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Production of Aspartic Acid-A Short Review

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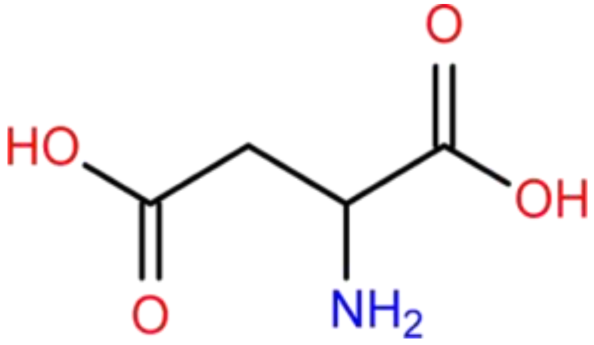
ABSTRACT:
Aspartic acid is also known as aspartate, is an alpha amino acid that is used in biosynthesis of proteins.It is used as artificial sweetener in the form of aspartame. It is prepared using fungal species like Aspergillusniger. There have been various attempts to produce aspartic acid efficiently from inexpensive raw materials[1].

INTRODUCTION:

Aspartic acid abbreviated as ASP or D; is encoded by the codons GAU AND GAC also known as aspartate is an alpha amino acid obtained as a product of the hydrolysis of proteins.Aspartic acid was first discovered in 1827 by AUGUSTE-ARTHUR PLISSON and isolated in 1868 from legumin in plant seeds and from asparagus juice. Aspartic acid is not an essential amino acid, which means that it can be synthesized from central metabolic pathway in humans (i.e;) they can synthesize it from oxaloacetic acid formed in the metabolism of carbohydrates and do not require dietary sources. There are two forms or enantiomers of aspartic acid. The name aspartic acid can refer to either enantiomer or a mixture of two. Of these two forms only one L-aspartic acid, is directly incorporated in to proteins. The biological roles of its counterpart, D-aspartic acid are more limited. Most chemical synthesis will produce both forms, DL-aspartic acid known as a racemicmixture. It can also be generated from ornithine and citruline in the urea cycle. Aspartate also participates in gluconeogenesis. Aspartic acid acts as a hydrogen acceptor in a chain of ATP synthase system.[2]



CHEMICAL STRUCTURE OF ASPARTIC ACID;

PHYSICAL PROPERTIES OF ASPARTIC ACID:

- State is colourless.
- Crystal in form.
- Soluble in water.
- Insoluble in ether.
- Aspartic acid is optically active.

BIOSYNTHESIS OF ASPARTIC ACID:

Aspartic acid can be synthesized by two different reactions, both of which involve a substrate that is a participant in the tricarboxylic acid cycle. It can be obtained by transamination of oxaloacetic acid with glutamic acid, whose biosynthesis will be examined below.

COOH-CH2-COCOOH+COOH-(CH2)2-CH(NH2)-COOH

COOH-CH2-CH(NH2)-COOH+COOH-CH2-CH2-CO-COOH

During the past 80 years the following methods for synthesizing aspartic acid have been reported; the decomposition of acid ammonium malate by heat , the racemization of active aspartic acid , and active asparagine , the reaction of maleic and fumaric acids with ammonia in a closed tube ,the reduction of oxaloacetic ester oxime , the reduction of silver fumarate by hydroxylamine hydrochloride , the reduction of nitrosuccinic ester[3] etc…,

- Amphoteric (react as acidic and basic).

Uses of aspartic acid;

Aspartic acid, which is available in all protein foods, forms *aspartame* when it's combined with phenylalanine (another amino acid)[4]. Aspartame is the commonly used artificial sweetener that can be a mild irritant to the nervous system[5].

Doctors don't recommend aspartic acid supplements for regular use, especially for children who generally have more sensitive nervous system[6].

Key uses of aspartic acid:

- Clinicians include aspartic acid in some natural programs for depression and immune function.
- Aspartic acid aids in energy production from carbohydrates and in RNA and DNA formation.

- Aspartic acid aids in liver detoxification from drugs and chemicals.
- Aspartic acid increases resistance to fatigue.

Synthesis of Aspartic acid:

ORGANISMS THAT PRODUCE ASPARTIC ACID

Several organisms such as Pseudomonas fluorescens, Pseudomonas aeroginosa, Bacillus subtilis, Bacillus megatherium, Proteus vulgaris, Escherichia: coli, and Aerobacteraerogenes, were found to be suitable for the production of aspartic acid[6].

PRODUCTION OF ASPARTIC ACID BY FERMENTATION;

A one-phase process for the fermentative production of L-aspartic acid in a medium containing fumaric acid and ammonia was developed by ichiro chibato,Toyonako and masahikokisumi in 1965.Like polyacrylamide, glucose, Fumaric acid, Maleic acid, Hydrocarbons, were used by different workers. Organisms such as E.coli, Brevibacterium, Bacillus and Pseudomonas were extensively used for the fermentative production of aspartic acid. A biochemical process of aspartic acid production has been reported from fumaric acid by transmination with the enzymes of bacteria.It is also known that small amounts of aspartic acid is produced from hydrocarbons or ethanol by culturing with wild strain of the genus Brevibacterium or corynebacterium[7].

DIETARY SOURCES OF ASPARTIC ACID

ANIMAL SOURCES; oysters, luncheon meats, sausage meats, wild game.

VEGETABLE SOURCES; sprouting seeds, oat flakes, asparagus, young sugarcane and molasses from sugar beets.

Survey of Literature was Depicted in Tabular form:

DIETARY SUPPLEMENTS; either as aspartic acid itself or salts (such as magnesium aspartate).[8]

APPLICATIONS OF ASPARTIC ACID:

Aspartic acid in food production:

- Aspartic acid is widely used as nutritional supplement and flavor enhancer in food production.
- In food industries aspartic acid is used to regulate the acidity and sweetness[9].

Aspartic acid in Beverage:

- Aspartic acid is widely used as nutritional supplement in beverages.
- Used in cool drinks to provide nutrition.
- Aspartic acid is widely used as intermediate in pharmaceuticals as an intermediate in medicine manufacture[10].

Aspartic acid in Cosmetics:

- Aspartic acid is used as Biodegradability in cosmetics[11].
- Aspartic acid in Agriculture/Animal Feed:
- It is used as nutritional supplement in fertilizer to improve use efficiency[12].
- It is also used in manufacturing of various organic chemicals.

SIDEEFFECTS OF ASPARTIC ACID:

- Aspartic acid may cause certain side effects such as enhanced libido (some people consider this a side effect), elevated aggression levels, , larger appetite, and increased hair growth.[13]

S.N	**SUBSTRATE**	**ORGANISM**	**YIELD**	**YEAR**	**REFERENCE**
1.	Maleic acid.	Pseudomonas aeroginosa	88.1%	1963	(14)
2.	Fumaric aicd and ammonia	Pseudomonas fluorescens, pseudomonas aeroginosa	3.6g/dl	1965	(15)
3.	Fumaric acid and ammonia	Pseudomonas trifolli B269-PY-5	More than 35%	1965	(16)
4.	Ammonium fumerate.	E. coli	600mg	1973	(17)
5.	Ammonium fumerate	E. coli	762gm/95%	1973	(18)

6.	Polyacryl-Amide.	E.coli	762gm	1974	(19)
7.	Hydrocarbons	Candida hydrocarbofumarica and B.species	150mg/l	1975	(20)
8.	Fumaric acid	Bacillus stearothermophilus.	85%	1977	(21)
9.	Glutaraidehyde and hexamethylenediamine.	E. coli	10gm	1979	(22)
10.	Ammonia fumerate	E. coli	2.18mole	1981	(23)
11.	Glucose	Brevi bacterium flavum	10.6g/30%	1982	(24)
12.	Ammonia fumerate	E. coli cells	70-97 molar %	1983	(25)
13.	Glucose.	Brevi bacterium flavum	22.6g/lit	1984	(26)
14.	Maleic acid and ammonia.	Bacillus subtilis	5*10-3 molar	1985	(27)
15.	Alpha-keto acid.	Pseudomonas dacuntae cells	Good yield	1989	(28)
16.	Ammonia fumerate	E. coli	95%	1995	(29)
17.	Ammonium aspartate.	Pseudomonas fluoroscens ,E. coli cells	77%	1996 1996	(30)
18.	Ammonium fumerate	E. coli	99.0wt		(31)
19.	Fumerate and ammonia.	Pseudomonas trifolli	Good yield	1999	(32)
20.	Fumaric acid	E. coli	83%	2000	(33)
21.	Cornybacterium glutamacium	Glutamic acid	5-7%	2003	(34)
22.	Polysuccinimide	Crosslinking agent diamine	85%	2005	(35)
23.	E.Coli	Sucrose or glucose	Better yield	2005	(36)

CONCLUSION:

The data reveals that *E.Coli species* is widely used for the production of Aspartic acid. As Aspartic acid is having several useful applications, further work with cheap substrates will help in the development of small scale industries.

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