Review article

# NON-NUTRITIVE SWEETENERS AND ITS HEALTH IMPLICATIONS -A REVIEW

*Channesh Patel [1], Sathya Kumaresan [2]*

*[1] Department of Conservative and Endodontics, College of Dental Sciences, Davangere-577004*

*[2] Department of Public Health Dentistry, Saveetha Dental College and Hospitals, , Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-600077*

## ABSTRACT

Nonnutritive sweeteners (NNS) have been widely used in various therapeutic and dairy products and have become an inseparable part of our routine life. They deliver far less calories and intense sweetness than their sugar-containing counterparts. The United States Food and Drug Administration recognizes Aspartame, saccharine, sucralose, neotame, acesulfame-K, and stevia safe for consumption by diabetics. They also aid in weight loss. However, there is inconclusive evidence to support most of their uses. In addition, the lack of interventional studies has proven inadequate to evaluate their efficacy in different populations like pregnant, breastfeeding women. Furthermore, the susceptible population comprising of diabetics, epileptic patients are more likely to sustain the deteriorating effects of NNS-containing products. The current review signifies the benefits and the potential risks of using them based on dietary guidelines.

KEYWORDS- Diabetes, metabolic disorder, non-nutritive sweeteners, obesity

## INTRODUCTION

### I.OBESITY

Obesity is a major public health problem across the globe(1). According to studies, obesity is complex and is a resultant of both host factors and environmental factors internally and externally(2).Though energy rich foods, large food portion sizes, inadequate physical activity, alterations in the gut micro biome are the far most several factors that contribute to obesity however, consuming diet rich in high fat and/or high sugar along with the use of artificial sweeteners (AS) are the recently known predominant causes leading to obesity. Obesity is a global menace affecting the quality of life. According to surveys, there is over indulgence in the use of artificial sweeteners as people are far more concerned by weight and its health-related implications(3).

Address for correspondence

Dr. Sathya Kumaresan, Department of Public Health Dentistry, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-600077
E-mail address- sathu.kumaresan@gmail.com

Control of blood glucose remains the utmost management of diabetes (4). So, it is very essential for the clients to choose right foods to comply with nutritional recommendations. This has led to emergence of artificial sweeteners that can considerably contribute to weight loss. As a result, food industries have come up with various

*How to cite this article: Channesh P &, Sathya K. Non-Nutritive Sweeteners and Its Health Implications -A Review. Int J Comm Dent 2022; 10 (1):13-17. DOI: https://doi.org/10.56501/intjcommunitydent.v10i1.601*
*Received: 27-04-22; Accepted: 10-06-22; Web Published: 14-06-2022*

intense sweeteners. These have not only added to the intense sweet taste but also to the low-calorie intake. Artificial sweeteners possess desirable characteristics ranging from its bulk, physical properties and intense sweetness. Due to these features, artificial sweeteners are appreciated as bulk sweetener(5). The mechanism involved for the low-calorie intake is that these sugars are not metabolized in the human body.

A sweetener is a food additive that is employed in mimicking the effect of sugar taste. Therefore, they are known as sugar substitutes. People often prefer these foods as they are composed of low-calories(6).These bulk sweeteners not only comply an intense sweet taste but also helpful in the management of obesity or diabetes mellitus(7). Artificial sweeteners have various applications as they are increasingly used in beverages, food, dietary products and medicines, etc.

Artificial sweeteners have gained attention worldwide as nutritional supplements that aid in weight-loss plan adherence(8).The current review signifies the benefits and the potential risks of using them based on dietary guidelines.

## II.TYPES OF ARTIFICIAL SWEETENERS

### Saccharin

Saccharin is an artificial sweetener no calories(9). This is the ancient sweetener commonly used in processed food and beverages industries. Saccharin is 300 times more sweetener than sucrose(9,10).

Uses

Saccharin is used in various food products like carbonated soft drinks, table top sweeteners, and in few desserts. In oral hygiene products this sweetener camouflages the undesirable flavour of other ingredients(11).

Permissible levels by an individual per day:5mg/kg of body weight

Health effects: Interventional studies suggested that saccharin shows both useful and harmful effects. It is likely to predispose cancer in rats, dogs and humans. In 1997, saccharin was banned by the FDA based on the results of animal studies linking saccharin to cancer.

### Acesulfame potassium (Ace-k)

Acesulfame potassium is a white crystalline material which is stable up to high temperatures (250 °C) and a commonly used general sweetener(12).It is widely used in many bakery products due to its phenomenal stability under high temperature

Uses

It is majorly used as table top sweeteners. In addition, it has got wide applications in sweet drinks, dairy products, chewing gums, oral hygiene products and pharmaceutical industries(13).

Health effects: In humans, acesulfame-K is not metabolized. It has no effect on potassium intake in spite of its potassium content. However, acetoacetamide, a by product of ace-K can be toxic if utilised in considerable amounts.

Permissible levels by an individual per day:15mg/kg of body weight

### Aspartame

Aspartame is the far most commonly used sugar substitute(14). This is highly stable in hot temperatures and also offers the modest solubility in water.

Uses

Aspartame has applications in all fields of processed food.

Health effects: The consumption of aspartame at higher doses may lead to significant hepatocellular injury. It also has serious consequences in the liver antioxidant grade.

Permissible levels by an individual per day:50mg/kg of body weight

### Neotame

Neotame is procured from aspartame and is the recently known artificial sweetner (15). The neotame was recognised as a tabletop artificial sweetener in the year 2002.According to Food and

Drug Administration (FDA or USFDA), it has few exceptions in poultry and meat products(16).

Health effects: Safety studies have indicated that neotame has no hostile effects in microscopic findings and clinical observations

Permissible levels by an individual per day:0.3mg/kg of body weight

**Sucralose**

Sucralose is the widely used sugar substitute across the globe(17). Sucralose is highly safe and stable at higher temperatures; hence it is primarily used in baked food products. Sucralose is up to 1000 times sweeter than sucrose, three times as sweet as aspartame, acesulfame potassium and two times as sweet as saccharin(17,18).

Health effects: Recent studies have indicated thymus glands shrinking with the intake of 5% sucralose in the diet. However, certain specific immunotoxicity studies have adequately proved the misconception that sucralose is not linked to the shrinkage of thymus glands as it may be primarily caused by nutritional deficiency.

Permissible levels by an individual per day:5mg/kg of body weight

**Natural Sugars Versus Artificial Sugars**

Sugars in diet can either be natural or artificial. Natural sugars known to mankind are predominantly fruit sugar (fructose) and milk sugar (lactose)(19).However, these sugars can raise blood sugar levels as these are rich in calories. Naturally occurring sugars are known as intrinsic sugars.

Artificial sweetners refers to caloric sweetener and are added in the form of sugars and syrups to the foods during its production and processing(21).These are characterized by extra calories with no nutritional value and are chemically indistinguishable from natural sugars. These are also known as extrinsic sugars. Though there is an increasing awareness about the use of herbal products in daily life, specifically related to health services (22), recent studies have reported that over consumption of added sugars has been in direct association with increased risk of heart disease, accelerated blood pressure, type 2 diabetes and obesity.

How do we overcome this global public health problem, the thumb rule lies in avoiding products with high content of sugars; however, the increasing use of sugar substitutes makes it difficult to determine the ingredients which are counted as sugars. In addition, there are circumstances while we sometimes add sugar to enhance sweet taste by ourselves. A reduction in added sugar intake can lower the obesity and heart disease epidemics. Recent dietary guidelines indicate that artificial sweetner limit should not be more than 100 calories per day (about 6 teaspoons or 24 grams) for women and 150 calories per day (about 9 teaspoons or 36 grams) for men(23).

**Research Limitations**

The usage of artificial sweetners confers difficulty in establishing a clear causality in previously conducted rodent studies. Although rodent models provide some insight into the effects of artificial sweetners, the outcomes are inconsistent in humans and yet controversial.

## CONCLUSION

Research is highly anticipated to concentrate on the desired quantities of sweetness and low caloric value among natural sugars. Products containing Stevia and Mono ammonium glycyrrhizin should be encouraged as it is free from the hazardous effects of other chemical based alternates. In addition, MAG (Mono ammonium glycyrrhizin) is commonly employed in chocolate-flavored products as it enhances the flavor of cocoa.It also increases the flavors and sweetens candy, confectionery, and beverages.

ACKNOWLEDGEMENT: Nil

CONFLICT OF INTERESTS: All the authors declare that there was no conflict of interest in the present study.

SOURCE OF FUNDING: Nil

**REFERENCES**

1. João Gregório M, Gregório MJ. Obesity as a Major Public Health Problem in Portugal: Achievements and Challenges [Internet]. Vol. 36, Portuguese Journal of Public Health. 2018. p. I – II. Available from: http://dx.doi.org/10.1159/000502305
2. World Health Organization. Diet, Nutrition, and the Prevention of Chronic Diseases: Report of a Joint WHO/FAO Expert Consultation. World Health Organization; 2003. 149 p. Accessed on 20.3.2022.
3. Lin J, Kao TW, Cheng YC, Fan KC, Huang YC, Liu CW. Dehydroepiandrosterone status and efficacy of dehydroepiandrosterone supplementation for bone health in anorexia nervosa: A systematic review and meta-analysis. Int J Eat Disord [Internet]. 2022 Apr 22; Available from: http://dx.doi.org/10.1002/eat.23714
4. Cefalu WT. Medical Management of Diabetes Mellitus. CRC Press; 2000. 768 p.
5. Mitchell H. Sweeteners and Sugar Alternatives in Food Technology. John Wiley & Sons; 2008. 432 p.
6. Blundell JE. Low-calorie sweeteners: more complicated than sweetness without calories [Internet]. Vol. 109, The American Journal of Clinical Nutrition. 2019. p. 1237–8. Available from: http://dx.doi.org/10.1093/ajcn/nqz015
7. Bartolotto C. Does Consuming Sugar and Artificial Sweeteners Change Taste Preferences? [Internet]. The Permanente Journal. 2015. Available from: http://dx.doi.org/10.7812/tpp/14-229
8. English Legal System. 2012. p. 378–378. Available from: http://dx.doi.org/10.4324/9781843143451-104
9. Duyff R. Academy of Nutrition and Dietetics Complete Food and Nutrition Guide, 5th Ed. HarperCollins; 2017. 816 p.
10. Cole AS, Eastoe JE. Biochemistry and Oral Biology. Butterworth-Heinemann; 2014. 570 p.
11. Rowe RC, Sheskey PJ, Quinn ME. Handbook of Pharmaceutical Excipients. Amer Pharmacists Assn; 2009. 888 p.
12. Solis-Medina A, Martínez-Magaña JJ, Quintanar-Jurado V, Gallegos-Silva I, Juárez-Rojop IE, Tovilla-Zárate CA, et al. Astrogliosis and decreased neural viability as consequences of early consumption of aspartame and acesulfame potassium in male Wistar rats. Metab Brain Dis. 2018 Dec;33(6):2031–8.
13. Jean-Michel Merillon, Kishan Gopal Ramawat. Sweeteners - Pharmacology, Biotechnology & Applications. Springer, pp. XVII, 657, 2018, 978-3-319-27027-2. ⟨hal-03248270⟩
14. O'Donnell K, Kearsley M. Sweeteners and Sugar Alternatives in Food Technology. John Wiley & Sons; 2012. 504 p.
15. Eric Walters D, Orthoefer FT. Sweeteners: Discovery, Molecular Design, and Chemoreception. Amer Chemical Society; 1991. 333 p.
16. Food and Agriculture Organization. Codex Alimentarius Commission: Procedural Manual. Food & Agriculture Org; 2011. 212 p.
17. de la Peña C. Empty Pleasures: The Story of Artificial Sweeteners from Saccharin to Splenda. Univ of North Carolina Press; 2010. 296 p.

18. Qin X. May Dysbiosis Caused by Dietary Chemicals Such as Sucralose and Saccharin Be More Detrimental to the Gut and Health Than Antibiotics? How? [Internet]. Vol. 25, Inflammatory Bowel Diseases. 2019. p. e20–e20. Available from: http://dx.doi.org/10.1093/ibd/izy198
19. Lee AK, Chowdhury R, Welsh JA. Sugars and adiposity: the long-term effects of consuming added and naturally occurring sugars in foods and in beverages [Internet]. Vol. 1, Obesity Science & Practice. 2015. p. 41–9. Available from: http://dx.doi.org/10.1002/osp4.7
20. Baikow VE. Extraction of Juice from Sugar Cane [Internet]. Manufacture and Refining of Raw Cane Sugar. 2013. p. 44–84. Available from: http://dx.doi.org/10.1016/b978-1-4832-3212-6.50012-8
21. Park S, Yaroch A, Blanck H. Changes in Consumption of Foods and Beverages with Added Sugars During the COVID-19 Pandemic Among US Adults [Internet]. Vol. 5, Current Developments in Nutrition. 2021. p. 242–242. Available from: http://dx.doi.org/10.1093/cdn/nzab029_043
22. Chaput JP, Sharma AM. Is physical activity in weight management more about "calories in" than "calories out"? [Internet]. Vol. 106, British Journal of Nutrition. 2011. p. 1768–9. Available from: http://dx.doi.org/10.1017/s0007114511002844