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ON THE METHOD OF ORTHODOX MANUFACTURE AND ITS EFFECT ON GRADE OUTTURNS AND MADE TEA CHARACTERISTICS

I—THE INFLUENCE OF WITHERS AND THE ROLLING PROCESS ON DHOOL AND GRADE OUTTURNS AND MADE TEA CHARACTERISTICS

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Certain regions of North-East India producing high-quality and flavoury teas, take very hard withers during the quality season.

This investigation was conducted with leaf ranging in wither from extra hard to soft, and rolled in conventional orthodox rollers on different programmes, to determine whether the methods adopted in North-East India conferred any advantages over the systems adopted in Sri Lanka.

It has been found that the soft withered leaf given two rolls produced teas with enhanced liquor quality at the expense of colour but with no corresponding improvements in valuation, and that the extra-hard and hard withered teas were considered to be worth less.

In addition, when grade outturns are taken into consideration it is apparent that the medium-withered leaf given four thirty-minute rolls, is the most suitable under Dimbula conditions.

INTRODUCTION

The majority of estates in Sri Lanka situated in the high elevational range (about 1200 m amsl) roll their leaf according to a 4 x 30 min. programme with medium-withered leaf (45% outturn made tea to withered leaf, MT/WL). In districts such as Darjeeling in North-East India, very hard withers are taken during the season and the leaf is hard rolled. This investigation was undertaken to study the effect of the type of wither and the duration of orthodox rolling on the made teas.

EXPERIMENTAL

Three orthodox rolling programmes consisting of four rolls of 30 min., three rolls of 30 min., and two rolls of 45 min. were tested with soft (38-42% outturn MT/WL), medium (43-47% outturn MT/WL), hard (48-52% outturn MT/WL), and extra-hard withered leaf (53-57% outturn MT/WL). Grade outturns, dhool outturns and the made tea characteristics of the BOP and BOPF grades from these treatments were compared with that from a control which was rolled on a four x 30 min. programme, with medium-withered leaf. Dhool temperatures were also measured at the end of each roll for each of the treatments under investigation.

This experiment was conducted in two stages; the first during the period March to May 1970, and the second during October and November 1971. In the first stage, medium, hard and extra-hard withered leaf was manufactured on orthodox rolling programmes of 4 x 30 min., 3 x 30 min., and 2 x 45 min. and compared with a standard (control) of medium-withered leaf given 4 x 30 min. rolls. During the second stage of this experiment, soft-, and medium-withered leaf were compared with the same control. The same type of rolling programmes were tested during the second stage.

Details of manufacture are given in Tables 1 and 2 below:

TABLE 1 — *Details of the withering and rolling programmes during Stage I of the experiment*

Treatment Code	Degree of Wither (% Outturn MT/WL)	Orthodox Rolling Programme (No. x time of rolling, min.)
C 1 (Control)	43–47	4 x 30
1	53–57	3 x 30
2	53–57	2 x 45
3	48–52	3 x 30
4	48–52	2 x 45
5	43–47	3 x 30
6	43–47	2 x 45

TABLE 2 — *Details of the withering and rolling programmes during Stage 2 of the experiment*

Treatment Code	Degree of Wither (% Outturn MT/WL)	Orthodox rolling programme (No x time of rolling, min.)
C 2 (Control)	43–47	4 x 30
7	43–47	3 x 30
8	43–47	2 x 45
9	38–42	3 x 30
10	38–42	2 x 45

Practical considerations did not permit all the treatment combinations to be tested on one and the same day. Only two treatments corresponding to the same degree of wither were, therefore, manufactured alongside a control on any given day.

For the purpose of conducting these experiments three 12.8 x 1.8 m (42 x 6ft) troughs each loaded with 680.4 Kg (1500 lb) of green leaf were used. The requisite wither was obtained by controlling the relative amounts of hot and cold air supplied to each trough and also by controlling the duration of wither. Charges of 226.8 Kg (500 lb) withered leaf were then taken from each of these troughs for rolling. In every instance the 1st and 2nd rolls were carried out in 119 cm and 114 cm single action (SA) pressure rollers respectively. The 3rd, when carried out, was in 114 cm SA pressure rollers and the 4th roll of the control was done in 86 cm SA pressure rollers. The 1st, 2nd and 4th rollers were fitted with crescent battens and standard (Rettie) cones but roller No. 3 had a table with crescent battens fitted with a Keegel cone. A 7-min.-on/3-min.-off routine of pressure application was adopted, except for the last 5 min. of the 45 min. rolls, when it was changed to 3-min.-on/2-min.off. In the programmes which consisted of 3 x 30 min. and 2 x 45 min. rolls, full pressure was applied from the commencement of rolling. In the case of the control, however, medium pressure was applied for the first roll and for the subsequent rolls pressure was regulated to reduce the big bulk to about 10 to 12 %.

Dhools were extracted on a 91 cm (3 ft) vibratory roll breaker fitted with a 5 and 6, 18 gauge (BS) mesh combination and fermented for 2¼ hr with a maximum range of fermentation time of 50 min. The teas were dried in a Sirocco ECP drier with average inlet and exhaust temperatures ranging from 87.8 to 90.5°C (190 to 195°F) and 53.3 to 55.5°C (128 to 132°F) respectively. The order of firing dhools was the same as that of dhool production. The teas were graded as per estate practice on a vibratory (Michie) sifter.

The treatments were replicated six times and BOP and BOPF samples were evaluated by a panel of tasters in Colombo on the basis recommended by Keegel (1959).

RESULTS AND DISCUSSION

The average dry matter content in the rolled leaf, the dhool outturns, and the temperature of leaf after each roll, for Stage 1 of this experiment are given in Table 3 and for Stage 2 in Table 4, together with the grade outturns for Stage 2.

TABLE 3 — *Duration of orthodox rolls and its influence on dhool outturn and leaf temperatures with medium, hard and extra-hard withered leaf*

Treatment Code (See Table 1)	Dry Matter Content of rolled leaf (%)	Dhool Outturn (%) 1st Dhool	2nd Dhool	3rd Dhool	4th Dhool	Big Bulk	% Loss in Rolling	Ambient Temperature (°F) Dry Bulb	Wet Bulb	Temperature of leaf immediately after rolls (°F) 1st	2nd	3rd	4th
C1	46.4	14.8	20.2	27.3	23.0	11.4	3.3	65.6	62.3	87.5	88.8	95.2	94.8
1	54.9	36.4	40.8	——	——	19.3	3.5	67.0	63.3	98.8	96.2	——	——
2	54.6	24.0	29.6	29.6	——	13.9	2.9	66.6	63.1	94.4	97.0	99.4	——
3	51.8	35.0	41.5	——	——	20.1	3.4	65.2	61.8	97.0	97.0	——	——
4	51.7	22.4	25.6	31.6	——	15.8	4.6	66.2	62.3	90.0	90.0	98.4	——
5	46.9	33.2	41.2	——	——	21.3	4.3	66.0	63.0	93.4	95.2	——	——
6	46.7	15.6	26.5	35.5	——	17.3	5.1	65.8	63.0	87.8	92.0	101.0	——
LSD (P=0.05)						4.8							

TABLE 4 — *Duration of orthodox rolls and its influence on dhool outturns, grade outturns and leaf temperatures with soft and medium withered leaf*

Treatment Code (See Table 2)	Dry Matter content of rolled leaf (%)	Dhool Outturn (%) 1st Dhool	2nd Dhool	3rd Dhool	4th Dhool	Big Bulk	% Loss in Rolling	Ambient Temperature (°F) Dry Bulb	Wet Bulb	Temperature of leaf immediately after rolls (°F) 1st	2nd	3rd	4th	Grade Outturn (%) BOP	BOPF	Dust No. 1	Total Main Grade
C2	45.0	18.2	21.4	20.8	16.7	17.1	5.8	66.1	62.8	86.8	87.9	86.3	89.7	60.4	9.9	8.8	77.2
7	45.5	20.7	30.8	——	——	42.4	6.1	66.0	63.0	90.5	94.2	——	——	53.3	9.9	6.9	70.1
8	44.8	19.0	21.3	22.0	——	33.1	4.6	66.5	63.0	87.8	90.7	90.9	——	54.2	9.3	6.8	70.3
9	40.5	10.6	18.6	——	——	64.4	6.4	66.2	62.3	86.8	87.8	——	——	44.7	5.9	5.5	56.1
10	41.7	12.0	15.5	22.1	——	43.5	6.9	66.8	63.0	84.8	87.1	88.6	——	52.3	8.2	6.3	66.8
LSD (P=0.05)						9.5								3.7	1.9	2.1	4.9

The average dry matter content of the rolled leaf was found to be within the ranges specified for each treatment in both stages.

It is seen from the results presented in Tables 3 and 4 that dhool outturns are lower and big bulk correspondingly higher in each two-or three-roll programme, when compared with the control which consisted of four 30 min. rolls. Although the total period of leaf rolling in the two- or three-roll programmes was the same, the three-roll programmes invariably yielded a higher total dhool outturn than the two-roll programmes and this disparity became wider, with softer withers. Further experimentation is required to determine whether the difference in total dhool outturn is due to an inherent difference in rate of dhool production during the rolling process or whether it is merely due to difficulties arising from dhool extraction during the roll-breaking operation. Dhool outturns increased steadily with increasing hardness of wither, as was observed by Evans (1931).

It is seen that the treatments given two rolls have resulted in higher temperatures for leaf bulk at the time of discharge than the treatments given three rolls, which in turn have higher temperatures than the controls given the four rolls. It seems likely that a part of the rise observed with the two rolled treatments is due to the longer duration of rolling.

There were no significant differences in the BOP, BOPF and Dust 1 outturns between the control processed on a four-roll programme and the two- and three-roll treatments given medium, hard or extra hard withers. Soft withers, however, result in depressing main grade outturns with either treatment even after the adding of cut leaf, as is to be expected with the extraordinarily high outturns of big bulk obtained.

The BOP and BOPF grades from the control (C1) and treatments 1 to 6 were reported on by the Colombo panel of tasters. They found no significant differences between any of these samples in respect of the colour of infused leaf, colour of infusion, strength, quality and flavour of liquor. Differences in valuation between these treatments were significant ($P<0.05$) and are given in Table 5.

TABLE 5 — *Mean valuation of the BOP grade as assessed by the Colombo Panel of Tasters*

Treatment Code	BOP Valuation (cents)
C 1	241
1	231
2	227
3	230
4	229
5	237
6	237
LSD ($P = 0.05$)	8

The BOP and BOPF samples from the control C2 and treatments 7 to 10 were also evaluated by the same Colombo Panel. In the BOP samples they found no significant differences in the colour of infused leaf, flavour, strength of liquor and in overall valuations. In respect of the colour of liquor and quality, differences were noticed and these are given in Table 6. No significant differences in the BOPF samples were seen by the Colombo Panel in respect of the liquoring characteristics and overall valuations.

TABLE 6 — *Mean evaluation of BOP as assessed by the Colombo Panel of Tasters*

Treatment Code	Colour	Quality
C 2	6.2	5.3
7	5.7	4.7
8	5.3	5.1
9	5.2	5.5
10	5.5	6.0
LSD ($P = 0.05$)	0.4	0.5

It can be seen from Tables 5 & 6 that for the BOP grade, the Colombo Panel of Tasters found that the soft withered teas manufactured on a two-or three-roll programme gave less colour and more quality than their corresponding four-roll, medium-withered controls. In all other liquoring characteristics and in infused leaf appearance, none of the treatments turned out to be significantly different, from that of the control manufacture. In respect of overall valuations, however, the hard, and extra-hard withered teas were considered to be worth significantly less than their controls.

For the BOPF grade the Colombo Panel did not report significant differences in any of the made tea characteristics looked at, or in overall valuations between the treatments processed on two-or three-rolled programmes (with withers ranging from soft to extra hard), and their medium withered, four rolled controls.

The results obtained by carrying out analysis of variance on differences in temperatures between the treatments and their respective controls are given in Tables 7 and 8.

TABLE 7 — *Differences in temperatures (°F) of rolled leaf bulk between the extra-hard, hard and medium withered treatments and their corresponding control*

Treatment Code	1st Roll	2nd Roll	3rd Roll
C 1	0	0	0
1	9.8	6.8	——
2	5.8	7.6	2.2
3	11.4	9.8	——
4	4.4	4.0	2.2
5	5.4	6.2	——
6	-0.2	3.0	8.8
LSD ($P = 0.05$)	4.0	7.8	3.2

TABLE 8 — *Differences in temperature (°F) of rolled leaf bulk between soft and medium withered treatments and their corresponding control*

Treatment Code	1st Roll	2nd Roll	3rd Roll
C 2	0	0	0
7	2.3	7.4	——
8	1.0	3.4	5.4
9	-0.8	-1.8	——
10	-2.1	-2.2	-0.1
LSD ($P = 0.05$)	n.s	2.0	4.2

It is evident from Tables 7 and 8 that the rise of temperature during rolling is dependent on the wither and that the harder the wither the higher the rise during the rolling process.

CONCLUSIONS

With the exception of the soft-withered treatment which resulted in an improvement in liquor quality, at the expense of colour for the BOP grade, none of the other treatments which ranged in wither from extra hard to soft, produced a tea superior to that given four rolls with medium-withered leaf. Despite this improvement in liquor the Colombo Panel of Tasters did not value the soft-withered teas significantly higher than the control teas. Grade outturns from the soft-withered leaf were depressed despite the addition of cut teas. BOPs from hard or extra-hard withered leaf were valued less. On the whole, experimental evidence would favour the standard form of orthodox manufacture consisting of four thirty-minute rolls with medium-withered leaf to the other programmes tested.

It is also apparent that the temperatures attained by the rolled leaf mass in a roller is strongly dependent on the degree of wither. The harder the wither taken, the higher will be the temperature attained. Similarly, the duration of rolling is seen to affect these temperatures. Longer rolls result in higher temperatures for leaf bulk at the time of discharge. The rate of dhool production is also seen to depend on wither, and the harder the wither the higher will be the dhool outturn.

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