



Artificial Sweeteners Benefits and Health Hazards: A Review

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Abstract

Excessive consumption of sugar-rich foods is the major cause of the global pandemic of obesity. A high intake of sugars increases the calorific value of the diet which results in to weight gain. In the recent years awareness towards health ,figure and fitness has increased. People demand for healthy and low calorie food products that support better health. Now a days Artificial sweeteners are used in remarkable amounts as sugar replacements in beverages drugs, canned foods and dairy products world wide that helps reducing weight. A potential method to reduce the calorific value of food while maintaining the sweet taste is using Artificial sweeteners .Artificial sweeteners is the group of chemical compounds featuring very high sweetness with almost zero calories. The available evidence suggests that replacing sugar with artificial sweeteners may support weight control. But the effect of artificial sweeteners on the regulation of appetite and sweet taste perception is not clear. Excessive use of these chemical compounds may lead to various hazardous effects such as Nausea, Emesis, bloating, digestive problems, headache, dizziness, diarrhea, stomach and thrombocytopenia, Parkinson's disease, cancer, Alzheimer's disease, multiple sclerosis, systemic lupus and autism etc

Due to various adverse effects of artificial sweeteners on hunger and appetite, it has been suggested that the ingestion of foods containing artificial sweeteners is not safe and effective method to reduce energy intake for weight loss. Besides this various studies suggest that frequent exposure to artificial sweeteners may lead to an increase appetite for sweet foods

Introduction

Higher sugar content in diet can increase the risk of obesity and overweight. The main cause of global pandemic obesity is the excessive consumption of sugar rich compounds in diet. According to WHO report daily intake of energy from added sugars must not exceed from 5 to 10%. But in many countries sugar consumption is higher than this amount. The solution of this problem of global obesity and overweight is to use sugar alternatives such as non nutritive sweeteners in place of sugars[1-5]. In the recent years awareness towards health ,figure and fitness has increased. People demand for healthy and low calorie food products that

support better health[6]. Now a days Artificial sweeteners are used in remarkable amounts in beverages drugs, canned foods and dairy products worldwide[7-9].

Synthetically derived chemical compounds which are thousand times sweeter than sucrose are called Non Nutritive sugars (NNS). These sweeteners are used in very small amounts due to their intense sweetening power. They can reduce the energy value of food products therefore also called sugar free[10]. Consumption of artificial sweetening agents is increasing day by day across all age groups[11].

Artificial sweeteners are regulated by the FDA (Food and Drug Administration). In United States Eight Non nutritive sugars are approved by FDA for use in food products[12]. They are classified in two classes viz-

1. Synthetically derived Non nutritive sugars- Aspartame, Acesulfame-k, Neotame, Sucralose, Saccharin, Advantame.
2. Natural origin- Stevia, monk fruit extract[13].

Clinical and Non Clinical Uses

Type-2 Diabetes

Diabetes type-2 (Diabetes mellitus) patients have problem in regulating their blood sugar levels. But by replacing their sugar intake with artificial sweeteners, they can enjoy sweet food and sugar levels remain stable in their blood as artificial sweeteners metabolize more slowly.

Weight loss/ Obesity

By replacing high energy sugar with artificial sweeteners having little or no energy, one can avoid problems associated with excessive calorie intake and over weight (obesity).

Hypoglycemia

Patients suffering from hypoglycemia will produce excess of insulin which causes decrease in blood glucose level from the amount needed for physiological action. These patients are suggested to avoid intake of high glucemic foods. Artificial sweeteners are best alternative for these patients.

Dental Care

Many liquid syrups contain sugars . These sugars are fermented by the microflora of the dental plaque which enhances dental decay. To prevent this doctors suggest sugar substitute medicines.

Artificial sweeteners are also used in toothpastes to make them taste better without causing damage to our teeth .

Foods and Beverages

Artificial sweeteners are widely used in making low calorie foods and beverages as single sweeteners or in combinations with other sweet substances.

Pharmaceuticals

Artificial sweeteners are used in medicinal tablets, powders and syrups to overcome undesired bitter flavors and tastes of active pharmaceutical ingredients for diabetic patients.

Cosmetics

Several types of cosmetics such as oral hygiene products like toothpaste and mouthwash, are sweetened to make them more pleasant for consumers by mixing artificial sweeteners in them.

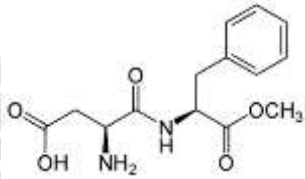
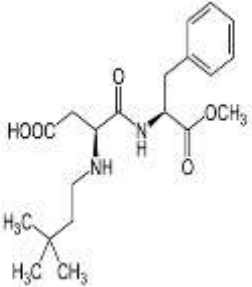
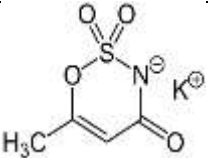
As sugar substitute.

Previous studies suggest that taste of Aspartame is very similar to the taste of sugar. Therefore it is used in various foods in place of sugar. In addition to this artificial sweeteners are also used in making jams, jellies, chewing gums, candies, dairy products, frozen desserts, pudding, baked foods and many more.

Enhances flavours

Aspartame can enhance the flavour of foods and beverages [6,14-22].

FDA Approved Artificial Sweeteners- Table1 [12,23]

Sweetener Name	Trade Name	Molecular formula	Sweetness compared to Sucrose	Calorific Value	Structure with IUPAC name
Aspartame	Nutra sweet, Equal And Canderel	$C_4H_{18}N_2O_5$	200×	4kcal/gm	 <p>Methyl L-α-aspartyl-L-phenylalaninate</p>
Neotame	Newtame	$C_{20}H_{30}N_2O_5$	7000-13000×	Doesn't provide energy as it is not metabolized in body	 <p>(3S)-3-[(3,3-Dimethylbutyl)amino]-4-[[[(2S)1-methoxy-1-oxo-3-phenylpropan-2-yl]amino]-4-oxobutanoic acid</p>
Acesulfame-k	Sunett and Sweet one	$C_4H_4KNO_4S$	200×	Doesn't provide energy as it is not metabolized in body	 <p>Potassium 6-methyl-2,2-dioxo-2H-1,2λ^6,3-oxathiazin-4-olate</p>

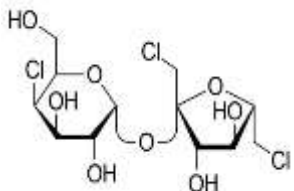
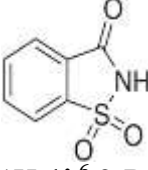
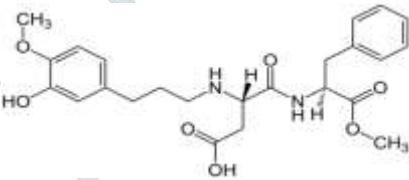
Sucralose	Splenda	$C_{12}H_{19}Cl_3O_8$	600×	Doesn't provide energy as it is not metabolized in body	 <p>1,6-Dichloro-1,6-dideoxy-β-D-fructofuranosyl-4-chloro-4-Deoxy-α-D-galactopyranoside</p>
Saccharin	Necta sweet	$C_7H_5NO_3S$	200-700×	Doesn't provide energy as it is not metabolized in body	 <p>1H-1λ⁶,2-Benzothiazole-1,1,3(2H)-trione</p>
Advantame	No brand name	$C_{24}H_{30}N_2O_7$	20000	Doesn't provide energy as it is not metabolized in body	 <p>(3S)-3-[[[3-(3-Hydroxy-4-methoxyphenyl)propyl]amino]-4-[[[(2S)-1-methoxy-1-oxo-3-phenylpropan-2-yl]amino]-4-oxobutanoic acid</p>

Table-1 Artificial sweeteners and their structures.

Health Hazards of using Artificial Sweeteners

Most common sugar substitutes in grocery store are sucralose, aspartame and saccharin. People use these artificial sweeteners in place of sugar in order to satisfy their sugar cravings by consuming zero calories. They are not aware about the possible side effects and health hazards of these chemically processed artificial sweeteners. has a list of which are termed high intense sweeteners FDA approved artificial sweeteners include saccharin, aspartame and stevia are labeled as GRAS (Generally recognized as safe by the FDA) and only those with phenylketonuria (pku) should avoid aspartame consumption.

According to the American Dietetic Association children below 2 years of age, lactating women and pregnant women should avoid artificial sweeteners even approved safe by the FDA

1. Saccharin, acesulfame-K and aspartame are responsible for DNA damage in peripheral lymphocyte of humans. In acidic medium acesulfame-K forms acetoacetamide and acetoacetamide-N-sulfonic acid while in basic medium acetoacetic acid and acetoacetamide-N-sulfonic acid are formed. These degradation products can cause breakdown of DNA strands.

2. Sucralose causes decrease in beneficial gut micro-organisms (Enterobacteriaceae a family of bacteria that can include Salmonella and E.coli) which helps to maintain a healthy immune system and normal metabolic functions in human body.
3. Aspartame can cause brain damage because one of its hydrolyzed components is phenylalanine which plays an important role in a neurotransmitter regulation.
4. Use of Artificial sweeteners can cause acute Nausea, Emesis, bloating, digestive problems, headache, dizziness, diarrhea, stomach and thrombocytopenia.
5. Long term use of Artificial sweeteners can cause chronic fatal diseases such as Saccharin causes low birth rate bladder cancer and hepatotoxicity. Acesulfame k causes Thyroid tumors. Aspartame can cause Lymphomas. Neotame causes Low birth rate and weight loss. Sucralose causes Thymus shrinkage .
6. Some previous studies suggest that there is a relationship between sweeteners and certain chronic fatigue syndromes such as Parkinson's disease, cancer, Alzheimer's disease, multiple sclerosis, systemic lupus and autism.
7. Artificial sweeteners are habit forming. These processed sugars are many times sweeter than sucrose. The long term usage of these artificial sweeteners can alter taste buds which results in a constant craving for foods that are overly sweet consequently, risks for weight gain increases.
8. Recent studies concluded that artificial sweeteners are actually linked to an increase risk of weight gain, obesity, type2 diabetes, hypertension and metabolic syndrome.
9. Some researches indicate artificial sweeteners are linked to tumor growth and cancer development. Aspartame induced lung and liver tumor in mice. Aspartame injected in rats caused on increased in tumors and leukemia. Studies on animals may not suggest same results with human but they point to a very real risk of cancer in human by prolonged usage of artificial sweeteners[9,24].

Conclusion

Artificial sweeteners provide some of the health benefits. But commonly these sweeteners are highly toxic on prolong exposure at high concentrations. Their consumption may lead to cause mild to serious side effects ranging from headaches to life-threatening brain damages. Various questions about the health effects of Artificial sweeteners have yet to be resolved. Therefore well-designed methods and studies are needed to understand the long-term effects of Artificial sweeteners on human health. There is a need for nutrition education awareness on reducing consumption of sugar-rich products among people.

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