The Effect of Changing Nano size, Energy Bonds and Solvents on the Magnetic permeability, Electric permittivity and Conductivity For Some Seeds (Aza-dirchta Indica (Neem), Trigonella Foenum Graecum (Fenugreek, Negella Sativa, and Elettaria Cardamomum)

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Abstract:

The main objective of this work is to study the effect of changing nano size, energy bonds and solvents on the magnetic permeability and electric permittivity and conductivity for some seeds. The **importance of this study** comes from the fact that organic materials like seeds are widely used in electronic devices that are made from polymers. **The research methodology** is based on

the experimental work and data analysis. It's well none thatSeed-sare widely used for human food and food supplements. Water is mainly used as its host environment. This requires studying their properties separately and this work stems from the importance of seeds in human life. This requires studying the physical properties of some widely used seeds to see how their nano structure and energy bonds affect their physical properties. To do this four seed samples which are azadirchta indica (neem), trigonella foenum graecum(fenugreek), negella sativa, and elettaria cardamomum were grinded in a powder form and their nano structure were examined using x-ray diffraction (XRD) spectrometer. The results show that the powders are nano particles having dimensions of 100, 27.3, 11.1, and 48.4nm respectively. Their energy bonds were determined using fourier transform form infrared spectrometer (FTIR). The FTIR results shows characteristic O–H,& H–bond, Fe2o3& Fe2o4, C-Br & N-O, and C-F & -C=C-H-H energy bonds. These four seeds were dissolved in water, methanol and ethanol solvents respectively to form 12 samples. The optical absorption, electric permittivity and conductivity were studied using ultraviolet spectrometer (UV). The results obtained shows that the electric permittivity, conductivity, magnetic permeability changes with the energy bonds, solvents and nano size.

المستخلص :

هـو دراسـة تأثـير تغيـر حجـم النانـو وروابـط الطاقـة والمذيبـات عـلى النفاذيـة المغناطيسـية والسـماحية الكهربائيـة والتوصيـل لبعـض البـذور. **تـأتي أهميـة الدراسـة** مـن حقيقـة أن المـواد العضويـة مثـل البـذور تسـتخدم عـلى نطـاق واسـع في الأجهـزة الإلكترونيـة المصنوعـة مـن البوليمـرات. تعتمـد منهجيـة الدراسـة عـلى العمـل التجريبـي وتحليـل البيانـات. مـن الجيـد أن البـذور تسـتخدم عـلى نطـاق واسـع في أغذيـة الإنسـان والمكمـلات الغذائيـة وتسـتخدم الميـاه بشـكل رئيـسي كبيئـة مضيفـة لهـا وهـذ ايتطلـب دراسـة خصائصهـا بشـكل منفصـل وهـذا العمـل ينبـع مـن أهميـة البـذور في حيـاةا لإنسـان. يتطلـب هـذا دراسـة الخصائـص الفيزيائيـة لبعـض البـذور المسـتخدمة عـلى نطـاق واسـع لمعرفـة كيـف تؤثـر بنيتهـا النانويـة وروابـط الطاقـة عـلى خصائصهـا الفيزيائيـة. للقيـام بذلـك، تـم طحـن أربـع عينـات مـن البـذور وهـي (النيـم) و (الحلبـة) والحبـة السـوداء والهبهـان ،في شـكل مسـحوق وتـم فحـص هيكلهـا النانـو ي باسـتخدام مطيـاف حيـود الأشـعة السـينية (XRD). أظهـرت النتائـج أن المسـاحيق

عبـارة عـن جسـيم اتنانويـة بأبعـاد 100 و 27.3 و 11.1 و 48.4 نانومـتر عـلى التـوالي. تـم تحديـد روابـط الطاقـة الخاصـة بهـم باسـتخدام تحويـل فوريـيه مـن مطيـاف الأشـعة تحـت الحمـراء (FTIR). تُظهـر نتائـجFTIR حيـث وجـد ان روابـط الطاقـة المميـزة لهـا هـي H – Oو&bond – H Fe2o3 C-F &-C = C-H-HوC-Br & N-Oو& Fe2o4 عـلى الترتيـب. تـم إذابـة هـذه البـذور الأربعـة في المـاء والميثانـول ومذيبـات الإيثانـول عـلى التـوالي لتشـكيل 12 عينـة. تمـت دراسـةا لامتصـاص البـصري، السـماحية والتوصيليـة الكهربائيـة باسـتخدام مقيـاس الطيفـف وقالبنفسـجي (UV). أظهـرت النتائـج المتحصـل عليهـا أن السـماحية الكهربائيـة، والتوصيليـة، والنفاذيـة المغناطيسـية تتغـير بتغـير روابـط الطاقة،والمذيبات،وحجـم النانـو.

Keywords: azadirchta indica (neem) seeds, trigonella foenum graecum seeds, negella sativa seeds, and elettaria cardamomum seeds, methanol, ethanol and water, nanoparticles, UV-Visspectrometer,FTIR,XRD.

The recommendation of this study requires extending this work to include other seeds and student other physical properties.

Introduction:

Nanotechnology is an interdisciplinary field of the science of physics, chemistry and materials sciences, meant for the design and fabrication of nano materials and their applications. This branch of science is destined to understand the fundamental physical and chemical properties and the phenomenon of nano materials and nanostructures and because of the novel applications of nano materials, the science of nano materials has evolved as a frontline research area (1, 2). Feynman pointed out the importance of nanotechnology at the annual meeting of the American Physical Society in 1959, in the classic science lecture entitled “There is plenty of room at bottom”. In the last three decades, many discoveries and inventions have been made in the field of nano science in terms of fabricating new materials and utilizing them for applications. Various new experimental techniques, with unique and desired properties of nano materials fabrication have been discovered. Considerable research efforts with different synthesis methods have given birth to different class of nano materials, typically classified into four categories based on their dimensionality, Zero dimensional

(0D), one dimensional (1D), two dimensional (2D), and three dimensional (3D). Quantum dots and the individual molecules fall in the0-dimensional structures where the nanoparticles are isolated from each other and the electros are confined in 3-D [3, 4]. One dimensional nanostructure (nano wires, nano rods, nano tubes, and nano obelte…) where at least one of the dimensions goes in the range of nano scale order are being highly utilized and have versatile application in the nano device fabrications. Thin nano films lie in the two dimensional structures and are studied extensively for the utilization of nano device application (5, 6). Three – dimensional nano materials include powders, fibrous, multilayer and polycrystalline materials in which the 0D, 1D and 2D structural elements are in close contact with each other and from interfaces. An important type of three- dimensional nano structured materials is a compact or consolidated (balk) polycrystalline with nano size grains, whose entire volume is filled with those nano grains. Applications of nano science in the field of medicine specifically that are related to the food supplements and seeds used in human food are very important. This comes from the fact that recently the food supplements and seeds were shown to play an important role in human health and life.Nanotechnology deals with the materials at nanoscale and the nanoparticles are being considered as its fundamental building blocks. The nanoparticles exhibits completely new and improved properties as compared to their bulk counterpart due to variation in specific characteristics such as size, distribution and of the particles which give rise to larger surface area to volume ratio (7). Metal nanoparticles have tremendous applications in the field of science and technology due totheir unique electronic, mechanical, optical and magnetic properties.In recent years the seeds nanoparticles have greatly focused the researcher's attention because of their important application as antimicrobial, catalytic, textile fabrics and plastics to eliminate micro organisms

(8). The seeds nanoparticles are specifically used as antibacterial/ antifungal agents in biotechnology and bioengineering. They can be used for targeted drug delivery which is more effective and having fewer side effects as compared to its bulk counterpart. The seeds nanoparticles can be synthesized by number of physical and chemical techniques (9-10).

Materials and Methods

Four samples azadirchta indica (neem) seeds, trigonella foenum graecum seeds, negella sativa seeds, and elettaria cardamomum seeds (see figures 1, 2, 3, and 4) were dissolved in three different solvents (water, methanol and ethanol.

Preparation of Samples:

Trigonella foenum graecum seeds were collected from the local market. The T. foenum graecum (seed) was powdered finely using morter and pestle. Five gram powder was dissolved in 250 mL beaker Including 25 mL (Distilled water, ethanol and methanol) for 72 hours. The neem seeds were collected from the local abofroa city. The neem (seed) was powdered finely using morter and pestle, 5gram powder was dissolved in 250 mL beaker including 25 mL (distillation water, ethanol and methanol) for 72 hours. The negilla sativa seeds were collected from the local market. The negella Sativa (seed) was powdered finely using morter and pestle. Then five gram powder was dissolved in 250 mL beaker Including 25 mL (distilled water, ethanol and methanol) for 72 hours. The elettaria cardamomum seeds were collected from the local market. The elettaria cardamomum (seed) was powdered finely using morter and pestle. Then five gram powder was dissolved in 250mL beaker including 25mL (Distilled water, ethanol and methanol) for 72 hours. The prepared extracts were studied by using UV/V, FTIR and XRD techniques.

Figure (1): Dry seed of Azadirchta Indica seeds (Neem seeds)

Figure (2): Dry seed of Trigonella Foenum Graecum

Figure (3): Dry seed of negell sativa

Figure (4): Dry seed of Elettaria Cardamomum

Characterization studies:

The material Characterization Lap has a wide variety of tools in terms of their structural, composition and optical properties. The crystal structure of the samples was characterized at room temperature by using a Philips PW1700 X-ray Diffraction. The location of band position of the examined were example by using the Fourier Transform Infrared spectrophotometer (FTIR) in the rang 400 to 4000 cm^{-1} to record some location of the band positions. The optical properties were examined by using UV-visible spectroscopy.

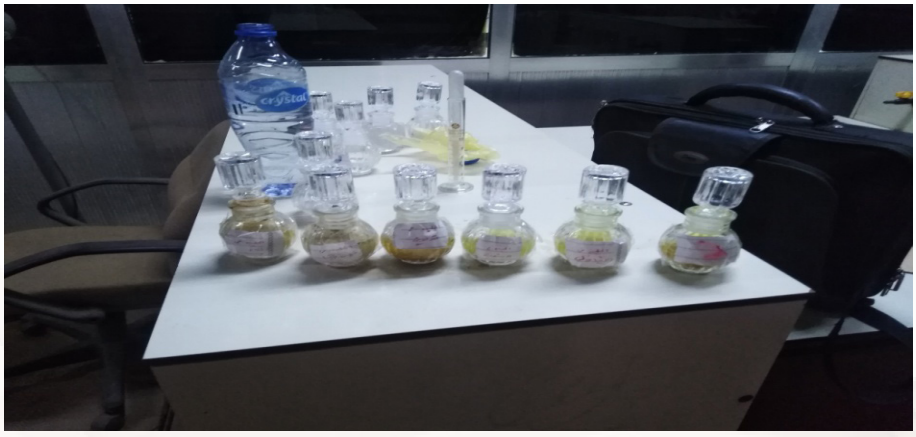


Figure (5): shows the solution of the samples.

Results and Discussion:

UV–Visible spectroscopy:

UV–Visible spectroscopy is an important technique to determine the formation and stability of metal Nanoparticle in aqueous solution.The optical properties of the 12 samples (four seeds three solvents) were studied using UV spectrometer.The UV- Spectra ofAzadirchta Indica seeds (Neem seeds) which determines the absorption, extension coefficient, refractive index, optical and electrical conductivities are shown in figures [(6),(7), (8), (9), and (10)]. The UV- Spectra ofTrigonella Foenum Graecum seeds which determines the absorption, extension coefficient, refractive index, optical and electrical conductivities are shown in figures [(1!),(12), (13), (14), and (15)]. The UV- Spectra ofNegella sativa seeds which determines the absorption, extension coefficient, refractive index, optical and electrical conductivities are shown in figures [(16), (17), (18),(19) and (20)]. The UV- Spectra of Elettaria Cardamomum seeds which determines the absorption, extension coefficient, refractive index, optical and electrical conductivities are shown in figures [(21), (22), (23), (24), and (25)]. Using some theoretical relations the electric permittivity and magnetic permeability were found and tabulated together with conductivities in table (1).

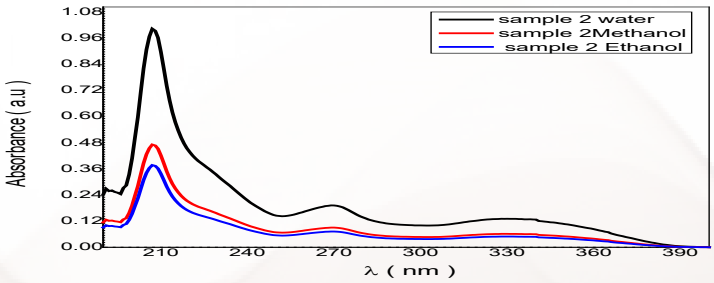


Figure (6)**:** optical Absorbance spectra of the threesamples of Azadirchta Indica dissolved by(water, methanol and ethanol).

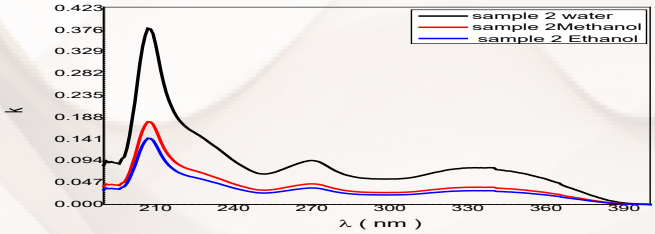


Figure (7):The variation of Extinction coefficient (K) with wavelength (λ) for the three samples of Azadirchta Indica dissolved by(water, methanol and ethanol).

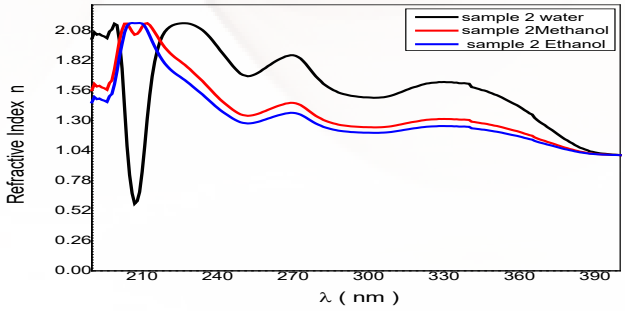


Figure (8):The variation of Extinction coefficient (K) with wavelength (λ) for the three samples of Azadirchta Indica dissolved by(water, methanol and ethanol).

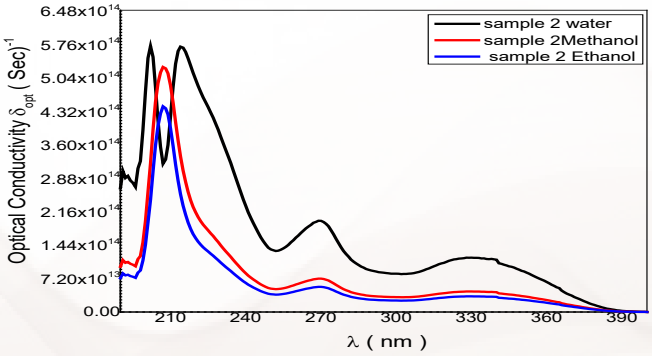


Figure (9): The Variation of refraction index (n) with wavelength of the three samples of Azadirchta Indica dissolved by (water, methanol and ethanol).

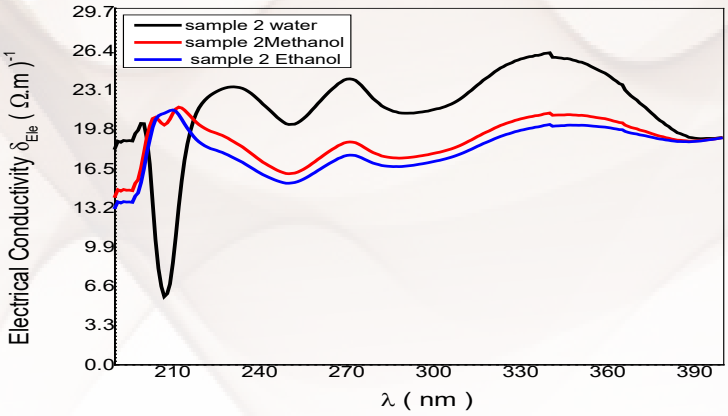


Figure (10):Plot of optical conductivity as a function of wave-length for the three samples of Azadirchta Indica dissolved by (water, methanol and ethanol).

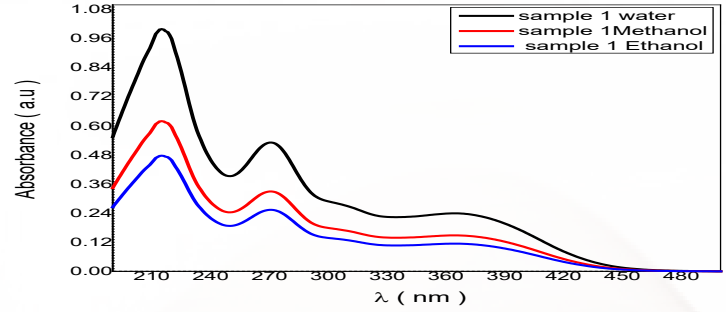


Figure (11): optical Absorbance spectra of the three samples of Trigonella Foenum Graecum dissolved by (water, methanol and ethanol).

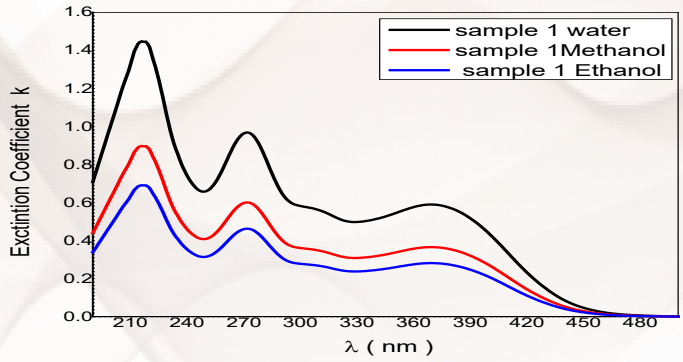


Figure (12): The variation of extinction coefficient (K) with wavelength (λ) for the three samples of Trigonella Foenum Graecum dissolved by (water, methanol and ethanol).

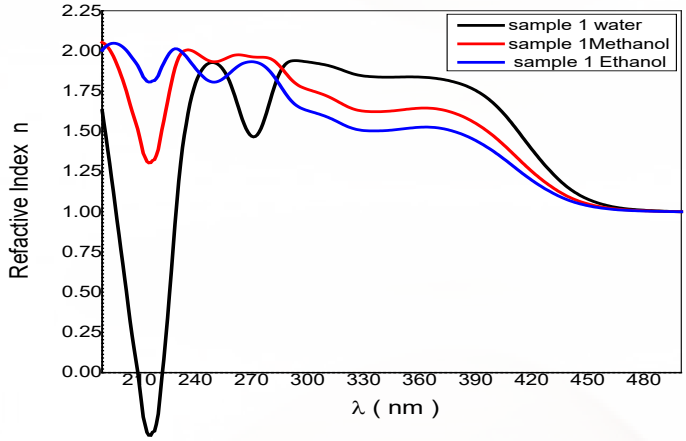


Figure (13): The Variation of refraction index (n) with wavelength of the three samples of trigonella Foenum Graecum dissolved by (water, methanol and ethanol)

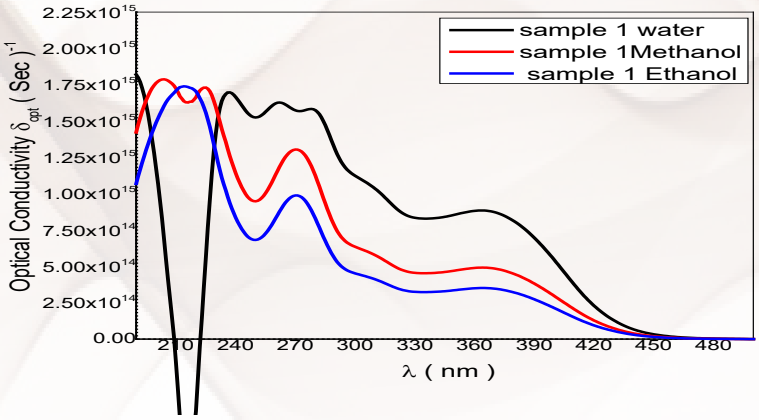


Figure (14): Plot of optical conductivity as a function of wavelength for the three samples of
Trigonella Foenum Graecum dissolved by (water, methanol and ethanol)

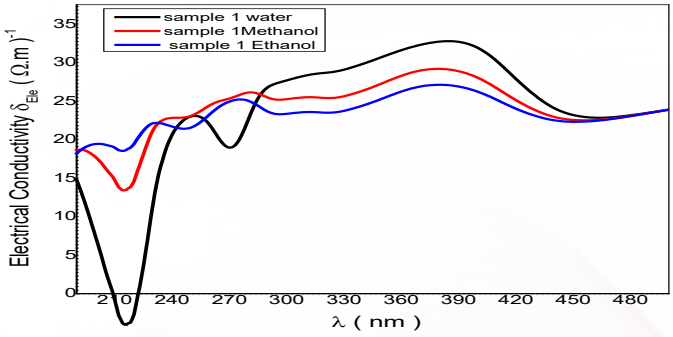


Figure (15): Plot of Electrical conductivity as a function of wavelength for the three samples of Trigonella Foenum Graecum dissolved by (water, methanol and ethanol)

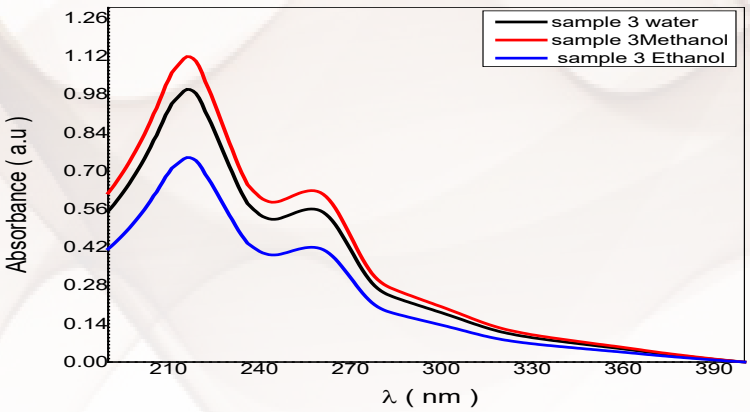


Figure (16): optical Absorbance spectra ofthe three samples of Negella sativa dissolved by (water, methanol and ethanol)

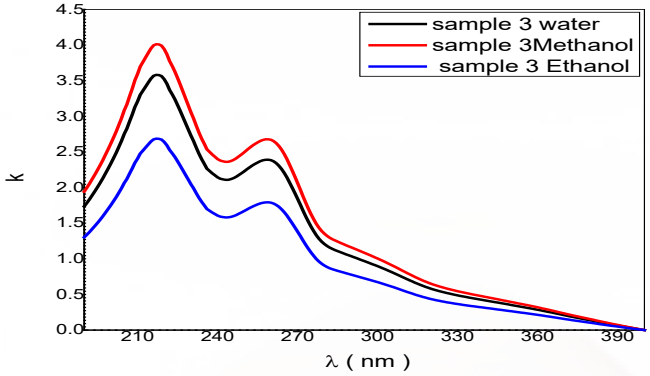


Figure (17): The variation of Extinction coefficient (K) with wavelength (λ) for the three samples of Negella sativa dissolved by (water, methanol and ethanol).

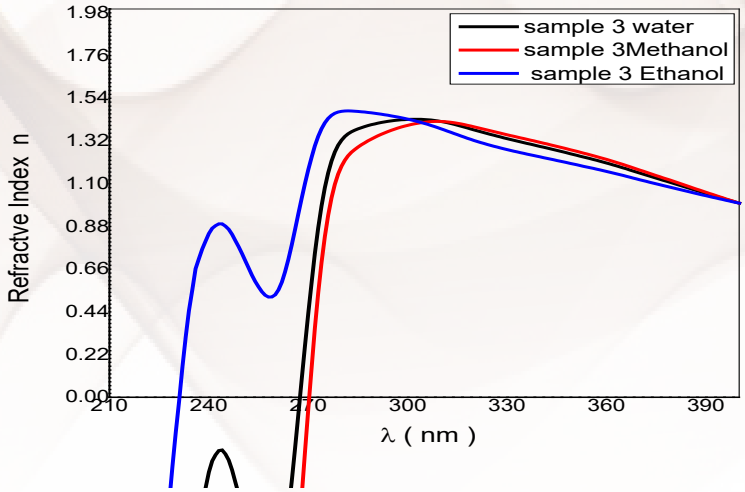
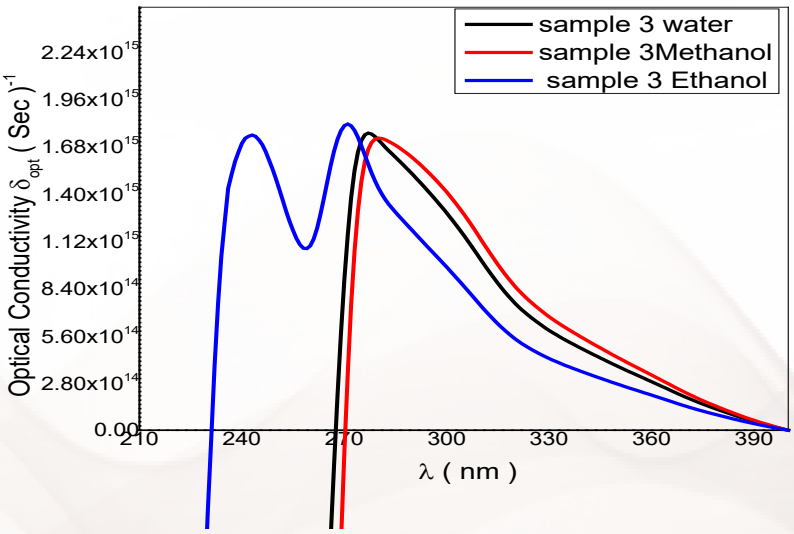


Figure (18): The Variation of refraction index (n) with wavelength of the three samples of Negella sativa dissolved by (water, methanol and ethanol).



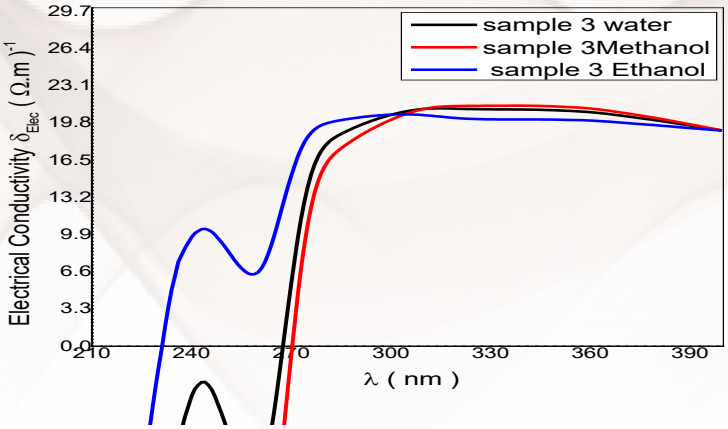
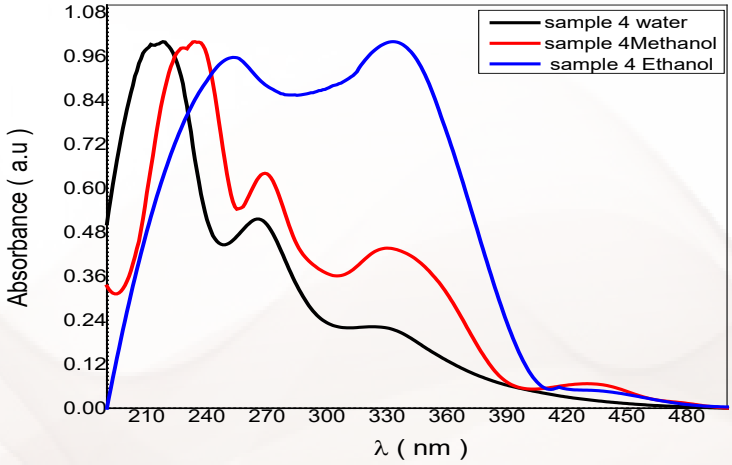


Figure (19): Plot of optical conductivity as a function of wavelength for the three samples of Negella sativa dissolved by (water, methanol and ethanol)

Figure (20): Plot of Electrical conductivity as a function of wavelength for the three samples of negella sativa dissolved by (water, methanol and ethanol).



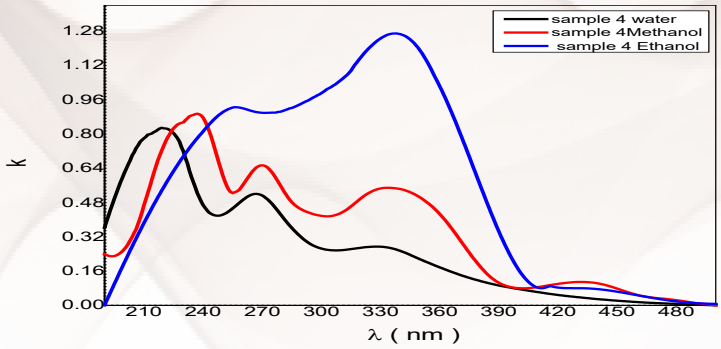


Figure (21): optical Absorbance spectra of the three samples of Elettaria cardamom dissolved by (water, methanol and ethanol)

Figure (22): The variation of Extinction coefficient (K) with wavelength (λ) for the three samples of Elettaria cardamomum dissolved by (water, methanol and ethanol)

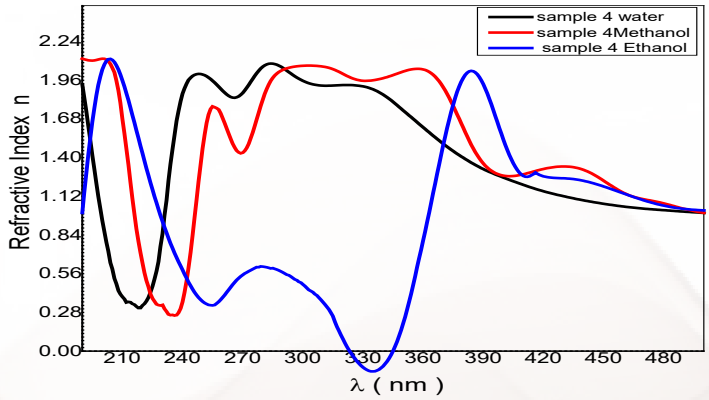


Figure (23): The Variation of refraction index (n) with wavelength of the three samples of Elettaria cardamomum dissolved by (water, methanol and ethanol)

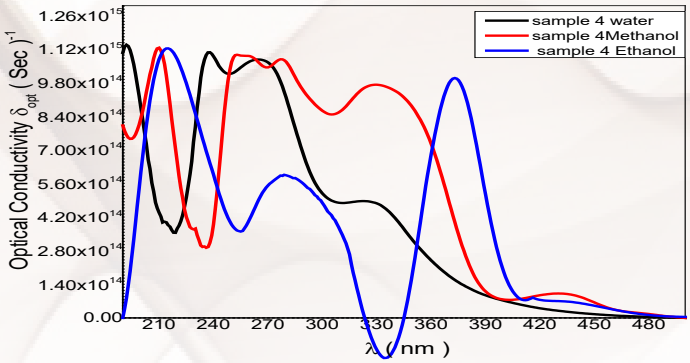


Figure (24): Plot of Electrical conductivity as a function of wavelength for the three samples of Elettaria cardamomum dissolved by (water, methanol and ethanol).

Table (1): The relations between seeds characteristic bonds, crystal size and electric and magnetic properties.

Sam/ no	Seed	Cha.co	Solve	x_s)) nm	n	K(a.u		$^{18}10^{-}$/	10^{14}/	
1	Neem	O–H,& H–bond	Water	100	2.14	0.378	4.44	11.5	5.7	26.32
2	Neem	O–H,& H–bond	Methanol	100	2.14	0.179	4.56	11.16	5.8	21.73
3	Neem	O–H,& H–bond	Ethanol	100	2.05	0.143	4.18	11.17	4.4	21.51
4	T.F	$Fe_2o_{3\&}Fe_2o_4$	Water	27.3	1.94	1.45	1.66	25.19	17	33.02
5	T F	$Fe_2o_{3\&}Fe_2o_4$	Methanol	27.3	2	0.899	3.19	13.93	17.9	29.16
6	FT	$Fe_2o_{3\&}Fe_2o_4$	Ethanol	27.3	2.05	0.69	1.66	14.64	17.4	27.16
7	N S	C-Br & N-O	Water	11.1	2.14	0.378	4.44	11.46	5.7	26.32
8	N S	C-Br & N-O	Methanol	11.1	2.14	0.179	4.55	11.18	5.2	21.73
9	N S	C-Br & N-O	Ethanol	11.1	2.05	0.143	4.18	13.19	4.4	21.51

Sam/ no	Seed	Cha.co	Solve	x_s)) nm	n	K(a.u		$^{18}10^{-}$/	10^{14}/	
10	E C	C-F & -C=C-H-H	Water	48.4	2.09	0.83	3.68	13.19	11.3	30.3
11	E C	C-F & -C=C-H-H	Meth-anol	48.4	2.11	0.89	3.76	13.16	11.3	35.05
12	E C	C-F & -C=C-H-H	Etha-nol	48.4	2.11	1.2	3.01	16.32	11.2	37.37

Fourier transforms infrared (FT-IR) spectroscopy

FTIR measurement was carried out to identify existence bimol-eculesin order to identify various phyto-chemical constituents in seeds extract and to ascertain the role they play in the reduction and stabilization of nanoparticle suspension, fourier transform infrared (FT-IR) spectroscopy was performed. It shows that the character-istic element for Azadirchta Indica seed are O–H,& H–bond, for Trigonella Foenum Graecum are Fe_2o_3 &Fe_2o_4, for negella sativa areC-Br &N O and for Elettaria Cardamomum areC-F & -C=C-H-H are shown in figures (25),(26),(27) and (28):

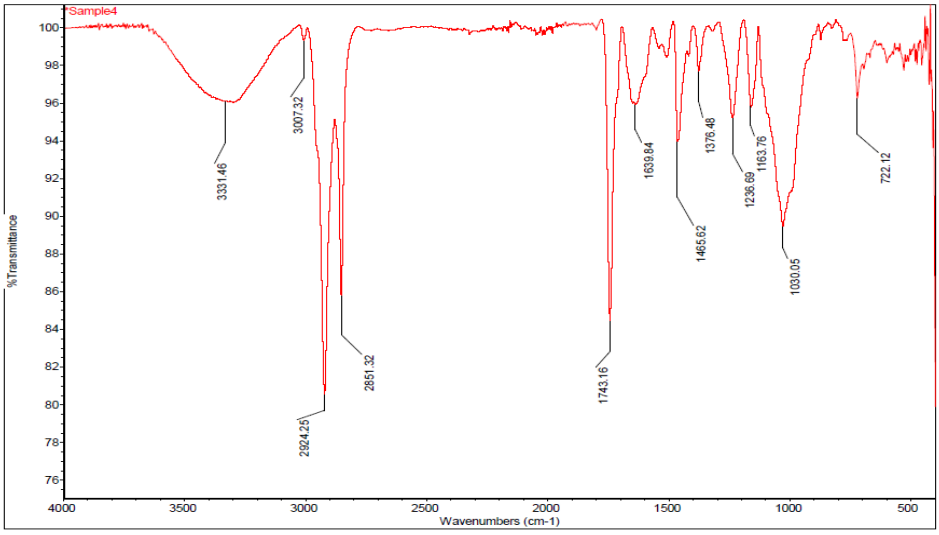


Figure (25): Fourier transform Infrared spectroscopy(FTIR) spectrum of Azadirchta Indica seeds.

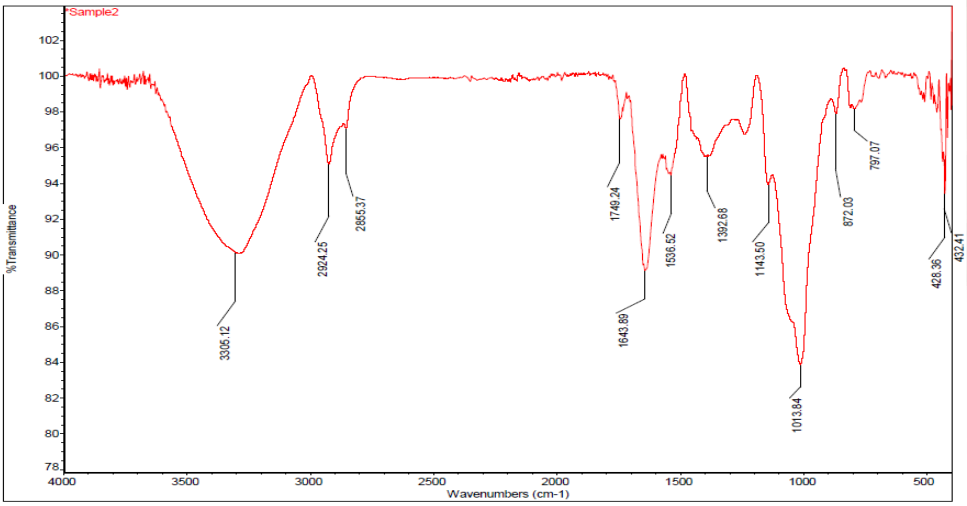


Figure (26): Fourier transform Infrared spectroscopy (FTIR) spectrum of Trigonella Foenum Graecum seeds.

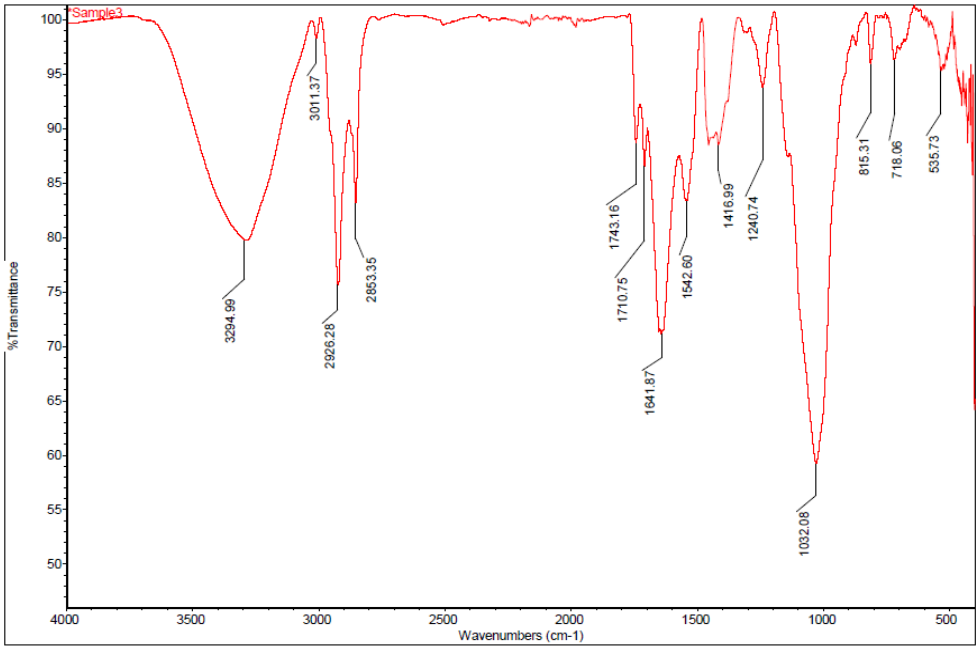


Figure (27): Fourier transform Infrared spectroscopy(FTIR) spectrum of Negella sativa seeds

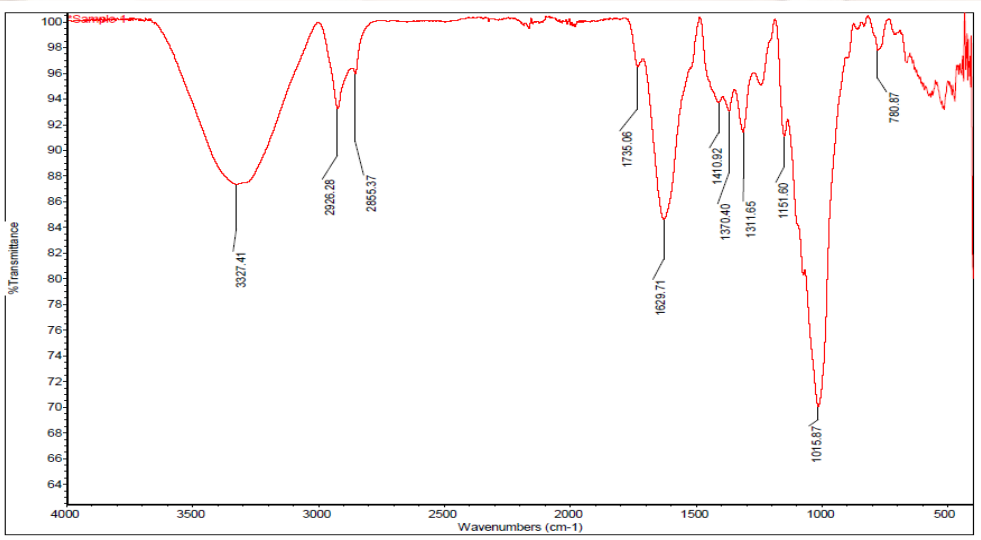


Figure (28):Fourier transform Infrared spectroscopy(FTIR) spectrum of Elettaria cardamomum seeds.

X-Ray diffraction:

The nanocrystalline nature of seeds is confirmed from XRD analysis. The powders of the four seeds were examined by XRD device to determine their crystal spacing and nano size beside their crystal form as shown in the figures and table below.

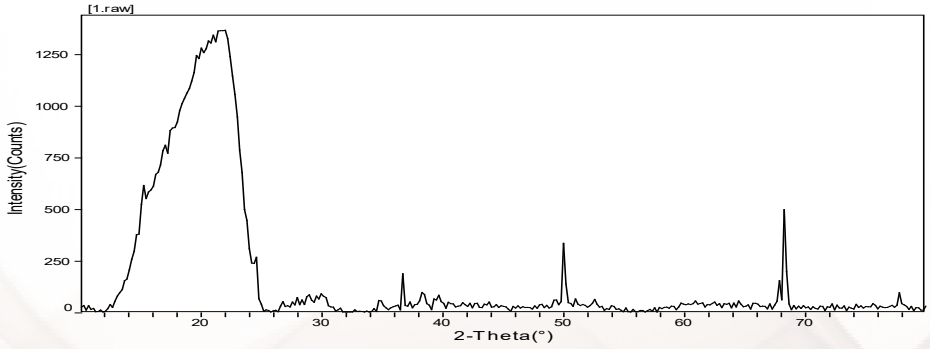


Figure (29): XRD spectrum of Azadirchta Indica be for sample.

Table (2) Lattice Constants from Peak Locations and Miller Indices [monoclinic- primitive] of Azadirachta Indica (neem).

2Θ	(d (10^{-10} m	h k l	(X_s(nm
20.063	4.4221	2 0 1	100

θ≡Diffractionangle.X_s ≡ crystal nano size.
d≡ crystal spacing.

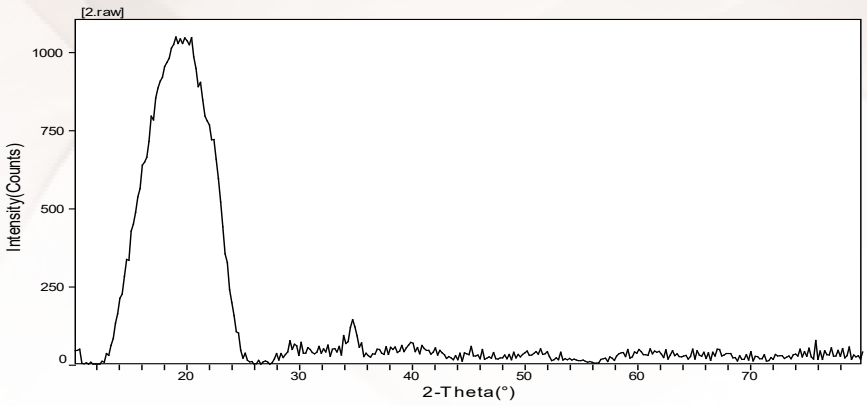


Figure (30):XRD spectrum of Fenugreek (Trigonella) after sample.

Table (3): Lattice Constants from Peak Locations and Miller Indices [Tetragonal –Primitive] ofFenugreek.

2Θ	(d (10^{-10} m	h k l	(X_s(nm
19.871	3.7831	0 02	27.3

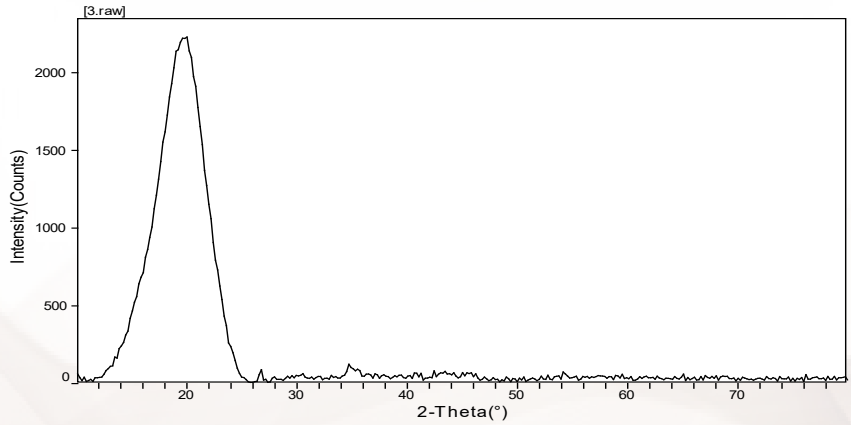


Figure (31): XRD spectrum of Nigella sativa before sample.

Table (4): Lattice Constants from Peak Locations and Miller indices[Triclinic –Primitive] ofnigella sativa .

2Θ	(d (10^{-10} m	h k l	(X_s(nm
19.191	4.621	7 2 1	11.1

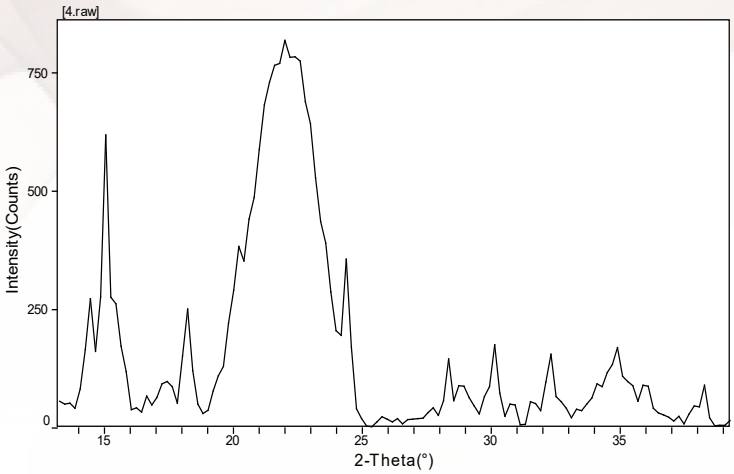


Figure (32): XRD spectrum of Elettaric cardomum after sample.

Table (5): Lattice constants from peak locations and miller indices [cubic –Primitive] of elettaric cardomum .

2Θ	(d (10^{-10} m	h k l	(X_s(nm
22.367	3.9715	2 00	48.4

Discussion:

In this work four different seeds (azadirchta indica (neem seeds), trigonella foenum graecum, negella sativa and elettaria cardamomum) were dissolved in three different solvents (water, methanol and ethanol).The optical properties of the 12 samples (four seeds three solvents) were studied using UV spectrometer. To determine the characteristic compounds which exist only in one of the seeds type, the four seeds bonds were determined using FTIR spectrometer. It shows that the characteristic bonds for Azadirchta Indica seed are O–H, & H–bond, for Trigonella foenum graecum are Fe_2o_3 &Fe_2o_4fornegella sativaare C-Br & N-O

and for elettaria cardamomum are C-F & -C=C-H-H . The UV-Spectra to azadirchta indica seeds (neem seeds) which determines the absorption, extension coefficient, refractive index, optical and electrical conductivities are shown in figures [(1), (2), (3), (4), and (5)]. The UV- Spectra to Trigonella Foenum Graecum seeds which determines the absorption, extension coefficient, refractive index, optical and electrical conductivities are shown in figures [(6), (7), (8), (9), and (10)].

The UV- Spectra to Negella sativa seeds which determines the absorption, extension coefficient, refractive index, optical and electrical conductivities are shown in figures [(11),(12), (13), (14), and (15)]. The UV- Spectra to Elettaria Cardamomum seeds which determines the absorption, extension coefficient, refractive index, optical and electrical conductivities are shown in figures [(16), (17), (18), (19), and (20)]. Using some theoretical relations the electric permittivity and magnetic permeability were found and tabulated together with conductivities in table (1). The results obtained indicate that all these parameters changes with the solvent type and seed type. The electric conductivity for Azadirchta Indica seeds (Neem seeds) are (26.32, 21.73, and 21.51), Trigonella Foenum Graecum seeds are (33.2, 29.16 and 27.16), Negella sativa seeds are (26.32, 21.73 and 21.51) and Elettaria Cardamomum seeds are (30.3, 35.05 and 37.37)for water, methanol and ethanol respectively.

The XRD results for all samples powders indicates that all samples are in the form of nano particles, as shown in figures (1), (2), (3) and (4) and tables (2),(3), (4).and (5).

For the magnetic permittivity it is very interesting to observe that the existence of Fe in fenugreek which has high magnetic moment increases it considerably where it attains maximum value of 25.19×10^{-18} for water (as shown by tables (1).

The result of the study:

- The XRD analysis is shows that all seeds are in the form of nano particles.

- The change of chemical bonds in the four seeds changes the conductivity as well as electric permittivity and magnetic permeability where the existence of iron band in the fenugreek makes its magnetic permeability larger.
- The change of solvents which acts as a matrix for the four seeds changes optical absorption, conductivity, and electric permittivity and magnetic permeability.

Conclusion:

The change of chemical bonds and crystal size of the four seeds (Azadirchta Indica (Neem seeds), Trigonella Foenum Graecum, Negella sativa and Elettaria Cardamomum) due to the change of solvents affect and change electric permittivity and conductivity beside the magnetic permittivity.

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