THE ESTIMATION OF THEAFLAVINS AND THEARUBIGINS IN MADE TEAS*

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As a result of investigations into the chemical composition of made tea it has been established that the coloured oxidation products extracted in the liquor represent a comparatively simple mixture of substances. Nearly all the colour is due to two classes of substances, neither of which have been previously recognised by chemists; and it has been suggested that these should be referred to as *Thearubigins* and *Theaflavins*.

The thearubigins—literally the rusty-brown substances found in tea—account for more than 10 per cent of the total dry matter in tea. There appear to be several closely related substances in this class.

The theaflavins are the substances responsible for the golden-yellow element of colour. There are two theaflavins, theaflavin and theaflavin gallate, both of which have been obtained as pure chemical substances, and together they account for up to 2 per cent of the dry weight of tea. It has been shown that the theaflavins undergo further oxidation during fermentation, and that this further oxidation results in the production of thearubigins.

Relationships to Liquor Characters

As already mentioned, the thearubigins and theaflavins together are responsible for almost all the colour of a liquor. The taster's assessment of colour must therefore be in terms of these two groups of substances. Both contribute to the depth of colour, but tone is largely dependent upon the amount of theaflavins. Good colour is associated with a high sum total of thearubigins and theaflavins and with a relatively high ratio of theaflavin to thearubigin.

Other liquor characters are also explainable in terms of these two groups of substances. Thus strength appears to be a property both of theaflavins and of thearubigins and is usually proportional to their sum total. Provisionally it has been concluded that briskness is due to a combination of theaflavins with caffeine. Quality is a rather complex character, but it appears probable that the theaflavin content is one of several factors concerned.

Analytical Estimation

We have been successful in developing an analytical method, involving the use of a spectrophotometer, for determination of the amount of both theaflavins and thearubigins in liquors. This method gives an accurate measure of the depth and tone of colour. As already indicated these values are also connected with factors such as strength, quality and briskness. The measurement of theaflavins and

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thearubigins in a liquor therefore gives a considerable amount of information about the tea concerned, although it is not claimed that these measurements tell us all we wish to know—for example the method tells us nothing about flavour or second flush quality.

Compared with tasting these results are both more accurate and more reproducible—a taster's palate is obviously less reliable than a precise scientific instrument. Further, the values obtained are not dependent upon fluctuations in the market, nor are they complicated by the fact that different tasters may be valuing teas for different markets.

Applications

For experimental work on tea manufacture it is considered that this new method, with its much greater precision, will prove of considerable value. On the other hand it is still necessary to supplement these results by the usual tasting reports. For routine evaluations of commercial teas it is considered that the normal tasting procedure will continue to be adequate. Tasting, compared with the new analytical method, is more economical both in time and in cost. However where tasting reports are conflicting, or when a garden wishes to rectify faults in manufacture, following an adverse report, it is considered that the tasting may well be followed by chemical analysis. The two methods of assessing a tea, tasting and analysis, are therefore complementary to each other.

In the orange grades of conventionally manufactured teas we have clear cut evidence that the best valuations are given to teas with a high sum total of theaflavins and thearubigins, and with a relatively high ratio of theaflavin to thearubigin.

On the arbitrary scales at present in use a good tea gives a theaflavin figure of 0.7 or over, and a thearubigin figure greater than 2.0. In other words the theaflavins must be responsible for at least 25 per cent. of the colour. Really poor teas may have the same sum total of theaflavins and thearubigins but a theaflavin figure as low as 0.3. For C.T.C. teas very much higher figures are obtained for both theaflavins and thearubigins, the best of these teas are those with theaflavin figures of the order 1.2 and with thearubigins at 3.0 or even higher. It is interesting to note that a few tobacco cut teas gave equally high figures for theaflavins, which accounts for the extremely good colour they show in the cup.

The analytical figures for theaflavins and thearubigins have given acceptable explanations of effects of varying time and temperature of firing in valuations and liquor characters. It has also been shown that when teas of high moisture content are stored at high temperatures, the deterioration which sets in is largely due to a destruction of theaflavins. Further uses for the method have been found when examining the very marked effects of infusing teas with different kinds of water.

We are now occupied in developing a considerably simplified procedure which will be more suitable for routine analyses of made teas in laboratories less well equipped than that at Tocklai. Even this simplified method however will require a certain amount of chemical skill and, if this method is to be used outside a laboratory, it will be necessary to have men properly trained in its use and applications. It must also be once more stressed, that although theaflavins and thearubigins are of very great importance in determining liquor characters, there are other factors involved which must not be lost sight of. We have not yet succeeded in explaining the whole of what constitutes good tea in terms of pure chemistry, and it will probably be some time before this goal is more nearly approached.