Technical information sheet

Dairy Goat Co-operative (N.Z.) Ltd

Non-protein nitrogen content of goat milk formula

Background

Milk contains nitrogen compounds in the form of amino acids in proteins (protein nitrogen) and as non-protein nitrogen compounds. Human milk contains between 18-30% of its nitrogen as non-protein nitrogen (Carlson, 1985; Ferreira, 2003). Infant formula manufactured from goat milk contains 9% of total nitrogen as non-protein nitrogen, respectively (Prosser et al, 2007).

The non-protein nitrogen fraction of milk is made up of nucleotides, polyamines and free amino acids Although present at very low concentrations, these components have very important functions in infants and are frequently added to infant formulas where the milk or alternative protein source is deficient. The main components of the non-protein nitrogen fraction of human and goat infant formula are summarised below.

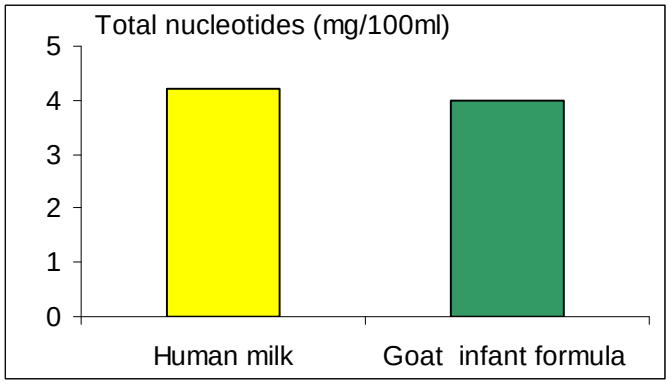
Nucleotides

Nucleotides are the structural units of the nucleic acids ribonucleic acid (RNA) and deoxyribonucleic acid (DNA). Infants cannot always synthesise enough nucleotides for the rapidly growing tissues. Consequently, nucleotides supplied by milk are important in providing optimal development of infants (Schaller et al, 2007).

There are five main monophosphate nucleotide forms present in milk – Cytidine (CMP), Uridine (UMP), Adenosine (AMP), Guanosine (GMP) and Inosine (IMP). There are no reports of thymidine (TMP) in milk. The function of the individual nucleotides is not known and the body is able to convert from one form to other.

Goat milk, like human milk, contains a complex array of monophosphate nucleotides and nucleosides, whereas cow milk does not. The monophosphate nucleotides in milk are generally converted to nucleosides in the intestine before being absorbed. Hence both are biologically important in the diet. The total amount of monophosphate nucleotides and nucleosides, in goat infant formula is similar to that in human milk without the need for adding further nucleotides. In contrast, cow infant formula have added nucleotides in the form of nucleotide monophosphates only.

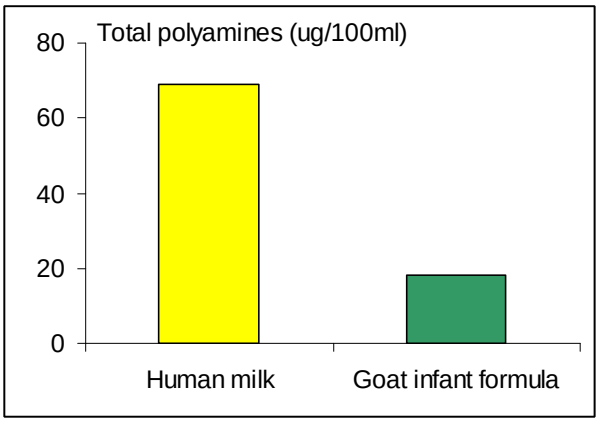
Figure 1 Monophosphate Nucleotides and Nucleosides in human milk and goat infant formula expressed as monophosphate nucleotides. Data for human milk are average values calculated from data in Gill & Indyk (2007) and Sugawara et al (1995). Data for the goat infant formula are from Prosser et al (2007).



Polyamines

Polyamines (spermidine, spermine and putrescine) are important for growth and digestive activity of stomach and intestinal cells (Pegg & McCann 1982) and may help to prevent or reduce sensitisation to food allergens (Dandrifosse et al 2000). Goat milk and goat-based infant and follow-on formulas have higher content of polyamines than cow milk or cow milk-based formulas (Prosser et al, 2007), though in both species the levels are much lower than in human milk (Loser, 2000).

Figure 2 Total polyamine levels in human milk and goat infant formula. Data for human milk are from Loser (2000) and for goat infant formula from Prosser et al (2007).



Free amino acids

Goat milk contains amino acids including taurine, glycine and glutamic acid that are not bound to milk proteins (Rutherfurd et al 2008). Taurine, a sulphonated amino-acid, is involved in bile salt formation, osmoregulation, antioxidation, calcium transport and in the central nervous system (Redmond 1998) is the main free amino acid. Human milk contains 3-4 mg/100ml taurine. The infant has a limited capacity to synthesise taurine so taurine is often added to infant formulas to provide similar levels as human milk. As taurine, is particularly high in goat milk, being 20-fold higher than cow milk (Prosser et al 2007), much less taurine is added to goat infant formula.

Summary

Goat milk is a good source of many of the components of the non-protein nitrogen fraction in human milk. In contrast, other milk sources have low levels of these compounds. As the non-protein nitrogen fraction of goat milk is retained in the goat infant formula, the bioactive components in this fraction are also retained in the formula. In contrast formula made from other milks, such as cow or soy, require significant addition of synthetic forms of components such as nucleotides and taurine to achieve levels similar to human milk.

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