

**[High Gamma-Amino Butyric Acid (GABA) tomatoes expected to prevent hypertension]**

Using the “genome editing techniques,” which enables the target DNA sequence to be intentionally altered, tomatoes rich in Gamma-Amino Butyric Acid (GABA), known to be component to relieve stress and suppress the elevation of blood pressure, were developed. It is expected to prevent hypertension by taking only two newly created tomatoes added to a dish every day.

[Genome editing techniques and CRISPR/Cas9]

Genome editing techniques cut the target DNA sequence of the genome (genetic information) of an organism and alter the gene action during the DNA-repairing process. Among the genome editing techniques, “CRISPR/Cas9” is the most practical and attracts attention as a candidate for the Nobel Prize.

[Global contribution to health promotion]

Dr. Hiroshi Ezura, Professor at the University of Tsukuba, succeeded in developing “high GABA tomatoes” (Image 1) rich in GABA, thus making complete use of CRISPR/Cas9. Tomatoes initially contain GABA. The high GABA tomato has a GABA content 4 to 5 times higher than that of standard tomatoes.

GABA is produced from glutamic acid under the intervention of GABA biosynthetic enzyme (glutamic acid decarboxylase, GAD). GABA content 4 to 5 times higher than that of standard tomatoes was successfully produced by activating the action of the enzyme.

For standard tomatoes, for example, GABA content increases when stress is given by a shortage in water, but decreases the yield.

However, tomatoes produced by this genome editing technique can increase the GABA content without decrease in yield.

A study examining whether an increase in GABA might reduce other nutritional components demonstrated no difference between new and old varieties of tomatoes.

Tomatoes are eaten all over the world. Assume that the cultivation of high GABA tomatoes produced in



Image 1: High GABA tomatoes
(laboratory strain)
(Supplied by the University of Tsukuba)

Japan spread into the world. In that case, people all over the world can eat this variety of healthy tomatoes. According to the World Health Organization (WHO), one billion people are globally suffering from hypertension. It is expected that the genome editing technology developed in Japan may contribute to people's health promotion around the world.

[No examination is required in the case of conventional breeding]

When high GABA tomatoes are produced, only the target DNA sequence is cut away without a foreign gene. It was confirmed that no foreign gene remained in tomatoes. Accordingly, examination for genetically engineered foods without foreign genes inserted is not necessary. They are different from genetically engineered foods with foreign genes inserted because there is no difference in genes compared with conventional breeding. GABA tomatoes will be on the market after consulting and submitting the application to the Ministry of Agriculture, Forestry and Fisheries and the Ministry of Health, Labour and Welfare. Moreover, GABA tomatoes are planned to conduct test-marketing within 2021.

[γ -aminobutyric acid (GABA)]

GABA is a type of amino acid composed of four carbon skeletons. GABA is primarily found in the hippocampus, cerebellum, and spinal cord in the vertebrate central nervous system. GABA is a functional component that acts as an inhibitory neurotransmitter that relieves stress and inhibits the elevation of blood pressure in animals. Its hypotensive action and relaxing effects were confirmed in multiple studies on human subjects in Japan and foreign countries. In addition to tomato, GABA is contained in foods including potato, Satsuma mandarin (Citrus unshu), unpolished rice, kale, and kimchi (Korean pickles).

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<http://www.naro.affrc.go.jp/laboratory/brain/contents/fukyu/episode/index.html>

<Project name>	Cross-ministerial Strategic Innovation Promotion Program (SIP) "Next-generation agricultural, forestry, and fisheries innovative technology"
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