Cheese and Its Relation to Disease*

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CHEESE is a standard item of diet and rates very high among foods from a nutritive standpoint. It is therefore important that it should be surrounded with all the necessary sanitary safeguards to insure a product free of disease germs. Cheese like other dairy products such as ice cream and butter does not receive the attention from public health officials that it merits. However, the long list of epidemics of disease traced to it [1,2] within recent years has awakened those responsible for the health of the people to the need of sanitary regulations governing its manufacture and sale.

EPIDEMICS TRACED TO CHEESE

A list of epidemics traced to cheese since 1883 has been compiled from the literature and various other sources and is presented in Table 1. A summary of these data shows that during this time there has been a total of 59 epidemics with 2,904 cases of disease and 117 deaths. While this total is sufficiently impressive to convince even the most skeptical, there is every reason to believe that this represents only a fraction of the total. After the epidemics reported by Baker [1] in Michigan during 1883–1884, there were no more epidemics recorded until 1893, after which there was a lapse of 21 years before another epidemic was reported. Thereafter, only an occasional epidemic due to cheese was reported in the literature until 1932 when the big epidemic occurred in Quebec with 627 cases and 57 deaths. This epidemic seems to have made public health officials conscious of the fact that cheese may be an important vehicle for the transmission of disease, and from that time on we find one or more epidemics reported each year except in 1933.

From 1935 to 1945, 40 epidemics were reported involving 1,741 cases and 47 deaths, which is over twice as many epidemics as the 19 which were reported in the previous 42 years. Such figures as these lead one to suspect strongly that during this time cheese had been overlooked as a source of disease.

While no attempt has been made to make a thorough search of the foreign literature for epidemics due to cheese, a partial list of such epidemics is recorded in Table 2. From 1901 to 1944 inclusive, 16 epidemics involving 526 cases and 2 deaths have been tabulated.

An analysis of the data in Table 1 shows that the most frequently reported disease is food poisoning which accounted for 35, or 61 per cent, of the 59 epidemics with 1,389 cases, or 47.9 per cent of the total 2,904 cases reported. Next in order comes typhoid fever with 16, or 27 per cent of the total number of epidemics. Although typhoid fever was responsible for only 27 per cent of the epidemics, it accounted for 1,354, or 46.6 per cent of the total

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TABLE 1

Outbreaks of Disease Traced to Cheese in the United States and Canada from 1883 to 1946

Disease	*Place*	*Date*	*Cases*	*Deaths*	*Kind of Cheese*	*Reference*	*Remarks*
Food poisoning	Hubbardston and Oxford. Mich.	Aug., 1883	14–15	0	Cheddar	Baker [1]	Cheese made in Ohio.
Food poisoning	Middleville, Mich.	May, 1884	50–60	—	"	Baker [1]	New cheese made by Horton at Fruitville, Mich.
Food poisoning	Jerome, Mich.	June, 1884	24+	—	"	Baker [1]	" " " " " " " "
Food poisoning	Jonesville, Mich.	June, 1884	10	—	"	Baker [1]	" " " " " " " "
Food poisoning	Flint, Mich.	June, 1884	4	—	"	Baker [1]	Cheese believed made at Clio, Mich.
Food poisoning	Big Rapids, Mich.	July 1, 1884	30	—	"	Baker [1]	Cheese made at one of the factories of Horton.
Food poisoning	Carson City, Mich.	July 8–9, 1884	13	—	"	Baker [1]	Cheese made by Horton at Fruitville, Mich.
Food poisoning	Lowell, Mich.	Aug. 28, 1884	13	—	"	Baker [1]	Origin of Cheese not determined.
Food poisoning	Mansfield, Ohio	1893	Many cases	—	Cheese	Reed [34]	Tyrotoxicon. Spoiled milk used for making cheese. Also two sick cows found among those supplying the milk.
Botulism	New York State	Oct., 1914	3	3	Cottage (homemade)	Nevin & Mann [31] Also Nevin [30]	Organisms and their filtrates toxic to mice, guinea pigs and rabbits.
Food poisoning	Kalamazoo, Mich.	June 20, 1916	6	—	Cheddar	Levine [24]	Coliform organism but poison was soluble and thermostable.
Typhoid fever	Bath township, Mich.	1917	51	4	"	Rich [37]	Cheese made at Chesaning, Mich., sold 9 to 30 days after it was made. Believed to be due to a typhoid carrier on farm.
Typhoid fever	4 counties	Feb., Mar., Apr., 1925	29	4	"	Wade & Shore [51]	Infection came from cheese made at Cooperative Creamery. Cheese sold 10 days after making. Typhoid carrier on farm delivering milk to creamery.
Food poisoning	Bedford, Me.	1925	9	0	Albanian cheese	Linden, Turner & Thom [23]	Large numbers of cocci present. Cultured organisms when fed to cats produced diarrhea within 4 hours.
Food poisoning	Kansas City	1926	22	0	Cheddar	Linden, Turner & Thom [23]	Large numbers of cocci present which were morphologically and culturally similar to those isolated from the Albanian cheese.
Food poisoning	U.S.S. Ruben James	1926	20 40	0	Cheese	Thomas & Carll [48]	Cheese part of 1,400 lb. lot procured in New York City. No evidence of Salmonella group.
Food poisoning	Apparently Ontario	1929	130+	0	Probably cheese	Hardman & McKinnon [21]	Outbreak believed to have been due to cheese served at church social. Others who had eaten of same cheese purchased at grocers became ill.
Typhoid fever	St. Maurice Valley, Que.	1932	627	57	Canadian cheese	Foley [14]	Cheese made from unpasteurized milk which was taken from several producers in whose families there were cases of typhoid fever.

Typhoid fever	Parkersburg, W. Va.	1934	24	2	Cottage cheese	U.S.P.H.[50]	Cottage cheese made from raw milk.
Food poisoning	Chicago, Ill.	1935	51	0	Wisconsin cheese	Bundenson [6] Also U.S.P.H.[50]	Green producing colonies of streptococci which were slightly hemolytic were reported by the laboratory. Women who had eaten the cheese in the town where it was manufactured also were ill.
Gastroenteritis	Whiting, Ind.	1935	8	0	Cream cheese	McCarthy [25]	"Gastroenteritis was no doubt due to saprophytic organisms rather than dysentery bacilli."
Food poisoning	Idaho	1935	12	0	Cheddar	U.S.P.H.[50]	Cheese made from pasteurized milk.
Typhoid fever	Thorsby, Calgary, Edmonton, Can.	1936	22	4	.....	Bow [3]	
Food poisoning	Mapleton, Minn.	1937	37	0	Cottage	U.S.P.H.[50]	*Staphylococcus albus* isolated. Cheese made from raw and pasteurized milk. Unpasteurized cream also used.
Food poisoning	Sunnyside, Wash.	1937	6	0	Cheddar	U.S.P.H.[50]	*Staphylococcus aureus* isolated.
Diarrhea	Chicago, Ill.	1937	11	0	Imported Romano	U.S.P.H.[50]	
Diarrhea	Chicago, Ill.	1937	24	0	Imported Pecorina	U.S.P.H.[50]	
Typhoid fever	Thorsby, Alberta, Can.	1938	8	0	.....	Bow [3]	
Food poisoning	Meridian, Idaho	1938	17	0	Cheddar	U.S.P.H.[50]	Raw milk used in making cheese. Fecal contamination present. Tyrotoxin suspected.
Botulism	Sheldon, N. Y.	1939	3	0	Homemade cooked cheese	N. Y. State Health News [33]	A case of botulism. Cheese prepared June 5 to 8 and consumed by 3 persons June 9 and 10.
Food poisoning	Michigan	1939	100–200	0	Cheddar	Hardman & McKinnon [21]	225 persons ate cheese from local factory at church supper. Estimated that 500–700 persons ate cheese from same factory and from 100–200 became ill.
Food poisoning	Yankton, S. D.	1939	25+	0	Colby	G. G. Frary [15]	*Staphylococcus aureus*. Cheese made from raw milk.
Typhoid fever	Manitoba	1939 to 1940	8 21 64	11	Cheddar	Bowman [4]	Cheese was not aged.
Food poisoning	San Francisco, Calif.	1939	4	0	"	U.S.P.H.[50]	
Gastroenteritis	Malden, Mass.	1939	10	—	Imported cheese	U.S.P.H.[50]	Staphylococci and Streptococci present.
Food poisoning	Stenislaus (Co.) Calif.	1940	6	0	Cottage home-made Mexican style	U.S.P.H.[50]	Made from raw milk and prepared several days before eating.
Food poisoning	Lena, Ill.	1940	10	0	Cheddar Longhorn	Breed [5] [50]	Intestinal disturbance in employee on cheese.

(Cont.)

TABLE 1 (Cont.)

Disease	*Place*	*Date*	*Cases*	*Deaths*	*Kind of Cheese*	*Reference*	*Remarks*
Food poisoning	Illinois	1941	10	0	Longhorn	Breed [5]	Probably by employee with intestinal disturbance.
Typhoid fever	Oswego, N. Y. (rural area)	1941	23	1	Cheese curds	Schlesinger [42] Also U.S.P.H.[50]	Cheese made from raw milk. Suspected carrier on dairy farm.
Gastroenteritis	Mt. Holly Twp., N. J.	1942	8	0	Cheddar	U.S.P.H.[50]	Grated cheese.
Food poisoning	Baltimore, Md.	1943	6	0	Munster	U.S.P.H.[50]	
Food poisoning	Lexington, Ky.	1943	86	0	Cottage	U.S.P.H.[50]	Pasteurized cottage cheese.
Typhoid fever	Quebec, Can.	1943	40	6	Cheddar	Gauthier & Foley [17]	Young unripened cheese. Typhoid carrier.
Food poisoning	Baltimore, Md.	1943	40	0	Munster	U.S.P.H.[50]	Large numbers of coliform group present.
Food poisoning	Detroit, Mich.	1944	104	0	Cheddar	U.S.P.H.[50]	*Proteus morganii* isolated also H_2S producing *E. coli.*
Food poisoning	Brooklyn, N. Y.	1944	5	0	Roquefort	U.S.P.H.[50]	Onset 45 min. after eating cheese. Two who did not eat it did not become ill.
Gastroenteritis	Roanoke, Va.	1944	71	0	Colby	U.S.P.H.[50]	*Staphylococcus aureus.*
Typhoid fever	California (9 counties)	1944	80	4	Romano Dolce Teleme	Halverson [20] Also [50]	Unripened. Cheese made from raw milk. *E. typhosa,* type C.
Typhoid fever	Sparks, Nev.	1944	3	0	"	U.S.P.H.[50]	Unripened. Cheese made from raw milk. *E. typhosa,* type C.
Typhoid fever	Indiana (16 counties)	1944	246	13	Cheddar	Rice [36]	Unripened, Longhorn, Colby type, poor quality cheddar cheese.
Typhoid fever	Alberta, Can.	1944	83	7	"	Menzies [29] Gershaw [18]	Unripened cheddar cheese, two to four weeks old. Typhoid carrier.
Typhoid fever	Victoriaville, Quebec	1944	29	1	"	C.J.P.H.[27] McCrady [27]	Unripened.
Food poisoning	Boise, Idaho (Garven field)	1944	31	—	Cottage	U.S.P.H.[50]	Cottage cheese suspected. Streptococci other than true lactic type.
Food poisoning	Anderson, Ind.	1945	9	0	Cheese	U.S.P.H.[50]	
Food poisoning	Fulton, Ky.	1945	34	0	Colby Longhorn	Tucker [49] Wright [53]	Made from raw milk and sold without ripening. Made 3-12-45, caused disease 3-26-45 to 4-2-45.
Food poisoning	St. Francisville, Ill.	1945	250	0	Colby Longhorn	Tucker [49] Sievers [45]	Dead mouse found in cheese vat by cheese maker. It was removed and cheese made and sold in Illinois, Kentucky, and Tennessee in less than two weeks.
Food poisoning	Tennessee (6 towns)	1945	250	0	Colby Longhorn	Tucker, *et al.*[49]	*Salmonella typhimurium* isolated from cheese.
Typhoid fever	Cornwall, Ontario	1946	19	—	Cheddar	Thompson [46]	Milk from farm where there was a typhoid carrier. Cheese used before 90 day holding period prescribed by law.

number of cases of disease and for 97.4 per cent of the total number of deaths. There were 4 epidemics listed as causing gastroenteritis, 2 as causing diarrhea, and 2 as causing botulism, with a 50 per cent mortality. In the case of typhoid fever there was approximatley 1 death for every 12 cases of the disease, which would indicate that the typhoid organism remained viable and virulent in cheese sufficiently long to cause severe infection. In contrast to the high mortality for typhoid fever there was not a single death reported in the 1,389 cases of food poisoning due to cheese, indicating that the organisms responsible for this condition either did not produce a potent toxin or else did not remain viable sufficiently long to cause a severe infection or to produce enough toxin to cause death.

The most recent epidemic of typhoid fever traced to cheese was at Cornwall, Ontario, in January and February, 1946. Since this epidemic has not been reported in the literature, the details as reported by Dr. M. G. Thomson, Medical Health Officer [46] at Cornwall, will be given.

Between 26th January and 25th February, 1946, nineteen cases of typhoid fever occurred in the City of Cornwall and the surrounding suburban area which were traced to two cheeses from one cheese factory and the carrier discovered some weeks later. After the fourth case was reported there was presumptive evidence that cheese purchased in two grocery stores was implicated. It was ascertained that one cheese in each store (which had been already sold so that no sample was available for bacteriological testing) was out, contrary to Dominion of Canada Food Regulations, within the ninety day holding period prescribed by those Regulations. These two cheeses were from the same factory and it now became necessary to find the carrier who infected the milk which went into those two cheeses. This was simplified owing to a case of typhoid fever occurring in the area supplying milk to the cheese factory in question. The patient had been on a visit to his mother and she was found to be a carrier of typhoid organisms. Milk from the farm operated by this woman had gone into the manufacture of the two cheeses in question which constituted one batch and these were the only cheeses from this factory which had been released to the retail grocers within the ninety day holding period prescribed by the Dominion Government Food Regulations. I may say that on investigating other milk producers whose milk went into the two cheeses in question, no other carriers were found.

I may say that stool specimens from all the possible food handlers in the grocery stores in question were all negative for *E. typhosa* though these tests were repeatedly done.

The organism in all the cases in this outbreak as well as in the stool specimens from the carrier was *E. typhosa*, Type E.

HOW TO PREVENT DISEASE FROM CHEESE

Two things stand out when a study is made of the various epidemics caused by cheese. One is that the cheese generally has been made from raw milk and that it has been sold and eaten too quickly after it has been made. Likewise, in the experiments testing the longevity of pathogens in cheese the data show that pathogenic bacteria die out more quickly at high than at low temperatures. This leads to the obvious conclusion that all milk and cream used in the manufacture of cheese should be pasteurized and aged at a high temperature. If this were done, the transmission of disease by eating cheese would disappear.

PASTEURIZING AND AGING CHEESE

Pioneer work for using pasteurized milk for cheese making was done in 1912 by Sammis and Bruhn [38] in Wisconsin. The following paragraph from their *Research Bulletin 27* is especially significant in view of the many cases of disease traced to cheese since that time:

This process should interest the farmer because of the increased yield of cheese, and the avoidance of the usual losses in yield and quality due to defective milk. It should interest the cheese maker because the process of making is systematized to such a degree that it is conducted upon a fixed schedule for

TABLE 2

Outbreaks of Disease Traced to Cheese in Other Countries

Disease	*Place*	*Date*	*Cases*	*Deaths*	*Kind of Cheese*	*Reference*	*Remarks*
Food poisoning	Finsbury	Oct., 1901	17	—	Dutch cheese	Newman [32]	Laboratory examination revealed a "poisonous ptomaine."
Food poisoning	.....	Nov., 1908	7	—	Cheese	Evans & Aberd [10]	All cases under 17. Cheese said to be new.
Food poisoning	Dover, England	1922	126	—	Canadian Cheddar	McCauley [20]	Organism closely resembled Gaertner group.
Food poisoning	England	1925	9	0	.....	Savage & White [30]	*Salmonella suipestifer.*
Paratyphoid B	England	1925	23	—	Italian cream cheese	Graham-Stewart [19]	*Salmonella schottmulleri* considered cause.
Food poisoning	Utrecht, Holland	1927	—	—	Cheese	Cleyndert [8]	Milk came from dairy affected with "foot and mouth" disease.
Food poisoning	Coblenz, Germany	1928	53	1	Schicht cheese	Reissland and Steinbach [35]	Gaertner's bacillus isolated from animal carcass. Thirteen persons showed positive Widal for Gaertner bacillus with higher agglutination for typhoid bacillus.
Gastroenteritis	Norway	1928	29	0	.....	Blix and Tisdal [2]	*Bacterium cholerae suis*
Gastroenteritis	Norway	1928	26	0	.....	Blix and Tisdal [2]	*Salmonella aertrycke.*
Gastroenteritis	Norway	1928	65	1	.....	Schytte and Tisdal [41]	*Salmonella aertrycke.*
Food poisoning	Bohemós (Prog.)	1935	7	—	Soft	Schubert & David [13]	A species of *B. coli* implicated.
Food poisoning	Breig prison	1936	100 25 others	0	White cheese	Kathe [23]	Blood of 7 patients agglutinated a hemolytic strain of hemolytic coli in dilutions as high as 1:1,600.
Food poisoning	France	1938	3	—	Pont L'Eveque	Florentin [13]	3 persons in a family of 4 ate the cheese and became ill. The other member who was not ill did not eat the cheese.
Food poisoning	Magdeburg, Germany	1938	28 4 others	—	Limburger	Schade [40]	Strain of *B. coli* isolated from cheese produced poisonous symptoms in mice.
Brucellosis	Eritrea, Italy	1943	Several	0	Cheese	Cilli [7]	Undulant fever traced to cheese containing *Brucella melitensis.* Cheese made from cow's, goat's, and sheep's milk.
Food poisoning	Norwich, England	1944	4	0	Goat's milk cheese (homemade)	MacDonald [28]	*Staphylococcus aureus* isoloted from one patient and from freshly drawn goat's milk.
NOTE: Since these tables were compiled, notice of two more epdemics due to cheese has been received from the U. S. Public Health Service as follows:							
Food poisoning	Stinesville & Anderson, Ind.	Oct., 1945	9	0	?		Private homes
Food poisoning	Barrio Miraflores Arecibo, P.R.	Mar., 1945	17	1	Native cheese		Raw milk used

all operations. It should interest the dealer because the cheese is more uniform in quality, and there is less need for cold storage for curing. Finally, the cheese should interest the consumer because it is more uniform in flavor than most cheese to be found on the retail counters, being made from pasteurized milk; and it is a more sanitary product than ordinary American cheese made from raw milk.

One of the reasons why cheese makers have resisted pasteurization is because the technique for making cheese from pasteurized milk is somewhat different from making it from raw milk. Rogers and associates worked for years studying and perfecting cheese making from pasteurized milk. This has developed the precision or "clock" method of making cheese from pasteurized milk which includes (a) use of pasteurized milk, (b) controlled starter cultures, and (c) exact timing of each operation in cheese making. They have demonstrated[9] that, contrary to popular belief, it is possible to make a high quality cheese more uniform in flavor from pasteurized milk. In fact they have shown that by using a good grade of milk and cream, pasteurizing and adding a starter, it is possible to age the cheese at a temperature of 60° F. instead of 40 to 50° F. thereby reducing the aging period from 6 to 8 months to 3 to 4 months. Erekson[11] points out that the higher temperature aging period was used for years but discarded because of certain disadvantages.

There are two safety factors in the pasteurized milk process of making cheese: First, pasteurization which is properly done will kill all asporogenic, pathogenic bacteria which have been responsible for so many epidemics and, second, the aging period at the higher temperature. Even though the ripening is for a shorter period of time, the higher temperature will help to kill any pathogens that may have escaped pasteurization or that have gotten into the cheese after pasteurization. All experiments with cheese artificially or naturally seeded with pathogens show that the pathogens die more quickly at the higher than at the lower temperatures.

STATE AND CITY LAWS ENACTED

California in 1944 was the first state to pass a law requiring that all cheese sold to the retail trade shall be pasteurized or made from pasteurized cream, milk, or skim milk which has been pasteurized, except cheese which has been allowed to ripen or cure for a minimum period of 60 days. Further requirements are made for labeling the variety, grade, factory number, state of origin, and date of manufacture. This law resulted from an outbreak of typhoid fever caused by green cheese in which there were 79 cases in 9 counties in California and 4 in Nevada.

Colorado likewise passed a similar state law which became effective January 1, 1945, which requires that all cheese shall be pasteurized or made from pasteurized cream, milk, or skim milk, except cheese which has been allowed to ripen for a minimum period of 120 days or longer if deemed necessary. In the same year New York amended the State Sanitary Code to require that Cheddar type cheese be pasteurized or that it be made from pasteurized cream, milk, or skim milk, or had been allowed to ripen at a temperature of not less than 35° F. for a period of not less than 60 days from date of manufacture.

Canada, due to the many outbreaks of disease traced to cheese, passed a regulation which became effective August 1, 1945. This regulation among other things requires:

1. Every manufacturer of cheese by the Cheddar or other process from raw or pasteurized milk that yields a hard-pressed cheese shall mark or brand within 24 hours after removal from the press every merchandising unit of such cheese correctly and distinctly with the date of manufacture indicat-

ing the day, month, and year when such cheese was put into press.

2. No person shall cut any Cheddar or other hard-pressed cheese made from raw or pasteurized milk for sale or consumption as such in Canada within a maturing period of 90 days from the date of manufacture. Throughout the first 10 days of said maturing period of 90 days the temperature of storage shall be maintained at not less than 58° F., and throughout the remainder of the period at not less than 45° F.

Illinois amended a former act regulating the sale of dairy products on May 5, 1945, which became effective January 1, 1946. The amended act requires, among other things, that cheese be made only from pasteurized milk and cream or be ripened or cured for at least 60 days at a temperature not lower than 35° F.

Indiana likewise has amended the regulations regarding the manufacture of cheese to the effect that milk and cream used in its manufacture must be pasteurized or that cheese made from raw milk must be held for at least 60 days before it can be used or sold.

New Jersey likewise has recently passed regulations regarding the manufacture and sale of cheese. They require that cheese be made from pasteurized milk or in lieu of this be held for a period of not less than 60 days before it is used or sold.

Alabama has had a law since 1929 which requires cheese made within the state to be made from pasteurized milk or aged for 60 days before it is sold.

New York City is the only city having a sanitary regulation requiring pasteurization of the milk or holding for a 60 day period. The new regulations became effective December 15, 1944, and briefly are as follows:

1. All kinds of Cheddar and Cheddar type processed cheese must be made from milk or milk products which have been pasteurized, or must be subjected to a heat treatment equivalent to pasterization. In lieu of pasteurization a minimum of 60 days of aging after manufacture of these types of cheese is permitted.

2. All soft cheese will be required to be made of pasteurized milk and milk products.

UNIFORM SANITARY REQUIREMENTS NEEDED

A committee representing the Wisconsin Cheesemakers' Association, Wisconsin Milk Producers' Association, the University and the State Department of Agriculture of Wisconsin, and the National Cheese Institute framed acceptable minimum sanitary requirements* for cheese factories and recommended their official adoption by Wisconsin as well as by other states producing cheese.

As Freidel and Yale[16] point out, the cheese industry itself is deeply concerned with proper public health protection for cheese, and feels that all concerned would benefit if all states would adopt uniform regulations. Since cheese is so widely distributed, this would make compliance with state regulations much easier for the industry.

There is a feeling on the part of some health officials that the easiest and best way to obtain uniform sanitary regulations for the 48 states for the manufacture and sale of cheese would be by federal regulations. The establishment of federal standards for interstate shipments of cheese would serve as a model for state regulations and would necessitate a high degree of compliance on the part of cheese manufactures since cheese is so widely distributed.

GENERAL DISCUSSION

It would appear from the data presented that the public health officials have neglected to place the proper sanitary safeguards around cheese. During the past 50 years or so there have been no less than 59 recorded outbreaks of disease with 2,904 cases and 117 deaths

* These requirements may be obtained from Dr. E. W. Gaumnitz, National Cheese Institute, 110 North Franklin St., Chicago, Ill.

in the United States and Canada. Since 1912 when it was first demonstrated that better cheese could be made from pasteurized milk than from raw milk, there have been at least 50 epidemics with 2,715 cases and 117 deaths. Doubtless most of them could have been averted if the knowledge gained at that time had been put into practice. Only recently, due to several large epidemics, have public health officials begun to act and then only in a very limited way. There are today only seven states and Canada that have laws regulating the manufacture and sale of cheese.

All the laws enacted so far have given an alternation between pasteurizing and holding for a definite period during which it is assumed that if any pathogenic bacteria are present, they will die out. The majority have required a 60 day holding period in lieu of pasteurization. This holding period is too short for the Cheddar type hard cheese since many of the pathogens do not die or their toxins are not inactivated in that time. A 90 day holding period would be preferable; a 120 day holding period much better.

It is interesting to note that it is necessary to heat the milk to a higher temperature in the making of Swiss cheese than in Cheddar cheese. However, the milk still gives a phosphatase test. To date there is no record of an epidemic traced to Swiss cheese. So far it has been impossible to make a Swiss cheese from pasteurized milk.

The discussion so far has pertained to Cheddar cheese. In the case of soft cheeses where an aging period of even 60 days might be detrimental to the quality of the cheese, the requirement should be that they be made only from pasteurized milk or cream with no definite holding period stated.

SUMMARY

There have been reported in the United States and Canada since 1883, 59 epidemics with 2,904 cases of disease and 117 deaths. There is every reason to believe that this represents only a part of the disease caused by cheese.

The organisms most commonly associated with cheese-borne infections are members of the *Salmonella* group such as *Salmonella aertrycke, schottmülleri, typhosus, suipestifer, typhimurium* and *cholerae suis; Staphylococci* such as *Staphylococcus albus* and *aureus*; of the *Brucella* group *Brucella melitensis* but not *abortus*; and *Clostridium botulinum*. There are no reports in the literature of undulant fever due to *Brucella abortus* although cheese doubtless is made from milk containing an abundance of these bacteria. Likewise there are no reports in the literature of septic sore throat or scarlet fever due to streptococci despite the fact that these organisms must be present at times in raw milk made into cheese. *Escherichia coli* is not considered as a cause of cheese poisoning. In Europe several investigators have considered it responsible for the toxin symptoms of illness due to cheese.

Contrary to the opinion of many cheese makers, pasteurized milk makes a consistently higher scoring and better flavored Cheddar cheese than cheese made from raw milk. Cheese made from pasteurized milk can be ripened in about half the time required to ripen cheese made from raw milk, since it can be held at a higher temperature. Experiments made by seeding pathogens into milk and making the milk into cheese show that the pathogens die out more rapidly at the higher temperatures.

There are seven states and Canada that now require cheese to be made from pasteurized milk or cream or to be held in storage for periods ranging from 60 to 120 days in lieu of pasteurization. The 60 day holding period is considered too short a time since pathogens may survive this storage period, especially if the cheese is held at

low temperatures, 40 to 50° F. A 90 day holding period is considered preferable and 120 days still better. All milk used in making soft cheeses should be required to be pasteurized since many soft cheese cannot be held for 60 days without spoilage or deteriorating in quality.

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