GLUTAMIC ACID

Possibilities of its Production in Pakistan and its Uses

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GLUTAMIC acid is one of the essential amino acids. It plays a central role in the intermediary metabolism. It is used in limited quantities as a drug in the treatment of mental deficiencies and for other medicinal purposes. Apart from its use as a constituent of food, it has recently been employed in depilatories[2] and hair-wave lotions to protect hair from damage. Glutamic acid hydrochloride is used to aid the production of a non-corrosive solder flux. Sodium salt of glutamic acid has been extensively employed in Japan and China for use as a food condiment. The condiments variously known as "Aji-no moto", "Ve-tsin" etc. are principally monosodium glutamate mixed with about 10-20% sodium chloride.

Glutamic acid was first isolated from proteins in 1866 by the German chemist Ritthausen,[3] and synthesized by Wulff,[4] in 1890. Compared to its production from proteins, the presently known synthetic methods are much more costly, intermediate yields are lower and the product obtained is usually the racemic inactive form which is difficult to convert into the active or dextro configuration.

In 1912, Ikeda[5] hydrolyzed a seaweed (*Laminaria japonica*) and separated glutamic acid from other amino acids. On neutralization with soda, the sodium glutamate was found to possess a desirable meat-like taste. Since then, it found its way into the culinary formulae of Japan and China. It was patronized by the public to such an extent that in 1930 its production in China rose to 350,000 pounds. A few years later, the Chinese material was beginning to compete with the Japanese product in Singapore, Malaya and the Philippines. The interest in the material rose in the United States during and since World War II from when it became available in abundance. It is mainly used by the food canning and dehydration industries.

Almost all proteinous materials contain variable quantities of glutamic acid. But wheat gluten, corn gluten, extracted soyabean flour, casein, peanut flour, yeast, dried distiller's solubles, extracted cottonseed meal and fish waste are a rich source of the acid. Other proteins such as egg albumen can also be used for making glutamic acid. The gluten proteins, however, are unique in the sense that they contain a very high percentage of glutamic acid as is clear from table I.[6]

TABLE I

Amino Acids	*Percentage*
Alanine	9.8
Arginine	1.5
Aspartic acid	1.7
Cystein	1.2
Glutamic acid	20.1-24.0
Glycine	0.4
Histidine	0.8
Isoleucine	3.7
Lysine	6.1
Methionine	2.0
Phenylalanine	6.6
Threonine	3.0
Tryptophane	Trace
Tyrosine	2.6
Valine	1.9

Use as Food Flavour

Pure monosodium glutamate possesses a meat-like taste, but essentially no odour. It is used in the preparation of certain soups and gravy flavourings. It can be used in water as a substitute for beef tea. It cannot, however, supplant meat. Monosodium glutamate suppresses undesirable sharpness in onion flavour, rawness in many vegetables and some meats, flavour of peel and earthiness in vegetables, particularly in potatoes, a volatile

characteristic note in boiled rice, bitter tastes in freshly opened canned vegetables, a fishy odour sometimes present in lima beans and bitterness in saccharine solutions are also dulled by the use of monosodium glutamate. A mixture containing sodium glutamate 1.787 g., NaCl 550 g. protein hydrolysate 257 g., and glutamic acid 137 g., in a wafer or chewing gum[7] taken 15 to 30 minutes before meal time suppresses the appetite. The flavour in the mouth is responsible for the feeling of fullness.

Production

For the production of glutamic acid on an industrial scale, gluten—a by-product of starch industry—is used for it is a cheap proteinous material. Wheat gluten which contains from 80 to 90 per cent protein, is a good source on account of its high glutamic acid content. Hydrochloric acid is generally the hydrolyzing agent for food hydrolysates. Gluten and hydrochloric acid are usually heated in the presence of a small quantity of finely granulated tin. The tin[8] accelerates the hydrolysis and removes any arsenic present. The solution is filtered, concentrated under reduced pressure, and the glutamic acid hydrochloride allowed to crystallize. The crude crystals are dissolved in water and neutralized with sodium hydroxide to pH 3.2 [9] to get glutamic acid. The glutamic acid slowly crystallizes out over a period of several days. It can be converted to monosodium glutamate by dissolving it in water and by neutralizing with sodium hydroxide to pH 5.4-6.2.

The glutamic acid and its sodium salt were prepared by hydrolyzing wheat gluten, maize and casein with hydrochloric acid. The yields under different conditions of time and acid concentration have been summarized in table II. It is clear that with wheat gluten, hydrochloric acid of specific gravity 1.18 gives the best yields when the hydrolysis is conducted for six hours. With maize gluten, the most favourable conditions are :—specific gravity of HCl 1.14, and duration of hydrolysis 12 hours.

Manufacture in Pakistan

The most important pre-requisites for the commercial production of glutamic acid in Pakistan are :—

(*a*) abundant supply of proteinous materials rich in glutamic acid ;
(*b*) cheap supply of hydrochloric acid ;
(*c*) availability of corrosion resistant equipment ;
(*d*) demand within the country or outside.

So far as the proteinous materials are concerned, maize gluten is available in fairly sufficient quantities. At present there are two established starch factories, one in Lyallpur and the other in Peshawar with a capacity of about 12.5 and 24.5 tons of starch per day, respectively. These two factories are making

TABLE II

YIELDS OF GLUTAMIC ACID AND SODIUM GLUTAMATE BY VARIOUS METHODS

Proteinous material	Time	Sp. Gr. of acid	Per cent of glutamic acid hydrochloride	Per cent of glutamic acid	Per cent of sodium glutamate
Wheat gluten					
(1)	.. 18 hours	1.18	14.0	9.0	11.5
(2)	.. 6 ,,	1.18	23.2	15.2	19 0
(3)	.. 6 ,,	1.03	——	14.5	17.6
(4)	.. 9 ,,	1.03	21.65	——	18.38
Maize gluten					
(1)	.. 9 ,,	1.03	10.4	6.8	7.4
(2)	.. 12 ,,	1.14	15.9	10.3	13.0
Casein	.. 24 ,,	1.14	18.1	11.5	14.3

their starch from maize. Besides these two factories, there are some smaller concerns making their starch from wheat. Their production, no doubt, is smaller but still they are producing a good amount of gluten. This gluten whether from maize starch or from the wheat starch is finding particularly no remunerative application. It is mainly used as a cattle feed. If it could be converted into glutamic acid, this by-product can yield better dividends. In addition to these two sources of gluten, Pakistan has also abundant supply of cotton-seed oil cakes which contain a good amount of gluten. This source can also be utilized for the production of glutamic acid.

Hydrochloric acid can, no doubt, be manufactured from sulphuric acid and sodium chloride. The capacity for the production of sulphuric acid in the country is much more than its consumption at present. The excess of sulphuric acid can be utilized in the production of hydrochloric acid. Hydrochloric acid is also now obtained as a by-product from the manufacture of D.D.T. and also from the caustic soda plant at Nowshera by electrolytic process through the production of hydrogen and chlorine.

Regarding corrosion resistant equipment, the country has to import it from abroad. Such equipment can be fabricated either from stainless steel containing molybdenum or it can be glass-lined or rubber-lined. Nowadays synthetic resins are also used for lining such equipment in order to withstand the action of concentrated hydrochloric acid.

Monosodium salt of glutamic acid, as is well-known, gives that peculiar meaty odour and flavour to the food which would be very popular among the meat-eating population of Pakistan. This material can be introduced in the beginning, in military rations, in restaurants etc. and when the general public gets sampled with it they would naturally go in for its consumption. If it could be made economically within the country, there will be a likelihood of an export market for it to countries *viz.* China, Japan and America where it has a fairly high record of consumption.

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