Tropical Agricultural Research Vol. 6 1994

Effect of some Controllable Parameters on Optimization of Characteristics in CTC Type Teas

A.S. Ranaweera, R.O. Thattil[1] and B.F.A. Basnayake[2]

Postgraduate Institute of Agriculture
University of Peradeniya
Peradeniya.

ABSTRACT. *The demand for CTC type teas has increased rapidly over the last few years. This demand can be fulfilled by increasing the production capacity with the required quality characteristics. Optimization of each character is essential in satisfying the requirements of different buyers. A study was carried out to investigate the effect of standard of leaf and fermentation temperature on the characteristics of CTC type teas. Optimum fermentation periods at three levels of temperature were given to dhools macerated from TRI 2025 clone, using a miniature CTC machine for two leaf standards. Sensory evaluations given by tea tasters were non-parametrically analyzed using the Friedman's test. Analysis showed that low temperature is preferred for optimizing the brightness of infused leaf and liquor; whereas elevated temperature is preferred for optimization of liquor colour and strength. Blending is suggested to satisfy different consumer requirements.*

INTRODUCTION

CTC type teas produce coloury and strong tea liquors due to severe maceration action in its rolling. Also a greater number of cups of tea can be obtained from them, than from other types of tea (Samaraweera, 1986). Therefore, CTC teas are preferred for tea bags. The demand for CTC teas has increased markedly within the last few years.

The Sri Lankan share of the world tea market has been predicted to be 5.5% by 1995 (Anonymous, 1989). There is a greater demand for bright,

---

[1] Department of Crop Science, Faculty of Agriculture, University of Peradeniya.

[2] Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Peradeniya.

strong liquors of Kenyan CTC teas and thick, strong colour liquors of Indian teas. The lack of some required characteristics causes a poor demand for Sri Lankan CTC teas.

The demand for the different characteristics in the CTC cup differs for different markets. For instance, strong coloury liquors are preferred for South Indian and Middle East markets; whereas strong brighter liquors made in North Indian and East African countries are in high demand for markets in developed countries. Demand varies with time and place. Therefore, valuation becomes very subjective. Required characteristics for a particular market should be optimized in order to fetch higher values. Optimization of relevant characteristics could be achieved only by the proper understanding of contributory factors which affect all characteristics of made tea.

Fermentation is the most crucial, but least understood stage of CTC manufacture. Fermentation mainly depends on leaf variety, plucking standard, fermentation temperature and degree of maceration. Formation of Theaflavins (TF) and Thearubigins (TR) by the enzymic oxidation of tea flavonols is the most important chemical reaction occurring during fermentation, which contributes to the liquor colour and strength. The required, favourable made tea characteristics such as, colour of infused leaf and made tea, brightness, strength and colour of the liquor should be optimized to satisfy the demand of the market. Characteristics of tea could be optimized at a given condition, by applying the optimum fermentation period for macerated dhool. The effect of temperature and the standard of leaf on the optimum period of fermentation have been reported by the authors previously (Ranaweera, Thattil and Basnayake, 1993). Estimation of the optimum fermentation period was carried out using the chloroform test (Samaraweera and Ranaweera, 1988). However, information pertaining to optimization of these characteristics of tea was not available in literature.

The main objective of this research study was to investigate the influence of leaf standard, fermentation temperature and period, on the characteristics of CTC teas. Characteristics studied were the colour of infused leaf, the colour, strength and brightness of liquor.

MATERIALS AND METHODS

All trials were carried out from August 89 to August 90 at the Tea Research Institute (TRI) of Sri Lanka, Talawakelle (elevation 1382 m amsl).

An experimental plot of TRI 2025 clone was selected, on the basis of its quality and yield (Ranaweera and Samaraweera, 1991), to get an adequate quantity of two leaves and a bud (2 and a bud), three leaves and a bud (3 and a bud) and banji leaf (banji), for 18 treatments. Approximately 2.5 kg of flush each from banji and 3 and a bud, and 5 kg from 2 and a bud were collected. These three groups (of leaf standard) were withered separately on the floor of St. Coombs factory of TRI. After 10 to 12 hrs of withering, 3 and a bud and banji were mixed at 1:1 ratio (standard B). Twenty gram duplicate samples were weighed from 2 and a bud (leaf standard A) and from standard B randomly, for moisture determination by standard oven method. Both standards of leaf were macerated separately in newly sharpened miniature CTC rollers, after pre-conditioning in 8" rotorvane. Macerated leaf from both standards were fermented at predetermined periods at 15°C, 25°C and 35°C (Ranaweera, Thattil and Basnayake, 1993). Approximate values from 10% variations were decided, after considering the coefficients of variability and critical results obtained from preliminary experiments at elevated temperatures. Optimum fermentation periods (OFP) for leaf standard A and B at different temperatures are given in Table 1. Notations used for the levels of each factor, in the 3 factor factorial experiment are given below.

Factor 1 (leaf standard); A: leaf standard A, B: leaf standard B

Factor 2 (temperature); L: low temperature 15°C,
R: room temperature 25°C, O: elevated temperature (oven) 35°C

Factor 3 (period of fermentation); 1: minus 10% from OFP, 2: OFP,
3: plus 10% to OFP

Values in Table 1 were used to optimize the fermentation periods at different levels of temperatures. Fermented dhool samples for the 18 treatment combinations were dried separately in a miniature dryer, at the end of the optimum fermentation. Dryer operations were fixed to obtain approximately 3% moisture of fired dhools.

Table 1. Optimum fermentation periods for different treatment combination

Treatment	AL1 BL1	AL2 BL2	AL3 BL3	AR1 BR1	AR2 BR2	AR3 BR3	AO1 BO1	AO2 BO2	AO3 BO3
Periods (mins)	120	135	150	65	75	85	48	53	58

Samples from all the forms of treatment were sent to five professional tea tasters for their sensory evaluations. Due to a poor response, the results from one taster were omitted. Raw ranks obtained from four tea tasters were analyzed (without aligning) non-parametrically, using "Friedman's" test (Lehmann, 1975). Minitab software package was used for the analysis of data. Raw values and averages were ranked separately, within each block (tasters and bathes) to find out the significant levels of treatment and to estimate the treatment medians.

RESULTS AND DISCUSSION

Raw values of sensory evaluations were analyzed using Friedman's test. Results from Friedman's analysis are given below in Tables 2a, 2b, 2c and 2d with the 1st, 2nd and the least preferred of treatments for all characteristics, based on their estimated medians.

Leaf infusion

Significant treatment differences ($P<0.5$) were found in the majority of cases. Leaf standard A is preferred at an elevated temperature for the best infusion. Leaf standard B at a lower temperature fermentation resulted in very poor infusion.

Liquor colour

Here too there were significant treatment differences in the majority of cases. Low temperature fermentation was preferred for the best liquor colour for both leaf standards.

Table 2a. Treatment preference for infused leaf.

Condition	Significant Level	Best	Second Best	Least
Batch 1	0.00	AO2	AO1	most in B
Batch 2	0.00	AO1,AO2	AO3	BL1
Batch 3	0.00	AR3	AO1	BL3
Batch 4	0.08	AO1,AO2	A and B	AL2
Batch 5	0.13	AO1,AL2	A and B	BO3
All batches	0.00	AO1	AO2	BR3
Taster 1	0.00	AO1	AO2	BL1,BR1
Taster 2	0.00	AO2	AO1	BR3
Taster 3	0.16	AO1	AL2	BL3,BO3
Taster 4	0.26	A and B	A and B	A and B
All Tasters	0.00	AO1	AO2	BR3

Table 2b. Treatment preference for liquor colour.

Condition	Significant Level	Best	Second Best	Least
Batch 1	0.05	BL1	BL2,BR1, BR2	BO2
Batch 2	0.01	BL2	BL3	AO2,AO3,BO3
Batch 3	0.22	AL2,AR3	BL1,BR3	BO1,AO2
Batch 4	0.02	BL2	AL2,BR3	BO2
Batch 5	0.11	BL3	AL1,AL3, AR3,BR2	AO1
All batches	0.00	BL3	BL2	AO2
Taster 1	0.00	AL2	BL2	BO1,AO2
Taster 2	0.01	BR3	AL3	AO1
Taster 3	0.39	AL1,BL3	AL3,BL1, BR2,BO1	BO2
Taster 4	1.0	all same		
All Tasters	0.00	AL2	BR3	AO1

Table 2c. Treatment preference for liquor strength.

Condition	Significant Level	Best	Second Best	Least
Batch 1	0.79	BL1	AL2	BO2,BL3
Batch 2	0.49	BL2	BL3,AL3, AR3	BO3
Batch 3	0.40	AL2,BO3	BL2	BO1
Batch 4	0.10	BL2	BO3	AO1
Batch 5	0.49	AR3	AL1,BL1, BR2	AO1
All batches	0.01	AL2	BL1	BO2
Taster 1	0.10	AL2,BO2	BL2	BO1
Taster 2	0.19	BR3	BL1	AO1
Taster 3	0.53	BL2	BR2,BL1, AR3	AR1
Taster 4	0.25	almost same		
All Tasters	0.00	BL1	AL2	BO2

Table 2d. Treatment preference for liquor brightness.

Condition	Significant Level	Best	Second Best	Least
Batch 1	0.46	almost same		
Batch 2	0.46	almost same		
Batch 3	0.00	AO2	AO3,AO1	AL1
Batch 4	0.62	AL2	AO1,AO3	AR1
Batch 5	0.53	AR3	AO2,BL1, BR1	BO3
All batches	0.30	AO2	AO1	BR3
Taster 1	0.04	AO1	AO2	AL1
Taster 2	0.76	BO1	AO2	AR1
Taster 3	0.15	AO1	AO2	BO3
Taster 4	0.55	almost same		
All Tasters	0.20	AO1	AO2	BL3

Liquor strength

Treatment effects were not significant when the batches and tasters were analyzed separately in most cases. However, treatment effect was significant when batches and tasters were pooled. A low fermenting temperature caused strong CTC liquors.

Liquor brightness

In the majority of cases, no significant treatment effects were observed. However, based on the ranks, an elevated temperature condition for fermentation using leaf standard A showed the preference for brighter liquor in CTC tea. No importance was given to the critical period within the range. The average of the ranks of the 4 tasters for different characteristics are given in Table 3.

Table 3. Average raw ranks of tea characteristics for all the forms of treatment.

Treatment	Infused leaf	Colour	Strength	Brightness
AL1	4.86	4.57	5.57	4.42
AL2	4.57	5.21	5.86	4.67
AL3	4.50	5.14	5.64	4.92
AR1	4.21	4.57	5.07	4.67
AR2	4.64	4.71	5.50	4.75
AR3	4.93	5.21	5.79	5.17
AO1	5.43	3.93	4.64	5.67
AO2	5.21	3.86	5.21	5.75
AO3	4.57	4.07	5.21	5.05
BL1	3.86	5.14	5.93	4.67
BL2	4.00	5.21	5.79	4.58
BL3	3.71	5.29	5.36	4.33
BR1	3.93	4.79	5.29	4.42
BR2	3.79	5.14	5.57	4.58
BR3	3.50	5.21	5.57	4.17
BO1	3.79	4.00	4.93	5.08
BO2	3.71	4.00	4.86	4.58
BO3	3.57	4.21	4.86	4.67

The graphical presentation of average raw scores over taster and batch combination for all treatments on different characteristics are given in Figures 1.1, 1.2, 1.3, and 1.4. These figures show that elevated temperature conditions for fermentation are very favourable for brightness of the liquor and infused leaf. Standard of leaf is also important for brighter infused leaf. However, low temperature conditions have resulted in good colour and strength in liquors.

CONCLUSIONS

Characteristics of CTC teas, namely infused leaf, liquor colour, strength, and brightness can be optimized at different conditions to satisfy the market requirement or demand. However, all characteristics cannot be optimized at a given condition. If, a buyer demands that all characteristics be presented in CTC cup, room temperature (22°C to 28°C) could be effectively applied without any energy wastage for fermentation. The alternative method is to achieve a blend from CTC teas to optimize characteristics. This is an important area of future research. However, an estimation of the optimum fermentation period is very important for all cases.

Brightness of the liquor and infused leaf can be obtained by using elevated temperature conditions for fermentation of dhool, macerated in CTC machine, for pre-determined periods. Optimum periods are very critical at elevated fermenting temperatures. Two leaves and a bud is preferred for brighter leaf infusion. Low temperature fermentation causes poor leaf infusion.

Colour and strength

Colour and Strength of CTC type tea liquors can be optimized using low temperature conditions for fermentation of CTC dhool for a given period. Mixture of three leaves and a bud and banji leaf does not affect the colour and strength of the liquor. Therefore, the quantity of production can be increased by adding tender three and a bud and banji, without affecting the quality.

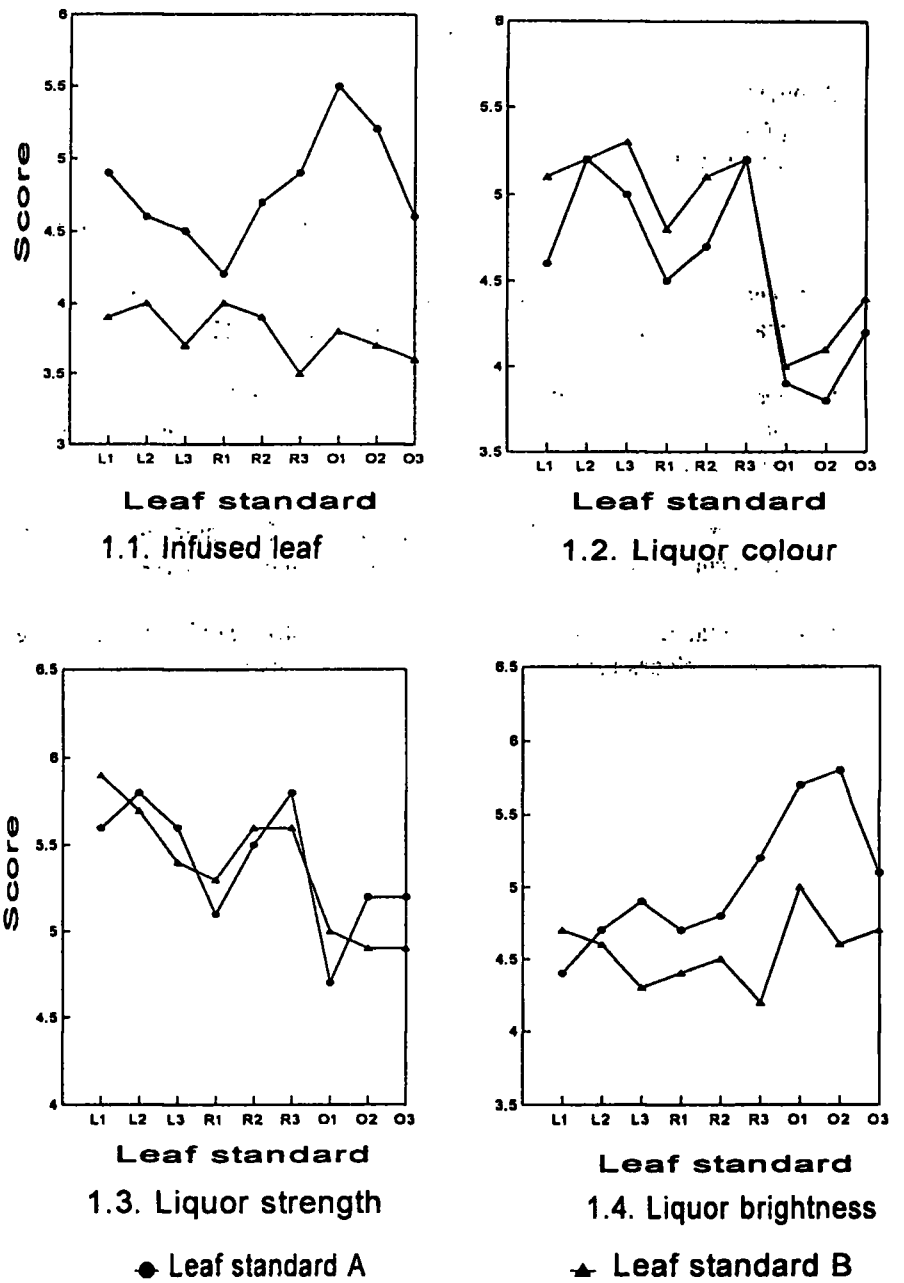

Figure 1. Average scores of different treatment combinations for different characteristics.

REFERENCES

Anonymous. (1989). FAO Technical Report. Committee on commodity problems: Intergovernmental Session on Tea. Food and Agricultural Organization, Rome. pp. 8-13.

Lehmann, E.L. (1975). Non parametrics. Holden-Day Inc., San Francisco.

Ranaweera, A.S. and Samaraweera, D.S.A. (1991). Quality of CTC teas made from different clones. SLJ. Tea Sci. 60(1): 22-29

Ranaweera, A.S., Thattil, R.O. and Basnayake, B.F.A. (1993). Effect of temperature on the optimum period of fermentation. Tropical Agricultural Research of Sri Lanka. 4:

Samaraweera, D.S.A. (1986). Some notes on CTC manufacture. Report of Technology Division, Tea Research Institute, Sri Lanka.

Samaraweera, D.S.A. and Ranaweera, A.S. (1988). Study of fermenting rates of clones using chloroform test. SLJ. Tea Sci. 57(1): 24-29.