

**CONSUMPTION OF ARTIFICIAL SWEETENERS: BOON OR BANE**

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Artificial Sweeteners (AS) having low/non-calorific value are among the most widely used food additives worldwide and also regularly consumed by lean and obese individuals alike. AS consumption is considered safe and beneficial owing to their low caloric content, yet supporting scientific data remains sparse and controversial. The objective of the present study was to review whether consumption of artificial sweeteners is boon or bane to human health. It has outlined the health effects of AS with respect to their association with weight gain and other metabolic health effects. Consumption of AS in the form of carbonated beverages may cause excessive weight gain. A case control study reveals the fact that AS can induce glucose intolerance by altering gut microbiota associated with the development of metabolic syndrome such as type 2 diabetes. In conclusion, sugar based sweeteners have long been suspected as the cause of obesity and consequent cardiovascular risk.

**KEY WORDS:** Artificial Sweeteners, Obesity, Cardiovascular diseases, Weight gain, Type 2 diabetes mellitus, Carbonated beverages.

**INTRODUCTION**

Artificial sweeteners are the sucrose substitutes which can give a sweet taste like sugar with low calories [1]. Artificial sweeteners can be available in natural and synthetic form in the market [2]. They are attractive alternatives to sugar that provide a sweet taste without any addition of extra calories. Therefore AS may support the weight loss of individuals and also receives special attraction from patients with diabetes [3].

For past few years there have been many questions raised by National Cancer Institute (NCI), Columbia, USA, regarding the AS causing cancer in animals. The examination on male rats showed an incidence of urinary bladder cancer and rats functioning in this case are similar to that of humans. Hence, AS were rejected by NCI and according to FDA reports they have minor side effects and some serious conditions like migraines, change in vision, nausea and vomiting, insomnia/sleep problems, change in heart

rate, depression, memory loss [4]. The relation between consumption of AS and weight gain was observed in adults by showing adverse effects on blood glucose levels and insulin sensitivity. Many large scale studies, like National Health and Nutrition Examination Survey (NHANES) showed a positive association between consumption of AS and weight gain. A study performed in 2007 resulted that AS raised the insulin levels slightly above the baseline, which adversely affects Type2 Diabetes [5]. It has been reported that the intake of AS caused neurological and behavioral disturbances such as headache and seizures due to changes in concentrations of catecholamine [6].

Thus, the results obtained from various studies showed many adverse effects of AS on normal individuals. The main objective of this study was to review whether the consumption of AS is a boon or a bane to the present lifestyle of humans.

**MECHANISM OF ARTIFICIAL SWEETENERS**

Many mechanisms were proposed to know the association between use of AS and weight gain. This comprises the dissociation of sweet taste from calories will promote appetite, which leads to cravings towards food and leads to weight gain [7]. This is being well noticed in infants, as they prefer sweetened food instead of vegetables and other healthier foods [2]. The data from humans and animal models stated that AS plays a vital role in the gastrointestinal tract (GIT) sweet receptor in addition to sucralose (Splenda™) and aspartame. These receptors are present in lingual taste buds and secreting cells of gut mucosa (glucagon like peptide-1 (GLP-1), which serve as mediators of GLP-1 secretion [8]. The study on rats showed that stimulation of taste receptors led to increased absorption of sugars from the bloodstream [9]. This potentially alters GIT by increasing insulin secretion. Hence the consumption of AS could lead to a more rapid absorption of sugar and increased GLP-1 and insulin secretion, potentially affecting weight, appetite and glycemia [10].

Now a days different formulations of artificial sweeteners are existing in market and they were mentioned in the table 1.

**FDA-APPROVED ARTIFICIAL SWEETENERS*****Stevia***

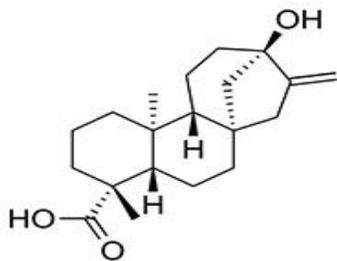
Trade Name: Natural and Zero Calories Sweetener [11].

Source: : *Stevia Rebaundia*

Sweetness (compared with sucrose): 40\*

Acceptable Daily Intake (ADI): 12mg/kg

Structure

***Xylitol***

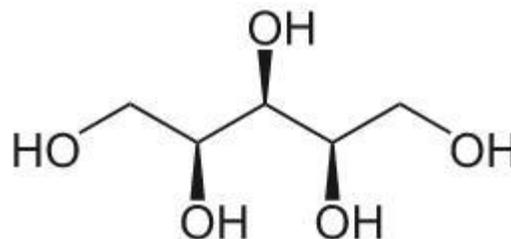
Trade Name: Xylo Sweet [12].

Source : Birch Trees.

Sweetness (compared with sucrose): 150\*

Acceptable Daily Intake (ADI): 0.4mg/kg

Structure

***Cyclamate***

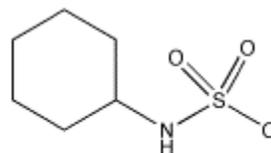
Trade Name: Sweet and Low, Splenda: no calorie sweetener [12].

Source: Derived from Saccharin.

Sweetness (compared with sucrose): 30-50\*

Acceptable Daily Intake (ADI): 2mg/k

Structure



Cyclamate

***Saccharin***

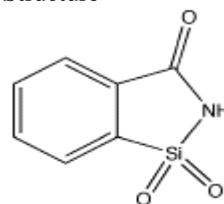
Trade Name: Sweet N' Low [11].

Source: Derived from Sucrose

Sweetness (compared with sucrose): 300\*

Acceptable Daily Intake (ADI): 5mg/kg

Structure



Saccharin

***Neomate***

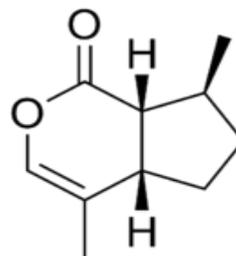
Trade Name: Made by NutraSweet.

Source: Derived from Aspartame.

Sweetness (compared with sucrose): 7000-13000\*

Acceptable Daily Intake (ADI): 0.10mg/kg

Structure



## EFFECT OF AS ON HEALTH

### *Effect of artificial sweeteners on gut microbiota:*

Gut microbes play a significant role in human health. Our gut contains over 100 trillion microbial cells, which influences our physiology, metabolism and immune system. Artificial Sweeteners interact with our digestive tract microbes and influence the makeup of microbial system which in turn quickens the development of metabolic syndrome [13]. AS disrupts our intestinal microflora and increases risks of obesity and diabetes and also found to induce gut dysbiosis and glucose intolerance.

*Effect of as on metabolism:* Diabetic people have difficulty in controlling their blood sugar levels and prefers AS because they can enjoy a varied diet while scheming their sugar intake [14]. However, recent research published in “Nature” reveals that AS increases unwanted pounds and disrupts the metabolic function [15]. Centre for disease control and prevention (CDC) stated that consumption of AS in the form of drinks may worsen the metabolic pathways of adults, which may raise severe risk of obesity and its related diseases [3]. Nearly 10 years study of the University of Texas Health Science Centre in San Antonio, Texas, USA found that AS consumers are growing nearly 3 times as much as those non-consumers. In near future these adults can be the victims of metabolic syndrome-a cluster of conditions like increased blood pressure [16], abnormal cholesterol levels, and increased blood glucose levels which puts at risk for cardiac disease [1].

*Effect of AS in weight gain:* For many years a large number of studies evaluated the relationship between AS consumption and weight gain and stated that weight gain is due to stimulation of the appetite, increased carbohydrate cravings, stimulation of fat storage [12]. As well as according to the survey of the Americans obesity was also occurring simultaneously with the increased use of AS. The Yale University neurobiologist Qing Yang conducted a review of the scientific literature on sugar substitutes and their effect on appetite and weight gain. The key findings of her review was summing up in the June 2010 issue of “Yale Journal Of Biology and Medicine,” and cited strong evidence showing a Link between a person’s customary intake of a flavor and the intensity of his preference for more of the flavor explored in fig 1. In other words, the sweet taste imparted by the sugar substitutes tends to increase the yearning for more of the sweetness, which leads to overeating.

Recently the San Antonio Heart conducted Study on 3,682 adults over a 7-8year period, and observed the increased initial Body Mass Index (BMI) in drinkers of AS. The American Cancer Society Study showed that 2.7% - 7.1% users gained weight compared to non users [17,18,5].

*Effects of AS on type II diabetes mellitus:* Glucose intolerance is a well known reason for type II Diabetes. Over the past 3-4 decades, it has shown a close parallelism between the rise in added sugar intake and global obesity [19].

Recommended calorie intake: (20)

Men and Active Women: 15cal/lb

Most Women, Sedentary Men, Adults over 55 years: 13cal/lb

Sedentary Women, Obese adults: 10cal/lb (20)

Pregnant, Lactating Women: 15-17cal/lb

Number of calories needed to maintain weight depends upon: Age, Sex, Height, Weight and activity level [21].

*Effects of AS on heart:* The latest research that explained the role of artificial sweeteners in heart disease and stroke was presented on February 10 in 2011 at the International Stroke Conference. The research done in conjunction with Columbia University and the University of Miami and it has studied approximately 3300 New Yorkers for just under a decade whose age was (40 and above) and their daily calorie consumption, exercise, alcohol use, smoking habits, blood pressure, cholesterol levels over the period [22]. It was found that those subjects who consumed diet sodas daily experienced a whopping and 61% are under higher risk of stroke and heart attack than those who consumed low calorie carbonated beverages [6].

## CONCLUSION

Recent epidemiological, clinical and laboratory results explored whether recommendations for the use of artificial sweeteners is certainly appropriate or not. A careful review of this literature by health professionals, including physicians, epidemiologists, and dietitians is essential to help consumers to take precise decisions about their health. In this review, we have explored the existing evidence supporting or refuting a link between artificial sweetener use and weight change and also other metabolic effects in children. Epidemiologic studies of artificial sweeteners use in children have generally shown a positive association between artificial sweetener intake and weight gain. In interpreting such studies, it is significant to consider the conditions required to support causality in such studies, together with the

potency of the involvement, stability findings, temporality, biological gradient, plausibility, unity between epidemiological and laboratory findings, and strength of the dose-response affiliation. Based on these criteria, causality is far from recognizing with regard to artificial sweetener use and weight gain in children. At the present time, the board of judges focused their study on role of increased AS use in the obesity and diabetes epidemics, whether they are harmful, beneficial or neutral. In particular, very little information exists on the topic of artificial

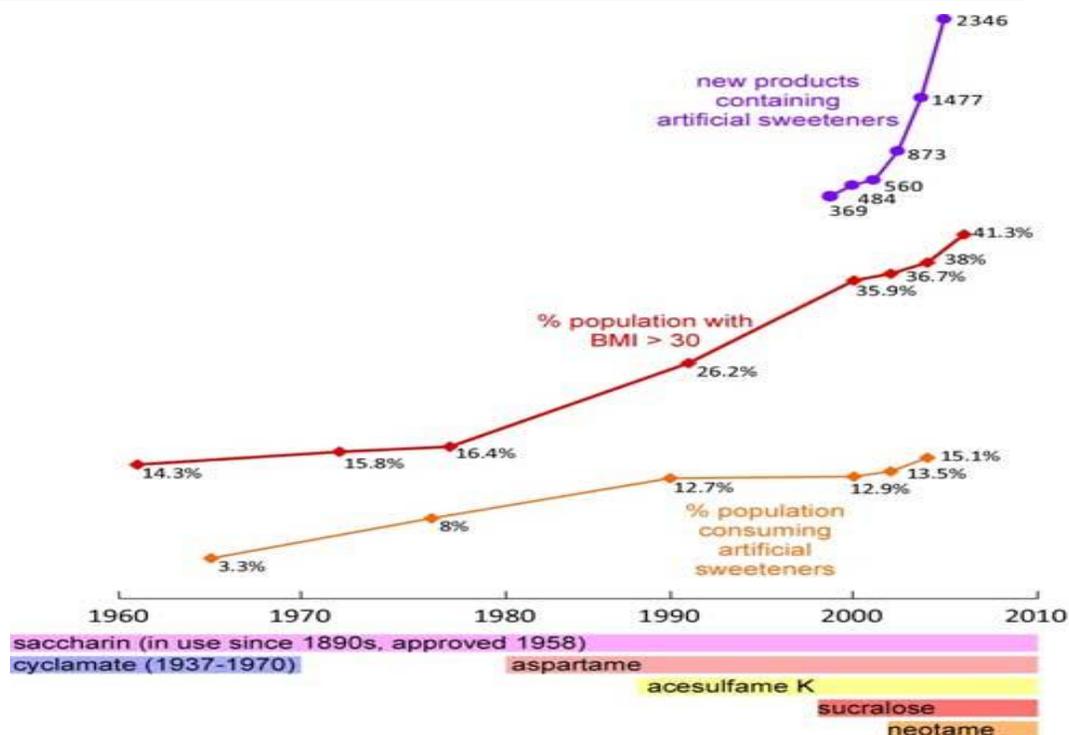
sweeteners in glucose metabolism. Our increasing understanding of the active metabolic role of such chemicals in animal models should support further study into the effects of these common food additives in humans.

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**Table 1: Formulations involving artificial sweeteners**

Name of the formulation	Trade name	Application
Sucralose	Sugar Free Natura	Weight Loss
Acefulsame Na	Robitussing	Cough
Aspartame	Diabetic Tussin	Chest Congestion
Neotame	Health Thru Nutrition	Ultra be tic multi vitamin
Xylitol	Protinix	Gastro esophageal reflux disease (GRD)
Aspartame	Melabic	Lowers insulin levels
Cyclamate	Chawanprakash	Metabolic disorders



**Fig.1: Effect of various Artificial sweeteners on BMI**

*\*BMI: Body Mass Index*

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