Artificial sweeteners: safe or unsafe?
Qurrat-ul-Ain,1 Sohaib Ahmed Khan2

Abstract
Artificial sweeteners or intense sweeteners are sugar substitutes that are used as an alternative to table sugar. They are many times sweeter than natural sugar and as they contain no calories, they may be used to control weight and obesity. Extensive scientific research has demonstrated the safety of the six low-calorie sweeteners currently approved for use in foods in the U.S. and Europe (stevia, acesulfame-K, aspartame, neotame, saccharin and sucralose), if taken in acceptable quantities daily.

There is some ongoing debate over whether artificial sweetener usage poses a health threat. This review article aims to cover the health benefits, and risks, of consuming artificial sweeteners, and discusses natural sweeteners which can be used as alternatives.

Keywords: Artificial sweeteners, Diabetes mellitus, Natural sweeteners, Reactive hypoglycaemia.

Introduction
Table sugar has been an essential component of human diet. Its excess can lead to unhealthy effect on the body, most notably diabetes mellitus. Therefore sugar substitutes were introduced as safer alternatives. These are now used by millions of people worldwide without knowing their harmful effects on the body.1

Artificial sweeteners (AS) are sugar substitutes used in place of regular sugar. Nowadays, they are found in various products termed “sugar free” or “diet”.2 Their sweetening ability is higher as compared to regular sugar, and they have fewer calories than table sugars.3 The six Food and Drug Administration (FDA) approved artificial sweeteners regulated as food additives include acesulfame-potassium, aspartame, neotame, saccharin, sucralose and recently approved advantame (derivative of aspartame).2

Benefits of artificial sweeteners
Many health benefits are associated with artificial sweeteners. This is the main reason for their worldwide popularity. According to nutritionist, Phyllis Roxland, “it enables people that are carb, sugar or calorie conscious to take in a wider range of foods that they would either not be allowed to eat or could only eat in such tiny amounts that they were not satisfying”.2 They are used in diabetes mellitus, as an alternative to sugar because they do not raise blood glucose levels. As they contain no calories, they can also be appropriately used for weight control.2 A number of diabetics face difficulty in adapting to non-sugary foods. Artificial sweeteners make this difficult transition easier, allowing people with diabetes to eat their favourite foods.2

They can also be used in reactive hypoglycaemia, dental care to avoid caries and help enhancing flavours.1 A statement from American Heart Association and American Diabetes Association in 2011 spelled out that non-nutritive sweeteners may be good for health by reducing or controlling weight and can have other beneficial metabolic effects too.4

Possible health concerns with artificial sweeteners
Artificial sweeteners may have detrimental effects on the body. They can cause variety of hazards including cancer.2 In 1970, a research was conducted which showed the association of saccharin with bladder cancer in laboratory rats.5 They are also associated with malignancies like leukaemia, lymphoma and multiple myeloma (in men).6 Similarly, another study which assessed the possible effects of five non-nutritive sweeteners on cell proliferation, morphology and cells’ DNA by utilizing Caco2, HT-29 (colon) and HEK-293 (renal) cell lines. DNA damage, if any, induced by AS, was studied. Results showed that cells became less well defined and flatter at higher AS concentration. Colon cells were found to be more affected than renal cells. It was also seen that sodium saccharin and sucralose caused more DNA fragmentation in all cell lines than any other ASs.7

High fructose intake may cause hypertriglyceridaemia and gastrointestinal (GT) symptoms in susceptible individuals.8 Bloating is another possible side effect of artificial sweeteners as the body is unable to completely absorb them. Some people also experience laxative effect from these substitutes, mainly from sorbitol and mannitol.9

Literature shows that use of artificial sweeteners can increase the risk of type 2 diabetes mellitus. In 2014, an
Although many AS are considered safe during pregnancy, women with any form of diabetes (gestational or diabetes mellitus) and insulin resistance must limit their use of these substitutes.16 According to Garland et al (1993) saccharin has been shown to cause effects as anaemia, iron and vitamin A deficiency, depressed growth and elevated vitamin E in rats.17 They are also linked with premature deliveries prompted by two observational studies published in 2010 and 2012. Therefore pregnant women must be advised to avoid these sweeteners.18,19

Artificial sweeteners are a ubiquitous part of modern life, especially of diabetics care. Artificial sweeteners are added to a wide variety of foods, drinks, drugs and hygiene products. Their chief advantages are that they don’t raise blood glucose levels, can be used to control weight and to treat hypoglycaemia. If used excessively, they can increase weight, promote obesity, and impairment of normal metabolic responses. These findings have now led to increase in importance of natural sweeteners in place of ASs as alternative to natural sugar. We conclude that artificial sweeteners should be used in a limited amount. Moreover, use of natural sweeteners should be increased.

References
Table 1: Benefits, limitations and potential risks of artificial sweeteners.

**Benefits**
- In diabetes mellitus
- In reducing/controlling weight
- In dental caries
- For flavour enhancement
- In reactive hypoglycaemia

**Limitations**
- No nutritional value
- May not manage craving for sweets
- Inability to boost metabolic response after high calorie intake
- Avoid in pregnancy

**Potential Risks**
- Malignancy (at very high dose)
- Hypertriglyceridaemia (fructose)
- Gastrointestinal symptoms
- Aggravation of diabetes (not proven)
- Weight gain
- Osteoporosis (due to phosphoric acid)

---

Table 2: Seven commandments for safe sweetener use.

1. Discuss AS use with your physician
2. Use an FDA approved AS
3. Use AS in moderate amount
4. Prefer natural sweeteners, wherever possible
5. Limit use of AS in pregnancy and lactation
6. Limit use of AS in children
7. Remember AS may lead to weight gain


---

10.4103/0976-500X.85936.