Drinking raw milk

The pros and cons of processing

Ann Woodriff Beirne examines the issues and evidence involved in the debate over the benefits and hazards of drinking raw vs pasteurised milk

Non-human milk has been part of the regular human diet in the UK for at least the last 7,000 years or so[1] and for the vast majority of that time it has been consumed raw.

In the last 100 years, the pasteurisation of milk has become routine and in some places is now a compulsory, legal requirement. Homogenisation has been around for over 100 years, too, but really only became widespread in the UK about 25–30 years ago.

The question is: has pasteurisation been of more benefit to human health in terms of the reduction of infectious diseases passed on by the milk? Or has it been more detrimental in the loss of a sound, nutritional, whole food, replacing it with a poor imitation?

What is milk?

Milk is an oil-in-water suspension. Oil droplets vary in size from 0.1–20µm and are surrounded by a milk fat globule membrane including casein micelles (32–300nm diameter) that helps to maintain the suspension.

Also included in this milk fat globule membrane are various fatty acid glycerides, cholesterol esters and the enzymes xanthine oxidase and 5'-ribonucleotidase. Within the fat globule the composition is 97–99% fatty acid triglycerides, in which the ratio of C14-C23 fatty acids outnumbers the C4-C8 fatty acids by 5 to 1. Fatty acid composition of milk varies depending on the breed of cow, time of year, quality of feed and lactation stage.

Apart from casein proteins in milk (which comprise about 80% of the total protein fraction), there are the whey proteins, which include lactoferrin, alpha lactalbumin and several enzymes, including: lipase, proteinases, alkaline phosphates, acid phosphatase, lactoperoxidase, lysozyme, superoxide dismutase (SOD) and xanthine oxidase.

Xanthine oxidase catalyses the oxidation of hypoxanthine to xanthine to uric acid with side production of H_2O_2 (hydrogen peroxide). In high O_2, high pH, low purine conditions it produces superoxide anions, also with side production of H_2O_2. (If SOD activity is diminished then this will result in rancidity.) One theory is that the H_2O_2 produced activates lactoperoxidase. Pasteurisation causes substantial loss of activity.[2]

Milk production in the UK

In the UK the dairy herds are pasture-fed for as much of the year as is practicable. From November until March the cows are housed in either cubicles or loose housing (large pens for up to 50 cows) and are fed on silage enriched with vegetable protein as necessary – many dairy herds use the Holstein cows, which were bred for their high milk output and they need extra protein to maintain the production without losing weight.

In April and October the cows are turned out into pasture during the day and brought in at night, often with supplemental silage feeding, as the grass is not abundant enough at these times of year. But in the summer the cows are out all the time and feed only on pasture.

The Dairy Products (Hygiene) Regulations 1995 are rigorously applied because farmers cannot afford to lose entire loads of milk due to contamination.

Dairies send inspectors to farms at least annually to ensure the hygiene quality is maintained.[3]

Pasteurisation

History

Pasteurisation is named after the French scientist Louis Pasteur who, in the mid-19th century, originally developed the heat treatments to prevent wine from souring and then went on to apply the same principle to beer and milk.[4]

The pasteurisation of milk was developed in the early 1900s to be sufficient to destroy the most heat-resistant, vegetative micro-organisms likely to be found in milk, *Mycobacterium tuberculosis* and *Coxiella burnetti* (the former is the causative organism of tuberculosis and the latter that for Q-fever, a feverish infection with flu-like symptoms).[5]

First provisions for pasteurisation were introduced into legislation in 1922 and in 1923 pasteurisation became commercially viable with the introduction of suitable equipment.[6]

Process

There are two commercial pasteurisation processes currently in use:

- High Temperature Short Time (HTST) – 72 deg C for 15 seconds
- Holder Technique – 60–63deg C for 30 minutes

Before pasteurisation all milk should be stored at around 5deg C to prevent growth of micro-organisms that are likely to cause spoilage of the milk.[7]

Reasons

Raw milk may contain several micro-organisms of various types. The greatest health risks are from the pathogenic bacteria (see box), whereas from the commercial point of view, the spoilage bacteria are more important. Sometimes bacteria can fall into both categories. Milk that leaves the healthy udder is relatively free from bacteria – bacterial contamination of milk is often from faecal or handling/processing sources.[7]

While there is a small risk that the *Streptococcus spp.* that often cause mastitis may also find their way into the milk, this should now be minimal because the vast majority of such organisms come out in the foremilk, which is discarded and not included in the bulk milk.[8] Cows that have chronic mastitis are usually culled.

Before the 1920s, bovine TB was widespread among dairy herds, as was bovine brucellosis (causative organisms *Brucella melitensis, Brucella abortus*). In the 1930s bovine TB affected ~40% of all cattle in the UK; today it is only about 0.07%.[9]

MAP

An organism that has fairly recently caused some controversy is the so-called MAP – *Mycobacterium avis paratuberculosis*, now often referred to as *Mycobacterium paratuberculosis*. This organism is the causative agent of a debilitating form of enteritis in cows called Johne's disease. It is estimated to be present in approximately 2% of cows in dairy herds in 1% of farms in the south-west of England.[5] Since 1913, it has been linked with Crohn's disease in humans,[5,10] although the evidence for this is still under debate.

In response to the suggestion that MAP may survive current pasteurisation processes, the dairy industry voluntarily increased the HTST pasteurisation to 25 seconds.[11] It should be noted that MAP is found in water supplies as well, is resistant to all current forms of water treatment and is highly adaptable to antibiotics, developing resistance rapidly and effectively.[5,10]

Common pathogenic bacteria that may be found in raw milk	***Disease condition caused***
Mycobacterium tuberculosis (TB)	*Human tuberculosis (TB)*
Mycobacterium bovis	*Bovine tuberculosis (TB)*
Yersinia enterocolitica	*Food poisoning*
*Clostridium spp**	*Food poisoning (also spore-forming)*
Bacillus cereus	*Food poisoning*
Escherichia coli	*Food poisoning*
Listeria monocytogenes	*Food poisoning, foetal damage (listeriosis)*
Salmonella spp	*Food poisoning (salmonellosis)*
Staphylococcus aureus	*Food poisoning*
Campylobacter jejuni	*Food poisoning*

**as obligate anaerobes, these will not last long as vegetative cells – they form endospores to protect themselves*

Pasteurisation

Benefits

Historically, there is no doubt that pasteurisation reduced the amount of *Mycobacterium bovis* in milk. Mass immunisation of herds against it and culling of chronically affected cows also helped to reduce the infective pool of the bacterium.

When the tubercle bacillus was first discovered by Robert Koch in 1882, it was assumed that the human and bovine strains were identical. This has since been shown not to be the case and it was Koch himself, in 1901, who first identified the ways in which they differed. There has been debate ever since about how much of the TB in the late 19th and early 20th centuries were attributable to *M.bovis* as the infectious agent.[12]

The current incidence of human tuberculosis cases attributable to *M.bovis* is approximately 1% of all biologically proven cases and is low and stable at about 45 new cases per year. Most of these are attributable to activation of latent infection or are acquired abroad.[13] Reducing the amount of MAP in the diet may be a step toward reducing the number of Crohn's disease patients, currently estimated at 80,000 in the UK and with ~4–8,000 new cases annually.[14]

Removing one potential source of Infectious Intestinal Disease (IID) from the food chain is seen by public health officials and government bodies as desirable.[15] The number of IIDs from raw milk is tiny compared with the number of cases from, for example, chicken, eggs, undercooked meats and meat products but the ratio of cases to consumers is higher. Very few people regularly consume raw milk, whereas huge numbers of people routinely eat eggs, chicken and meat products.

Doubts

One doubt that has been raised is that the heat treatment of milk may denature the milk proteins.

Casein is relatively unaffected by HTST pasteurisation, being quite heat stable at such temperatures, although sterilisation and UHT treatments may affect it adversely.[16]

Whey proteins – those not in the casein micelle and therefore found in the water-soluble fraction of milk – are at higher risk of heat damage. These include many of the enzymes mentioned in the composition of milk above.

The Food Advisory Committee have suggested that the whey changes are similar to those that occur in the first stages of digestion[17] and that this would therefore make no appreciable difference to their nutritional value. However, this is a debatable point, as the damage frequently involves irreversible cross-linking of proteins,[16] thus rendering them less able to be digested in the stomach.

Animal studies have been carried out that seem to indicate that pasteurised milk is an inferior nutritional product compared to raw milk (cited in 16) and that homogenisation (q.v.) further reduces the nutritional value.

Young calves do not thrive on pasteurised milk. One study on rats showed that pasteurised, homogenised milk had a significantly increased ability to provoke an antibody response to bovine proteins when inoculated, suggesting that the allergenic potential of bovine milk proteins may be increased by the processes of pasteurisation and homogenisation.[18]

Any beneficial bacteria, such as the *Lactobacillus acidophilus* and *Bifidobacter spp.* would be lost in the pasteurisation process. These bacteria are known to be beneficial for maintaining healthy gut flora but they also contribute to the bacteriostatic mechanisms in milk that help prevent the growth of pathogens.

Pasteurisation is not recommended for human breast milk in milk banks because of the damage to bacteriostatic mechanisms.[31] The risks of post-production contamination outweigh the benefits, except in relation to HIV-positive mothers, where the reduction of the HIV load is seen as paramount.[32]

In the late 1920s through to the 1940s, several papers appeared on the effects of pasteurisation on the nutritional aspects of milk. These found that pasteurising milk:

- Affects the haematogenic and growth-promoting properties of milk[19]
- Decreases resistance to pulmonary TB in children[20]
- Destroys or severely reduces natural 'inhibins' present in raw milk, which protect against the growth of *Bacillus diphtheriae, Staphylococcus aureus, Bacillus coli, Bacillus prodigiosus, Bacillus procyaneus, Bacillus anthracis* (causative agent of anthrax), *Streptococci spp* and unidentified wild yeast[21]
- Contributes to scurvy in children who had no other potential source of vitamin C intake – pasteurisation has been shown to reduce milk content of vitamin C by 25-50%[22–26]
- Contributes to the susceptibility of infants to infection from other pathogens[23]
- Contributes to the loss of vitamins A, B1, B6, B12 and folate from milk[27,28]
- May destroy the milk protein carriers that facilitate the absorption of iron, zinc and vitamin B12 [27]
- Reduces solubility of calcium and may reduce its absorption by up to 50%[29,30]

Raw milk

Benefits

Dr John Crewe, of the then-called Mayo Foundation (now Institute), published an account of the benefit of raw milk in the *Certified Milk Magazine* in 1929.[33] In it he claims to have successfully used a raw milk diet to improve conditions such as high blood pressure, obesity, tuberculosis, diseases of the heart and kidneys, diabetes, prostate enlargement, psoriasis, oedema (associated with heart and renal conditions). The eponymous Milk Cure was simple – small amounts of raw milk were given to the patients at half-hour intervals throughout the day, totalling 5–10 American quarts (5.5–11 litres) in a day.

In the sanatoria of the early 20th century, tuberculin-tested raw milk was often prescribed to help build up the patient.[16]

Today UK dairy herds are in such good health, microbially speaking, that there is little risk of transmission of pathogenic bacteria so long as good hygiene practice is followed in the processes of milking, storage, transport and packaging. The number of cases of illness attributable to drinking unpasteurised milk in recent years is very small. Although there have been several cases of salmonellosis attributed to raw milk, quite often no alternative sources have been investigated and raw milk has been blamed without proof.

Post-pasteurisation contamination is a risk factor that needs to be taken into account with respect to milk-borne infectious agents. There have been many cases of salmonellosis and *Campylobacter jejuni* infection outbreaks associated with pasteurised milk.[16] It is possible that this is due to inadequate pasteurisation but is much more likely to be due to post-pasteurisation contamination.

When raw milk goes sour it is still edible, unlike sour pasteurised milk, which is foul-tasting.[27] The bacteriostatic mechanisms in milk help to prevent the spoilage of milk – pasteurisation removes this option, thus opening the door to post-production contamination.

Some of the food poisoning scares relating to raw milk products, particularly the soft cheeses, have been ambivalent as to whether the infective agent was present from the outset or if it was in fact from contamination during handling and storage.[27]

Replacing downer cows is one of the major costs in the modern dairy industry. Much hamburger meat comes from cows that become lame in confinement operations, where cows are fed on grains and live an average of 42 months compared with 12–15 years for pasture-fed cows. All photos: NewTrends Publishing.

Raw milk and babies

As well as protecting the milk itself from spoilage, bacteriostatic mechanisms in raw milk may be beneficial to the neonatal gut by helping with prevention of infection from pathogenic bacteria. As a source of lactoferrin and beneficial *Lactobacillus* and *Bifidobacter* bacteria, raw milk may help to build a healthy gut flora in babies who can't or won't be breastfed.

In these days of super-cleanliness and über-sterilisation, does it make sense to remove a source of potentially beneficial bacteria from neonates? Raw milk has to come from herds that are certified as OTF (officially tuberculosis-free) and this is checked four times a year.[34]

Maybe if these neonates had healthy gut flora in the first place it would be harder for it to become compromised later by unhealthy bacteria, including MAP. Research has shown that children who were brought up on raw milk had higher resistance to infection by *Mycobacterium tuberculosis* and to other bacterial infections.[35]

However, the Government guidelines for raw milk state that children should not be fed raw milk; they also recommend that babies under one year should not be fed any cows' milk, raw or pasteurised.

Doubts

There have been incidences of disease with serious consequences attributed to the consumption of raw milk in recent times. In California, an unfortunate elderly lady with chronic leukaemia was brought into hospital suffering from severe *Salmonella dublin* bacteriaemia, from which she died 17 days later. She was a long-term consumer of raw milk from the Alta Dena dairy. Several other cases of *Salmonella dublin* were also traced back to the same dairy at that time, with a few more hospitalisations but no more deaths.[36]

The question raised, however, is: would she have succumbed to the salmonellosis if her immune system had not just been mostly inactivated by her chemotherapy treatment?

Other doubts include the risk of gastro-intestinal upset. In most children and adults the effects are distressing rather than dangerous but, again, the immuno-compromised are at higher risk. Neonates are also at higher risk, not only because of their immature immune system, but also because of their low bodyweight, so they run the risk of severe dehydration and debilitation from gastro-intestinal disorders.

Homogenisation

Process

The first homogeniser was patented in 1899 by Auguste Gaulin. Since then, there have been many others but the basic process works thus:

The milk is squirted through a very fine nozzle at variable pressures to disrupt the fat globule and its native membrane structure. The globule sizes are reduced to ~0.1 µm in diameter by this process. After a few seconds, the casein micelles re-group around the new, smaller globules. The ratio of membrane to fat globule is much higher and this

means that the specific gravity of the globules increases. Thus the new globules are less able to rise to the surface of the milk, where they could coalesce to form the cream layer.[37]

Reasons

Homogenisation is a commercial process done for commercial reasons. The benefits are that the milk is a uniform colour throughout, that there is no cream layer on the surface and that the shelf-life is extended by up to four-fold. Unhomogenised milk generally lasts about three days, whereas homogenised milk lasts for up to 11 days before it goes off.[38]

Doubts

Around 35 years ago cardiology expert Dr Kurt Oster and a colleague, Dr Donald Ross, started to investigate xanthine oxidase (XO), a natural enzyme found in milk. It is also made by other animals, including humans, in the liver. They proposed that bovine XO was managing to get into the human bloodstream directly through the gut wall and was attacking native plasmalogen, a part of the blood vessel lining material. This damage would then lead to plaque build-up and atheroma, and thence to coronary artery/cardiovascular disease. In fact, they claimed that it could be a leading cause for the rise in heart disease.

Their contention is that the homogenised milk fat globules are too small to be digested; that they pass through the stomach virtually untouched and into the small intestine where, if the conditions are favourable, they can pass straight through the gut wall and into the bloodstream, bypassing the normal fat digestion processes, not entering the lacteals as digested fats do, but entering instead the hepatic portal blood system. They compared the fat globules to liposomes, artificially created packages designed to deliver substances directly to the cells without being digested en route.[39]

There has since been more work done on xanthine oxidase and its effects that seems to indicate that there is no reason why bovine XO should have any different effect in the body than native XO and that in fact it may be beneficial and protective rather than damaging.[40]

In his book, *The Untold Story of Milk* (see Review), Ron Schmid cites research done by other scientists refuting Dr Oster and his colleagues' work. This shows that the work they did was flawed and based on the theory that homogenised fat globules are too small to be digested.

However, sheep and goats' milk fat globules are naturally much smaller than bovine milk and are often referred to as 'naturally homogenised'. As a result it is impossible to 'cream off' sheep and goats' milk to make butter and cream in the same way as with cows' milk. Yet both sheep and goats' milk are well digested by the human system.

The book also disclaims the idea that the XO found in atherosclerotic areas of the cardio-vascular system is due to bovine XO. In one study, animals fed with corn oil (maize oil) showed increased XO activity. From this it would seem as though the increased consumption of vegetable and grain oils since the 1930s may also be linked with XO-induced damage.[38]

Discussion

It is likely that the quality of raw milk has changed since the 1920s – widespread use of agrochemicals has left us with a legacy of fat-soluble toxins in our environment, such as lindane and DDT, that may have contributed adverse health effects. Even in organic herds with good microbiological profiles, the legacy of general pesticide use over the past few decades may still be evident.

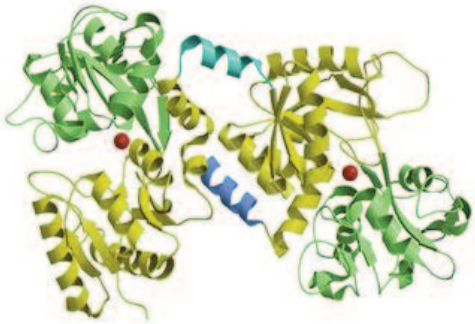
Because of this it seems possible that raw milk today may still not be of the same quality as that produced in the 1920s and '30s. Although it might be microbiologically cleaner, and apparently the UK has some of the best hygiene standards in the world, it is still likely to be contaminated with some potential toxin, although at a level deemed too low to cause concern.

However, the same can be said of pasteurised milk because the pasteurisation process removes very few of these environmental toxins. It is valid to discuss whether or not the native bacteriostatic mechanisms in milk would have a sufficient effect on the MAP bacteria – is it possible that no pasteurisation might be of more benefit than more pasteurisation?

As for homogenisation, unlike pasteurisation it provides no health benefits, only commercial ones. More independent, unbiased research needs to be done on the potential risks of xanthine oxidase and other factors associated with reduced milk droplet size before any reasonable conclusion can be reached. In the UK milk sold in supermarkets is almost certainly homogenised, whereas milk sold in bottles by the milkman is likely to be unhomogenised.

Conclusion

It has become increasingly difficult to obtain pure, unadulterated milk over the last 25 years since the retail sale of raw milk through outlets other than registered production holdings (at the farm gate or in a farmhouse catering operation) or by distributors/milk roundsmen was banned in England and Wales in 1985.



Above: Elegant complexity is revealed in this diagram of lactoferrin, an enzyme in raw milk that protects against pathogens and ensures complete assimilation of iron in the milk. Pasteurization's rapid heating warps and distorts this fragile, three-dimensional structure, rendering it ineffective and possibly toxic. **Below**: Raw milk delivery truck in Italy; similar vending machines are installed in schools and offices across continental Europe.

There is clear evidence that pasteurisation removes *Mycobacterium bovis* and *M.tuberculosis* from milk. However, controls are already in place to ensure that milk should come only from herds that are officially tuberculosis-free so this becomes largely irrelevant in terms of public health.

In the case of pasteurisation for the prevention of IIDs there is evidence that raw milk is frequently less likely to be at fault than post-pasteurisation contaminated milk. The number of IIDs attributable to pasteurised dairy foods is much higher than to raw milk, although it must be remembered that far more people consume pasteurised dairy produce than unpasteurised.

As detailed earlier, pasteurisation causes the loss of:

- Enzymes
- Water-soluble vitamins
- Mineral-carrying whey proteins that help absorb the minerals
- Other whey proteins, such as lactoferrin, that help to promote healthy gut bacteria in neonates
- Solubility of calcium, thus decreasing its absorption
- Potentially beneficial bacteria
- Bacteriostatic mechanisms that help to protect against infectious organisms.

Is the loss of all these benefits of a food

substance worth the diminution of a risk that is perhaps overstated?

Remember also the dying words of Louis Pasteur himself: 'The germ is nothing, the terrain is everything'. If regular consumption of raw milk has a beneficial effect on the immune system, promoting stronger immunity to disease in general, then the risks from the consumption of raw milk are outweighed by the benefits. Bacteria that are sometimes present in raw milk have no opportunity to flourish in a vigorous, healthy environment with a strong immune system.

Regarding homogenisation, more work needs to be done to clarify whether or not there are potential adverse health aspects.

In personal preference, I drink unhomogenised milk. As to the raw vs. pasteurised milk issue, I am undecided. Not having been brought up on it, my system is unaccustomed to it; but if the milk could be certified pathogen-free and was easily available, then I would more than likely convert to raw milk. ✪

Armed raid on raw milk outlet in California

A raid by armed police on Rawsome Foods in Venice, California, on 30 July demonstrates the difference between the aggressive attitude of many officials in North America against raw milk and its supporters and the more benign approach found in most European countries.

Agents, including FBI and FDA, took thousands of dollars' worth of raw dairy products and shut the group down for not having a public health permit (even though they are a private food club). Legal action is now in progress, as are others against similar raids in other parts of the US.

In Canada sale of raw milk is banned but farmer Michael Schmidt of Glencolton Farms, near Toronto, is fighting a legal action over his cow-share program after several raids on his farm.

The main north American organisation supporting the raw milk movement is The Weston A. Price Foundation (WAPF), PMB 106-380, 4200 Wisconsin Avenue, NW, Washington, DC 20016, USA; (www.westonaprice.org; (202) 363 4394), a charity founded in 1999 to disseminate the research of nutrition pioneer Dr Weston Price. It runs A Campaign for Real Milk (www.realmilk.com), which posts articles on the health benefits and sources of raw milk in many countries, including the UK. It recently helped launch a Farm-to-Consumer Legal Defence Fund to help farmers and sellers defend themselves.

A documentary, *Farmageddon…The Unseen War on American Family Farms*, produced by Kristin Canty, is due for release in January; more details: www.farmageddonmovie.com . It includes harrowing tales of seven dairy farmers and co-op owners who were raided and shut down for selling raw dairy products to the public.

- In Britain, WAPR's London chapter (www.westonaprice.org/london) runs meetings and is preparing a conference in March at which a similar British film will be launched (see Diary). Currently there are some 30 British outlets selling raw milk, two of which distribute nationally.

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