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CLASSIFICATION OF TEA SAMPLES WITH IRIDIUM NANOPARTICLES INCORPORATED ACTIVATED CARBON ELECTRODE

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ABSTRACT

Tea is generally classified as green non-fermented tea to black fermented tea depending upon the process of production. It is highly season-specific and climate dependent in all over the world. Leaves are plucked from the field and brought to processing. Conventionally tea samples are tested by expert human panels called “tea tasters”and the gradation of tea is done on the basis of marks that are given by these tasters which are highly subjective with numerous problems like inaccuracy and non-repeatability, laborious and time consuming due to various human factors like individual variability, decrease in sensitivity due to prolonged exposure, infection, and adversemental state at different times. Green tea samples were collected from Tocklai experimental station, TRA, Assam and the total polyphenol contents of tea samples were calculated by UV spectrophotometer using Gallic acid as standard. In this paper, we attempted to synthesize iridium nanoparticle by simple chemical method using sucrose, iridium trichloride, nitric acid and the prepared iridium nanoparticles incorporated activated carbon was used as working electrode in typical cyclic voltammetry study to analyze different tea samples. The structural information and morphology of the synthesized iridium nanoparticle were done by using x-ray diffraction (XRD) and Field Emission Scanning Electron Microscopy (FESEM). Principle component analyses (PCA) was performed in clustering tea samples which showed the discrimination of tea samples.

Keywards:*Iridiumm nanoparticles, Total poly phenols, Discrimination, Principal component analysis*

INTRODUCTION

Traditionally tea is served as black but in recent years green tea is becoming popular due to presence of antioxidant compounds like tea polyphenols, tea caffeine, amino acids, saponins, etc. The non-fermented product i.e, green tea obtained by leaves desiccation which is an excellent source of polyphenolic antioxidants. Large numbers of compounds are presented in gree tea as catechins and GTCs [1, 2]. The catechins present in green tea are commonly called polyphenols. The major catechins found in green tea are (-)-epicatechin, (-)-epigallocatechin, (-)-epicatechin-3-gallate, and (-)-epigallo-catechin-3-gallate. The total polyphenol content is one of the major parameters for the evaluation of tea quality and it's assay should be applied for the quality control of manufactured and imported teas. These substances show a strong antioxidant activity, and are known also for their effects on human body, such as the antibacterial, antiviral and antiallergenic [3, 4]. Conventionally, quality estimation of tea samples are carried out by panels of experts known as tea tasters. They are assign score to a particular tea sample separately for aroma, flavor and taste [5]. But it depends upon so many factors such as inaccuracy and unpredictability due to several human factors like fatigue, individual variability and variable mental states [6]. There are some methods like gas chromatography [7], high performance liquid chromatography [8], lipid membrane taste sensor [9] have been developed for the quality assessment of tea. Although these methods show high accuracy, precession but that processes are time consuming and require expensive equipments, skilled manpower, and complex pretreatment of the samples. To overcome these problems inexpensive, less time consuming electrochemical methods have been developed. Classification of tea samples are done by a number of electrochemical methods like conductometry, potentiometry, pulse voltammetry, differential pulse voltammetry etc. We have used very simple, sensitive and versatile cyclic voltammetric technique for the classification of green tea samples. This is a three electrode voltammetry i.e, working electrode, reference electrode, and counter electrode.

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The potential is applied between the reference electrode and the working electrode and the current is measured between the working electrode and the counter electrode. In this technique working electrode potential is ramped linearly with time in such a way that when the ramp reaches at the set potential, the potential ramp is inverted forming a triangular signal. In the case of cyclic voltammetry only oxidation and reduction peaks are measured. As tea samples contain large number of constituents, it is not possible to consider only the peak current for data analysis. Hence we have taken the whole voltammogram for the complete analysis of data. It has been reported that, Iridium modified carbon used as working electrode have great potential for the detection of H_2O_2 released from the enzymatic reaction at a relatively low applied potential with a favorable signal-to-noise ratio which suggests that the electrode can be used for the fabrication of screen-printed biosensors [10]. In another work, a thin film electrode consisting of a 3.3% atomic concentration of iridium nanoparticles dispersed in graphite-like carbon (Ir-NDC) by a simple RF sputtering method has been prepared for enzymatic glutamate detection [11].

In this work, we have attempted to synthesize Iridium nanoparticle by simple chemical route using sucrose, iridium trichoride and nitric acid. The iridium nanoparticles are incorporated by activated carbon and used as a working electrode for cyclic voltammetry study of green tea samples. We have collected the tea samples from Tocklai experimental station, TRA, Assam.