Infant formula is a poor substitute for breast milk, but some want to make it more like the real thing. **Jo Whelan** reports

Winning formula?

BREAST is best. There's no doubt about it. The list of proven benefits grows longer every year. Breastfed babies are not only protected against a huge range of infections, they also enjoy lifelong benefits, from higher intelligence to a lower risk of obesity and diabetes.

The reason, we are discovering, is that breast milk is the ultimate functional food. As well as providing babies with the essential nutrients they need to grow and develop, it also contains hundreds of active components that do everything from targeting dangerous pathogens and boosting the development of a baby's gut to preventing allergic reactions and increasing appetite. What's more, the composition of breast milk changes over time to match babies' needs – levels of natural painkillers called beta-endorphins are highest right after birth, for instance, while levels of most nutrients gradually fall over the first year or so.

Due to its benefits, health authorities recommend breastfeeding exclusively for the first six months of a baby's life, followed by breastfeeding in addition to solid food until children are at least a year old. Yet in the US, just 11 per cent of babies are exclusively breastfed up to the age of six months. In the UK, the figure is just 3 per cent. Despite all the public-health campaigns encouraging new mothers to breastfeed, tens of millions of babies worldwide are raised on infant formula rather than breast milk.

Given that so many babies are getting formula, shouldn't we do everything possible to make it better? Yes, argue some researchers and companies. It is becoming feasible to manufacture human proteins like those in milk, which could be added to formula.

"In developing countries this would be of benefit for those who cannot, for various reasons, be breastfed," says Bo Lönnerdal of the University of California, Davis, who studies breast milk and nutrition. "Even in California, in very affluent communities, formula-fed infants have more infections – and are ill longer when they get infected – than breastfed infants. So just about anybody would benefit from a formula that contained more components that fight infection."

Like most things to do with formula milk, though, just about every aspect of this idea is fraught with controversy. Can formula really be made more like breast milk? Is it safe to produce breast-milk proteins by genetic engineering? And could enhanced formula do more harm than good by undermining the "breast is best" message?

Mimicking human breast milk is virtually impossible. Besides the fats, proteins, carbohydrates, minerals and vitamins that babies need to survive, breast milk also includes hormones, immune signalling molecules, antibodies and even living immune cells. It also contains live bacteria that help colonise a baby's gut, along with substances that promote the growth of beneficial gut bacteria.

Protective factors

We still have much to discover about what's in breast milk and what it does. For instance, it has recently been found that breast milk contains endocannabinoids that stimulate suckling and appetite – essentially giving babies "the munchies". Earlier this year it was even reported that human milk contains stem cells, although it remains unclear what, if anything, they do.

What we do know is that breast milk helps protect babies against disease in numerous different ways. It contains hundreds of specific substances that provide general protection against infections, ranging from sugars that stop bacteria sticking to gut cells, and fats that disrupt certain kinds of viruses, to an array of signalling molecules that stimulate immune development.

It also includes tailor-made protection in the form of antibodies specific to viruses, bacteria and toxins that the mother has already been exposed to. In breastfed babies, these antibodies help mop up pathogens and toxins in the mouth, throat and gut. The way in which they are produced is highly sophisticated: some milk antibodies are secreted by immune cells that have migrated from the mother's gut to her breasts.

Breast milk also contains living immune cells from the mother, which have been shown to survive in the baby's gut, where they may target pathogens directly. Some even enter the infant's body proper, and might help "educate" its immune system. A mother's milk also appears to teach her infant's immune system what not to attack: it contains potential allergens eaten or even breathed in by the mother, along with factors that tell the baby's immune system not to overreact to them.

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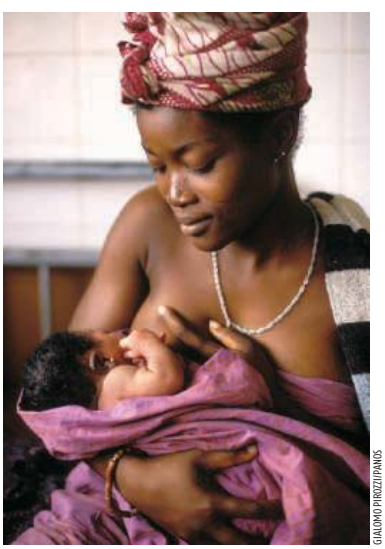

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Formula milk lacks the hundreds of active components found in breast milk

By contrast, most infant formulas are made from cow's milk. This also contains active components, but many are specific to cows, the levels differ greatly from those in human milk and they can be damaged during the production of formula. "The proteins in cow's milk formula are quite different from those in breast milk," Lönnerdal says. In fact, not only does formula lack the active components of human milk, it is also not a very good nutritional match (see "Too much of a good thing?", page 40).

Yet breastfeeding can have drawbacks, the biggest being that some infections can be passed to babies via breast milk – including ▶