



A COMPREHENSIVE ANALYSIS: MORPHOLOGICAL, PHYTOCHEMICAL, THERAPEUTIC AND TOXICOLOGICAL CHARACTERIZATION OF THE PLANT EUPHORBIA TIRUCALLI LINN.

Semimul Akhtar, Rishabh Mittal, Shruti, Gaurav Verma
Professor, Student

Gitanjali College of Pharmacy, Lohapur, Nalhati BirBhum, SRMS College of Engineering & Technology, Bareilly

ABSTRACT-

This review is to bring out a significant understanding of the plant Euporbiatirucalli that is of great medicinal importance. This article avails with information regarding its morphology, phytochemistry, therapeutic uses, toxicology and pharmacological activities of the various parts of the plant. The plant shows various pharmacological activities through its phytoconstituents such aseuphol, euphorbol, hexacosonate, cycloeuphordenol, cyclotirucanenol, tirucalicine, tri-methyl ellagic acid, gallic acids, terpenic alcohol, taraxerone, euphoringinol, taraxerol, β -amyrin, etc. which show different pharmacology action like analgesic, anthelmintics, antiarthritic, antimicrobial, anti-HIV, anti-inflammatory, antioxidant, antiviral, CNS depressant/neuropathic pain, anticancer, genotoxic/mutagenic, hepatoprotective, immunomodulatory, larvicidal, molluscicidal/ovicidal/piscicidal, myelopoiesis, proteolytic/chitinolytics pharmacological activities. This shows the significant role of the plant this review can be helpful to provide information for the preparation of herbal dosage forms for such ailments

Keywords- Euphorbia tirucalli, pencil-cactus, Euphorbiaceae, Aveloz, Indian spurge tree.

INTRODUCTION-

According to the World Health Organization (WHO), conventional medicines are used by about 80% of the population in developing countries for basic health care. India is known as the world's botanical garden because it is

the world's greatest cultivator of medicinal plants. Over the centuries, many medicinal plant derivatives are used either in their natural state or in a semi-synthetic state. Nowadays, herbal medicines are used worldwide as they have very few side effects. This has provided India with a fantastic opportunity to find lead compounds with the therapeutic value from plants used in the traditional system of Ayurveda, which can be used in the development of new medicines.(1)

Euphorbiaceae is a vast blooming plant family with many different vegetative forms, some of which are very important.(1) Euphorbia Tirucallilinn, also known as 'pencil cactus', 'milk bush', 'Indian spurge tree', 'naked lady', 'finger euphorbia' is a small flowering plant that belongs to the family 'Euphorbiaceae' (2,3). Universally, also known as 'Aveloz'.(2) The caustic milky latex and distinctive inflorescences of Euphorbia plants render it easily distinguishable (cyathia).(4) This plant is a native of East Africa and Madagascar; however, it has been widely distributed all along with the world because of its great tolerance towards climatic conditions.

The binomial system classifies Euphorbiatirucalli as the member of the following taxonomical classes, a Kingdom: Plantae, Sub-Kingdom: Tracheobionta, Division: Magnoliophyta, Super-Division: Spermatophyta, Class: Magnoliopsida, Sub-Class: Rosidae, Order: Malpighiales, Genus: Euphorbia, Family: Euphorbiaceae, Species: tirucalli Linn.(1) Advanced scientific techniques have been used to analyze E. tirucalli extensively, and a number of active components were identified in different parts of the plant and pharmacologically studied..(5) E. tirucalli has extensively been used as conventional medicine in countries such as India, South America, Asia, and Africa for treating a variety of medical ailments including cancer, sarcoma, rheumatism, asthma, syphilis, colic, whooping cough and leprosy.(3,6) Despite the widespread usage of the E. tirucalli latex, few studies have shown the effectiveness of orally consumed latex for the treatment of cancer.⁶Euphorbiaceae's chemical diversity is mostly due to its isoprenoid constituents. Diterpenoids, such as casbanes, jatrophanes, daphnanes, tiglanes, and ingenanes, as well as triterpenoids and sesquiterpenoids, account for the bulk of the metabolites described in this genus.(4)

MORPHOLOGICAL DESCRIPTION

MACROSCOPIC CHARACTERIZATION-

Euphorbia tirucalli is presumably the most popular and widely distributed species of all the plants of the Euphorbia family. It is an evergreen plant since its branches and stem remain green and functional throughout the year and are usually protected from being fed by the herbivores because they contain a white poisonous latex¹. E. Tirucalli is a large flowering shrub or a tiny tree which can grow about 4 to 12 m tall.(2)

- **Branches**—Branches are smooth, cylindrical, polished and are developed into phylloclade.²These pencil shaped branches are about 7 mm wide and exude a milky white sap when incised. These are arranged in whorls 10 forming bushes which is the most known characteristic of the plant.(1)
- **Stems/bark**—The stem of the plant is about 15 to 20 cm wide with upright stems. The dried stems have a greenish brown appearance, fractured and fibrous, and have an acrid flavor but no distinct odor. On the bark, there are occasionally visible, small projections, such as a protrusion, as well as black, rough, transverse bands.(1,2)

FIGURE 1: BRANCHES OF *E. TIRUCALLI*⁹FIGURE 2: FULL- FLEDGED FORM OF *E. TIRUCALLI*⁹

- **Leaves**-Its leaves are small, slender, oblanceolate and spotted of about 1.3 to 2.5 cm in length upto 2 cm in width and about 2 mm thick. They are tapered to the sessile base. They are very rarely seen because they fall very quickly (deciduous) and are present at the tip of young and leafy branchlets. The ends of young leafy branchlets are tomentose, with curled brown hairs, and glabrescent. Green branches have taken over the function of leaves.(1)
- **Flower**-Flowers are tiny, judicious, greenish pink or yellow, they are found at the ends of short branches and are clustered on terminating twigs. Flowers are discreet and are present in mass at the top of short branches and are stalkless. *E. Tirucalli* grows flowers and fruits in October and November-December respectively. The plant is a dioecious plant that more often produces male flowers. Flowers are pollinated by insects. 2mm long styles are unified at the support with a thick bifid recurved apex. The perianth is 3 lobed below the ovary (0.5 mm long lobes) covered with tomentose.(2,7)
- **Fruits**-Fruits are glabrescent tripartite capsules that are almost 8 to 12 millimeters in diameter. Yellowish red-colored, pubescent capsules undergo dehiscing while they are still on the tree. These are nearly globose, slightly lobed longitudinally, short-stalked and on a tomentose pedicel.(1,2)
- **Seeds**-Seeds of dimensions upto 3.4 to 4mm x 2.8 to 3mm are soft, ovoid and glabrous. They are buff (yellowish- beige) colored with brown spots and a white caruncle surrounded by a dark brown ventral line.(1,2)
- **Latex**-Milky white latex is produced by the plant on damaging the branches which are used for a variety of diseases. This caustic milky sap is also been used in binding the knife blades to handle due to its high adhesive properties. The milky juice is acrid, vesicant and rubefacient.(2)
- **Roots/ wood**-Lateral roots are produced that do not grow very much deep. Closed grained white wood is present which is fairly rigid.(2)

2.2 MICROSCOPIC CHARACTERIZATION-

The thinnest transverse section of the stem was studied under trinocular microscopes. The results showed circular outlines displaying little notches due to immersed stomata. Central vascular bundles consisting of xylem and phloem are surrounding the empty pith. Vascular cylinders are easily distinguishable, conjoint, collateral and open.¹⁴ Broad

parenchymatous cortex consists of stone cells and fibers. The cross-section shows both upper and lower single-layered epidermises embedded with mesophyll and vascular bundles. The heterogeneous mesophyll are amphistomatic consisting of lactifers. (8) There is a 5-7 cell large phloem with a strainer duct and supporting cells, as well as single to bi-seriate medullary rays in parallel with that of the xylem. Lactiferous canals are in continuation all over the phloem, cortex and pith. 3-5 transversely oval peltate glands are arranged which are concealed by trichomes. Small curved styles are present which have two lobes. styles. (2) Powder microscopy of the plant shows the availability of trichomes, sharp pitted vessels, lactiferous cells with paracytic stomata that emerged in parenchyma cells, annular ring vessels, xylem fibers, grouped lactifer cells, pitted and reticulate vessels, lignified fibers and latex producing glands. (2,9)

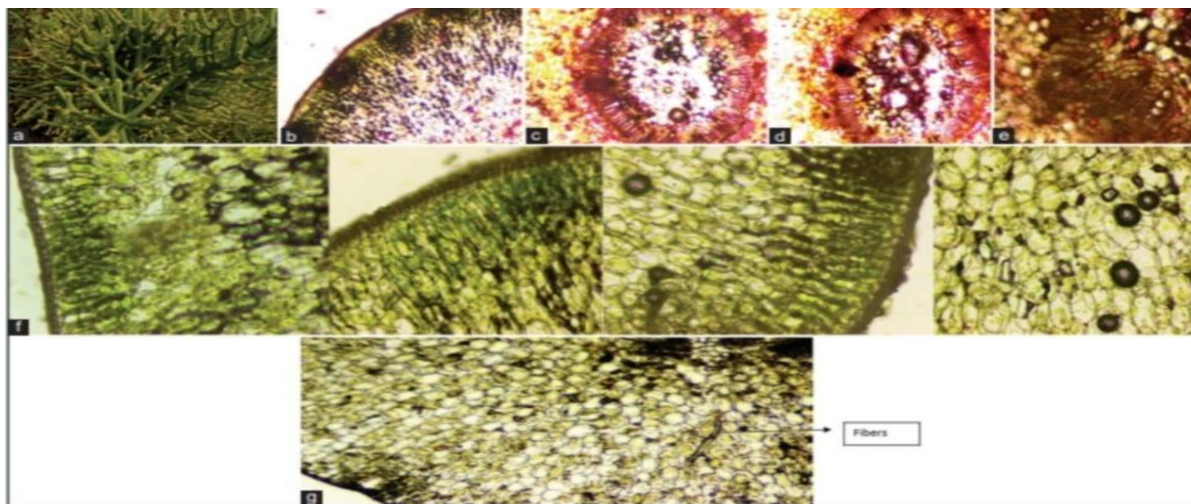


FIGURE 3: (a) characteristic appearance of aerial parts (b) epidermis with minute grooves (c) pith region and phloem with latex canals (d) vascular bundles (e) augmented vascular bundles (f) augmented epidermis, cortex region cells and stone cells (g) cortex with fibers (10)

3.0 GEOGRAPHICAL DISTRIBUTION-

Euphorbia tirucalli is mostly cultivated as a decorative plant or hedge plant in almost all parts of the world.² The plant *Euphorbia tirucalli* is local to the region of East Africa and America it was investigated to flourish in various countries like Eritrea, Kenya, Malawi, Rwanda, Sudan, Ethiopia, Senegal, Tanzania, Angola, Uganda, Mauritius and Zangibar.^{1,3} It often occurs in parched wilderness and acclimatize in brushwood, open forest and grasslands of about 2000 m. E. *tirucalli* was appeared to have the ability to thrive in almost all kinds of soil with pH between 6 to 8.5. It is found to be flourishing in grassy hills, rocky outcrops, ridges and river banks. It is also found in Brazil, India, Indonesia, Malaysia, Philippines and Vietnam, etc. In India, it grows particularly in drier parts of South India and Bengal. The plant can thrive in a wide range of environments. (10) It can grow under conditions that are unfavorable to most crops such as very high altitudes, poorly eroded and saline soils and tropical areas with low rainfall but they can not handle frost and thus are limited by frigidity. (1,7)

4.0 PHYTOCHEMISTRY OF EUPHORBIA TIRUCALLI-

The chemical constituents of various parts of the plant *Euphorbia tirucalli* have been studied extensively. *Euphorbia tirucalli* includes almost 7.4% of citric acid, malonic acid and succinic acid. This plant has provided some

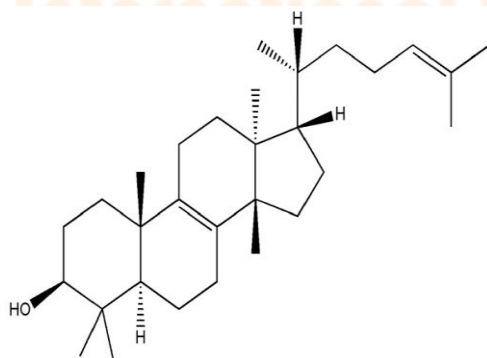
phytochemicals like flavonoids, tannins, diterpenes, steroids and alkaloids, etc. it also contains terpenes, euphol, ephorbol, tirucallol, taraxasterol, cyclo euphorenol, beta-sitosterol, terpenic alcohol and trigliane.(2,5) The plants of the euphorbia family are easily distinguishable as they ooze out a milky white latex when damaged /incised. This latex was produced in the plant by an organ called lactifer.¹The latex is present in every single shoot of the plant. A brittle and lustrous resin having melting point 65-75 degreesC, ketone euphorone and linseed oils are some important constituents of the dried latex.(2) Fresh latex contains various constituents, majorly triterpenes with the molecular formula of C₃₀H₅₀O. The plant gives a positive Liebermann-Burchard test and a violet coloration with ceric sulphate which indicates the presence of tri-terpenoid in the compound. The absorption of the tri-substituted double bond and hydroxyl group by IR spectrum reads (3055, 1650 and 810 cm⁻¹) and (3410 cm⁻¹) respectively.¹⁰ It contains phorbol esters, ingenol esters and 12-deoxyphorbol esters which are carcinogenic and promote tumor progression. It also contains euphol, tirucallol, tirucallicine, euphoringinol, cycloartenol, aamyryn, lanosterol etc.(1-3,5) A study reported seven compounds isolated from *E. tirucalli*, including arjunolic acid, quercitrin, eriodictyol, scopoletin, 3,3',4-trimethyl ellagic acid, afzelin and gallic acid.(11) various physical and chemical constituents of the plant of euphorbia tirucalli have been listed in tables as follows:

TABLE 1: PHYSICAL CONSTITUENTS OF THE PLANT EUPHORBIA TIRUCALLI(2)

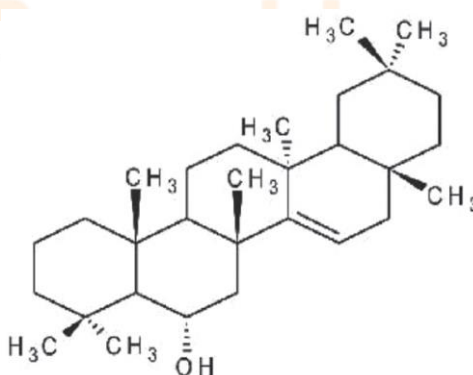
PARAMETERS	RANGES
Foreign matter	NMT 1 %
Total ash value	NMT 12 %
Acid insoluble ash	NMT 2.5 %
Ethanol soluble extractives	NLT 13 %
Water-soluble extractives	NLT 22 %
Solid matter	28
Caoutchouc	2.8- 3.8
Water-soluble substances	53.8- 79.9
Resin soluble substances	59- 63
Rubber-like substances	12-14

TABLE 2: CHEMICAL COMPOSITION OF DIFFERENT PARTS OF E. TIRUCALLI (2,12)

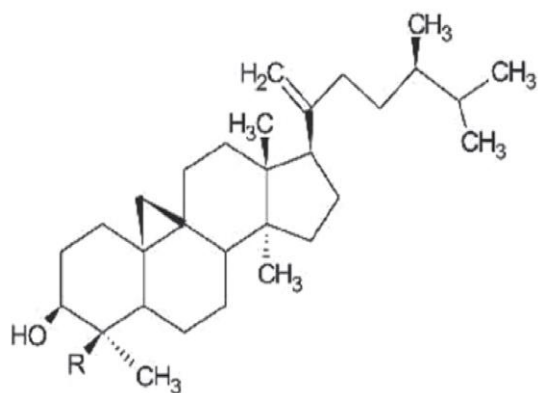
PART OF THE PLANT	MAJOR CONSTITUENTS
Leaves	Beta-amyrin
Dried latex	Ketone euphorone, resin
Latex	Triterpenes, Euphol, diterpene esters of phorbol, ingenol, beta-sitosterol, euphorbolhexacosonate, cyclotirucanenol, tirucallicine, trimethylellagic acid, sterols, cyclo euphordenol, glut-5-en3-beta-ol, taraxasterol, tirucallol, isoeuphorol, terpenic alcohol
Stem	hentriacontanol, hentriacontene, euphorone, euphorcinol, glucosides, ellagic acid, cyclotirucanenol, corilagin, casuarin, euphorbin A and F, tirucallin A and B, 3,3' dimethylellagic acid, taraxerol, 4 deoxyphorbol ester
Bark	Euphorbol, cycloartenol, ingenol triacetate, 24 methylene cycloartenol, beta sitosterol, taraxerone, 12-deoxy-4 beta-hydroxyphorbol-13-phenyl acetate, beta sitosterol, euphol
Stem-bark	Taraxeranetriterpene, euphorcinol, cycloart-23-ene, 3beta,25 diol, euphorginol, taraxerol
Stem-callus / shoot callus	Stigmasterol, campesterol, palmitic acid, linoleic acid, beta-sitosterol, isofucosterol, cycloartenol, euphol



(A) EUPHOL

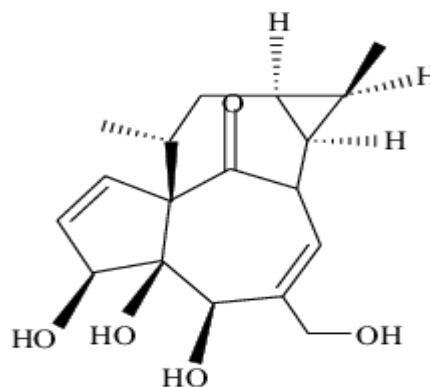


(B) EUPHORGINOL

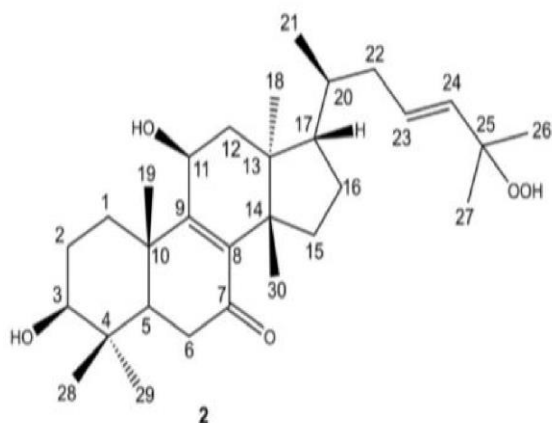


(C) CYCLOTIRUCANENOL R= Me

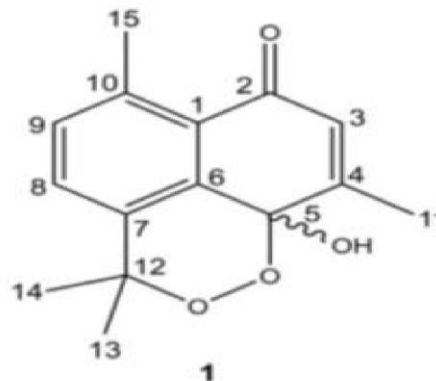
(D) CYCLOEUPHORDENOL R= H



(E) INGENOL



(F) EUPHOROL



(G) TIRUCADALENONE

FIGURE: 4. STRUCTURE OF SOME IMPORTANT CONSTITUENTS OF EUPHORBIA TIRUCALLI(1,4,13)

5.0 EXTRACTION

As the term suggests extraction includes separating bioactive constituents of the plant or animal tissue from the remaining inert part with the help of selective solvents in the standard extraction procedure. (1) The selective solvent known as the menstrum is used to attain the therapeutically active form of drug and eliminates the inert part called marc from a crude drug. Various technique involved in the extraction of medicinally active plants are as follows- Infusion, Decoction, Digestion, Maceration, Percolation, Hot Continuous Extraction (Soxhlet), Aqueous Alcoholic Extraction by Fermentation, SCF Extraction, Counter-current Extraction, Ultrasound Extraction (Sonication) & Phytonics process. Methanol, chloroform, petroleum ether, acetone for various activities are used for the extraction of *E. tirucalli*. (1,14,15)

6.0 PHARMACOLOGICAL ACTIVITIES-

6.1 Anti-arthritic Action—BET (bio-polymeric fraction) generated from *Euphorbia tirucalli* was reported to have dose-dependent anti-arthritic activity. The studies were conducted on the adjuvant-induced arthritis models in rats treated with BET fraction of the plant shows concentration-dependent inhibition of edema in the paws. The maximum therapeutic effects are seen at the dose of 100-200mg/kg orally. This plant also shows in-vivo immune-modulatory

activity which inhibits arthritis. The major mechanism of action include repression of both helper t cells (CD4+ cells) and killer t cells (CD8+ t-cells), decrease in intracellular IL-2 and Interferon by flow cytometry.(1,2,16)

6.2 Anthelmintic Activity-The extracts of the latex of the plant made from the solvents petroleum ether and dichloromethane-methanol were shown to expel out parasitic worms called helminths from the body. The dichloromethane-methanol extract was known to be effective against *Pheretimaposthumaearthworm* with 10 unusual concentrations (0.1-1.0%). The study shows a reduction in life span or time to paralysis and death of earthworms when treated with the dichloromethane-methanol and petroleum ether and extract.(2)

6.3 Antimicrobial/Antibacterial/Antifungal activity-Anti microbial/ antibacterial/ antifungal effects of the plant were studied using extracts of the plant in different solvents like acetone, methanol, dichloromethane, petroleum ether, chloroform and hexane. The leaves and stem of *Euphorbia tirucalli* were extracted in alcohol which was shown to be effective against laboratory and clinically isolated gram-negative as well as gram-positive bacteria such as *E.Coli*, *Bacillus subtilis*, *S. aureus*, *Pseudomonas aeruginosa*, *Proteus Vulgaris*, *Salmonella enteritidis*, *Candida albicans*, *C. tropicalis*, *Klebsiella pneumoniae*, *Aspergillus niger*, *A. flavus*, *A. fumigatus* and *Fusarium oxysporum* by agar well diffusion assay.(5)

Acetone extracts were found to be highly sensitive to *E. coli*. It also acts against *Candida Albicans*, *Aspergillus niger* and *Aspergillus fumigatus* with the MIC (minimum inhibitory concentration) of 500µg, 750µg, and 750µg respectively. Its chloroform extract was found to be sensitive against *Bacillus subtilis*, *Proteus Vulgaris*, *S.aureus*, *E. coli*, *Aspergillus niger* and *Candida Albicans* with the MIC (minimum inhibitory concentration) of 750 mcg/ml, 250 mcg/ml, 500mcg/ml, 500 mcg/ml, 1000mcg/ml and 750 mcg/ml respectively for different strains of bacteria.(5)

The methanolic extracts of the plant have shown to be effective against *Bacillus subtilis*, *S. aureus*, *E. coli*, *C. Albicans* and *E. faecalis*. The MIC with methanolic extracts was considered to be 500 µg for *S. aureus* and *E. coli*, although *B. subtilis*, *E. faecalis* has MIC of 750 µg and 1000µg for *C. albicans*.¹ The methanolic extract of the plant has shown to have the greatest Antimicrobial activity against certain gram-positive bacteria and fungi.(2)

6.4 Analgesic-The extract of the latex of the plant using dichloromethane-methanol and petroleum ether as a solvent was studied for having analgesic activity by tail immersion technique and acetic acid-induced writhing technique on rats or mouse. A prominent decrease in the number of writhes was seen at the dose of 300mg/kg, 100mg/kg and 30mg/kg of aqueous, dichloromethane-methanol and petroleum ether extract respectively.(2)

6.5 Anti-cancer/ cytotoxic effects-Cytotoxic effect in human gastric cancer cells were seen by the use of *Euphorbia tirucalli* latex. This antiproliferative effect was suggested to be caused by the enhanced p27^{kip1} and reduced cyclin B1 levels. PD98059 causes inhibition of ERK (Extracellular-signal-regulated kinase) 1/2 activation which ultimately alleviates *euphorbia* induce expression of pro-apoptotic protein and thus causing cell death. Moreover, various studies have been conducted for studying the anti-proliferative and cytotoxic effects of the

plant using BST assay and MTT assay. Euphorbia tirucalli extract, evaluated on BEL-7402 (hepatic carcinoma) and A-549 (Lung cancer) cell lines show significant anticancer activity.(2) A study reported that the administration of Euphorbia tirucalli latex in water to Walker 256 tumor-bearing rats showed a reduction in proliferation, mass of tumor cell and cachexia with significant immune-modulatory effects.(17)

6.6 Hepato-protective action-Aqueous extract of aerial portions of the plant have been investigated for its hepatoprotective activity in Wistar rats and mice. The study was done on rats against carbon tetrachloride (CCl₄) induced hepatic damage. The activity on Hepatoprotective action was investigated by estimating the extent of reversal of enhanced biochemical markers like alkaline phosphatase, bilirubin, oxaloacetate transaminase, serum glutamate pyruvate transaminase, serum glutamate cholesterol, triglycerides and also by measuring the tissue glutathione (GSH) levels and reduction in tissue lipid peroxidation. Significant hepatoprotective activity was seen at 125 mg/kg and 250mg/kg this action was suggested to be due to the reduced serum enzymes, triglycerides, bilirubin, and tissue lipid peroxidation although increased tissue GSH levels are seen in a dose-dependent manner.(1,2,5)

6.7 Antioxidant activity-The Methanolic extract was found to have strong dose-dependent antioxidant activity by DPPH, superoxide, hydroxyl radical reducing capacity. The aqueous extract of the plant was also studied by reducing capacity, superoxide anion and free radical scavenging assay for its antioxidant action.^{1,3} About 54% of superoxide anion and maximum hydroxyl radical scavenging activity was seen at the concentration of 100mcg/ml (5)

6.8 Anti-inflammatory action-In TPA-induced skin inflammation in mice, Euphol, extracted from the latex of Euphorbia tirucalli, was found to exhibit anti-inflammatory properties. The study concluded that the ability of euphol to prevent edema and leukocyte infiltration, overexpression of COX-2 and chemokines, and activation of ERK, PKCa, and PKCd are associated to its anti-inflammatory properties.(6)

6.9 Immunomodulatory effects-Treatments of tumor-bearing animals with Euphorbia tirucalli extracts showed stimulated marrow myelopoiesis and decreased spleen colony formation at the doses of 125, 250, 500 mg/kg. tumor-bearing mice were observed to be suffering from myelosuppression and increased no. of spleen colony-forming unit-GM. Treatment with E. tirucalli completely restored the differential marrow, cell counts.¹The biopolymeric fraction of the plant was also studied for Immunomodulatory activity. BET prominently lowered the leucocyte count and vascular permeability in a dose-dependent manner, as well as a 25.0%–28.2% delayed-type hypersensitivity reaction.(6)

6.10 Molluscicidal/ Larvicidal/ Ovicidal activity-Euphoringinol isolated from the stem or bark of the plant was investigated to have molluscicide property opposing to the Lymnaea acuminata and Biomphalaria glabrata which is a mollusk causing schistosomiasis. Dilutions prepared from the latex collected from the plant were evaluated against B. glabrata, which shows LD₅₀ at 28 ppm and LD₉₀ at 85 ppm.(3,6) Larvicidal activity was seen against

Anopheles funestus and A. gambiae using fresh latex of Euphorbia tirucalli in different dilutions. The highest dilution (1:250) is most preferable to prevent overdose of latex.(3)

6.11 Antiviral activity-The extracts obtained from Pet. ether and dichloromethane-methanol as solvent have shown 80% and 81% resistance to the tomato mosaic virus and tobacco mosaic virus respectively at the concentration of 150ppm.(6) The End Point Titration Technique (EPTT) and MTT colorimetric assay have been used to determine magnitude of the preparation to subside the lysing effect of herpes simplex virus type 2 and Viability of infected and uninfected cell cultures is reduced. The aqueous and methanolic extract of the plant's leaves and the stem has the highest antiviral activity.(2)

6.12 CNS depressant / neuropathic pain-Pet. ether, dichloromethane-methanol and aqueous extract of the latex were evaluated for its CNS depressant action or locomotor activity using actophotometer with chlorpromazine as a standard or reference drug. Results showed a relatively more significant decrease in the locomotor activity was seen in the aqueous extract of the plant when compared to pet ether or dichloromethane-methanol extract. A study revealed that euphol isolated from E. tirucalli was a promising compound for managing neuropathic pain.³

7.0 MEDICINAL USES –

7.1 Traditional uses-

TABLE: 3 TRADITIONAL USES OF EUPHORBIA TIRUCALLI (18)

PART OF PLANT USED	DISEASES TREATED
Whole plant	Leprosy, Biliousness, leucorrhea, cancrroids, Cancer, sarcomas
Latex	Cancer, asthma, cough, earache, snakebite and scorpion sting, toothaches, skin problems, rheumatism, warts, neuralgia, purgative, syphilis, gonorrhea, dyspepsia, colic, jaundice, enlargement of spleen, hemorrhoids, epilepsy
Branches	Gastralgia, colic (decoction of branches is used)
Barks	Fractures
Stems	Colic and gastric problems, leprosy, swelling, paralysis
Roots	Snake bites, infertility in women, colic, gastralgia
Wood	Leprosy, foot paralysis after childbirth

7.2 Ornamental uses-They are preferred as ornamental plants in India because they are easy to grow, require low maintenance and are evergreen with beautiful pencil-like branches.(1,2)

7.3 Energy Source -It has been reported that Euphorbia tirucalli latex contains petroleum-like hydrocarbons mainly C30 triterpenoid that on cleaving gives gasoline which is more inexpensive than crude petrol. Nowadays,

attention is given to biodiesel manufacturing to decrease overdependence on fossil fuels. Along with methane and biogas, this plant was also considered to be a source of biomass for the generation of biogas mostly through chopped substances underneath a thermophilic environment. In 19 days, it produces approximately 1.06 L of biogas each day. (1,2)

7.4 Source of rubber and adhesives- The latex of *Euphorbia tirucalli* has been observed to possess various hydrocarbon polymers, resins and terpenes which can be used for the manufacturing of rubber substitutes. (2) At east African beaches, resins were utilized to produce good quality adhesives for securing blades to the handle of wood and spearheads to their shaft due to its strong fixative power. (1)

7.5 Agroforestry and soil conservation- *Euphorbia tirucalli* is a drought-resistant plant cultivated in semi-arid locations to promote soil conservation through afforestation and reforestation. *Euphorbia tirucalli* has an important role in conservation and reforestation programs in countries like Kenya, Sri Lanka and Tanzania and. Moreover, it has featured in agroforestry programs as an inter-crop, border-line differentiation and live fencing around compounds. (1,2)

7.6 Use as pesticide- A dose-dependent toxic effects or pesticidal features of *E. tirucalli* latex was reported on various pests including *Biomphalaria glabrata*, *Aedes aegypti* and *Culex quinquefasciatus* (Mosquitoes), *Lymnaea natalensis* (mollusk) and *Staphylococcus aureus* (Bacteria) and some parasites including *Hoplolaimus indicus*, *Helicotylenchus indicus* and *Tylenchus filiformis*, etc. (1,2)

8.0 TOXICITY

The developmental toxicological screening of the aqueous solution of *Euphorbia tirucalli* latex have been reported in Wistar rats. In this study, on the first post coitum day, the Wistar rats were divided into two groups. The control group was subjected to distilled water while the treated group was subjected to latex aqueous solution. Maternal variables were: body weight, clinical signs of toxicity, liver, kidneys, ovaries, amount of corpora lutea and their weight. According to the results, it was concluded that the aqueous solution of latex did not affect implantation or tubic embryo development, but it seems to change the placenta morphology. (19) The latex cause irritation to human eyes and was reported to cause kerato-conjunctivitis and uveitis from exposure to the eyes. Its latex and phytotherapeutic solutions were investigated for genotoxicity and mutagenicity by Ames, Induc and Chromo test. Induc test showed a prominent escalation of the lysogenic cycle & a significant reduction in survival of bacteria while Ames and Chromo test showed no signs of genotoxicity and mutagenicity. (2)

9.0 Investigational protocol for study of anti-inflammatory and analgesic activity (20,21)

Anti-inflammatory activity of aqueous extracts of *E. tirucalli* latex can be evaluated in laboratory animals such as Albino rats and mice using plethysmometer by the following procedure.

Healthy albino rats are divided into 3 groups namely control, standard and treated group. Rats are injected subcutaneously with an inflammation inducing agent i.e. Carrageenan at the dose of 1 mL/ Kg in the sub-plantar

region of right hind paw. Inflammation due to introduction of saline solution of Carrageenan is observed after 3-5 hours of injection, using plethysmometer. This method is very useful method for evaluation of oral action of anti-inflammatory agents. Animals in control group receives 1% tween 80 at the dose of 1 mL/Kg. Animals in standard group receives ibuprofen at the dose of 40 mg/Kg while treated groups animals are given aqueous extracts prepared from E.tirucalli at the dose of 300mg/Kg. The reduction in the inflammation can be observed by measuring the paw volume before and after 2 hours of introduction of drug and extract. The inhibitory actions of latex extracts are compared with that of standard i.e. ibuprofen.



FIGURE 5: PLETHYSMOMETER

Analgesic activity can be evaluated in mice using 2 techniques-

Tail Immersion Method- In tail immersion technique thermal stimuli are used for inducing pain in animals. Healthy Albino mice are divided in 3 groups namely control, standard and treated group. Control group receives 1% tween 80 at the dose of 1 mL/Kg. Animals in standard group are given a standard analgesic drug eg. aspirin at the dose of 25mg/kg. Treated group animals are given aqueous extracts prepared from E.tirucalli latex at the dose of 300mg/kg. Water is heated to about $50 \pm 1^\circ \text{C}$ before the start of the test. The time taken for the rats to remove their tail out of water is recorded. The inhibitory actions of latex extracts are compared with that of standard.

Acetic Acid Writhing Method- In acetic acid writhing technique, after 30 minutes of administration of extracts and standard drugs, acetic acid (3% v/v) are administered at a dose of 0.1mL/10g intraperitoneally. The onset and severity of writhing response is noted for 10 minutes. The inhibition of pain response by drug treatment is recorded.

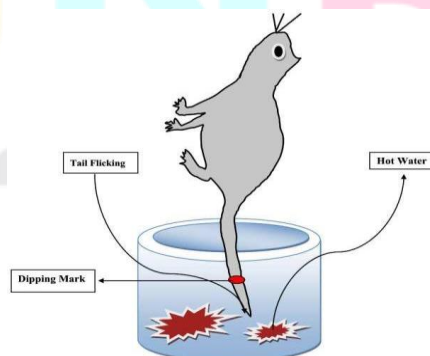


FIGURE:6 ACETIC ACID WRITHING TECHNIQUE²²

10.0 CONCLUSION

In recent years we have come across more new plant species which have great medicinal significance. Such plants like *Euphorbia tirucalli*, a plant that has a wide range of medicinal capabilities but yet not has got much attention, the plants phytochemical screening reveals a significant number of medicinal properties that can allow us to control various diseases. The plant's constituents should undergo analytical evaluation and toxicology studies further to increase our understanding of the usefulness of this plant for human society.

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