



INFORMATION FOR HEALTH PROFESSIONALS

NUCLEOTIDES

Nucleotides are the structural units of DNA and RNA which determine heredity and are present in every cell. They are also involved in transferring energy within and between cells and in the synthesis of proteins, fats and carbohydrates.

Nucleotides are compounds made up of pyrimidine (*uracil, thymine and cytosine*) or purine (*adenine, guanine*) nitrogen bases, a sugar component (ribose) and one to three phosphate groups. They exist as a monophosphate, diphosphate or triphosphate.

Most nucleotides in foods do not occur as free nucleotides but as nucleoproteins and nucleic acids. These are broken down by enzymes during digestion to nucleotides, nucleosides and purine and pyrimidine bases before being absorbed. Nucleosides are the preferred form for absorption by the intestinal mucosa. Most dietary nucleotides are rapidly metabolised and excreted.

The body can make its own nucleotides using products of normal metabolism – amino acids, sugars, carbon dioxide - as its precursors. However as this uses lots of energy the preferred pathway is to use recycled nucleic acid (pyrimidine and purine) bases from regular cell breakdown and from food. This usually supplies enough nucleotides for the body. However during times of limited nucleotide intake, rapid growth such as during infancy, certain disease states and tissue repair after injury, the body may not be able to manufacture enough nucleotides for its needs. During infancy the cells of the mucosa may have limited ability to synthesise nucleotides. Dietary nucleotides may help to supplement endogenous synthesis and optimise the function of the rapidly dividing cells of the gastrointestinal tract and immune systems.

Nucleotides are part of the non protein nitrogen fraction of breast milk which also includes compounds such as amino sugars and carnitine. Non protein nitrogen represents about 25% of the total nitrogen in breast milk. Breast milk contains the free nucleotides *cytidine monophosphate (CMP)*, *adenosine monophosphate (AMP)*, *uridine monophosphate (UMP)* and *guanosine monophosphate (GMP)*. It also contains free nucleosides, bases, nucleic acids and associated compounds. The quantities of the individual nucleotides vary but cytidine is usually reported to be in the greatest amount. The nucleotide inosine is derived from adenosine.

In contrast to breast milk, cow's milk contains only 2% of its total nitrogen as non protein nitrogen so many of the non protein containing components of breast milk are present in much lower amounts. Cow's milk is rich in orotic acid, a precursor of uracil while the other nucleotides are either absent or present in exceedingly low levels.

The lower rates of gastroenteritis and diarrhoea in breast fed babies compared to formula fed babies can be partly explained by breast milks higher content of nucleotides. Nucleotides have a prebiotic effect, increasing the numbers of the good bacteria, bifidobacterium, in the baby's bowel which protects them from infections. Research has shown that adding nucleotides to infant formula produces a softer stool and with a bifidobacterium content similar to that of the breast fed baby.

Potential positive effects of nucleotides for the infant include:- enhancement of immune function; greater iron absorption and bioavailability; an intestinal microflora with increased bifidobacteria and reduced enterobacteria; softer more frequent stools; promoting the development and maturation of the gut; changes in plasma lipoproteins and other lipids (higher HDL, lower LDL and increased LCPs).

Nucleotides are an optional ingredient permitted in infant formula. All Heinz Nurture Infant formulas (Standard and Gold) contain nucleotides (#AMP, GMP, CMP, UMP, IMP).

AMP = adenosine 5'-monophosphate; GMP = guanosine 5' -monophosphate; CMP = cytidine 5'-monophosphate; UMP = uridine 5'-monophosphate; IMP = inosine 5'-monophosphate



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