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ISOLATION AND CHARACTERIZATION OF CAFFEINE FROM WASTE TEA

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ABSTRACT

Caffeine*(3,7-Dihydro-1,3,7-trimethyl-1H-purine-2,6-dione)* is a widespread naturally occurring xanthine derivative found in a variety of plants but commonly found in coffee beans and tea leaves. Caffeine containing products have been consumed for hundreds of years for their taste, aroma and CNS stimulating properties. However there are many controversies and misconceptions about this chemical. Caffeine finds widespread applications in agriculture, in avian repellency, Military, as CNS stimulant and diuretic. The present investigation deals with isolation of caffeine from waste tea and characterization using UV-VIS and FTIR spectra.

KEYWORDS: Caffeine, Tea, Alkaloid, FTIR, UV.

INTRODUCTION

Tea and coffee are the most popular beverages for centuries, primarily due to their aroma, pleasant taste and stimulant effects.[1] Caffeine is an odourless, slightly bitter, bioactive heterocyclic amine present in more than 60 plants Drop it. It is found mostly in beverages such as coffee or tea and in chocolates. A number of products used as the counter pain relievers, headache remedies and antihistamines also contain Caffeine. In recent years, caffeine received increasing attention in food and pharmaceutical industries, due to its pharmacological properties which comprise stimulation of the central nervous system, peripheral vasoconstriction, relaxation of the smooth muscle and myocardial stimulation.[2,3] The caffeine is still facing many controversies and misconceptions like its intake could result

in enhanced risks of caffeine addiction, cancer, miscarriages, breast diseases, osteoporosis and hypertension etc.Caffeine is one of the most thoroughly investigated ingredient in the human food .In 1958, the US Food and Drug Administration (FDA)designated Caffeine as "generally recognized as safe" (GRAS) for consumption.[4]

The goal of the present study is to isolate caffeine from waste tea powder and to characterize by UV and FTIR spectra

MATERIAL AND METHOD

Materials

Waste tea (collected from restaurants), Basic lead acetate, 2 N Sulphuric acid, Chloroform were purchased from Merck Mumbai Ltd.

Methods

1) Collection of Waste Tea

The waste tea (used black tea) was collected from tea canteens and restaurants at place sangola in Solapur District of Maharashtra. The wet material was shade dried on laboratory benches and powdered and stored in well closed air-tight containers.

2) Isolation of Caffeine from Waste Tea

The waste tea was placed in a beaker and 500ml distilled water was added to it .Mixture was digested for 15 minutes.It was filtered on buchner funnel at suction. To the hot filtrate basic lead acetate solution was added drop wise to precipitate proteins and tannins. The addition was continued until no more precipitate was formed. The precipitate was allowed to settle down and the solution was filtered. To the filtrate dilute sulphuric acid was added to remove lead as precipitate of lead sulphate. The addition kept continued until no more precipitate appeared.The content was again filtered. The clear solution obtained which was concentrated to 300ml and decolourized by adding animal charcoal .The filtrate was shaken using 75 ml. chloroform in a separating funnel and the chloroform layer was collected. The chloroform evaporated on water bath to obtain crude caffeine. It was recrystalised from ethyl alcohol and melting point and TLC of pure product was done [5], [6],[7]. Caffeine was characterized by FTIR and UV spectra.

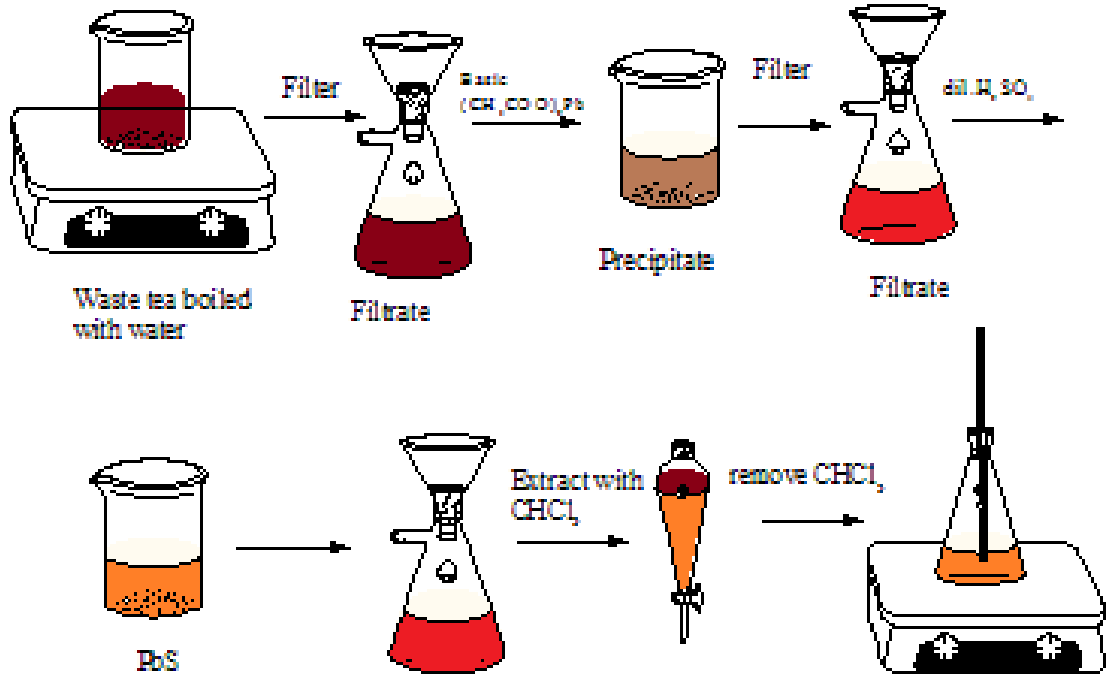

Fig. 1- Flowsheet of extraction of caffeine from waste tea

3. UV-Visible Spectroscopic Study

Ultraviolet-visible spectra were recorded using UV-Visible spectrophotometer,Model Shimadzu UV-1800 and chloroform was used as solvent. The ϰmax values of test sample and standard were recorded.

4. Thin layer chromatography(TLC)

Purity of isolated compound was checked using Thin Layer Chromatography and compared with standard. The test sample was dissolved in chloroform and applied on precoated TLC plates with Silica gel (Merck) using solvent system chloroform: acetone: methanol(40:30:30 V/V) and detection was done by observing plate under U.V.light.

5. Fourier Transformation Infra-Red (FTIR) Spectroscopy

FTIR Spectra were recorded in the wave number range of 4000-400 cm-1 using Potassium bromide on Perkin-Elmer FTIR spectrophotometer and compared with standard FTIR spectra. The KBr pellet was prepared used for this study.

RESULTS AND DISCUSSION

1. Comparisons of TLC and UV Spectroscopic study of isolated compound with Standard of Isolated Compound

UV-Visual Spectroscopic study and Thin Layer Chromatography (TLC) of the isolated compound were found almost similar to that of the standard caffeine, so this study concludes that the isolated compound may be caffeine.[8,9,10]

2. FTIR Spectra

From FTIR studies found that the corresponding spectra all the functional groups are within the range and IR spectra of isolated caffeine almost matched with the spectra of standard caffeine. This study concludes that the isolated compound was caffeine.[11,12] Corresponding spectra for isolated caffeine and the standard caffeine are given in Table 2.

The pure caffeine isolated from waste tea was characterized by FTIR and UV-Visible spectras.

1. Comparisons of UV-Visible Spectra and Thin layer chromatography(TLC) and Melting Points

UV-Visible spectroscopic study and Thin Layer Chromatography (TLC) of the isolated compound were found almost similar to that of the standard caffeine. From λmax and Rf values and M.P., it is concluded that isolated compound must be caffeine.

Table-1 Comparisons of UV Spectra (λmax), TLC(Rf) and Melting Points of isolated compound with standard

Sample	UV Spectra (λmax in nm)	TLC (Rf value)	Melting Point (in ^{0}K)
Test	273	0.66	506
Standard	273	0.66	508

2. FTIR Spectra

From FTIR studies, it has been found that the corresponding spectra showed all the functional groups are within the range.The IR spectra of isolated caffeine matched with the spectra of standard compound. Corresponding spectral information for isolated and standard caffeine is given in **Table-2**

Table-2: Comparison of vibrational frequencies of test sample and standard.

Type of Group/ Bond	Vibrational frequencies (cm^{-1}) Standard Caffeine	Vibrational frequencies (cm^{-1}) Isolated Caffeine
C=O stretch.	1703	1699
C-C stretch.	974	974
C-H bending	1361	1259
C-N stretch.	1546	1549
N-H stretch.	3111	3212
C-H stretch.	2953	2955

CONCLUSION

The caffeine was isolated from waste tea and characterized by spectral methods.Our investigation indicated that compound isolated from waste tea powder must be caffeine and thus waste tea powder could be a source of caffeine. Caffeine finds widespread applications in agriculture due to its antibacterial, antifungal , insecticidal properties and developed for house hold pest management against snails.[13] It is applied in diverse fields like avian repellency damaging rice crops, Military, as CNS stimulant and diuretic.[14,1516]

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