Give us our daily dairy – *or not?*

"We are one of the very few mammals who drink the milk of another mammal after weaning" (author unknown)

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As children, most of us were told to drink a glass of milk at dinnertime, "You need your calcium", our parents would say.

Humans have been consuming milk and milk products since the domestication of suitable animals. Initially, milk was used to feed infants, but from the late 19th century, adults also began consuming milk and other dairy products due to new storage and preservation techniques. From the early 20th century dairy was considered a staple food. This was due in part to the industrialisation of cattle farming, pasteurisation and doorstep delivery. Developments also occurred in the heat treatment of dairy, as well as developments in packaging and refrigeration[1]. By 1943 the Ministry of Food was providing over four million UK schoolchildren with milk each day[2].

Today, milk is one of the most common allergens and has been linked to various cancers, eczema, asthma, irritable bowel syndrome (IBS), Crohn's disease (CD) and *Acne vulgaris*. Proponents of milk and dairy products argue the benefits, especially for growing children[3] and those at risk of osteoporosis[4]. Opponents argue that humans have not evolved enough to be able to digest and absorb dairy and this has led to, or exacerbated, chronic diseases.

Research over the years has provided conflicting results, so what IS the truth about milk and dairy products? Are they harmful to us or protective?

Composition

While the exact composition of milk varies between species, breeds and their feed, whole milk and dairy products have a high proportion of fat and protein and also contain some important vitamins and minerals.

Whole cow's milk typically contains 3.4g protein and 3.6g fat per 100g[1]. Milk contains all the essential amino acids in the correct proportions for humans[1]. Fat accounts for a third of the energy and is made up of mainly saturated fat, with some mono- and poly-unsaturated fats[5]. Lactose is the only significant carbohydrate in milk, while cheese and butter have less.

Milk also contains numerous enzymes for the digestion of milk and, alongside yoghurt, contains high levels of calcium and is a source of vitamin D, riboflavin and phosphorous[5]. Retinol, which converts to vitamin A in the body, and other fat-soluble vitamins can also be found in full-fat dairy products[5].

What the Research Says

Cancer

To date, research on the link between dairy and cancer has focussed largely on the prostate, breast and colon.

Milk and dairy products have traditionally been recommended to increase calcium and to improve bone density and prevent osteoporosis[4]. However, high levels of calcium (>2000mg/day) may increase the risk of prostate cancer (PC)6. This is equivalent

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to drinking 1.6L of milk per day which would actually be difficult to consume at such high amounts.

The mechanism of this potential risk is attributed to calcium down-regulating the conversion of inactive vitamin D to its active form, 1-25-dihydroxycholecalciferol[7]. Cholecalciferol has been shown to be antiproliferative, antimetastatic and has a differentiating effect in PC[8]. Milk seems to be the main culprit[9], but calcium from vegetables, fish and supplements may also contribute to an increase in risk of PC[10].

In the long disputed area of dairy intake and breast cancer, the Norwegian Women and Cancer study found there is only a weak link with dairy[11]. This link may be due to the whey acidic protein content of milk[12]. A recent review suggests dairy, but not milk, may instead have a protective effect in breast cancer risk[13].

Dairy's protective effects may go further than breast cancer and this is an area where experts seem to agree. Yoghurt has been found to provide a significant protective effect against colorectal cancer[14]. This may be attributed to calcium or it could be due to other chemo-protective ingredients such as conjugated linoleic acid (CLA), vitamin D, butyric acid, sphingolipids, and probiotic bacteria[15]. Cow's milk may also offer protection during conventional treatment and was found to improve the gut lining following chemotherapy damage in mice and enhanced the action of a chemotherapeutic agent[16].

Other health issues

Dairy avoidance is traditionally recommended by the medical and nutritional community for those with Crohn's disease (CD). A small study on juvenile CD found that remission was extended with the exclusion of dairy[17]. More recent research suggests that avoidance should be based on individual tolerance[18,19] and may extend remission[17].

IBS

A significant improvement was reported by IBS patients in both symptoms and IgG4 levels when dairy was excluded from the diet of IBS patients[20]. Cases of IBS may result in gut permeability, allowing milk proteins to enter the blood stream, thereby increasing the inflammatory response and resulting in dairy intolerance.

Acne vulgaris

Dairy is strongly associated with a higher incidence of acne in teenagers[21]. According to one review, this may be due to a deficiency in Nuclear Fox01, a key transcription factor that mediates insulin action on gene expression, caused by whey proteins in milk, which has been implicated in the pathogenesis of *Acne vulgaris*[21] and may cause follicular inflammation, increased sebum production, the activation of androgen receptors and comedogenesis[22].

Eczema and atopic allergy

Due to previous studies that demonstrated a higher incidence of eczema among babies fed cow's milk versus breast milk, it has been recommended that cow's milk is avoided or minimised during pregnancy and lactation[23,24]. However, several recent studies have demonstrated no association between cow's milk and eczema[25]. These results may be attributed to high levels of ruminant fatty acids, which include protective n-3 long-chain polyunsaturated fatty acids, found in breast milk[26,27]. This protective influence on risk seems to be limited to the first year of life[28], but may also help reduce the incidence of wheezing in young children[29].

The culprits

What about the hormones?

There are several natural hormones found in milk that may be a contributing factor to the effect on our health. Commercial farming practices may mean that dairy cows also have additional hormones to organic cows, but more research is needed in this area.

Natural growth hormones, found in milk and dairy, such as insulin-like growth factor-I (IGF-I) have been shown to increase with milk consumption in both children[30] and adults[31,32]. This may be due to calcium in milk which raises IGF-I[31], milk's ability to raise insulin levels which in turn raises IGF-I[34] or that casein, the main protein in milk, has residual IGF-I in it[30].

Insulin is another hormone that may be problematic as elevated levels may lead to insulin resistance, a factor in Type2 diabetes[35]. Bovine insulin, differing by three amino acids to human insulin, appears to survive pasteurisation and crosses the gut barrier, as immunity to it in milk-consuming children is common[36,37]. Young children have more permeable guts than adults, but this may be a consideration for adults as well[37,38].

Epidermal Growth Factor (EGF) receptors are over-expressed in many cancers[39,40]. Betacellulin is an EGF hormone found in milk, cheese and whey[41], which may enter the circulation through the luminal receptors in the gut[41,42].

Steroids are hormones found in commercial pasteurised milk and include 5-androstanedione and 5-pregnanedione, which are progesterone, oestrogen and dihydrotestosterone (DHT) precursors as well as progesterone and oestrogen[43]. Oestrogens found in the human diet are believed to come mainly from dairy[44] with elevated oestrogen metabolites since cows are usually milked in the late stages of pregnancy[45]. US researchers measured oestrogen metabolites and found that skimmed milk has more total oestrogens than part-skimmed and whole milk[44]. Oestrone sulphate is the most prevalent form of oestrogen and is highly bioactive[46].

Amine

Dairy products also contain amines, which are mainly formed from the decarboxylation of amino acids[47]. They can have toxicological effects if allowed to accumulate and have been linked to migraines[48].

Calcium

Calcium is the main mineral involved in bone formation and it is important to have sufficient levels of calcium in the diet to prevent osteoporosis[4]. The National Osteoporosis Society recommends between 1000-1500mg of

calcium per day[49]; 100g of whole milk contains 118mg of calcium[5].

Although calcium from dairy is highly bioavailable, vegetables and fish are also excellent sources of calcium. Per 100g of food, high calcium levels are found in tofu (510mg), sardines with bones (500mg), almonds (240mg), watercress (170mg) and chickpeas (160mg)[5,49]. Absorption is dependent on sufficient vitamin D, normal intake and requirement of the individual and the presence of binding substances[50]. A diet high in protein and sodium is acidic and can increase urinary calcium excretion and diminishes bioavailability despite increasing intestinal absorption[51]. Lactose tends to increase calcium absorption so individuals drinking lactose-free milk may have reduced calcium absorption[51].

Pasteurisation

The process of pasteurisation unfortunately denatures the casein protein in milk, rendering it more difficult to digest and may affect its allergic potential[52]. Additionally, the enzymes that are present in milk and aid digestion are destroyed during pasteurisation. Raw milk is nutritionally superior to pasteurised milk in terms of its natural protein structure and the presence of enzymes, but it is a controversial subject. It may also offer a protective effect, when compared with boiled milk[52].

A recent study found that raw milk was inversely associated with asthma in farm children[53] and a recent review found a consistently protective effect across studies examined, but were unable to identify the mechanisms[54].

What's the best type?

Modern milk and dairy products are quite different from what was consumed by our ancestors due to pasteurisation, which can destroy dangerous bacteria such as salmonella and *E.coli* O157.

In England, Wales and Northern Ireland, unpasteurised cows milk for drinking can only be sourced from tuberculosis (TB)-free herds. It can also only be sold direct to the consumer or via farmers' markets, milk rounds or farm catering operations.

The bacterium *M. bovis*, which causes TB in cattle, can also infect humans. Only a very small number of human TB cases due to *M. bovis* infection have been reported in the UK in recent years and there is no evidence that these have been caused by recent consumption of milk or dairy products. The vast majority of human TB is caused by another bacterium, *Mycobacterium tuberculosis*.

Proceed with Caution

The subject of milk and dairy products is still under scrutiny and is subjective. In cases of colorectal and breast cancer it may have protective effects, but may be best avoided in cases of prostate cancer. Avoidance for Crohn's disease should be considered, but taken on individual basis of intolerance, while those with IBS and *Acne vulgaris* should consider an exclusion diet. To date, research on eczema is ongoing and inconclusive, but pregnant and nursing mothers may want to consider consuming organic milk that may have fewer hormones or dairy alternatives. Healthy individuals may be interested in considering raw milk as a further alternative.

For a list of raw milk and dairy product suppliers, go to:

http://www.seedsofhealth.co.uk/resources/dairy/index.shtml

For more information, see the Food Standards Agency website:

http://www.food.gov.uk/foodindustry/guidancenotes/hygguid/rawmilkcream#h_4

http://www.food.gov.uk/news/newsarchive/2011/mar/rawmilk

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