Phenylalanine; an essential amino-acid with relevance to weight loss.

Phenylalanine (abbreviated *Phe*) is an essential amino acid, which means that it cannot be biosynthesised in the human body. It is essential mainly because it can be converted in the body into tyrosine (abbreviated *Tyr*), another essential amino acid, which in turn acts as a precursor for a variety of so-called neurotransmitters as well as for such diverse substances as thyroid hormone and melanin. As you can see from the chemical structures, these two amino acids are very similar, and it is easy to understand how the body can convert phenylalanine into tyrosine, unless you suffer from a rare condition called phenylketonuria (see below):

![Chemical structures of phenylalanine and tyrosine](image)

In fact, the World Health Organization dietary requirements for phenylalanine and tyrosine make no distinction between the two, and are expressed as “*Phe + Tyr*”; the requirement is 63 mg per gram of protein, and if this is calculated out based on the RDA for protein, 50 grams per day for an individual not on a weight loss diet, it comes to 3.15 grams of “phenylalanine and tyrosine” per day.

Apart from the wellknown role in ensuring an appropriate amount of thyroid hormone, the weight loss connotations of an adequate intake of *phenylalanine and tyrosine* are obvious to the scientist; the neurotransmitters that are made in the body from tyrosine are dopamine, noradrenalin (norepinephrine) and adrenalin (epinephrine). Noradrenalin is the hormone that is responsible for thermogenesis (it increases metabolic rate and stimulates breakdown of fat), and dopamine is used in nerve cells to replenish noradrenalin. Both dopamine and noradrenalin also have actions in the central nervous system, for example, noradrenalin suppresses hunger.

However, just as it is important to achieve a good balance in the intake of essential fatty acids, it is equally important to have a balanced intake of amino acids. In other words, even though phenylalanine is required to make hormones that facilitate weight loss, it should be ingested as part of the daily protein ration and not as excessive amounts of the free amino acid. The reason for this is that other essential amino acids act as precursors for hormones too, such as tryptophan (precursor for serotonin) and the equilibrium of the hormone systems is important for good physiological function!

There is another connection to weight loss, namely the non-nutritive sweetener aspect:

**PHENYLKETONURICS: CONTAINS PHENYLALANINE!**

If you wonder why the labels on many diet products bear this statement in large print, don't worry about it, since you are obviously not a phenylketonuric and therefore can metabolize phenylalanine perfectly! The sweetener aspartame is actually a dipeptide (that is, a compound made of two amino acids), in ester form. The amino acids are aspartic acid and phenylalanine:

![Chemical structure of aspartame](image)

By law, products containing aspartame must bear the above statement "prominently and conspicuously" on the label. This is to ensure that phenylketonurics, who must limit their phenylalanine intake, make allowance for the aspartame content when calculating how much of the product they can use.

Phenylketonuria, or PKU, is an inborn error of amino acid metabolism, with a frequency of approximately 1:15000 live births in North America. PKU sufferers have low or negligible levels of the enzyme phenylalanine hydroxylase in their livers, and consequently cannot metabolize phenylalanine correctly; they cannot convert it to tyrosine, but it is broken down to phenylpyruvic acid.
If untreated from birth, PKU results in mental retardation and delayed development. However, it is now almost invariably detected during neonatal screening and readily treated with a special infant formula that contains only enough phenylalanine to cover growth requirements (remember that tyrosine can replace phenylalanine almost completely). Phenylalanine intake is adjusted during growth, but it is generally advisable for patients to continue on special diets even after adolescence.

Since phenylalanine is a common amino acid in almost all proteins, phenylketonurics must be very careful in their food choices if they select normal food. It is extremely unlikely that they would ever use protein supplements!

You cannot acquire PKU; you either have it from birth, or you will never have it. If you have it, you will be aware of it, and know how to live with it! If you do not have PKU, the statement “PHENYLKETONURICS: CONTAINS PHENYLALANINE!” is not for you, and you should in fact feel comfortable with the fact that, unlike its competitors, this “non-nutritive” sweetener does actually provide a little positive nutrition for those trying to lose weight. Every serving of product sweetened with aspartame contributes a little phenylalanine to your daily requirement, and though the effect will be small, that phenylalanine will find its way into the hormones that are partially responsible for keeping your metabolism optimized during your weight loss programme. For the record, 100 mg aspartame, after digestion, gives 56 mg phenylalanine, or less than 2% of your daily requirement, 45 mg aspartic acid, and 11 mg methanol. Most products sweetened with aspartame contain 50 mg – 150 mg per serving, depending on the product and how much it needs to be sweetened.

There have been a number of suggestions that aspartame causes side effects. These have never been substantiated, and it seems illogical to assume that two natural amino acids which are consumed in multi-gram quantities in normal food are suddenly going to cause problems when consumed in milligram quantities as part of a “non-nutritive” sweetener (a misnomer, because as you saw above, it does have nutritive value). The body has no way of distinguishing the amino acids in aspartame from the same amino acids in conventional food, and treats them in exactly the same way. Concern has been expressed about the methanol which forms part of the aspartame molecule and is released in the small intestine when the molecule is digested. However, this concern has no foundation in reality. Methanol, and its metabolic breakdown product, formaldehyde, are found in many foods. Methanol, for example, is present as the free substance in small amounts in fruits, and quite large amounts are present in fruits and fruit juices in the bound form, and is released when these fruits are consumed and digested. For example, a diet soda may contain up to 180 mg aspartame per 12 oz serving, and this serving would release nearly 20 mg methanol when hydrolyzed by enzymes in the small intestine. The same enzymes are responsible for the release of methanol from fruit juices, and for a 12 oz serving the amount of methanol released would range from 26 mg for a serving of orange juice to as much as 120 mg from a serving of tomato juice. About 35% of the methanol so absorbed is excreted unchanged via the expired air (much as is the case with the more common ethanol), while about 5% is excreted unchanged in urine. The remainder is converted first into formaldehyde, a little of which may be retained for metabolic purposes (see below), but most of the formaldehyde is further oxidized to formic acid and excreted in urine. Formates can be found in urine even in individuals who have not been exposed to aspartame or fruit.

Formaldehyde itself is present in small amounts in foods, such as fish, some cheeses and some mushrooms. It is rapidly converted in the body into formic acid, though a little gets trapped in the so-called “one-carbon moieties” that are vital in certain metabolic pathways. In fact, the essential amino acid methionine provides most of the “one-carbon moieties”, in the form of labile methyl groups which can be converted into formyl groups, and methanol can be a byproduct of some metabolic pathways which require these “one-carbon moieties”.

So what is the problem? If methanol in such small quantities is bad for the human body, then it would make sense to give up fruits and fruit juices before cutting back on aspartame. In reality, the amounts of methanol consumed as aspartame, fruit juices or other foods are far below the level at which any toxicity could be expected, and the body both has the mechanisms for dealing with these amounts and is capable of doing so without any repercussions.

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