IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A REVIEW ON NOVEL APPROACHES OF LANTANA CAMARA AND ITS THERAPEUTIC USES

[1]Pantulu Bhavana, [2]Koppula Maheshwari, [3]S.Pravalika, [4]Md. Ghouse Pasha, [5]J.V.C Sharma

[1,3,4] ,Student of Joginpally B.R Pharmacy College, JNTUH, Bhaskar Nagar, Yenkapally, Moinabad, Telangana, India.

[2] Department of Pharmaceutics, , Faculty of Pharmacy, Joginpally B.R Pharmacy College, JNTUH, Bhaskar Nagar, Yenkapally, Moinabad, Telangana, India.

[5]Department of Pharmacognosy, Joginpally B.R Pharmacy College, Faculty of Pharmacy, JNTUH, Bhaskar Nagar, Yenkapally, Moinabad, Telangana, India.

Abstract: Over the last few years researches mainly focused on identifying and validating plant derived compounds further profound investigations proved that various parts of plant such as leaf, root, seeds, flower, fruit etc provides not only nutrition but also acts as defensive mechanism in treating various diseases. Lantana camara belongs to the family Verbenaceae. It is listed as important medicinal plant but also stated as noxious weed. Present review mainly focuses on nanoparticles which have been extracted from Lantana and their role in health care system, diagnosis in drug delivery system, its present and future prospects.

***Index Terms*: Lantana camara, defensive mechanism, noxious weed, nanoparticles.**

INTRODUCTION

Lantana camara is one of the most rudimentary medicinal weed in the world[1].The term *Lantana camara* retrived from Latin word "lento"implies "to bend"[2].*Lantana camara* popularly known as Lantana, Spanish flag ,Surinam Tea plant, Wild sage is one of the flagrant weed and has been entered in 60 countries[3].The flowers of Lantana undergo colour changes and occur in cluster with yellow orange red mix or white pink lavender. Berries are round, 2-seeded drupe, fleshy , initially green colour and by changing to purple colour and finally it turns to bluish black colour. The leaves of Surinam tea plant possess strong aroma. In this plant the Seed germination is easier and faster[4].

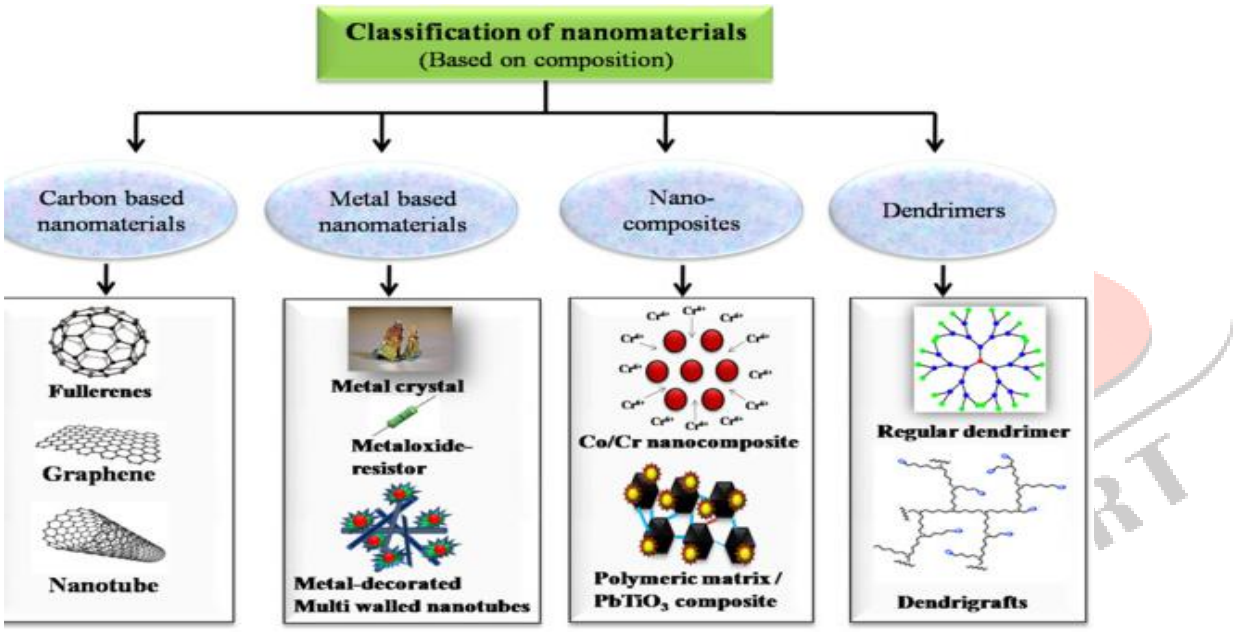
TAXONOMIC CLASSIFICATION [5]:

Kingdom: Plantae
Subkingdom: Tracheobionta
Super division: Spermatophyta
Division: Magnoliopsida
Subclass: Asteridae
Order: Lamiales
Family: Verbenaceae
Genus: *Lantana*
Species: *Camara*

Parts Used: Apart from the entire plant, leaves, flowers, stem, seeds, roots seeds can also be used. Medicinal herb pictured a principal source of curative compounds. Considering venerable times, medicinal plants are used to treat various kinds of health problems.Scrutinizing of these plants provided a base of bioactive molecules which are used for the development of newer pharmaceutical products. Recently there is a developing attentiveness in the pharmacological assessment of numerous plants used in conventional system of medicine many of traditionally known plants have been broadly examined by advanced scientific methods and reported for various medicinal properties like anti inflammatory activity, anti diabetic activity, hepatoprotective activity, anti fungal activity, anti bacterial activity, antihelmintic activity, larvicidal activity, antioxidant activity etc[6-15].

NANOPARTICLES:

Extensively studied nanoparticle materials are made up of metal which are easier to synthesize. Nanoparticles have a broad range of applications like surface coating agents, anti bacterial /antimicrobials, catalysts, detectors etc.detectors, Some of the most studied metallic nanoparticles include silver (Ag) [16-17], gold (Au) [18], platinum (Pt)[19-21] , and palladium(Pd)[22.]Nanoparticles constitute a particle with a nanometer size of 1-100 nm. The nanoscale material due to an increase in the ratio of the surface area per volume of the material/particle. the material has unique, new and superior chemical and physical properties when compared to its bulk structure[23].Even though the methods involved in synthesis of nanoparticles results in different anticipated characteristics of a particles, the physical and chemical methods include lithography, ultrasonic fields, UV irradiation and photochemical reduction processes for the synthesis of nanoparticles have their own pitfalls while they are costly, labour-intensive, and toxic to both organisms and the environment [24-28].



SYNTHESIS OF SILVER NANOPARTICLES USING FRESH LEAVES OF LANTANA CAMARA:

- Silver nanoparticles can be synthesized by several methods like chemical reduction. Since the Chemical reduction methods are economical and easier to prepare these are most commonly used[29.]
- But the use of chemicals in the synthesis of Ag nanoparticles results in the adsorption of toxic chemicals on the surface of the material so that it will have adverse and harmful effects on its application [30].

(A) Silver nanoparticles **(B) silver VS gold nanoparticles**

Preparation of Leaf Extract: fresh leaves of L.camara were collected and washed with tap water at first and then surface was cleaned with distilled water until no impurities remainedthen the fresh leaves were cut into small pieces and 10g was weighed and put into a beaker with 100ml of distilled water, the mixture was heated for 20 mins at 60°C while stirring occasionally and it is allowed to cool at room temperature the mixture was filtered using Whatman 42 filter paper and then

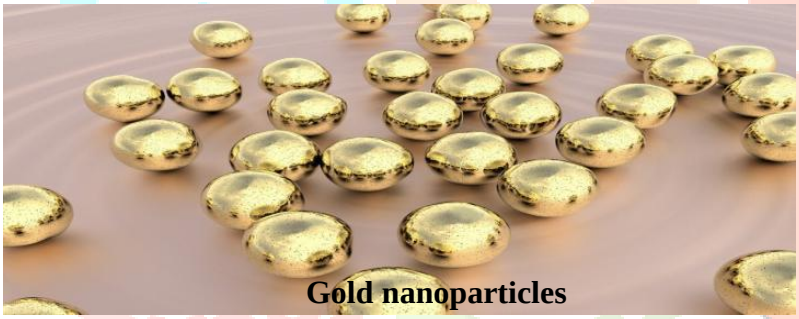
centrifuged at 81 G-force for 20 mins. Theobtained extract is refrigerated and is used for synthesizing silver nanoparticles from precursor solution of AgNO3.

Figure: Lantana camara

Synthesis of silverNanoparticles: AgNO3 powder was dissolved in distilled water to prepare 10mM AgNO3 stock solution from which a series of 1 mM; 2 mM; 3 mM ; 4 Mm and 5 mM AgNO3 solutions were prepared. These prepared solutions of AgNO3 are mixed with 1:1[v/v] aqueous extract that is obtained from fresh leafs of lanthana and made to volume of 50ml in a flask.The flask was wrapped with a aluminum foil and it was heated in a water bath at 60°C for 5 hours. The mixture was stored in the refrigerator for the antibacterial activity test and further examined by using UV Visible spectrophotometer and Ttransmission Electron Microscopy[31].

PREPARATION OF ROOT EXCTRACT FOR SYNTHESIS OF GOLD NANOPARTICLES:

Lantana camara healthy roots were collected and washed with tap water followed by distilled water until there is no debris remained.



Gold nanoparticles

Further, roots were chopped and surface sterilized using 70% alcohol, 0.1% mercuric chloride, and Tween 20 of each at 5 mins of interval followed by a wash with distilled water. The roots were shadow dried at room temperature and agitated with a sterile electrical blender to obtain a powdered form. The powdered samples should be stored in a amber coloured bottle which protects the sample from sunlight[32].

SYNTHESIS OF PLATINUM NANOPARTICLES FROM LEAF EXTRACT:

We achieved double benefits in synthesizing platinum nanoparticles using notorious weed Lantana by avoidance of toxic chemicals and the utilization of a noxious weed. Here we also investigated how nanoparticle synthesis wins over reaction conditions like concentration of both leaf extract and the metal precursor solution, the effect of an ascorbic acid, external mild organic reducing agent, duration of heating, initiation temperature etc.

Fresh leaves of Lantana were collected and the extract was prepared by boiling a blend of 2 gms dry weight equivalent of entirely washed fresh leaves and 100 mL of distilled water in a 300 mL beaker for 2 mins. The solution was decanted and stored at 4°C and was used within a week of having been prepared. Hexa chloro platinic acid should be purchased from Sigma Aldrich. A mild organic reducing agent, ascorbic acid was taken in order to decrease the duration of heating as an approach towards green synthesis, all chemicals used were of analytical grade. The associated platinum nanoparticle solution was purified by centrifugation at 12,000 rpm for 15 min with the precipitate produced by this process re-dispersed in deionized water again for the synthesis platinum nanoparticles the mixture containing metal precursor H2PtCl6.6H2O; leaf extract and ascorbic acid was heated at 95°C for 8 mins. The solution becomes characteristic black colour indicating the formation of platinum nanoparticles[33].

NOVEL APPROACHES OF NANOPARTICLES IN HEALTH CARE SYSTEM:

TREATMENT OF CANCER:

Cancer is a life-threatening disease that is characterized by the continuous growth of cells.There are a number of drugs are available clinically for the treatment of cancer such as imatinib, gefitinib, rituximab, bevacizumab, lapatinib etc. chemotherapeutic approach followed to kill cancerous cells by inhibiting the process of cell division. But this approach is successful for highly developed stages of cancer because drugs can reach the site of cancer cells with reduced specificity. Hence the concept of nanoscale devices is designed to develop biodegradable self-assembled nanoparticles, which are used for targeting the delivery of anticancer drugs [34].Nanotechnology is gaining popularity in research that leads to the development of sophisticated, multifunctional, novel approaches which can recognize cancer cells and deliver drugs to target organ or tissue and help to prevent precancerous cells from becoming malignant [35]

TREATMENT OF PARKINSON`S DISEASE:

It is a neurodegenerative disorder which involves in the decreased levels of dopamine in the corpus striatum of the brain due to the loss of nigrostriatal dopaminergic neurons. The major symptoms include tremors at rest, bradykinesia, postural abnormalities, and muscular rigidity etc. So Dopamine precursor L-Dopa is most commonly preferred for the treatment of Parkinson's disease. Nano technological drug delivery system for neurodegenerative disorders is in the form of polymeric nanoparticles which can cross blood brain barrier to achieving high drug loading capacity and can be targeted towards mutagenic proteins. Nano wires implantable biosensors are also developed for the treatment of PD [36-37].

TREATMENT OF CARDIO VASCULAR DISEASE:

Cardiovascular imaging is one of the most useful diagnostic tools for cardiovascular diseases. Gold nano-wire is used as a good scaffold for the delivery of stem cell in the infracted myocardial muscle as it has the ability to synchronize the electrical impulse in the cardiac stem cells[38-39].

CHEMOTHERAPY OF TUBERCULOSIS:

Nanoparticle based drug delivery systems have significant potential for the treatment of tuberculosis. Nanoparticles are used as drug carriers due to their carrier capacity, high stability, feasibility of the inclusion of both hydrophobic and hydrophilic drug substances. Nanoparticles are used to design sustained or controlled release of drug from the matrix. These properties of nanoparticles facilitate the bioavailability and reduction of the dosing frequency of drugs[40]. Clofazimine is a newly developed as anti-tubercular drug used for the treatment of mycobacterial infection. But the use of this drug is very limited due to its less solubility. So it is formulated as a nanosuspension with a particle size of 385nm which can overcome the solubility problems and toxicity of drugs[41].

NANOMEDICINE FOR HIV TREATMENT:

Drug delivery systems by nanotechnology modulate the distribution of both Lipophilic and hydrophilic drugs into various tissues compartment due to their small size. Due to these properties of nanoparticles they are useful in clinical development for the treatment of HIV[42].

TREATMENT OF ALZHEIMER'S:

It is an age-related neurodegenerative disorder which is characterized by dementia (loss of memory) So, nanotechnology facilitates to attain early diagnosis of Alzheimer's disease by providing a highly potent signal transduction mechanism. Signal transduction is the process through which a biological signal transforms into a recordable signal and is amplified to be recorded. The application of nanotechnology in molecular diagnosis is mainly based on the physical, chemical and biological characteristics of nanoparticles[43]

TREATMENT OF DIABETES:

Insulin-loaded nanosphere is generally prepared by polymerization of isobutyl cyano acrylate in acidic medium to avoid ddegradation. These nano-spheres contains a mean size of 145 nm and their association rate is of 1 U of insulin per milligram of the polymer used[44]. The insulin nano pump is developed to inject Insulin to the patient's body at a constant rate to balance the level of sugars in blood. This pump can administer small doses of Insulin over a long period of time[45]

NANOTECHNOLOGY IN REDUCTION OF OBESITY:

Nanotechnology can be used as a powerful public health tool for the provision of low calorie food which plays an important role in controlling obesity. Nanotechnology based food and health food products and food packaging materials are provided to consumers in some countries[46].

NANOTECHNOLOGY IN RHEUMATOID ARTHRITIS:

The commonly used anti-inflammatory agent is Diclofenac sodium is loaded in a magnetic core with ethyl cellulose used for parenteral administration. The nanocomposites possess significant characteristics such as improved therapeutic level and prolonged drug release for efficient delivery of Diclofenac sodium to the site of inflammation [47]. Nano emulsions of Indomethacin can be used for improved transdermal delivery of drugs [48].

NANOTECHNOLOGY IN DIAGNOSIS:

Carbon Nanotubes: Carbon nanotubes are designed based on biosensors and employed for the detection of analytes in the healthcare system. It is also used for monitoring and detection of amino sugars, protein, albumin sugars, amino acids, immunoglobulin, neurotransmitters, insulin and human chorionic gonadotropin etc. These are categorized into different types such as single walled, Double-walled and multi walled carbon nanotubes. SWNTs are characterized by strong covalent bonding, one-dimensional structure and nanometer size of 0.4–2 nm. The electrical and mechanical properties of SWNTs may change due to breaking of C=C bond during chemical processes. DWNTs are made up of a pristine carbon nanotube core and chemically functionalized nanotube shells. DWNTs in biological systems are used as imaging and therapeutic agents. MWNTs consist of concentric tubes with multiple rolled layers of graphene [49-50].

Graphenes: It consists of thin layer of tightly packed carbon atoms and bonded all together in a hexagonal honeycomb. It is used in diagnostics and biosensors due to its considerable properties like high mechanical strength, good thermal conductivity, elevated elasticity, and optical properties. It is a transparent substance with a very low production cost and environmentally friendly mainly helpful for the identification of biological samples such as glucose, hemoglobin, cholesterol, dopamine, uric acid[51-52].

Quantum Dots: These are inorganic nanocrystals which are prepared in between 3 and 15 nm and suitable for binding with specific biomolecules. They have unique optical properties like narrow emission spectra, broad excitation, high photochemical stability, and less photo bleaching. It is used for the development of optical biosensors to identify organic compounds, ions, and biomolecules such as nucleic acids, amino acids, proteins, enzymes, sugars and neurotransmitters [53-54]. They have also been used for the *in vivo* detection of target sites in cancer [55]. Because of their high sensitivity, specificity, cost effectiveness, small size and rapid detection of analytes quantum dots are widely used as a diagnostic tool [56].

NANOTECHNOLOGY IN DRUG DELIVERY SYSTEM:

The drug delivery system significantly produces an impact on the use of drugs in patients. This system should minimize the side-effects and also reduce both the dose and frequency of dosage. Due to their small size and large surface area there is a large affinity for drugs and small molecules like antibodies or ligands for targeting specific diseases and releasing therapeutic agents at the controlled rate [57-58]. Nanodrug delivery system distributes fixed amounts of drugs for optimum biological activity with less toxicity. However considerable attempts are made to synthesize and process drug carrier nanoparticles. Currently many drug substances are under investigation for drug delivery at the nanoscale to treat various disease[59-60].

EMERGING SCENARIO OF NANOPARTICLES:

The advancement in nanotechnology will lead to innovative synthetic routes along with new processing strategies with economical manufacturing process. So the time required for new drug development in the area of nanotechnology can be reduced which can save human lives [61-62]. In coming year's nanotechnology will play a significant role in the health care system to provide an innovative prospect for early detection of diseases, diagnostic and remedial measures to improve health condition and also enabling precise and effective therapy tailored to the patients[63-64].

CURRENT & FUTURE DEVELOPMENTS:

Currently various investigations are carried out on nanotechnologies to utilize its application in the field of therapeutic, diagnostic and drug delivery systems. In recent times, nano-based drug delivery systems are applied to facilitate the successful delivery of drugs into the target sites. Generally, the main targets in the body system are the receptors or proteins on cell membranes and cell surfaces respectively. Nanotechnology will play a key role to revolutionize medicine in future developments. The nano robotic tools can be applicable in the treatment of various cardiovascular diseases and atherosclerosis by the year 2028. This technology can be applied to activate the immune system to decrease any infections and destroy cancer cells Nan oncology provides targeted delivery of anticancer drugs for the treatment of cancerous and precancerous cells. There will be evolutionary development in the health care system with the help of nanotechnology in the next coming years[65-66].

THERAPEUTIC USES OF LANTANA CAMARA:

Antibacterial activity: Ethanolic extracts of *Lantana camara* leaves and roots were reported for antibacterial activity. Microdilution method is performed for in-vitro antibacterial activity. The extracts exhibited antimicrobial activity against *Staphylococcus aureus, Proteus vulgaris, Pseudomonas aeruginosa*, Escherichia coli, *Víbrio cholareae* and two multiresistant strains *E. coli* and *S. aureus.*

Antifungal activity: The Lantana *camara* extracts of hot water and ethanol is screened for its activity against wood destroyingwhite and brown fungi. Though the both extracts resulted resulted in efficient white and brown antifungal activity. But, the ethanol extract at very low concentration about 0.01% was shown to have highly potential antifungal activity.

Hemolytic activity: The hemolytic activity of *Lantana camara*is performed by using aqueous extract .the solvent fractions of different concentrations were taken [125,250,500,1000 µg/ml] using spectroscopic method. The aqueous extract and its solvent fractions exhibited very low hemolytic activity towards human erythrocytes.
The hemolytic activity of the different extracts was found in the order of :
Chloroform fraction > hexane and ethyl acetate fraction > aqueous extract > ethanol fraction >methanol fraction.

Antimotility activity: Methanol extract of Lantana. *camara* leaves was reported antimotility activity in mice. Intestinal motility assayed by charcoal meal test in mice. A dose of 1 g/kg body weight extract completely inhibited the transit of charcoal in mice. Intraperitoneal administration of 125mg/kg and 250 mg/kg body weight the extracts significantly reduced the fecal output in castor oil induced diarrhoea in mice.

Anti mutagenic activity: 22β-dimethylacryloyloxy and 22β- acidacetoloxy lantanolic acid from *L. camara* showed antimutagenic activity. The antimutagenicity test performed by micro-nucleus test in Swiss mice. High anti mutagenic activity is exhibited by both of the compounds in Mitomycin - C induced mutagenesis in mice.

Antioxidant activity: The leaves of *Lantana camara* was reported by reducing power activity and 1,1- diphenyl-2-picrylhydrazyl by radical scavenging assay. The antioxidant activity is exhibited by the leaves. .younger leaves shown to exhibit stronger antioxidant activity when compared to matured or older leaves.

Antiurolithiatic activity: The leaves of *Lantana camara ethanolic extract* was reported for antiurolithiatic activity against ammonium and chloride ethylene glycol induced calcium oxalate urolithiasis in male albino rats. Extract treatment significantly reduced the deposition of calcium; oxalate and also decreased urinary excretion of calcium; oxalate and creatinine.

Mosquito controlling activity: Mosquito larvicidal activity of ethanol and methanol extracts of leaves and flowers of *Lantana camara* were reported against 3rd and 4th instar larvae of *Ae. aegypti* and
Cx. quinquefasciatus mosquito. Both extracts exhibited significant larvicidal activity against both species of mosquitoes; however, at low concentrations extracts were highly active against *Ae. aegypti* than that of *Cx. Quinquefasciatus*[67].

TOXICITY OF LANTANA CAMARA:

Lanata is one among the most toxic plants known so far possibly within top ten. Reports of *Lantana camara* toxicity have been stated from India, America, Australia, New Zealand, and South Africa. The consumption of high amount of plants material leads to toxicity. It is reported that goats,sheep,and cattle are susceptible to lantadenes A, B, D and iatrogenic acid toxicity were as rats, horses, neonatal calves and lambs are not susceptible to lantadene A. The prominent clinical sign of poisoning includes jaundice and photosensitization. Loss of appetite in poisoned animals occurs within 24- hours and decrease in appetite is also observed,most severely poisoned animals die within 2- days of poisoning but usually death occurs after 1 -3 weeks after poisoning. The kidneys are pale in colour and swollen swollen, the gall bladder is grossly distended and the liver is enlarged. The oral toxic dose of lantadene A for sheep is 60mg/kg is toxic and 1–3 mg/kg by intravenous route[68-69.]

CONCLUSION:

It is quite obvious that from this review Lantana camara used for numerous therapeutic purposes different types of nanoparticles extracted from this plant even individual part have their own therapeutic benefits such as cardiovascular diseases, atherosclerosis anti cancer, anti viral etc. Nanotechnology will play a key role to revolutionize medicine in further developments.

REFERENCES

1. Kumarasamyraja D, Jeganathan NS and Manavalan R: Pharmacological review of Lantana camara L. International Journal of Pharm Res 2012; 2: 1-5.
2. Ghisalberti EL: Lantana camara Linn.: Review. Fitoterapia 2000; 71: 467-485.
3. Lui, X.R. (2011). Quantitative risk analysis and prediction of potential distributionareas of common lantana (*Lantana camara*) in China. Computational Ecology and Software.1:60-65.
4. Neena Priyanka and Joshi, P.K.(2013). A review of *Lantana camara* studies in India. International Journal of Scientific and Research Publications. 3(10): 1-11.
5. Mishra A: Allelopathic properties of *Lantana camara*, a review article.2014;32-52.
6. Rajkumar V et al. Evaluation of cytotoxic potential of *Acorus calamus* rhizome. Ethnobotanical Leaflets. 13 (6); 2009: 832- 839.
7. Kumar SV, Sankar P and Varatharajan R. Anti-inflammatory activity of roots of *Achyranthes aspera*. Pharmaceutical Biology.47 (10); 2009: 973-975.
8. Sabu MC and Kuttan R. Anti-diabetic activity of medicinal plants and its relationship with their antioxidant property. Journal of Ethnopharmacology. 81 (2); 2002:155-160.
9. Adama K et al. *In vitro* anthelmintic effect of two medicinal plants (*Anogeissus leiocarpus* and *Daniellia oliveri*) on *Haemonchus contortus*, an abosomal nematode of sheep in Burkina Faso. African Journal of Biotechnology. 8 (18); 2009:4690-4695.
10. Kumar G, Karthik L and Rao KVB. Phytochemical composition and *in vitro* antimicrobial activity of *Bauhinia racemosa* Lamk (Caesalpiniaceae). International Journal of Pharmaceutical Sciences and Research. 1 (11); 2010: 60-67.
11. Kumar G, Karthik L and Rao KVB. Antimicrobial activity of latex of *Calotropis gigantea* against pathogenic microorganismsan *in vitro* study. Pharmacologyonline. 3; 2010: 155-163.
12. Kumar G, Karthik L and Rao KVB. *In vitro* anti-Candida activity of *Calotropis gigantea* against clinical isolates of *Candida*. Journal of Pharmacy Research. 3 (3); 2010 :539-542.
13. Dhanabal SP et al. Hepatoprotective activity of theIndian medicinal plant *Polygala arvensis* on D-galactosamine-induced hepatic injury in rats. Fitoterapia. 77 (6); 2006:472-474.
14. Priya CL et al. Antioxidant activity of *Achyranthes aspera* Linn stem extracts. Pharmacologyonline. 2; 2010:228-237.
15. Pitasawat B et al. Screening for larvicidal activity of ten carminative plants. Southeast Asian Journal of Tropical Medicine and Public Health. 29 (3); 1998: 660-662.
16. B. Ajitha, Y. Ashok Kumar Reddy, and P. Sreedhara Reddy, "Green synthesis andcharacterization of silver nanoparticles using *Lantana camara* leaf extract," *Materials Science and Engineering: C*, vol. 49, pp. 373–381, 2015.
17. A. Feng, S. Wu, S. Chen, H. Zhang, W. Shao, and Z. Xiao, "Synthesis of silver nanoparticles with tunable morphologies via a reverse nano-emulsion route," *Materials Transactions*, vol. 54, no. 7, pp. 1145–1148, 2013.
18. M. Moreira dos Santos, M. João Queiroz, and P. V. Baptista, "Enhancement of antibiotic effffect via gold:silver-alloynanoparticles," *Journal of NanoparticleResearch*, vol. 14, no. 5, pp. 859–866, 2012
19. .H. F. Aritonang, D. Onggo, C. Ciptati, and C. L. Radiman, "Synthesis of platinum nanoparticles from K2PtCl4 solution using bacterial cellulose matrix," *Journal of Nanoparticles*, vol. 2014, Article ID 285954, 6 pages, 2014.
20. H. F. Aritonang, D. Onggo, C. Ciptati, and C. L. Radiman, "Insertion of platinum particles in bacterial cellulose membranes from PtCl4 and H2PtCl6 precursors," *Macromolecular Symposia*, vol. 353, no. 1, pp. 55-56, 2015.
21. H. F. Aritonang, V. S. Kamu, C. Ciptati, D. Onggo, and C. L. Radiman, "Performance of platinum nanoparticles/ multiwalled carbon nanotubes/bacterial cellulose composite as anode catalyst for proton exchange membrane fuel cells," *Bulletin of Chemical Reaction Engineering & Catalysis*, vol. 12, no. 2, pp. 287–292, 2017.
22. R. W. Raut, A. S. M. Haroon, Y. S. Malaghe, B. T. Nikan, and S. B. Kashid, "Rapid biosynthesis of platinum and palladium metal nanoparticles using root extract of *Asparagus racemosus* Linn.," *Advanced Materials Letters*, vol. 4, no. 8, pp. 650–654, 2013.
23. B. L. Cushing, V. L. Kolesnichenko, and C. J. O'Connor, "Recent advances in the liquid-phase syntheses of inorganic nanoparticles," *Chemical Reviews*, vol. 104, no. 9, pp. 3893–3946, 2004.
24. E.McGillicuddy, I. Murray, S. Kavanagh et al., "Silver nanoparticles in the environment: sources, detection and ecotoxicology," *Science of the Total Environment*, vol. 575, pp. 231–246, 2017.
25. S. Kaviya, J. Santhanalakshmi, B. Viswanathan, J. Muthumary, and K. Srinivasan, "Biosynthesis of silver nanoparticles using *Citrus sinensis* peel extract and its antibacterial activity," *Spectrochimica Acta Part A: Molecular and Bimolecular Spectroscopy*, vol. 79, no. 3, pp. 594–598, 2011.
26. O. V. Kharissova, H. V. R. Dias, B. I. Kharisov, B. O. Pérez, and V. M. J. Pérez, "The greener synthesis of nanoparticles," *Trends in Biotechnology*, vol. 31, no. 4, pp. 240–248, 2013.
27. V. V. Makarov, A. J. Love, O. V. Sinitsyna et al., "Green nanotechnologies: synthesis of metal nanoparticles using plants," *Acta Naturae*, vol. 6, no. 1, p. 20, 2014.
28. M. Akter, M. T. Sikder, M. M. Rahman et al., "A systematic review on silver nanoparticles-induce cytotoxicity: physicochemical properties and perspectives," *Journal of Advanced Research*, vol. 9, pp. 1–16, 2018.
29. A. Zielinska, E. Skwarek, A. Zaleska, M. Gazda, and J. Hupka, "Preparation of silver nanoparticles with controlled particles size," Procedia Chemistry, vol. 1, no. 2, pp. 1560–1566, 2009.

30. A. Singh, D. Jain, M. K. Upadhyay, N. Khandelwal, and D. H. N. Verma, "Green synthesis of silver nanoparticles using Argenone mexicana leaf extract and their charactrization," Digest Journal of Nanomaterials and Biostructures, vol. 6, no. 1, pp. 483–489, 2010.

31. Henry F. Aritonang , Harry Koleangan , and Audy D. Wuntu " Synthesis of Silver Nanoparticles Using Aqueous Extract of Medicinal Plants' (Impatiens balsamina and Lantana camara) Fresh Leaves and Analysis of Antimicrobial Activity"Hindawi International Journal of Microbiology Vol.2019,

32. Rajendiran Ramkumar,govindasamy Balasubramani,Ramalingam Karthik Raja,Manickam Raja,Raji Govindan,Easwaradas Kreedapathy Girija & Pachiappan Perumal. *Lantana camara* Linn root extract-mediated gold nanoparticles and their invitro antioxidant and cytotoxic potentials;ARTIFICIAL CELLS,NANOMEDICINE,AND BIOTECHNOLOGY(an International Journal) vol:45,2017issue:4 ;pages:748-757

33. Musthafa O. Mavukkandy, Sudip Chakraborty, Tasneem Abbasi and Shahid A. AbbasiA Clean-Green Synthesis of Platinum Nanoparticles Utilizing a Pernicious Weed Lantana (Lantana Camara) American Journal of Engineering and Applied Sciences 2016, 9 (1): 84.90 DOI: 10.3844/ajeassp.2016.84.90

34. Boisselier E, Astruc D. Gold nanoparticles in nanomedicine: preparations, imaging, diagnostics, therapies and toxicity. Chem Soc Rev 2009; 38(6): 1759-82.

35. Brigger I, Dubernet C, Couvreur P. Nanoparticles in cancer therapy and diagnosis. AdvDrugDelivRev2002;54(5):631-51

36. Italia JL, Bhatt DK, Bhardwaj V, Tikoo K, Kumar MN. PLGA nanoparticles for oral delivery of cyclosporine: nephrotoxicity and pharmacokinetic studies in comparison to Sandimmune Neoral. J Control Release 2007; 119(2): 197-206.

37. Jain KK. Nanodiagnostics: application of nanotechnology in molecular diagnostics. Expert Rev Mol Diagn 2003; 3(2): 153-61.

38. Henderson CS, Madison AC, Shah A. Size matters-- nanotechnology and therapeutics in rheumatology and immunology. Curr Rheumatol Rev10(1) 2014;

39. He H, Pham-Huy LA, Dramou P, Xiao D, Zuo P, Pham-Huy C. Carbon nanotubes: applications in pharmacy and medicine. BioMed Res Int 2013; 2013578290

40. Feng L, Liu Z. Graphene in biomedicine: opportunities and challenges. Nanomedicine (Lond) 2011; 6(2): 317-24.

41. Biswa Mohan SahooB.V.V Ravi Kumar , Ch. Niranjan Patra, J. R Panda, Bibhash C. Mohanta and Narahari N. Palei.Nanotechnology: A Novel Approach forDrug Development in Health Care System *Current Nanomaterials*, 2020, *Vol. 5, No.*

42. Linazasoro G. Potential applications of nanotechnologies to Parkinson's disease therapy. Parkinsonism Relat Disord 2008; 14(5): 383-92.

43. Kuntworbe N, Al-Kassas R. Design and *in vitro* haemolytic evaluation of cryptolepine hydrochlorideloaded gelatine nanoparticles as a novel approach for the treatment of malaria. AAPS PharmSciTech 2012; 13(2): 568-81.

44. Gelperina S, Kisich K, Iseman MD, Heifets L. The potential advantages of nanoparticle drug deliverysystems in chemotherapy of tuberculosis. Am J Respir Crit Care Med 2005; 172(12): 1487-90.

45. Grodzinski P, Silver M, Molnar LK. Nanotechnology for cancer diagnostics: promises and challenges.Expert Rev Mol Diagn 2006; 6(3): 307-18.

46. Jayaraj RL, Chandramohan V. Nanomedicines for Parkinson disease: current status and future perspective. Int J Pharm Bio Sci 2013; 4(1): 692-04.

47. Chan WCW, Nie S. Quantum dot bioconjugates for ultrasensitive nonisotopic detection.Science1998281(5385):20168.

48. Cheng Y, Zhao L, Li Y, Xu T. Design of biocompatible dendrimers for cancer diagnosis andtherapy: current status and future perspectives. Chem Soc Rev 2011; 40(5): 2673-703.

49. Lin JH, Lu AY. Role of pharmacokinetics and metabolism in drug discovery and development. Pharmacol Rev 1997; 49(4): 403-49. PMID: 9443165

50. Li SD, Huang L. Pharmacokinetics and biodistribution of nanoparticles. Mol Pharm 2008; 5(4): 496-504.

51. Mamo T, Moseman EA, Kolishetti N, *et al.* Emerging nanotechnology approaches for HIV/AIDS treatment and prevention. Nanomedicine (Lond) 2010; 5(2):269-85.

52. Mittal G, Kumar MN. Impact of polymeric nanoparticles on oral pharmacokinetics: a dosedependent case study with estradiol. J Pharm Sci 2009; 98(10): 3730-4.

53. Moghimi SM, Hunter AC, Murray JC. Nanomedicine: current status and future prospects. FASEB J 2005; 19(3): 311-30.

54. Biswa mohan sahool.B.V.V Ravikumar,ch.Niranjan patral, J.R Pandal, Bibhash C.Mohanta and Narahari N..Palei Nanotechnology:A Novel Approach For Drug Development In Health Care System Current Nanomaterials,(5)2020

55. Nasiruddin M, Das S. Nanotechnology based approach in tuberculosis treatment. 2017; pp. 1-12.

56. Nakache E, Poulain N, Cand F. Biopolymer and polymer nanoparticles and their biomedical applications. In: Handbook of Nanostructure and Nanotechnology. 2000; 5: pp. 577-35.

57. Int J Pharm 2009; 382(1): 270-6. PMID: 19712736

58. Petros RA, DeSimone JM. Strategies in the design of nanoparticles for therapeutic applications.2010;9(8): 615-27.

59. Pham CT. Nanotherapeutic approaches for the treatment of rheumatoid arthritis. Wiley Interdiscip RevNanomed Nanobiotechnology 2011; 3(6): 607-19.

60. Sinha R, Kim GJ, Nie S, Shin DM. Nanotechnology in cancer therapeutics: bioconjugated nanoparticlesfor drug delivery. Mol Cancer Ther 2006; 5(8): 1909- 17.

61. Rosi NL, Mirkin CA. Nanostructures in biodiagnostics. Chem Rev 2005; 105(4): 1547-62.

62. Deb S, Ghosh K, Shetty SD. Nanoimaging in cardiovascular diseases: Current state of the art. Indian JMedRes2015;141(3):285-98.

63. Timko B. Advances in drug delivery. Annu Rev Mater Res 2011; 41: 1-20.

64. Varshney HM, Rajnish K, Shailender M. Novel approaches for insulin delivery: current status. Int J of Therap Appl 2012; 7: 25-31.

65. Vashist SK, Zheng D, Al-Rubeaan K, Luong JHT, Sheu FS. Advances in carbon nanotube based electrochemical sensors for bioanalytical applications. Biotechnol Adv 2011; 29(2): 169-88.

66. Patil M, Mehta DS, Guvva S. Future impact of nanotechnology on medicine and dentistry. J Indian Soc Periodontol 2008; 12(2): 34-40.

67. Sanjeeb Kalita, Gaurav Kumar, Loganathan Karthik, Kokati Venkata Bhaskara Rao: A Review on Medicinal Properties of *Lantana camara* Linn.ISSN 0974-3618*Research J. Pharm. and Tech. 5(6): June 2012*

68. Sharma OP et al. A review of the toxicity of *Lantana camara* (Linn) in animals. Clinical Toxicology. 18 (9); 1981: 1077-1094.

69. Sharma OP, Makkar HPS and Dawra RK. A review of the noxious plant *Lantana camara*. Toxicon. 26 (11); 1988: 975-987.