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EFFECT OF SOME PROCESS VARIABLES ON THE PRODUCTION OF TEA DURING THE FLAVOUR SEASON IN THE UVA PROVINCE OF SRI LANKA

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The applicability of experimental evidence gathered under conditions prevalent during the Dimbula quality season, to predict the effects of process variables in tea manufacture in Uva has often been questioned. The present investigation was carried out to test the effect of some process variables on the production of tea during the flavour season in the Uva Province of Sri Lanka. The variables investigated were tat *vs* trough withering, pure orthodox rolling *vs* mixed rotorvane-orthodox rolling and the times of plucking of green leaf.

Although no detectable differences in liquoring character of tat- and trough-withered leaf have been observed during the Dimbula season, no experimental evidence is yet available as to whether troughs are suitable to wither green leaf during the peak of the flavoury season in Uva. In experiments on tat- and trough-withering carried out at Aislaby Estate, Bandarawela, both BOP and BOPF samples of tat-withered leaf were preferred by tea tasters to those that had been trough-withered. The tat-withered leaf showed improved quality and flavour over the trough-withered leaf. On the other hand, the trough-withered leaf had improved colour and strength of liquor. The overall valuations based on these characteristics were in favour of tat-withered leaf.

BOP and BOPF samples processed by pure orthodox rolling were preferred to those from mixed rotorvane-orthodox rolling by tea tasters. The pure orthodox method resulted in improved quality and flavour of teas over the rotorvane-orthodox programme and a significant increase in value of 64 cts per Kg and 73 cts per Kg was obtained for the BOP and BOPF samples respectively.

Tea tasters preferred both BOP and BOPF grades obtained from leaf brought into the factory in the evening to those obtained from leaf brought into the factory in the morning. The BOP and BOPF samples obtained from evening leaf showed an improvement in quality resulting in a significant overall valuation of 154 cts per Kg and 176 cts per Kg respectively over the morning leaf.

INTRODUCTION

The recommendations made by the Tea Research Institute on the production of high quality and flavoury teas are based largely on experimental findings made at its St Coombs Factory situated in the Dimbula District of Sri Lanka. The applicability of these findings to the Uva Province where flavour, when present, is more pronounced and distinct in character to that in Dimbula, has often been questioned.

Troughs have been found to be just as good as tats for withering tea leaf during the Dimbula season (Kandappah 1966). There is however, no experimental evidence reported, to substantiate these findings in the case of withering leaf during the peak season in Uva, despite the fact that troughs are used in many factories there. In order to test this, the present investigation was carried out at Aislaby Estate, Bandarawela, situated in Uva, during the season of August 1972.

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Experimental evidence available at present indicates that high elevation teas from the western districts of Sri Lanka processed by a mixed rotorvane-orthodox form of rolling are just as good as those processed entirely in orthodox rollers, even during the height of the quality season. The present investigation sought to determine whether the same was true for the eastern districts in Uva.

Experiments carried out at St Coombs in the Dimbula District (Kirtisinghe 1968) indicate no differences in made tea characteristics and overall valuations of teas produced from leaf plucked at different times, *ie.*, morning, noon and evening. R. L. Wickremasinghe (unpublished) has however obtained chemical evidence which seems to indicate that leaf harvested in the evenings was somewhat superior to morning leaf. In some areas of North-East India, high quality and flavoury teas manufactured from morning leaf have been preferred to those from the evening leaf (Ulla 1967). This work sought to determine whether the same was true for Uva.

EXPERIMENTAL

Two trials carried out simultaneously (randomized block design) investigated the effect of two methods of withering and two methods of rolling utilizing leaf harvested at two different times of the day. The treatment combinations which were replicated six times are outlined schematically below.

TRIAL 1 — Varied rolling programmes

Morning leaf withered on	Tats	(Rotorvane-orthodox rolling	—Treatment 1
		(Pure orthodox rolling	—Treatment 2
	Troughs	(Rotorvane-orthodox rolling	—Treatment 3
		(Pure orthodox rolling	—Treatment 4

TRIAL 2 — Rotorvane-orthodox rolling throughout

Morning leaf withered on	Tats	—Treatment 1
	Troughs	—Treatment 3
Evening leaf withered on	Tats	—Treatment 5
	Troughs	—Treatment 6

It will be noted that treatments 1 and 3 are common to both trials and that the effects of the method of withering is investigated in both trials. The first part of the paper presents the results pertaining to withering. The second part deals with the effect of methods of rolling, and the final part concerns the effect of the time of plucking in the development of liquoring characteristics.

PROCEDURE

Throughout this experiment seven-day plucking rounds were adopted and it was arranged to assign leaf for various treatments from pre-selected fields according to a randomized schedule in order to obviate the effect of day-to-day variations in the type of leaf gathered. The morning leaf used in these experiments, harvested between 7.00 and 12.00 hours reached the factory by 12.30 hours. The evening leaf, plucked between 14.00 and 17.00 hours reached the factory by 18.00 hours. An adequate number of leaf bags from each field were apportioned to the two withering treatments, tat and trough withering, in more or less equal quantities in random order of arrival of the bags at the factory.

Leaf was withered on tats of synthetic open weave material spread at the rate of 1 Kg of green leaf on 1.0 to 1.2 m^2 of tat area (1 lb per 5 to 6 sq. ft.) Natural withers without the use of hot air were taken by allowing the leaf to remain on the tats for such time as was required to wither the leaf to approximately 45% outturn of made tea to withered leaf (MT/WL). When necessary, a pair of withering fans of aerofoil cross-sections were used to deliver air to the loft at the rate of approximately 70 l/min per Kg of green leaf (10 ft^3/min per lb of leaf). Trough withers were taken on units which measured 12.8 m × 1.8 m (42 × 6 ft) and loaded with leaf charges of 680.4 Kg (1500 lb) of either morning or afternoon leaf. As with the tat withering, medium withers of 45% outturn MT/WL were aimed at, and for this purpose fresh air was delivered at the rate of 70 l/min per Kg of leaf on the troughs (10 ft^3/min per pound of leaf).

Leaf processed by the pure orthodox form of rolling was given four rolls, each of 25 min duration. The 1st and 2nd rolls were carried out in a 120 cm (47 inch) single action pressure roller, the 3rd and 4th rolls were done in 112 cm (44 inch) epicyclic roller. On a 5 min on/5 min off routine, half pressure was applied for the first roll and full pressure for the second. For the initial roll the withered leaf charge was 272 Kg (600 lb).

Each of the two rotorvanes utilized in these experiments had six forward-pitched vanes and three reverse-pitched vanes. The reverse-pitched vanes occupied the positions three, five and seven from the feed-end of the machine. The discharge end of the machine had a variable aperture iris end plate. Throughout the experiments this end plate was kept in the maximum pressure position which allowed a discharge aperture of about 15% of the cross-sectional area of the rotorvane barrel. The shaft speed of each machine was 34 rpm.

The leaf processed by the mixed rotorvane-orthodox form of rolling were given a pre-conditioned roll of 15 min in a 120 cm SA roller, one pass through two 20.3 cm (8 inch) rotorvanes followed by two further orthodox rolls of 25 min duration in 120 cm epicyclic rollers. The charge used for these rolls were 272 Kg (600 lb) of withered leaf and no dhool was extracted after the pre-conditioned rolls. Each of the two rotorvanes, operated as a banded pair, was fed at an average rate of 680 Kg (1500 lb) hr^{-1} and during processing, each of the rotorvane barrels was injected with oxygen at a rate of 6 l/min.

The rolled leaf was sifted twice for dhool extraction through a 1.4 m (4.5 ft) on a vibratory rollbreaker fitted with Nos. 5 and 6 mesh combinations constructed with 18 gauge (BS) wire.

Treatments 1 and 2 were manufactured simultaneously. The same procedure was applied to treatments 3 and 4. The order of manufacture corresponding to these two methods of withering was, however, on a randomized plan.

The extent of fermentation, carried out on concrete tables, was judged by olfactory tests (nose firing) and this resulted in a day-to-day variation in the initial period of fermentation, which fluctuated between 1 and 1½ hr over the period of the experiment. On any particular day, however, this period was constant for any one method of rolling, and on the average, mixed rotorvane-orthodox dhools received a fermentation 5 min shorter than that of pure orthodox dhools. In every case the range of fermentation throughout was about 1 hr.

Two ECP driers were used to fire the fermented dhool from the six treatment combinations. The first of these machines was a Sirocco drier, (1.8 m) and the other was a CCC drier (1.2 m). On any one day, while one of these driers was used to fire dhools from mixed rotorvane-orthodox rolling, the other was used for pure orthodox dhools—the order of using being randomized. Both driers were operated at inlet temperatures ranging from 77° to 88° C. The exhaust temperatures varied from 54° to 65° C.

It is a popular belief that flavour is more marked in the early dhools than in the later dhools and big bulk. To enhance that effect (if any) it was therefore decided to carry out the investigation using 60% of the early dhools for the various treatment combinations. Subject to this condition, representative fired tea samples taken proportional to wet dhool outturns were sorted into grades by the use of hand sieves. To have better control of this operation, grading was carried out at St Coombs under controlled conditions. Although all grades associated with high grown manufacture were extracted by this technique and grade outturns noted, only BOP and BOPF were evaluated by the TRI Taster for liquoring characteristics. Evaluations on duplicate samples were on the basis recommended by Keegel (1959). In addition, these samples were valued by a taster in Colombo.

RESULTS AND DISCUSSION

1. *Tat and Trough Withering*

The mean dry and wet bulb temperatures of air used for withering morning leaf on both the tats and the troughs were 25.0° and 17.5° C respectively. In the case of evening leaf, the corresponding temperatures were 20.7° and 17.3° C respectively. The mean duration of wither of trough-withered morning leaf was 5.5 hr whereas the duration of wither on tats was 4.7 hr. This difference in the period of wither was significant ($P < 0.05$). However, in the case of evening leaf there was no significant variation in the duration of wither obtained by the use of troughs and tats. The mean period of wither in this case was 8.8 hr.

The degree of wither calculated on the basis of outturns made tea to wet dhool (MT/WD) was found to be not significant for morning leaf as well as evening leaf. The average figures obtained for morning leaf and evening leaf were 45.2 and 48.3% respectively.

Rolling was primarily carried out to develop quality and flavour at the expense of appearance to some extent. The total duration of rolling was short and the big bulk outturn was high. For all the six treatments the ratio of the total dhool to the big bulk was in the range 60/40 to 70/30.

Analysis of data relating to grade percentages corresponding to the various treatments was found to be not significant for all the grades. In every instance the total main grades (BOP, BOPF and Dust No. 1) extracted from the representative samples using hand sieves were about 70%.

Morning leaf

The TRI Taster did not detect differences between the brightness of infusion of both the BOP and BOPF grades in the various treatments. His evaluations on colour, strength and quality of liquor and overall valuations of the BOP and BOPF grades derived from the tat-and trough-withered morning leaf processed by mixed rotorvane-orthodox rolling are given in Table 1.

TABLE 1 — *Made tea characteristics and evaluations of BOP and BOPF from tat-and trough-withered morning leaf manufactured by mixed rotor vane-orthodox rolling*

Treatment	Grade	Colour	Strength	Quality	Valuation (cts/Kg)
1	BOP	4.8	5.0	6.3	1332
3	BOP	5.1	5.4	5.8	1286
LSD (P=0.05)		0.26	0.24	0.39	44
1	BOPF	4.8	5.2	6.4	1316
3	BOPF	5.2	5.4	5.8	1235
LSD (P=0.05)		0.25	NS	0.42	40

From Table 1 it is seen that in the case of BOP grade, colour and strength of liquor of the trough withered leaf manufactured by mixed rotorvane-orthodox-rolling (Treatment 3) were significantly better than that of the tat-withered leaf manufactured in a similar manner (Treatment 1). This was achieved at the expense of quality resulting in a lower overall valuation for trough-withered leaf. Similar results were obtained with BOPF grades except in respect of strength of liquor where the TRI Taster did not detect any differences between the tat-and trough-withered leaf.

Table 2 gives the mean evaluations of BOP and BOPF obtained from tat-and trough-withered leaf but processed by pure orthodox types of rollling.

TABLE 2 — *Made tea characteristics and evaluations of BOP and BOPF from tat-and trough-withered morning leaf manufactured by pure orthodox rolling*

Treatment	Grade	Colour	Strength	Quality	Valuation (cts/Kg).
2	BOP	4.4	4.8	7.2	1407
4	BOP	4.6	5.1	6.2	1341
LSD (P=0.05)		NS	0.24	0.39	42
2	BOPF	4.5	4.7	7.2	1385
4	BOPF	4.8	5.0	6.2	1310
LSD (P=0.05)		0.25	0.26	0.42	40

From Table 2 it is seen that no differences in colour of liquor were observed between tat-and trough-withered BOP manufactured by pure orthodox rolling. Better strength of liquor at the expense of quality resulted in a depression of overall valuation in BOP's obtained from trough-withered leaf processed by pure orthodox rolling (Treatment 4) when compared with that obtained from tat-withered leaf processed similarly (Treatment 2). Results obtained in the case of BOPF grade were similar except for colour of liquor where the taster preferred the trough-withered leaf to that of tat-withered leaf.

A taster in Colombo did not find any significant difference in the valuations of the BOP and BOPF grades from the tat-and trough-withered morning leaf, manufactured by pure orthodox rolling.

The Colombo taster's valuations of the BOPs manufactured by mixed rotor-vane-orthodox type of rolling from the tat-and trough-withered leaf, were not statistically significant but he showed a slight preference for tat-withered leaf (P <0.10). In the case of the BOPF grade, he preferred the tea from tat-withered leaf (P <0.05). Valuations given by the Colombo taster are presented in Table 3.

TABLE 3 — *Mean valuations of BOP and BOPF from tat-and trough withered morning leaf processed by mixed rotor-vane-orthodox rolling as assessed by Colombo taster*

Treatment	Grade	Valuations (cts/Kg)
1	BOP	966
3	BOP	783
LSD (P=0.05)		NS
LSD (P=0.10)		163
1	BOPF	1010
3	BOPF	776
LSD (P=0.05)		212

The overall effect of the method of withering on made tea characteristics of the BOP and BOPF grades from morning leaf based on evaluations given by the TRI and Colombo tasters are given in Tables 4 and 5 respectively.

TABLE 4 — *Mean evaluation of tat-and trough-withered BOP and BOPF from morning leaf as assessed by the TRI taster*

Type of withering	Grade	Colour	Strength	Quality	Valuation (cts/Kg)
Tat	BOP	4.6	4.9	6.6	1369
Trough	BOP	4.9	5.2	6.0	1314
LSD (P=0.05)		0.18	0.17	0.28	29
Tat	BOPF	4.7	4.9	6.8	1349
Trough	BOPF	5.0	5.2	6.0	1272
LSD (P=0.05)		0.18	0.18	0.30	29

From Table 4 it is evident that a significant ($P < 0.05$) improvement in the colour and strength of liquor at the expense of quality were obtained with troughs in both the BOP and BOPF grades. In overall valuations, however, tat-withered leaf was preferred to trough-withered leaf by the TRI taster for both grades.

TABLE 5 — *Mean valuations of BOP and BOPF from tat-and trough-withered morning leaf as assessed by the Colombo taster*

Type of withering	Grade	Valuation (cts/Kg)
Tat	BOP	988
Trough	BOP	833
LSD (P=0.05)		145
Tat	BOPF	999
Trough	BOPF	822
LSD (P=0.05)		150

From Table 5, it is seen that the Colombo taster has confirmed the findings of the TRI taster with regard to overall valuations.

Evening leaf

In the case of evening leaf, the TRI taster detected a significant difference only with regard to the quality of liquor of the BOP grade and his mean valuation of the BOP grade from tat-withered leaf was significantly higher than that from trough-withered leaf. He did not report any differences between the corresponding samples of the BOPF grade. The Colombo taster, however, did not value the BOP grade differently. He did, however, value the BOPF grade from tat-withered leaf significantly higher than that of trough-withered leaf. These results are presented in Table 6.

TABLE 6 — *Effect of tat-and trough-withering on the BOP and BOPF grades from evening leaf*

Type of withering	Quality (BOP)	Valuation (cts/Kg) (BOP)	Valuation (cts/Kg) (BOPF)
Tat	7.9	1486	1184
Trough	7.4	1440	937
LSD (P= 0.05)	0.39	44	229

2. *Pure orthodox and mixed rotorvane-orthodox rolling*

The mixed rotorvane-orthodox and pure orthodox rolling programmes yielded average aggregate dhool outturns of 67 % and 65% respectively and were not significantly different ($P < 0.05$). Total main grade outturns too were not significantly different.

The TRI taster's mean evaluation of colour, strength and quality of liquor and overall valuations of the BOP and BOPF samples from tat-withered leaf, processed by mixed rotorvane-orthodox and pure orthodox rolling are given in Table 7.

TABLE 7 — *The TRI taster's mean evaluation of BOP and BOPF from mixed rotorvane-orthodox rolling and pure orthodox rolling from tat-withered leaf*

Treatment	Grade	Colour	Strength	Quality	Valuation (cts/Kg)
1	BOP	4.8	5.0	6.3	1332
	BOP	4.4	4.8	7.2	1407
LSD (P= 0.05)		0·26	NS	0.39	42
1	BOPF	4.8	5.2	6.4	1316
2	BOPF	4.5	4.7	7.2	1385
LSD (P= 0.05)		0.25	0.26	0.42	40

From Table 7 it is seen that there were no significant differences between the Treatments 1 and 2 in respect of colour of infusion and strength of liquor of the BOP grade. The colour of the liquor of the BOP grade from tat-withered leaf manufactured by mixed rotorvane-orthodox (Treatment 1) was preferred to that of the same leaf manufactured by pure orthodox (Treatment 2) rolling. This was achieved at the expense of quality of liquor resulting in a significantly lower overall valuation for mixed rotorvane-orthodox rolled leaf. The results obtained with the BOPF grade were similar except in respect of colour of liquors where the TRI taster observed an improvement in the tea produced by the mixed rotorvane-orthodox form of rolling.

TABLE 8 — *Mean evaluation of the BOP and BOPF grades from mixed rotorvane-orthodox and pure orthodox rolling, as assessed by the TRI taster from trough-withered leaf*

Treatment	Grade	Colour	Strength	Quality	Valuation (cts/Kg)
3	BOP	5.1	5.4	5.8	1286
4	BOP	4.6	5.1	6.2	1341
LSD (P= 0.05)		0.26	0.24	0.39	42
3	BOPF	5.2	5·4	5.8	1235
4	BOPF	4.8	5.0	6.2	1310
LSD (P= 0.05)		0.25	0.26	NS	40

From Table 8 it is seen that the TRI taster did not detect significant differences between Treatments 3 and 4 in respect of colour of infusion of both grades. In the case of the BOP grade, colour and strength of liquor of the trough-withered leaf processed by mixed rotorvane-orthodox rolling (Treatment 3) were significantly better ($P < 0.05$) than leaf processed by pure orthodox rolling (Treatment 4). It is, however, achieved at the expense of quality, resulting in a lower valuation for rotorvane-orthodox processed leaf.

Similar results were obtained with the BOPF grade except in respect of the quality of liquor where the TRI taster did not detect any differences between Treatments 3 and 4.

The Colombo taster did not value either grade from mixed rotorvane-orthodox and pure orthodox processed leaf withered on tats as well as on troughs, differently.

Table 9 separates out the effect of the method of rolling by combining results already enumerated in Tables 7 and 8.

TABLE 9 — *Mean evaluation of mixed rotorvane-orthodox and pure orthodox processed BOP and BOPF grades as assessed by TRI taster*

Type of rolling	Grade	Colour	Strength	Quality	Valuation (cts/Kg)
RV-orthodox	BOP	4.9	5.2	6.0	1310
Orthodox	BOP	4.5	4.9	6.6	1374
LSD ($P=0.05$)		0.18	0.17	0.28	29
RV-orthodox	BOPF	5.0	5.3	6.1	1274
Orthodox	BOPF	4.7	4.9	6.7	1347
LSD ($P=0.05$)		0.18	0.18	0.30	29

From Table 9 it is seen that the TRI taster reported that mixed rotorvane-orthodox rolling produced BOP and BOPF grades with better colour and strength of liquor at the expense of quality of liquor. In overall valuations, however, he preferred BOP and BOPF grades obtained from pure orthodox rolling. It must be noted, however, that these results are obtained with more or less the same period of fermentation for the two methods of rolling. Whether this would differ if rotorvane teas have a shorter period of fermentation in comparison with orthodox teas to develop less colour and strength, is a matter that needs further investigation.

In this investigation, oxygen, at the rate of 6 l min^{-1} was injected into the barrels of the rotorvanes during rolling in the mixed rotorvane-orthodox programme. The influence of oxygen on made tea characteristics during the Uva season at peak is not known, with certainty. An experiment carried out at St Coombs indicate that oxygen injection did not improve infusions, colour, strength, quality or result in different overall valuation (Kirtisinghe 1967). It is, therefore necessary to further investigate whether oxygen injection has any bearing on the quality and flavour of teas produced by mixed rotorvane-orthodox rolling.

3. *The influence of the time of plucking*

The mean dry and wet bulb temperatures in the withering lofts for morning leaf were 25.0° and 17.5° C respectively. The corresponding temperatures for evening leaf were 20.7° and 17.3° C respectively. The mean duration of wither for morning leaf was 5.1 hr whereas the evening leaf had a longer period of wither, 8.8 hr. The morning leaf had a wither of 45.2% outturn (MT/WD), while for the evening leaf the wither was harder, at 48.3% outturn MT/WD. Morning leaf yielded a dhool percentage of 67.1, whereas the evening leaf yielded a significantly higher dhool percentage, 73.6.

The TRI taster's mean evaluation of colour of infusion, colour, strength and quality of liquor and overall valuations of BOP and BOPF grades of tat-withered morning and evening leaf are given in Table 10.

TABLE 10 — *Mean evaluation of BOP and BOPF of tat-withered morning and evening leaf as assessed by the TRI taster*

Treatment	Grade	Infusion	Colour	Strength	Quality	Valuation (cts/Kg)
1	BOP	5.6	4.8	5.0	6.3	1332
5	BOP	5.5	4.7	4.9	7.9	1486
LSD (P=0.05)		NS	NS	NS	0.46	44
1	BOPF	5.6	4.8	5.2	6.4	1316
5	BOPF	5.2	4.7	4.9	7.9	1473
LSD (P=0.05)		0.18	NS	0.28	0.51	57

From Table 10 it is seen that there were no significant differences between the Treatments 1 and 5 in respect of colour of infusion, colour and strength of liquor in the BOP grade. The quality of liquor and overall valuation of the BOP grade from tat-withered evening leaf (Treatment 5) were better than that of tat-withered morning leaf (Treatment 1).

In the case of the BOPF grade, there were no significant differences in colour of liquor between treatments. Better colour of infusion and strength of liquor were obtained at the expense of quality of liquor resulting in lower overall valuation for the BOPF grade from the tat-withered morning leaf than from tat-withered evening leaf.

Table 11 gives the mean evaluation of BOP and BOPF grades of morning and evening leaf withered on troughs.

TABLE 11 — *Mean evaluation of BOP and BOPF of trough-withered morning and evening leaf as assessed by the TRI taster*

Treatment	Grade	Infusion	Colour	Strength	Quality	Valuation (cts/Kg)
2	BOP	5.7	5.1	5.4	5.8	1286
6	BOP	5.4	4.8	4.7	7.1	1450
LSD (P=0.05)		0.24	0.26	0.26	0.46	44
3	BOPF	5.6	5.2	5.4	5.8	1235
6	BOPF	5.2	4.7	4.8	7.4	1431
LSD (P=0.05)		0.18	0.28	0.28	0.51	57

From Table 11 it is seen that in the case of both BOP and BOPF grades, colour of infusion, colour and strength of liquor of trough-withered morning leaf were significantly better than that from trough-withered evening leaf. The lower quality of liquor resulted in poorer overall valuation for morning leaf.

Table 12 separates out the effect of morning and evening leaf by combining the results from Tables 10 and 11.

TABLE 12 — *Mean evaluation of BOP and BOPF grades from morning and evening leaf as assessed by the TRI taster*

Type of leaf	Grade	Infusion	Colour	Strength	Quality	Valuation (cts/Kg)
Morning	BOP	5.7	4.9	5.2	6.0	1310
Evening	BOP	5.4	4.6	4.8	7.6	1464
LSD (P=0.05)		0.13	0.18	0.18	0.33	31
Morning	BOPF	5.6	5.0	5.3	6.1	1274
Evening	BOPF	5.2	4.7	4.8	7.6	1451
LSD (P=0.05)		0.12	0.20	0.20	0.36	40

The BOP and BOPF grades obtained from morning leaf were preferred to those obtained from evening leaf in respect of colour of infusion, and colour and strength of liquor. It was, however, achieved at the expense of quality, resulting in a lower overall valuation.

The difference in value between tat-withered morning and evening leaf reported by the Colombo taster was not significant and are not conclusive. The same was true with trough-withered morning leaf. However, the difference between the mean valuation of morning and evening leaf was large enough to show the Colombo taster's clear preference for the evening leaf. These results are tabulated in Table 13.

TABLE 13 — *Mean evaluation of BOP and BOPF grades from morning and evening leaf as assessed by the Colombo taster*

Type of leaf	Grade	Valuation (cts/Kg)
Morning	BOP	875
Evening	BOP	1109
LSD (P=0.05)		207
Morning	BOPF	893
Evening	BOPF	1061
LSD (P=0.05)		161

Morning leaf was withered at higher temperatures 25.0° C than the evening leaf 20.7°C. During flavoury season in N.E. India, flavour seemed to be conserved by withering at low temperature (Deb 1966; Barbora 1967). It is not known whether the difference in evaluation between the morning and evening leaf in the present investigations is merely due to the time of plucking of the leaf or to the temperature of withering. During our experiment, the duration of wither of morning leaf was 5.1 hr which is shorter than that for evening leaf (8.8 hr). The degree of wither for morning leaf and evening leaf were 45.2 and 48.3% outturn MT/WD respectively. It was also noted during the same experiment at Aislaby Estate, the morning leaf was manufactured during evenings and the evening leaf was manufactured during early mornings. The influence of the degree of wither, the duration of wither and the time of manufacture on quality and flavour during the Uva flavoury season warrants further experimentation to quantify the differences between morning and evening leaf, under similar conditions of manufacture.

CONCLUSIONS

Experimental evidence indicates that, under the conditions of withering described, the use of tats is to be preferred to that of troughs for withering leaf plucked in the morning. Although the colour and strength of teas from trough-withered leaf was superior to that from tat-withered leaf, the enhanced quality of the latter led to both the Colombo taster and the TRI taster valuing tat-withered leaf significantly higher. It is, however, important to note that the difference in the duration of wither between the two systems of withering may have had an effect on this result. In our investigation the duration of trough withering was 5.5 hr as against 4.7 hr withering in tats. The influence of the duration of wither on made tea characteristics during the Uva season is not known and further experimentation is necessary to investigate whether different rates of spreading leaf on troughs or different rates of air flow from that which we have used in the course of our experiments could produce teas similar to, or better than, that obtained on tats.

Depressed quality ratings for trough-withered leaf compared with tat-withered leaf were also given by the TRI taster for teas manufactured from evening leaf. Tat-withered leaf was valued higher than that of trough-withered leaf by him. This was confirmed by the Colombo taster.

The effect of the method of withering on colour and strength of liquors of tea from morning leaf was however not observed in the case of evening leaf. This effect may possibly have been marked by the harder withers adopted for evening leaf.

Experimental evidence indicates that under the conditions of rolling described and with the same period of fermentation, pure orthodox rolling is preferred to mixed rotorvane-orthodox rolling in respect of made tea characteristics and overall valuations.

Under the conditions described, the experimental evidence indicates that evening leaf is preferred to morning leaf in respect of made tea characteristics and overall valuations.

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