

Company: Catalyst Industries Pvt. Ltd.

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Chemical Formula: CH₁₈N₂O₅

Chemical Name: Aspartame

Use case:

- a. What is the use of this compound?

Aspartame is an artificial, peptide, non-saccharide sweetener 200 times sweeter than sucrose and is commonly used as a sugar substitute in foods and beverages. It is a methyl ester of the aspartic acid.

Due to this property, even though aspartame produces roughly the same energy per gram when metabolized as sucrose, 4 kcal (17 kJ), the quantity needed to produce the same sweetness is so tiny that its caloric contribution is negligible. Aspartame may hydrolyze(break down) into its constituent amino acids under elevated temperature or high pH conditions. Aspartame is undesirable as a baking sweetener and prone to degradation in products hosting a high pH, as required for a long shelf life. In products requiring a longer shelf life, such as syrups for fountain beverages, aspartame is sometimes blended with a more stable sweetener, such as saccharin.

Aspartame is an ingredient in approximately 6,000 consumer foods and beverages sold worldwide, including (but not limited to) diet sodas and other soft drinks, instant breakfasts, cereals, sugar-free chewing gum, cocoa mixes, frozen desserts, juices, laxatives, chewable vitamin supplements, milk drinks, pharmaceutical drugs and supplements, shake mixes, tabletop sweeteners, teas, instant coffees, topping mixes, wine coolers, and yoghurt.

- b. Are there any alternatives to this compound? Name a few.

We thoroughly observed and compiled a list of potential alternative sweeteners (both artificial and natural).

Below are 5 listed alternatives to this compound.

Market Analysis Report

S. No.	Sweetener	Regulatory Approval	Type	Calories per gram	Aftertaste	Taste onset	Stability at pH3
1.	Neotame	Approved	Artificial	0	None	Immediate	Stable
2.	Advantame	Approved	Artificial	0	None	Immediate	Stable
3.	Stevia derivatives	Approved	Natural	0	Bitter	Immediate	Stable
4.	Mogrosides	Approved	Natural	0	Bitter	Immediate	Stable
5.	Thaumatococcus	Approved	Natural	4	Licorice	Immediate	Stable

- **Neotame:** It's an artificial sweetener chemically similar to aspartame but much sweeter. It is created by modifying the structure of aspartame to enhance its stability and sweetness. Neotame is approximately 7,000 to 13,000 times sweeter than sucrose (table sugar) and is often used in tiny quantities to sweeten foods and beverages.

Like aspartame, neotame is a low-calorie sweetener and is approved for use in many countries, including the United States and the European Union. It provides sweetness without adding significant calories to foods and beverages, making it popular in various low-calorie or sugar-free products.

- **Advantame:** Advantame is derived from aspartame, but it is much sweeter and has a slightly different chemical structure. It is approximately 20,000 times sweeter than sucrose (table sugar), making it one of the most potent sweeteners. It is used in tiny quantities to provide sweetness without adding significant calories to foods and beverages.
- **Stevia Derivatives:** Stevia derivatives refer to various compounds derived from the leaves of the *Stevia rebaudiana* plant, which are used as sweeteners. The primary sweet compounds found in the stevia plant are called steviol glycosides. These compounds are responsible for the intense sweetness of stevia extracts and are often used as sugar substitutes in foods and beverages.
- **Mogrosides:** Mogrosides are natural compounds found in the fruit of the *Siraitia grosvenorii* plant, also known as monk fruit or *luo han guo*. These compounds are intensely sweet, even sweeter than sugar (sucrose), but they do not contribute any calories to the diet. They provide sweetness without the caloric content of sugar, making them appealing for individuals looking to reduce their sugar intake or manage their calorie consumption.
- **Thaumatococcus:** Thaumatococcus is a natural sweetener and flavor modifier derived from the fruit of the *Thaumatococcus daniellii* plant native to West Africa. It is an intensely sweet protein-based sweetener, around 2000 to 3000 times sweeter than sucrose (table sugar), making it one of the most potent natural sweeteners known.

Why is this compound superior to its alternatives?

- As of 2017, reviews of clinical trials showed that using aspartame in place of sugar reduces calorie intake and body weight in adults and children. A 2017 review of the metabolic effects by consuming aspartame found that it did not affect blood glucose, insulin, total cholesterol, triglycerides, calorie intake, or body weight. While high-density lipoprotein levels were higher compared to control, they were lower compared to sucrose.
- As of 2023, regulatory agencies, including the FDA and EFSA, and the US National Cancer Institute(NCI), have concluded that consuming aspartame is safe in amounts within acceptable daily intake levels and does not cause cancer. These conclusions are based on various sources of evidence, such as reviews and epidemiological studies finding no association between aspartame and cancer.
- Has good **Water quality!** i.e. aspartame passes through wastewater treatment plants mainly unchanged. **Wastewater treatment** is a process that removes and eliminates contaminants from wastewater and converts this into an effluent that can be returned to the water cycle.
- Aspartame is rapidly hydrolyzed in the small intestine by digestive enzymes, breaking aspartame down into methanol, phenylalanine,aspartic acid, and further metabolites, such as formaldehyde and formic acid. Due to its rapid and complete metabolism, aspartame is not found in circulating blood, even after ingesting high doses of over 200 mg/kg.
- Many other properties of Aspartame make it superior to its alternative. Some are listed below as:
 - ❖ Taste: Aspartame is known for its taste profile, which resembles sugar without the bitter aftertaste associated with other artificial sweeteners like saccharin or cyclamate.
 - ❖ Caloric Content: Aspartame is virtually calorie-free, making it a popular choice for those looking to reduce calorie intake or manage weight.
 - ❖ Safety: Extensive research has been conducted on aspartame's safety, and regulatory agencies such as the U.S. Food and Drug Administration (FDA) and the European Food Safety Authority (EFSA) have approved its use in foods and beverages. However, it's worth noting that some controversies and debates exist around its safety, with some studies suggesting potential health concerns.
 - ❖ Reduced aftertaste: Unlike some other artificial sweeteners, aspartame typically leaves less of an aftertaste, contributing to a more enjoyable eating or drinking experience for many consumers.

c. Is this compound imported in India? What is the magnitude of imports?

- Various companies import aspartame into India for use in the food and beverage industry. It is regulated by the Food Safety and Standards Authority of India (FSSAI), which sets standards and regulations for food additives, including sweeteners like aspartame. Imported aspartame must comply with the regulations and standards set by the FSSAI to ensure its safety and quality for consumption. Additionally, food and beverage products containing aspartame must comply with labeling requirements to inform consumers about the presence of the sweetener in the product.
- As per Volza's Global Import data, Aspartame import shipments in World stood at 22.5K, imported by 2,379 World Importers from 1,846 Suppliers. Whereas, as per Volza's India Import data, Aspartame import shipments in India stood at 2.9K, imported by 217 India Importers from 249 Suppliers.
- World imports most of its Aspartame from China, Japan and India. India imports most of its Aspartame from China, the United States and France and is the 2nd largest importer of Aspartame worldwide.
- The top 3 importers of Aspartame are the United States with 5,557 shipments followed by India with 2,926 and Peru at the 3rd spot with 1,979 shipments.
- Top 3 Product Categories of Aspartame Imports in India are:
 1. HSN Code 29242990 : 29242990
 2. HSN Code 29420090 : 29420090
 3. HSN Code 29242930 : 29242930

HSN Code 29242990 : 29242990

- As per Volza's India Import data, Aspartame and HSN Code 29242990 import shipments in India stood at 1.1K, imported by 129 India Importers from 151 Suppliers.
- India imports most of its Aspartame and HSN Code 29242990 from China, France and United States and is the largest importer of Aspartame and HSN Code 29242990 in the World.
- The top 3 importers of Aspartame and HSN Code 29242990 are India with 1,130 shipments followed by Pakistan with 184 and Nepal at the 3rd spot with 104 shipments.

HSN Code 29420090 : 29420090

- As per Volza's India Import data, Aspartame and HSN Code 29420090 import shipments in India stood at 308, imported by 32 India Importers from 48 Suppliers.
- India imports most of its Aspartame and HSN Code 29420090 from China, Japan and France and is the largest importer of Aspartame and HSN Code 29420090 in the World.

- The top 3 importers of Aspartame and HSN Code 29420090 are India with 308 shipments followed by Nepal with 63 and Bangladesh at the 3rd spot with 14 shipments.

HSN Code 29242930 : 29242930

- As per Volza's India Import data, Aspartame and HSN Code 29242930 import shipments in India stood at 214, imported by 34 India Importers from 43 Suppliers.
- India imports most of its Aspartame and HSN Code 29242930 from China, Japan and United Kingdom and is the largest importer of Aspartame and HSN Code 29242930 in the World.
- The top 3 importers of Aspartame and HSN Code 29242930 are India with 214 shipments followed by United States with 32 and Ghana at the 3rd spot with 5 shipments.

Economic feasibility:

- RAW Materials needed for its synthesis:
 - Aspartic acid
 - Phenylalanine
 - Methanol
 - Diketene
 - Acetic anhydride
 - α -Amino Acid Ester Acyltransferase (AET)
 - Hydrochloric Acid (HCl)
 - Borate buffer
- Preliminary economic feasibility based on cost of raw materials, solvents and product selling price:

Cost of Raw Materials:

Aspartic acid: Depending on the source and quantity purchased, the cost can vary but is typically around Rs. 260 per kilogram.

Phenylalanine: Similarly, the cost varies but is generally around Rs. 1000 per kilogram.

Methanol: The cost of methanol can vary depending on factors such as purity and volume purchased. It is generally priced around Rs. 40 per kg

Diketene: Diketene is relatively expensive and can cost around Rs. 300 per kilogram.

Acetic anhydride: Acetic anhydride costs vary but are typically between Rs. 160 - 170 per kilogram.

Hydrochloric Acid: costs around Rs. 15 per kg

Borate Buffer: costs around Rs. 185 per kg

Cost of Solvents:

Depending on the specific production process, various solvents may be used. These can include water, organic solvents, and acids. The cost of solvents will depend on the type, quantity, and purity required for the process.

Selling Price of Aspartame:

- 1) The selling price of aspartame varies based on factors such as market demand, competition, purity, and regulatory standards. As of the latest available data, the price can range from Rs. 1500 - 1800 per kilogram.

- References:**
1. <https://www.volza.com/p/aspartame/import/import-in-india/>
 2. <https://www.greyb.com/blog/aspartame-alternatives/>
 3. https://en.wikipedia.org/wiki/Aspartame#Commercial_uses

List the contributions of each author:

First Author looked at the Import statistics in India and globally.

Second Author prepared the use case and the alternatives of Aspartame.

Third Author looked at the economic feasibility.

Fourth and Fifth Author curated the import and selling data.

Sixth Author proofread and made formatting as well as curating contributions.

Market Analysis Report

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