

Comparison of Quality Parameters of Organic vs Conventionally - Grown Tea

W S C Ranasinghe, A C Liyanage, M J Jayasundera, T U S Peiris
and I S B Abeysinghe
(*Tea Research Institute of Sri Lanka, Talawakelle, Sri Lanka*)

ABSTRACT

At present there is a widespread interest globally for food crops grown under organic systems of cultivation. This has led tea producers to grow organic tea, as there is an increasing demand internationally for a product free of pesticides and other chemicals.

Quality is one of the most important parameters used to evaluate any product. In tea, quality is assessed by organoleptic evaluation by professional tea-tasters, and by measuring chemical parameters which contribute to quality, such as theaflavin (TF), thearubigin (TR), total polyphenols and flavour.

The present study was initiated to investigate whether there is a significant difference in quality between organic and conventional teas. A total of 16 estates (six organic and 10 conventional estates) were selected and categorized into six groups. For matching each organic estate, two conventional estates in the same locality, producing a common grade of tea were selected. Tea samples were evaluated by professional tea-tasters, and then analysed for chemical parameters: TF, TR, total polyphenols, caffeine, catechins, soluble solids and crude fibre. This exercise was carried out for a period of six months at two-weekly intervals. The data were analysed statistically.

The results indicate that conventional teas have significantly higher TF and TR content, while some organic teas have a significantly higher crude-fibre content. There was no significant difference in total polyphenols, caffeine and soluble solids between the two types of tea. The results of the tasters' evaluation of both tea types were not conclusive.

Key words: Tea, organic, conventional, quality, chemical parameters.

INTRODUCTION

In the mid-nineteen fifties, three major developments in agricultural technology, namely, application of nitrogen fertilizer, introduction of insecticides and introduction of weedicides, led to a sharp increase in tea productivity and reduction in labour costs, but soon the harmful effects of indiscriminate and continued use of these chemicals led to undesirable consequences (Sivapalan, 1993). As a result, at present there is a widespread interest in the world to grow food crops under organic systems of cultivation.

Organic farming is an environmentally friendly, socially just, culturally sensitive and economically viable system that should involve efficient management and sustainable agricultural practices (Ranaweera, 2001). Organic tea production involves assisting nature to grow healthy tea bushes, and conserving the natural enemies of insect pests, diseases and weeds in order to minimize crop losses caused by these agencies. This is achieved by following modern agronomic practices and completely eliminating synthetic pesticides and fertilisers. A far greater effort and more specialised skills are necessary to bring about such a change of practice, and yet at the same time managing such systems at economic levels (Sivapalan, 1993).

Sri Lanka was the first to introduce organic tea to the world, organic tea cultivation being first undertaken in Sri Lanka in 1983. In the year 2000, about 336 MT of organic tea were produced in the country. At present organic tea contributes less than 1% of the total tea exported. The land extent under organic tea is 2000 ha, which is 1% of the total land extent under tea (Mohotti, 2002). In 2001, the turnover of organic tea was US\$ 3,565,000. This amounts to 26.8 % of total organic produce (spices, fruits, etc.) exported from Sri Lanka, according to a survey conducted by the Lanka Organic Agriculture Movement in 2002.

The variable maintenance cost of organically grown tea is 2-3 times higher than for conventionally grown tea, but the ecological awareness of the consumers, combined with concern over traces of pesticide residues found in tea, has opened up a new market for organic tea. Organic teas do not compete with conventionally grown teas in the open market; they occupy a niche market. Consumers, who want to buy organic tea, do not settle for conventionally grown tea if the former is not available. They are willing to pay higher prices for organic tea.

Organic tea is developed mainly to meet concerns about health and the environment, and as a sustainable production system.

For any product, quality is an important parameter. In tea, quality is defined as a combination of liquor and flavour characteristics. So far no studies have been conducted to determine if there is any difference in quality between conventional and organic teas. A study was therefore carried out using black tea samples from 16 estates, comprising six organic, and ten conventional estates as controls, for comparing nine quality parameters.

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MATERIALS AND METHODS

Black tea samples from a total of 16 estates (six estates producing organic teas and ten estates producing conventional teas) were selected. Two conventional estates, from the same locality producing the same grade of tea, were selected for comparison with each organic estate. Accordingly six groups were formed, each groups consisting of one organic and two conventional estates.

These six groups are situated in three different agro-ecological regions. Groups 1, 2 and 4 belong to the Up-country Intermediate Zone (IU 2 region); groups 5 and 6 belong to the Up Country Wet Zone (WU 2 region); and group 3 belongs to the Mid-Country Intermediate Zone (IM 2 region). Four of the groups produced BOP, one produced BOPF and the other produced FBOP, as main grades (Table 1).

Table 1: Grouping of estates and grades of tea used in the study

Group	Estate	Type	Grade
1	Stassens	O	BOP
	Haputale	C	
	Glenanore	C	
2	Needwood	O	BOP
	Haputale	C	
	Glenanore	C	
3	Koslanda	O	FBOP
	Ampitikanda	C	
	Craig	C	
4	Greenfields	O	BOPF
	Dambetanna	C	
	Pitarathmalee	C	
5	Ouvahkeile	O	BOP
	Henfold	C	
	Waltrim	C	
6	Venture	O	BOP
	Kew	C	
	Theresia	C	

C- Conventional O- Organic

In order to maintain a common particle size among and between clusters for a specific grade, BOPs were sieved through meshes 12-18, BOPFs were sieved through meshes 14-22, and FBOPs were sieved through meshes 8-12.

Sampling was carried out 12 times for a period of six months at two week-intervals starting from June 2004.

All 16 samples were analysed for theaflavins (TF), thearubigins (TR), caffeine, catechins, total polyphenols, soluble solids, crude fibre and moisture. The samples were sent to three professional tasters for evaluation. In the case of the chemical parameters, data of individual groups were analysed. The data from the tasters' evaluations were analysed using Friedman's Test. Data analysis was carried out using Statistical Analysis System Software (SAS) and Mini Tab Software.

Determination of TF, TR and TC

TF, TR and TC were determined by the method of Roberts and Smith (1961).

Determination of moisture content

Moisture content was determined by the method described in Anon (2004 a).

Determination of catechins and caffeine

Catechins and caffeine were determined by the method described in Anon (2004 b).

Determination of total polyphenols

Total polyphenols were determined by the method given in Anon (2004 c).

Determination of soluble solids

Soluble solids were determined by the method given in Anon (2004 d).

Determination of crude fibre

Crude fibre was determined by the method given in Anon (2004 e).

Tasters' (sensory) evaluation

Sensory evaluation was performed by a panel of three professional tasters, and the rankings were assessed for individual parameters: infused leaf, colour, strength, quality and flavour.

Data analysis

Data analysis for the chemical parameters was carried out using SAS Software. The tasters' evaluations were analysed using Mini Tab Software.

RESULTS AND DISCUSSION

Black teas produced in different parts of the world have been shown to differ in quality. Although the variations could in part be due to geographical and environmental conditions, they could also be due partly to the genetic make-up of the planting material. At the same time, in order to produce quality tea it is necessary to maintain good plucking standards, as well as sound manufacturing practices.

Quality is normally described in subjective terms by the tea trade. Producers define quality tea as that, which when sold, gives a high income. Tea traders define quality tea as that which gives maximum profit, while consumers define quality tea as tea with overall taste and class.

Research prompted by the requirements of the tea trade has been conducted to define chemical indicators of quality. In practice, quality is the overall effect of several quality parameters assessed by professional tea tasters.

In the present study, data from the analysis of nine chemical parameters, together with tasters' evaluations, have been compared in respect of organic and conventional teas. All the samples were sieved through the relevant meshes prior to analysis, in order to maintain consistency and to obtain a common particle size within the group for the appropriate grade. This exercise was carried out to minimize grade variations. The summary of chemical parameters for both types of tea is shown in Table 2.

Table 2: Summary of Chemical Parameters

Group	Type	%TF	Pr>F	%TR	Pr>F	%TPP	Pr>F
1	Org	0.87	0.1665	11.91 ^B	0.0146*	24.69 ^A	0.0169*
1	Haputale	0.87		12.88 ^{BA}		22.53 ^{BA}	
1	Glenanore	0.76		14.01 ^A		20.54 ^B	
2	Org	0.76 ^B	0.0313*	12.07 ^B	0.0008**	20.53	0.1132
2	Haputale	0.87 ^A		12.88 ^B		22.53	
2	Glenanore	0.76 ^B		14.01 ^A		20.54	
3	Org	0.75	0.7563	12.10 ^A	0.0576	21.55	0.6178
3	Ampitikanda	0.74		11.22 ^B		22.35	
3	Craig	0.78		11.12 ^B		22.41	
4	Org	0.72 ^B	0.0464*	13.37 ^B	<0.0001**	20.94	0.5122
4	Dambethenna	0.85 ^A		15.31 ^A		22.25	
4	Pitaratmalee	0.83 ^{BA}		13.14 ^B		22.08	
5	Org	0.73 ^B	0.0003**	13.78 ^B	0.0589	20.94	0.8989
5	Henfold	0.86 ^B		14.90 ^{BA}		20.54	
5	Waltrim	1.05 ^A		15.03 ^A		20.47	
6	Org	0.80 ^B	0.0257*	14.96	0.2928	23.40	0.1819
6	Kew	1.01 ^A		15.13		21.79	
6	Theresia	0.99 ^A		14.36		21.34	

Group	Type	% SS	Pr>F	% Caffeine	Pr>F	%Crude fibre	Pr>F
1	Org	40.75	0.7911	3.12	0.3367	11.85	0.6552
1	Haputale	41.35		2.76		11.80	
1	Glenanore	41.95		3.14		12.72	
2	Org	40.10	0.7010	2.63	0.2933	12.79	0.2374
2	Haputale	41.35		2.76		11.80	
2	Glenanore	41.95		3.14		12.72	
3	Org	41.26	0.4769	2.94	0.7033	12.75 ^A	0.0433 [*]
3	Ampitikanda	40.75		3.16		11.94 ^{BA}	
3	Craig	42.75		3.18		11.55 ^B	
4	Org	40.88	0.7255	2.80	0.2650	11.78	0.2368
4	Dambethenna	41.68		2.41		11.59	
4	Pitaratmalee	42.61		2.48		11.16	
5	Org	39.17	0.6679	2.36	0.0990	12.91 ^A	0.0013 ^{**}
5	Henfold	40.45		2.81		11.60 ^B	
5	Waltrim	38.73		2.88		11.71 ^B	
6	Org	43.09	0.6215	2.74	0.3440	11.78	0.3359
6	Kew	42.28		2.66		11.61	
6	Theresia	41.62		2.39		12.05	

Means with the same letter are not significantly different from each other.

* Comparisons significant at $p = 0.05$ level

** Comparisons significant at $p = 0.01$ level

TPP – Total Polyphenols

SS - Soluble Solids

The results (Table 2) indicate that the TF levels in four groups, 2, 4, 5 and 6, show significant differences ($\alpha = 0.05$) between organic and conventional teas. These four groups had higher proportions of TF in conventional teas than in organic teas. Groups 1 and 3 do not differ significantly. Groups 1, 2 and 4 show a significantly higher level of TR ($\alpha = 0.05$) in conventional teas than in organic teas. Groups 3 and 5 are significantly different at $\alpha = 0.1$.

TF and TR are produced as a result of polyphenol oxidase (PPO) enzyme activity on the polyphenols during fermentation. PPO activity is found to be higher in tender shoots than in mature shoots. Low TF and TR levels in organic teas suggest a low activity of PPO in organic shoots.

In most cases, marginal lands, which are plentiful but of low profitability, are used for organic tea cultivation. The plants in organic tea lands are less succulent because only organic manure is applied. Further, the plucking standard for organic tea is

generally low when compared with conventional teas (7-10 days plucking rounds, as against 4-5 days in conventional teas). These factors could contribute significantly to low TF and TR levels in the organic teas, as other major factors (such as type of manufacture and fermentation period) were more or less the same in the conventional and the organic estates.

When considering total polyphenols, only group 1 is significantly different from the other groups (Table 2). For soluble solids, no significant difference is found between organic and conventional teas, in all six groups. No significant difference is also found in the caffeine content of organic and conventional teas in all six groups.

Where crude fibre content is concerned, there is a significant difference between organic and conventional teas in two groups (groups 3 and 5, at $\alpha = 0.05$), with a higher proportion of crude fibre in the organic teas. Groups 1, 2, 4 and 6 do not show a significant difference in crude fibre content.

The leaf standard of organic teas is poor when compared to conventional teas. Crude fibre content is known to increase with maturity of the plant. Further, potassium has been reported as playing an important role in the accumulation of crude fibre. It has been found that the presence of higher levels of potassium inhibits the formation of starch, owing to condensation of monosaccharides to form polysaccharides, which is one of the components of crude fibre.

Where there is no application of nitrogen and potassium fertilizers, the teas show an increase in crude fibre content when compared to teas for which higher levels of nitrogen and potassium have been applied (Venkatesan et al., 2001). Conventional tea estates use high amounts of nitrogen and potassium fertilizer to increase yield. These could be possible explanations for the high crude fibre content of the organic teas in groups 3 and 5.

Statistical analysis of the data for flavour and catechin levels and the tasting scores (Table 2) gave inconclusive results owing to high values of the coefficient of variation (CV). This could be attributed to inconsistencies in the tasters' preferences for a particular tea.

CONCLUSIONS

The theaflavin and thearubigin content is significantly higher in conventional teas than in organic teas. Crude fibre is found in significantly higher proportions in organic teas than in conventional teas. No significant differences were seen in total polyphenols, catechins, caffeine and soluble solids between the two types of tea.

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