

The Constituents of Breastmilk

All mammalian milk contains water, fat, protein, carbohydrates, minerals and vitamins. The proportions of these nutrients vary in the different milks. Human milk contains other important factors that are absent from artificial formulae, these include hormones, enzymes, growth factors, essential fatty acids, immunological and non-specific protective factors.

Fat

Fat is the principle source of energy for infants and in human milk is very easily digested.

Human milk contains essential fatty acids in different proportions to those present in cow's milk and includes some of which are commonly absent in artificial formula. These essential fatty acids are needed for a baby's growing brain and eyes, and for healthy blood vessels. There is evidence to suggest that preterm babies fed on artificial feeds, which lack these essential fatty acids, may have less satisfactory mental development and eyesight.

Protein

The protein in different milks varies in quality, as well as in quantity. It is an important nutrient, and it might be thought to be advantageous for a baby to receive large amounts of it. However, all other mammals grow faster than humans, so they need milk with a higher concentration of protein (humans have the slowest rate of growth and development). It is difficult for a human baby's immature kidneys to excrete the extra waste from the protein in animal milks.

Much of the protein in cow's milk is casein which, because of its molecular structure, forms thick, indigestible curds in a baby's stomach. There is less casein in human milk, and its structure means that it forms softer curds which are easier to digest. The soluble or whey proteins are also different. In human milk, much of the whey protein consists of anti-infective proteins, which help to protect a baby against infection. Animal milks do not contain the same kinds of anti-infective protein and so do not protect human babies.

Babies fed on artificial formula may develop intolerance to protein from animal milks. They may develop diarrhoea, abdominal pain, rashes and other symptoms when they have feeds which contain the different kinds of protein. Babies who are fed animal milks or formula may be more likely than breastfed babies to develop allergies which may sometimes cause eczema and respiratory wheeze.

The anti-infective proteins in human milk include lactoferrin (which binds with iron, and prevents the growth of bacteria which need iron), lysozymes (which kill bacteria)

and antibodies (immunoglobulin, mostly IgA). Other important anti-infective factors include the bifidus factor (which is thought to promote the growth of *Lactobacillus bifidus*. *L. bacillus* may inhibit the growth of harmful bacteria, and gives breastfed babies' stools their yoghourty smell).

A baby can develop an intolerance or allergy after only a few formula feeds given in the first few days of life.

Carbohydrates

The sugar lactose is the main carbohydrate in milk readily breaking down into glucose for immediate energy needs and galactose for liver storage to meet future energy needs. The lactose content of human milk is higher than in the milk of other mammals, reflecting the baby's needs for glucose as a source of energy for the brain..

Vitamins

Vitamins can be fat or water- soluble. The fat-soluble vitamins are A, D,E & K. These may vary in breastmilk. They are present in higher amounts in the fat-rich hindmilk. It is therefore very important to ensure that babies are able to feed for as long as they wish on the breast so that they get the hindmilk.

The breastmilk of a well-nourished mother contains plenty of Vitamin A, which is important for the baby's sight and reduces the severity of infections. Breastmilk can supply much of the vitamin A that a child needs even into the second year of life.

The water-soluble vitamins are the B complex, C and folic acid.

A mother who eats a well-balanced, varied diet will be consuming plenty of water and fat soluble vitamins, and her breastmilk will contain enough of both for all her infant's needs. Vitamin supplements for breastfed babies are important for babies of women who exist on an impoverished diet, lacking fresh foods, or those adhering to diets low in particular vitamins, but are probably not necessary for the majority of the healthy population.

Minerals

The levels of sodium, calcium, phosphorous and magnesium in breastmilk are considered ideal for the term baby. While breast milk may contain significantly lower concentrations of minerals than formula milk, absorption may be more complete in breastfed babies because of the presence of specific transport factors in milk.

Iron

Iron is important for the formation of blood. Different mammalian milks contain similar, very small amounts of iron, but there is an important difference, and babies switched too early to unmodified cow's milk are at risk of anaemia. Breastmilk has a relatively low iron content but the iron is bound inside the lactoferrin molecule, which makes it easier for the infant to absorb (more bio-available). It also makes it inaccessible to pathogenic iron-seeking bacteria, which limits their proliferation.

Infant formula contains 5-6 times as much iron as breastmilk. This is present as “free iron” (i.e. not bound with another compound) and is therefore less bio-available and supports growth of iron-seeking bacteria, thus increasing the risk of gut infection in the infant.

Therefore, in spite of the apparently low levels of iron in breastmilk, exclusively breastfed babies **do** get enough iron, and they are protected against iron-deficiency anaemia until at least six months of age, and often longer. By contrast giving a healthy term breastfed baby iron supplements may increase risk of infection.

Water

Breastmilk is water-rich. It also has a low electrolyte concentration, which ensures sufficient free water is available to a baby even in very hot dry weather.

Other Factors

Colostrum and mature breastmilk contain many hormone and growth factors. The functions of some are not yet fully understood, but epidermal growth factor, which is present in both, has been shown to stimulate the growth and maturation of the intestinal villi. Undigested cow's milk protein can pass through the immature infant gut into the blood, and may cause intolerance and allergy to milk protein. Epidermal growth factor helps to prevent the absorption of large molecules by stimulating rapid development of the gut. This “seals” the baby's intestine, so that it is more difficult for proteins to be absorbed without being digested. It is possible that antibodies also help to prevent the development of allergies by coating the intestinal mucosa and preventing the absorption of larger molecules. This may help to prevent intolerance to other foods.

Other Differences Between Breastmilk and Formula Milks

Artificial formula milks are very different from breast milk, although the constituents have been added in quantities which are adjusted to make them approximate to those in breastmilk. Formula milks are made from a variety of products, including animal milks, soybean and vegetable oils. While they may be nutritionally comparable in broad terms, they are unable to duplicate the vast array of functional components that make breastmilk a living, interactive fluid. In the past, several problems have arisen from inappropriate amounts of some of the constituents of formulae.

The faeces of an artificially fed baby are different from those of a breastfed baby. This is partly because an artificially fed baby's faeces contain more undigested food. The reduced digestibility is why there are longer intervals between feeds in formula fed babies. The faeces of a breastfed baby appear quite loose and are passed at irregular intervals. Due to ongoing research, the artificial formula milks of today are different from those used in the past, and those used in the future will be different again. However, they will never be equivalent to breastmilk.