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CHANGES IN THE POLYPHENOLIC CONSTITUENTS OF TEA LIQUORS DURING STORAGE

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Theaflavin content and taste evaluation were used as indices of quality in tea liquors during storage. High temperature decreased theaflavin content leading to a 'stale' taste while antioxidants such as ascorbic acid and antimicrobial agents were helpful in preserving quality, except that the former gives an acid taste, otherwise tasteless antioxidants, soluble in water, have to be used.

INTRODUCTION

The quantitative chemical composition of tea liquors, made up predominantly of polyphenolic compounds, is known to be responsible for the quality and taste of tea. (Sanderson *et el* 1976) The oxidized polyphenols, which form the major portion of the polyphenol fraction in a tea liquor can be broadly classified into theaflavins and thearubigins. Theaflavins are the direct products of enzymatic oxidation and have been known to be closely correlated to quality (Roberts 1962). Tea liquors which have 'gone off' are characterized by a very low theaflavin content.

The chemical changes occurring during the storage of black tea under a variety of conditions have been investigated by Wickremasinghe and Perera (1972) Stagg (1974) and Jayaratnam and Kirthisinghe (1974). The changes associated with poor storage conditions leading to development of off tastes have generally been shown to be related to moisture absorption followed by fungal growth with or without accompanying auto-oxidative changes often leading to a decrease in extractable theaflavin content. The changes occurring in tea liquors on the other hand have not been studied in any great detail. Millin *et el.*, (1969) have reported some results of such an investigation but their data is confined to the effect of high temperature on the tea liquors.

The present study is a more detailed investigation of the changes undergone by tea liquors during storage using theaflavin content and taste evaluation as indices of quality in the liquor. The need for such a study has become more apparent recently with the growing popularity of liquid ready-to-drink teas and instant teas, during the processing of which the storage of large quantities of liquor becomes necessary.

MATERIALS AND METHODS

Preparation of extract

An extract comparable to the normal cup of tea was prepared by brewing a weighed quantity of black tea (2.5 g) in freshly boiled water at 90-95°C for 5 minutes. The solution was filtered and used for the investigation.

Additives were dissolved in the freshly prepared solution. In some experiments the solutions were deaerated and nitrogen was bubbled into the solution for 10 minutes and the solution stored under nitrogen in a well stoppered flask.

Theaflavin, thearubigin and thearubigin polymers were determined by the method described by Takeo (1974). All spectrophotometric estimations were carried out on a Unicam SP 500 spectrophotometer. Paper chromatographic investigation of the solvent extracted fractions showed that the fractionation by solvent extraction was quite effective.

Determination of Flavanols

Total flavanols were determined by the vanilin method described by Swain and Hillis (1959).

RESULTS

Effect of Temperature and Light:

It is evident from the data presented in Table 1 that storage in the light does not have any marked effect on the theaflavin content. The total thearubigin polymer fraction is also unaffected by light. Temperature on the other hand has a marked effect leading to a sharp decrease in the theaflavin content of the tea liquors. Such decreases were further found to have a marked effect on taste which was 'stale' after the heat treatment. Autoclaving of tea extracts led to very similar changes.

Effect of Antioxidants and Preservatives

It was found that the theaflavin content and the fresh taste of tea liquors could be preserved by the addition of both an antioxident and a preservative (Table 2). The addition of only an antioxidant led to occasional fungal contamination which resulted in sharp decreases in theaflavin content and also the development of off tastes. It is evident that ascorbic acid at higher concentration provides better protection although at these levels the acid taste of ascorbate itself becomes obvious.

TABLE 1 — *Effect of temperature and light on the polyphenolic constituents of tea liquors (Per cent increase or decrease after 10 days storage)*

	TF	*TR*	*TRP*
(a) In light at room temp. (27°C)	-16	+24	+11
(b) In the dark at room temp.	-14	+7	+23
(c) In the dark at 80°C	-39	+37	+79
(d) Autoclave treatment (1.05 Kgs/SN centimetre for 15 min)	-12.2	5.4	4.7

TABLE 2 — *The effect of antioxidants antimicrobial agents and inert atmosphere (% increase or decrease after 10 days storage)*

	TF	*TR*	*TRP*
(1) Control A*	- 40.6	+ 9.7	- 4.8
(2) Control B	- 9.6	+ 7.9	+ 6.3
(3) 0.2% Ascorbic*	- 46.3	+ 11.5	+ 0.1
(4) 0.4% Ascorbic*	- 25.3	+ 23.1	- 5.5
(5) 0.4% Ascorbic	- 2.5	+ 12.5	- 5.5
(6) 0.1% Benzoate	- 22.1	+ 13.3	+ 11.8
(7) 0.4% Ascorbic + 0.1% Benzoate	- 3.2	- 16.7	+ 4.2
(8) 0.8 Ascorbic 0.1% Benzoate	- 0.3	+ 11.2	- 2.0
(9) Storage in inert atmosphere	- 1.5	+ 13.8	+ 1.8

*Fungal contamination evident after 5 days.

DISCUSSION

The results presented in this study indicate that the degradative changes occurring during the storage of tea liquors are associated with the development of 'off tastes' and a decrease in theaflavin content. These are caused primarily by (a) Autoxidative reactions as demonstrated by the action of ascorbic acid which removes oxygen from solution and thereby prevents autoxidation (b) Changes brought about by microbial contamination as evidenced by the protective action of antimicrobial agents.

The auto oxidative reactions are in particular accelerated by higher temperatures as shown by rapid increase in the thearubigin fraction at an elevated temperature. This observation further explains the rapid deterioration observed when hot tea solutions are stored in vacuum flasks.

The protective action of ascorbic acid is of practical value in tea based beverages where the acid taste is part of the recipe, otherwise tasteless antioxidents soluble in water have to be used to achieve this protection. De-aeration and packaging under an inert atmosphere could be beneficial wherever this can be done. Antimicrobial agents are however effective at concentrations which do not affect the taste.

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