Constituents in Tea Leaf and Their Contribution To The Taste of Green Tea Liquor

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Green tea liquor is a flavorous beverage that has a mild astringent property due to the presence of catechin gallates. The palatability of the liquor is associated with relative combination of catechins, amino acids, caffeines and other constituents. A high-grade green tea is richer in amino acids and caffeine than a low one although difference in catechin content is not obvious.

Amino acids are considered then to be important in the palatability of green tea, while too much catechins in the liquor give raw pungency and reduce the hedonic value of liquor. However, details in correlation of the constituents with taste of green tea are still unknown.

Soluble constituents in green tea

Tea leaf contains a very large amount of polyphenols, which is the most specific feature of tea. These phenolics are catechins, flavanols, leucoanthocyanines and phenolic acid and their derivatives. Among them catechins are predominant. Caffeine and amino acids are also known as important components.

In the manufacture of green tea (Sencha and Gyokuro), fresh shoots are steamed on the first step of process. Then, chemical make-up of green tea is closely similar to that of raw shoots as to nonvolatile components.

The chemical compositions of green tea and

Table 1. Approximate composition of water soluble substances in green tea (Sencha) and fresh shoots (Assam variety)

	Green Tea[1]			Fresh shoots[2]	Taste quality
	High grade	Medium grade	Low grade		
	%	%	%	%	
Epigallocatechin gallate	8.2	7.8	7.8	9–13	bitter and astringent
Epicatechin gallate	2.1	2.2	2.2	3– 6	bitter and astringent
Epigallocatechin	3.4	3.8	3.7	3– 6	bitter (sweet)
Epicatechin	0.8	0.9	0.9	1– 3	bitter (sweet)
Flavonol glycosides	0.9	1.0	1.1	3– 4	no taste
Leucoanthocyanines	0.5	0.5	0.5	2– 3	astringent
Phenolic acids and depsides	*	*	*	5	
Caffeine	3.0	2.6	2.4	4	bitter
Amino acids	2.9	1.5	1.0	4	bitter, sweet, sour
(Theanine)	(1.9)	(1.0)	(0.6)	(2)	sweet
Simple carbohydrates	2.7	4.0	4.4	4	sweet

* Phenolic acids and depsides of green tea was not determined.

fresh shoots of Assam variety are shown in Table 1.[1),2)] In Japan green tea (−)-epigallocatechin gallate, (−)-epicatechin gallate, and (−)-epigallocatechin are quantitatively major polyphenols. Among phenolic acids the presence of 1 to 2% of theogallin was reported.[2)] Furthermore, theanine is a characteristic substance accounting for more than one half of the amino acids content.

Variation in catechins and amino acids content of tea shoots

There are generally three seasons for plucking tea shoots in Japan. The first crop obtained in spring furnishes a high quality of green tea. The second and the third crops are harvested in summer and they are inferior than the first crop. It is also known that crops of fine plucking or earlier plucking in each season give a better quality than coarse plucking or later plucking in the same season. In the latter, the proportion of the mature part of leaves is larger than in the former.

Catechins of the samples which were plucked from the same blocks at every 3~5 days' throughout flush were determined.[3)] (Fig. 1) The relatively earlier plucking, especially in the second season, was rich in catechin gallates. The content of amino acids in tea shoots is higher in the first crop or earlier plucking than in the second and the third crops or later plucking as shown in Fig. 2.[4)]

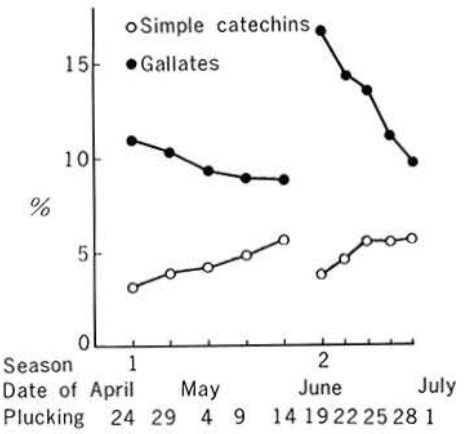


Fig. 1. Variation of catechins content in fresh shoots throughout flushes. (Samples were prepared from the clone for green tea: Yabukita.)

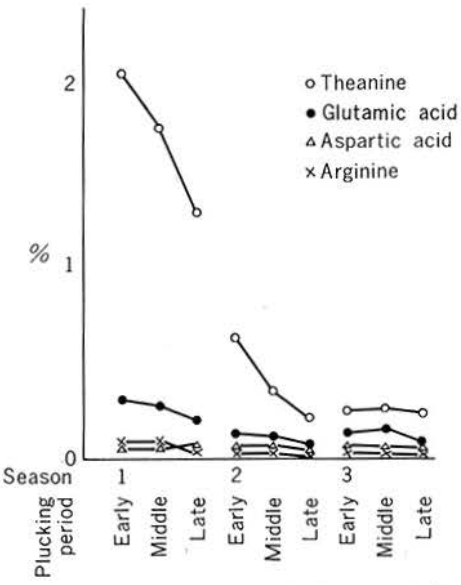


Fig. 2. Variation of amino acids content in fresh shoots throughout flushes. (Samples were prepared from the clone used for green tea: Tamamidori)

The distributions of catechins and amino acids throughout the shoots consisting of four leaves and a growing apex are shown in Table 2. Younger parts were generally richer in catechin gallates and poorer in simple catechins than more matured ones.[3)] Amino acids are richer in younger parts than matured ones.[4),5),6)] Stem was distinctly rich in theanine and poor in catechins.

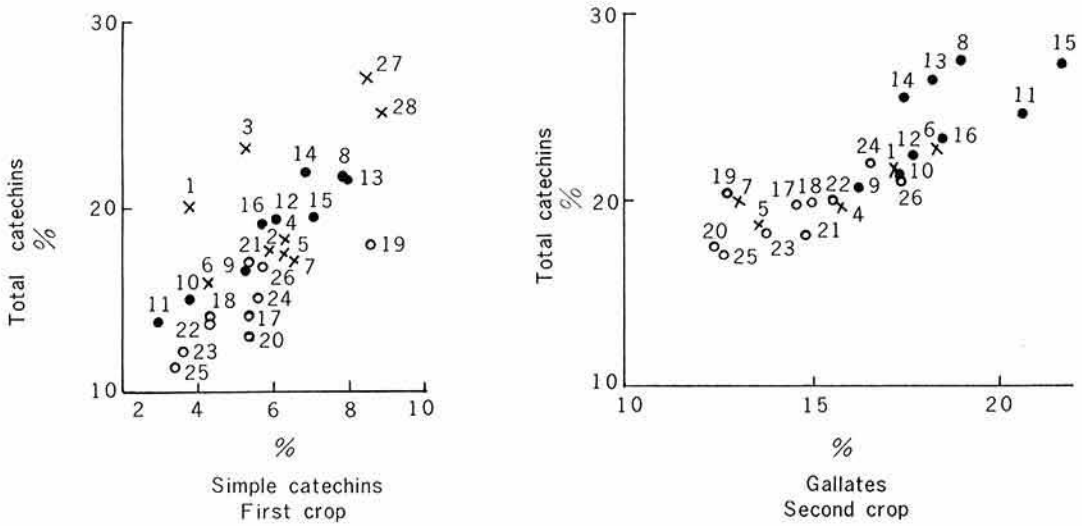
Furthermore, the content of catechins in shoots of various clones used for green tea and black tea was compared as shown in Fig. 3. In Japan the clones used for black tea are almost mutual hybrids between the Assam variety and Japan jat of China variety, while those used for green tea belong to Japan jat of China variety. The clones for black tea were richer in all catechins, especially in gallates than those for green tea.[7)] However, difference in amino acids content between both groups is still obscure.

Thus, a close relation seemed to exist

Table 2. Content of catechins and amino acids in the different parts of shoots[3),4)]

	Bud + First leaf	Second leaf	Third leaf	Fourth leaf	Stem
	%	%	%	%	%
Epigallocatechin gallate	10.7	8.2	6.4	5.6	3.4
Epicatechin gallate	3.3	2.3	2.0	1.7	1.4
Epigallocatechin	3.2	5.2	5.0	4.5	4.0
Epicatechin	1.2	1.4	1.3	1.3	3.0
Theanine	1.15	0.96	0.75	0.60	4.33
Glutamic acid	0.24	0.20	0.19	0.17	0.30
Aspartic acid	0.14	0.13	0.09	0.08	0.10
Arginine	0.12	0.07	0.06	0.05	0.05

Samples were prepared from the first crops of the clones used for green tea.



×: Specific clones

1	Unknown	8	AN	17	N
2	A	9	AN	18	N
3	C	10	C	19	N
4	N	11	AN	20	N
5	N	12	A	21	A
6	C	13	AN	22	C
7	C	14	A	23	N
27	A	15	NA	24	N
28	A	16	AC	25	N
				26	N

●: Clones for black tea

○: Clones for green tea

A: Assam variety C: China variety N: Japan jat of China variety

Fig. 3. Varietal difference of catechins in shoots.

between the amino acids content and the quality of gree tea from the results of the above analysis. However, the effect of catechins on the quality of green tea is not simple and comprehensive study has to be carried out inclusive of other constituents.

Table 3. Correlation of the chemical constituents with the sensory evaluation of green tea liquors.

	*	** Evaluation	*** Statistical judgment	Theanine	Other amino acid	Simple catechins	Gallates	Caffeine	Other soluble substances
				%	%	%	%	%	%
Gyokuro	First infusion	29	+	0.84	0.60	1.57	3.16	2.72	13.00
	Second infusion	114.5		0.30	0.18	0.64	1.86	1.26	6.22
	Third infusion	170	−	0.08	0.06	0.28	1.25	0.29	2.77
Sencha of high grade	First infusion	44	+	0.88	0.41	2.72	2.64	1.81	11.62
	Second infusion	65		0.36	0.14	1.27	1.77	0.80	5.19
	Third infusion	142	−	0.10	0.07	0.62	1.28	0.17	2.15
Sencha of medium grade	First infusion	43.5	+	0.22	0.15	2.36	2.36	1.23	9.83
	Second infusion	77		0.12	0.05	1.21	1.63	0.55	4.62
	Third infusion	135	−	0.06	0.02	0.64	1.05	0.16	3.43
Sencha of low grade	First infusion	78		0.32	0.20	3.22	1.33	1.33	11.89
	Second infusion	113		0.15	0.05	1.56	1.06	0.56	6.08
	Third infusion	160	−	0.06	0.02	0.84	0.65	0.13	3.05

* Three grams of samples were infused three times with 180 ml of boiling water for the test.
** The values are the sum of ranks given for respective liquors by fifteen panels.
*** Statistical judgment was determined by the Kramer's method.
\+ It could be considered significantly flavorous at the 5% level.
− It could be considered significantly poor at the 5% level.

Correlation of the chemical constituents with the sensory evaluation of green tea taste

Sencha (common green tea) of high, medium and low grade, and Gyokuro (finest green tea) were subjected to chemical analysis as well as organoleptic test. The correlation of the chemical analysis on catechins, amino acids, caffeine and soluble matter with the sensory evaluation on the liquors were computed.

The desirable liquors were rich in various constituents including catechin gallates, caffeine and amino acids, and showed comparatively a high ratio of amino acids to other constituents as shown in Table 3.[8] The multiple correlation coefficient between sensory evaluation and four component groups (catechins, amino acids, caffeine and other soluble substance was most significant (r=0.965).

Various constituents occur in tea shoots. From the results of past experiments, it seems that a palatability of green tea is more affected by cooperation of various component groups rather than a single group such as catechins alone. However, their roles in taste character of green tea are not so sufficiently revealed. Further works must be carried out from various points of view.

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