

Raw Milk And Cheese Production - a Critical Evaluation of Scientific Research

by Professor Verner Wheelock, September 1997

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There are several elements in this country which advocate that all milk used for the production of cheese should be pasteurized initially. For example, a recent statement from the IFST has recommended that milk used in the production of cheese should undergo full pasteurization (1). In the document the author analyzed 16 outbreaks since 1980 in which cheese was considered to be the source of the pathogens. Of those, 13 were using unpasteurized milk. In reaching the conclusion on pasteurization, the authors noted that raw milk cannot be guaranteed to be free from pathogenic bacteria.

A detailed examination of the case presented in the IFST document reveals some serious flaws in the argument:

1. The outbreak linked to *Listeria monocytogenes* Vacherin Mont D'Or in Switzerland between 1983-87 was responsible for at least 122 cases, including 34 deaths (2). However, it has been clearly established that the contamination with *L. monocytogenes* was not due to its presence in the milk before production, but arose because of contamination in the dairies and cellars where the cheese was stored (Bille, personal communication). Thus the suggestion of pasteurization is irrelevant and, in any event, ineffective in this case.
2. In an outbreak in Canada (3) of *Salmonella typhimurium* in cheese, the IFST document attributes this to unpasteurized cheese. In fact the author cited by the IFST stated that the cheese had been manufactured from either pasteurized milk (16 secs. at 73.80 deg C) or a lower un-pasteurization heat treatment (16 secs. at 66.70 deg C). The authors of the IFST document are wrong to categorize this as non-pasteurized, when it is impossible to distinguish between cheeses made from milk treated in different ways. Thus the milk may or may not have been raised to pasteurization temperature, but it certainly was heat treated.
3. In 1983, an outbreak of entero-toxigenic *E. coli* which caused over 3000 cases (0 deaths) in Denmark, the Netherlands, Sweden and the USA, brie cheese was implicated (4). The IFST include this as one of the 13 outbreaks associated with cheese made from unpasteurized milk even though it accepts that only some of the brie cheese was made from un-pasteurized milk at the time. Again, conclusions are being drawn which cannot be justified. The authors point out that, in the USA, cheese from the implicated lots were distributed to 16 states but illness was reported in only 5 cases. The uneven distribution is consistent with post-production contamination.
4. A survey by Nooitgedagt and Hartog (5) on brie and camembert showed that a considerable proportion of these cheeses are contaminated with undesirable bacteria, especially *E. coli*. They also recorded temperature abuse during storage which in their view indicated a failure of Good Manufacturing Practice (GMP) and poor distribution practice.
5. In 1984, there was an outbreak in Grampian involving verocytotoxin-forming *E. coli* with over 20 cases (0 deaths) (6). The investigators of this outbreak have clearly concluded that this was due to post-production contamination and not to the use of raw milk per se.

Malta has an active policy of slaughtering affected herds - the herds involved with this outbreak were identified and slaughtered. Brucellosis due to *B. melitensis* has never been reported in animals in Great Britain. An outbreak of brucellosis due to *B. abortus* occurred in 1993 but this was eliminated by slaughter of the infected cattle and tracing of contacts.

An outbreak of *Brucella melitensis* in Malta between 1992 and 1994 was linked to the contamination of cheese made from unpasteurized milk from sheep and goats (7). Two of the people involved were from the UK. The relevance of this is extremely dubious because

1. In 1985, Mexican-style cheese was linked to over 142 cases (48 deaths) of *L. monocytogenes* (8), which occurred in California. The investigation concluded that *L. monocytogenes* was most likely introduced into the cheese by a failure of the pasteurization process so that milk which had already been pasteurized was contaminated. The investigators felt that this contamination most likely came from

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contaminated raw milk although there was no conclusive proof that this actually occurred. In fact the authors of the report recognized that the introduction of the organism could have been due to the contamination of the plant environment. It should also be noted that the presence of any listeria organism could not be found in dairy herds that supplied raw milk to the manufacturing plant.

2. In 1995, there were 6 cases of listeriosis in France which were linked to Brie de Meaux, a soft cheese made from raw milk (9). The investigation was unable to identify the precise cause, although the actual source of production was identified. Disinfection and control measures were reinforced at production level, which suggests that the investigators suspected post-production contamination had been occurring. It is also worth recording that the authors of the investigation stated this was the first outbreak of listeriosis of a raw-milk cheese documented in France.
3. Between December 1984 and February 1985, there were 13 cases of staphylococcal poisoning amongst guests attending a Hogmanay dinner in Ayrshire (10). This was linked to sheep milk cheese made from raw milk. The investigation found that milk from sheep with clinical mastitis was incorporated into the supply for cheese production. It was also found that the starter culture was contaminated with E. coli. When these issues were addressed, production was re-started in June 1985 still using raw milk. Although the authors advocate the use of pasteurized milk for cheese production, there were apparently no further problems recorded, even though the investigation report was not published until 1989.
4. It is relevant to make reference to an outbreak of listeriosis which occurred in Massachusetts in 1983, that was linked to pasteurized milk from a single plant. All milk was processed with the same equipment and was pasteurized at times and temperatures which exceeded the FDA regulations at the time (11).
5. Investigations by the authors performed both before and after the managers of the plant had been notified of a possible problem, revealed that the facility was clean, modern and well run. No defect that could have resulted in improper pasteurization and no source of contamination were identified. Records on temperatures and phosphatase testing during the outbreak period were consistent with proper pasteurization. The authors of the investigation concluded that intrinsic contamination of the milk and survival of some organisms despite adequate pasteurization is both consistent with the results of the investigation and biologically plausible.

Therefore pasteurization is not effective for what it has been claimed to be - a preventative for bacteria contamination.

DISCUSSION

It should be clear from the above analysis that the logic employed in the IFS document is somewhat flawed with respect to the recommendations on pasteurization of milk for cheese production.

The argument adopted by the IFST seems to be - as there have been a few outbreaks of food poisoning linked to cheese made from raw milk, it follows that all milk should be pasteurized for the production of cheese.

My analysis clearly demonstrates that this reasoning cannot be substantiated. First of all, in many of the outbreaks investigated the presence of pathogens in the milk **has not been the cause of the outbreak**. Secondly, pasteurization itself is no guarantee of safety since there can be failure of the process, which can result in large numbers of cases. It should also be noted that in some outbreaks the IFST has **wrongly interpreted** reports of investigations and assumed that unpasteurized milk has been used, in the absence of unequivocal evidence to this effect. In reality, cheese is rarely involved in outbreaks of food poisoning (12) as it is a low risk food. Furthermore, the most frequent causative factor in cheese-related outbreaks is post-production contamination (13). It is extremely

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rare to encounter reliable evidence which clearly shows that pathogens in cheese originate directly from the raw milk used in its production.

It follows from this that as with any form of food production it is necessary to analyze the entire process and identify the critical control points. This should apply to all cheese manufacture.

It would be naive to assume that all raw milk used for production of cheese is always free of pathogens. However, there is good evidence that any pathogens present are unlikely to survive the cheese production process.

This conclusion is supported by work in Switzerland (14) in which *Campylobacter jejuni*, *Staphylococcus aureus*, *E. coli*, *Listeria monocytogenes* and *Salmonella typhimurium* were inoculated into raw milk at the beginning of cheese production along with the starter. The cheeses were hard (Emmentaler-type) and semi-hard (Tilsiter-type) manufactured individually in a special cheese-making system that was completely self-contained. In this exercise the most resistant strain for each species was selected and the amounts were added to obtain 10⁴ - 10⁶ cfu.

The results showed that none of the inoculated potentially pathogenic bacteria, except for a low number of *Staphylococcus aureus* could be found in the experimental hard cheese one day after manufacture. All subsequent determinations were free of potentially pathogenic bacteria and toxins.

It is important to have an effective starter culture both to provide good quality cheese and to prevent the growth of pathogens. Lactic acid is especially effective in combating pathogenic bacteria.

It should be apparent that the case for requiring all cheese to be made from pasteurized milk does not stand up to rigorous examination. What is undoubtedly crucial is to ensure that appropriate measures specifically geared to the nature of the process are applied across the whole cheese production line. Blind faith in pasteurization is likely to lead to more problems than it solves and to limit efforts to improve total hygiene in food production.

The reality is that any risk assessment will show quite clearly that the risks associated with cheese made from raw milk are very low. Between 1992 and 1994, the Communicable Disease Surveillance Centre (CDSC) found that there were 516 confirmed outbreaks of food borne disease. Only 17 (i.e. about 3%) were linked to milk and milk products. Obviously, the number linked to cheese of all types would be even smaller. If we accept the data collected by the IFST as reasonably representative, then the number of cases (and deaths) due to cheese made from raw milk is only about 10% of the total linked to cheese as a whole.

As a general rule, cheese made from raw milk is confined to small operations, whereas cheese made from pasteurized milk may involve large volumes produced by big plants. Hence if something does go wrong then the impact on public health will of course be much greater where there is a large output than with a small one.

However, if contamination does occur then the proliferation of pathogens would be much more pronounced in a process based on pasteurized milk than in one based on raw milk because the competitive organisms have been eliminated (15).

Furthermore in France, where there is widespread production of cheese from raw milk, there is ample evidence indicating that the number of cases of food poisoning linked to this cheese is extremely low.

In the light of even a crude risk assessment it is obvious that cheese made from raw milk certainly does not constitute a hazard which needs to be addressed. What is more, the very low risk is recognized by the vast majority of consumers who choose to eat this type of cheese.

One must ask the question, is there any justification for insisting on a law requiring all milk for cheese production to be pasteurized - especially when there is no valid evidence to demonstrate that this would result in higher standards of food safety?

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