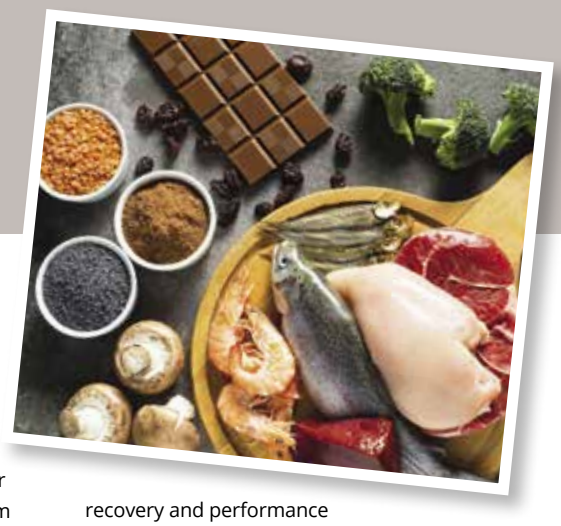
Nucleotides



- **RNA and DNA replication, especially pertaining to cells of the immune system and gut,**
- **The synthesis of protein,**
- **Hormones and lipids,**
- **Energy stores and metabolism,**
- **Co-factors to metabolise fat,**
- **Carbohydrates and proteins,**
- **And cell membranes (red blood cells)**

Can you name the one type of nutrient that is common to all the functions of the body listed above?

The answer is 'nucleotides'.

When we consider nutrients, what normally comes to mind are the macros, proteins, fats, and sugar, or the micro-nutrients, vitamins, minerals and trace elements, and there are RDAs for most of the nutrients in these two groups.

Since nucleotides are also a foundation for the effects of many micro- and macro-nutrients, they should really be considered as a crucial micro-nutrient class.

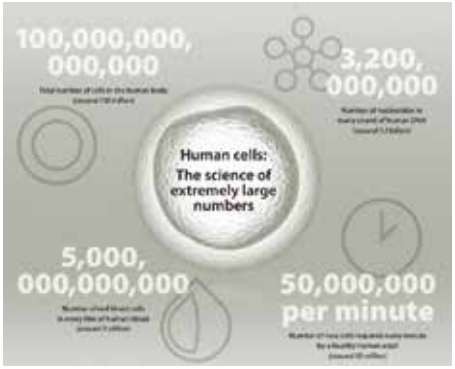
Despite this, nucleotides are still not included in nutritional recommendations.

Although nucleotides have no RDA, they make up a category in the EU regulation Food for Specific Groups (FSG). Indeed, nucleotides are a mandatory ingredient in infant formula (0-6 months) and some intensive care medical recovery foods. As a little aside, it might interest sports men and women that nucleotides are regularly supplemented into animal nutrition in order to support immune and gut health, whilst maximising nutrient absorption and muscle production (as opposed to fat deposition).

You may be asking yourself; "so, why if nucleotides are so ubiquitous in their involvement in our bodily functions, are they so rarely supplemented in adult diets?"

To put it simply, nutritionists, scientists, and medics are trained to believe that adult bodies can make (de-novo) or salvage enough nucleotides to cover all their needs, apart from when recovering in accident and emergency.

Along with production and salvage pathways, nucleotides can be obtained from our diet, which is generally considered to be adequate to cover the body's needs. However, when nucleotide production is most important, such as during chronic disease, infection, recovery from injury, and during times of high stress and performance, this is unlikely.



Extremely large numbers: just some of the mind-boggling large numbers associated with human cellular and microbiology.

Additionally, no account has been taken for how our modern diets have moved away from evolutionary times. Humans have historically eaten parts of animals that have high levels of nucleotides in organ meats; such as the liver, stomach, intestines, and brain (in other words, the offal). It has now become common practice to discard the offal and eat the less nutritious meat.

In 2015 the Department for Environment, Food and Rural Affairs (DEFRA) published their survey of 150,000 households from the time period 1974 to 2014. It was observed that liver and other offal was purchased 92 and 87 per cent less by the end of this period compared to the start. For example, a weekly consumption of 36 grams of liver dropped to just 3 grams.

What's more, vegetarian and vegan diets have been found to be particularly devoid of nucleotide dense foods.

So, what are nucleotides?

Nucleotides are composed of three subunit molecules: a nucleobase, a five-carbon sugar (ribose or deoxyribose), and a phosphate group, consisting of one to three phosphates.

They are divided into two groups: purines, in which the bases consist of a double ring structure; and pyrimidines, in which the bases consist of a single ring structure.

These are the main nucleotide types found in the body.

- **Purines:** Adenosine and Guanosine
- **Pyrimidines:** Cytidine, Thymidine and Uridine

A balanced available pool of all five nucleotides is required for successful cellular replication; i.e. the formation of DNA and RNA molecules. Put simply – the highest demand for dietary nucleotides is where there is a rapid demand for new cells, energy, and protein synthesis. It is important to know that some cells and organs in the body lack the ability to produce nucleotides, or de novo/salvage pathway cannot cover their needs. These include bone marrow derived cells, such as white blood cells (leukocytes) and red blood cells (erythrocytes), intestinal mucosa cells (epithelial), cells of the intestinal flora (e.g. bifidobacteria), and certain brain cells.

Circumstances in which dietary nucleotides can become conditionally essential:

- During periods of insufficient intake – malnutrition/eating disorders
- Where there is a high demand – stress/sports recovery and performance
- Where there is a high rate of growth – infants/pregnancy
- In the presence of infection or chronic disease – viruses, bacterial and GI distress
- Inadequate nutrition – specialised or restrictive diets

Other situations where nucleotides can become conditionally essential:

- Poor methylation, affecting nucleotide production
- Impacts of environment on cellular methylation, including foods
- Genetic SNPs affecting methylation cycles, including the folate and methionine cycles, directly affect de novo synthesis of nucleotides
- With a prevalence towards stress in modern society and a downturn in nucleotide production, the end result will be a propensity towards a deficient immune system because pyrimidine synthesis is impaired and the pools are drained
- In older age, the cell's own production of nucleotides decreases and leads to a even faster ageing process

To conclude

Poor nucleotide reserves lead to poor DNA expression, poor protein synthesis etc...

These are situations where a therapist needs to consider adding balanced, purified nucleotides (which are predominantly of the pyrimidine type), to their patient supplement protocol. Only 5 to 15 per cent of nucleotides derived from food are absorbed by the body. Pure forms of nucleotides, derived from sustainable yeast sources, can be easily degraded by digestive enzymes to the forms that are easily absorbed, with the availability around 80 per cent.

Fortunately, nowadays health professionals have very well researched nucleotide based supplements available to add to their nutritional toolbox, enhancing the effectiveness of their supplementation/treatment protocols.

• References available upon request

www.nucleotide4health.org is an independent website with contributions from scientists and health professionals from around the world, including reports on the clinical trials and published papers pertaining to nucleotide research.