



Effective Utilization of By-products

The Ajinomoto Group’s product manufacturing process generates by-products. The group sees these by-products as valuable resources, and is working to recycle them as co-products. The “Bio-cycle”, which is a system for effectively utilizing by-products that come from the amino-acid fermentation production process, is a representative example of the Ajinomoto Group’s resource recycling production model.

“Bio-cycle”, a system for effectively utilizing by-products

The Ajinomoto Group’s manufacturing process generates by-products, or unintended secondary products. The majority of these by-products are concentrated fermentation liquors derived from the fermentation production process for amino acids, which are the group’s primary product. Nearly all the concentrated fermentation liquors are effectively utilized as valuable co-products such as fertilizer and livestock feed.

The “Bio-cycle”* represents the Ajinomoto Group’s resource recycling production model, which effectively utilizes the by-products derived from its amino-acid fermentation production. We have built up the Bio-cycle over a 30-year period at different locations around the world, with a view toward the local recycling of resources. This experience has given the group a foundation to develop various initiatives that are currently being taken to effectively utilize resources from a range of manufacturing processes other than amino-acid fermentation production.

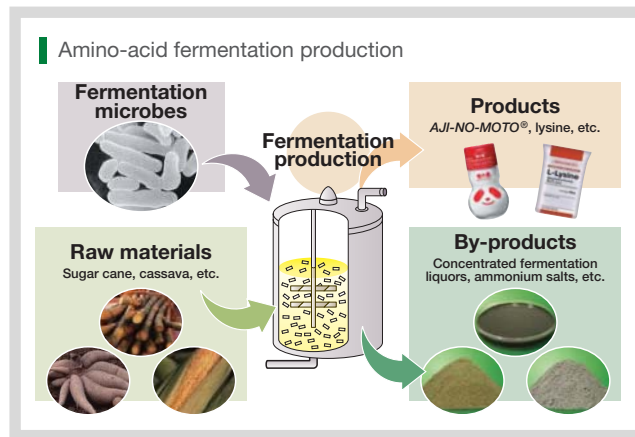
➡ See page 17, Feature 2: Commitment to Agriculture that Does not Impact the Environment, for details.

Amino-acid fermentation production and its by-products as valuable resources

The Ajinomoto Group produces about 1 million tons of amino acids annually from agricultural products such as sugar cane, cassava, and corn. In that process, the group also produces about 2 million tons of by-products such as concentrated fermentation liquors, or about 2 times the intended volume of amino acids. The Ajinomoto Group sees these by-products as valuable resources that are produced from agricultural raw materials. The group processes the by-products according to their components and properties, and effectively utilizes them as organic fertilizers and other products in the agricultural sector, thereby properly demonstrating their value. The Ajinomoto Group has achieved a 99% resource recovery ratio for by-products derived from its amino-acid fermentation production.

The Ajinomoto Group refers to these fertilizers and other products that it manufactures and markets as “co-products”, with the same pride as its core product amino acids.

➡ See also page 26, The Amino-acid Fermentation Production Material Flow and Environment Tasks.



By-products are a trove of nutrients

By-products’ value as resources filled with nutrients can be seen in concentrated fermentation liquors, which are the most abundant fermentation by-product. By nature, microorganisms make the nutrients they need to survive. The fermentation microbes used in amino-acid production also make a number of nutrients besides amino acids at the same time. Accordingly, concentrated fermentation liquors, which are the liquid by-product remaining after the target amino acids have been extracted from the fermentation broth, are nutrient troves filled with compounds that are essential to the maintenance of plant and animal life.

Example analysis of concentrated fermentation liquors

Nitrogen	5.0%	Organic carbon	5.0%
Phosphorus (P ₂ O ₅)	0.2%	Amino acids	5.0%
Potassium (K ₂ O)	1.0%	Organic acids	5.0%

Developing uses for by-products and the results of their effective utilization

By-products, which are produced in a variety of liquid and solid forms, are processed according to their components and properties. About 90% are effectively utilized as fertilizer, mainly in the agricultural sector. However, the Ajinomoto Group is working to develop a variety of uses based on scientific data, since natural characteristics, crop characteristics, and needs differ from region to region.

Research laboratories and centers belonging to Ajinomoto Co., Inc., as well as the group’s regional technology development centers and technology departments at plants around the world, cooperate with public research institutes in different countries to advance studies and research about the results of using these fertilizers and other co-products, including assessments of environmental effects.*

The progressing research and development of uses for these co-products is leading to a growing body of scientific knowledge about the effects of their use. This knowledge includes the fact that co-product fertilizers are rich in active ingredients such as organic nitrogen and minerals, and are highly effective at improving the growth and quality of crops, as well as at activating soil microorganisms and the functional capabilities of the soil itself.

→ See pages 37–40, **Environmental Research and Technology Development**, for details.

Types of by-products and sample uses

By-products	Uses
Concentrated fermentation liquors	Liquid fertilizer: field crops, industrial crops, fruit trees (Asia, North and South America)
	Liquid feed: cattle (EU, North America), aquaculture (Thailand)
	Raw material for solid fertilizer (Japan)
	Silage additive
Microbial cell proteins	Protein feed: cattle, hogs (EU)
Solid by-products (Waste activated carbon, excess sludge, by-product salts, filter aids, etc.)	Raw material for solid fertilizer
	Soil conditioners
	Raw material for cement
	Fuel, etc.

Researching effective utilization based on scientific data

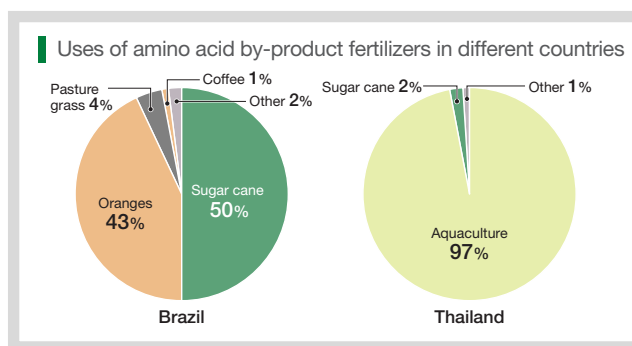


Effective utilization in different countries and communities

The Ajinomoto Group has about 30 amino-acid fermentation plants in 14 countries, and conducts community-based production activities in each country. The group distributes by-products derived from the amino-acid fermentation process as amino acid by-product fertilizers, and is developing other uses according to the circumstances of the agricultural industry in the local community and the location of the plant.

In Brazil, for example, which produces a large volume of sugar and oranges, the Ajinomoto Group markets about 50% of its co-products as fertilizer for sugar cane and about 40% as fertilizer for oranges. In the Philippines, it markets almost all its co-products as fertilizer for sugar cane. In Vietnam, it markets about 60% as fertilizer for rubber plantations, and the rest as fertilizer for cultivating sugar cane, pineapples, coffee, and nuts. In Thailand, it markets its co-products as aquaculture feed for raising fish and shrimp in coastal areas.

The methods for applying fertilizer are varied, even for the same crops. In addition to dispersion from trucks, fertilizers are applied using diverse methods, including hand casting, mixing in irrigation water, and sprinklers, according to the agricultural situation of the country.



Application of amino acid by-product fertilizer (liquid) in different countries



Brazil

Thailand

Pursuing the next big leap in the recycling-oriented business model

In 2001, the Ajinomoto Group established FD Green (Thailand) Co., Ltd., a specialized subsidiary whose main business is the recycling of resources in the agricultural sector. The company has carved out a position as a top producer of organic fertilizer in Thailand, and is actively communicating with and educating the agricultural population and other members of local communities, and providing technological support, as well as enhancing research for effective use of by-products and technology-development functions.



From a company brochure about FD Green (Thailand) Co., Ltd.

Initiatives by Ajinomoto Co., Inc. to effectively use by-products at its Kawasaki plant

The by-products of Ajinomoto Co., Inc.'s Kawasaki plant include excess sludge in wastewater, fermentation microbes, amino-acid waste liquor, amino-acid residue (acid-degraded soybeans) generated by the liquid flavoring production processes, and sweepings, waste activated carbon, and the like produced by production process. We promote the use of these by-products as valuable products.

Excess sludge in wastewater is dried and sold; about 3,000 tons of this dried sludge are sold each year. Amino-acid residue is expected to have effective uses as a deodorizer for the manufacture of soil conditioners and compost. As a result of joint verification with outside research institutes and feed companies, we sell about 1,500 tons per year, contributing to the cultivation of better-tasting vegetables.

We separate the food residue generated in the production processes. Residue that can be converted into animal feed is certified by the Ministry of Agriculture, Forestry, and Fisheries as a certified feed plant*, and sold as feed. Although we are not yet able to sell the other by-products—fermentation microbes, waste activated coal, and amino-acid waste liquid—for a fee, they are used for composting and other fertilizer applications.



Composting experiment

* A plant that manufactures animal feed that contains no animal protein other than fish and shellfish