Skin and intestinal reactions to cow’s milk was described by Hippocrates (460-370 B.C.) and Galen of Pergamum (130-210 AD). Both are ancient Greek physicians so there has been an awareness of problems with cow’s milk for a considerable period of time.

Cow’s milk is the most common form of allergic reactions, although the actual prevalence is disputed.

Digestion of Cow’s Milk

In cattle, digestion of casein proteins is initiated by rennin, which produces a curd. In humans, since rennin is not present, curds are not formed. The precipitate formed from human milk is much finer and softer and easier to digest.

Casein from cows binds to bile acids which limits the ability to make fatty acids soluble. Calcium, iron, zinc magnesium and magnesium bind to casein which possibly limits their availability.

There is a considerable difference in the content of cows milk and human milk. A lot of effort is involved in “humanising” cows milk for use in baby formula so that it is suitable for consumption. [1]

Component	Units	Cow's Milk	Human Milk	Allergenic
Protein	% energy	20	8	
Casein	% protein	87	29	
alpha-casein	% casein	55	12	*
Whey	% protein	20	60	
beta-lactoglobulin	% whey	30	0	*
Lactoferrin	% whey	2	35	
Micelle size	nm	182	64	

The net protein utilization of whey protein, irrespective of source, is superior to that of casein, 95% compared to 80%. A significant amount of effort has been made in “humanising” cow’s milk infant formula. The amino acid profile of pre-term newborn babies fed a whey-predominant formula more closely resemble those of breast-fed infants. [2]

Babies fed a casein-predominant formula have:

- higher levels of blood urea nitrogen
- higher levels of amino acids phenylalanine, methionine, tyrosine

- lower levels of taurine and cystine
- higher levels of ammonia
- lower serum pH – blood is more acidic

Gastroenteritis

Since the 1950s, it has been known that “that breast-fed babies are relatively resistant to gastroenteritis”. Breast-fed babies have greater amounts of *Lactobacillus* due to higher levels of lactose, low protein and low phosphate content. [3]

Flora of the breast-fed infant is dominated by *Bifidobacterium* and *Lactobacillus* which produce lactic acid and are beneficial. *Staphylococcus* bacteria is also higher in breast-fed babies which can be detrimental. *Lactobacillus* and *Bifidobacterium* bacteria inhibit the growth of many pathogenic bacteria such as *Staphylococcus*, *Salmonella*, *Yersinia*, *Clostridium*, *Listeria* species and *Escherichia coli*.

A decrease in *Bifidobacterium* bacteria in human intestine indicates an unhealthy state.

The flora of casein-based formula-fed infants contains more *Bacteroides*, *Clostridium* species as well as Enterobacteriaceae. Enterobacteriaceae is a large family of many mostly harmless bacteria but does include common pathogens such as *Salmonella* and *Escherichia coli* which are associated with gastroenteritis and other intestinal problems. [4] [5]

Bifidobacterium and *Lactobacillus* and other bacteria produce B vitamins and vitamin K. They ferment non-digestible carbohydrates (dietary fibre) into short-chained fatty acids (acetate, propionate and butyrate) which are essential to our well-being.

Other intestinal bacteria produce substances that are harmful to the host, such as putrefactive products, toxins and carcinogenic substances. When harmful bacteria dominate in the intestines, essential nutrients are not produced and the level of harmful substances rises.

Bovine casein promotes the growth of disease causing bacteria. Neonatal necrotizing enterocolitis, where a portion of the bowel dies) is much more evident in formula-fed infants.

Inflammation and Allergy

Casein has considerable inflammatory characteristics. [6]

The following table the prevalence of potential allergenic symptoms with cow's milk proteins. [7] These values are taken from a number of different studies and show a wide range of prevalence.

The homology represents the amount of similarity with the proteins in human milk compared with cow's milk. [8]

Component	Prevalence of Allergies %	Notes
Caesin		
• αS1-casein	65-100	Trace amounts only in human milk
• αS2-casein		
• β-casein	35-44	47% similarity (homology) with human milk
• κ-casein	35-41	Low homology with human milk
Whey		
• α-lactoalbumin	0-67	72% homology with human milk
• β-lactoglobulin	13-62	Absent in humans
• Immunoglobulins	12-36	
• Serum albumin	4.9-5.1	80% homology with human milk
• Lactoferrin	0-35	Much higher concentration in human milk
• Lysozyme		

Immune Response to Cow's Milk Proteins

Antibodies are produced when our bodies recognise a protein as foreign. Antibodies to cow's milk proteins can be detected at birth and levels generally increase until weaning. Antibodies to β-lactoglobulin and α-casein were measured in the blood of formula-fed infants of 31 to 41 weeks of gestation. [9]

Antibodies to bovine serum albumin (BSA), casein and to β-lactoglobulin found in the control group of "normal" children and those with type 1 diabetes in a Finnish study. The diabetic children had a significant increase in anti-BSA antibodies. [10] [11]

Serum antibodies to five major proteins of cow's milk: casein, bovine serum albumin (BSA), α-lactalbumin, β-lactoglobulin A, and β-lactoglobulin B, were compared in patients with Crohn's disease and 20 matched controls. IgG and IgM antibodies to cow's milk proteins were significantly elevated in patients with inflammatory bowel disease as compared to controls. [12]

β-Casomorphins

Casomorphins are formed from casein when mammal milk is digested. They bind to opiate receptors which results in calming the infant and most likely assists in bonding with the mother.

A 2009 paper studying the effects of breast feeding on motor development, showed that elevated levels of antibodies to bovine β-casomorphins-7 was associated with a "a risk factor for delay in psychomotor development and other diseases such as autism". The study concluded that "breast feeding has an advantage over artificial feeding for infants' development during the first year of life". [13]

Bovine β-casomorphins has also been associated with apnea (the suspension of breathing) and sudden infant death syndrome (SIDS).[14]

Recently, significantly higher levels of bovine β-casomorphins have been detected in the urine of children that have impaired early child development. Their hypothesis is that casomorphins interact with opioid and serotonin receptors and thereby "setting the stage for autistic disorders". [15]

Lactose Intolerance

Milk is toxic to approximately 75% of the world's population. [16]

Adults do not produce the enzyme lactase which is required to break down lactose (milk sugar). Children have this ability but the ability is lost by 7 or 8 years. [17]

The production of cheese and yogurt around 9,000 BCE in the Middle East, allowed adults to consume dairy products without the ill-effects of bloating and diarrhoea.

By approximately 5,500 BCE, herders reached central Europe, a genetic mutation allowed lactase to be produced into adulthood, allowing milk to be consumed without discomfort.

As well as northern Europe, western Africa (Algeria, Mauritania, Senegal, Guinea), Arabia, Pakistan & Gujarati have independently developed populations that are lactose tolerant as adults.

Lactose comprises of two simple sugars: glucose and galactose.

Research funded by The National Dairy Promotion and Research Board, and the US Department of Agriculture, tested a treatment for lactose intolerance by feeding patients with *Lactobacillus acidophilus*, which is found in yogurt. The study failed to show that *Lactobacillus* had any benefit. [18]

Since galactose is routinely used by researchers to promote aging in animal experiments, it is apparent that evolution (or nature, if you prefer) has a good reason to ensure that our consumption of galactose is limited.

Type 1 Diabetes

In 1990s, Finland had the highest incidence of diabetes and cow’s milk consumption in the world.

In Finland, researchers compared levels of incompletely digested cow’s milk protein (Bovine Serum Albumin – BSA) in 142 diabetic children. Levels of IgG anti-BSA antibodies were higher than 3.55 RFUs (relative fluorescence units) for the 142 diabetic children whilst each non-diabetic child in the control group of 79 children had levels of less than 3.55. [19]

There was no overlap of the levels between the two groups of children. All children with diabetes had a higher level of the antibodies (which can only occur from consuming cow’s milk) than the group without diabetes.

Significant increases in BSA antibodies in diabetic children have been found in other studies in Finland [20] and France. [21]

For Type I diabetes, there is a specific sequence of 17 amino acids that is found in proteins in cow’s milk. The immune system recognizes this sequence as a foreign intruder so antibodies are produced to eliminate the unwanted invaders. Unfortunately, the same 17 amino acid

sequence is found on the cells of the pancreas that produce insulin. Consequently, the immune system is unable to distinguish the cow's milk protein fragments from the pancreatic cells. It therefore destroys both which leads to the inability of the pancreas to produce insulin and leads to a life time dependency of insulin injections and their consequences. [22]

Summary

Mammals have evolved over millions of years to provide nutrition for their infants in the first stage of life. There are significant difference between species depending upon factors such as rates of growth.

A bull reaches maturity at 9-10 months, so the rate of growth is markedly different to humans. Consequently, the composition of bovine milk is very different to that of humans. The consequences of cow's milk consumption are potentially harmful.

Related articles

The A2 Milk Story
Comparison of Dairy Milks with Human Milk

Footnotes

1. Inglingstad, R. A. et al. (2010) Comparison of the digestion of caseins and whey proteins in equine, bovine, caprine and human milks by human gastrointestinal enzymes. *Dairy Science & Technology*. 90 (5), 549–563.
2. Miller, J. et al. (1990) Casein : A Milk Protein with Diverse Biologic Consequences. *Casein*. (43129), 143–159.
3. Bullen, C. L. & Willis, A. T. (1971) Resistance of the breast-fed infant to gastroenteritis. *British Medical Journal*. 3 (5770), 338–343.
4. Bullen, C. L. & Willis, A. T. (1971) Resistance of the breast-fed infant to gastroenteritis. *British Medical Journal* 3 (5770), 338–343.
5. Lara-Villoslada, F. et al. (2007) Beneficial effects of probiotic bacteria isolated from breast milk. *British Journal of Nutrition*. 98 (S1)
6. Miller, J. et al. (1990) Casein : A Milk Protein with Diverse Biologic Consequences. *Casein*. (43129), 143–159.
7. Hochwallner, H. et al. (2014) Cow's milk allergy: From allergens to new forms of diagnosis, therapy and prevention. *Methods*. 66 (1), 22–33.
8. Miller, J. et al. (1990) Casein : A Milk Protein with Diverse Biologic Consequences. *Casein*. (43129), 143–159.
9. Müller, G. et al. (1986) Cow milk protein antigens and antibodies in serum of premature

infants during the first 10 days of life. *The Journal of Pediatrics*. 109 (5), 869–873.
10. Karjalainen, J. et al. (1992) A Bovine Albumin Peptide as a possible trigger of insulin-dependent Diabetes Mellitus. *New England Journal of Medicine*. 327 (5), 302–307.
11. Dahlquist, G. et al. (1992) An increased level of antibodies to β-lactoglobulin is a risk determinant for early-onset Type 1 (insulin-dependent) diabetes mellitus independent of islet cell antibodies and early introduction of cow’s milk. *Diabetologia*. 35 (10), 980–984.
12. Knoflach, P. et al. (1987) Serum antibodies to cow’s milk proteins in ulcerative colitis and Crohn’s disease. *Gastroenterology*. 92 (2), 479–485.
13. Kost, N. V. et al. (2009) β-Casomorphins-7 in infants on different type of feeding and different levels of psychomotor development. *Peptides*. 30 (10), 1854–1860.
14. Sun, Z. et al. (2003) Relation of β-casomorphin to apnea in sudden infant death syndrome. *Peptides*. 24 (6), 937–943.
15. Sokolov, O. et al. (2014) Autistic children display elevated urine levels of bovine casomorphin-7 immunoreactivity. *Peptides*. (56), 68–71.
16. Saltzman, J. R. et al. (1999) A randomized trial of Lactobacillus acidophilus BG2FO4 to treat lactose intolerance. *The American Journal of Clinical Nutrition*. 69 (1), 140–146.
17. Curry, A. (2013) The Milk Revolution. *Nature*. 500.
18. Saltzman, J. R. et al. (1999) A randomized trial of Lactobacillus acidophilus BG2FO4 to treat lactose intolerance. *The American Journal of Clinical Nutrition*. 69 (1), 140–146.
19. Karjalainen, J. et al. (1992) A Bovine Albumin Peptide as a possible trigger of insulin-dependent Diabetes Mellitus. *New England Journal of Medicine*. 327 (5), 302–307.
20. Saukkonen, T. et al. (1994) Children With Newly Diagnosed IDDM Have Increased Levels of Antibodies to Bovine Serum Albumin But Not to Ovalbumin. *Diabetes Care*. 17 (9), 970–976.
21. Levy-Marchal, C. et al. (1995) Antibodies against bovine albumin and other diabetes markers in French children. *Diabetes Care*. 18 (8), 1089–1094.
22. Karjalainen, J. et al. (1992) A Bovine Albumin Peptide as a possible trigger of insulin-dependent Diabetes Mellitus. *New England Journal of Medicine*. 327 (5), 302–307.