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Clonal variations in the response of black tea quality due to plucking standards

Martin Obanda & Philip O. Owuor

Tea Research Foundation of Kenya, PO Box 820, Kericho, Kenya

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Black tea quality, as measured by chemical quality parameters and sensory evaluations, declines with coarse plucking standards. The extent of the decline varies with clone. Clone 6/8, with a high polyphenol content in the green leaf had a higher decline than clone S15/10 with low polyphenol content. Results suggest a possible variation of recommended plucking standard for different clones.

INTRODUCTION

The recommended tea (*Camellia sinensis* L.(O) Kuntze) plucking practice for manufacture of quality black tea is two leaves and a bud (Eden, 1976). Although the exclusive use of such a plucking standard is difficult, it is reckoned that the two leaves and a bud ensures high quality (Othieno, 1988) irrespective of the cultivar or clone of tea. In Kenya, the recommendation is supported by results of studies on the effect of plucking standards on the quality of black tea manufactured from a widely grown clone 6/8 leaf. The quality of black teas of clone 6/8 declines with coarse plucking (Owuor *et al.*, 1987). Together with results from other studies (Mahanta, 1988) it was thought that plucking two leaves and a bud would achieve a compromise between yields, plucker productivity and quality in all the tea cultivars. Consequently, this plucking practice is followed by most tea industries irrespective of the leaf variety and method of manufacture. In a recent study, Obanda and Owuor (1992) demonstrated that tea clones differ markedly in the levels of polyphenols present in the shoots and the total polyphenol content correlated significantly with the black tea quality rating of the clone. The relationship between total polyphenol content and quality was considered logical because it is from the oxidation of the various polyphenols in green leaf that theaflavins, thearubigins and some other products found in black tea are formed. Indeed, Hilton *et al.* (1973) has demonstrated a similar relationship in the effect of season and nitrogen on black tea theaflavins. Together, theaflavins and thearubigins (Roberts & Smith, 1963; Cloughley *et al.*, 1981; McDowell *et al.*, 1990) and unoxidised polyphenols (Ding *et al.*, 1992) contribute to the brightness, colour, mouthfeel and astringency of black teas. These are the main characteristics which determine the quality of plain black teas produced in Kenya.

Recently (Obanda & Owuor, 1992), clone 6/8 showed high green leaf polyphenol content and overall black tea quality as determined by professional tea tasters. In another study, due to higher levels of plain black tea chemical quality parameters, clone 6/8 was shown to produce black tea of higher quality than clone S15/10 (Owuor & McDowell, 1994; Owuor *et al.*, 1994). Clone S15/10 has a low polyphenol content (Obanda, personal observation) but it is probably the highest yielding tea in the world (Oyamo, 1992). It is therefore now being widely established in the East African tea estates. As the quality of plain black tea is dependent on the polyphenol content, which declines with rise in shoot maturity (Thanaraj & Seshadri, 1990), there is a need to ascertain whether the quality black tea of low polyphenol content clone S15/10 would respond in the manner expected for that of high polyphenol content clone 6/8. The present study compares the effect of plucking standards on black tea quality of clones S15/10 and 6/8.

MATERIALS AND METHODS

Leaf

Tea shoots, consisting of up to four leaves and a bud were plucked from clones 6/8 and S15/10 planted at Timbilil Estate of the Tea Research Foundation of Kenya, altitude 2178 m amsl, altitude 0°22'S and longitude 35°21'E. For each clone, the plucked shoots were then separated into different plucking standards of one leaf and a bud, two leaves and a bud, three leaves and a bud and four leaves and a bud, respectively. The experiment was replicated three times.

Black tea manufacture

Sorted leaf was withered for 18 h at ambient conditions to achieve a moisture content of 68–70%, then macerated by passing it through a 'Crush, Tear and Curl' (CTC) machine. The macerated leaf (dhool) was fermented for 90 min at 22°C. Fermentation was terminated by using a miniature fluid bed dryer (FBD) at such temperature that the exhaust air temperature did not exceed 80°C. Firing was stopped when the moisture content of the black teas was approximately 3%. The black teas manufactured were then subjected to chemical analysis and sensory evaluations by two professional black tea tasters with tea firms in Mombasa. The sensory evaluation scores were based on briskness, brightness, infusion, thickness and flavour on a scale of 0–20 for each component for taster A, and 0–10 for taster B. The best quality teas were given the highest score.

Black tea chemical quality parameters

The total theaflavins content (μmols/g dry weight) was measured by the Flavognost method (Hilton, 1973), while total colour, thearubigins content and percent brightness were determined by the Roberts and Smith method (1963).

RESULTS AND DISCUSSION

Theaflavins and thearubigins together contribute to the brightness, colour and mouthfeel of black tea liquors (Roberts & Smith, 1963; Cloughley *et al.*, 1981; Ding *et al.*, 1992). Similar to previous studies (Owuor *et al.*, 1987) there was a concurrent decline in total theaflavins content, percent brightness and total colour of black tea liquors of either clone 6/8 or S15/10 with coarse plucking (Tables 1, 3 and 4). Thearubigins content did not change with plucking standard (Table 2). The method (Roberts & Smith, 1963) used to determine thearubigins content has since been shown to slightly overestimate their levels since the assay fraction includes a flavonol glycosides contribution (McDowell *et al.*, 1990). This could have contributed to lack of response of thearubigins to plucking standards as the pattern of change in flavonol glycosides is unknown. This aspect is currently being studied.

Clone 6/8 leaf has a high polyphenol content (Obanda & Owuor, 1992) whereas clone S15/10 has a low polyphenol content (Obanda, personal observation). Clone 6/8 black teas were therefore expected to have more theaflavins than clone S15/10 as demonstrated by

Table 1. Clonal variation in theaflavins content (μmols/g) of black teas due to plucking standards

Plucking standard	Theaflavins content (μmol/g) 6/8	S15/10	Mean
1 + bud	27·3	13·7	20·5
2 + bud	26·3	14·3	20·3
3 + bud	24·1	12·6	18·3
4 + bud	17·8	11·0	14·4
Mean	23·9	12·9	

CV (%)	7·52		
LSD	Plucking Std (*A*)	Clone (*B*)	*A* × *B*
$P \leq 0.05$	1·71	1·21	2·42
0·01	2·37	1·68	3·36
0·001	3·30	2·34	4·67

Table 2. Clonal variation in thearubigins content (%) of black teas due to plucking standards

Plucking standard	Thearubigins content (%) 6/8	S15/10	Mean
1 + bud	16·1	9·21	12·7
2 + bud	16·4	10·0	13·2
3 + bud	16·9	9·69	13·3
4 + bud	16·6	9·11	12·9
Mean	16·5	9·50	

CV (%)	5·52		
LSD	Plucking Std (*A*)	Clone (*B*)	*A* × *B*
$P \leq 0.05$	N.S.	1·21	N.S.
0·01	N.S.	1·68	N.S.
0·001	N.S.	2·34	N.S.

Table 3. Clonal variation in liquor brightness of black teas due to plucking standards

Plucking standard	Brightness (%) 6/8	S15/10	Mean
1 + bud	27·36	20·22	23·79
2 + bud	26·59	22·57	24·58
3 + bud	22·44	21·72	22·08
4 + bud	19·44	19·34	19·39
Mean	23·96	20·96	

CV (%)	11·35		
LSD	Plucking Std (*A*)	Clone (*B*)	*A* × *B*
$P \leq 0.05$	3·16	2·23	4·46
0·01	4·38	3·10	6·19
0·001	6·09	4·31	8·61

Table 4. Clonal variation in total colour of black tea liquors due to plucking standard

Plucking standard	Total colour 6/8	S15/10	Mean
1 + bud	5·27	3·68	4·48
2 + bud	5·30	3·43	4·36
3 + bud	4·92	3·07	4·00
4 + bud	4·49	2·81	3·65
Mean	4·99	3·24	

CV (%)	7·59		
LSD	Plucking Std (*A*)	Clone (*B*)	*A* × *B*
$P \leq 0.05$	0·39	0·27	0·55
0·01	0·54	0·38	0·76
0·001	0·75	0·53	1·06

Table 5. Plucking standard effect on the mean total score of black tea liquors prepared from clones 6/8 and S15/10 as assessed by professional tasters A and B

Plucking standard	Clone 6/8		Clone S15/10	
	Taster A	Taster B	Taster A	Taster B
1 + bud	137	51	87	42
2 + bud	131	46	95	42
3 + bud	105	36	102	36
4 + bud	111	31	104	31
CV (%)	8·89	3·13	10·96	6·18
SE (Treats)	8·76	1·05	7·52	1·05
LSD $P \leq 0.05$)	21·43	2·56	NS	3·73
0·01)	32·46	3·87		5·36
0·001)	52·18	6·23		7·89

data in Table 1. Similar results were shown recently (Owuor & McDowell, 1994; Owuor *et al.*, 1994). Although the theaflavins content for both clones declined with the coarser plucking standard, the difference in theaflavins content between the leaf and a bud plucking standard and the four leaves and a bud plucking standard black teas were much larger for clone 6/8 than S15/10. The influence of plucking standard on theaflavins content was therefore more pronounced in clone 6/8 than clone S15/10. The distribution of polyphenols within the tea shoots may be different for either clone, with the levels of polyphenols for clone 6/8 declining more rapidly with shoot maturity than for clone S15/10.

The decline in brightness with coarse plucking standard was very significant for clone 6/8 whilst that of S15/10 remained insignificant (Table 3). The lack of change in brightness with coarse plucking standard further demonstrates the possible minimal influence of shoot maturity on the polyphenol composition of clone S15/10 shoots. Similar patterns were observed in total colour (Table 4) and sensory evaluations (Table 5). Tasters were not unanimous on the influence of plucking standard on the quality of black teas for clone S15/10 (Table 5). Taster A could not differentiate black teas from different plucking standards for clone S15/10. Taster B could differentiate between black teas from different plucking standards for clone S15/10. However, the range of the mean total scores by taster B for clone S15/10 was much closer than that given by the same taster for clone 6/8 black teas. The diminished mean total score range for clone S15/10 black teas by taster B indicates the difficulty experienced by this taster in distinguishing black teas produced from clone S15/10 at different plucking standards compared to those from clone 6/8. For clone 6/8, both tasters could easily distinguish the black teas manufactured from different plucking standards. The scores for these teas were significantly different and showed that both tasters displayed less preference for black teas from the coarser plucking standard for clone 6/8.

The ability for tasters to distinguish between different black teas is dependent on the presence of chemical substances responsible for the characteristic taste and quality of black tea. This study demonstrates that the effect of plucking standard on clone S15/10 black teas was minimal compared with clone 6/8 as measured by the levels of theaflavins, brightness and total colour. It was probably due to this lack of change in these chemical plain black tea quality parameters that tasters experienced difficulties in distinguishing between black teas from different plucking standards for clone S15/10. For clone 6/8 the differences were large and it was therefore a relatively easier task for each taster to distinguish between the teas produced from different plucking standards.

The results presented here demonstrate that plucking standard recommendation should vary with clones for maximum profits in tea production. Because the price tea fetches is partially determined by tasters preferences and chemical composition (Ellis & Cloughley, 1981), it is likely that producers may not benefit from the expected price premium on black teas produced from finely plucked leaf of clone S15/10. The use of a slightly coarse plucking standard should therefore be advantageous to producers of clone S15/10 black teas. For clone 6/8, producers are more likely to fetch better prices if they produce black teas from finely plucked leaf of clone 6/8.

The differences observed in the influence of plucking standards for different clones show that tea producers may follow the recommended plucking standard (Othieno, 1988) for clone 6/8. For other clones, the plucking standard to be adopted should be independently determined so as to ensure highest quality and optimum economic returns.

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