

Effect of Non-Nutritive Sweetener, Aspartame Chemical: Used In Diet Beverages

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ABSTRACT

The use of the artificial sweetener, aspartame, has long been contemplated and studied by various researchers, and people are concerned about its negative effects. On a weight basis, the metabolism of aspartame generates approximately 50% phenylalanine, 40% aspartic acid and 10% methanol. The detailed mechanisms of the effects of aspartame on the electrophysiological response are still unclear; therefore, this study was designed to clarify whether longer-term aspartame consumption has any effect on the physiological environment. Though several studies on toxic effect of aspartame metabolite have been studied, there are scanty data on whether aspartame exposure administration could release formate, a methanol metabolite thereby inducing oxidative stress and neurodegeneration in brain discrete region.. The aim of this study was to evaluate the effect of aspartame on the different bodyparts of the humans. This article analyses the direct and indirect role of toxic effects of metabolites of aspartame.

KEYWORDS: ADI, Dipeptide, FDI, phenylalanine.

INTRODUCTION

Aspartame is a non-nutritive sweetener that is used predominantly in various 'diet' and 'low-calorie' products, such as beverages, instant breakfasts, desserts, breath mints, sugar-free chewing gum, vitamins, and pharmaceuticals, consumed by millions of people who are attempting weight loss, young adults and diabetic persons worldwide.^{1,2}

Aspartame is a methyl ester of the dipeptide of the natural amino acids L-aspartic acid and L-phenylalanine.³ Fig-1 shows the structure of Aspartame. Under strongly acidic or alkaline conditions, aspartame may generate methanol by hydrolysis. Under more severe conditions, the peptide bonds are also hydrolyzed, resulting in free amino acids.⁴ It is derived primarily from two naturally occurring amino acids chemically combined and designated by the chemical name N-L-aspartyl-L-phenylalanine-l-methyl ester (APM).⁵ Aspartame is a white, odorless, crystalline powder. It is about 200 times sweeter than sugar and is readily dissolvable in water.

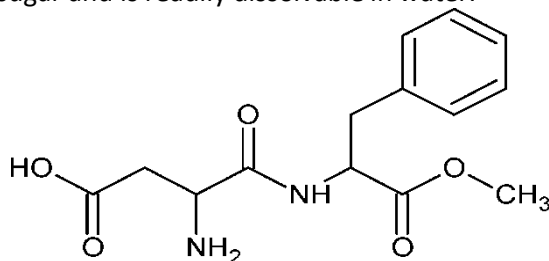


Fig-1: Structure of Aspartame

MATERIALS/METHODS

The oral administration of aspartame in a safe dose of 40 mg/kg bodyweight/day (as recommended by EFSA, 2012) was tested in Wistar albino rats for a longer period (90 days). Electrophysiological responses, including heart rate variability (HRV) and electroencephalogram (EEG) pattern, reassessed in a folate-deficient animal model along with control animals using BIOPAC and EEG equipment (model RMS EEG–24brain new-plus: RMS – Recorder and Medicare systems). In this study, the folate-deficient animal model /human model was used to mimic human ethanol metabolism in rats.⁶ In this study adults and child were taken as different bodyweights and as per servings, it was measured the concentration of Aspartame which was further discussed below.

ASPARTAME METABOLISM

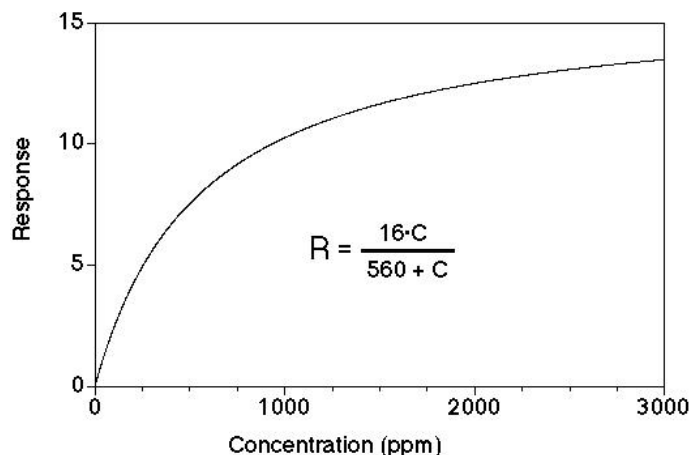
When aspartame is digested in the body, it is converted to three components: aspartic acid, phenylalanine, and methanol.⁵ The aspartic acid in aspartame has been synthetically altered to carry the methanol molecule, the hydrocarbon responsible for the sweetness of the chemical. Because the methanol is not bonded to a fiber molecule as it is in fruits and vegetables, it is not safely carried out of your body but rather is converted by an enzyme into formaldehyde. The different concentrations of phenylalanine, aspartic acid and methanol in different food products of same quantity are given in table-1 below:

Table-1:

Food/Beverages	Phenylalanine	Aspartic Acid	Methanol
Diet Coke(8 oz.)	60	48	12
Milk(8 oz.)	404	592	-
Banana	58	146	21
Tomato Juice(8 oz.)	39	231	71

There is equation explained and given by graph below which allows to calculate sweetness response(R) for any concentration(C).

Aspartame Concentration vs. Response



Or we can rearrange the equation algebraically to

$$C = (560 * R)/(16 - R)$$

Then we can calculate the concentration required (C) to give a desired response (R).

The FDA (Food and Drug Administration) has set the ADI (Acceptable Daily Intake) and for aspartame at 50 mg/kg of body weight per day^{8,9} given by table-2. This is the highest ADI of any of the six non-nutritive sweeteners, with the other five ranging from 0 to 15 mg/kg of body weight per day.

Table-2:

Aspartame containing product	Aspartame(mg)	Approximate number of servings per day to reaches ADI	Approximate number of servings per day to reaches ADI
		Adult(lb)	Child(lb)
Diet soda(12oz.)	192	17	6
Gelatine(4oz.)	81	42	14
Table top sweetner(packet)	35	82	32

CONCERNED HEALTH PROBLEMS

The components of aspartame can lead to a number of health problems. Side effects can occur gradually, can be immediate, or can be acute reactions.¹⁰ Adverse reactions and side effects of aspartame include:

Eye Problems: blindness in one or both eyes, decreased vision and/or other eye problems such as: blurring, bright flashes, squiggly lines, tunnel vision, decreased night vision, pain in one or both eyes decreased tears, trouble with contact lenses, bulging eyes.

Ear Problems: tinnitus - ringing or buzzing sound, severe intolerance of noise, marked hearing impairment.

Neurologic Problems: epileptic seizures, headaches, migraines and (some severe)dizziness, unsteadiness, both confusion, memory loss, both severe drowsiness and sleepiness paresthesia or numbness of the limbs severe slurring of speech severe hyperactivity and restless legs atypical facial pain severe tremors.^{11,12}

Psychological/Psychiatric Problems: severe depression, irritability, aggression, anxiety, personality changes, insomnia phobias.^{13,14}

Chest Problems: palpitations, tachycardia, shortness of breath, recent high blood pressure.¹⁵

Allergic Reaction

An allergic reaction to aspartame occurs when you ingest the substance, and your immune system identifies it as a threat to your body. Although the FDA has approved aspartame as safe for human consumption, in certain people, the body mistakes the chemical as harmful.¹⁶

As a result, the body creates various chemicals that attack the aspartame, which cause common side effects of an allergy. Most allergic reaction symptoms develop within minutes of consuming aspartame.

Gastrointestinal Problems

The gastrointestinal system is commonly affected by an allergic reaction to aspartame. Inflammation in the lining of the intestines often leads to nausea, vomiting, diarrhea, abdominal cramping, stomach pain, gas and bloating. During the allergic reaction, your body produces histamine in the soft tissue of your intestines, which produces swelling. Gastrointestinal symptoms will subside after the substance is expelled from your body.^{17,18}

CONCLUSION:

It remains fairly common for people to believe they are choosing the 'healthier' option when reaching for a diet soda instead of the regular one, but research has been surfacing over the past few years which suggest consuming artificial sweeteners might not be the best idea either. Of course, this does not mean that we should return to regular sodas instead, as [the amount of sugar](#) found in these drinks is literally deadly; sugar represents a major contributing factor in the prevalence of multiple chronic diseases which continue to plague the Global population. Aspartame changes the ratio of amino acids in the blood, blocking or lowering the levels of serotonin, tyrosine, dopamine, nor-epinephrine, and adrenaline. The intense sensation of sweetness allows the use of such small doses so that the product is almost non-caloric although its energy value is 4 kcal/g of aspartame.

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