ROTORVANE MANUFACTURE TECHNIQUES

W. C. A. de Silva and G. W. Sanderson

Introduction

Experiments on Rotorvane manufacture commenced in January 1963 to explore the possibilities of using the machine in Ceylon factories. Since then various techniques of using the machine, ranging from 100% Rotorvane manufacture to rotorvaning of bulk from various rolls, to rotorvaning of dhools and big bulk have been carried out. This work has already been reviewed by Keegel (1964) and by Weragoda (1964). In this paper the outcome of two series of experiments which were carried out in the early part of this year, using a 1962 model Rotorvane (Weragoda 1964) are discussed.

Period of Fermentation Study

The first trial was designed to determine the effect of period of fermentation on rotorvaned teas. This work was carried out during the Dimbula flavoury season (February) which permitted the study of the effect of Rotorvane manufacture on flavour.

To accentuate the possible effect of Rotorvane manufacture on fermentation, the trial was carried out using 100% Rotorvane manufacture. Medium withers were taken and all dhools were extracted using the Rotorvane only. The difficulties of passing withered leaf through the Rotorvane (Keegel 1964) were overcome by preconditioning the leaf in an Orthodox roller for a period of 10 minutes under very light pressure prior to rotorvaning.

The Rotorvane was run at a speed of 25 r.p.m. with the following average intakes:—

1st pass — 1200 lb/hr
2nd pass — 2200 lb/hr
3rd pass — 2400 lb/hr

This investigation compared five fermentation periods for rotorvaned leaf with a standard fermentation period for leaf of Orthodox manufacture which acted as a control. The treatments may be outlined as follows:—

	Type of Manufacture	Period of fermentation on a charging inverval of 1 hr.
(A)	100% Rotorvane	1 hr.
(B)	100% Rotorvane	1½ hrs.
(C)	100% Rotorvane	2 hrs.
(D)	100% Rotorvane	2½ hrs.
(E)	100% Rotorvane	3 hrs.
(F)	Orthodox (4×30 minute rolls) ..	2¼ hrs.

It was necessary to pass the leaf through the Rotorvane three times, each time extracting dhool using a Rotorvane Ball Breaker and an ordinary Roll Breaker, in order to reduce the big bulk to about 10%. In Orthodox manufacture the application of pressure was regulated to obtain about the same big bulk outturn.

The teas from this investigation were graded and the B.O.P's were sent to panels of Tasters in Colombo and in London for evaluation. Evaluations were made as recommended by Keegel (1959). Table 1 gives a summary of the tasters' evaluations.

TABLE 1.—*The effect of Fermentation Period on Teas made by Rotorvane Techniques*

All teas are compared with Orthodox teas which were made simultaneously. The results are given as average marks given by Colombo or London tasters for 6 replications of the experiment.

Characteristic	Tasters Panel	L.S.D. at 5% Level	ROTORVANE TREATMENTS					F Orthodox Manufacture
			A 1 hour Fermentation	B 1½ hours Fermentation	C 2 hours Fermentation	D 2½ hours Fermentation	E 3 hours Fermentation	
Infusion	Colombo	0.504	4.64***	5.47ns	5.86ns	5.75ns	5.83ns	5.53
	London	0.611	5.06***	5.75ns	6.19ns	6.22ns	6.33ns	6.22
Colour	Colombo	0.578	3.42****	4.36**	5.06ns	5.61ns	6.08***	5.08
	London	0.643	2.28****	3.69****	5.11ns	6.14***	6.58****	5.06
Strength	Colombo	0.449	4.39***	4.97ns	5.17ns	5.75***	5.89***	5.14
	London	0.610	3.44****	4.25***	5.08ns	5.75ns	5.97ns	5.47
Quality	Colombo	ns	5.44	5.69	5.81	5.44	5.28	6.00
	London	0.545	4.86****	5.61***	6.17ns	6.08ns	5.42****	6.50
Flavour	Colombo	ns	1.81	1.78	1.69	1.47	1.56	1.86
	London	0.606	3.11****	3.81ns	4.06ns	3.64*	2.86****	4.25
Valuation	Colombo	ns	257.9 Cts.	267.9 Cts.	263.6 Cts.	260.4 Cts.	256.9 Cts.	273.5 Cts.
	London	2.6d	56.06d****	61.45d ns	61.88d ns	62.00d ns	60.17d **	63.26d

ns = Not significantly different from Orthodox mean.

* = Significantly different from Orthodox mean at < 5% level.

** = ,, ,, ,, ,, ,, < 2% ,,

*** = ,, ,, ,, ,, ,, < 1% ,,

**** = ,, ,, ,, ,, ,, < 0.1% ,,

From Table 1 it is seen that a very short period of fermentation commencing at 1 hr is detrimental for rotorvaned teas because it is inferior in all respects to the control, namely orthodox tea. Similarly a period of fermentation of 1½ hrs for rotorvaned teas cannot be recommended because the indications are that colour, strength, and quality are inferior to Orthodox teas and therefore will bring about a discount in the valuation. A period of fermentation of about 2 hrs for rotorvaned teas appears to be the optimum, since the tea produced is not significantly different to Orthodox teas in any respect. Caution must be exercised in extending the period of fermentation beyond 2 hours because there are strong indications that colour and strength will develop at the expense of quality and flavour. A very long period of fermentation (3 hours) will definitely bring about an improvement in colour and strength of rotorvaned teas at the expense of quality and flavour and thereby bring about a discount in the final valuation.

Thus it is seen that normal periods of fermentation as given to Orthodox teas apply equally well to 100% pure Rotorvane teas. Nothing will be gained from very short or very long periods.

Mixed Rotorvane-Orthodox Rolling Programmes

Earlier investigations had been carried out to determine the effect of introducing the Rotorvane at various stages of rolling and completing the rolling process using the Rotorvane only (Keegel 1964). Outstanding Rotorvane teas were not produced. In some cases the colour and strength were better than Orthodox teas, but the adverse appearence of Rotorvane teas was a serious drawback. It was noted, however, that the dhool produced in the first pass through the Rotorvane was superior in appearance to those dhools produced in the later passes. With this in mind an investigation was designed to determine what effect the introduction of a single pass through the Rotorvane into an orthodox rolling programme would have on the appearance and liquoring properties of the made tea.

Five rolling programmes were compared in this investigation. They can be outlined as follows:—(The Rotorvane was run at 25 r.p.m. and medium withers were taken throughout).

Programme I.—Leaf was preconditioned in an ordinary orthodox roller for a period of 10 minutes under very light pressure. The preconditioned leaf was passed through the Rotorvane once and dhool was extracted using a Rotorvane Ball Breaker and an ordinary roll breaker. The bulk was given two 30 minute orthodox rolls to reduce the big bulk to about 10%.

Programme II.—Leaf was given a normal 30 minute orthodox roll and dhool was extracted. The first roll bulk was passed through the Rotorvane once and dhool was extracted as in Programme I. The bulk obtained after this operation was given another 30 minute orthodox roll to reduce the big bulk to about 10%.

Programme III.—Leaf was given two 30 minute orthodox rolls and dhools were extracted. The second roll bulk was passed through the Rotorvane once and dhool was extracted as in Programme I. The bulk obtained after this operation was given another 30 minute orthodox roll to reduce the big bulk to about 10%.

Programme IV.—Leaf was given three 30 minute orthodox rolls and dhools were extracted. The third roll bulk was passed through the Rotorvane once and dhool was extracted as in Programme I. The bulk obtained after this operation was in the region of about 10% and no further rolling was carried out.

Programme V.—Completely orthodox manufactured. This was included for comparison.

The teas from this investigation were evaluated by a panel of 6 tasters in Colombo on the same basis as in the first trial. Table 2 gives a summary of the tasters evaluations.

TABLE 2.—*The Effect of four Rotovane—Orthodox Rolling Programmes on the characteristics of the Made Tea compared to 100% Orthodox Teas made Simultaneously*

The results are given as average marks given by Colombo tea tasters on teas from 4 replications of the experiment.

Programme	Characteristic					
	Infusion	Colour	Strength	Quality	Flavour	Valuation
I (Rotorvane)	5.83***	6.00***	5.83**	5.96*	1.83 ns	257.0 Cts.**
V (Orthodox)	5.33	5.33	5.21	5.54	1.62	249.2 Cts.
II	5.50 ns	4.63 ns	4.96 ns	5.79 ns	1.50 ns	241.2 Cts. ns
V	5.29	4.88	5.13	5.42	1.54	241.9 Cts.
III	5.29 ns	5.62 ns	5.50 ns	5.21 ns	1.46 ns	243.5 Cts. ns
V	5.42	5.62	5.58	5.13	1.42	242.5 Cts.
IV	4.63**	4.42 ns	4.54 ns	4.50 ns	1.08 ns	225.0 Cts. ns
V	4.96	4.54	4.58	4.58	1.00	224.3 Cts.

n.s. = not significantly different from Programme V (Orthodox) mean

* = significantly different at < 5% level from Programme V (Orthodox) mean

** = significantly different at < 1% level from Programme V (Orthodox) mean

*** = significantly different at < 0.1% level from Programme V (Orthodox) mean.

It can be seen from Table 2 that Programme I has yielded a tea significantly superior to orthodox teas (Programme V) in infusion, colour, strength, quality and valuation. Programmes II, III and IV in general did not produce teas significantly different from teas of orthodox manufacture. Further the analysis of the differences between Programmes I to IV and the corresponding Programme V showed that Programme I is significantly superior to Programmes III and IV with respect to infusion, colour and strength, and that it is significantly superior to Programme II with respect to colour and strength, interactions being in general nonsignificant.

The frequencies which the programmes I to IV yielded teas superior (S), equal (E) and inferior (I) to corresponding teas produced by the adoption of programme V (orthodox manufacture) are shown in table 3.

TABLE 3.—*Observed Frequencies of Teas of Programmes I to IV being Superior, Equal, and Inferior to Teas of Programme V.*

Programme V compared with	CHARACTERISTIC																	
	Infusion			Colour			Strength			Quality			Flavour			Valuation		
	S	E	I	S	E	I	S	E	I	S	E	I	S	E	I	S	E	I
Programme I	13	10	1	15	6	3	13	8	3	9	12	3	4	19	1	16	4	4
Programme II	8	12	4	4	11	9	7	6	11	7	13	4	3	17	4	8	3	13
Programme III	2	17	5	4	17	3	7	9	8	7	11	6	3	20	1	12	4	8
Programme IV	1	15	8	2	17	5	4	15	5	5	15	4	2	21	1	11	3	10

S = Superior to programme V or Orthodox Manufacture.
E = Equal to programme V or Orthodox Manufacture.
I = Inferior to programme V or Orthodox Manufacture.

Statistical analysis of the data displayed in Table 3 using the Chi-Square Test confirmed the superiority of Programme I over the other rolling programmes examined, including 100% orthodox.

Discussion and Summary

It is concluded that normal periods of fermentation as given to orthodox dhools are equally suitable for Rotorvane dhools at high elevations where quality is the main consideration. It is also evident that a 100% Rotorvane tea which is equal in every respect to orthodox tea can be produced if the correct procedures are employed.

The effect of Rotorvane manufacture on flavour which was found is also interesting. It was unknown earlier whether or not Rotorvane manufacture would have an adverse effect on flavour (Keegel 1964). The results reported here indicate that flavour can be developed in Rotorvane teas to the same extent, if not more so, as in orthodox teas, provided the correct conditions are given.

Rotorvane Programme I as outlined above produced a tea superior to orthodox tea manufactured under the same conditions, whilst Programmes II, III and IV produced teas with little or no difference as compared to orthodox teas manufactured simultaneously. These results should be reproducible provided the Rotorvane is run at a speed of 25 r.p.m. and for medium withers. Whether Rotorvane Programme I will be a success at other machine speeds and for different withers is not known. Investigations are now in progress to determine the answers to these questions.

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