Production Technique of Shade Grown High Quality Tea in Japan - Matcha tea cultivation and production -

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Introduction

I would like to explain a little about the production technique of shade-grown high quality tea in Japan. There are three types of shade-grown tea, which differ in their time period in shade and production methods: Matcha, Gyokuro, and Kabusecha. Recently shade-grown tea production is increasing nationally.

Shading cultivation began more than 400 years ago. While shading cultivation originally began as a way to protect the tea from frost damage, farmers realized that this tea was different from tea grown in the open sunlight. The differences between the shade-grown tea and the non-shade grown tea are unique flavor, smell, fresh green color, and softness.

1 Effects of shading

(1) Free amino acids

Compared with Sencha, grown in open sunlight, Matcha and Gyokuro have more free amino acids content (Figure 1). So, it is clear that shading cultivation increases free amino acids content.

When comparing Matcha and Gyokuro, Matcha, which spends a longer time in the shade, has more free amino acids content (Figure 1). So, it is also clear that free amino acids content varies based on time in the shade.

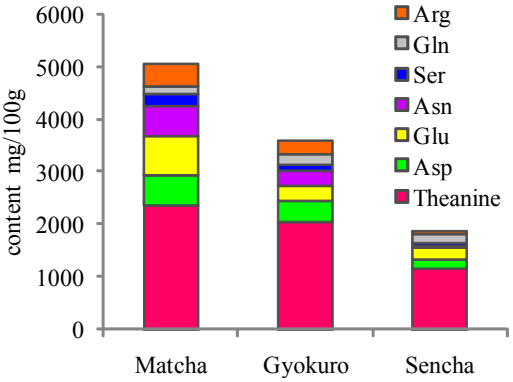


Figure 1 Free amino acids content in high quality green tea products.
（9 types of tea products collected by Kyoto Prefectural Tea Research Division in 1985）.

(2) Theanine

Theanine makes up about 40% of the free amino acid content found in tea. Theanine is synthesized from the substances glutamic acid and ethylamine in the root. Tea and related species are the only plants that theanine is found in. Theanine produces a rich *umami* flavor, and is said to be the main source of the flavor of green tea. Recently, it has been observed that theanine's effect is not limited to its flavor; it also influences mental functionality and relaxation.

As theanine is exposed to sunlight, it splits into ethylamin and glutamic acid. Then, through many processes, it plays a part in the synthesis of catechins. Therefore by shading the plants, it's possible to suppress this process and preserve most of the Theanine that gives the new shoots their rich *umami* flavor.

Theanine was discovered by Yajiro Sakato, the 10th head of our Research Division. This year marks the 60th anniversary of the discovery of theanine.

(3) MMSC (methylmethionine sulfonium chloride) and DMS (dimethyl sulfide)

One of the tea components is MMSC, which is converted into DMS when heated during the manufacturing process. DMS is called the "aroma result from shade," and is an important component since it gives shade-grown tea its unique flavor. So, this means that when more DMS is stored in the tea leaves due to the shade, the quality of the shade-grown tea rises. Therefore shading cultivation that

increases the MMSC content in fresh tea leaves produces high quality shade-grown tea. Compared with the leaves used for Sencha, the fresh leaves used for Matcha and Kabusecha have more MMSC content (Figure 2). So, it is clear that shading cultivation increases the MMSC content in tea leaves.

Additionally, Matcha leaves, which are shaded for a longer time period, have more MMSC content.

So, it's clear that shading time also affects MMSC content.

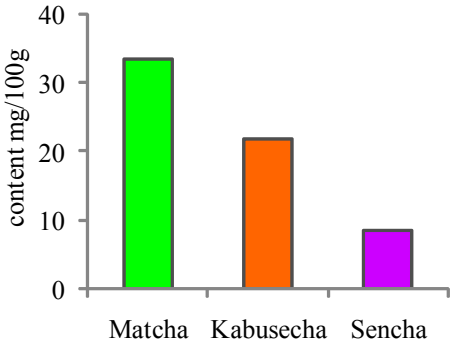
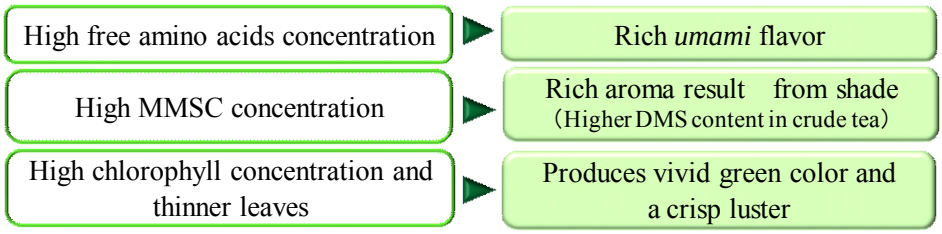


Figure 2. MMSC content in fresh leaves, by tea type. (Kyoto Pref. Tea Industry Research Div., in 1982).

(4) Chlorophyll and thickness of leaf

Shade causes several other changes, such an increase in chlorophyll and a decrease in the thickness of the leaves.

(5) Fresh Leaves of Shade Grown High Quality Tea



2 Matcha tea cultivation and production

(1) Shading cultivation.

Shading cultivation refers to the practice of covering tea fields with material to shade them, for a fixed time before the tea is picked. In order to make high-quality Matcha, it is necessary to keep an 85-98% shading rate and for the shading period to be at least 30 days.

1) Honzu shading

Honzu shading is method that began more than 400 years ago. The method involved spreading a reed screen over a rack, and shaking straw over that. Honzu shading is still used today, particularly in Kyoto. The reason why this method has been in continuous use for a 400-year period is that Honzu shading produces the most high-quality Matcha. However, for the last few decades, it has become increasingly difficult to obtain material for Honzu shading. Additionally, spreading straw from on top of the reed screens is very dangerous work, and requires very skilled workers.

2) Black cheesecloth double –layer shading

In the 1970s, our research division and others researched a new shading method, and developed black cheesecloth double-layer shading. Using this method, the black cheesecloth can be opened and closed like a curtain, so the work has become extremely simple.

Figure3 compares sensory test results for Tencha, the raw material for Matcha, when grown with Honzu shading and with black cheesecloth double-layer shading. As you can see, black cheesecloth double-layer shading is not only easier in terms of labor, but also produces Tencha very close to that of Honzu shading in quality.

Because of this, black cheesecloth double-layer shading is

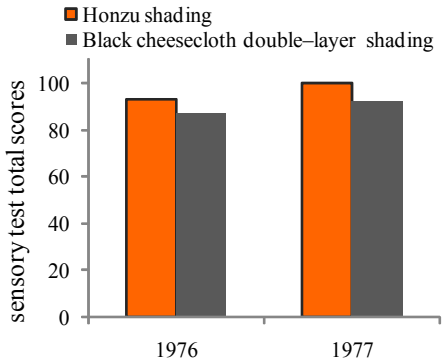


Figure 3.Comparison of Tencha quality between Honzu shading and Black cheesecloth double-layer shading.
(Kyoto Pref. Tea Industry Research Div.).

now used for more than 90% of high quality shading tea fields.

(2) Manufacture of Tencha, the raw material for Matcha.

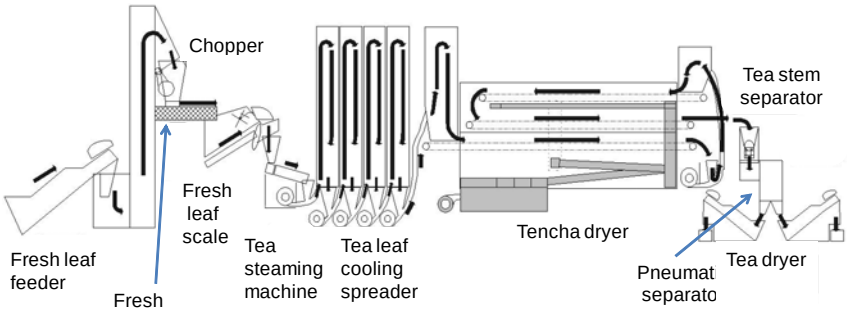


Fig. 4. The modern manufacturing process for Tencha.

Previously, Tencha production required the steamed tea leaves to be spread over a hoiro, repeatedly mixed by hand, and dried (Photo1).

In the 1920s, several prototypes using conveyor methods were invented. Among these, a tea retailer in Uji invented the Horii-style machine, which is the model for the modern Tencha machine. Our research division made improvements on the Horii-style machine and developed the second model of the Kyo-cha-ken Dryer in 1927 (Photo 2). After that, a number of other improvements were added, creating the Tencha machine of today.

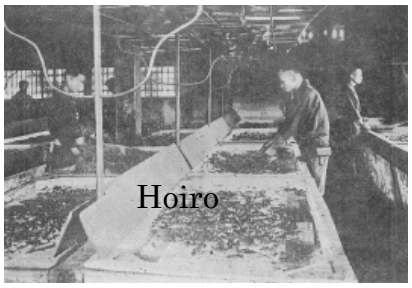


Photo 1.Old manufacturing process of Tencha.

The conveyor belt covered in steamed leaves passes through the brick Tencha machine. The tea leaves get their unique flavor as they are dried from the radiant heat that spreads from the brick walls, which are heated by burners.

Additionally, invention of a tea steaming machine for Tencha and a tea leaf cooling spreader are important contributions to improving tea quality.

Photo 2. The second model of Kyo-cha-ken Dryer under development in 1927.

(3) Grinding (Tencha → Matcha)

Tencha that have gone through initial processing is made uniform in size by selection and cutting. Once it is completely dried, it is ground with a stone mill, and it is Matcha at last.

1) Characteristics of stone mills

Stone mills have been used for grinding Matcha powder for a very long time. The reason why is that special indentations are carved into the top and bottom stones, so that they simultaneously shear, tear, and twist the tea, giving the tea its pleasant texture and making it more aromatic.

Also, as a result, the stone mill steadily emits Matcha powder of a uniform particle size, so the powder can also be kept at a uniform temperature, giving the powder a mild burnt smell, producing Matcha's unique aroma.

2) Comparison by milling method

Presently, various excellent milling methods are being developed, and these new milling methods are being tested. But, there is a major difference in particle size between these methods when they are

applied to the same Tencha (Figure 5), and the Matcha ground with other methods has lower chroma than the Matcha ground with a stone mill, giving the tea an inferior color (Figure 6).

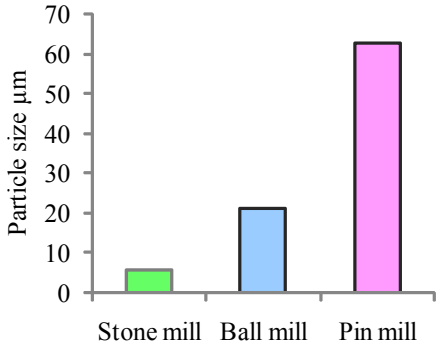


Figure 5.Comparison in particle size by milling method. (Kyoto Pref. Tea Industry Research Div., in 1999).

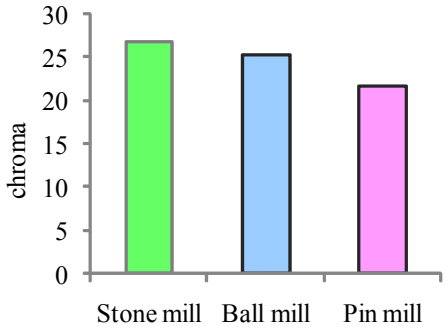


Figure 6.Comparison in chroma by milling method. (Kyoto Pref. Tea Industry Research Div., in 1999).

Even in modern times with our advanced science and technology, it is clear that the old-fashioned stone mill produces the best Matcha.

3 Research initiatives (Aiming to further improve quality and energy efficiency)

- Developing new types of shade-grown tea.
- Identifying the environmental conditions for Honzu shading.
- Identifying relationship between shade-grown tea quality and light quality.
- Improving energy efficiency in the Tencha drying process.
- Establishing a storage method that ensures quality improvement.