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Aspartame and cancer risk

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Abstract. Due to the current trend towards sugar-free diets and requirements for cost reduction in the industrial production of foodstuffs, sweeteners that can replace traditional sugar are in the spotlight. However, scientists have been skeptical about the safety of aspartame, one of the sweeteners, since it was officially approved as a food additive. In 2023, the World Health Organization officially listed aspartame as a class 2B carcinogen. Based on multiple experiments conducted by scientists, it can be inferred that aspartame may be carcinogenic. Since consuming aspartame is not beneficial to the human body and has potential harm, the author suggests minimizing or avoiding consumption of foods containing aspartame or replacing this harmful artificial sweetener with natural sweeteners.

Keywords: artificial sweeteners, aspartame, cancer, obesity.

1. Introduction

A sweetener is a food additive, which mimics the effect of sugar on taste. Therefore, they called sugar substitutes. Consumers often select those foods, which are composed of low calories sweetener because they want the taste of sweetness without added calories. The dietary option that such product provides may be especially helpful in the management of obesity or diabetes mellitus [1].

In this article, the main thing the authors want to explore is the relationship between aspartame and cancer. Aspartame is an artificial sweetener that is commonly used as a sugar substitute in many foods and beverages. It is made up of two amino acids, phenylalanine and aspartic acid, and is approximately 200 times sweeter than sugar.

Aspartame is often used in low-calorie or sugar-free products, as it provides sweetness without adding calories. It is commonly found in diet sodas, chewing gum, yogurt, and other processed foods.

While aspartame has been approved for use by several regulatory agencies, including the FDA in the United States, it has also been the subject of controversy and health concerns. Some studies have linked aspartame consumption to headaches, dizziness, and other health issues, although the evidence is not conclusive.

Aspartame, as a kind of sweetener, has been widely used in the production of foodstuffs. However, it is a known fact that excessive consumption of aspartame can lead to a number of diseases. Current evidence suggests that long-term consumption of non-sugar sweeteners has no benefit in terms of reducing body fat in adults or children. On the contrary, long-term consumption of non-sugar

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sweeteners may have potential adverse effects, including increased risk of type 2 diabetes, cardiovascular disease, and mortality in adults, among other issues.

Many scientists have done a lot of experiments to find out the relation between aspartame and the potential of getting cancer. As early as 1996, Olney and other scientists found that the increased brain cancer incidence rates in U.S. that coincided with the introduction of aspartame into food stuffs in the early 1980s. Therefore, they suggest that aspartame intake may be associated with an increased incidence of brain tumors. However, actually, aspartame consumption does not increase the prevalence of brain cancer, as shown by the results of several animal studies.

In 1997, a group of scientists investigated aspartame consumption among experimental participants from Los Angeles and San Francisco by in-person interview. Their experiment was conducted on 56 case patients and 94 control subjects who were born in 1981 or later (to correspond with the U.S.Food and Drug Administration [FDA]approval of aspartame). The experiment done by Gurney et al. shows that kids with brain tumors did not get more aspartame than healthy kids [2].

In 1974, The scientists used 2 or 4g/kg b.w./day to treat the rats for 104 weeks. Histopathology was performed on all gross lesions and on 20–25 organs and tissues from all control and treated animals. The result is that there are no significant differences in the incidence of the various type of tumor. In this experiment, aspartame shows no relation to the brain cancer as well [3].

Several experiments have shown that aspartame consumption does not increase the risk of brain cancer.

Although whether the aspartame study possessed sufficient sensitivity to detect a carcinogenic effect is still an open question. But, based on the several experiments have done so far, we can roughly deduce that no significant direct relationship between aspartame and brain cancer. But that doesn't mean aspartame doesn't cause cancer.

The global sweeteners market produced about 19,000 million tons in 2012. In various kinds of food that people encounter in their daily lives, there are traces of sweeteners, such as candy, biscuits, cakes, canned food, and beverages. Aspartame is widely used as a food additive in the production of food, so it is important to study whether aspartame is carcinogenic to human health.

2. The relationship between aspartame and cancer risk

2.1. Type of cancer caused by aspartame

Although the results of several animal experiments show that aspartame is not associated with brain cancer, it does not mean that aspartame is not carcinogenic. According to some experiments, aspartame has the potential to cause some kind of cancers, like Non-Hodgkin's lymphoma (NHL), breast cancer and some cancers caused by obesity.

A research show that in men, risk of NHL was significantly elevated for subjects who consumed $1 serving diet soda/d compared with in subjects who reported no consumption. Risk was even greater for the consumption of $2 servings diet soda/d, and the association showed a linear trend [4].

In a crowd-sourcing experiment done by Charlotte Debras and other scientists, the scientists surveyed 102,865 adults from France by recording their diet for 24 hours. In this way, the scientists obtained the intake and consumption of sweeteners in the diets of these people. The relationship between sweeteners and cancer incidence was assessed by Cox proportional hazards models and found that consumers with higher intake of total artificial sweeteners had a higher risk of developing overall cancer compared to non-consumers. The study shows that aspartame and acesulfame-K were associated with increased cancer risk. And higher risks were also observed for breast cancer and obesity-related cancers [5]. The author believes that the reason why the consumption of sweeteners leads to an increase in the incidence of breast cancer may be that the consumption of sweeteners leads to obesity, which is one of the causative factors of breast cancer. According to several studies, higher BMI is positively associated with breast cancer incidence in postmenopausal women [6].

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In 1973, a group of scientists have done an experiment on rats to explore the carcinogenicity of aspartame. They found an increase in the incidence of breast cancer after aspartame treatment in females [3].

Whether it is through survey data obtained from the population or animal experiments done on rats, the results show that artificial sweeteners and some cancers, like breast cancer, Non-Hodgkin's lymphoma and obesity-related cancers, show a certain association.

2.2. The effects of aspartame differed in gender

In many experiments to study the carcinogenicity of aspartame, the results obtained in male and female individuals have shown some differences

In 1973, a group of scientists have done an experiment on rats to explore the carcinogenicity of aspartame. They found that after being treated by aspartame both male and female rats showed a decrease in body weight. But, an increase in the incidence of breast cancer after aspartame treatment was observed only in females. Aspartame-treated male rats did not differ significantly from controls in the incidence of tumors [3].

In an experiment done by a group of scientists, they found that men who consume more drink contained artificial sweeteners have a higher risk of NHL and multiple myeloma, but no increased risks of NHL and multiple myeloma in women [4].

According to Morando Soffritti and other scientists (2014), the reasons why aspartame affects people of different genders to different extents is probably because the recognized hyper enzymatic activity of alcohol dehydrogenase type 1 in men (as compared to women), which may induce higher conversion of methanol into formaldehyde. Alcohol dehydrogenase type 1 is one of the five types of Alcohol dehydrogenase. The main alcohol enzyme present in the human stomach and liver is ethanol dehydrogenase type 1. ADH1 can break down alcohols in the body. It breaks down ethanol by oxidizing it to acetaldehyde. Aspartame is aspartyl phenylalanine methyl ester. Aspartame enters the body orally and produces three common metabolites including aspartic acid, phenylalanine and methanol by the action of enzymes. Both methanol and ethanol are metabolized in the body by alcohol dehydrogenase. Men have higher levels of the enzyme ethanol dehydrogenase than women, so men are more efficient at converting methanol to formaldehyde, which is harmful to the human body. Similarly, the differing results between male and female rats exposed to APM may be due to the higher activity of ADH1 in females than in males, which could explain the leukemogenic effect observed in female rats.

The carcinogenicity of aspartame varies in men and women due to the fact that aspartame affects men and women in not quite the same way. Based on the experiments the scientists have done, it can be hypothesized that aspartame may cause different kinds of cancer in people of different genders.

2.3. Aspartame indirectly causes cancer by contributing to obesity

In a study done by Charlotte Debras and other scientists, higher risks were observed for obesity-related cancers [5]. The author hypothesizes that aspartame causes obesity-related cancer on the principle that aspartame first causes obesity, and then obesity further causes cancer.

Unlike obesity caused by excessive intake of high-calorie sugar, replacing sugar with AS triggers a compensatory mechanism in the neuronal system, this is because although AS stimulates sweet receptors in the oropharynx and satisfies sensory needs, its lack of energy supply or participation in metabolism prevents blood glucose and insulin secretion from being at the same level, which in turn induces a greater craving for food and energy [7]. Therefore, drinking too many drinks or eating too many foods with artificial sweeteners may cause people to eat more food than needed and then make people become excessive obesity.

What’s more, obesity contributes to the development of some kinds of cancer. For example, cancer of the digestive system. Colorectal cancer, liver cancer, Pancreatic, stomach and esophageal cancers are common digestive cancers.

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Therefore, aspartame may cause cancer by contributing to obesity, which suggests an indirect relationship between aspartame and cancer.

3. Conclusion

Sweeteners were originally created to replace sugar and satisfy the pursuit of sweetness while reducing the harmful effects of sugar on the human body. However, numerous experiments as well as data have proved that excessive consumption of aspartame is harmful to the human body to a certain extent. Aspartame is more significantly associated with obesity-related cancers than other cancers. Nowadays, as people's demands for healthy diets continue to rise, natural sweeteners are gradually replacing some of the artificial sweeteners. Natural sweeteners are generally extracted directly from nature or modified appropriately to obtain a class of chemical components with a sweet taste, most of which are secondary metabolites of plants or microorganisms [8]. Natural sweeteners including Siraitia grosvenorii, Stevia rebaudiana, Rubusoside, etc. Natural sweeteners have a much better safety profile than artificial sweeteners such as aspartame. In 2023, aspartame classified as a 2B carcinogen by WHO. Finding safer sweeteners to replace aspartame has been the focus of some of the scientific research. The author believes that if the problem of high extraction costs and difficulty in mass production of natural sweeteners can be solved, natural sweeteners will definitely add a force to people's healthy diet.

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