Evaluation of Large Leaf Size Grades and Off Grades Percentages Using Different Roll Breaker Mesh Numbers in Low Country Tea Processing

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ABSTRACT

The ultimate percentage of different grade out-turn of made tea depend on roll breaking operation. The choice of correct roll breaker mesh or mesh combination is the basic and simple answer for attaining the desired grade composition of the product. In this study, an attempt was made to identify the correct roll breaker mesh or mesh combination to enhance the percentage of large leaf grades. Two different roll breaker mesh sizes namely roll breaker mesh number 4 and roll breaker mesh number 3 and 4 combination were used for this experiment as control and treatment respectively. Low country tea manufacturing procedure was followed and manufactured large leaf size grades OP, OP1, OPA, OPA large, PEKOE, and off grade using selected two different roll breaker mesh sizes. The weight percentages were calculated in each grade.

Study revealed that use of mesh number 3 and 4 combination for roll breaking the rolled dhools enhance the PEKOE grade percentage effectively, while reducing off grade percentage. Therefore use of mesh number 3 and 4 combination is more suitable for low country tea processing than mesh number 4 for roll breaking the rolled dhools.

KEY WORDS: Dhools, Large leaf grades, Off grades, Roll breaker, Tea processing

INTRODUCTION

Tea, *Camellia sinensis* (L) O. kuntze is the major plantation crop in Sri Lanka. Annual production of tea is 317 million kilograms and the tea sector has contributed 1.2 percent to the Gross Domestic Production (GDP) in year 2005 (Anon, 2005).

Today Sri Lanka tea has dispersed nearly 106 countries. The major competitors are Kenya, China, and Indonesia. An added advantage can be gained through increased productivity, value addition and quality improvement of made tea (Sivaram, 2002).

The type of made tea could be broadly categorized as Black, Oolong, and Green Tea. The quality of Green and Oolong tea produce in Sri Lanka is negligible. Out of black tea produced, More than 92 percent is of the Orthodox type and the balance is the Cut Tear Curl (CTC) type (Sivaram, 2002).

The chain of operations in Orthodox black tea processing can be distinguished in withering, rolling, roll breaking, fermentation, drying, grading and packing. As first unit operation withering is done for extract part of the moisture from withered leaf. Then withered leaves undergo the process of rolling to break up the cells or compartment and mixed up the chemical component of the leaves. Roll breaking is done after the batch (dhool) is removed from the roller. Leaf that is satisfactory removed by a vibrating sieve sent for fermentation and leaf that passing over the top is then sent on to the next roller for further rolling. Fermentation is the third stage of tea manufacture whereby the leaf enzymes oxidize on contact with air. Sorting is the fifth stage of manufacture. The dried leaf is sorted mechanically by sifting the different leaf size particles or grades through different size meshes. After sorting teas are packed in airtight containers in order to prevent absorption of moisture, which is the principle cause of loss of flavor during storage.

The ultimate percentage of different grade out turns of the uncut products depends on rolling and roll breaking operation. The choice of correct roll breaker mesh or mesh combination is the basic and simple answer for attaining the desired grade composition of the product. The success or failure of tea manufacture depends largely on it (Kathiravetpillai, 1986).

The main objectives of roll breaking are to remove leaf which has been twisted off the dhool which clogs and impedes circulation and further twisting action on the large leaf, to prevent over fermentation of the dhool and to cool the bulk of leaf of which the temperature has risen excessively during the rolling period (Keegel, 1983).

The process of roll breaking can be regarded as a first step in the grading of the tea. It makes grading of the dried teas simpler, minimizes the possibilities graying and has a marked influence on the ultimate grading percentage of the made teas. Rolled leaf sifting will allow some differentiation of fine and coarse leaf because the first fines will contain a large portion of leaf from the tenderness parts of the leaves.

Roll breaking should not be considered only as a removal of fines from time to time, but it should primarily determine the extent of rolling. If the mesh is too large, part of the fines will go to the fermentation room in under-rolled condition. With too small a mesh, leaf actually reduced to fines is brought back in to the roller. Obviously the effect of wet sorting on appearance and quality will therefore is only indirect; the operation proper has no influence at all on the properties of the tea. Bad roll breaking also results in uneven infused leaf (Werkhowen, 1988).

Therefore this study was carried out to identify correct roll breaker mesh or mesh combination to enhance the grade mix in low country tea processing system.

MATERIALS AND METHODS

This research was carried out at the St. Joachim Tea factory managed by the Tea Research Institute, Low Country Station, Ratnapura (22.1m amsl) from February 2006 to June 2006, to evaluate the percentage of large leaf size grades and off grades using two different roll breaker mesh sizes.

Roll Breaker mesh number 4 was used as control in this experiment, which has recommended for low country tea processing by Tea Research Institute (Keegal, 1983). Roll breaker mesh number 3 and 4 combination was used as treatment, which are commonly using in low country tea factories. Only large leaf sizes grades PEKOE and off grades were taken to consideration. Large leaf size grades were OPA, OPA large, OP, and OP1, which can be easily discerned visually, and the partials are elliptic in shape. The grade of PEKOE can not discerned actual differences visually and with the three dimensions taken in direction mutually of right angles are more or less the same (Mohamed *et al,* 2004).

Experiment was carried out over a period of three months with eight replicates almost two to three days were taken to complete a replicate.

Two batches were taken separately as control and experiment. As first unit operation withering was carried out for 12 to 14 hours. In each batch 2x275kg withered leaf were charged for two separate precondition rollers and 4x20 minutes rolling program was adopted with 5 minutes ON/5 minutes OFF pressure application. Then preconditioned leaf was passed through roll breakers. First, second, third, fourth dhools and big bulk of first batch were extracted by using roll breaker mesh number 4 while the dhools of other batches extracted from roll breaker mesh 3 and 4 combinations. Reciprocate type roll breakers with 120 cm width and 280 cm length were used for both treatment and control. The gauge of the wire mesh that use was 18^{th} standard wire gauge.

Wet dhools weight of each batch was taken separately and percentages were calculated. Fermentation was allowed to continue on fermentation racks separately. The bed height was controlled at 3 to 4 Inches. Then teas of each batch were fired in 6 feet ECP drier (Endless Chain Pressures Drier) (3 stages). Firing order was third dhool, second dhool, first dhool, fourth dhool and big bulk. Residence time of the drier, inlet temperature and exhaust temperature were controlled at 21 minutes, 230^{0}F and 125-130^{0}F respectively. Moisture content of wet and dry dhool was checked using standard oven method.

Then dry dhool of each batch was passed through Middleton stalk extractor with perforation size of 5 and 8 to separate fractions. Then only the large leaf size fraction teas of both batches were taken and winnowed dhool wise, respectively. Heavy fraction that was separated into first and second winnowing boxes was selected and further grading was done. Flacky type teas that were separated in to other winnowing boxes separated and weight was taken as off grades.

Selected heavy fraction incorporated with MICHIE number 4, 6 and 8 (figure 2) then extracted OPA and OPA large were even by passing through Middleton mesh number 4 and 9 while OP and OP1 extracted passing through mesh number 4 and 7(figure. 2).

Weight was taken after each and every manufacturing step. Finally weight of graded tea was taken in both batches separately. Pooled- t test was used to analyze the data.

(A) Standard Oven Method

Ten gram of wet dhool sample was taken and kept in oven. Temperatures was controlled at 103+2^{0}C until weight became constant for six hours then weight was taken and moisture content was calculated on wet basis.

(B) Calculation of grade percentage

Grade percentages were calculated using the equation of

$$\text{Grade percentage} = \frac{\text{Weight of a grade}}{\text{Total dry dhool weight}} \times 100\%$$

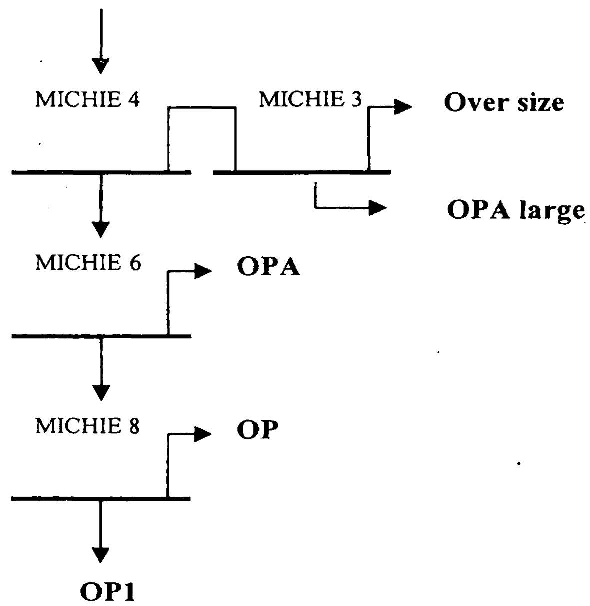
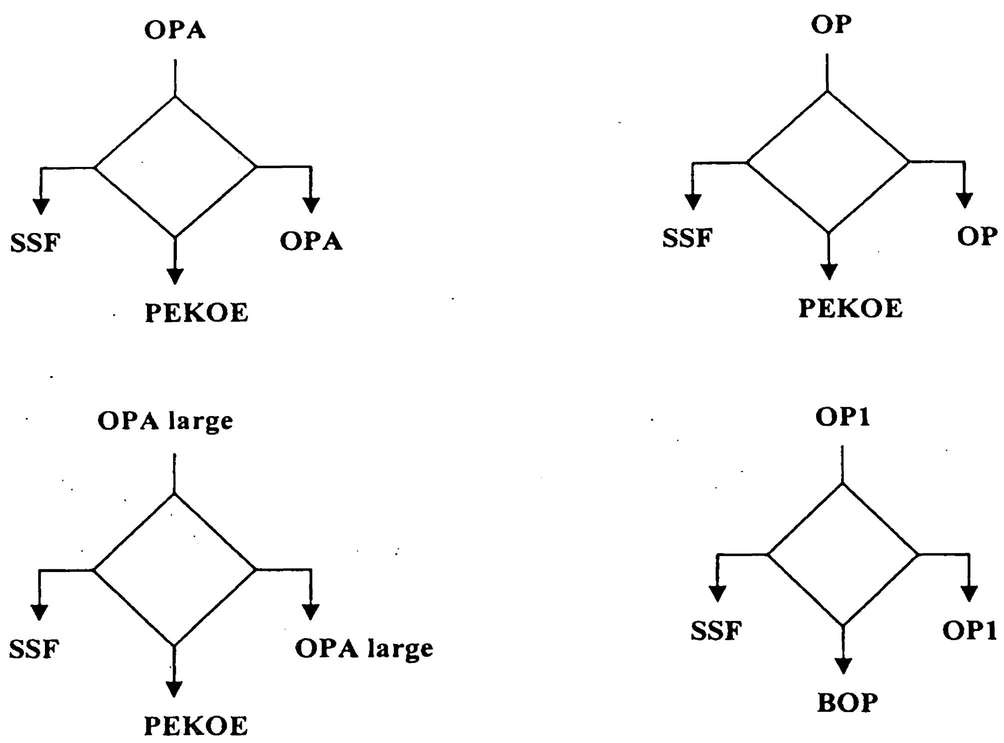


Figure 1 - Shifting program after winnowing



SSF-Small Size Fraction **BOP**- Broken Orange Pekoe **OP**- Orange Pekoe **OPA**- Orange Pekoe A
OP1-Orange Pekoe first grade leaves

Figure 2 - Flow Chart of Grade Even Procedure

RESULTS

The average moisture content of dry and wet dhools were ranged from three to four percent and 64 to 65 percent respectively.

According to the figure 5, percentage of big bulk out-turn was comparatively high in roll breaker mesh number 4 (control batch) (50.75 %) compared to that in roll breaker mesh number 3 and 4 combination (Experimental batch). A higher percentage of wet dhool out-turn were shown in roll breaker mesh number 3 and 4 combination.

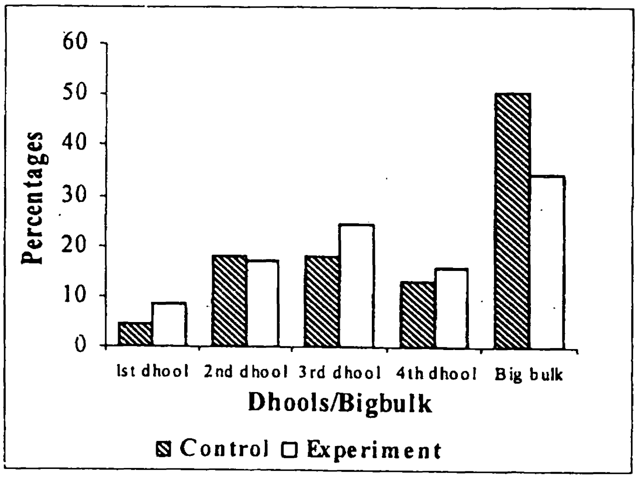


Figure 3 - Variation of Wet Dhools and Big bulk Percentages

(A) OPA Large

Results indicated that there was no significant difference in grade percentage of OPA large between two roll breakers.

(b) OPA

There was significant difference in OPA percentage between two different roll breaker mesh numbers ($P<0.05$). Highest mean value was showed by roll breaker mesh no 3 and 4 combination (Table 1).

(c) PEKOE

There was a significant difference in PEKOE grade percentage between two different roll breaker mesh numbers ($P<0.05$). Highest mean value was showed by roll breaker mesh no 3 and 4 combination.

(d) OP

Results indicated that there was no significant difference in grade percentage of OP between two roll breakers.

(e) OP1

Results indicated that there was no significant difference in grade percentage of OP1 between two roll breakers.

Table 1 - Mean value of grade percentages in different roll breaker mesh sizes:

Roll breaker mesh size	Grades					
	OPA	OPA large	OP1	OP	PEKOE	Off grades
Control (mesh No.4)	5.47 [a]	1.51 [a]	4.77 [a]	8.92 [a]	1.41 [a]	8.5 [a]
Experiment (mesh No.3 &4)	8.80 [b]	1.33 [a]	5.09 [a]	8.01 [a]	4.01 [b]	6.4 [b]

Numbers denoted by different letters are significantly different at $P<0.05$

(F) Off Grade

There was a significant difference in off grade percentage between two different roll breaker mesh numbers ($P<0.05$). Roll breaker mesh number 4 was showed highest mean value.

DISCUSSION

The size and appearance of the dhool is very important factor in low country tea manufacturing. The size of the dhool determine by the size of the roll breaker mesh. Higher big bulk out-turn is preferable but should not be exceed 25 percent (Keegal, 1983).This experiment revealed that dhool out-turn also largely depend on the mesh size and roll breaker mesh number 3 and 4 combination showed best results of wet dhool and big bulk out–turn than roll breaker mesh number 4.

The result indicated that use of roll breaker mesh number 3 and 4 combination can obtain high percentage of OPA and PEKOE grades than roll breaker mesh number 4 while reducing the off grade percentage. As main grades are highly demanded, higher OPA and PEKOE grade percentage of a factory is more beneficial.

For the month of June 2006, the low grown elevation average and Cost of Production (COP) of St. Joachim tea factory was 191.87 Rs/kg and 169.50 Rs/kg, respectively. The average price of OPA, PEKOE and off grade were 129.83 Rs/kg, 190.77 Rs/kg and 123 Rs/kg respectively (Table. 2).

Table 2 - Tea Sale Average Prices and Production in the St. Joachim Tea factory:

Tea Grade	Production quantity (%)	Average prices(Rs/kg)
OPA	15.16	129.83
PEKOE	1.00	190.77
OP	8.61	140.77
OP1	5.67	157.95
Off grades	16.20	125.00

Source: Tea sale average price sheet, Bartleet production marketing (Pvt) limited.

According to the average price of grades and cost of production, it revealed that producing high percentages of premium grades such as PEKOE has high possibility to increase the profitability of the factory than producing high percentages of OPA and off grades. Tea is the most labor intensive among all other plantation crops. It has both an agricultural and a manufacturing dimension. Further Processing of off grades is also most labor-intensive and it increases the COP. Therefore by using roll breaker mesh number 3 and 4 combination it can be minimize the labor requirement as it produce low amount of off grades.

Hence, there is possibility to increase profitability of low country tea factories by increasing main grades percentage such as PEKOE by using roll breaker mesh number 3 and 4 combination.

CONCLUSION

The results of the study revealed that use of mesh number 3 and 4 combination for roll breaking the rolled dhools enhanced the PEKOE grade percentage effectively while reducing off grade percentage. Therefore mesh number 3 and 4 combination is suitable for low country tea processing than mesh number 4 for roll breaking the rolled dhools. This study was carried out only for the large leaf size grades due to the limitation of the time. Therefore further research studies on roll breakers are essential to increase main grades percentages.

ACKNOWLEDGEMENT

Authors acknowledge the grateful support of Professor S.J.B.A Jayesekara, Dean, Faculty of Agriculture and Plantation Management and Dr M.N.D Fernandopulle, Head, Department of Plantation Management for the support and guidance given. Authors wish to offer there gratitude to the Dr M.A. Wijeratne, Officer in charge, Tea Research Institute, Low Country Station, Ratnapura for giving permission to conduct this research and staff members of the Technology Division, Tea Research Institute, Low Country Station, Ratnapura for the valuable assistance provided throughout the research project. Authors would also like to thank the factory officer, staff and workers, St. Joachim tea factory, Ratnapura for their kind help given. Authors would also like to thank Ms. D Perera, Assistant lecturer in Mathematics and statistics for assistance in statistical analysis in this study and the staff of the computer unit.

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