Aspartame—facts and fiction

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In September of 2008, I was invited to New Zealand by the New Zealand Nutrition Foundation to discuss the results of a recent review on the safety of aspartame published in the scientific journal Critical Reviews in Toxicology.\(^1\) Unfortunately urban myths surrounding this sweetener are causing undue concern and many New Zealanders are choosing to switch from diet versions of products to high calorie sugar-sweetened versions. This is of concern in a nation where obesity and diabetes, which have well-document health risks, are on the rise. Therefore, I welcomed the opportunity to present the scientific facts about aspartame, in order to help New Zealanders make informed decisions.

As lead author for a team of nine independent internationally esteemed toxicologists, I reviewed hundreds of studies on aspartame safety, providing me with a clear understanding of the science. This review was powerful because as a team, we arrived at our conclusions based on the totality of all safety studies available—published and unpublished (pre-market safety evaluation studies).

The key findings of the review\(^1\) with respect to aspartame safety were:

- Aspartame is completely broken down in the intestine to components found in other foods.
- Aspartame consumption (even at levels much higher than consumed by the highest users) has virtually no impact on blood levels of amino acids, methanol or glucose.
- Aspartame safety is clearly documented and well established through extensive laboratory testing, animal experiments, human clinical trials and epidemiological (population) studies.
- There is no evidence from numerous well conducted studies that consumption of aspartame at levels found in the human diet are associated with conditions of nervous system, behaviour, or other illness.
- Aspartame does not cause mutations, and there is no credible evidence that it causes cancer.

Therefore, the overall conclusion of the study is that, based on the current information available, aspartame is safe to consume even at levels much higher than the highest users are currently consuming.

The problem with many of the "aspartame toxin" stories is that they contain just enough science to make them sound plausible, so I wasn’t surprised to hear that even some medical professionals have been questioning the safety of aspartame.
To counter some of the misinformation, I make five key points:

• Firstly, when aspartame undergoes digestion in the gut lumen and epithelial cells lining the gut, the breakdown products are phenylalanine and aspartic acid (two amino acids present in many protein-containing foods) and a small amount of methanol (also present in most fruits and vegetables).\(^2,3\) The amounts of these are much less than found in other foods. For example, aspartame from a can of diet soft drink provides less methanol than a banana, and far less (only 20\%) than from the same amount of tomato juice.\(^2,4\) Because aspartame never enters the bloodstream as a whole,\(^3,5\) studies where aspartame is directly injected into the body, or added to cells grown in a dish, cannot be used to assess safety for humans. This also explains why aspartame cannot possibly cross into the fetus during pregnancy or into breast milk. In fact studies show that amounts normally consumed in the diet are safe during pregnancy and lactation.\(^6-12\)

• Secondly, it is necessary to explain how our body deals with the methanol produced when the body digests aspartame. The human body is well-equipped to use small amounts of methanol routinely produced from foods and drugs. First, alcohol dehydrogenase in the liver converts it into formaldehyde, which is used within seconds or converted to formic acid, which in turn is used by the body or converted into water and carbon dioxide for excretion.\(^13\) The fact that formaldehyde and formic acid are breakdown products of aspartame sounds scary. But the body is very efficient at using up formaldehyde (it actually needs it for some reactions and therefore produces it endogenously in much greater amounts than we could ever produce by ingesting aspartame),\(^14\) and so formaldehyde never builds up in the body. If the body doesn't need it, it converts formaldehyde to formic acid within minutes. In most cases the formic acid will be either excreted in the urine, or broken down to carbon dioxide and water. However, this takes more time and if there is a lot of methanol (or formaldehyde) coming into the body, formic acid can build up and that causes the adverse effects seen in methanol poisoning.\(^13\) So when the safety of aspartame was being assessed, many studies were conducted to examine whether the consumption of aspartame would affect blood methanol, formaldehyde or formic acid levels in humans. People consuming up to 200 mg aspartame/kg body weight (the normal daily consumption is 5 mg/kg) had a small increase in blood methanol, but this was 100X lower than the amount needed to cause methanol poisoning), no change in formic acid levels (there is always a small amount in blood) and formaldehyde was not detected. Studies in infants and children showed the same thing. People given 10 mg aspartame /kg body weight (about double a normal daily amount), every hour for 6 hours were monitored and there was no change in blood methanol, or any other metabolites.\(^3,5\) So, the amount of aspartame in diet drinks or foods produces so little methanol that there is no chance it could cause a build up of formic acid and cause adverse effects.

• Thirdly, another urban myth is that the methanol in aspartame is handled differently from the methanol in foods, because it is not consumed with ethanol, as it often is in other foods. As I’ve already explained, there isn’t
enough methanol produced from consuming aspartame to cause methanol toxicity. However the statement is worthy of discussion because it is based on science, but is incorrectly extrapolated. Ethanol is also metabolised in the liver by alcohol dehydrogenase. This is why methanol poisoning (high blood methanol, high blood formic acid), is treated clinically by administering ethanol. This stops further production of formic acid as alcohol dehydrogenase will preferentially metabolise ethanol, and slow the methanol metabolism. This gives the body time to breakdown the excess levels of formic acid before more is produced.

So the argument that the ethanol protects against methanol poisoning is correct, but this only is relevant when there is sufficient levels of methanol to cause a build-up of formic acid, and when there is sufficient ethanol to offset the metabolism of methanol. When people consume foods and drinks containing aspartame, such a small amount of methanol is released and metabolized, that there is no change in blood methanol or blood formic acid levels, so it makes absolutely no difference if you concomitantly consume ethanol or not.

• Fourth, allegations have been made that industry-funded studies always find no adverse effects while “independent” studies find adverse effects. This argument is both misleading and false. For example, three studies in mice conducted by the US National Toxicology Program (an independent group) concluded that aspartame is not a carcinogen. And a recent large scale US National Cancer Institute epidemiological study (also independent) came to the same conclusion. In addition, industry-initiated research most often examines the effects of ingesting aspartame—so as to test what happens when aspartame is consumed in foods and drinks. Many “independent” researchers study unrealistic situations such as injecting aspartame directly into the bloodstream, brain or other organs, and/or use doses far beyond what anybody could conceivably consume. At doses thousand of times what human consume, as with any compound, adverse effects will be seen. This is often a result of creating an unnatural and imbalanced intake of amino acids.

• Lastly, two studies in rats conducted by the Ramazzini Foundation are often upheld as scientific proof of adverse effects due to aspartame. The first study reported an association between aspartame and leukaemia and lymphomas, and the second reported increased cancers in rats fed aspartame for their lifetime, and whose mother was fed aspartame during pregnancy. This research, which is in contrast to all previous studies finding no effect of aspartame on cancer, has been carefully reviewed by numerous international food safety authorities and other experts. All found serious flaws in the research methodology and interpretation of results, which are discussed at length in our most recent review as well as a subsequent letter to the editor.

Some of the flaws included:

• The experimental animals were housed unconventionally, without the treatment groups being in the same environment. This resulted in some
groups contracting high rates of respiratory infection—a known risk factor for lymphoma and leukaemia.

- When the pathology slides used to draw conclusions about the rates of leukaemia and lymphoma by the researchers were examined by independent reviewers, they did not draw the same conclusions.

- The researchers did not provide information about the baseline rat diet used in their studies. It is known that it is not the conventional “rat chow” diet, and that nutrient levels were not re-adjusted depending on dose of aspartame used, as they are in conventional studies. Therefore there is a possibility that some findings could have been due to nutritional deficiencies in some groups.

- The researchers most recently reported a cancer risk from prenatal exposure to aspartame, without providing any data on aspartame intake (or indeed any other parameter) during pregnancy in rats.

In addition, 14 previous studies in various animal models found no evidence of aspartame causing or promoting cancer development.\(^1\) Thus the independent reviews all agree that there is no credible evidence that aspartame is carcinogenic.

I hope that this article helps clarify the scientific facts about aspartame so that New Zealanders can make fully informed choices about their consumption of aspartame sweetened foods and beverages in future.

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**References**


