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Analysis of the roughness of the ground material of Ipomoea leaves, estimate the percentages of extraction using multiple solvents, and determining the effective functional groups using infrared technology

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Abstract :

The current research aims to analyze the roughness of ground Ipomoea Purpurea leaves and determine the size of the particles using atomic force microscopy technology(AFM). The percentages of plant extract of these leaves were estimated, as the extraction process was carried out by the soxhlet device and using multiple solvents. The results showed that the percentage of plant extract of Ipomoea leaves using acetone solvent gave the best value, which is (32.14%) when compared with the rest of the solvents used in this research. In addition, the FTIR spectrum of I. Purpurea leave powder and the prepared alcoholic extracts were studied, which showed the presence of many active functional groups, including the carbonyl group and the hydroxyl group and others.

Keywords: Extraction, FTIR spectra, Ipomoea purpurea(I. Purpurea), plant extract.

تحليل خشونة المادة المطحونة لأوراق ايبوميا وتقديرالنسب المئوية للاستخلاص باستخدام مذيبات متعددة وتحديد المجاميع الفعالة بتقنية الاشعة تحت الحمراء

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مستخلص:

يهدف البحث الحالي إلى تحليل خشونة أوراق نبات ايبوميا بوربوريا المطحونة وتحديد حجم الجزيئات من خلال تقنية المجهر القوة الذرية. تم تقدير نسب المستخلص النباتي لهذه الأوراق، حيث تمت عملية الاستخلاص بجهاز ساكسوليت وباستخدام مذيبات متعددة. أظهرت النتائج أن نسبة المئوية لمستخلص النباتي لأوراق ايبوميا باستخدام مذيب الاسيتون أعطى أفضل قيمة وهي (32.14٪) عند مقارنتها مع باقي المذيبات المستخدمة في هذا البحث. بالإضافة الى ذلك تم دراسة تحليل طيف الاشعة تحت الحمراء (FTIR) لمسحوق أوراق ايبوميا والمستخلصات الكحولية المحضرة، حيث بينت وجود المجاميع الوظيفية الفعالة كثيرة منها مجموعة الكاربونيل ومجموعة الهيدروكسيل وغيرها .

الكلمات المفتاحية: الاستخلاص ، طيف الاشعة تحت الحمراء(FTIR) ، ايبوميا بوربوريا ، المستخلص النباتي.

1. Introduction

Plant waste and residues are used mainly for heating and energy and are usually consumed locally.The waste hierarchy refers to reducing, recycling and classifying these wastes based on their importance in society and reducing them in the environment and affect human health. This hierarchy leads to the extraction of the greatest amount of useful products and the generation of the least amount of plant waste [1-3].

Extraction is one of the most important processes through which the largest possible amount of plant extract is obtained. There are several factors that affect the extraction process, the most important of which are (particle size of the ground material, type of solvent used, temperature and extraction method)[4-5]. Solvent extraction is considered the best method over other methods, as it is highly efficient in extracting the components present in the plant and is also economical, especially when producing biofuels. It is also called the chemical extraction method or leaching method[6-7].

Ipomoea purpurea is a climbing plant from the ivy family that is distinguished by its tolerance of hot climatic conditions, as it tolerates heat and thirst in the summer[8-9]. This plant belongs to Convolvulaceae family includes between 600-700 species[10]. It is considered a climbing herb and is found in abundance in the tropical and subtropical regions, because of the large number of types of this plant, it is used in many fields, including medical, nutritional and others[11-14].

The plant has many names, including (morning glory, sitt el-Hassan, telephone wire and tall morning glory), and its native habitat is Central America and Mexico[15,9]. In addition, it is called “Qanqina” in Iraq, especially in Baghdad. This plant grows very quickly and spreads by spreading stem fragments . This is a deciduous shrub that reaches a height of 3 m and extends and creeps up to 15 m, with many and dense branches[16-17]. The leaves are simple, full-edged or lobed, heart-shaped and the stems are covered with brown hairs. It produces beautiful, funnel-shaped flowers that are white, pink, or blue. The flowers are tubular with short petioles in blue to purple inflorescences, depending on the type. They bloom all year round except winter. It

is commonly used as an ornament in gardens, on the sides of houses and fences, easily degraded and environmentally friendly[18-22].

Ipomoea leaves have multiple health benefits, including (removing toxins from the body, eliminating respiratory congestion and inflammation, antibacterial and antiparasitic, antioxidants, reducing the pain and infection of burn wounds on the skin, larvicide, Diarrhea, Blood purifier, Constipation, Preventing the spread or development of cancer, Relieve cough symptoms and other benefits)[23-27]. Previous studies have proven that Ipomoea leaf extract contains important chemical compounds, including flavonoids, alkaloids, saponins, tannins, proteins, amino acids and diterpenes[28-30,20].

The current research includes an analysis roughness of ground material of Ipomoea Purpurea leaves, determine the particle size, estimate the extraction percentages using different solvents, and determine the locations of the effective groups through infrared technology.

2. Material and Methods

2.1. Materials and tools used in the research:

Organic solvents (ethanol, acetone and n-hexane)\BDH, distilled water, Sensitive Balance (Sartorius\ Germany), electric grinder, electric heater, electronic thermometer, Soxhlet apparatus (Quick fit\ England) , Rotary evaporator(Yamato\ Japan) , Atomic Force Microscope apparatus (Core-AFM 2023, Nanosurf- Switzerland). Infrared Spectrometer(Shimadzu \ Japan).

2.2. Collection and grindation of I. purpurea leaves:

Fresh leaves of Ipomoea purpurea were collected from the gardens of agricultural Ramadi School / Ramadi District /Anbar Governorate . After that, some physical operations were carried out on the leaves, the most important of which was the removal of all unwanted impurities and the exclusion of infected leaves and dust, then it was washed with water well and dried at room temperature 25˚C for (8-10) days remove moisture as shown in Figure (1). The leaves were then ground using an electric grinder to obtain a fine powder in

which the size of the particles is small to increase the area of contact of the sample with the solvent, then the powder was kept in bags for the purpose of using it in the extraction process at a later time[31].

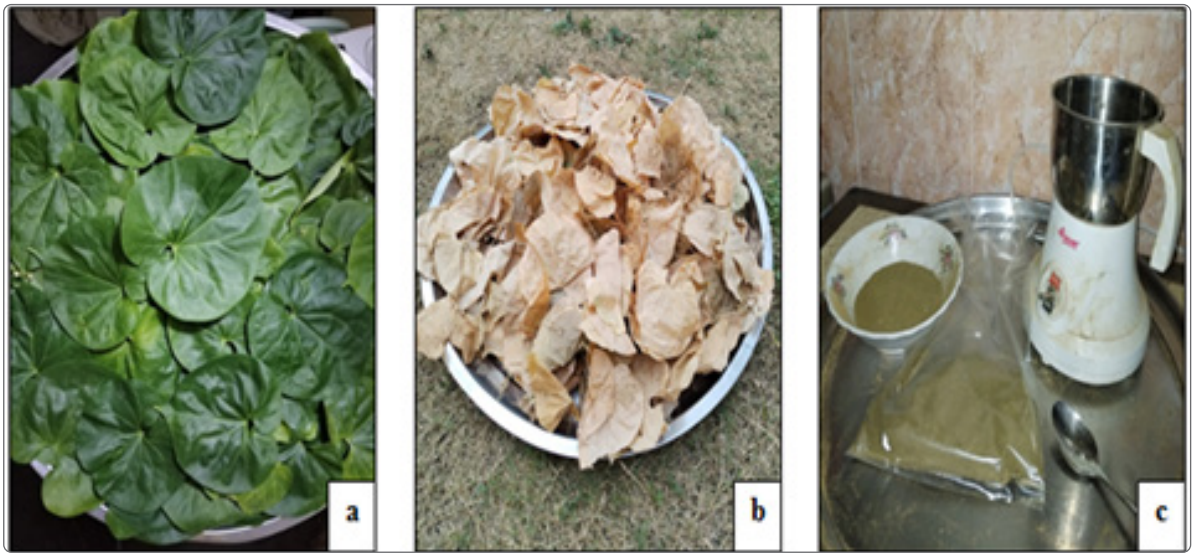

Figure (1): (a) Fresh leaves of I. purpurea, (b) Dry I. purpurea leaves, (c) I. purpurea leaves powder

2.3. AFM analysis of the ground material:

An analysis of the ground leaves of I. purpurea plant was conducted using the atomic force microscope technique(AFM) in order to identify many things, including (surface roughness, particle size, particle size distribution ...etc). This analysis was conducted at the University of Baghdad / College of Science / Department of Chemistry.

2.4. Preparation of the plant extract:

The weight of 25gm was taken from the leaves of I. purpurea, which were ground on shape Pre-fine powder and then put in a thimble (Favorit cellulose extraction thimbles: size 43 X 123 mm). Extraction was done sequentially by adding (200 ml) solvents of various polarities, including ethanol, acetone and n-hexane. The extraction process was done by soxhlet apparatus[32,5] for four hours. The sample in organic solvents was then separated from the solvent using a rotary evaporator. The extraction yield or percentage of alcoholic extraction was calculated by ap-

plying the equation(1) shown below[5]. The crude extracts were kept in a glass containers. After that stored in refrigerator at 4˚C temperatures with proper labeling until chemical measurements will be performed later.

$$\text{Yield (wt.\%)} = \frac{\text{Weight of extract produced}}{\text{Weight of leaves powder used}} \text{ X } 100\ \% \quad \ldots\ldots\ldots\ldots(1)$$

2.5. Fourier-transform infrared spectroscopy analysis (FTIR)

The FT-IR measurement of I. purpurea leaves powder and the prepared extracts was carried out in order to determine the active functional groups present in those extracts[33]. The infrared spectroscopic measurements were recorded using a SHIMADZU (FT-IR) device within the range (400-4000 cm-1) in terms of wave number, as these analyzes were conducted in University of Baghdad / College of Science / Department of Chemistry.

3. Results and Discussion

3.1. AFM measurement of I. purpurea leaves powder

This technique was used to analyze the roughness of the ground material in order to identify its surface topography (surface morphology) and determine the internal and external diameters of the material layers before performing the extraction process, which is shown in Figure (2). An analysis of the ground material particles was also carried out to confirm the presence of a large number of material atoms on their outer surfaces, as shown in Figure (3). These factors are of great importance in the extraction process, as they increase the chemical activity of the materials present in the ground plant, making them used in various chemical applications[34].

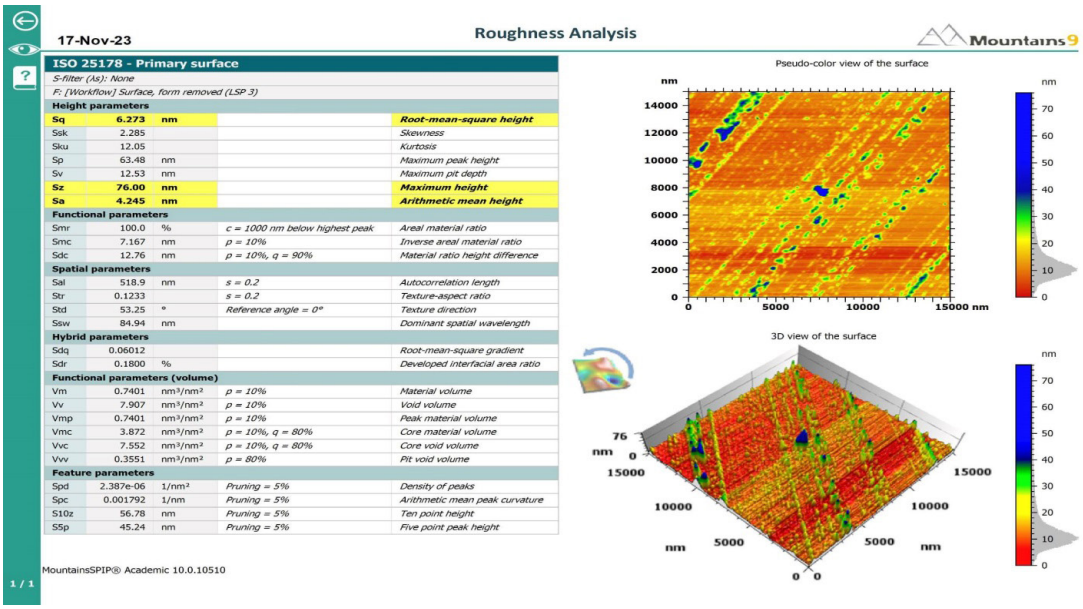

Figure (2): Roughness analysis of I. purpurea leaves powder

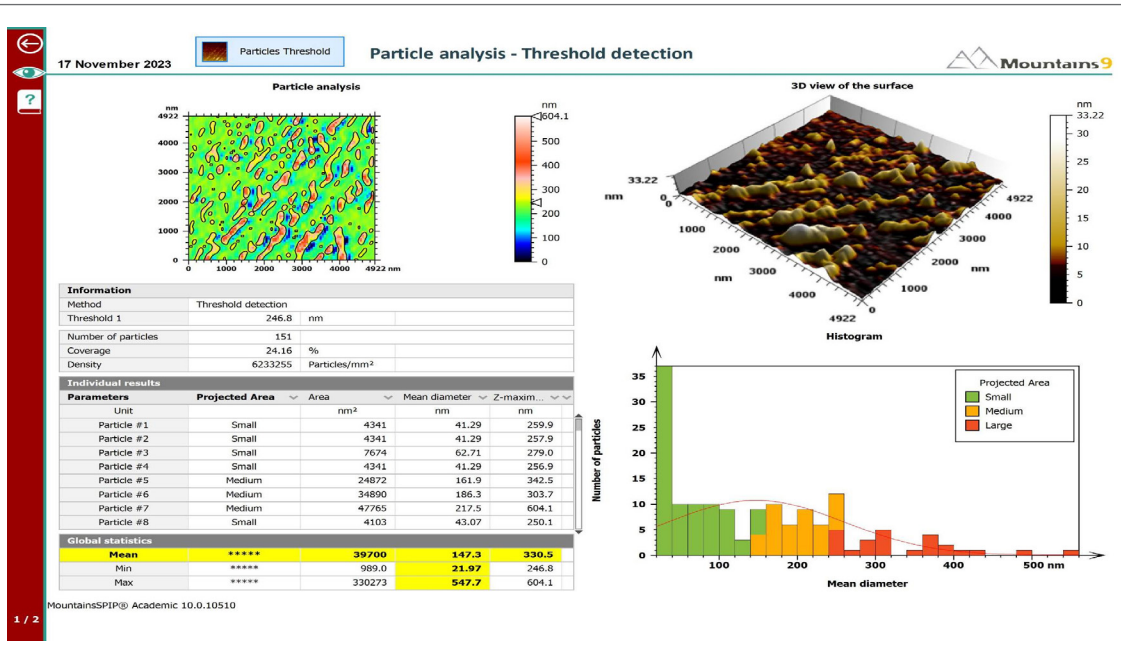

Figure (3): Particle analysis of I. purpurea leaves powder

3.2. Extraction percentages of I. purpurea leaves

The results obtained showed that there is a clear difference in terms of the percentages of the extraction process, which were calculated through equation(1) and shown in Table(1) and Figure(4). The results showed that the percentage of plant extract of I. purpurea leaves using acetone solvent gave

the best value, which is (32.14%) compared to the rest of the solvents used in this research, which are ethanol and hexane and their percentage (19.3% ,10.86%), respectively. The reason for this is depends on the polarity of the solvent selectively selected in the extraction process. In other words, this is due to the moderate low polarity index of acetone, as shown in most previous research[35-36,24].

Table (1): Extraction percentages of I. purpurea leaves by use of various solvents.

Solvent used (Organic solvent)	Extracted weight(g)	Percentages of I. purpurea leaves extract (%w/w)
Ethanol	4.825	19.3
Acetone	8.035	32.14
exaneH	2.715	10.86

Figure (4): I. purpurea leaves extract is indicated using:
(a) Ethanol solvent, (b) Acetone solvent and (c) Hexane solvent

3.3. Fourier transform infrared analysis (FTIR)

FTIR is an important technique for characterizing biologically active compounds from plant extracts [33]. In addition, the active functional groups were identified, as shown in the table (2) and figures from (5) to (8).

3.3.1. The FTIR spectra for ground material of I. purpurea leaves

Figure (5) shows the absorption package at range (3460-3417cm^{-1}) refers to the stretching of the (O-H) bond of carboxylic acid. Band at (3016 cm^{-1}) indicates the (C-H str.) aromatic. Absorption bands at between (2954-2852cm^{-1}) were due to stretching frequency (-CH_2 aliphatic). A strong band appears at the frequency (1739 cm^{-1}) refers to stretching vibration of carbonyl group (C=O). It was also observed that a band appeared at (1623 cm^{-1}) due to the vibration of bond (C=C) aromatic. While absorption band at (1436 cm^{-1}) refers to asymmetric bending of (–CH_3) in the ground material of I. purpurea leaves.

Table (2): Summarization of Infrared absorption results (cm^{-1}) for plant extracts prepared from I. purpurea leaves

NO	Group	Wave number (cm^{-1})	Absorption sites values of FT-IR			
			I. purpurea leaves	Plant extracts using multiple solvents		
			Powder	Acetone	Ethanol	Hexane
1	O-H	3500-3200	3460-3417	3463-3409	3419	3434-3417
2	C-H Stretching	3090–3000	3016	3083	3078	3012
3	-CH_2	3000–2800	2954-2852	2921-2852	2923-2852	2921-2852
4	C=O	1750–1620	1739	1733	1731	1737
5	C=C	1660-1540	1623	1635	1641	1643
6	-CH_3 Bending	1472–1427	1436	1463	1461	1463

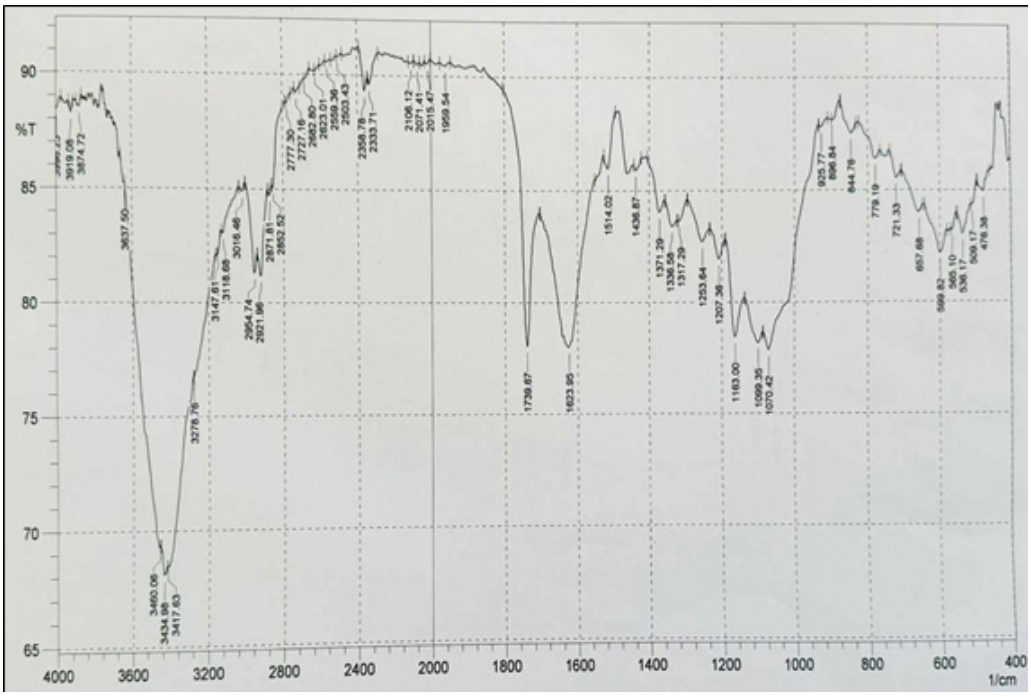

Figure (5): FTIR spectrum for ground material of I. purpurea leaves

3.3.2. The FTIR spectra for Plant extracts

Figures showed (6),(7),(8) that all plant extracts indicated the appearance of the band between (3463-3417 cm^{-1}) attributed to stretching vibration of (O-H) bond of alcohol or carboxylic acid. Characteristic absorption bands respectively: (3083, 3078 and 3012 cm^{-1}) due to stretching vibration of (C-H) aromatic. It was observed that other strong signals appeared at range (2923-2852 cm^{-1}) due to stretching symmetric and asymmetric (-CH_2 aliphatic) respectively.

The characteristic absorption at (1733, 1731 and 1737 cm^{-1}) which were due to stretching vibration of (C=O) carbonyl group and also a bands were observed at (1635, 1641 and 1643 cm^{-1}) refers to the vibration of bond(C=C) aromatic. While absorption bands at (1463,1461 and 1463cm^{-1}) refer to asymmetric bending of (–CH3) in all plant extracts. Appearance these effective functional groups in alcoholic extracts indicates the presence of many effective compounds in I. purpurea leaves, such as: (alkaloids, flavonoids, glycosides, proteins, saponins and others),which was explained by most previous research[37-,38,20,29].

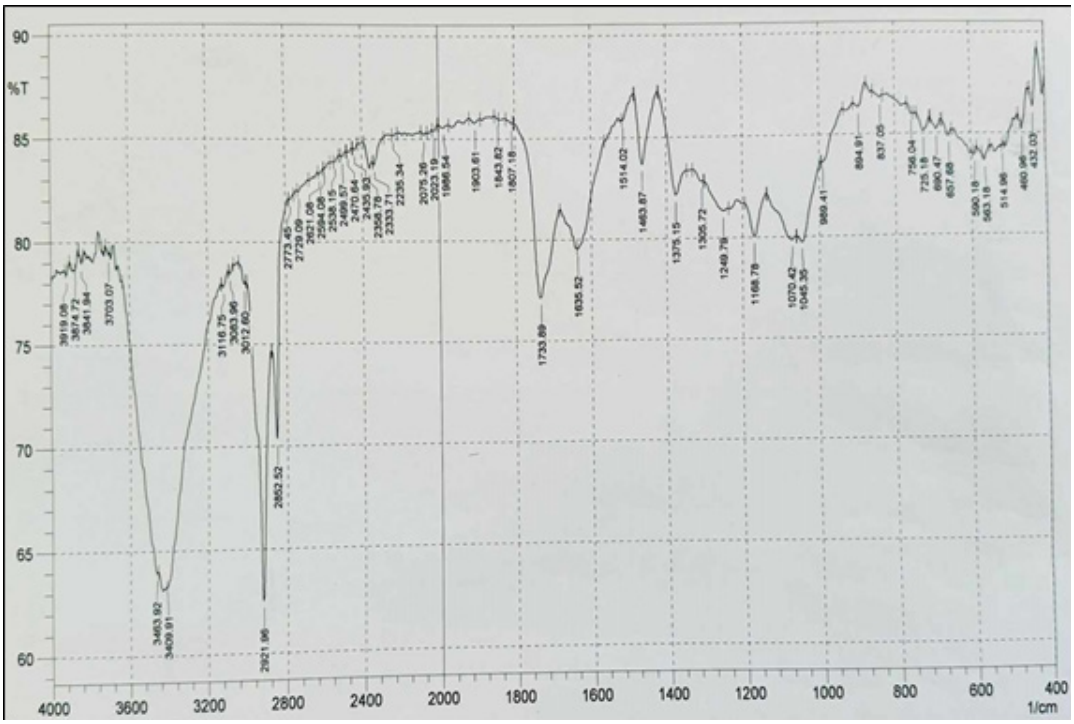

Figure (6): FTIR spectrum for plant extract of I. purpurea leaves using acetone solvent

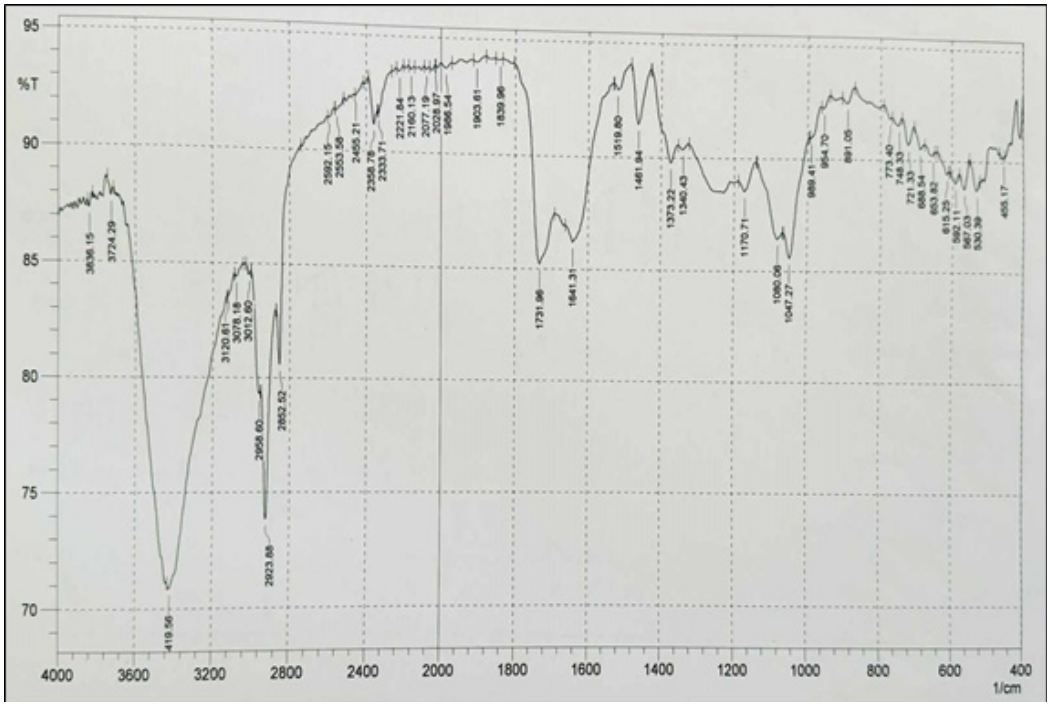

Figure (7): FTIR spectrum for plant extract of I. purpurea leaves using ethanol solvent

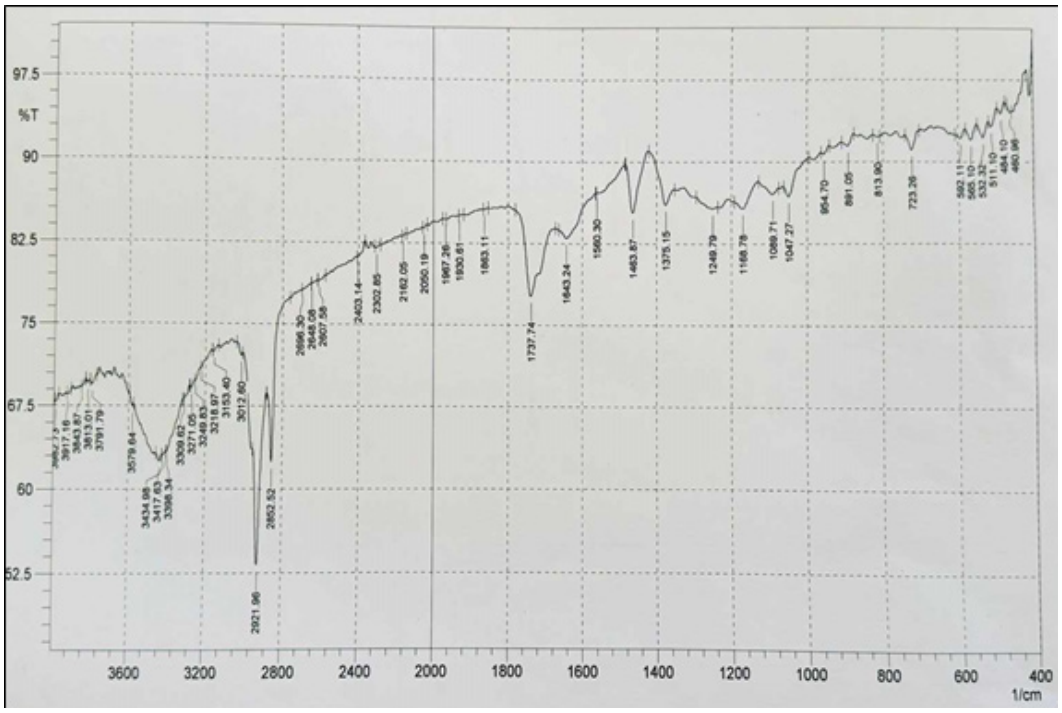

Figure (8): FTIR spectrum for plant extract of I. purpurea leaves using hexane solvent

4. Conclusions

The following important points can be deduced from the results obtained in this study:

1- Atomic force microscopy measurement showed that the powder particles of the ground material of Ipomoea Purpurea leaves were small, and this leads to high efficiency in the extraction process due to the availability of a large surface area.

2- The best solvent in the extraction process for these leaves was acetone solvent, as it gave the highest percentage.

3- The infrared spectrum showed the appearance of many active groups, this indicates the presence of many important compounds in the leaves of this plant.

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