

Michiyo Tsujimura

-The First Japanese Woman Doctor of Agricultural Science in the Studies of Tea-

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Tea is the most widely enjoyed beverage in the world. It was Michiyo Tsujimura who first discovered the chemical structure of the substances that compose the particular bitter-astringent taste of tea.

Michiyo Tsujimura succeeded to draw out the bitter-astringent component of tea as a crystal form and elucidated four kinds of catechins. Recently, the physiological and medical functions of catechins are found, such as eliminating activated oxygen from the body, which are known to accelerate the aging of cells and cancerogenic. Through this process, blood pressure is lowered and hardening of the arteries can be prevented. Thus, it is proven that tea contributes enormously in preserving our health. Her discovery of this chemical structure has been groundbreaking for later researchers.

Astringent Components of tea

Substance	Taste
(1) epi-gallocatechin gallate	bitter, astringent
(2) epi-catechin gallate	bitter, astringent
(3) epi-gallocatechin	bitter, sweet aftertaste
(4) epi-catechin	bitter, sweet aftertaste

Searching for the Truth

Michiyo Tsujimura was born in Okegawa, Saitama Prefecture in 1888. Her father was the principal of a combined lower and upper elementary school. Tsujimura was raised in a nurturing family of nine: parents, one elder brother, one elder sister, Michiyo, two younger brothers, and two younger sisters. She showed strong interests in plants from her young age. She graduated from the Okegawa upper elementary school, passed the elementary school teachers' licensing exam and started teaching in an elementary school. A year later, she was admitted to Tokyo Prefectural Women's Normal School to continue her studies. Four years later, in 1909, with high spirit for study, Tsujimura entered the Science Department of Tokyo Women's Higher Normal School (now known as The Ochanomizu University). Here, she had the opportunity to study under Professor Kono Yasui known as the first Japanese woman doctor of science. This environment enabled her to extend her research.

The graduates of the women's higher normal school were required to teach for a certain period. Therefore, after she graduated, Tsujimura returned to the teaching position even though she made up her mind to keep the interest of searching the truth of nature and to get into the research career in natural science. In order to be a researcher, she should have entered a university but at that time in Japan, woman could hardly get admitted by universities. In 1913, for the first time, The Tohoku Imperial Univer-

sity (now known as The Tohoku University) admitted three women, but after that, no woman could get the admission for this university in those days. In 1918, The Hokkaido Imperial University (now known as The Hokkaido University) admitted female students only in a special course. At that time, there were several foreign professors from U.S.A. or other countries in The Hokkaido Imperial University and this university considered as progressive with regard to women; however, even in this university women were not admitted as regular students. Plus, female research assistants had to work without salary. Since Tsujimura was so eager to continue her advanced studies, in 1920, she was posted to research assistant position at The Department of Agriculture in The Hokkaido Imperial University. Then, she moved to Sapporo, Hokkaido.

By the advice of Professor Kinsuke Kondo, Tsujimura studied food nutrition and the nutritional need for silkworms in The Food Nutritional Laboratory of Agricultural Chemistry. Even the male students were impressed with her earnest dedication to her research. She recalled later that male students had treated her very kindly.

Finding the Astringent Components through patience

In 1922, Tsujimura moved to The Medical Chemical Laboratory in The Medical Course of The Tokyo Imperial University (now known as The University of Tokyo) and started the researches of vitamins and the protein in Acorn nut under Professor Saburo Kakiuchi. Professor Kakiuchi was the expert in cell metabolism and nutrition. He is now well known that he developed biochemistry as a new field of medical science in Japan. On September 1st in 1923, when the Great Kanto Earthquake gave the serious damages in Tokyo, Tsujimura was in the middle of her experiment. But, she ran out of the building with the analytical balance, which was used for her experiment. This balance was a precious precision machine at that time. This unique episode tells us how much Tsujimura took care of the experimental instruments.

As a result of this disastrous earthquake, the laboratory was burnt down and Tsujimura had to move to The Riken Foundation (The Institute of Physical and Chemical Research). In this laboratory, she studied under the famous agricultural chemist, Professor Umetaro Suzuki who has been known of his discovery of Vitamin B1. Tsujimura began to research on vitamins of green tea at the request of Professor Suzuki. Tsujimura discovered that green tea contains a large amount of vitamin C through the joint research project with Masataro Miura. Consequently, Tsujimura published this result in the scientific paper. This resulted in a tremendous increase in the Japanese green tea export to the United States. She concentrated her mind on determining the unknown components of tea, especially the cause of astringent taste.

In 1929, for the first time in the whole world, Tsujimura succeeded in crystallizing epi-catechin and epi-gallocatechin, two important substances cause of astringent taste of green tea. This research required much patience because she needed to boil a large amount of green tea repeatedly in order to obtain a small amount of crystals available for each time. She had the strong principle expressing her patience, “Chemistry is not suitable for those who want to see results in a certain period of time.”

Tsujimura extracted the strongly astringent substance, tea tannin (epi-catechin gallate) as crystal and determined its chemical structure. She published these results in a paper titled “The Summary of Chemical Components of Green Tea.” As this paper was highly evaluated, she was conferred the doctorate degree in agriculture from The Tokyo Imperial University in 1923. Therefore, she became the first Japanese woman doctor in agricultural science.

On the other hand, H.S. Mitchell published a paper arguing that Japanese green tea did not include vitamin C. It made Tsujimura experiment on green tea again. She found that since Mitchell soaked tea for five minutes in boiling water, the vitamin C must have been destroyed. When tea leaves were brewed one minute in hot water (around 55-60 degrees C.) following to the Japanese traditional way, she proved that vitamin C remained.

Nurturing the Students’ Interests in Science and their “Crystallized” Abilities

In August, 1949, Tsujimura was appointed to the professor’s position at Ochanomizu University. She became a professor of The Food Chemistry, and also a dean of Faculty of Home Economics. She dedicated herself not only to her own research, but also to education for the students, researchers and assistants. She taught them the principles of research: to observe everything precisely through their own eyes, to extract the pure substances as much as possible until they satisfy, to make sure no impurities left, which might cause the wrong results, and to treat the experimental instruments with extra care in order to get good results. The essay, “Observations on a Scientist’s Daily Life” teaches the importance of mother’s support for nurturing the children’s scientific interests and also the necessity to teach physics or chemistry in girl’s schools in order to rationalize the students’ daily lives. This essay demonstrates Tsujimura’s eagerness as an educator. She also points out in this essay that the importance of “pondering every subject thoroughly” and “determining the foundations of matters even they seem trivial.” For example, she explains in this article the reason why boiling water is suitable for bancha and why not for green tea. Green tea made by boiling water tastes bitter. This bitter taste is caused by the different quantity of the astringent substances containing in tea.

In the publication from The Physical and Chemical Research Institute, Tsujimura claims that nothing is more important than seeing the truth. This message was delivered with her experiences of extracting the crystal form of catechin. In case of extracting the crystal, it is crucial that no impurities should be left. Tsujimura gave the young people the message by drawing a lesson from her own experience: “find your own crystal and keep polishing it until you see the light of truth.”

In 1968, when Tsujimura looked back her career as a researcher, she recalled and told her students that “my research work was full of difficulties but it was very enjoyable. Finding no regrets in my life was my supreme happiness.” She liked plants; she was accomplished in Japanese flower arrangement and Noh (Houshou-ryu) holding the teaching certificates. Sometimes, she chanted Noh sonorously. She passed away at the age of 81 in 1969. Until a day before her death, she was enjoying her life by going for a walk and taking care of her carps and a dog.