

Bookmark()

Milks are complex lipid emulsions in water containing protein, fat, lactose, vitamins and minerals, as well as enzymes, hormones and immunoglobulins which provide initial immunity functions,

There is approximately 5,500 species of mammals which initially supply their young with milk. There are vast differences in milk composition among the mammal species.

Mammals provide milk for their growing infants that provide a unique collection of proteins, carbohydrates and fats.

Human milk is markedly different to other mammals, in particular to its protein content.

Proteins in human milk provide sufficient of protein to sustain infants for the first six months without any additional food, as well as supplying the means of establishing suitable environment for the growth of healthy intestinal bacteria and providing the proteins involved in the immune system.

The name *Casein* is derived from the Latin word for cheese. Casein is the curds portion of milk (as in curds and whey) which is insoluble portion that is formed in acid conditions or by the action of rennin.

The main nutritional function of casein is the transport of calcium and phosphorus. Fast growing species (rodents and cattle) have a much higher casein content than humans and elephants which are slower growing. ¹

Casein is only found in milk whilst whey proteins are also found in the blood.

Digestion of casein curds is much slower than that of whey proteins.

Since casein is insoluble in water, it forms globules (micelles) which vary in size and composition according to species.

There are three main divisions of casein: alpha (α), beta (β) and kappa (κ), with α -casein separated into S1 and S2 subdivisions. β -casein has two variants which are discussed separately. β -casein contains 209 amino acids. The A1 and A2 variants differ only at amino acid position 67, which is histidine in A1 or proline in A2 milk.

A comparison of the milk of dairy animals and humans is shown below. This paper suggests that mare's milk is a more appropriate substitute for human milk than other dairy species.²

| Component | Unit | Mare | Cow | Sheep | Goat | Human |
|--------------------------|--------------|------|-----|-------|------|-------|
| Gross energy | kcal/g | 480 | 674 | 1090 | 670 | 677 |
| Fat | % of energy | 23 | 48 | 62 | 55 | 48 |
| Carbohydrate | % of energy | 60 | 32 | 18 | 25 | 44 |
| Protein | % of energy | 18 | 20 | 20 | 20 | 8 |
| Caesin | % of protein | 56 | 87 | 88 | 80 | 29 |
| • α -casein | % of casein | 47 | 55 | 50 | 26 | 12 |
| • β -casein | % of casein | 46 | 30 | 40 | 54 | 65 |
| • κ -casein | % of casein | 8 | 15 | 10 | 16 | 24 |
| Whey | % of protein | 44 | 20 | 22 | 25 | 61 |
| • α -lactalbumin | % of whey | 30 | 21 | 12 | 30 | 35 |
| • β -lactoglobulin | % of whey | 30 | 58 | 68 | 55 | 0 |
| • Immunoglobulins | % of whey | 17 | 12 | | 13 | 22 |
| • Serum albumin | % of whey | 4 | 7 | 4 | 0 | 8 |
| • Lactoferrin | % of whey | 9 | 2 | | 3 | 30 |
| • Lysozyme | % of whey | 9 | | | | 5 |
| Micelles size | nm | 255 | 182 | 210 | 260 | 64 |

- The values listed are averages from a number of sources. These values vary according to the study and the age of the infant. Tables such as these can indicate a precision that does not exist.
- Some authors state that α -casein is absent from human milk. The published figure of 0.06 g / 100 g of milk is significantly less than the dairy species.^{3 4}
- With its smaller micelle size, human milk precipitate is finer and more easily digestible than the firm curds of cow's milk. They contain less calcium and phosphorus than that of cow's milk.
- The need for protein is the greatest in the first year of life. Human milk contains only 6-8% of protein (by energy). This is the lowest of any mammal that has been studied. Other dairy species contain approximately 20% protein.

- The amount of casein as a proportion of protein is lower in humans than other dairy species. This varies throughout lactation. Whey to casein ratios vary from 80:20 in early lactation to 50:50 in late lactation.⁵
- The amount of lactoferrin is higher in humans than other species. In humans, 30% of whey proteins is lactoferrin compared with 2% in cows. As well as providing iron, lactoferrin has antimicrobial activity and is important in growth of beneficial bacteria.⁶ Many other factors in human milk are also involved in immune response.

It is fascinating that breast milk contains a significant concentration of amylase. Amylase is involved in the digestion of starches which are not present in milk. This suggests that breast milk aids in the digestion of complex carbohydrates when solids are introduced. This is consistent with the view that starches are important in human nutrition.⁷

Related articles

[The A2 Milk Story](#)

[Comparison of Dairy Milks with Human Milk](#)

Footnotes

1. De Kruif, C. G. & Holt, C. (2003) 'Casein Micelle Structure, Functions and Interactions', in P. F. Fox & P. L. H. McSweeney (eds.) *Advanced Dairy Chemistry—1 Proteins*. Boston, MA: Springer US. pp. 233-276.
2. Potocnik, K. et al. (2011) Mare's milk : composition and protein fraction in comparison with different milk species. *Mljekarstvo*. 61 (2), 107-113.
3. Jensen, R. G. (1995) *Handbook of Milk Composition*. Academic Press.
4. Miller, J. et al. (1990) Casein : A Milk Protein with Diverse Biologic Consequences. *Casein*. (43129), 143-159.
5. Lönnerdal, B. (2003) Nutritional and physiologic significance of human milk proteins. *American Journal of Clinical Nutrition*. 77 (6), 1537S-1543S.
6. Lönnerdal, B. (2003) Nutritional and physiologic significance of human milk proteins. *American Journal of Clinical Nutrition*. 77 (6), 1537S-1543S.
7. Lönnerdal, B. (2003) Nutritional and physiologic significance of human milk proteins. *American Journal of Clinical Nutrition*. 77 (6), 1537S-1543S.