

A Comprehensive Review on the Health Safety of Aspartame

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Abstract: *Aspartame being a non - nutritive sweetener is one of the most commonly used artificial sweeteners. Even Though studies show that it induces oxidative stress in human beings and causes decreased levels of dopamine and serotonin in the brain and hyperexcitability of neurons. It is also said to cause damage to amino acids, proteins, DNA and lipids. Moreover, systematic study held by a research team have identified aspartame increases the risk of overall cancer by 1.3% in nearly more than 100000 french adults. It has also shown development of malignant tumor and lesion in the rats and mice in the experiments done in previous years.*

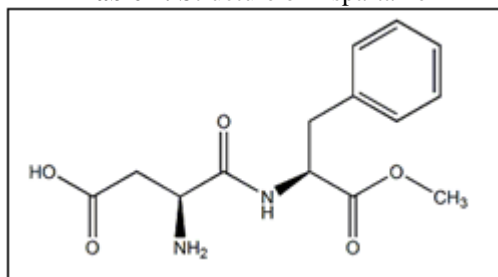
Keywords: Artificial sweeteners (AS), Aspartame, Cancer, Tumor, Reactive oxygen species (ROS), Saccharin

1. Introduction

What are artificial sweeteners? Artificial sweeteners are also called non - nutritive sweeteners due to their negligible calorific value. They came into existence due to the increased obesity and Type 2 diabetes. They act as a suitable substituent as they are way sweeter when compared to sucrose as they are called “High Intensity Sweeteners”, thus adding a very little quantity is sufficient for its effect^[1, 2].

Aspartame (**Table 1**) is one such artificial sweetener, it is 200 times sweeter than sucrose^[3, 4] and it is the most commonly used sweetener being used in more than 5000 food products. It has been available in the market for more than 40 years and prior it was used as sweetener in pharmaceutical preparations till 1970's.

Table 1: Structure of Aspartame



Even though, studies have given controversial ideas about the effect of aspartame in human health. Further we will see about the data on aspartame below.

Oxidative Stress:

Moving on, Oxidative stress is a phenomenon in which an imbalance is created in production and accumulation of Reactive Oxygen Species in cells and tissues and the ability of the biological system to detoxify these reactive products. ROS such as hydroxyl radical, hydroperoxyl radical and superoxides get accumulated leading to damage of amino

acids, proteins, DNA and lipids resulting in serious issues. Being aware of these issues, we should know that Aspartame has some possible uncertainties in inducing oxidative stress leading to accumulation of ROS. Speaking of, even neuronal cells have PolyUnsaturated Fatty Acid (PUFA) making it susceptible to ROS, leading to reduced acetylcholine esterase activity^[5, 6].

This was proven by experiments conducted on rats, which resulted in memory and emotional impairments^[7].

Metabolites of Aspartame:

Aspartame, after reaching the digestive tract, breaks down to 3 major components namely - Aspartic acid, Phenylalanine and methanol. Thus aspartame causes the elevation of levels of phenylalanine and aspartic acid in the brain^[8].

Phenylalanine blocks the transport of important amino acids to the brain leading to reduced levels of dopamine and serotonin.

Aspartic acid at high concentration causes hyperexcitability of neurons^[9].

This was also observed in an experiment in the 1980's in which rats and mice were subjected to aspartame and the results suggested that aspartame impairs the memory in rats and influenced memory and cognitive responses in mice.

Aspartame as a whole molecule causes severe issues. Thus, introduction of aspartame via parenteral route rather than oral leads to increased conditions of its consequences.

Thus under healthy conditions, aspartame is metabolized and the risk is very low, however studies have shown that long term use of aspartame affects the tight junction integrity of the gut, in such cases aspartame enters as whole molecule into the bloodstream drastically increasing its consequences.

Cancer Risk:

For many years there were speculations on Artificial sweeteners being a carcinogen [10, 11] without any solid evidence it remained a speculation but a study undertaken by NutriNet - Sante showed that use of aspartame increases the chance of cancer [12].

In 2022, an organization named NutriNet - Sante made volunteers take aspartame in more than one source and made regular tests on the individuals. The study reported cancer incidence for more than 102000 French adults. And stated that people using Artificial Sweeteners are 1.3% more likely to develop overall cancer.

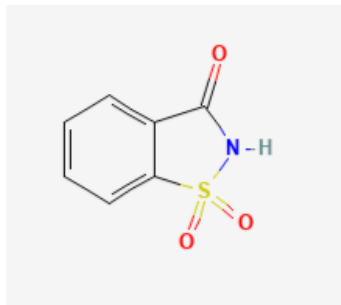
More importantly, Experiments on rats showed that prenatal exposure to aspartame increased cancer risks in rodent offspring. By this experiment we can come to an idea of the danger of artificial sweeteners for female humans when pregnant [13].

Other Artificial Sweeteners:

Other than aspartame, Saccharin and acesulfame k are Artificial sweeteners which are on the spot light. Studies conducted in early 1960's saccharin (Table 1) in combination with cyclamate resulted in bladder cancer, particularly in male rats. Thus, in 1969 cyclamate was banned but later got approved as the evidence was not strong [13].

In 1981 saccharin at high dose was found to cause bladder cancer and was added to US national toxicology report but was later revoked in 2000 as it does not apply to humans.

Table 1: Structure of Saccharin



2. Discussion

Aspartame was in controversy for decades, thus it was always in experimental studies. In the year 1978 a experiment on rats was held which showed that aspartame causes tumors in the urinary system and other problems such as calcification of renal pelvis, venous thrombosis and development of lesions in several regions [14]. Further, in the year 2006, Ramazzini Institute held an experiment with a large number of mice and rats which caused malignant tumors in several organs. Thus they concluded that aspartame is a "CARCINOGEN FOR RODENTS" [14].

But there was no solid evidence to prove aspartame caused health issues in humans. Moreover, in the year 2006 a group of NCI researchers published an analytical document from

NIH AARP diet and health study stating that aspartame was not associated with lymphoma, leukemia and brain tumor in humans [15]. But in the year 2019 29 scientists from over 18 countries gave high priority for review of aspartame by IARC, which again triggered the need for review on health safety of aspartame for humans.

Finally, in the year 2022, an organization named NutriNet - Sante held a mass experiment involving volunteers to take aspartame from several sources daily. On regular check - ups several incidents of cancer were observed in nearly 102000 French adults. Thus they concluded that aspartame increases the overall cancer risk by 1.3% [16, 17].

3. Conclusion

Keeping the above data in mind we can come to a conclusion that Aspartame is definitely a carcinogen for rodents but in humans it only increases the chance of cancer. We are not going to take aspartame in parenteral mode and we take it orally only in trace amounts thus accumulation of its metabolites are barely possible.

But however, the world is changing, there "May" be a future in which several deaths may have been caused due to Artificial Sweeteners. There is a tamil proverb saying "when taken above the limit, even the fruit of immortality will definitely kill you", this may be true in the case of AS as aspartame is found to disrupt tight junction integrity of guts. Thus my points to avoid the possible future are to avoid long term regular use of beverages with aspartame, avoiding intake of overdose of aspartame by several sources and predominantly pregnant women are sincerely advised not to take aspartame or any kind of artificial sweetened beverages along their trimesters [18].

Following the above points with a healthy lifestyle we can definitely avoid the threat posed by Artificial Sweeteners to mankind.

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