337; 515.276.3344
Fax: 515.276.8655
E-mail: dgronstal@foodprotection.org



International Association for
Food Protection®



2005 Workshops

WORKSHOP 1 METHODS

Friday, August 12

1:00 p.m. to 5:00 p.m.

*Statistics as a Tool for the
Microbial Evaluation of Foods*

Saturday, August 13

8:00 a.m. to 4:30 p.m.

*Methods, Methods Everywhere
but Which is Right for Me?
Selection and Verification
of Methods*

WORKSHOP 2 TRENDING DATA

Friday, August 12

1:00 p.m. to 5:00 p.m.

*Statistics as a Tool for the
Microbial Evaluation of Foods*

Saturday, August 13

8:00 a.m. to 4:30 p.m.

*Out of the Filing Cabinet
and Into Use: Real World
Experience with Trending Data*

WORKSHOP 3 FOODBORNE INVESTIGATIONS

Friday and Saturday

August 12-13

8:00 a.m. to 5:00 p.m.

*Epidemiology and Foodborne
Illness: How Disease
is Detected and How
Investigations Proceed*



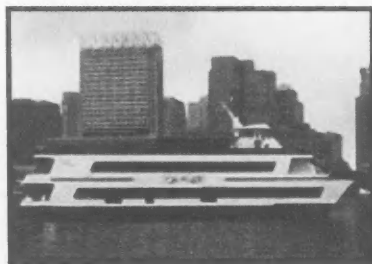
Monday Night Social – Harbor Cruise

Monday, August 15, 2005

6:30 p.m. – 10:00 p.m.

Cost: \$45.00 ♦ \$55.00 after July 13

Price includes dinner



Purchase your ticket online at www.foodprotection.org
or call the Association office at 800.369.6337; 515.276.3344

Take advantage of one of your Member benefits:

IAFP Online Membership Directory

All you need is your Member number and password
(your last name).

If you have any questions,
E-mail Julie Cattanach at
jcattanach@foodprotection.org

Order Your Before Disaster Strikes Booklet Today!

**Before Disaster Strikes...
A Guide to Food Safety in the Home**

Available in Spanish

See page 331 in this issue of *FPT*
or Contact the Association office
at 800.369.6337; 515.276.3344

Go to our Web site at
www.foodprotection.org
and place your order.



**BEFORE
DISASTER STRIKES...**

**A GUIDE
TO FOOD SAFETY
IN THE HOME**

 International Association for
Food Protection
6200 Aurora Ave., Suite 0300W
Des Moines, IA 50322-2864

COMING EVENTS

MAY

- **1-3, 2005 Food Marketing Institute Show**, McCormick Place Convention Center, Chicago, IL. For more information, call 202.220.0657; E-mail: fmi@fmi.org.
- **1-3, ADPI/ABI Annual Conference**, Fairmont Hotel, Chicago, IL. For more information, call ADPI at 630.530.8700; E-mail: info@adpi.org.
- **2-6, Thermal Processing: Principles & Practices in Food Preservation**, Guelph Food Technology Centre, Guelph, Ontario, Canada. For more information, contact Marlene Inglis at 519.821.1246; E-mail: minglis@gftc.ca.
- **11-12, Essentials of Auditing Management**, Las Vegas, NV. For more information, call 708.957.8449 or go to www.silliker.com.
- **12-14, Interbake China 2005**, Guangzhou International Conventional and Exhibition Center, Guangzhou, China. For more information, contact Ms. Athena Wu at 86.20.87746095; E-mail: sales@faircanton.com or go to www.faircanton.com.
- **12-17, The 30th National Conference on Interstate Milk Shipments**, Hyatt on Capitol Square, Columbus, OH. For more information, contact Leon Townsend at 502.695.0253; E-mail: ltownsend@ncims.org.
- **17-18, Breaking News on Practical HACCP and Food Safety**, Oakfield Farm, Johannesburg, Gauteng, South Africa. For more information, contact Susan Peterson at (011)609.5886; E-mail: haccp@telkomsa.net.
- **17-18, Pennsylvania Association of Milk, Food and Environmental Sanitarians Annual Spring Meeting**, Penn State University, State College, PA. For more information, contact Gene Frey at 717.397.0719; E-mail: erfrey@landolakes.com.
- **17-19, Intermediate Laboratory Methods in Food Microbiology**, South Holland, IL. For more information, call 708.957.8449 or go to www.silliker.com.
- **18, Allergen Program Toolkit for Food Service & Retail**, Guelph Food Technology Centre, Guelph, Ontario, Canada. For more information, contact Marlene Inglis at 519.821.1246; E-mail: minglis@gftc.ca.

- **19, Ohio Association of Food and Environmental Sanitarians Spring Meeting**, Waldo, OH. For more information, contact Gloria Swick-Brown at 614.466.7760; E-mail: gswick@odh.ohio.gov.
- **23-26, 3-A SSI Annual Meeting**, Four Points by Sheraton Milwaukee, Milwaukee, WI. For more information, contact Timothy Rugh at 703.790.0295; E-mail: trugh@3-a.org.
- **23-26, AOAC Midwest Section Meeting and Expo**, Kansas City, MO. For more information, contact Ron Jenkins at 816.891.0442; Web site: www.midwestaoac.org.
- **24, Associated Illinois Milk, Food and Environmental Sanitarians Annual Spring Meeting**, Bloomington, IL. For more information, contact Don Wilding at 217.785.2439; E-mail: dwilding@idph.state.il.us.
- **24-26, Penn State Food Microbiology Short Course Detection and Control of Foodborne Pathogens**, Penn State University, Berks-Lehigh Valley College, Reading, PA. For more information, contact Dr. Hassan Gourama at 610.396.6121; E-mail: hxg7@psu.edu; http://foodsafety.cas.psu.edu.
- **31, Microbiology VI: Salmonella Control**, Guelph Food Technology Centre, Guelph, Ontario, Canada. For more information, contact Marlene Inglis at 519.821.1246; E-mail: minglis@gftc.ca.

JUNE

- **6, HACCP for On-line Supervisors**, GFTC, Guelph, Ontario, Canada. For more information, contact Marlene Inglis at 519.821.1246; E-mail: minglis@gftc.ca.
- **7-8, Sensory Evaluation, Part I**, GFTC, Guelph, Ontario, Canada. For more information, contact Marlene Inglis at 519.821.1246; E-mail: minglis@gftc.ca.
- **8, Texas Association for Food Protection Annual Meeting**, Omni Hotel, Austin, TX. For more information, contact Tom Supak at 979.836.7977; E-mail: tommy.supak@bluebell.com.
- **9-10, Sensory Evaluation, Part II**, GFTC, Guelph, Ontario, Canada. For

more information, contact Marlene Inglis at 519.821.1246; E-mail: minglis@gftc.ca.

- **12-15, 4th IDF International Mastitis Conference**, Maastricht, The Netherlands. For more information, go to www.fil-idf.org/mastitis2005.
- **13-14, Brazil Association for Food Protection Annual Meeting**, Conselho Regional de Química do Estado de São Paulo, São Paulo, SP, Brazil. For more information, contact Maria Teresa Destro at 55.113.091.2199; E-mail: mtdestro@usp.br.
- **15-17, Advanced Meat Processing**, GFTC, Guelph, Ontario, Canada. For more information, call 519.821.1246; E-mail: gftc@gftc.ca.
- **16-24, XXV Quarter Century Gala International Workshop/Symposium on Rapid Methods and Automation in Microbiology**, Kansas State University, Manhattan, KS. For more information, contact Daniel Y. C. Fung at 785.532.5654; E-mail: dfung@oznet.ksu.edu.
- **29-30, 4th European Young Cereal Scientists and Technologists Workshop**, Vienna, Austria. For more information, call 32.16204035 or go to www.boku.ac.at/dlwt.

JULY

- **12-14, HTST Pasteurization and Controls Seminar**, LaQuinta Inns & Suites, San Antonio, TX. For more information, call 210.628.1596; E-mail: mvk1030@aol.com.

AUGUST

- **12-13, IAFFP 2005 Workshops**, See page 320 of this issue.
- **14-17, IAFFP 2005, the Association's 92nd Annual Meeting**, Baltimore Marriott Waterfront Hotel, Baltimore, MD. For more information, see page 317 of this issue or contact Julie Cattanach at 800.369.6337; E-mail: jcattanach@foodprotection.org.
- **15-19, Culinology Arts for Food Technologists, A Culinology® Work-**

COMING EVENTS

shop, The Culinary Institute of America, St. Helena, CA. For more information, contact Deb North at 404.252.3663; E-mail: dnorth@kellencompany.com.

SEPTEMBER

- **11-14, 4th International Whey Conference**, Chicago, IL. For more information, contact James Page at 630.530.8700 or go to www.IWC-2005.org.
- **20-22, New York State Association for Food Protection Annual Meeting**, Holiday Inn, Liverpool, NY. For more information, contact Janene

Lucia at 607.255.2892; E-mail: jgg3@cornell.edu.

- **20-22, Washington Association for Food Protection Annual Conference**, Campbells Resort on Lake Chelan, Chelan, WA. For more information, contact Bill Brewer at 206.363.5411; E-mail: billbrewer1@juno.com.
- **23-27, The 7th International Exhibition on Food & Drink Industry**, International Exhibition & Convention Center, Hochiminh City, Vietnam. For more information, contact Nguyen Ba Vinh at 84.90340.6383; E-mail: vinhba@hn.vnn.vn.

OCTOBER

- **11-13, HTST Pasteurization and Controls Seminar**, LaQuinta Inns & Suites, San Antonio, TX. For more information, call 210.628.1596; E-mail: mvk1030@aol.com.
- **11-13, North Dakota Environmental Health Association Annual Meeting**, Holiday Inn, Fargo, ND. For more information, contact Deb Larson at 701.328.1291; E-mail: djlarson@state.nd.us.

IAFP UPCOMING MEETINGS

AUGUST 14-17, 2005
Baltimore, Maryland

AUGUST 13-16, 2006
Calgary, Alberta, Canada

JULY 8-11, 2007
Lake Buena Vista, Florida

AUGUST 3-6, 2008
Columbus, Ohio

CAREER SERVICES SECTION

ASSISTANT OR ASSOCIATE PROFESSOR OF PRE-HARVEST SAFETY OF FOODS OF ANIMAL ORIGIN

The Department of Large Animal Clinical Sciences, College of Veterinary Medicine and the National Food Safety and Toxicology Center at Michigan State University are seeking applicants for a faculty position to foster and support the pre-harvest safety of food products of animal origin. This is a tenure-track position with annual-year appointment at the rank of assistant or associate professor. The major responsibility is to direct and expand the on-line Professional Masters (ProMS) in Food Safety program. This includes developing a high-quality, scholarly program of instruction in the area of pre-harvest safety of food products of animal origin. In addition to the on-line program, this person will be expected to contribute to undergraduate, graduate, and professional instruction in the University. A primary emphasis will be placed on leadership in distance education. An additional responsibility is to enhance cooperation and facilitate the creation of new, cooperative programs among the Department of Large Animal Clinical Sciences, the National Food Safety and Toxicology Center, the Diagnostic Center for Population and Animal Health, and external partners. The successful candidate will be expected to develop a creative, independent, and productive research program in the safety of food products of animal origin, including publication of the results in professional/scientific journals.

The National Food Safety and Toxicology Center is an integrative unit at MSU, with faculty from many departments contributing to its mission to reduce food-related disease globally through research, education, and outreach. Pre-harvest safety of food products of animal origin refers to safety considerations in the production and transport of live-stock, through the slaughter process. The on-line, Professional Master of Science in Food Safety Program at Michigan State University is an accredited Master of Science in Food Safety degree program offered through the College of Veterinary Medicine. This is a non-thesis program intended for mid-career/mid-management working professionals.

Qualifications: DVM degree or equivalent and PhD, MPH, or equivalent post graduate degree with an emphasis in the pre-harvest safety of foods of animal origin. This could range from animal production through animal transport and slaughter processing. Familiarity with food animal production and processing systems. Knowledge and experience with applied epidemiological methods is desirable. Demonstrated experience and skills in distance education. Although experience teaching an on-line course will be of benefit, greater emphasis in selection for this position will be placed on organizational aspects of on-line teaching and an understanding of its potential impact on the educational landscape. Excellent speaking and writing skills and the ability to communicate effectively with professional peers and colleagues, livestock producers, and students. Excellent skills in networking and partnership development.

The application deadline is June 30, 2005, or until a suitable candidate is identified. Contact Dr. Barbra Straw, Search Committee Chairperson, Department of Large Animal Clinical Sciences, Michigan State University, East Lansing, MI 48824.

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CAREER SERVICES SECTION

Director of Regulatory Affairs, Scientific and Regulatory Affairs Department

The National Milk Producers Federation (NMPF) is seeking a full-time Director of Regulatory Affairs for the Scientific and Regulatory Affairs department. NMPF, based in Arlington, VA, develops and carries out policies that advance the well-being of U.S. dairy producers and the cooperatives they collectively own. The members of NMPF's 32 cooperatives produce the majority of the U.S. milk supply, making NMPF the voice of nearly 50,000 dairy producers on Capitol Hill and with government agencies.

We are seeking an individual who possesses good written and oral communications skills and is organized, detail-oriented, able to handle multiple tasks, able to meet short deadlines with a positive attitude and is proficient in general computer software applications, including Microsoft Word, Excel, PowerPoint, and Outlook.

Qualifications:

- MS or Ph.D. (preferred) in Food Science, Dairy Science, or related field.
- Experience interpreting and working with technical regulations and standards.
- Experience interacting with regulatory agencies.

Specific Responsibilities:

- Support the Vice President of Scientific and Regulatory Affairs in developing and managing the scientific and technical support activities to achieve NMPF public policy objectives related to public health, food safety, food security, nutrition, standards of identity, and international standards.
- Identify and address scientific and technical elements of current and proposed regulations impacting dairy producers and processors.
- Provide relevant and substantive assistance to NMPF members on a wide variety of technical issues.
 - Manage and conduct liaison activities with key federal and state regulatory agencies, international organizations, scientific, professional, and technical information groups.
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- * Provide support for enhancing and improving in-plant environmental controls.

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- * 5-10 years of experience in Food Industry (with BS). 1-4 years of experience in Food Industry (with MS).
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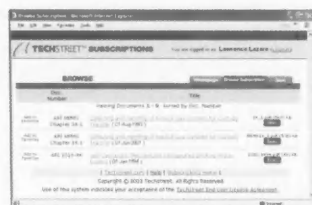


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ERRATUM

In the article "Inhibition of *Listeria monocytogenes* and *Salmonella* by Natural Antimicrobials and High Hydrostatic Pressure in Simulated Cooked Bacon," by Aymerich et al., that appears in the *Journal of Food Protection* 68(1):173-177, Figures 1 and 2 are reversed. The figures for the figures are accurate and correspond to the text.

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- F2153 Tape 2: Personnel and Personnel Facilities
- F2154 Tape 3: Building and Facilities
- F2155 Tape 4: Equipment and Utensils
- F2160 Tape 5: Production and Process Controls
- F2161 GMP: Sources & Control of Contamination during Processing
- F2162 *GMPs for Food Plant Employees: 5 Volume Video Series Based on European Standards and Regulations*
- F2163 Tape 1: Definitions
- F2164 Tape 2: Personnel and Personnel Facilities
- F2165 Tape 3: Building and Facilities
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The International Association for Food Protection (IAFP) Foundation Fund was established in the 1970s to support the mission of IAFP – “To provide food safety professionals worldwide with a forum to exchange information on protecting the food supply.”

Advancing Food Safety Worldwide®

We live in a global economy and the way food is grown, processed, and handled can impact people around the world. From a public health perspective, it often provides unique challenges to food safety professionals. Combine these issues with the complexity of protecting the food supply from food security threats and the challenges seem overwhelming. However, with your support the Foundation can make an impact on these issues. Funds from the Foundation help to sponsor travel for deserving scientists from developing countries to our Annual Meeting, sponsor international workshops, and support the future of food science through scholarships for students or funding for students to attend IAFP Annual Meetings.

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