Bifidobacteria, lactobacilli and staphylococci are the predominant organisms in the faeces of breast fed babies whereas in formula fed babies coliforms, enterococci and bacteroides predominate.

In vitro studies suggest that the mechanisms responsible are probably related to the acid base properties of the formula and 'immunological' proteins such as lactoferrin and sIgA. In human babies however the addition of bovine lactoferrin to an infant formula has little effect on the faecal flora and does not move it in the direction of the breast fed baby.

There are various possible explanations of this lack of effect, e.g., inactivation of the lactoferrin when it is added to a formula, and immunological responses in the intestine to a foreign protein. We consider the most likely explanation is that other factors necessary for the optimum activity of lactoferrin were not present or in inappropriate concentration, e.g. sIgA, lysozyme, citrate, bicarbonate. If human lactoferrin is added to an infant formula it may be these other factors will require attention if the lactoferrin is to have a significant effect. An iconoclastic interpretation which cannot be completely excluded is that the hypothesis of lactoferrin bacteriostatic activity is based on in vitro studies and is not a reflection of what happens in babies.

The faecal flora of a breast fed baby is very different from that of a baby receiving either cow's milk or a modern infant formula (Figure 1). Among breast fed babies bifidobacteria...
lactobacilli and staphylococci are the predominant organisms, whereas in formula fed babies the predominant organisms are enterococci, coliforms, and bacteroides (I).

**MECHANISMS**

Why is this? Some mechanisms are related to the physico-chemical properties of the two foods, particularly their acid base properties, and others to the properties of the food proteins, but these mechanisms are related.

**Acid Base Properties**

The preponderance of lactobacilli in the stools of breast fed babies has been explained broadly along the following lines. Not all of the lactose and the small amount of oligosaccharide in breast milk are absorbed, indeed normal breast fed babies excrete reducing sugars in their stools. The large bowel, therefore, contains small amounts of lactose and oligosaccharide which favour the growth of lactobacilli and as acid is generated from the bacterial metabolism of the carbohydrate, the resulting low pH also favours the growth of lactobacilli rather than *E. coli*. The low phosphate and casein contents of breast milk limit its buffering capacity so maintaining the lower pH. In addition various substances such as bicarbonate and citrate form buffer systems which apart from their buffering properties may affect the intestinal flora via interactions with iron and lactoferrin.

There is not much information about the acid base properties of infant formulas. We have made a number of determinations on representative formulas. Generally the values are between those of breast milk and cow’s milk, and the demineralised whey formula had the lowest buffering capacity, presumably reflecting the lower casein and very low phosphate content (Table 1). Care is necessary in extrapolating from these *in vitro* observations to the metabolic effects on the babies *in vivo*. In most milks and formulas the measurable titratable acid is mainly citric acid which after absorption is rapidly metabolised to carbon dioxide and so does not contribute to the net load of metabolic acid. The major sources of acid in the intermediary metabolism of the baby are from the endogenous production of organic acids, of sulphuric acid from sulphur amino acids, and from hydrogen ions released during bone deposition (2–4). These strictures do not apply when considering the effect of a diet *in the gut* although its early intraluminal digestion may well alter its acid-base characteristics and hence its microbiological effect.

The number of studies relating acid base properties of a diet to faecal flora is small. When sodium bicarbonate was added to cow’s milk to bring its pH to between 7.2 and 7.4 the