Journal Homepage: - www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI: 10.21474/IJAR01/4302
DOI URL: http://dx.doi.org/10.21474/IJAR01/4302
ISSN NO. 2320-5407

RESEARCH ARTICLE

GREEN SYNTHESIS OF *ANNONA MURICATA* (L) ZNO NPS UV ABSORBER ON TEXTILE.

M. Anish Sharmila and *R.I. Sathya.
Department of Home Science, Gandhigram Rural Institute-Du, Dindigul 624 302, Tamil Nadu, India.

Manuscript Info

Manuscript History

Received: 18 March 2017
Final Accepted: 22 April 2017
Published: May 2017

Key words:-
Annona Muricata (L), Cotton Bleached fabric, ZnO NPs, UV absorber.

Abstract

This present study to develop an UV absorber ZnO NPs prepared by green method (GM) using Annona muricata (L) leave extract and chemical method (CM) using zinc acetate and sodium hydroxide as a substitute for the chemical method. The characterization of ZnO NPs confirmed by Ultraviolet Visible Spectroscopy, XRD, SEM, EDAX, FTIR and. UV-absorbers (ZnO NPs) coated on cotton bleached fabric were evaluated the Ultraviolet Protection Factor it showed the mean UPF 30.26 and 24.58 good and very good protection level according to Australian/New Zealand Standard (AS/NZS 4399) that revealed the significant improvement in the UV absorbing properties on treated cotton fabric

Introduction:-

UV absorbers are a substance to capable of absorbing short wave solar radiation and of restoring the absorbed energy to the environment and decrease the harmful effects of UV radiation on human skin, as well as the textile materials. [1,2] The standard rate of UV protection, is depending on numerous factors, such as weave of the material and chemical additives such as UV absorbers. [3] It has significant impact on the UV protection properties, there are various UV absorbers frequently added to the textile during manufacturing process. [4] ZnO is one of the inorganic UV absorber; the mechanism of UV absorption is semiconductor material involves the use of photon energy to excite electrons from the valence band to the conduction band. [5] The bandgap energy (ZnO =3.37 eV), which is highly depending on the degree and the kind of crystalline of the inorganic coating. [6] Excellent light fastness and UV protection has much longer period than organic UV absorbers, [5] cost effective, high yielding and simple to implement. [7]

ZnO has been obtain by precipitation in an emulsion system with zinc acetate dehydrate used as a precursor of potassium hydroxide or sodium hydroxide as precipitate agent. [8] These chemical approach productions can lead to the development of inorganic nanoparticles with large scale of fabrication. [9] There are a several essential aspects of synthesis with environmental concerns, with involving the selection of nontoxic, capping and reducing agents, the choice of harmless solvents and the development of energy accomplished using green method. [10] Green chemistry can build into a moderately pollutant free chemicals and solvents water, natural extracts from plants aqueous leaf extracts. [11]

Natural substances such as phenolic acids, flavonoids, anthraquinones and high molecular polyphenols have been considered as sunscreen agents because of their ultraviolet ray absorption in the UV region. [12,13] Plant extract contains polyol compounds which are responsible for the reduction of met ions and water soluble heterocyclic components stabilize the metal nanoparticles formed. This reduction of the metal salts and formation of

Corresponding Author:- R.I. Sathya. Professor
Address:- Department of Home Science,Gandhigram Rural Institute-Du, Dindigul 624 302, Tamil Nadu, India.

nanoparticles using plant extract mainly depends upon the choice of solvent reducing agent and the capping agent used. [14,15] Plant extracts containing bioactive alkaloids, phenolic acids, poly phenols, proteins, sugars and terpenoids are have an important role in first reducing the metallic ions and then stabilizing. [16] In general the plant chemical that protect plant cells from environmental hazards such as pollution, stress, drought, UV exposure and pathogenic attack. [17,18] The absorption of the secondary metabolites phenolic, glucoside, phenolic acids, favonoids. [19] UVB absorbing compounds other than Flavonoids, some phenolic acids (Singapyl esters) and carotenoids have recently been acknowledge to play a role in UV protection. [20]

In the case of every individual plant responses specific UV protective and adaptive have been found induction of UV absorbing phenolic compounds that afford UVB attenuation. [21,22] UVB radiation leads to increase in the amount of Flavonoids and phenolic acids [19,23] UVB attenuation, depending on their leaf structure and pigment composition, variation in susceptibility to enhance. [19,24] UVB induced accumulation of UVB absorbing compounds. [24,25]

Annona.muricata (L), commonly known as soursop, graviola, a native to the warmest tropical area in South and North America and is now widely distributed throughout tropical and subtriopical parts of the world India, Malaysia and Nigeria. [26] *A. muricata* is an evergreen, eract tree reaching 5-8 m in height. [27] Annona leaf family annonaceae, Tamil mulluchitta, [28] it is a medicinal herb is extensively accessible in India, these plant leaves, stem; root and seed all the parts are having antibacterial activity against numerous pathogens, Antitumor, Anti- parasitic, Insecticidal and Anti-microbial activities. [29,30] The extracted from its leaves treat with various skin disorders. [31] The presents on phytochemicals are alkaloids, Flavonoids, carbohydrates, cardiac glycosides, saponins, tannins, phytosterol, terpenoids and proteins. [32]

In the present work deal with the synthesis and characterization of UV absorber (ZnO NPs) Green and chemical method particles and their characterization were analysed and applied on to cotton bleached fabrics using pad-dry-cure method to evaluate the UV protection function in the treated textiles by standardized test procedures.

Material and Methods:-

Selection of the Material: 100% grey cotton 40s count fabric (purchased from Xavier fabrics Madurai, Tamil Nadu, India.) pre-treated, bleached fabric were selected for the further study.

Selection of Chemicals: Zinc acetate dehydrate (Merck, 99%), Sodium hydroxide (NaOH) (Merck, 99%) was used as the introductory material was supplied by Sigma-Aldrich chemicals.

Plant Source: Fig 1 shown the *Annona Muricata* (L) plant leaves were collected Vettoornimadam, Nagercoil, Kanyalumari District, Tamil Nadu.

Fig 1:- *Annona Muricata* (L) Leaves

Scientific Classification of *Annona Muricata* (L)

Kingdom	**:**	**Plantae**
Order	**:**	**Magnoliids**

Family : Annonaceae
Genus : *Annona*
Species : *A. muricata*

Table 1:- Phytochemical Screening of *Annona muricata* (L) ethanolic leaf extract

Flavonoide	+ve
Saponins	+ve
Tannins	+ve
Steroids	–ve
Alkaloids	+ve
Triterpenoids	+ve
Anthrequinone	–ve
Reducing sugar	–ve
Cardiac glycosides	+ve

Where +ve = Present, -ve- absent [30]

Qualitative phytochemcial of *Annona muricata (L)* leaves extract contain Flavonoids, polypehenol, phobatannins, tannin, saponins glycosides, anthroquinones, polyphenol, steroids, alkaloids, carbohydrate, amino acid and steroids. Quantitative analysis revealed that *Annona muricata* (L) rich amount of total phenol (178.61±1.45 mg/gm), tannis (20.08±0.25 mg/gm), alkaloids (85.23±0.38 mg/gm), saponin (35.59±0.18 mg/gm), and Flavonoids (121.09±0.62 mg/gm), were presented. [28]

Preparation of plant Extraction:-
Annona muricata (L) fresh leaves were washed double distilled water in order to remove the dust particles and air dried for 15 days and to make a fine powder in an electric grinder. The plant extract was prepared by mixing 50 g of leaf powder with 500 mL of ethanol solvent extract with constant stirring on a magnetic stirrer. Filtered the extract through a Whatman no. 1 filter paper, and the filtrate was stored at -4 °C temperature.

Synthesis Procedure:-
ZnO NPs was synthesised by two methods, Green Method-(GM) and Chemical Method-(CM).
Methods Flow Chart

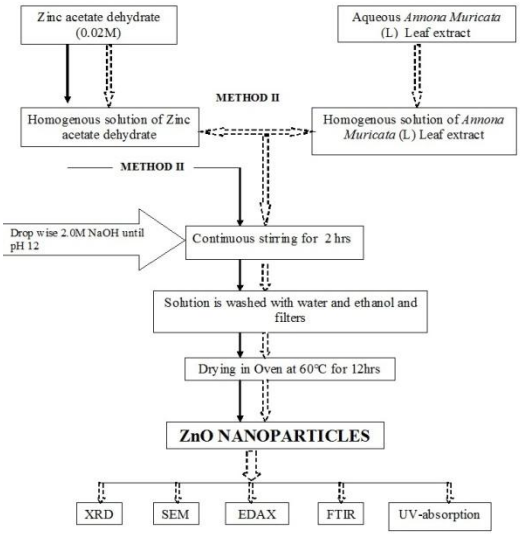


Fig 2:- Synthesis process GM and CM

Green Method (GM):-
50 ml of ethanol 0.02M aqueous Zinc acetate dehydrate was added under constant stirring at 60˚C. Aqueous leaf extract of *Annona Muricata* (L) were introduced into the above solution after 20 min stirring at different sets (0.25, 0.5, 1 ml). To the same 2.0M NaOH was added to make pH 12 resulted in a pale white aqueous solution. This was

then placed in a magnetic stirrer for 2hrs. The resultant the solution was allowed to settle for overnight and the supernatant solution was discarded carefully. The remaining solution was centrifuged at 5000 rpm for 20 min and then taken out and washed over and over again with distilled water followed by ethanol. The obtained powder dried at 60˚C for 12hrs in hot air oven, to get the zinc oxide nanoparticles.

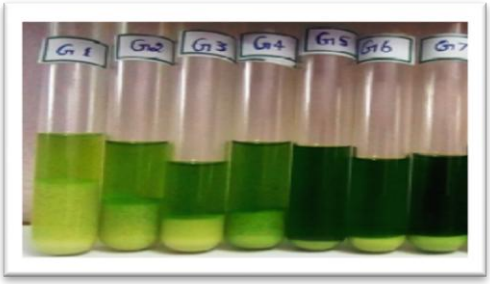


Fig 3:- Green Method (GM) synthesis optimizing concentration

Fig 2 shown the similar process follow by the entire Green Method synthesis process optimize with different concentration of *Annona muricata* (L) leave extract eventually named as G1-1:1, G2- 1:2, G3-1:3, G4-1:4, G5-1:5, G6-1:6, G7-1:7. For example G1 1:1 (Zinc acetate dehydrate : *Annona muricata* (L) leave extract), temperature and concentration involving the interplay between the metal ion precursors and the reducing agent.[33]

Chemical Method (CM):-

0.02M aqueous Zinc acetate dehydrate was dissolved in 50ml ethanol under vigorous stirring at 60˚C, aqueous 2.0M NaOH was added drop by drop to reach pH 12. This was then placed in a magnetic stirrer for 2hrs. After completion of the reaction, the white precipitate formed was centrifuged at 5000 rpm for 20 min then taken out and washed thoroughly with distilled water followed by ethanol to remove the impurities. The precipitate was dried in a hot air oven at 60˚C for 12hrs.

Fig 4:- Chemical Method (CM)

UV absorber Finish on Fabric:-

UV absorber ZnO NPs coated bleached cotton fabric by pad-dry-cure method. These UV absorber nanoparticles have a primary role in determining their adhesion to the fabrics. 1% of ZnO NPs GM and CM UV absorbers were coated 1:20 material liquor ratio with 1% of acrylic binder. Nanoparticles are well bound to the fabric surface even without the use of a binder. However, a binder may used, when a higher level of wash fastness is required. [34] To the coating process padding mangle speed was 15 m/min with a pressure of 15 kg/cm^2 were followed, after padded fabrics were taken out dried naturally and cured for 3 minutes at 150˚C.

UV absorber (ZnO NPs) Characterization Analysis:-

The Phase evolution of calcined powder as well as that of sintered samples was studied by X-ray diffraction (XRD) technique (Panalytical X-ray Diffractor) using Cu Kα radiation. The generator voltage and current was set at 40 KV and 30 mA respectively. Samples were scanned in the 2θ range in continuous scan mode. The scan rate was 0.04o/sec. All the peaks can be well indexed to the Zincite phase of ZnO (International Center of Diffraction Data JCPDS) Particle diameter D was calculated via the Debye-sherrer formula $D= K\lambda / (\beta \cos\theta)$, where K is Sherrer constant, λ is the X-ray wavelength (1.54060 A˚), β is the peak width of half maximum, and θ is the Bragg diffraction angle. Scanning Electron Microscopy (SEM) VEGA 3 TESCAN machine was used to characterize the particle size, morphology of nanoparticles. EDAX measurements were confirm the structural element analysis carried out by X-Flash-Bruker. The characterization involved Fourier Transform Infrared Spectroscopy (FTIR) analysis of nanoparticles by Perkin in Elmer Spectrum 1000 spectrum in attenuated total reflection mode, and using

the spectral range 4000-400 Cm^{-1} with the resolution of 4 cm^{-1}. UV absorption were characterised in Perkin Elmer UV-VIS Spectrometer, Lamda -19 to known the kinetic behaviour of nanoparticles. The scanning range for the samples was 200-800 nm at a scan speed of 480 mm/min. The spectrophotometer was equipped with 'UV Winlab' software to record and analyze data. The UV-Vis absorption spectra of all the samples were recorded and numerical data were plotted.

Ultraviolet Protection Factor:-

UPF categories with relative transmittance and protection level equation (1) according to the Australian/New Zealand Standard (AS/NZS 4399). It was the first among the existing classification systems and is the most widely adopted it established a classification system of fabrics according to their sun protection properties shown in table2. The results are discussed in respect to this standard. [35]

$$UPF = \sum_{290}^{400} \frac{\mathbf{E}(\lambda).\mathbf{S}(\lambda).\mathbf{\Delta}(\lambda)}{\mathbf{E}(\lambda).\mathbf{T}(\lambda).\mathbf{S}(\lambda).\mathbf{\Delta}(\lambda)} \text{---------- (1)}$$

Where

Eλ = erythermal spectral effectiveness,

Sλ = solar spectral irradiancies Wm-2nm-1,

Tλ = spectral transmittance of the fabric,

Δλ = the bandwidth in nm,

λ = the wavelength in nm.

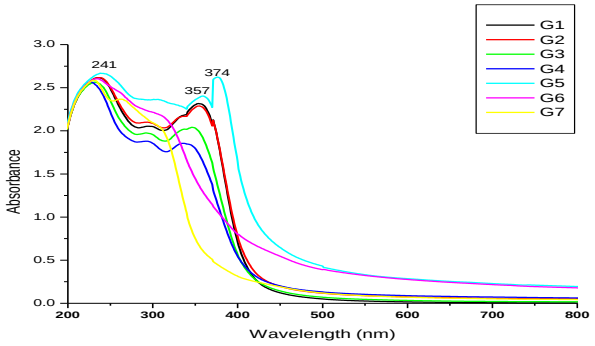
Table 2:-

UPF Range	Protection Category	$UVBE_{eryt}$ transmittance (%)
< 15	Insufficient protection	> 6.7
15-24	Good Protection	6.7-4.2
25-39	Very Good protection	4.1-2.6
40-50, 50+	Excellent Protection	≤ 2.5

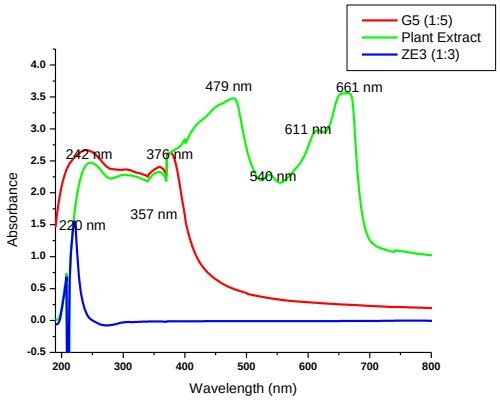
Results and Discussion:-

Ultraviolet Visible Spectroscopy:-

Confirmation and monitoring of the reduction of zinc ions to zinc oxide nanoparticles was UV-Vis spectrum in the range of 200-1000 nm. The spectrum showed distinct peaks of UV absorption are depends on several factors such as band gap, oxygen deficiency, size and structure of the NPs, surface roughness and impurities. [36].



(a)



(b)

Fig 5:- UV absorption shown (a) GM different concentration (b) GM G5 1:5, CM and Pure Annona muricata (L) ethanol extract,

UV absorption spectrum peaks shown fig 5 (a) that G5 demonstrate the high UV absorption peak 658nm, 438nm, 358nm, 246nm than other peaks. The Concentration of 1:5 samples G5 is particular are followed by the further synthesis and application process.

Fig 5 (b) shown that CM show the high UV absorption peak 220nm peak, 250nm, 300nm, has a bend. The Concentration of 1:3 samples ZE3 is particular the further synthesis and application process. The peak appearance in the absorption curves positioned the plant extract of ***Annona muricata*** **(L)** had absorbance band at 246nm, 299nm, 355nm, 4381nm and 654-660 bend. The UV sunscreen function of the epidermis is mainly fulfilled by phenolic comounds, Flavonoids and hydroxycinnamic acids, which all have absorption maxima in the UV part of the spectrum. The intense absorption band around 260 nm with a weaker band above 300nm (is flavones, flavanones) 260-300nm around flavones or 360 nm flavonols. [37] There were identified the maxima wavelengths specific to polyphenols at 280-330 nm, to Flavonoids and quinines obtained by polyphenols, oxidation at 390-420 nm and chlorophylls at 600-660 nm. According to the UV-Vis spectra of each plant can observe the absorption peaks in the region 400-412 nm and 600-660 nm region, 220-280nm and 330-420 nm corresponging to phenolic acids and their derivatives (flavones, flavonols, phenylpropenes and quinones), richest in phenolic derivatives 289 nm and Flavonoids 330 nm. [38] **GM G5 1:5** at 376 nm, Absorption 255 nm for zinc nano crystals embedded into SiO_2 matrix, 358 nm corresponds to peak of ZnO shell layer [39] The UV absorption spectrum shows an absorption band at 355 nm due to ZnO nanoparticles. [40] ZnO nanopowder is exhibits a strong absorption band at about 355 nm. [41] The absorption of UV range up to 361.75 mm and almost all the visible spectrum radiations are transmitted by the ZnO nanoparticles. [42] **CM** shown at 220 nm, The UV peak at 230 nm is due to the transition of inner shell electron to the conduction, which is almost reported in the case of UV-visible absorption of all metal and metal oxide nanoparticles. [39] Absorption peak found at about 258 nm due to the ZnO nanoparticle which lie much below the band gap wavelength of 358 nm. [43] The UV visible absorption spectroscopy of ZnO nanoparticles in ethanol solvent shows an excitonic absorption peak at about 214 nm, which lies much below the band gap wavelength of 388 nm of bulk ZnO. [44,45]

XRD:-

The XRD pattern of ZnO nanoparticles is illustrated in Fig 6 (a) illustrated UV absorber GM G5 1:5 peaks located at 2θ = 33.26˚, 58.78˚ are associated well agreed with the JCPDS 21-1486, the powder pattern as cubi structure and the crystallite size of nanopowder around 86 nm.

(b) UV absorber CM the diffraction peak (JCPDS 89-1397) located at ZnO at 2θ = 31.93˚, 34.53˚, 36.32˚, 47.82˚, 56.62˚, 62.88˚, and 68.26˚ are associated with (100), (022), (101), (102), (103) and (112) plains. All the reflections can be assigned to the standard powder pattern for the pure hexagonal phase structure of ZnO with lattice constants a=3.2516 A˚, c=5.2000 A˚. The particle size attained material was determined by using light scattering, the results reveals that particle sizes between 50 nm were obtained. ZnO NPs sharp peaks appearing about 2θ of 36.25˚, 31.7˚, 34.4˚, 47.62˚, 56.6˚, 62.8˚,67.9˚ were assigned to (111,100,002,102,110,103,112 and 102) plain value for JCPDS

card no 36-1451. [46] ZnO NPs (JCPDS 36-1451) 2θ = 31.41˚, 34.31˚, 36.92˚, 47.79˚, 56.54˚, 62.81˚,728.91˚ and 77.17˚ these location of the characteristic Bragg reflection were indexed (111,002,311,222,400,331,420 and 422) planes of ZnO wurtzite structure. [47]

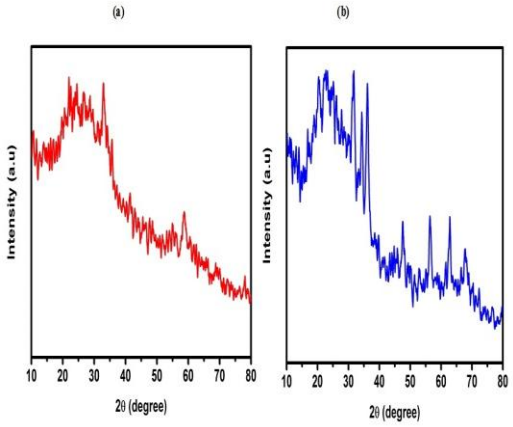


Fig 6:- X-ray diffraction (a) GM G5 1:5 and (b) CM

SEM:-

Fig 7 (a), (b) imaged by GM G5 1:5 dogged the particles size and external morphology of the ZnO NPs. It shown cubi structure composed of quite a lot of individual small nanoparticle. (c), (d) the morphology of CM is represents that the SEM images confirm the morphology of ZnO NPs show nano flake like structure. As the growth progresses nanoparticles aggregate to form a variety of morphology such as cubes, spheres, triangle, hexagons, pentagons, rods and wires. [48].

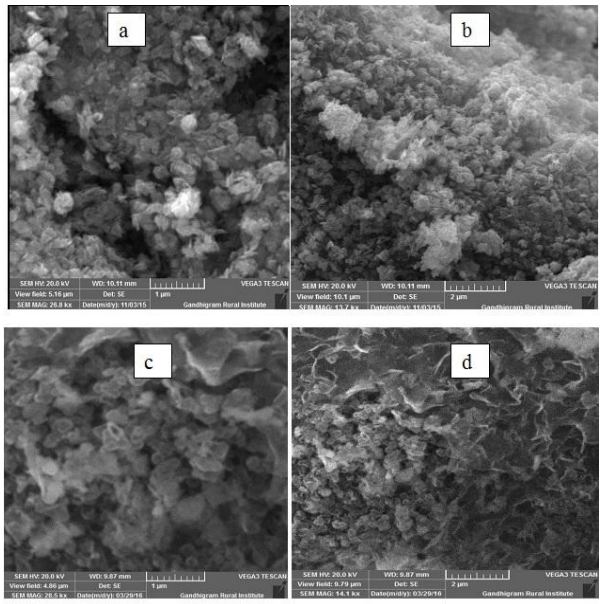


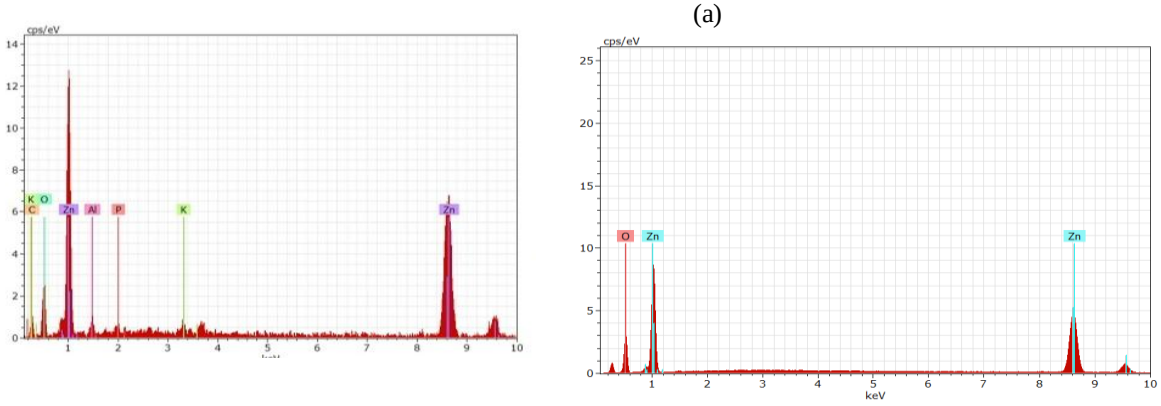
Fig 7:- shows Scanning Electron Microscopy - GM G5 1:5 (a) 1µm, (b) 2µm of and CM (c) 1µm, (d) 2µm

EDAX:-

EDAX result further confirm the structural element analysis ZnO NPs. Fig 8 (a) GM G5 1:5 the spectrum peaks of zinc and oxygen element 63.85 and 26.15 % the developed a green and chemical route of nanoparticles using *Annona Muricata* (L) is being eco-friendly and can be an effective alternative for the large scale synthesis of ZnO NPs. The spectra also indicate like (C, K, Al, P) P.E. Ochieng *et al* 2015 [47] reported silicon, chlorine and potassium the impurities (Cl, K and Si) could be of biological origin present in the plant extract. The presences of copper and carbon elements were due to carbon coated copper adhesive used as sample holder.

Fig (b) CM indicates that are composed of zinc and oxygen of 72.89 and 24.91% proves ZnO NPs is essentially free from impurities.

(a)



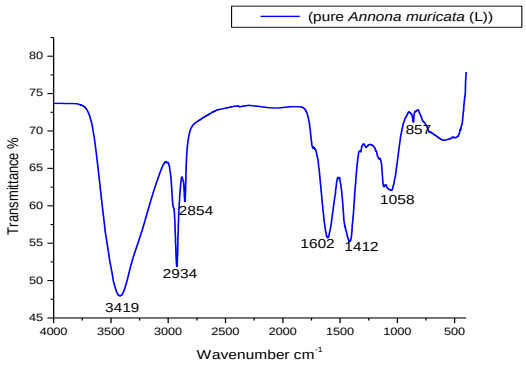
(b)

Fig 8:- EDAX (a) GM G5 1:5 and (b) CM ZE3 1:3

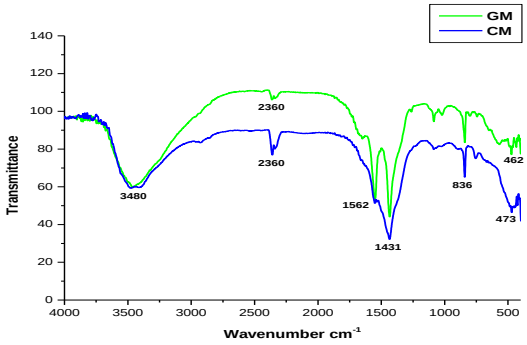
FTIR:-

FTIR measurements were carried out in order to determine identify for the capping and efficient stabilization of the metal nanoparticles synthesized by Annona muricata (L) leaf extract. The IR spectrum of ZnO nanoparticles band shown Fig 9 (a) shown pure *Annona muricata* (L ethanol extract) 3419 cm^{-1} functional group of Alcohol O-H, H bond strong intensity, 2934 cm^{-1}, 2854 cm^{-1} Alkane C-H stretching, 1602 cm^{-1} C-H and C=O stretch in polyphenol respectively. 1412 cm^{-1} Aromatic C=C multiple band, 1058 cm^{-1} Alkyl halide C-F stretch strong, 857 cm^{-1} P-*subst.Benzenes*.

Fig 9 (b) shown GM G5 1:5 the pattern of absorption at 462 cm^{-1} and 473 cm^{-1} at CM the band could be attributed to the metal oxygen the characteristic stretching vibration of ZnO nanoparticles. Absorption at 450-540 cm^{-1} identifies the presence of ZnO nanoparticles.[11] Band 836 cm^{-1}aromatic C-H out of plane bending is a typical nano substituted benzene ring 1,2,3, tri-substituted benzene ring and 1,4 di-substitute benzene ring. The frequencies of α-D- glucose in the region at 836 and 902 cm^{-1}. [49,50] Medium absorption in the region 1431cm^{-1} often implies an aromatic ring. This band is absorbed CO_2 spectrum may be due to zinc carbonate, while the absence of bands in this region in either of the CO spectra indicate that in these cases no carbonate was formed [51] The band at 2360 cm^{-1} is due to CO_2 [52] for the soluble CO_2 (g) in the narrowing of band within increase in line intensity to change of structural features of the materials, this may be due to a change in crystalline and/or distortion of symmetry caused by the insertion of various foreign impurities with progressive heating temperature. [53] Broad IR bands at 3430 cm^{-1} can be attributing to the characteristic functional group alcohol O-H stretching vibration. [54] 3410-3460 cm^{-1} O (2) H--O(6) intermolecular H-bonds. [55,56] .



(a)



(b)

Fig 9:- FTIR (a) Pure Annona muricata (L) ethanol extract (b) GM G5 1:5 and CM

SEM ZnO NPs Fabric:-

Fig 10 characterize the SEM Micrographs 10 µm magnifications were represent the GM G5 1:5 and CM ZnO NPs were well diffuse on the surface in both the side of the fabric, while aggregated nanoparticles are noticeable.

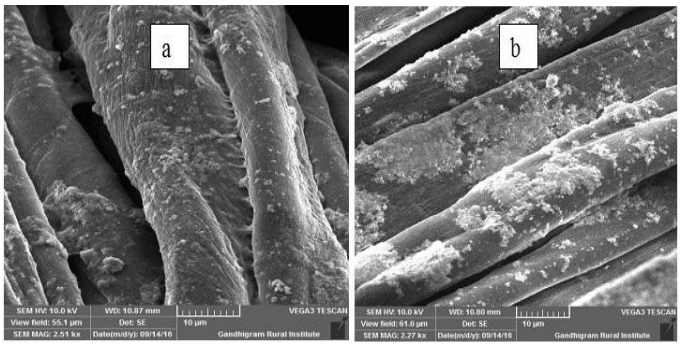


Fig 11:- (a) GM G5 1:5 (b) CM, UV absorber (ZnO NPs) coated fabric

UPF Analysis:-

Zinc oxide nanoparticles are very special among the nanomaterials due to their organometallic properties. [57] Nadanathangam vigneshwaran *et al* 2006 [58] reported the UPF factor for the control cotton fabric is calculated to be 1.54, 2.48 and 3.71 for bulk ZnO NPs coated cotton fabric, respectively two half fold increases in UPF in comparison with the control fabric. The UPF values and the per cent of UV transmission for UV-A and UV-B ranges were represent in Table 3.

Table 3:- Ultraviolet Protection Factor

Samples Code	Mean T (UVA)%	Mean T (UVB) %	Mean UPF	UV Protection
Gf	3.97	4.27	24.37	Good protection
Bf	5.53	6.67	12.30	Insufficient protection
$BfGM_{UVAb}$	4.43	3.14	30.26	Very Good protection
$BfCM_{UVAb}$	3.74	4.28	24.58	Good protection

Abbreviation:-

Gf - Grey fabric, Bf- Bleached fabric, $BfGM_{UVAb}$ - Bleached Green Method UV absorber, $BfCM_{UVAb}$ - Bleached fabric Chemical Method UV absorber.

Table 3 shows that the Cotton bleached fabric (Bf) has insufficient protection significantly lower than the standard value. It's classifying the clothing need UV-shield, These UV absorber (ZnO Nps) GM G5 1:5 and CM coated $BfGM_{UVAb}$, $BfCM_{UVAb}$ both are give good protection against UV radiation, $BfGM_{UVAb}$ give very good protection compared to $BfCM_{UVAb}$. Grey cotton fabric (Gf) has starch added for the warp yarns before weaving process, thus reason behind that it gives good protection. Natural plant extract been considered as potential sunscreen resource because of their ultraviolet rays absorption characteristic in the UVA, UVB region and their antioxidant activity.

There is strong evidence of DNA-damaging ultraviolet rays induces the accumulation of UV light absorbing flavonoids and other phenolics in dermal tissue of the plant body which are having excellent antioxidant and photo protective properties. [59,60] In this green method increased the concentration of *Annona muricata* (L) plant extract, it has high in flavonoid and other phenolic compounds, these reason behind GMG5 1:5 enhanced the UV absorption properties than CM UV absorber. (Fig 11).

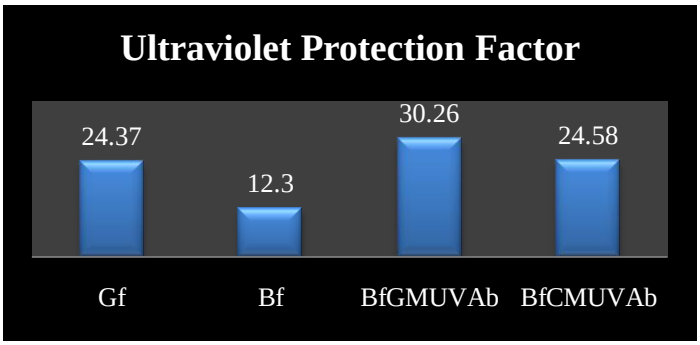


Fig 11:- Ultraviolet Protection Factor Treated/Un treated fabrics

The interesting aspect of the nanoparticles treatment is their wash fastness. The treated fabric was tested after 25 washes again and no significant change in its sunscreen activity was observed. [34] Wash fastness can be further improved with the formation of covalent bonding between nanoparticles and the fabric surface. In these cases the excellent properties are still remained after about 55 home laundering. [61]

Conclusion:-

ZnO is bio safe, bio compatible and can be used for bio medical application in coating, with these unique characteristics ZnO could be one of the most important nanomaterials in applications, Green synthesis of nanoparticles is a novel materials that are eco friendly, cost effective, stable nanoparticles with a great important for wider a application. It is a safer and best alternative conventional method. ZnO NPs embedded green synthesis potential application such as UV protection ability in textiles and sunscreen. The performance of characterization analysis GM G5 1:5 UV absorber has well, it can be concluded that the active ingredients in *Annona muricata* (L) extract and its Green method (GM) ZnO NPs are highly UV absorber due to the competitive energy absorption.

Reference:-

1. Kathryn L., Hatch. Uli Osterwalde M.S., (2006). Garments as Solar Ultraviolet Radiation Screening Materials. *Elsevier Saunders, Dermatol Clinics*, 24, 85-100.
2. Pailthorpe M.T., (1993). Textile Parameters and Sun Protection Factors. *In Proceedings of the Textile and Sun Protection Mini-Conference, University of New South Wales*.
3. Lisa B Samalonis., (2014). Shelter From the Sun. 22 (6), 1-9.
4. Gantz G M., and Sumner W G., (1957) Stable Ultraviolet Light Absorbers. *Textile Res J*. 3(27), 244–251.
5. Dodd A., McKinley T., Tsuzuki M., Saunders. (2008) A Comparative Evaluation of the Photocatalytic and Optical Properties of Nanoparticulate ZnO Synthesised by Mechanochemical Processing, *J. Nanopart. Res*, 10, 243-248.
6. Mahltig B., Bottcher H., Rauch K., Dieckmann U., Nitsche R., Fritz T., (2005) Optimized UV Protective Coatings by Combination of Organic and Inorganic UV absorbers. *Elsevier- Thin solid Films*, vol 485, 108-114.
7. Agnieszka Kolodziejczak Radzimska., Teofil Jesionowski., (2014) Zinc Oxide- From synthesis to Application; A Review. *Materials*, Vol 7, 2833-2881.
8. Kolodziejczak Radzimska., Annika Betke and Guido Kickelbick., (2012) Bottom-Up, Wet Chemical Technique for the Continuous Synthesis of Inorganic Nanoparticles. *Inorganics* 2, 1-15.
9. Annika Betke., Guido Kickelbick., (2014) Bottom-Up, Wet Chemical Technique for the Continuous Synthesis of Inorganic Nanoparticles. *Inorganics*, Vol 2, 1-15.
10. Haohong Duan., Dingsheng Wang., Yadong Li., (2015) Green chemistry for nanoparticle synthesis. *Chem. Soc. Rev*. vol 44, 5778-5792.
11. Gnanasangeetha D.,SaralaThambavani D., (2013) One Pot Synthesis of Zinc Oxide Nanoparticles via Chemical and Green Method. *Research Journal of Material Sciences* Vol. 1(7), 1-8.

12. Liu MC., Lin CT., Shau MD., Chen ZS., Chen MT., (1996) J *Food Drug Anal.*
13. Ramu G., Senthil Kumar G., Ramesh B., (2012) Biological and Chemical Sciences Preliminary study of Anti-solar activities of Lantana camara L. plants with yellow and red flowers. *Research Journal of Pharmaceutical*, Vol 3, 981.
14. Sutradhar P., Debnath N., Saha M., (2013) Microwave-assisted rapid synthesis of alumina nanoparticles using tea, coffee and triphala extracts. *Journal of Advanced Manufacturing Technology,* Vol 1, 357-361.
15. Bunghez I.R., Ion R.M., (2010) Gold and silver nanoparticles:Green synthesis and analytical investigations. *The Scientific Bulletin Valahia University-Materials and Mechanics-Nr*. 5(year 8), 26-30.
16. Castro L., Blazquez, M L., Munoz J.A., Gonzalez F., Garcia balboa C., Ballester A., (2011) Biosynthesis of gold nanowire using sugar beeet pulp. *Process Biochem.* Vol 46, 1176-1082.
17. Gibson EL., Wardel J., Watts CJ., (1998). Fruit and Vegetable Consumption, Nutritional Knowledge and Beliefs in Mothers and Children. *Appetite*, Vol 31, 205-228.
18. Arora A., Nair MG., Strasburg GM., (1998). Structureactivity relationships for antioxidant activities of a series of flavonoids in a liposomal system. *Free Radical Biology and Medicine*, Vol 24, 1355-1363.
19. Anu Lavola., Ritta Julkunen Tittos Pedro Aphalo., Tania De La Rosa., Tarja Lehto., (1997). The effect of u.v.-B radiation on u.v.- absorbing secondary metabolites in birch seedlings grown under simulated forest soil conditions. *Nea Phytol*, 137, 617-621
20. Li J., Ou-Lee TM., Raba R., Amundson RG., Last RL., (1993). Arabidopsis flavonoid mutants are hypersensitive to u.v.-B irradiation. *Plant Cell* 5, 171-179.
21. Bornman JF., Teramura AH., Young AR., Bjorn LO., Moan J., Nultsch W., (1993). Effects of ultraviolet-B on terrestrial plants. *Environmental UV Photohiology*. 427-471.
22. Caldwell MM, Teramura AH., Tevini M., Bornnian JF., Bjorn LO., Kulandaivelu G., (1995). Effects of increased solar ultra- violet radiation on terrestrial plants. *Ambio.* 24, 166-173.
23. Lavola A., (1997). Accumulation of flavonoids and related compounds in birch {Betulaceae) induced by UV-B irradiance. *Tree Physiology*.
24. Sullivan JH., Teramura AH., **Dillenbur**g LR., (1994). Growth and photosynthetic responses of field-grown sweetgum {Liquidambar styracifiua; Hamamelidae) seedlings to UV-B radiation. *American Journal of Botany*. 81, 826-832.
25. Evini M., Teramura AH., (1989). UV-B effects on terrestrial plants. *Photochemical Photobiology*. 50, 479.
26. Adewole S.O., Caxton Martins E.A., (2006). Morphological changes and hypoglycemic effects of *Annona muricata* Linn. (Annonaceae) leaf aqueous extract on pancreatic B-cells of streptozotocin-treated diabetic rats. *Afr. J. Biomed. Res. 9*, 173-187.
27. De Souza, R.; Benassi, E.; da Silva, R.R.; Afonso, S.; Scarminio, I.S. Enhanced extraction yields and mobile phase separations by solvent mixtures for the analysis of metabolites in *Annona muricata* L. Leaves. *J. Sep. Sci.* 2009, *32*, 4176–4185.
28. Shibula K., Velavan S., (2016). Determination of bioactive compounds in Annona muricata leaf extract. *J Bioscience and Technology*. Vol 7(3), 726-768.
29. Sundarrao., (1993). Preliminary screening of antibacterial and antitumor activities of Papua New Guinean native medicinal plants. *Int. J. Pharmacog*. 31(1), 3-6.
30. Usunobun U., Okolie NP., Anyanwu O G., Adegbegi AJ., (2014). Phytochemical Screening And Proximate Composition of Annona Muricata Leaves. *European Journal of Botany Plant Science and Pathology.*
31. Padma P., (2001). Effect of Annona muricata and Polyalthia cerasoides on brain neurotransmitters and enzyme monoamine oxidase following cold immobilization stress. *J. Natural Remedies*. 1(2), 144-146.
32. Edeoga HO., Gomina A., (2000). Nutritional values of some noncomventional leafy vegetables of Nigeria. *J. Econ. Taxon. Bot*. 24,7-13.
33. Wang L., Chen X., Zhan J., Chai Y., Yang C., Xu L., Zhuang W., Jing B., (2005). Synthesis gold of nano and microplates in hexagonal liquid crystals. *J.phys.chem*. 109, 3189-3194.
34. Kathirvelua S., Louis D., Souza., Bhaarathi Dhurai., (2009) UV protection finishing of textiles using ZnO nanoparticles. *Indian Journal of Fibre and Textile Research.* Vol. 34, 267-273.
35. Daniele Grifoni., Laura Bacci., Sara Di Lonardoa., Patrizia Pinelli., Arianna Scardigli., Francesca Camilli., Francesco Sabatini., Gaetano Zipoli., Annalisa Romani., (2014). UV protective properties of cotton and flax fabrics dyed with multifunctional plant extracts. *Dyes and Pigments- Elsevier.* 105, 89-96.
36. Imran khan., (2013). Structural and optical properties of Zr doped ZnO nano particles. *Opt mater*. 35,1189-1193.
37. Furuya M., Galston AW., (1965) Flavonoid complexes in Pisum sativum. - I Nature and distribution of the major component. *Phytochemistry*. 4, 285-296.

38. Florina Bunghez., Carmen Socaciu., Florina Zagrean., Raluca Maria POP., Floricuţa Ranga., Florina Romanciuc., (2013). Characterisation of an Aromatic Plant-based Formula using UV-Vis Spectroscopy, LC–ESI(+)QTOF-MS and HPLC-DAD. *Bulletin UASVM Food Science and Technology*. 70(1), 16-24.
39. Singh SC., Swarnkar RK., Gopal R., (2010). Zn/ZnO core/shell nanoparticles synthesized by laser ablation in aqueous environment: Optical and structural characterizations. *Bull. Mater. Sci.*Vol. 33, pp. 21–26.
40. Satyanarayana Talam., Srinivasa Rao Karumuri., Nagarjuna Gunnam., (2012) Synthesis, Characterization, and Spectroscopic Properties of ZnO Nanoparticles. *International Scholarly Research Network, ISRN Nanotechnology*. 6.
41. Jin YD., Yang JP., Heremans PL., (2000) Single-layer organic light-emitting diode with 2.0% external quantum efficiency prepared by spin coating, *Chemical Physics Letters*. Vol 320, 387-392.
42. Swati S., Kulkarni., (2015). Optical and Structural Properties of Zinc Oxide nanoparticles. *International Journal of Advanced Research in Physical Science (IJARPS.* Vol 2, Issue 1, 14-18.
43. Zhang DH., Xue ZY., Wang QP., (2002). Formation of ZnO nanoparticles by the reaction of zinc metal with aliphatic alcohols. *Journal of Physics D*, Vol. 35, no. 21, 2837-2840.
44. Pathik Kumbhakar., Devendra Singh., Chandra S., Tiwary., Amya K., Mitra., *Chalcogenide letters* 5 (2008) 387-394.
45. Route Harish Kumar., Renu Rani., (2013) Structural and Optical Characterization of ZnO Nanoparticles Synthesized by Microemulsion. *International Letters of Chemistry, Physics and Astronomy*, Vol 14, 2299-3843.
46. Muthu Chudarkodi R.R.1., Rajalaxshmi A., (2016). Green Synthesis, Characterization of ZnO nanoparticles and Ceion doped ZnO nanoparticles assisted Sesbania Grandiflora for photocatalytic application. *Research Journal of Material Sciences.* Vol. 4(2), 1-6.
47. Ochieng PE., Iwuoha E., Michira I., Masikini M., Ondiek J., Githira P., Kamau GN., (2015). Green Route Synthesis and Characterization of Zno Nanoparticles Using Spathodea Campanulata. *International Journal of Bio.Chemi.Physics*, Vol. 23, 53-61.
48. Akhtar MS., Panwar J., Yun YS., (2013). Biogenic synthesis of metallic nanoparticles by plant extracts" *ACS sustain. Chem. Eng.* Vol 1, 591-602.
49. Vasko PD., Black zll J., Koenxg L., (1971) *Carbobyd. Res*. Vol 19, 297.
50. Johnj Cael B., Jackl.Koenig., Andjohnblackwtll., (1974). Infrared and Ra+An Spectroscopy Of Carbohydrates Part Iv. Identificationd F Configuration- and Conformati6n-Sensi-Ixvmb Odes For D-Glucose By Normal Coordinate Analysis. *Carbuhydkate Research*. 32, 79-91.
51. Taylor JH., Amberg CH., Infrared Spectra of Gases Chemisorbed on Zinc oxide 1. Co and Co2. *Can J.Chem*, 535-539.
52. Pramodaa KP., Tianxi Liua., Zhehui Liua., Chaobin Hea., Hung Jue Sueb., (2003). Thermal degradation behavior of polyamide 6/clay nanocomposites Polymer Degradation and Stability. 81,47-56.
53. Pandaa RN, Hsieha MF., Chunga RJ, Chinb TS., (2003). FTIR, XRD, SEM and solid state NMR investigations of carbonate-containing hydroxyapatite nano-particles synthesized by hydroxide-gel technique. *Journal of Physics and Chemistry of Solids.* 64, 193-199.
54. Russell JD., (1979) Infrared Spectroscopy of Ferrihydrite: Evidence for the Presence of Structural Hydroxyl Groups. *Clay Minerals*, Vol 14, 109-114.
55. Ivanova NV., Korolenko EA., Korolik E V., Zbankov RG., (1989). Mathematical processing of IR-spectra of cellulose. *Zurnal Prikladnoj Spektroskopii*. 51, 301–306
56. Barbara Hinterstoisser., Lennart Salmen., (1999). Two-dimensional step-scan FTIR: a tool to unravel the OH-valency-range of the spectrum of Cellulose I Cellulose 6. 251-263.
57. Shekhawat MS., Ravindran CP., Manokari M., (2014). A biomimetic approach towards synthesis of Zincoxide Nanoparticles using hybanths enneaspermus (L) F. muell. *Tropical Plant Resaerch An International Plant Research*, 1(2), 55-59.
58. Sampath Kumar AA., Kathe PV., Varadarajan., Virendra Prasad., Nadanathangam., Vigneshwaran., (2006). Functional finishing of cotton fabrics using zinc oxide–soluble starch nanocomposites, *Nanotechnology*. Vol 17, 5087-5095.
59. Mishra, AK., Mishra A. and Chattopadhyay P., (2012). Assessment of In vitro Sun Protection Factor of Calendula Officinalis L. (Asteraceae) Essential Oil Formulation. *J Young Pharm*. 4(1), 17–21.
60. Dipali Gupta., (2013). UV Absorbing Properties of Some Plant Derived Extracts. *Research Journal of Chemical and Environmental Sciences* Vol 1, Issue 2, 34-36.
61. Daoud WA., Xin JH., (2004). Low temperature sol-gel processed photocatalytic titania Coating. *Journal of Sol-Gel Science Technology*.29, 25-29.