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Barcelona, October 23, 2015

How aspartame consumption may harm the body.

Aspartame is a methanol-ester of a dipeptide (aspartyl-phenylalanine), with considerable sweetening power. Its components are essentially innocuous for most people (aspartic acid and phenylalanine are "normal" amino acids, present in most food proteins and in our own tissue proteins). Excess phenylalanine may harm a small number of people, those suffering phenylketonuria, but this caveat applies also to a large number (most) of foods and food components. These components are the basis of the "no harm" or even "natural" appreciation of this artificial sweetener, in contrast with most of the other products in this class. However, the main problem of aspartame, i.e. the main source of the problems that its ingestion may provoke lie on the presence of a minor portion of methanol, a common, simple alcohol, which toxicity is extreme and that often is simply ignored or considered much less profound than it is given the small amounts aspartame can provide.

Before explaining the effects of aspartame in our bodies, it is best to state the main perils posed by methanol, since most of the potential problems of aspartame are derived from the presence of this extremely common alcohol.

Methanol is a fairly usual compound in foods, but it is seldom found as free alcohol (except as contaminant) and more usually esterifying (bound) to carbohydrate chains and other biological compounds, a condition in which it is not toxic and even forms part of essential molecules. Methanol can be freed in small proportions from plant fiber during fermentation, generally in the gross intestine, but most of it is believed to be used as fuel, directly by the microorganisms that help us digest this component of diet. It is extremely difficult to quantify how much methanol is freed and used by bacteria or that absorbed by our organism (and later detoxified), because of the complexity of the gross intestine digestion and formation of stool, but it is generally assumed that only free methanol poses a significant danger to our health if taken by mouth.

Smoke (including those of tobacco, pot, wood or grass fires or even the apparently innocuous bonfires) are a major source, since free methanol is highly volatile and may be easily absorbed via respiratory tract (if not burnt before). A few foods contain small also amounts of methanol, in part consequence of microorganism action on fiber, starchy chains or sugars; but alcoholic beverages, especially those distilled, contain a small (albeit significant despite its variability) proportion of methanol or its esters with acetic or other short chain common acids. Aspartame is another source of methanol because it is broken up in our organism yielding its constitutive amino acids and methanol.

Acute methanol intoxication is apparently not different from that of common alcohol (ethanol), methanol smell, aspect and taste are practically undistinguishable from those of ethanol. A reason why even nowadays, too much people become severely ill (or die) from acute or cumulative chronic methanol poisoning, often because of accidental drinking, or exposure to its fragrant vapors. Methanol is also a common industrial solvent and chemical component, much cheaper than ethanol and not subjected to the same control and taxes as the alcohol used for drinks, cleaning and toiletries.

Our organism possesses a number of enzymes capable of transforming most alcohols to their oxidized forms, first aldehydes and then acids, as a way to use their energy to sustain our metabolism, and do other functions; but also to detoxify them, rendering (in theory) innocuous byproducts. In the metabolism

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of normal alcohol and methanol, the enzymes implicated are, essentially alcohol dehydrogenases and aldehyde dehydrogenases. They are present in most tissues, especially in the liver (it receives alcohols from the intestine and detoxifies them, using their energy). Other less-known tissues also contain high alcohol dehydrogenase activities; a case in point is the eye's retina, where the enzyme helps the visual pigment recycle itself in the process of vision.

When we ingest alcohol, it is rapidly absorbed (even in the stomach), increasing its levels in blood. The liver (and all other tissues with alcohol dehydrogenase, tend to oxidize it to acetaldehyde, which is more toxic (it binds proteins and functional molecules, hampering the cell metabolism). Acetaldehyde is then again oxidized to acetic acid by aldehyde dehydrogenase, rendering the typical acid of vinegar, acetic acid. One of its derivatives i is then used in the metabolism as fuel to produce energy or to synthesize fats as main fates of the product, which no longer is dangerous.

Ethanol has a number of deleterious effects, well known but nevertheless ignored by many. It is, basically a powerful source of energy (as described above) with the additional danger of producing a toxic intermediate, acetaldehyde. But is main immediate physiological effect is that of an anesthetic. Alcohol easily dissolves (in) lipids and fats, and thus penetrates fast and easily into fatty tissues or structures from the bloodstream, including membranes, nerve sheaths and adipose depots, remaining there until it is processed out of the system. This distribution affects the function of the myelin sheaths covering the nerves and controlling the speed of transmission of the electric signals of the whole nervous system, changing its function and speed. An anesthetic of the same type as ethanol produces first a general situation of excitation, followed by somnolence and depression, then anesthesia, followed by blockage of physiological functions and death. The different anesthetics have different length for these phases, which are well known by those looking for excitation and disinhibition, but which often turns into loss of control, depression, sleep, coma and death. People with low alcohol dehydrogenase activity show more marked and rapid symptoms even with lower doses of alcohol. This continues until the enzymes eliminate most of the alcohol remaining in the body. Breath and urine are also complementary ways out for the anesthetic,

Since most alcoholic beverages contain small amounts of methanol (and other compounds even more difficult to eliminate) methanol competed with ethanol for the alcohol dehydrogenases. Unfortunately, the higher abundance of ethanol and the marked preference of the enzymes for it provokes the slow accumulation of the initially low concentrations of methanol to more substantial levels in blood and tissues. In the end, the dehydrogenases use increasing amounts of methanol because ethanol is dwindling. This is especially concentrated in the tissues where there is a higher concentration of alcohol dehydrogenase, but a sizeable part of alcohol is lost through evaporation (breath) and urine.

The real problem is that methanol is oxidized to formaldehyde in the first step because of the action alcohol dehydrogenase. Formaldehyde is much more reactive than acetaldehyde, and tends to bind spontaneously proteins, DNA and other compounds in the cells' structures, provoking damages. Part of the malaise of the hangovers is a consequence of methanol poisoning (with a powerful component of dehydration and other additional ill effects). The rapid binding of formaldehyde to proteins makes difficult the task for aldehyde dehydrogenase to convert this one-carbon compound to formic acid, which is also toxic, and which elimination is problematic. The accumulation of newly formed formaldehyde in the retina is the cause of its destruction (causing irreversible blindness) in the unfortunate that drink wood alcohol (methanol) or tainted drinks. The combined effects of acetaldehyde and formaldehyde also destroy the liver (alcoholic cirrhosis) and serious damages in other organs, tissues and the nervous system. Death is a very common occurrence in methanol poisoning.

If we compare the chain of events for ethanol and methanol;

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Ethanol (2 carbon) --> **acetaldehyde** (2 carbon) --> acetate (2 carbon) –> normal metabolism

Methanol (1 carbon) --> **formaldehyde** (1 carbon) --> **formiate** (1 carbon) --> 1C detoxyfucation,

we can find the similarities in metabolism, but the differences are enormous, first, the ethanol is processed faster, and results in only one fairly toxic (in bold) compound, acetaldehyde, whilst methanol oxidation proceeds more slowly and the toxic compounds are two (in bold), especially formaldehyde (underlined too). This is the main product used for embalming corpses, and in the laboratory to "fix" tissues so that they are not corrupted by microorganisms. Binding of formaldehyde produces loss of function for the affected proteins and structures, including DNA, which no longer can translate its information properly and is altered or destroyed. Partial exposure also produces damages, which may be cumulative (i.e. the well-known liver cirrhosis, brain damage of alcoholics or the fetal alcoholic syndrome), but which may alter the cell reproducing systems with mutations that may be transferred to the descendants or, more commonly, inducing the development of cancer. Modification of proteins by formaldehyde (and other agents) may modify its structure, inducing unwanted autoimmune responses that lie at the base of many common (and extending) chronic diseases that affect a growing number of individuals, and for which there is no cure available. The increases in the incidence of a number of autoimmune diseases, and other with unknown etiology has been postulated to be in part consequence of deep alteration of cell mechanisms produced directly within the cell. The extensive utilization (and unduly accepted social use) of spirits (and inebriation) may be in part responsible for a significant decrease in general health and early death, but, especially, of the alteration of the future possibilities of the unborn because of the consumption of ethanol (and methanol, which is always present) by their parents (via mother's placenta, but sperm-carried information may be also affected).

Let's return now to aspartame. The first studies done on monkeys and rats proved that aspartame was in part absorbed by the intestine and broken up in tissues. In a series of experiments that my group conducted in 1997-98 in rats, we used aspartame with the methanol moiety marked with radioactive carbon. This way we could follow where the methanol only carbon went. To our dismay, a large part of this label remained in the rat body, i.e. it was not totally oxidized or excreted. We found high levels of radioactivity in the liver, retina, brain, and in all other tissues tested, obviously including intestine contents. The effects were cumulative. We analyzed further the results and found that the label was attached to protein-amino acids, DNA (and RNA) components. We assumed that this was a consequence of formaldehyde binding, since free methanol or formic acid do not bind so extensively and strongly. These results have not been repeated and/or proven wrong, in spite of the insistent pressure to disregard the study by means of ill-fetched "responses". But not experimental data. The facts are hard to rebate and remain irrespective of the void caused around them (and the unfortunate Authors of the study, cursed by severe reduction of funds to do research, sleazy intents of discredit and imposed academic ostracism). A number of scientists finds strange that aspartame methanol moiety, truly small, could have so severe and cumulative effects on DNA and protein cell structures, while the estimated levels of oral methanol ingestion are much higher. This is true, but a direct consequence of the same principle that was devised to make aspartame "safe". It is a peptide, but many short peptides are absorbed whole (i.e. not broken into the constitutive amino acids) in the intestine, being later broken up by other cells, mainly in the splanchnic bed. Aspartame is, however, a peculiar peptide, it is bound to methanol, which probably (nobody knows yet, this is an area where there are very few studies (the reader can imagine why) and thus is not easily broken up as occurs with most of the other short peptides produced in the intestine by the digestion of protein (a few are excreted in the urine, anyway). It seems that its small size and physical characteristics of the compound may facilitate its absorption through membranes. Inside the cells, the enzymes (probably an esterase) free the methanol

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and then dispose of the peptide. This methanol, albeit in tiny amounts has found its way into a cell crossing all barriers (intestine microbiota, intestine wall, etc.) set to prevent alcohols entering the cells. Alternatively, methanol is broken by macrophages or other blood or endothelial cells and methanol is produced and absorbed into the cells. In any case, methanol enter the cells. The almost universal presence of alcohol dehydrogenases continues the process and formaldehyde is formed, in small –sub-lethal— amounts, which interfere with the cell function. Add continued use, accumulation of damages, time for mutations in DNA to flourish into cancer or loss of function and we have a several-generation poisoning that extends its damage to everybody, and which consequences will not stop in just one generation.

What else is known, of aspartame poisoning? Damages set during development, nervous system damages, neuromuscular ailments, psychologic alterations, liver damage, deep permanent alterations of vision, and a very large number of diseases which origin is hard to pin on a single product because of the stealthy way methanol (and its enforcer formaldehyde) act. The enormous extension of aspartame use, favored by powerful use of the media, the negative campaigning against whoever tries to explain the problem, and the epidemics of "obesophobia" helps understand the extension of the malaise.

The worst of all is that artificial sweeteners are as effective against obesity as peashooters against grizzlies. Obesity is largely part of a deeper problem (metabolic syndrome) with multiple causes and serious comorbidities, and (as everybody knows) is not akin to gluttony but a serious disease itself.

I know that aspartame, initially presented as a more "natural", biologically friendly product is a poison. I am sure that the damage was not intended, and came as a surprise to those developing the product (otherwise they would be simply genocides), but now we know enough, the experimental data is mounting, and simply ignoring it will not stop the dead, ailing and disabled for life from piling up. The use of aspartame in drugs or in low-energy diets is damaging and an oxymoron. The key is information, use the media to explain that drug use is bad, smoking too, drinking alcohol is even worse, but using aspartame is ingesting poison directly, and not even for pleasure. The battle for serious and trustful information is one of the pillars of democracy and advanced societies, and it should be based on ethic principles.

I hope that this fairly superficial information helps somebody. Even if I only convince one person at all I would have been the effort. Thanks for reading.

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