



FOURIER TRANSFORM-INFRA RED (FT-IR) SPECTROSCOPIC CHARACTERIZATION OF THE ESTERS OF ABRUS PRECATORIUS LEAVES

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Abstract: Esters because of their importance in the chemical industry have received great attention. In this study, esters from the leaves of *Abrus precatorius* were extracted using petroleum ether, chloroform, methanol and mixture of these solvents in different ratios. The extracts after fractionation using column chromatography were qualitatively identified with Fourier-transform infra-red (FTIR) spectroscopy. 1,2,3—trisubstituted alkane had the highest intensity in all the extract with exception of the extract obtained from chloroform:methanol (50:50) which had halo-compound as the most intense compound. The extracts also had carboxylic acid, secondary alcohol, carbodiimide, sulfonamide, alky ester, and alkene with varying intensity. The leaves of *A. precatorius* contained esters and other bioactives that could find use in pharmaceutical and other chemical industries.

Keywords: Fourier-transform infra-red, *Abrus precatorius*, esters, 1,2,3—trisubstituted alkane

Introduction

The prevalence of diseases such as obesity, diabetes, and cardiovascular disease is increasing worldwide, and a significant portion of these diseases is thought to be due to excessive consumption of sugar- and calorie-rich foods. (Xiao et al., 2024). These days, artificial sweeteners are getting more attention. So research is needed to make natural sugar with the desired amount of sweetness, low caloric value and at least observed physiological effects. (Chattopadhyay et al., 2014). Esters compounds are known for sweetness and have been synthesized into artificial sweeteners (Cloninger & Baldwin, 1974). Many synthetic sweeteners that are widely used have been shown to cause cancer and are non-nutritive. Hence demand greatly increased for natural sweetening agents, especially for non-sacchariferous sweetening agents, because they are highly potent, useful, safe and low-calorie sugar alternatives. Recently it was found that Himalayan forests are good sources of plants containing non-saccharide sweetening agents (Priya et al.).

Abrus precatorius L. is a weedy subtropical vine with leaves known to be sweet-tasting that might not necessarily derive from the presence of sugars (Inglett, 1968; Paul et al., 2013). In the last few decades a very large number of structurally unrelated compounds have been synthesized and evaluated for sweetness, carbohydrates, nitro - anilines, benzamides, amino acids, dipeptides, dihydrochalcones, flavonoids, isocoumarins,

sulfamates, oximes, saccharins, acesulfames, urea derivatives, sesquiterpenes, diterpenes, triterpenes, and some sweet substances isolated from plants (Dwivedi, 2022).

Fourier transform infra-red (FTIR) spectroscopy, a rapid, nondestructive, and a time saving analytical tool has been used to detect several ranges of functional groups. It is sensitive to variations in molecular structure and also provide information on the basis of chemical composition and physical state of the sample being investigated. (Cocchi et al., 2004). It is among one of the most widely method used in the identification the chemical constituents, elucidate the compound structures, to suggest and offer an insight into its uses in traditional medicine (Ashokkumar, 2014; Muthukumaran et al., 2017). This study was designed to identify the phytoconstituents in the different fractions from the leaf of *A. precatorius* using their FTIR profile.

Materials and Methods

Reagents

Every reagent that was used were of analytical grade. Chloroform (Surechem Suffolk, England), Methanol (Lobachemie PVT, Mumbai, India), Ethanol (SIGMA-ALDRICH, Chemie GmbH, Steinheim), Sodium hydroxide (BDH Chemicals Ltd, Poole England), Ferric chloride (BDH Chemicals Ltd, Poole England), Concentrated Sulphuric acid
Sample Collection

Abrus precatorius L. leaves were collected from the botanical garden of the Federal Polytechnic, Ilaro, Nigeria. Washed, air-dried and pulverized using an industrial blender (BLP404 (DE)

Extraction of esters from *A. precatorius* leaves

The air dried powdered leaves (500 g) was soaked in methanol (95%) for seventy two hours, at room temperature and was stirred intermittently. The methanolic layer was decanted off, the mixture was then filtered with muslin cloth, and filter papers to obtain a filtrate that was concentrated with a vacuum rotary evaporator (Eyela N-1300) at 70 °C.

Phytochemical screening

The extracts were screened for saponins, flavonoids, glycosides, cardiac glycosides, tannins, phenols, terpenoids, alkaloids, steroids, quinones and anthraquinones as described by Ayoola et al. (2008) and Samejo et al. (2013).

Isolation and purification of bioactive compounds

Seven grams of crude extract was fractionated using gravity column Z163988-1IA (70 cm × 24 mm × 28 mm, Zigma-Aldrich, St. Louis, MO, USA) as described by Bajpai *et al.* (2016) and eluted under gravity with solvents of differing polarities. The extracts obtained were concentrated on a vacuum rotary evaporator (Eyela N-1300) and freeze dried (DYNAVAC, Dynavac Engineering, Australia)

Results

The results of the phytochemical screening of *A. precatorius* leaves suggested the presence of alkaloid, tanins, cardiac glycosides, phenol and saponins, flavonoids that are consistent with previous studies (Lebri *et al.*, 2015).

Table 1: Solvent system used in the column-chromatography for the isolation of esters from *A. precatorius*.

Solvent	Ratio	Volume (mL)	Fraction
Petroleum ether : Chloroform	80:20	500	1
Chloroform : Methanol	80:20	500	2
Chloroform : Methanol	50:50	500	3

Table 2: FTIR spectrum Chloroform and Methanol (80:20)

Peak Number	Wavenumber (cm ⁻¹)	Compound	Intensity	Type of compound
1	782	C-H	96.61	1,2,3-trisubstituted Alkene
2	902	C=C bending	92.56	Alkene
3	1092	C-O stretching	87.58	secondary alcohol
4	1218	C-O stretching	36.21	Alkyl ester
5	1356	S-O stretching	41.28	sulfonamide
6	1420	O-H bending	79.07	Carboxylic acid
7	1707	C=O stretching	24.07	Carboxylic acid
8	3000	C-H stretching	94.62	Alkene

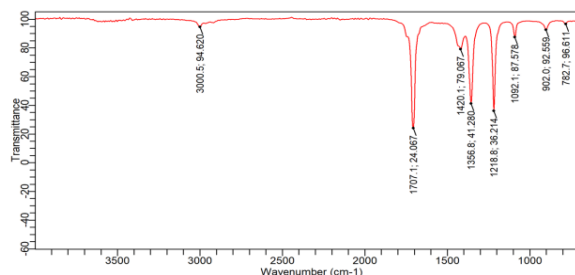


Fig. 1: FTIR spectrum of petroleum ether and chloroform (80:20)

The FT-IR analysis of the three fractions obtained showed different absorption bands with different intensities which indicated different functional groups. Prominent absorption band were observed 3000-782, 3004-782, and 3004-670 cm⁻¹ for fractions 1, 2, and 3, respectively. 1707, 1356, 1218 cm⁻¹ were observed in all the three fractions, this indicates the presence of carboxylic acid, phenol and amines containing phytochemicals. Petroleum ether: chloroform fraction presented the bands shown in Fig.1. C-H stretching was detected at 3000 cm⁻¹ which suggest the presence of an alkene (Kakur'akov'a *et al.*, 2002). Carbonyl stretching (C=O) was observed at 1707 cm⁻¹ indicating the presence of carboxylic acid functional group, carbonyl (C=O) group is also a functional group of flavonoid, in which, stretching vibrations in carbonyl compounds was found between 1750-1600 cm⁻¹ of mid-IR (Henczkowski *et al.*, 2001)

Hydroxyl (O-H) bending absorbance at 1420 cm⁻¹ indicated the presence of a carboxylic acid causing

the stretch of the carbonyl group (Kakur'akov'a *et al.*, 2002). Sulfonamide S-O stretching absorption band were observed at 1356 cm⁻¹ indicating the presence of sulfonamide functional group. At 1218 cm⁻¹ C-O stretching absorption band was observed indicating the presence of an alkyl ester, another C-O stretching was also observed at 1092cm⁻¹ these are indicative of esters, carbohydrates and phenols (Khairudin *et al.*, 2014; Carballo-Meilan *et al.*, 2014).

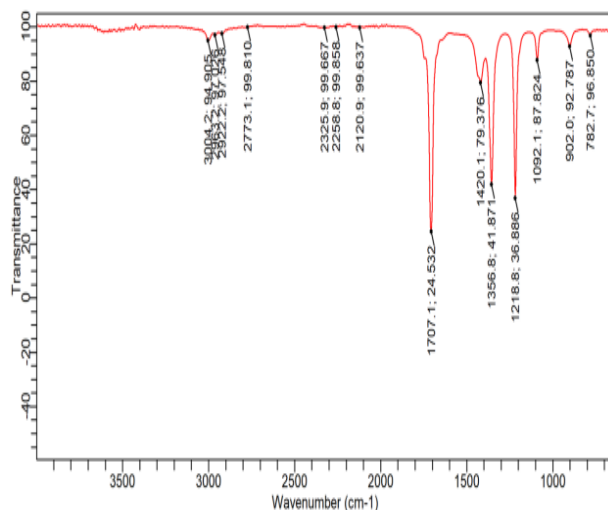


Fig 2: FTIR spectrum Chloroform and Methanol (80:20)

C=C bending indicative of an alkene and C-H bending indicating 1, 2, 3-trisubstituted compound were observed at 902 and 784 cm⁻¹, respectively.

Table 3: FTIR spectrum Chloroform and Methanol (80:20)

Peak number	Wavenumber (cm ⁻¹)	Functional group	Intensity	Type of compound
1	784	C-H bending	96.65	1,2,3-trisubstituted
2	902		92.79	
3	1092	C-O stretching	87.82	Secondary alcohol
4	1218	C-O stretching	36.89	Alkyl ester
5	1356	S-O stretching	41.87	Sulfonamide
6	1420	O-H bending	79.38	Carboxylic acid
7	1707	C=O stretching	24.53	Carboxylic acid
8	2120	C≡C stretching	99.64	Alkyne
9	2258	N=C=O stretching	99.86	Isocyanate
10	2325		99.67	
11	2773	C-H stretching	99.80	Aldehyde
12	2922	C-H stretching	97.54	Alkane

13	2963	C-H stretching	97.03	Alkane
14	3004	C-H stretching	94.90	Alkene

Chloroform: methanol 80: 20 fraction presented the bands shown in Fig. 2. Several C-H stretching were observed at different absorption bands of 3004, 2963, 2922, 2773 cm⁻¹, this would be due to stretching vibrations of CH₂ and CH₃ groups (Oliveira *et al.*, 2016) and the band at 2325 cm⁻¹ was not identified. At 2258 cm⁻¹ N=C=O was observed indicating an isocyanate.

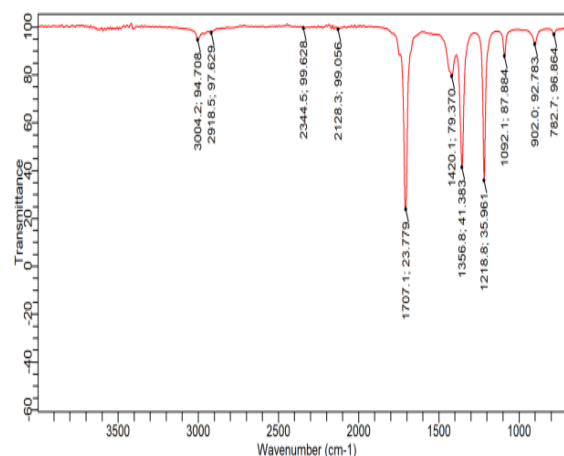


Fig 3: FTIR spectrum Chloroform and Methanol

The three fractions showed absorption at 1707 cm⁻¹ which indicates the occurrence of carbonyl functional group that is of a carboxylic acid functionality which could possibly indicate the presence of esters in the three samples. The three fractions are indicative of the presence of bending OH which suggests the presence of carboxylic acid functionality. The presence of stretching C-O absorption were evident in the three fractions at 1092 cm⁻¹ indicating the presence of primary alcohol in the three fractions. Fractions 2 showed the presence of stretching alkane absorption C-H at 2963 cm⁻¹. 2922 cm⁻¹ while fraction 3 showed alkane at 2918 cm⁻¹. Stretching alkene absorption were observed at 3000, 3004, 3004 cm⁻¹ for fractions 1, 2, and 3, respectively. 1, 2-disubstituted alkane were observed in the three fractions at 782 cm⁻¹.



Table 4: Chloroform and Methanol (50:50)

Peak number	Wave number (cm ⁻¹)	Functional group	Intensity	Type of compound
1	670	C-Br stretching	98.28	Halo-compound
2	782	C-H bending	96.86	1,2,3-trisubstituted
3	902		92.78	
4	1092	C-O stretching	87.88	Secondary alcohol
5	1218	C-O stretching	35.96	Alkyl ester
6	1356	S-O stretching	41.38	Sulfonamide
7	1420	O-H bending	79.37	Carboxylic acid
8	1702	C=O stretching	23.78	Carboxylic acid
9	2128	N=C=N stretching	99.06	Carbodiimide
10	2344		99.63	
11	2918	C-H stretching	97.63	Alkane
12	3004	C-H stretching	94.71	Alkene

Conclusion and Future Works

In this present study, qualitative photochemical screening of methanolic extract of *A. precatioris* showed the presence of alkaloids, tanins, glycosides, saponins. Fractionation of the methanolic extract which was followed by FT-IR spectroscopy showed the presence of compounds with carbonyl, hydroxyl, and carboxylic acid functionalities which can be ascribed to the presence of esters. These compounds can be further screened for different kind of biological activities. Further research will also be needed to find out the structural analysis of the compounds by the use of NMR and mass spectrophotometer.

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