

ANALYSIS OF 'CREAM' OF TEA

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Chemical analysis of 'cream' showed that it was a complex consisting of caffeine, theobromine theaflavin gallate, thearubigins, epigallocatechin gallate, epicatechin gallate, triacetidin, caffeic acid, gallic acid and ellagic acid. 'Cream' from low-grown teas contained smaller amounts of these compounds than high-grown teas, although the relative proportion of thearubigins was higher. 'Creaming down' is accompanied by chemical breakdown reactions and is not solely a combination of theaflavins, thearubigins and caffeine, as has hitherto been assumed.

Previous studies (Roberts 1962 ; Bhatia 1964), on the composition of 'cream' showed that the main constituents were theaflavins, thearubigins and caffeine. In the present study it was found that several other compounds enter into the 'cream' complex, and evidence was also obtained that 'creaming down' is not a purely physical process, as there are indications of chemical breakdown reactions occurring during the formation of 'cream'. Our interest in the chemical composition of 'cream' arose from two observations—firstly that the majority of low-grown teas 'cream down' at a much slower rate than high-grown teas, and secondly that extraction of tea liquors with the solvent, isobutyl-methyl ketone, (hereafter referred to as i-BMK), results in the loss of the ability to 'cream down'. Accordingly, analyses were made by paper chromatography of (a) the 'cream' itself, (b) the liquor remaining after removing the 'cream', (c) the i-BMK extract of tea liquors and (d) the aqueous layer remaining after extraction with i-BMK.

Results and Discussion

Analysis of 'Cream'

High- and low-grown teas were infused and set aside to 'cream'. The 'cream' was then separated by centrifugation in a refrigerated centrifuge at 5000 rpm, washed twice with ice-cold distilled water on the centrifuge, dissolved in boiling distilled water, and analysed by two-dimensional paper chromatography, using butanol-acetic acid-water (6 : 1 : 2) and 6% acetic acid as solvents. The 'cream' in all samples of tea was found to consist of mainly caffeine and theaflavin gallate, together with theobromine thearubigins, ellagic acid, triacetidin, epigallocatechin gallate, epicatechin gallate, caffeic acid and gallic acid, as well as two unidentified compounds. A comparison of high- and low-grown teas showed that the 'cream' of the latter contained smaller amounts of all these compounds, although the relative proportion of thearubigins to theaflavins was higher in these teas. The former observation could account for the comparative slowness of 'creaming' of low-grown teas, and the proportionately higher levels of thearubigins could account for the relative 'dullness' of the 'cream'. One of the low-grown teas was exceptional in that it 'creamed down' at a rate faster than any of the high-grown teas. Analysis of the 'cream' (which was dull) from the liquor of this tea showed extremely high amounts of theaflavin gallate, thearubigins and caffeine and high levels of

all of the other components. The above results suggest that the main components necessary for 'cream' formation are theaflavin gallate, thearubigins and caffeine, and that a high content of thearubigins results in the production of a dull 'cream'. Furthermore, it may be expected that a 'bright cream' would be associated with good quality, as the formation of a 'bright cream' is indicative of a high level of theaflavin gallate in the liquor. It is also noteworthy that triacetidin is a pink coloured compound and may also play a part in determining the colour of the 'cream'. The role of the other compounds present in 'cream' is not known.

Analysis of liquor remaining after removal of 'cream'.

The supernatant remaining after removal of the 'cream' by centrifugation contained the p-coumarylquinic acids, chlorogenic acids, theogallin, gallic acid, epicatechin, epigallocatechin, ellagic acid, theaflavin, phloroglucinol and two unidentified compounds. The last three compounds were not present in alcoholic extracts of tea and probably arose as a result of breakdown processes occurring during the formation of 'cream'. All of the compounds in the supernatant do not enter into the composition of 'cream' and it is of interest that epigallocatechin, epicatechin and theaflavin occur in this fraction, whilst their gallates are found in the 'cream'.

Analysis of the i-BMK extract of tea liquors

The compounds invariably found in the i-BMK layer were theaflavin, theaflavin gallate, epigallocatechin gallate, epicatechin gallate, caffeine, theobromine, gallic acid, myricetin-3-glycoside and an unidentified compound which was the same as one of the three unidentified compounds in the cream. Many of the compounds constituting the 'cream' are, therefore, extracted by i-BMK but no 'cream' formation would be expected in this extract because of the nonpolar nature of this organic solvent. The indications are that the 'cream' complex is held together by hydrogen bonds and this type of bond will not form in nonpolar media. In this connexion it was found that evaporation of the solvent from the i-BMK layer yielded a residue which dissolved in boiling water and 'creamed down' readily on cooling. On comparing the i-BMK extracts of high-grown with low-grown teas, the former, as expected, showed a higher content of theaflavin gallate. It was also observed that the exceptionally 'fast creaming' low-grown tea showed a very high content of caffeine in the i-BMK layer and this could possibly account for its unusual 'creaming' properties.

Analysis of aqueous layer remaining after extraction with i-BMK

The residual aqueous layer after extraction with i-BMK, which did not 'cream', contained the following compounds, p coumarylquinic acids, chlorogenic acids, theogallin, gallic acid, epigallocatechin, myricetin - 3 - glycoside, isoquercitrin, kaempferol - 3 glycoside, rutin, galloylbisepigallocatechin, caffeine and corilagin. Although caffeine is present here, none of the other compounds occurring in 'cream' were detectable. It is also of interest that some of these compounds found here, notably rutin and corilagin, were not detectable in the supernatant after removal of the 'cream', although this supernatant contained phloroglucinol and ellagic acid. These latter compounds could be derived from rutin and corilagin respectively and indicate that 'creaming' is accompanied by breakdown reactions and is not due only to a combination of theaflavins, thearubigins and caffeine. This view is also supported by the occurrence of caffeic and gallic acids in 'cream'.

Summary

- 1 — 'Cream' is composed of the following compounds—theaflavin gallate, thearubigins, caffeine, theobromine, epigallocatechin gallate, epicatechin gallate, caffeic acid, gallic acid, ellagic acid, triacetidin and two other compounds, which have not been identified.
- 2 — 'Creaming down' is accompanied by chemical breakdown reactions, and is not due primarily to the formation of a complex between theaflavins, thearubigins and caffeine.
- 3 — 'Cream' containing a high proportion of thearubigins will be 'dull'.

References

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