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Manufacture of Dairy Products From Unpasteurized Milk: A Safety Assessment

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ABSTRACT

The prevalence of *Salmonella, Campylobacter,* and *Yersinia* spp. in the food chain, and the more recent emergence of *Listeria monocytogenes* and hemorrhagic *Escherichia coli* as foodborne pathogens, are of public health concern. The ability of some of these bacterial agents to grow in milk and dairy products, to survive prolonged periods of refrigerated storage, and to withstand thermal treatments of raw milk at subpasteurizing temperatures, place new emphasis on the need for stringent control of milk processing operations and plant environment. Mandatory use of pasteurized milk may provide the only viable option for production of pathogen-free milk products.

The incidence of foodborne outbreaks of bacterial etiology has steadily increased in recent years. In addition to the familiar class of disease agents such as *Salmonella* spp., *Staphylococcus aureus, Bacillus cereus, Campylobacter jejuni, Clostridium perfringens,* and *Yersinia enterocolitica*, a new generation of foodborne pathogens consisting of *Listeria monocytogenes*, hemorrhagic *Escherichia coli,* and *Streptococcus zooepidemicus* has emerged. The presence of bacterial pathogens in raw milk and the widespread use of heat-treated (non-pasteurized) milk in the manufacture of dairy products is of concern.

Consumption of adulterated foods frequently engender enterocolitic symptoms that may include diarrhea, abdominal pain, fever, prostration, nausea, and vomiting. Although foodborne infections and intoxications are generally self-limiting, they can degenerate into more serious chronic conditions (*6*). Bacterial infection represents the outcome of a confrontation between natural host defenses and bacterial virulence factors. Structural host defenses against attachment of pathogens to the intestinal wall (colonization) rest on the synergism between mucosal goblet cell secretion of mucus, intestinal peristalsis, and sloughing of lumenal epithelium (*94*). To counter such cleansing mechanisms, infectious agents elaborate proteinaceous adhesins in their cell wall (fimbriae or other outer membrane proteins) which specifically bind to receptors on the intestinal mucosa (*14,21,81*). Following colonization of the intestinal mucosa, the course of the infection differs with invasive and non-invasive agents. An invasive microorganism such as *Salmonella* spp. penetrates lumenal epithelial cells and the lamina propria where it induces an inflammatory response with concurrent production of diarrheagenic enterotoxin (*73*). The latter activates adenylate or guanylate cyclase enzymes in epithelial cells which potentiate a net efflux of electrolytes and water into the lumen. In contrast, Shiga, Vero (VT), and Shigella-like (SLT) cytotoxins are inhibitory in their action; they block protein synthesis with ensuing death of the host cell (*73*). Non-invasive pathogens do not penetrate epithelial cells but remain attached to the mucosal surface (colonization) where they elaborate and secrete enterotoxins and/or cytotoxins (*94*).

Recent surveys have identified a variety of bacterial infectious agents in raw milk (Table 1). Although the incidence of contaminated samples is generally low, the presence of *L. monocytogenes* in 45% of raw milk samples in Spain (*19*) and of *Y. enterocolitica* in 83.9% of milk tested in France (*89*) is of significance. Recoveries of *L. monocytogenes* (12.0%) and *Salmonella* spp. (4.7%) in raw milk from the United States are of special interest because these values correspond to the levels of contamination on dairy farms implicated in the outbreak of listeriosis in Massachusetts in which 14/49 cases died (*32*), and in the massive outbreak of *S. typhimurium* in Illinois where >16,000 confirmed cases of illness were reported (*46*).

The widespread occurrence of pathogenic bacterial species in raw milk inevitably led to numerous outbreaks linked to milk and dairy products (Table 2). Consumption of certified raw milk in California and neighbouring States was the cause of recurrent episodes of human *S. dublin* infections with disturbing numbers of fatalities. Distribution of contaminated raw milk by local dairies led to three large community outbreaks in Australia (1976) and in Scotland (1976 and 1981). The importance of *C. jejuni* type 2 infections in more than 500 rally participants in Switzerland who had consumed a raw milk chocolate drink

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TABLE 1. *Incidence of foodborne pathogens in raw milk.*

Agent	Country	Number of Samples		Reference
		Tested	Percent Positive	
B. cereus	United States (1982)	100	9	Ahmed et al (*1*)
C. jejuni	United States (1981)	108	0.9	Doyle and Roman (*22*)
	Netherlands (1981)	200	0	Oosterom et al (*59*)
	United States (1982)	195	1.5	Lovett et al (*50*)
	England (1984-87)	1138	6.0	Humphrey & Hart (*39*)
E. coli 0157:H7	United States (1986)	24	4.2	Wells et al (*92*)
	Canada (1986)	1012	2.0	Clarke et al (*11*)
Listeria monocytogenes	Spain (1982-83)	95	45.0	Dominguez et al (*19*)
	United States (1983)	121	12.0	Hayes et al (*38*)
	United States (1984)	650	4.1	Lovett (*49*)
	France (1986)	337	4.2	Gledel (*36*)
	Canada (1986)	445	1.3	Farber et al (*28*)
Salmonella spp.	United States (1985)	678	4.7	McManus & Lanier (*54*)
	Canada (1985-86)	511	2.9	McEwen et al (*53*)
	England (1984-87)	1138	0.2	Humphrey & Hart (*39*)
Yersinia enterocolitica	Canada (1977)	131	22.1	Schiemann & Toma (*72*)
	France (1980)	56	83.9	Vidon & Delmas (*89*)
	United States (1982)	100	12.0	Moustafa et al (*57*)
	Northern Ireland (1985)	150	11.3	Walker & Gilmour (*90*)

is overshadowed only by the numerous family and community outbreaks of *C. jejuni* reported in the United Kingdom (*75*). Identification of a new foodborne pathogen, *Streptococcus zooepidemicus*, in a small milkborne episode in England and Wales is noteworthy by virtue of its rare association with foods and high virulence. The Canadian episode of *Y. enterocolitica* infections in 1975 was attributed to the consumption of unpasteurized milk at a maple sugar bush outing.

The number of incidents from pasteurized milk is equally significant (Table 2). Although such occurrences do not question the efficacy of the pasteurization process nor the safety of properly pasteurized products, they do caution against potential post-process contamination of dairy products and need for stringent time-temperature control of thermal processes. In 1976, pasteurized chocolate milk was incriminated in a large outbreak of *Y. enterocolitica* 0:8 which involved many children, some of whom underwent needless appendectomies. Although no processing deficiencies were uncovered in the implicated plant, it was suggested that post-process addition of chocolate syrup may have favored late contamination of the dairy product. Chocolate milk was also linked to a more recent outbreak of >860 cases of *S. aureus* intoxication in the United States (1985). Involvement of *Y. enterocolitica* 0:13 serotype in a foodborne episode in the United States (1982) was highly unusual because this serogroup had been previously associated with monkeys only (*71*). It was suggested that transportation of milk cartons to retail outlets in crates contaminated with mud from a pig farm, together with cross-contamination of the pasteurized product through consumer handling, and growth of *Y. enterocolitica* during refrigerated storage of milk in the home potentiated this outbreak. Both outbreaks of *C. jejuni* in the United Kingdom (1979 and 1982) involved schoolchildren. The first milkborne outbreak of listeriosis of unknown cause in the State of Massachusetts (1983) claimed the lives of 14 of 49 affected persons. More recently, consumption of milk laden with multiply-resistant *S. typhimurium* resulted in the largest foodborne outbreak in the United States where 16,284 confirmed cases of salmonellosis and 7 deaths were reported. Although intensive plant investigation failed to ascertain the cause of this epidemic, a cross-connection between raw and pasteurized milk lines may have been at fault.

From the historical milk powder outbreak of *S. newbrunswick* in 1965 to the more recent incident of *S. ealing* in an infant powdered milk preparation in the United Kingdom, several important episodes associated with *Y. enterocolitica, S. derby,* and *C. perfringens* have been reported (Table 2). Contamination of the milk drying plant environment, use of large volumes of filtered air for drying, and physical deterioration of milk dryer walls thus providing a unique ecological niche for the survival and growth of pathogens have played a determinant role in the occurrence of powdered milk outbreaks (*10,66,91*).

Cheese adulterated with one of several infectious agents played an important role in the epidemiology of foodborne disease (Table 2). Pasteurized Cheddar cheese contaminated with *S. heidelberg* at levels of 0.36-1.8 cells/100 g was at the origin of a multistate outbreak whose underlying cause remains unknown. Plant investigations suggested that holding of raw milk for 1-3 d in non-refrigerated tanks may have resulted in high numbers of salmonellae that over-extended the efficacy of the pasteurization process. Violative filtering of milk after rather than before pasteurization was also entertained as a possible contributing factor in product defect (*33*). In 1984, Canada witnessed its largest outbreak from cheese where consumption of pasteurized or heat-treated (non-pasteurized) Cheddar resulted

TABLE 2. *Large outbreaks associated with milk and milk products.*

Country	Agent	Number		Reference
		Cases	Deaths	
Raw Milk				
United States (1974)	*S. dublin*	74	18	Kamei et al (*42*)
Canada (1975)	*Y. enterocolitica*	138	0	deGrace et al (*18*)
Australia (1978)	*S. typhimurium*	500	0	Seglenieks & Dixon (*74*)
Scotland (1978)	*S. dublin*	190	0	Small & Sharp (*78*)
Scotland (1981)	*S. typhimurium*	654	2	Cohen et al (*12*)
Switzerland (1981)	*C. jejuni*	500	0	Stalder et al (*79*)
England & Wales (1984)	*S. zooepidemicus*	12	8	Edwards et al (*26*)
Canada (1988)	*E. coli* O157:H7	30	0	Duncan et al (*24*)
Pasteurized Milk				
United States (1976)	*Y. enterocolitica* 0:8	222	0	Black et al (*8*)
United Kingdom (1979)	*C. jejuni*	324	0	Jones et al (*41*)
United States (1982)	*Y. enterocolitica* 0:13	172	0	Aulisio et al (*7*) Tacket et al (*83*)
England & Wales (1982)	*C. jejuni*	400	0	Anon (*5*)
United States (1983)	*L. monocytogenes*	49	14	Fleming et al (*32*)
United States (1985)	*S. typhimurium*	18,284	7	Lecos (*46*) Ryan et al (*67*)
Sweden (1985)	*S. saintpaul*	153	0	Andersson et al (*2*)
United States (1985)	*S. aureus*	860	0	Lecos (*45*)
Powdered Milk				
United States (1965-66)	*S. newbrunswick*	29	0	Bryan (*10*)
Trinidad (1976)	*S. derby*	3,000	0	Weissmar et al (*91*)
United States (1981)	*Y. enterocolitica*	239	0	Shayegani et al (*76*)
United Kingdom (1980)	*C. perfringens*	77	0	Anon (*4*)
United Kingdom (1985)	*S. ealing*	48	1	Rowe et al (*66*)
Whipped Butter				
United States (1977)	*S. aureus*	100	0	Anon (*3*)
Cheese				
Cheddar				
United States (1976)	*S. heidelberg*	339	0	Fontaine et al (*33*)
Canada (1984)	*S. typhimurium* PT10	1500	0	D'Aoust et al (*15*)
Emmental				
Canada (1977)	*S. aureus* (SEB)	15	0	Todd et al (*88*)
Mozzarella				
Italy (1981)	*S. typhimurium*	100	0	Felip & Toti (*31*)
Queso Blanco (homemade)				
United States (1983)	*S. zooepidemicus*	16	2	Espinosa et al (*27*)
French Brie/Camembert				
United States (1971)	*E. coli* 0:124 (EIEC)	387	0	Marier et al (*52*)
Scandinavia (1982)	*S. sonnei*	50	0	Sharp (*75*)
United States (1983)	*E. coli* 0:27 (ETEC/ST)	169	0	MacDonald et al (*51*)
Mexican Style (soft)				
United States (1985)	*L. monocytogenes* 4b	181	65	James et al (*40*)
Vacherin (raw milk/soft)				
Switzerland (1985)	*S. typhimurium*	22	0	Sadik et al (*70*)

in more than 1500 cases of *S. typhimurium* PT 10 infections. Manual override of the flow diversion valve reportedly transferred contaminated raw milk into vats of pasteurized cheese-milk. Several episodes involving *S. aureus* contamination of starter cultures used in the production of emmental cheese (Canada, 1977), the manufacture and retail distribution of Queso Blanco soft-cheese made with raw milk from cows with *Streptococcus zooepidemicus* infection of mammary glands (United States, 1983), and identification of enteroinvasive and enterotoxigenic *E. coli* as well as *S. sonnei* in French brie and camembert cheese reiterate the potential of raw milk as a source of bacterial pathogens and need for quality control at critical points in the manufacturing process. Disease and high mortality from *L. monocytogenes* 4b in a Mexican-style cheese (United States, 1985) undoubtedly set the stage for current levels of awareness and concern for the presence of this virulent agent in the food chain.

Cost estimates for foodborne disease outbreaks are revealing (Table 3). Direct costs are expenditures attributed to the epidemiological investigation of incidents, laboratory diagnoses, treatment of patients, loss of income by affected parties, and financial losses sustained by food manufacturers or operators as a result of negative publicity or product recall. Indirect costs relate to arbitrary monetary compensations for grief, pain and suffering, and for loss of life (*87*). Cost per case comparisons of selected outbreaks showed higher values for cheese than milkborne incidents. However, these costs were substantially lower than those attributed to international outbreaks from milk chocolate, canned salmon, and corned beef. The recall and destruction of huge inventories of specific incriminated product in the latter episodes accounted for most of the sustained economic losses. The impact of specific etiologic agents on cost estimates is of interest. Although equivalent costs per case were noted for processed foods contaminated with *S. aureus* and non-typhoid salmonellae, homologous costs for *S. typhi* and *C. botulinum* were significantly higher (*87*). Economic studies further showed that the average cost per case of salmonellosis was higher for processed foods than for foods associated with foodservice establishments (*86,87*).

The growing list of outbreaks of bacterial etiology from dairy products and, more specifically, the Canadian episode of *S. typhimurium* PT 10 from pasteurized and heated-treated (non-pasteurized) Cheddar cheese led us to a series of studies on the thermal resistance of bacterial pathogens in raw milk. A non-exhaustive survey of cheese plants in Canada revealed that 31 (33%) of 90 plants surveyed, manufactured Cheddar from non-pasteurized milk and, of these, 3 also produced Cheddar from raw milk. Heat treatments of 15-16 s at <64.5°C were used in approximately half of the plants that produced heat-treated cheese (*17*). These findings help define the 60-74°C temperature range selected for our thermal inactivation pilot plant studies. The mean and minimum residence time of milk in the holding tube of a high temperature-short time (HTST) regenerative plate pasteurizer was 17.6 and 16.2 s, respectively. Bulk raw milk was inoculated with a mixture of 10 or more strains of each of the following test organisms: *Salmonella* spp., *Campylobacter* spp. *Yersinia enterocolitica*, hemorrhagic *E. coli*, and *L. monocytogenes* (*16,17,30*). After equilibration of the pasteurizer at each test temperature, a heated milk sample was withdrawn at the inlet of the receiving bulk tank for enumeration of viable cells by the most probable (MPN) technique. Summary results on the maximum temperature for survival of bacterial pathogens in fluid milk are presented in Figure 1. Heat treatment of milk at 60°C produced a minimum 3 $\log_{10}$ reduction in viable *Salmonella* spp. and 2 $\log_{10}$ reduction with the heat resistant *S. senftenberg* 775W (*17*). Strains of *Campylobacter* spp. and *Y. enterocolitica* showed a 4

TABLE 3. *Economics of foodborne disease outbreaks*[a].

Food	Country	Etiological Agent	Number		Cost ($\times 10^3$)[b]		Cost/Case
			Ill	Deaths	Direct	Indirect	
Raw Milk	Scotland (1981)	*S. typhimurium*	654	2	$152	$1,226	$2,108
	United States (1985)	*S. typhimurium*	16,284	7	?	?	?
Cheese							
Cheddar/ Monterey	United States (1965)	*S. aureus*[c]	42	0	$490	-	$11,676
Emmental	Canada (1977)	*S. aureus*[c]	15	0	$653	-	$43,00
Cheddar	United States (1976)	*S. heidelberg*	234	0	$251[d]	-	$1,073
Chocolate	Canada-U.S.A. (1973-74)	*S. eastbourne*	≥200	0	$62,063	-	$30,317
Corned Beef	Scotland (1964)	*S. typhi*	507	3	$163,485	$871	$324,174
Canned Salmon	Belgium (1982)	*C. botulinum*	2	1	$148,246	$1,585	$74,915,000

[a] Adapted from Todd (1985) J. Food Prot. 48:621-633.

[b] Cost estimates expressed in 1983 $US dollars.

[c] Contamination of starter cultures.

[d] *Excludes* cost to the manufacturer.

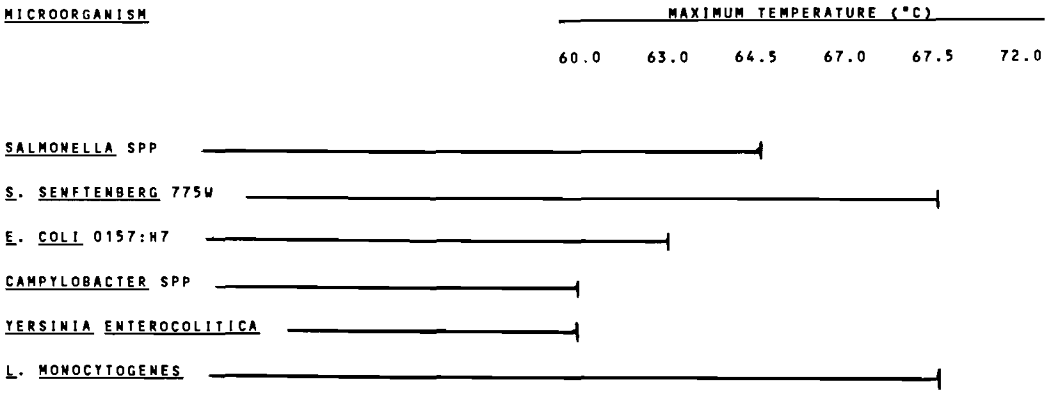

Figure 1. *Maximum temperature (Tmax) for survival of bacterial pathogens in heated milk.*

TABLE 4. *Survival of pathogens in milk and milk products during storage.*

Food	Organism	Storage Temperature (°C)	Survival Period^a	Reference
Milk				
Raw	*A. hydrophila*	5	>7d (*GROWTH*)	Palumbo et al (*60*)
	C. jejuni	4	21-30 d.	Oosterom et al (*59*) Doyle & Roman (*22*)
	Y. enterocolitica	4	*GROWTH* (≥4 Log/7 d)	Greenwood & Hooper (*37*)
Pasteurized	*S. sonnei* *S. flexneri*	25	5m	Taylor & Nakamura (*84*)
Butter	*S. typhimurium*	4	2.5m	Sims et al (*77*)
Milk Powder	*L. monocytogenes*	25	3m	Doyle et al (*23*)
	S. montevideo	Ambient	12m	Ray et al (*64*)
Casein Powder	*S. anatum*	Ambient	23m	Pearce (*63*)
Cheese				
Cheddar	*S. muenster*	5	4m	Wood et al (*95*)
	S. typhimurium	5	8m	D'Aoust et al (*15*)
	S. typhimurium *S. newport* *S. infantis*	7	10m	Park et al (*62*)
	S. newbrunswick	4.5	9m	White & Custer (*93*)
	L. monocytogenes	6-13	14m	Ryser & Marth (*69*)
Colby	*E. coli* (ETEC/EIEC)	3-10	>3m	Kornacki & Marth (*43*)
	L. monocytogenes	4	>5m	Youssef & Marth (*96*)
	Y. enterocolitica	3	>2m	Moustafa et al (*58*)
Brick	*E. coli* (ETEC/EIEC)	7	>2m	Frank et al (*35*)
Feta	*L. monocytogenes*	4	>3m	Papageorgiou & Marth (*61*)
Camembert	*L. monocytogenes*	6	*GROWTH*	Ryser & Marth (*68*)
	E. coli (ETEC/EIEC)	7-12	≤1.5m	Frank et al (*34*)
Soft/ Semi-Soft	*L. monocytogenes*	4	>12m	Farber et al (*29*)
	L. monocytogenes	12	*GROWTH*	Breer (*9*) Terplan (*85*)

[a] Survival for days(d) or months(m).

$\log_{10}$ reduction at 60°C with no survivors at ≥63°C. Hemorrhagic *E. coli* was marginally more heat resistant, exhibiting a 2-3 $\log_{10}$ reduction in counts at 60°C and absence of viable cells at ≥64.5°C (*16*). The propensity for the survival of *L. monocytogenes* in milk was unexpectedly high and compared with that observed with *S. senftenberg* 775W (Fig. 1). Thermal inactivation of *L. monocytogenes* increased slowly with increasing treatment temperature, and showed a 1.0 $\log_{10}$ (60°C) to a 2-3 $\log_{10}$ (64.5°C) reduction in counts and no viable cells at >67.5°C. Comparable results with naturally contaminated milk suggest that localization of *L. monocytogenes* within macrophages does not confer protection against the lethality of heat treatments (*30*).

Our findings on the heat resistance of bacterial pathogens in milk heated at non-pasteurizing temperatures underscore the importance of hygienic collection and refrigerated storage of milk on the farm, and rapid transport of milk to the dairy plant. A temperature abuse or undue delay in processing raw milk could promote the growth of psychrotrophs such as *Listeria, Yersinia,* and *Salmonella* spp. to levels that might overextend the efficacy of thermal processing at non-pasteurizing temperatures. The ability of *Y. enterocolitica* to grow and produce toxin in fluid milk held at 4°C *(82)*, the recent indications that the minimum temperature for *Salmonella* growth approaches 2°C (*14*), and the propensity for populations of *L. monocytogenes* to increase by 6 $\log_{10}$ units upon suspension in milk for 48 h at 10°C *(20)* are most disquieting. The potential health hazard is further increased by the growth permissive time-temperature regimens used in cheese manufacture. Although regulations in several countries require refrigerated storage of non-pasteurized cheese for a minimum of 60 d, this approach to decontamination of potentially adulterated cheese is grossly ineffective. In addition to the persistence of bacterial pathogens in fluid milk, butter, powdered milk and casein, recent studies have underscored the ability of infectious bacterial agents to survive in a variety of cheese for periods of up to 12 months or more (Table 4). Reports on the growth of *L. monocytogenes* in soft and semisoft cheese held at 6-12°C are of great concern.

TABLE 5. *Human infectious doses of foodborne pathogens.*

Etiological Agent	Infectious Dose	Reference
A. hydrophila	Unknown	Stelma (*80*)
B. cereus (diarrhea)	$\geq 10^5$/G	Kramer & Gilbert (*44*)
C. jejuni	≥500	Stern & Kazmi (*81*)
	≤500 (Milk)	Robinson (*65*)
E. coli		
EIEC	10^6-10^8	Williams et al (*94*)
ETEC	10^8-10^{10}	Dupont et al (*25*) Levine et al (*47*)
EPEC	10^6-10^{10}	Levine et al (*48*)
EHEC	Unknown	Doyle & Padhye (*21*)
L. monocytogenes	Unknown	Lovett (*49*)
S. typhimurium	1-6 (Cheddar)	D'Aoust (*13*)
Shigella spp.	$\leq 10^2$	Morris (*55*)
Yersinia enterocolitica	10^9	Morris & Feeley (*56*)

The human infective dose, the number of bacterial pathogens that need to be ingested to cause illness, plays a determinant role in human pathogenicity. Although the infective dose for several etiological agents has yet to be determined, numbers of pathogenic *E. coli* and *Y. enterocolitica* in excess of 10^6 cells are required for illness (Table 5). In contrast, fewer than 500 cells of *C. jejuni* in milk and as few as 1-6 cells of *S. typhimurium* in Cheddar cheese caused disease. Such human susceptibility to infection predicates the need for pathogen-free dairy products. Futhermore, contemporary increases in the antibiotic resistance of salmonellae (Table 6) and other enteric bacteria that can readily contaminate the milk supply tend to compromise the successful clinical management of human systemic infections.

TABLE 6. *Antibiotic resistance in* salmonella[a].

Country	Period	No. Strains Tested	% Resistance[b] A	C	Tp	Multiple[c] (≥2)
Human						
United States	1967	400	8.0	0.0	NA[d]	15.0
	1975	754	17.2	0.8	0.4	20.8
	1984	1293	20.0	5.0	3.0	NA
Rwanda	1974-80	244	4.5	4.5	0.0	NA
	1981-84	240	45.0	47.5	9.2	NA
Nonhuman						
Belgium	1979	604	9.8	21.9	10.1	25.3
	1985	341	15.2	32.8	3.8	38.7
England	1975	3815	0.7	0.3	0.2	NA
	1983	4895	14.6	13.6	16.4	NA
France	1974-75	3624	1.1	11.8	NA	13.9
	1978-80	13579	9.9	21.8	2.4	45.0

[a] Adapted from D'Aoust (*14*)

[b] Ampicillin (A); chloramphenicol (C); trimethoprim sulfamethoxazole (Tp).

[c] Resistance to two or more antibiotics.

[d] Not available.

An assessment of the potential health hazard associated with the manufacture of dairy products from non-pasteurized milk should recognize the following facts:

(1) The ability of bacterial pathogens to survive, grow, and produce toxins during refrigerated storage of raw milk.
(2) The propensity of infectious agents to survive heat treatment of milk for 16-17s at subpasteurizing temperatures.
(3) The ability of pathogens to grow during the manufacture and ripening of cheese.
(4) The growth of *Listeria* spp. in refrigerated soft cheese with a generation time of 1.5d at 4°C.
(5) The survival of bacterial pathogens well beyond the 60-d mandatory refrigerated storage of cheese manufactured from unpasteurized milk.
(6) The high fat content of milk products that tend to protect pathogens against human gastric acidity.
(7) The low human infective dose for some bacterial pathogens.
(8) Possible degeneration of diarrheal disease into more serious and costly chronic conditions.
(9) The increasing antibiotic resistance in bacterial populations.
(10) The staggering costs of foodborne outbreaks to the manufacturer and to the public purse.

From these strong elements of risk, the critical question on whether or not we can afford any longer to manufacture dairy products from unpasteurized fluid milk needs to be resolved.

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