

## Artificial Sweeteners: Compositions, Benefits, Side-Effects

### **Introduction**

A constant innovation in the field of artificial sweeteners has triggered a new intellectual property battle among various innovators. The history of the artificial sweeteners goes back to the 19th century when the first artificial sweetener (Saccharin) was accidentally discovered by a Constantine Fahlberg in 1879. It took nearly nine decades before the next major artificial sweetener Aspartame was brought into existence by James Schlatter in 1965 followed by acesulfame potassium in 1967 by Hoechst AG. In recent times, a variety of artificial sweeteners have been introduced to the market, one of them is the Stevia which has altogether changed the present and future of artificial sweeteners' market as well as the trend of patent filings in the recent years.

Sweetness, the traditional sensory indicator of both nutrients and calories, adds to the sensory appeal of any given food. Though humans have always had this temptation for foods having a sweet taste, the present-day scenario is rapidly changing with our changing lifestyles. With people getting more concerned about their health, particularly mindful of the calorie's intake, this enhanced awareness has increased the market demand for artificial sweeteners. Therefore, sugar-free foods are gaining more popularity and are indeed becoming the talk of the town.

Artificial sweeteners or intense sweeteners can be used as an alternative to table sugar. They can be naturally occurring or artificially synthesized based on which, they are broadly classified as natural and artificial sweeteners. They may also be categorized into nutritive and non-nutritive sweeteners. Where the nutritive sweeteners contain calories and energy, the non-nutritive sweeteners act as a zero or low-calorie alternatives to nutritive sweeteners.

### **Majorly Used Artificial Sweeteners**

There are five artificial sweeteners approved by the FDA.

Sold under the brand Sweet N Low®, SugarTwin®, Saccharin is the oldest known artificial sweetener. Though mainly produced from phthalic anhydride, it can also be developed from toluene and is considered 300 to 500 times sweeter than sugar. It is often used in toothpaste, dietary foods, dietary beverages, etc.

Similarly, Aspartame is another artificial sweetener and is a combination of two amino acids: phenylalanine and aspartic acid. It is 200 times sweeter than sucrose and is sold under the brand names NUTRASWEET and EQUAL.

Another example is Acesulfame-K, commonly used as Sunett and Sweet one. Due to its extraordinarily long shelf life, it is mainly used in candies, canned foods, and alcoholic beverages.

Another one is Sucralose, which was discovered in 1976 and is made from sucrose. It is 600 times sweeter than sucrose and is sold under the trade name Splenda and brand name Natura Sweet.

One recent development is the Neotame which is similar to aspartame and is 7000 to 13000 times sweeter than sucrose. It is used mainly in beverages and soy-based nutritionally fortified products.

### **Risks and Health Benefits of Artificial Sweeteners**

It is becoming the need of the hour to address the health benefits and the side-effects of artificial sweeteners. Being used primarily by the people suffering from Diabetes Mellitus as an alternative to sugar, they can also be used to control blood sugar level, obesity, and for dental care.

Despite the variety of commercial and health benefits, the artificial sweeteners are found to be associated with a variety of side effects as well. It has been found to trigger malignancy, Gastrointestinal Symptoms And Hypertriglyceridaemia, Bloating, Weight Gain and Type 2 Diabetes Mellitus when consumed in a very high concentration. Studies show that people who consume artificially sweetened drinks had a 47% higher increase in BMI than those who did not.

### **Stevia- The New Buzzword**

Stevia is an emerging artificial sweetener. Gaining rapid acceptance and magnified market revenues, it is a highly potential non-nutritive sweetener extracted from the leaves of *Stevia rebaudiana*. The primary components responsible for the sweet properties of the plant are glycosides of steviol. Stevioside is 250-300 times sweeter than sucrose and is very stable at 200 degree Celsius. The main stevioside producing countries are China and Paraguay with adjacent parts of Brazil. Continuous research is being done to further understand the possible health benefits associated with stevia. Initial studies indicate that stevia can lower the blood pressure levels as well. Consumers employ the dried leaves, liquid extracts, crystals or powder of Stevia by adding it to their drinks. However, there is a need for further studying and understanding Stevia (and its compounds) in order to derive greater benefits for mankind.

### **Recent Market Trends**

The demand for artificial sweeteners is accelerating at a very high speed. The use of artificial sweeteners in food and drink products has grown considerably over the past five years, from being 3.5% in 2009 to 5.5% in 2012 and is further expected to increase by 9.7% from the levels in 2013. If we speak individually, China is the world's largest source of high-intensity sweeteners, accounting for 77% of world production in 2017 followed by Indonesia, Western Europe, the United States, Japan, and South Korea.

However, the market for stevia has shown a roaring increase in recent years. Stevia has already stolen the intense sweetener market share. The demand is growing strongly in both developed and developing countries and by 2021, it is expected to reach 4 thousand to 5 thousand metric tons annually. There are multiple market players in this domain with Ajinomoto Co. Inc., Anhui Jinhe Industrial Co.Ltd. , Archer Daniels Midland Company, Beijing Vitasweet Co. Ltd., Cargill Inc, Celanese Corporation, Changzhou Niutang Chemical Plant Co. Ltd., Gansu Fanzhi Biotech Co., Ltd., GLG Life Tech Corporation, Golden Time Chemical (Jiangsu) Co. Ltd., Guilin GFS Monk Fruit Corp. and NutraSweet etc. leading the artificial sweeteners market.

(Source: IHS Markit Report)

### Intellectual Property Trends

Continuous research is being carried out for the development of efficient and safe artificial sweeteners starting another intellectual property race for the different innovators. The major assignee in this domain is Kvasenkov Oleg Inavovich followed by Nestec SA with development majorly oriented towards non-alcoholic beverages and food and foodstuffs (A23L class according to IPC classification system). Whereas the United States of America remains the leading country in this domain.

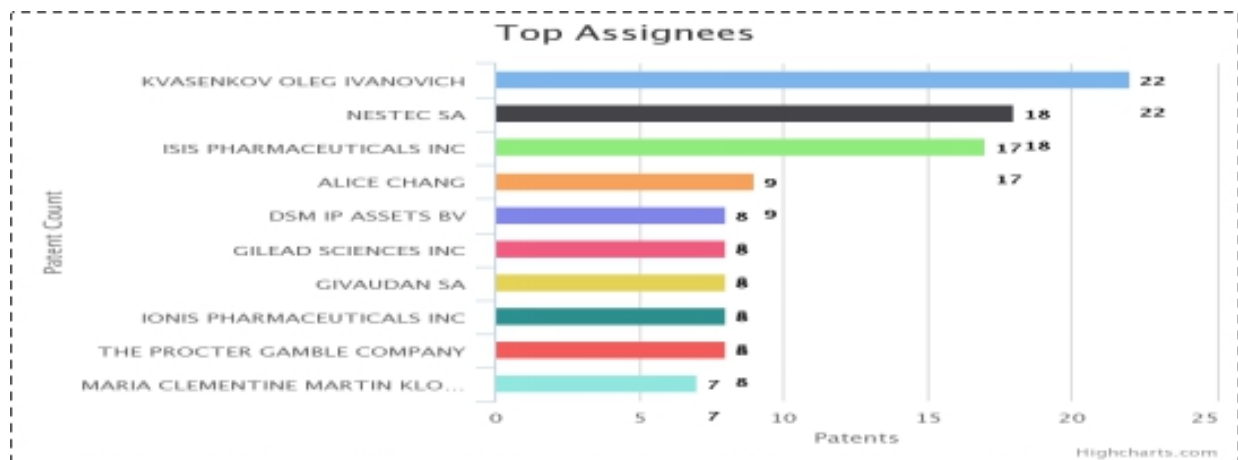


Fig 1. Major Assignees in Artificial Sweetener Research & Innovation

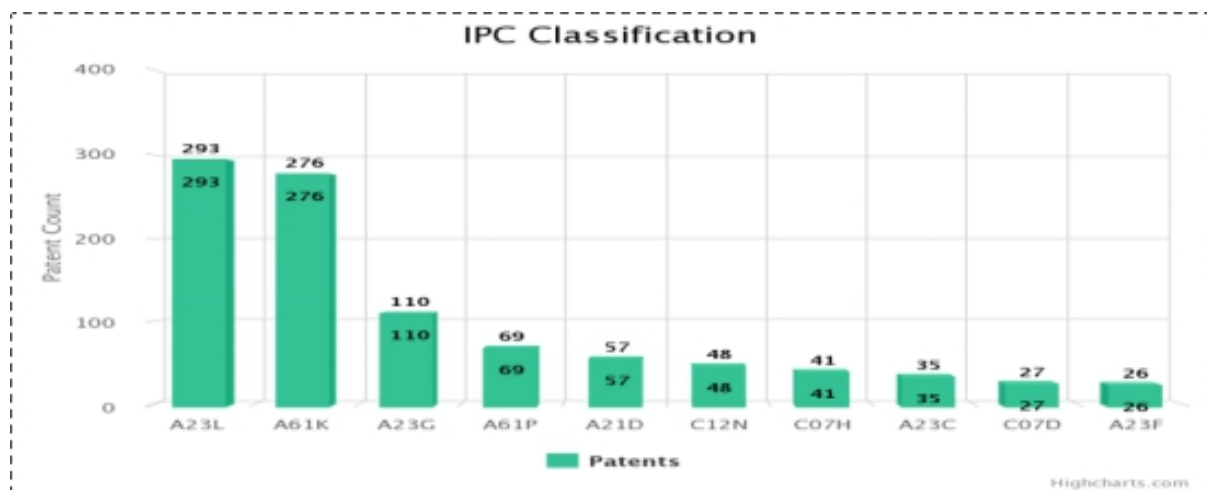
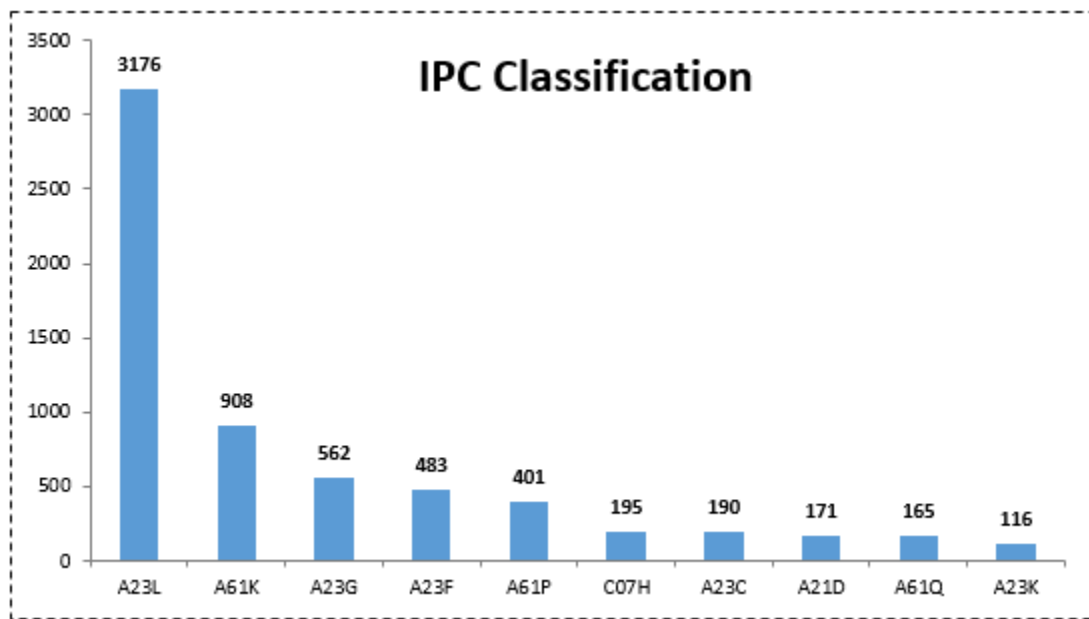


Fig 2. Major IPC Classes in Artificial Sweetener Research & Innovation



**Fig 3. Major countries involved in Artificial Sweetener Research & Innovation**

Talking about stevia, the leading company is Coca-Cola followed by Cargill. The IPC classification trend depicts that the major patent citations belong to foods or foodstuffs (A23L), followed by preparations of medical, dental, or toilet purposes (A61K), and Cocoa, cocoa products, e.g., Chocolate, substitutes for cocoa or cocoa products, confectionery, chewing gum, ice-cream, preparation thereof (A23G). Among countries, China is leading in this domain and is second to none.



**Fig 4. Major IPC Classes in the Domain- Stevia Extract**

## Conclusion

As an efficient alternative to sugar, the artificial sweeteners carry an immense industrial potential. However, a rational innovation in the direction of health with fewer health risks will be required, so that the artificial sweeteners could be truly projected as a healthy & low-calorie alternative.



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