ABSTRACT
Plumbago indica L. is a medicinal herb species in the genus Plumbago described by Linnaeus of the species Plantarum, extensively in the hot and humid areas to use in the conventional structure of herbs. The distinct division of that plant is used to heal rheumatism, menstrual irregularities, tumors, leptotic infections, acquired immune disease, numbness, immobility, swollen glands, eczema, conjunctivitis, flatulence, extravagated, piles, anorexia, etc. The plant contains a variety of Phyto-constituents including sugars, alkaloids, flavonoids, steroids, phenols, and gums. Numerous categories of research were supported out in distinct kingdoms on the pharmacology of that remedial herb. Methodologically and biologically demonstrate data were concluded on that paper to clear the way for well-founded convenience detailed sources and invigorate further research.

Keywords: Plumbago indica L., Phytochemical analysis, Pharmacological agents, Medicinal herbs, Phyto-constituents.

INTRODUCTION
Plumbago indica L. syn. Plumbago rosea L. is a category of flowering plant distributed in parts of South-East Asia, region, the Arabian Peninsula, Europe, Malaysia, Indonesia, Africa, China, and India. Plumbago indica L. has a vast area of pharmacological interest against numerous infectious conditions. Plumbago indica L. is universally used in conventional techniques such as in herbalism, Siddha, Perso-Arabic, and Homeopathy and also in unrestricted generic formulations of the farmer’s populations.1-3

Common name – Chitraka (in Ayurvedic), Sheetraj, Chita (in Unani), Chitraka, Chitrakamool (Trade Name).

MORPHOLOGY
Plumbago indica L. is an ayurvedic remedial plant and it is an evergreen perpetual herb or shrub that grows and spread in warm lush climates up to a height of 1.5meters. It remains stem erect or branched from the base. Leaf parts of Plumbago indica L. are alternate, simple, and oval to elliptic, 8-13cm long, plane, glossy with wavy margins, and have a pointed base. Flowers are bisexual, intense red, 3-5cm long, forming very long-winded, lax spine, and axillary slender reaching 60 cm. The calyx is a tiny, tube-like formation along with ribs covered by prescribed glands with red color. Plumbago indica L. precise with inflorescent throughout a complete year without fruit.4-5

CHEMICAL CONSTITUENTS AND MEDICINAL PROPERTIES
Plumbago indica L. herb part root carry Plumbagin in as active constituent along with other isolated compounds from other parts of the herb including plumbagin, dihydrolavivinods, (stem), Chitanone (leaves), glucose, and steroids from flowers, fruits, seeds respectively. Plumbagin shows several pharmacological activities against bacterial infections, antitumor, cardioprotective with several therapeutic effects. Plumbagin additionally acts as an irritant. Therefore, produce stimulant action such as the fast release of the secretions in the central nervous system at low doses and may cause death due to collapse of respiration and paralysis at a high level of doses. Historically as per data reported. Showed anti-implantation and abortion studies reported in animals (rat) due to toxic effects of Plumbagin. Because of its toxic effects, it is a life-threatening exercise. Reported in-vitro studies declare that Plumbago indica L. have an agent which interferes with mutagenicity.6-8

EXPERIMENTAL PHARMACOLOGY
Anti-fungal activity
Methanol extract showed strong antifungal activity with zone inhibition of (10.0-27.0) mm while the greatest antifungal activity was found due to toxic effects of Plumbago indica L.9

The active constituents Plumbogin was reported as fungicidal against C. albicans with MIC and MFC values 0.78 and 1.56µg/mL.11

Anti-Acne Activity
The MIC of Plumbago indica roots extraction with acetone against P. acnes, S. epidermidis, and M. furfur was found to be 600, 200, and 300µg/mL.12

The anti-acne activity showed by acetone extract of Plumbago indica (in gel formulation) was investigated against P. acnes, S.epidermidis,
and yeast by well diffusion method has potential activity against acne-causing microorganisms.\textsuperscript{15}

As Table 1 contains the taxonomical classification of \textit{Plumbago indica} L. Figure 1 shows morphological characters of \textit{Plumbago indica} L. A: flowers, B: roots. \textit{Plumbago indica} L.

### Antimicrobial activity

Methanolic extracts of \textit{Plumbago indica} was showed antimicrobial activity with zone inhibition ranging 7.0-25.0mm against \textit{Staphylococcus aureus}, \textit{Salmonella typhi}, and \textit{Salmonella paratyphi} with MIC was found 31.25-125µg/mL with the use of ciprofloxacin as a standard.\textsuperscript{14}

PPE (Plumbago derivative-rich \textit{Plumbago indica} extracts) was not less than 13.0\%w/w contains and shows antimicrobial effects against \textit{Propionibacterium acnes}, \textit{Staphylococcus aureus}, and \textit{Staphylococcus epidermidis} by micro-dilution assay method, and its stability was determined quarterly when stored in a well-closed container at temperature 4±2°C in dried powder form which is to be protected from light.\textsuperscript{15}

With the use of the Disc Diffusion Assay method of \textit{Plumbago} release dynamic antimicrobial action against methicillin-resistant \textit{Staphylococcus aureus}. \textit{Plumbago} reported high specificity with the DNA gyrase binding site with a high affinity and a minimum energy barrier of - 7.651kcal/mol after molecular docking.\textsuperscript{16}

### Antifertility Activity

\textit{Plumbago indica} showed a percentage pre-implantation loss of 40\% and 50\% against control at doses of 200 and 400mg/kg b/w. \textit{Plumbago indica} and \textit{A. lanata} at a focus of 10\% have shown no motility. Both \textit{Plumbago indica} and \textit{A. lanata} possess no motility of spermatozoa in rats within 60 sec at a concentration use 10\%.\textsuperscript{17}

### Analgesic Activity

Methanolic extract of \textit{Plumbago indica} has been shown significant suppression of pain response by using the acetic acid-induced writhing method at dose concentration 250mg/kg and 500mg/kg in young Swiss-albino mice.\textsuperscript{19}

Aqueous extracts of \textit{Plumbago indica} were estimated with a dose of 300mg/kg body weight; carrageenan-induced paw volume showed analgesia 68.29\% and 45.2\% find out by Eddy’s hot plate method.\textsuperscript{20}

### Antimalarial activity

\textit{In vitro} antimalarial activity of \textit{Plumbago indica L.} was claimed in \textit{Plasmodium berghei}-infected mouse model at the dose level of 25mg/kg BW administrated daily up to 4 days was safe and produced antimalarial activity.\textsuperscript{21}

### Antibacterial activity

MIC of methanolic extract was found to be 20µg/mL on both \textit{Escherichia coli} and \textit{Klebsiella pneumonia}, while aqueous extract had a Microbial Inhibitory concentration of 10 and 20µg/mL of \textit{Escherichia coli} and \textit{Klebsiella pneumonia}.\textsuperscript{22}

Ethanol extracts (80\%) possess activity against \textit{Bacillus subtilis}, \textit{Staphylococcus aureus}, \textit{Escherichia coli}, \textit{Pseudomonas aeruginosa}, MIC is 6.25mg/mL for \textit{Bacillus subtilis} and 12.5mg/mL for \textit{Staphylococcus aureus}, \textit{Escherichia coli}, and \textit{Pseudomonas aeruginosa}.\textsuperscript{23}

Plumbagin was exhibited activity against \textit{Staphylococcus aureus} with MIC and MBC/MFC value 1.56 and 25.0µg/mL.\textsuperscript{11}

### Antimycobacterial activity

Using a pure and safe composition of the recombinant version of Mtb/ThyX, a structural arrangement of the associated compound obstructs its activity leads to cell death. \textit{Plumbago} quashes mycobacterial cells by targeting with a vital enzyme named ThyX, required for their abidance.\textsuperscript{23}

### Antioxidant Activity

\textit{In vitro} antioxidant activity possess by methanolic extracts of \textit{Plumbago indica} by using 2,2-diphenyl-1-picrylhydrazyl in a test construct by the method Oyaizu along with Hydroxyl radical scavenging activity.\textsuperscript{24}

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<th>Table 1: Taxonomic profile: \textit{Plumbago indica} L.</th>
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Figure 1: \textit{Plumbago indica} L.\textsuperscript{3} A: flower; B: roots.
Hepatoprotective Activity
The alcoholic root extract of *Plumbago indica* was afforded remarkably safe against paracetamol-induced hepatocellular injury treated with 200mg/kg and 400mg/kg of body weight with reference drug-Silymarin (100mg/kg).  

Anti-influenza Activity
Methanolic and ethanolic extracts of *Plumbago indica* exhibited 100% depletion in both concurrent and post treatment evaluation at concentration 10mg/mL, 5mg/mL and 1mg/mL. 

Cardioprotective Activity
After Plumbagin treatment of animals, repossess the heart weight and body weight and ameliorated by plumbagin treatment, from doxorubicin-induced damage.  

Plumbagin increases activities of creatine kinase and cardiac troponin and restored the level of lipid peroxide markers, increased anti-oxidative enzymes, decreased pro-inflammatory cytokines by oral administration.  

Free radicals scavenging (oxidative stress) was controlled by plumbagin by decreasing ROS and lipid peroxide levels in animals with heart injuries, with redox imbalance by injury by transcription factors NF-kB and Nrf-2. Pro-inflammatory cytokine expressions were remarkably quashed by plumbagin treatment. 

Macrofilaricidal Property
That property *Plumbago indica* was reported against Setaria digitata, an ailarial parasite of cattle with an inhibitory concentration range from 0.02 and 0.05mg/mL.  

Antifertility Activity
Acetonic and Ethanolic extracts exhibit antifertility activity with doses 200 and 400mg/kg measured on estrogenic activity in rats and confirmed by histopathology study of the uterus.  

Ethanolic extract of *Plumbago indica* roots shows the anti-implantation effect with loss of 40 percent and 50 percent against control dose at a concentration of 200mg/kg and 400mg/kg body weight which recommended percentage defeat was 30 percent and 40 percent at 200mg/kg and 400mg/kg body weight.  

Plumbagin (acetone extract) with the dose levels, 200 and 400mg/kg body weight showed significant estrogenic and anti-estrogenic activity (p< 0.05) (p<0.001) in female rats.  

Anti-inflammatory Activity
Plumbagin suppresses T cell expansion in response to polyclonal mitogen concanavalin A by blocking cell cycle progression induced IL - 2, IL - 4, IL-6, and IFN - γ cytokines. Also suppressed CD69 and CD25 in activated T cells. 

Genotoxic Effect
*Plumbago indica* root ethanolic extract of (EERP) serves potential therapeutic effects at concentration 25-100µg/mL induced cell kills and cytotoxic effect at concentrations of ≥500µg/mL in-vitro. 

Anticancer Activity
*Plumbago indica* L., Methanolic extraction against brine shrimp nauplii and evaluate LC₅₀ and LC₉₀ was 5.0µg/mL and 12µg/mL.  

Ethanolic extract (50-250µg/mL) reflects cytotoxicity in HE-17 cell lines by using MTT assay. 

Plumbagin down the feasibility of human prostate cancer cells (PC-3, LNCap, and C4-2) with ROS origination and decrease of intracellular GSH levels together with superoxide dismutase 2 (Mn-SOD).  

Plumbagin acted as a potent inducer of ROS, proteasome inhibitors causing DNA double-strand break by oxidative DNA base damage and suppression of cellular glutathione.  

Plumbagin inhibits tumor development and no sign of toxicity at 200 or 500ppm dose levels decrease Stat3, AKT, PKCE, and COX, both primary and castration-resistant prostate cancer in Pten-KO mice as compared with the control group.  

Antiproliferative effect
*Plumbago indica* L. and *P. zeylanica* L., in stomach and breast cancer cell lines, confirmed cell kills by nucleus staining. 

Anti-diarrhoeal Effect
Plumbagin produces inhibition in smooth muscle contractility and delayed in intestinal motility and; inhibits both cAMP-activated and Ca²⁺ Cl-channels as per mechanism and can be used in the therapy of CT-induced, rotaviral diarrhea and travelers with the inhibition of CaCC–calcium-activated Cl-channels and cystic fibrosis Transmembrane conductance regulator in both HT-29 cells and mouse colon. 

Toxicity study
*Plumbago indica* root crude extract in hamster’s mortality, behavior, histochemical, histopathological replaces with dose at 0, 100, 400, 1000, and 3000 mg/kg orally for 24hr and every day for 7 days assessment. The parameters show differences in hepatic panel tests (ALT and AST) and renal function tests (creatinine and BUN). 

CONCLUSION
As per published literature on *Plumbago indica* L. reported a variety of active ingredients with many potential therapeutic uses. Further investigations should be carried out to recognize and establish other potential Phyto-constituents and pharmacological activities. 

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CONFLICT OF INTEREST
The authors declare that there is no conflict of interest. 

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