Note

The Application of the Pouchong Tea Process to the Leaves from Tea Plants, var. *assamica* Dominant Hybrids

Michiko KAWAKAMI, Tei YAMANISHI*
and Akio KOBAYASHI*

Ibaraki Christian Junior College,
Hitachi-shi 319-12, Japan

*Laboratory of Food Chemistry,
Ochanomizu University,
Bunkyo-ku, Tokyo 112, Japan

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Pouchong tea is a well-known semi-fermented tea with a characteristic floral aroma. Its production involves special withering processes: solar-withering and turn-over treatment during indoor-withering, followed by parching on a pan, rolling and drying.¹⁾ High-grade pouchong tea is produced from shoots of var. *sinensis* dominant hybrids such as var. Chin-shin-oolong.

In previous work^{2,3)} we investigated the effects of solar-withering and indoor-withering on the formation of aroma components in pouchong tea, using var. Chin-shin-oolong, var. Bohea and var. Hwang-shin-oolong, all cultivated in Taiwan.

The present paper is on the aroma patterns of pouchong tea made from three varieties used for black tea manufacture in Sri Lanka.

On February 10, 1983, in the flavory season, fresh leaves of tea plants, var. Chinese JAT (very yellowish green), TRI 2023 (deep green) and DT-1 (slightly yellowish), cultivated in Dimbula, Sri Lanka, were plucked around noon when the sun was shining. The fresh leaves from each variety were divided into two: one half was subjected to the pouchong tea process and the rest was directly pan-fired and dried to be made into green tea for use as a control sample (Fig. 1).

The same method as used in the previous study⁴⁾ was applied to prepare the aroma concentrates from the six tea samples. The aroma concentrates were analyzed by GC-MS, using a Hitachi 663 gas chromatograph coupled with a Hitachi M-80A+M003 mass spectrometer. The com-

FIG. 1. Preparation of Tea Samples.

TABLE I. IDENTIFICATION OF THE AROMA CONSTITUENTS OF AND COMPARISON OF THE AROMA COMPOSITIONS AMONG THE SIX TEA SAMPLES

Peak Scan No.	Aroma components	10 ⁻² mg/100 g tea					
		Chinese JAT		DT-1		TRI 2023	
		A-1*	A-2*	B-1	B-2	C-1	C-2
134	Hexanal	4.3	3.4	1.8	1.1	1.8	0.6
151	(Z)-3-Penten-2-one	1.8	0.7	1.8	2.0	4.1	0.6
153	4-Methyl-3-penten-2-one	4.3	2.0	2.5	1.1	4.1	0.6
159	1-Penten-3-ol	8.6	5.4	1.8	3.1	7.1	2.6
195	(E)-2-Hexenal	1.2	2.7	0.6	1.1	2.9	0.6
212	Pentanol	12.8	11.5	4.8	7.2	9.4	2.6
226	2-Methylpyrazine	3.7	4.1	1.2	2.0	1.8	0.6
248	Cyclohexanone	3.7	0.7	1.8	1.1	0.6	***
266	(Z)-2-Pentenol	6.7	3.4	2.5	2.0	5.3	1.3
276	2,6-Dimethylpyrazine	2.5	2.7	0.6	1.1	1.2	0.6
298	Hexanol	3.1	3.4	2.5	2.0	2.4	2.6
329	(Z)-3-Hexenol	23.9	24.4	7.3	19.4	38.8	51.8
342	Nonanal	3.1	0.7	0.6	1.1	1.2	0.6
351	(E)-2-Hexenol	1.8	2.0	1.2	6.1	2.9	2.6
361	Tetradecane	1.2	1.4		2.0	5.3	1.9
393	Linalool oxide I (<i>cis</i> , furanoid)	18.4	18.3	35.8	31.4	10.0	8.3
399	Acetic acid	14.7	13.6	11.0	10.2	17.1	3.2
415	Furfural	4.3					tr.
418	(Z)-3-Hexenyl butyrate		2.0		1.1		4.5
420	Acetol acetate**		3.4		2.0		
426	Linalool oxide II (<i>trans</i> , furanoid)	37.3	57.7	106.8	180.3	30.0	19.8
451	2-Ethylhexanol	3.1	2.0	2.5	1.1	3.5	1.3
	(E),(E)-2,4-Heptadienal	3.1	0.7			1.2	
462	2-Acetylfuran	3.1	3.4	1.2	2.0	1.8	
483	Benzaldehyde	8.0	6.1	3.7	2.0	3.5	1.3
506	Propionic acid	1.8	3.4	1.8	2.0	1.8	tr.
524	Linalool	43.5	44.1	78.3	83.0	71.7	49.2
536	Octanol	11.0	6.1	4.8	3.1	2.9	3.2
545	Isobutyric acid			3.1	2.0	2.9	1.3
546	5-Methylfurfural	4.3	4.8				
559	(E)-2-Octenol	4.9	2.0	3.7	2.0	3.5	1.3
578	2,6,6-Trimethyl-2-hydroxycyclohexanone	6.1	2.0	2.5	1.1	5.3	2.6
589	1-Ethyl-2-formylpyrrole	3.1	1.4	1.2	1.1	4.7	1.3
603	3,7-Dimethyl-1,5,7-octatriene-3-ol	8.6	3.4	2.5	1.1	3.5	2.6
610	β -Cyclocitral	3.1	2.0	1.2	1.1	1.8	3.8
622	Butyric acid	1.2	2.7	1.8	1.1	0.6	
636	Safranal	1.8	1.4	1.8	1.1	2.4	0.6
664	Furfuryl alcohol	3.1	11.5	3.1	2.0	1.2	1.3
667	(Z)-3-Hexenyl hexanoate	11.6	13.6	1.8	3.1	4.7	40.9
677	Isovaleric acid	4.9	11.5	10.4	8.2	10.0	5.1
702	4-Heptanolide	2.5	2.7		2.0	0.6	1.9
710	α -Terpineol	8.0	5.4	12.1	7.2	12.9	8.3
724	5-Heptanolide + unknown	11.6	5.4	7.9	5.2	12.3	3.2
751	Naphthalene	3.1	2.0	1.8	1.1	2.4	1.3
765	Linalool oxide III (<i>cis</i> , pyranoid)	8.0	12.9	9.1	14.4	tr.	3.2
766	Valeric acid		3.4			2.9	
801	Methylsalicylate	22.1	6.1	8.7	12.2	14.7	16.0
	Linalool oxide IV (<i>trans</i> , pyranoid)		25.1	81.9	94.3		
851	Nerol			2.5	2.0	2.4	1.3
906	Hexanoic acid	33.7	46.9	11.0	10.2	17.1	54.9

TABLE I. (continued)

Peak Scan No.	Aroma components	10 ⁻² mg/100 g tea					
		Chinese JAT		DT-1		TRI 2023	
		A-1*	A-2*	B-1	B-2	C-1	C-2
914	Geraniol	23.9	19.0	6.4	2.4	8.2	5.1
	Guaiacol			4.0	3.7		
921	Geranylacetone	8.6	4.1	3.7	2.0	5.3	4.5
936	Benzyl alcohol	14.7	20.4	10.4	13.3	11.8	8.9
979	2-Phenylethanol	11.0	14.3	2.5	4.1	5.3	5.1
996	Benzyl cyanide	1.8	1.4	1.8	2.0	1.2	1.3
1016	β -Ionone	9.2	2.7	3.1	0.6	10.0	1.9
	<i>cis</i> -Jasmone	9.8	8.8	24.3	31.2	5.3	22.4
1041	Heptanoic acid	4.3	4.1	3.7	3.1	2.9	1.3
1046	(<i>Z</i>)-3-Hexenoic acid	6.1	16.3	4.8	3.1	7.6	22.4
1053	2-Acetylpyrrole					5.3	
1057	(<i>E</i>)-2-Hexenoic acid		3.4	2.5	3.1	2.9	8.3
1067	unknown	8.0	4.1	1.2	6.1	2.4	14.1
1076	5,6-Epoxy- β -ionone	6.7	3.4	3.7	2.0	6.5	7.0
1096	Phenol	14.1	28.5	34.0	24.6	23.5	17.3
1112	2-Formylpyrrole		2.0				
1126	4-Ethylguaiacol	2.5	1.4	3.7	1.1	2.4	1.3
	Phenethyl butyrate		1.4	0.6	2.0		
1157	Nerolidol	18.4	25.1	38.2	79.9	24.1	35.1
1172	Octanoic acid	8.0	5.4	6.6	4.1	5.3	8.3
1188	<i>p</i> -Cresol	2.5	3.4	3.7	3.1	2.9	2.6
1197	<i>o</i> -Cresol			3.7	1.1	2.9	0.6
1224	unknown	23.9	12.9	12.1	8.2	17.6	24.3
1240	(<i>Z</i>)-3-Hexenyl benzoate	3.1	2.0			3.5	3.2
1263	Bovolide	7.4	3.4	8.5	4.1	10.0	5.1
1283	Theaspirone					7.6	8.9
1296	Nonaic acid	5.0	3.0	1.8	1.8	1.6	2.5
	Ethylphenol**	1.7	2.4	3.0	2.3	1.9	2.6
1316	4-Vinylguaiacol		2.7	2.5	2.0	1.2	1.3
1374	Jasmine lactone	4.9	6.8	4.2	17.4		4.5
1394	2,6-Dimethylphenol	1.2	2.0	1.2	1.1	1.8	3.2
1451	Dihydroactinidiolide	3.1	1.4	1.8	2.0	5.3	4.5
1455	Methyl palmitolate**	3.7	1.4	3.1	2.0	2.9	3.8
1470	Methyl jasmonate	6.1	3.4	1.8	5.2		5.1
1482	Isoeugenol	1.8	2.0	1.8	1.1	1.2	0.6
1529	4-Vinylphenol	10.4	12.9	7.9	8.2	10.0	13.4
1572	Indole	14.1	34.6	38.2	238.8	45.9	72.2
1816	Phytol						
Yield of aroma concentrate (mg/100 g tea)		6.13	6.79	6.92	10.25	5.88	6.39

* 1, control; 2, pouchong tea.

** Never reported previously.

*** A blank space means no peak.

pounds in individual peaks on GC were characterized by matching the GC retention times and MS data with those of authentic compounds and our previous data^{3,5,6)} or published data.⁷⁾ With twenty women panelists selected from among our university students, tea infusions prepared by pouring 120 ml of boiled water into a tea cup

containing 2.5 g of a sample tea, and steeping for 2 min, were subjected to a sensory test.

A typical gas chromatogram of an aroma concentrate from pouchong tea is shown in Fig. 2. The results of GC peak characterization of and the concentrations of individual compounds in the aroma concentrates from the

TABLE II. SENSORY TESTING OF THE AROMA OF TEA INFUSIONS

Variety	1. Control green tea	2. Pouchong tea
A (Chinese JAT)	Green-leafy and bitter aroma, resembling Japanese green tea	Sweet cigarette-like and roast aroma with greenish odor
B (DT-1)	Green note weaker and aroma better than in A	Floral and Chinese jasmine tea-like, with slightly greenish and hay-like aroma
C (TRI 2023)	Weak, and Japanese green tea-like	Sweet and somewhat black tea-like aroma but weak

Note: Among the three pouchong teas, order of odor preferability was 1st B-2, 2nd A-2 and 3rd C-2. The tastes of the infusions from all samples were light and not so bitter.

six samples are listed in Table I. The amounts of (Z)-3-hexenyl hexanoate, nerolidol, jasmine lactone and indole were higher in pouching tea than those in green tea, while the amounts of ionone-related compounds (2,6,6-trimethyl-2-hydroxycyclohexanone and β -ionone) and bovolide which was a light-produced flavor⁸⁾ were lower in pouchong tea. These differences in aroma components between pouchong tea and green tea were common to the three varieties and were apparently caused by the special withering process in pouching tea manufacture.^{2,3)} Benzyl cyanide, *cis*-jasnone, nerolidol, jasmine lactone, methyl jasmonate and indole in pouchong tea made from var. DT-1 developed remarkably. It is thought that all of these are contributory components for the characteristic aroma of pouchong tea. var. DT-1 is used for manufacturing black tea of the highest quality. The terpene indexes⁹⁾ of var. DT-1, var. TRI 2023 and var. Chinese JAT were 0.98, 0.92 and 0.82, respectively. Of these three varieties, var. DT-1 seems to be the best for making pouchong tea, although it is a var. *assamica* dominant hybrid. The results of sensory evaluation (Table II) appear to be closely related to the aroma composition data (Table I).

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