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Research Article

Application of Electronic Nose to Predict the Optimum Fermentation Time for Low-Country Sri Lankan Tea

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The fermentation stage is vital during the black tea manufacturing process to produce the best-quality tea. The oxidation of tea biochemical compounds results in the appearance of characteristic smell peaks during the fermentation stage. These subtle changes in tea aroma are hard to detect unless one is a trained personnel. Here for the first time, we applied e-nose to monitor the fermentation process of Sri Lankan low-country tea. In this study, detection of smell peaks during fermentation was conducted by a custom-made e-nose (Digi-Nose) with four gas sensors. Singular value decomposition (SVD) is applied to eliminate the noise and dimensionality reduction in the sensor responses observed. The prediction of the time of appearance of smell peaks was conducted with a support-vector machine (SVM). Finally, theaflavin content with time was compared to validate the optimum fermentation times observed with an e-nose.

1. Introduction

Tea is a popular beverage due to its stimulating effects and health benefits consumed by people all around the world. There are several different tea varieties such as black tea, green tea, and oolong tea based on the level of oxidation of polyphenolic compounds. Black tea is fully oxidized tea. The production of black tea has several steps such as withering, rolling, fermentation, drying, and finally sorting and packaging. Among them, fermentation is the critical stage and it plays an important role in determining the quality of final black tea.

In this stage, chemical constituents and enzymes react in the presence of oxygen to produce polyphenolic compounds due to the stress initiated by plant cell rupture [1]. In addition, physical parameters (humidity and temperature) and thicknesses of the fermentation bed have a significant impact on the quality of tea produced [2]. The fermentation stage results increase in theaflavin (TF) and thearubigin (TR) with time due to the oxidation of catechins and their gallates. [3, 4]. TR content of tea is always considerably higher than the TF, and the preferred ratio of TR: TF is 10 : 1 [4]. The levels of TF increase during fermentation and reach a maximum point and then decrease while thearubigin is increasing [3, 4] with time. The golden color of tea liquor corresponds to high TF content, while the dull color in tea liquor is a result of over fermentation [5]. If the tea particles are underfermented or overfermented, it leads to less tea quality. Therefore, finding optimum fermentation time is important [3, 4].

The aroma of the brewed tea is another important factor setting the price for tea. The aroma of tea particles during the