

Over the last 100 years, tea process is predominantly controlled by manual intervention and colour of tea leaves (both finished as well as in-process) play the most important role in optimization of the length of the processes, estimation of quality and gradation of finished tea. The advances of digital image processing techniques have been successfully employed for objective assessment of tea quality and the following applications were developed:

Fermentation end-point detection

Determination of optimum point in fermentation process is crucial for quality in manufactured black tea. Over or under fermentation may lead to significant quality degradation. Traditionally, the fermentation end point is determined by two physical parameters; namely: (a) observing the odor (apple type flavor) and simultaneously, (b) monitoring the leaf colour (coppery brown).

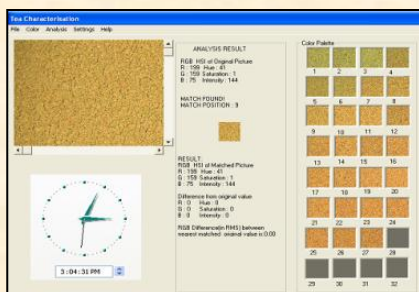
An Image processing based e-vision system has been developed to detect the end point of fermentation using a suitable color matching algorithm backed-up with the soft computing technique. During training of the software, a color-palette /image database is required to be created with taking color images of the leaf with various stages of fermentation process. This is called a standard image database. During the actual fermentation process, any leaf image at any stage of the fermentation process can be compared against those of the standard database to determine an estimation of the remaining time for fermentation. Being physical, this colour comparison is a very convenient tool to determine end point of fermentation instantly with a high degree of accuracy, repeatability with respect to finished tea quality. The software framework enables data logging, audio-visual alarm annunciation, etc.

Finished Tea Classification

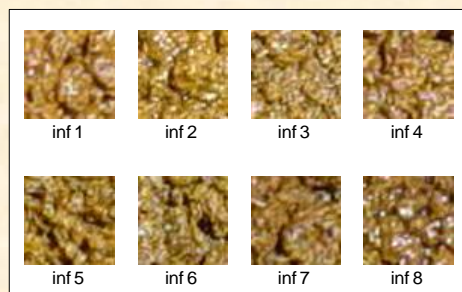
Since the beginning of the tea industry, experts have been traditionally measuring the quality of the processed tea by measuring grain size, appearance, and liquor color, infusion and flavor in a subjective manner (n a 1 to 10 scale) to determine the quality of manufactured black tea depending entirely on visual inspection method alone. E-vision system captures the images of various tea samples for analyzing those samples using color matching/ soft computing technique to provide a color index value (like tea tasters' score) more precisely and reliably. It also finds a suitable match from the previously created image database. Monitoring will be done based on grain-size, dry leaf texture, dry leaf appearance, liquor color (with out milk), liquor color (with milk) etc. A suitable color-matching algorithm with soft computing technique has been utilized to determine the nearest match from this image database. Ultimately this color indexing may also be correlated with the tea tastes' grading.

Manufactured Tea Gradation

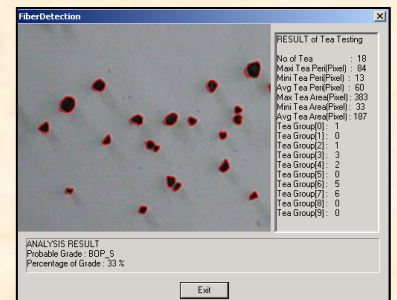
Instant estimation of manufactured tea grade at Drier-mouth is one of the desirable requirements for quality tea production. It is very difficult to find out percentage of tea grade at Drier output at any moment of time. An innovative image processing based solution has been developed to determine the percentage of various tea grades at Drier-mouth output as an estimation of consistency in quality tea production.



Fermentation



Infusion Tasting



Tea Grading