The Consumer Education Project Of Milk SA
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MILKSPLAT

The effect of heat treatment on the nutritional value of milk and milk products

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The increasing awareness of what is “natural” or “unprocessed” often raises the question of how heat treatment affects the nutritional value of milk and other milk products.

In order to make it safe for human consumption, various food products undergo heat treatment to limit or destroy any potential harmful bacteria. There are four different heat treatment options available, namely:

- Pasteurisation;
- Ultra-pasteurisation;
- Ultra-high temperature processing (UHT); and
- Sterilization.

The effect of heat treatment (specifically pasteurisation) on the nutritional value of milk will be discussed in this article, based on scientifically proven research.

1. **Milk proteins**

Pasteurisation does not change the protein quality of milk. Whey proteins denature to a limited extent during heat treatment, but the nutritional value and protein qualities do not get affected by it.

The nutritional value of milk proteins is determined by their digestive abilities and the availability of essential amino acids. These nutritional values are not affected by heat treatment, although the functional characterisations of milk proteins (e.g. emulsifying, water binding, and dissolving properties) might change. Short-term high temperature treatment does not cause significant chemical changes or meaningful negative secondary structural changes.

One of the most important essential amino acids in milk is lysine. Research shows that the available amount of lysine in milk only slightly decreases (1-4% decrease) after pasteurisation, and that the influence of heating on the other amino acids in milk are negligible. Milk still stays a valuable source of lysine in the diet.

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2. Milk fat

In humans, the size of the fat globule is the key physico-chemical factor that regulates the bioavailability of fatty acids. Smaller fat globules are broken down easier due to their higher surface accessibility. Smaller fat particles, which form as a result of homogenisation and pasteurisation of milk, would favour fat lipolysis, possibly due to the positive access of lipase (enzymes that break down fat) to the fat cells. This proves that the commercial heating of milk does not have a significant impact on milk fat.

3. Vitamins and minerals

Pasteurisation does not cause any change in the concentrations of minerals, which are very heat stable. Milk is a good source of calcium and phosphorus. Heat treatment appears to have no significant effect on the bioavailability of calcium, the major milk mineral; both the total amount of calcium and the bioavailability of the calcium in milk remain unchanged after pasteurisation.

The iodine concentration of milk can vary greatly. This is mostly determined by the area of pasture (geographical area of the herd) as well as the diet of the milk producing herd. For example, the potassium-iodine supplements in a cow's feed may contribute to an increased iodine concentration of milk. The effect of pasteurisation on the iodine concentration of milk is debatable. For example, one study has shown that the iodine concentration decreased with as much as 20% after pasteurisation, while another has shown that sterilization, which is a far more intense heat treatment than pasteurisation, has no influence on the iodine concentration.

Research shows that the folate, vitamins B12 , vitamin C, B6 and B1 content of milk decreases with less than 10% after pasteurisation. Vitamin B2 and the fat soluble vitamins A, D, E and K are very heat stable and, therefore, are not affected by heat treatment and pasteurisation.

Because milk naturally contains little vitamin D, it is most of the time fortified with this ingredient in various countries. Vitamin D plays a vital role in calcium absorption and is therefore of utmost importance to ensure a healthy bone structure. In South Africa milk is not fortified with vitamin D. The assumption is made that the high exposure to sun light should contribute to a positive vitamin D-status amongst South African citizens and therefore they should have sufficient vitamin D to support bone health.

4. Milk allergies

Research shows that unpasteurised milk could possibly offer protection against allergies. However, these findings may also be attributed to country lifestyle and farm surroundings and are not only due to the consumption of unpasteurised milk.

An allergy is a protein induced reaction of the immune system. The protein in cow's milk can therefore cause a specific reaction in patients with cow's milk allergies. Babies usually outgrow this allergy within their first year and statistics show that only 6% of the world population, over 6 years of age, suffer from cow's milk allergies.

Babies can be more susceptible to cow's milk allergies because of the fact that their digestive systems are still developing. Due to the lower pepsin-/enzyme activity and higher pH in the gut (thus a lower acid concentration), consumption of proteins or peptides can cause a severe immune reaction in babies. A study among children with confirmed milk protein allergies showed that neither unpasteurised, homogenised nor pasteurised milk could be tolerated.

All of the best known proteins in all mammal milk are potential allergens for babies with a milk allergy. Heat treatment can lower the allergenic abilities of whey proteins, but have no noticeable influence on the allergenic abilities of casein. Casein represents 80% of the proteins in milk and is substantially heat resistant. Whey proteins are therefore more labile when it gets exposed to heat and mildly sensitive to denaturising against the pasteurisation temperature. The mobility of certain parts of the protein chain can thus increase, which causes the protein polypeptide to break down, possibly causing an allergic reaction. Heat treatment can therefore not be linked unequivocally to a lowered allergenic ability. Studies conducted on mice showed that casein and whey proteins of sterilized milk are less allergenic than those of unpasteurised milk. Further studies are needed to confirm the difference between the allergenic abilities of pasteurised- and unpasteurised milk.

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5. Antimicrobial characteristics

Various potential antibacterial components in milk, such as lactoferrin, lysozyme and lacto peroxidase are minimally influenced, if at all, by pasteurisation.

Conclusion

Research has therefore confirmed the minimal effect of heat treatment on the nutritional value of milk, especially when considering the beneficial effect of reducing or destroying harmful bacteria. According to the law, unpasteurised milk cannot be sold in South Africa, except in isolated cases where it is permitted by the local authority.

With acknowledgement to the action team of SCHN of the IDF

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