International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 5 Sep-Oct 2021, pp: 766-772 www.ijprajournal.com ISSN: 2249-7781

A Review On Phytochemical And Antimicrobial Activity Calotropis Procera

Ms.Bhargavi Sai Krishna [1], Dr. B.Bharathi [2], Dr. Deepa C. Philip [3]
[1] *BSc MLT 4th Year (Intern), MMM College of Health Sciences*
[2] *Associate Professor-Dept of Microbiology, MMM College of Health Sciences*
[3] *Principal, MMM College of Health Sciences*

Date of Submission: 25-09-2021 Date of Acceptance: 8-10-2021

ABSTRACT
Calotropis procera Linn has been used in several traditional medicines to cure various diseases. Different parts of the plant have been used in Indian traditional systems of medicine for the treatment of leprosy, eczema, elephantiasis, asthma, bronchitis, fever, rheumatism, indigestion, colds, eczema, diarrhea, ulcers, tumors, piles, and diseases of spleen, liver, and abdomen. The milk juice is regarded as drastic purgative and caustic flowers were considered to improve digestion, catarrh, and increase appetite. The pungent latex extracted from the leaf and flowers of C. procera is processed and used in the commercial preparation of eye tonic. In addition, preparations from the latex with honey are used as antibiotics and also in the treatment of toothaches and cough. The traditional folk healers use the milky latex of C. procera for several ailments. The water, ethanol, acetone, and some other organic solvent extracts of this plant have been reported to have insecticidal, larvicidal, antimicrobial, anti-inflammatory, antipyretic, analgesics, anti-cancerous, antimalarial, and antiparasitic activities. Various studies have revealed that the leaf, latex, root, and flower extracts of Calotropis procera showed both phytochemical and antimicrobial properties. The present review summarizes the phytochemical and antimicrobial activity of Calotropis procera.

I. INTRODUCTION

Calotropis procera Linn., also known as Alarka, Surya, Suuryaahvya, Vikirna, Vasuka, Tapana, Tuulaphala, Kshriparna, Arkaparna, Aasphota, Aakh, Madaar, Ashar in India (1), belongs to the Asclepiadaceae family and grows in the tropical region and most abundant in Bangladesh, India, Burma, Pakistan and the sub-Himalayan tract (2,3) and also native to North Africa, tropical Africa, Western Asia, South Asia, and Indochina.

This plant was used first time as a medicinal plant by Ved Sushruta, which is about 800–900 AD. C. procera is used from the very ancient period in folk beliefs as well as a drug of choice for different ailments. Its different formulas are found in the old Vedic book of India, "Sushruta Samhita". In the old days, Hindus used it at the time of worship of the sun in the period of Ved. Therefore, the name of "Arkaputra" or "Arka prana" was awarded to this plant, which means such leaf or shining leaf (4).

Different parts of the plant have been used in Indian traditional systems of medicine for the treatment of leprosy, ulcers, tumors, piles, and diseases of spleen, liver, and abdomen (3).

The water, ethanol, acetone, and some other organic solvent extracts of this plant possess insecticidal (5), larvicidal (6), antibacterial and antiparasitic activities (7).

The milky white latex obtained from the plant exhibits potent anti-inflammatory activity in various animal models that are comparable to standard anti-inflammatory drugs (8). The latex of C. procera has also been tested in guinea pigs and found to have good efficacy in the healing of dermal wounds (9).

The aqueous extract of the latex has been shown to inhibit cellular infiltration and afford protection against the development of neoplastic changes in the transgenic mouse model of hepatocellular carcinoma (10).

The chloroform extract of the root has been shown to exhibit protective activity against carbon tetrachloride-induced liver damage (11). An ethanol extract of the flower is reported to have antimicrobial, anti-inflammatory, antipyretic, analgesics (12), anti-cancerous (13), and antimalarial (14) activities.

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 5 Sep-Oct 2021, pp: 766-772 www.ijprajournal.com ISSN: 2249-7781

The different parts of the plant have been investigated by several workers and found to contain pentacyclic triterpenes (15-18), an alkaloid (19), cardenolides (20), phytosterols (18,21) and triterpenoid saponins (22).

Calotropis procera is either used alone or with other herbs to treat common diseases such as fever, rheumatism, indigestion, colds, eczema, and diarrhea. In addition, preparations from the latex with honey are used as antibiotics and also in the treatment of toothaches and cough (23). The leaf extract, chopped leaf, and latex of C. procera have shown great promise as nematicides in-vitro and in-vivo (24).

The leaf and fruit extracts of C. procera when boiled together can be used in the extraction of guinea worm by immersion of the infected limbs, either for several hours or three consecutive days. The dry leaves in northern Nigeria are used as a remedy for asthma, cough, etc (25,26). The dry leaves and pithy stems are burned for patients to inhale smoke or the leaves are smoked like tobacco in a pipe for the treatment of paralysis, arthralgia, swellings, and intermittent fevers (27). Different parts of C. procera have been reported to exhibit ethnomedicinal and nutritional properties while phytochemical evaluation of the plant parts revealed the presence of essential and trace elements in varying quantities (28-31).

Calotropis procera is used medicinally, to treat boils, infected wounds, and other skin problems in people and to treat parasitic skin infestation in animals. It also yields ash for making gunpowder, the latex is processed and used in treating vertigo, baldness, hair fall, toothaches, intermittent fevers, rheumatoid/joints swellings, and paralysis (32). The whole plant when dried and consumed is a good tonic, anthelmintic, and an expectorant (27,33). Traditionally, the dried root is powdered and effectively used to cure bronchitis, asthma, leprosy, eczema and elephantiasis, hepatic and splenic enlargement (32). The milk juice is regarded as drastic purgative and caustic flowers were considered to improve digestion, catarrh, and increase appetite (34). The pungent latex extracted from the leaf and flowers of C. procera is processed and used in the commercial preparation of eye tonic (32). The traditional folk healers use the milky latex of C. procera for several ailments. Leaf latex is applied on fresh cuts, stopping bleeding immediately. The presence of alkaloids, calotropin, calotaxein, and uskerin has also been reported. It is also used by traditional medicine practitioners in Gwari communities for the treatment of ringworms (35).

PHYTOCHEMICAL AND ANTIMICROBIAL ACTIVITY

- Phytochemical investigation and assessment of antibacterial activity of Calotropis procera leaf (36)showed the presence of alkaloids, tannins, flavonoids, terpenoids, and anthraquinones in different solvent extracts (methanol, water).

The antibacterial effect of Methanol and aqueous extracts of leaf of C. procera on different bacteria namely, Escherichia coli, Staphylococcus aureus, Staphylococcus epidermidis, Proteus vulgaris, Pseudomonas aeruginosa, Bacillus subtilis, Micrococcus luteus using agar well diffusion method. Antibacterial activity was expressed as the zone of inhibition (mm) produced by the plant extract compared with the streptomycin (positive controls). The Aqueous extract showed antibacterial activity on the Escherichia coli (3mm), Staphylococcus aureus (5mm), Proteus vulgaris (2mm). The methanol extract showed antibacterial activity on the Escherichia coli (4mm) and Staphylococcus aureus (3mm). It has been concluded that the aqueous extract showed better antibacterial activity than methanolic extract.

- Preliminary phytochemical screening and antibacterial activities of ethanolic extract of Calotropis procera flowers against human pathogenic strains showed the presence of tannins, steroids, saponins, and flavonoids while alkaloids are absent (37).

Antibacterial action was seen against four Gram-positive microorganisms, (Staphylococcus aureus, Bacillus subtilis, Bacillus pumilus, and Micrococcus luteus, and Gram-Negative micro-organism (Escherichia coli, Pseudomonas aeruginosa, and Proteus vulgaris). The antibacterial action of the extract is compared with a standard drug (rifampicin, 50 µg/ml) at various concentrations (5, 10, 20, 30, and 50 µg/ml), which revealed a notable antibacterial inhibitory activity of ethanolic extract of the flowers. It has been concluded that the ethanolic extracts of flowers of Calotropis procera showed the antibacterial action is dose-dependent on different pathogenic strains.

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 5 Sep-Oct 2021, pp: 766-772 www.ijprajournal.com ISSN: 2249-7781

➢ Biological evaluation of the antimicrobial activity of Calotropis procera against a range of bacteria (38), where methanolic extracts of leaves of Calotropis procera were used to check the antibacterial activity against Proteus mirabilis, Pseudomonas aeruginosa, Bacillus cereus, Escherichia coli, Klebsiella pneumonia, Salmonella typhi, and Enterococcus faecalis using disc diffusion method. Different concentrations of methanolic extracts of leaves of Calotropis procera were used (10 µg, 9 µg, 5 µg, 4.5 µg, 4 µg, 2.75 µg, 2.5 µg, 2 µg, 1.25 µg, 1 µg, 0.5 µg, 0.02 µg, 0.0005 µg). Results showed that leaf extract was more effective against Proteus mirabilis, Pseudomonas aeruginosa, and Bacillus cereus. There was no antibacterial activity of the extract against Escherichia coli, Klebsiella pneumonia, Salmonella typhi, and Enterococcus faecalis.

There was no effect on bacterial growth at 4.5 and 0.5µg concentration. Maximum effect was achieved when 5 µg of leaves extracts was used against Bacillus cereus with a zone of 22 ± 2 mm, while least activity was obtained at 2.75 µg with a zone of 10 ± 2 mm. When the dose was increased to 9 µg and 10 µg, there was no significant increase in the zone of inhibition. Similarly, there was no effect on bacterial growth at 2, 1.25, and 0.5 µg concentrations. Maximum effect was achieved when 5 µg of leaves extracts was used against Pseudomonas aeruginosa with a zone of 22 ± 2 mm, while least activity was obtained at 1, 4µg, with a zone of 12±2, 12±2 mm. When the dose was increased to 9 µg and 10 µg, there was no significant increase in the zone of inhibition. There was no effect on bacterial growth at 9, 5, 2, 0.5, and 0.025 µg concentration. Maximum effect was achieved when 2.5 µg of leaves extracts was used against Proteus mirabilis with a zone of 22 ± 2 mm, while least activity was obtained at 4.5 µg with a zone of 12± 2 mm. When the dose was increased to 10 µg, there was no significant increase in the zone of inhibition. It has been concluded that the methanolic extracts of leaves of Calotropis procera may be used as a treatment for the infection caused by Proteus mirabilis, Pseudomonas aeruginosa, and Bacillus cereus.

➢ Evaluation of phytochemical and antibacterial properties of Calotropis procera (Ait) R. BR. Leaves, where different solvent extracts, methanol, ethyl acetate, ethanol, acetone, and aqueous extracts of C. procera leaves were subjected to qualitative estimation of phytoconstituents which revealed the presence of alkaloids, tannins, saponins, flavonoids, sterols, terpenoids, cardiac glycosides, proteins, and sugars, where reducing sugars were considered to be absent in the acetone and aqueous extracts (39).

The antibacterial studies revealed that the aqueous extract of C. procera showed the highest activity against M. aureus (21 mm), indicating its high susceptibility followed by acetone extract against B. subtilis (19 mm). The lowest activity was observed against P. aeruginosa (12 mm) for ethyl acetate and methanol extract. The aqueous extract of C. procera showed antibacterial activity against Gram-positive bacteria like B. subtilis and M. aureus as well as Gram-negative bacteria like E. coli. Acetone and ethanol extracts showed maximum antibacterial activity against both Gram-positive and Gram-negative bacteria. Ethyl acetate and methanol extracts showed a moderate inhibitory effect.

Lower MIC values were exhibited by the ethanol extracts against most of the microbial strains, followed by acetone and methanol. Ethyl acetate extracts exhibited comparatively higher MIC values for 50% of the microorganisms, indicating less effectiveness of this extract. Among the various bacterial strains tested, the lowest MIC values were obtained for B. subtilis and E. coli, indicating that these bacteria were most sensitive to the C. procera leaves extracts; followed by M. aureus and P. aeruginosa. The minimum inhibitory concentration (MIC) values of aqueous and organic solvent extract varied from 5-20 mg/ml. It has been concluded that, since the leaves of C. procera possess significant antibacterial properties and contain phytoconstituents, it can be potentially exploited for the development of novel chemotherapeutic agents.

➢ Phytochemical properties and antibacterial activities of the leaf and latex extracts of Calotropis procera (40) showed the presence of tannins, steroids, saponins, and flavonoids while alkaloids were absent in both extracts. The antibacterial effect results obtained revealed that the ethanolic extracts of both latex and leaf have antibacterial activities on Escherichia coli and Staphylococcus aureus but with no activity against Salmonella species, and Pseudomonas species at all concentrations. The antibacterial effect was more pronounced against E. coli, which was seen to be more sensitive to both the leaf and latex ethanolic extracts at a concentration of 10,000 µg/ml with a

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 5 Sep-Oct 2021, pp: 766-772 www.ijprajournal.com ISSN: 2249-7781

zone of inhibition of 15 mm and 10 mm respectively. The minimum inhibitory concentration (MIC) for the leaf ethanolic extract was 2000 µg/ml while the minimum bactericidal concentration (MBC) of the latex ethanolic extract was 2000 µg/ml. It has been concluded that ethanol was the best extraction solvent for a fraction with antibacterial properties of the C. procera leaves and latex and the leaf extracts had stronger activity in comparison with those of the latex.

- The phytochemical and antimicrobial properties of root and leaf extracts of Calotropis procera (41), where the phytochemical and antimicrobial properties of water, methanol, and ethanol extracts obtained from root and leaf of Calotropis procera were investigated. The phytochemical screening showed the presence of alkaloids, flavonoids, tannins, saponins, and cardiac glycosides, balsams, and volatile oil and steroids with higher amounts in water extracts.

The antimicrobial activity of Pseudomonas aeruginosa, Salmonella typhi, Escherichia coli, Staphylococcus aureus, and Streptococcus pyogenes were tested against at concentrations of 30, 60, 90, and 120 mg/ml. Methanol and ethanol extracts did not show a significant effect against the tested organisms at 120 mg/ml as compared with those of tetracycline. Salmonella typhi showed the highest inhibition with 22 mm followed by Pseudomonas aeruginosa with 20 mm. It has been concluded that the use of water extract of this species in ethnomedicine and could provide a lead in the isolation of antibacterial agents from water extracts of Calotropis procera.

- Phytochemical and antimicrobial Evaluation of Aqueous and Organic Extract ethanol of Calotropis procera Ait Leaf and Latex (42). The bioactive constituents extracted from the leaf and latex were tested against pathogenic organisms (Escherichia coli, Salmonella typhi, Bacillus subtilis, Candida albicans, Aspergillus niger) using the Agar well diffusion method. The ethanolic latex extract showed significant activity against all the test organisms. The results revealed that ethanol is a more effective extractive solvent for the antimicrobial activity of leaf and latex of C. procera. The ethanol extract of the latex gave the widest zone of inhibition (21mm) against B. subtilis compared to E. coli (16 mm) and A. niger (16 mm).

All the extracts inhibit the growth of all the organisms except B. subtilis of which aqueous extract does not affect. The Minimum Inhibitory Concentration (MIC) for the latex extract was between 3 and 7.5 mg/ml for bacteria, and 5.0 to 7.0 mg/ml for fungi. For the leaf extract, the MIC for bacteria was between 5.0 and 10.5 mg/ml and 11 and 15 mg/ml for fungi. It has been concluded that the aqueous and ethanol extracts of the leaf and latex of Calotropis procera inhibit the growth of some bacteria and fungi test isolates with an inhibitory ability that increases with temperature.

- Antimicrobial activity of extracts and latex of Calotropis procera and synergistic effect with reference antimicrobials (43) showed the strongest activities on the leaf and latex methanolic extracts, where Escherichia coli, Staphylococcus epidermidis, and Bacillus species were the most sensitive. In these cases, inhibition zones ranged between 11.0 to 23.5 mm and minimum inhibitory concentrations between 0.25-1.5 mg/ml. All extracts showed biocidal activity against all of the tested fungal strains with diameters of inhibition zones ranging between 9.0 and 26.5 mm against Candida albicans, C. tropicalis, Penicillium chrysogenum, and Saccharomyces cerevisiae.

To test any synergistic effect between the latex methanolic and Ciprofloxacin and Clotrimazole, the extract was added to the tested antibiotics at concentrations equal ½, ¼, 1/8, and 1/32 and 0 of the original MIC values. Results revealed that the MICs of the two antimicrobial standards were lowered indicating a synergistic interaction between the botanical and the conventional drugs. It has been concluded that the utility of extracts and latex of C. procera in developing novel antimicrobial biorationals of plant origin.

- A study on the phytochemical and antibacterial activities of Calotropis procera leaf organic Fractions, which were tested against vancomycin and methicillin-resistant bacteria isolated from wound patients (44) showed the presence of alkaloids, flavonoids, tannin, saponin, terpenoids, cardiac glycoside, and phenols.

The bacterial isolates used are; Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Proteus mirabilis, and Streptococcus pyogenes. Agar well diffusion method was used to determine the antibacterial activities of the extracts on resistant bacterial isolates. Ethanol extract had the highest zone of

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 5 Sep-Oct 2021, pp: 766-772 www.ijprajournal.com ISSN: 2249-7781

inhibition against Staphylococcus aureus and Escherichia coli with 16.03 mm and 12.05 mm respectively while cold and Hot water extracts recorded the lowest zones of inhibition values of 3.54 mm and 5.53 mm respectively against Klebsiella pneumonia and Pseudomonas aeruginosa. However, the n-Hexane extract had no inhibitory effect against Streptococcus pyogenes and Proteus mirabilis. It has been concluded that the leaf extracts of Calotropis procera possess antibacterial potency which will assist in the preliminary treatment of wound infections, most especially because of its high inhibitory effect against Staphylococcus aureus.

- The antifungal activities of aqueous extract of stem bark of Calotropics procera were determined against Epidermophyton flocosumand Trichophyton gypsum using agar diffusion techniques. The crude extract of C. procera showed activity on E. flocosumand T. gypsum at 4.0 mg/ml. The result of minimum inhibitory concentration (MIC) was 0.5 and 0.9 mg/ml and that of minimum fungicidal concentration (MFC) were 2.0 and 4.0 mg/ml, respectively (35). The antimicrobial effect of ethanol, aqueous, and chloroform extracts of leaf and latex of Calotropis procera on six bacteria namely, Escherichia coli, Staphylococcus aureus, Staphylococcus albus, Streptococcus pyogenes, Streptococcus pneumonia, and three fungi: Aspergillus niger, Aspergillus flavus, Microsporum boulardii and one yeast Candida albicans was determined using agar well diffusion and paper disk methods.

The results revealed that ethanol was the best extractive solvent for antimicrobial properties of leaf and latex of C. procera followed in order by Chloroform and aqueous ($P<0.05$). The ethanolic extracts of latex gave the widest zone of inhibition (14.1 mm) against E. coli using agar well diffusion while 9.0 mm was recorded for the same organism in the disc plate method. The growths of six bacterial isolates were inhibited by the three extracts except for P. aeruginosa and S. pyogenes that were not inhibited by the aqueous extracts of both leaf and latex. Similarly, the growth of four test fungi was inhibited by ethanol and chloroform extracts while the aqueous extract was the least effective on the test fungi. The best antifungal activity was recorded by ethanol extract of latex against Candida albicans. The minimum inhibitory concentration (MIC) for the ethanol extract was between 5.0 and 20.0 mg/ml for fungi. This study revealed that the latex demonstrated a strong inhibitory effect on the test organisms than leaf (45). Bhaskar reported that Chloroforms extract of C. procera seeds exhibited better antimicrobial activity (46). A new cardenolide, proceragenin, screened for its biological effect showed significant antibacterial activity against both Gram-positive and Gram-negative bacteria.

II. CONCLUSION

Based on all the above-conducted studies it can be concluded that the leaf, latex, root, and flower extracts of Calotropis procera showed both phytochemical compounds and antimicrobial properties. It has been concluded that the presence of these phytochemicals in the extracts of Calotropis procera is responsible for the antibacterial activity exhibited in all the above studies. The presence of these phytochemicals is an indication that it may have some medicinal potential, this is due to the fact that each of the components identified has one therapeutic usage or another. It has also been concluded that plant extract has a different effect at different concentrations against a specific bacterium at different concentrations.

It can be concluded that there is a number of phytochemical compounds present in plant extracts of Calotropis procera leaf, latex, root, and flower which are responsible for their antimicrobial properties. The antibacterial nature of this plant and suggests that this plant could be exploited in the management of diseases caused by these bacteria in humans and animals.

Further investigation is needed for confirmation of antibacterial action by isolating pure chemical constituents and also to identify which compound is responsible for antimicrobial action and to be carried on the same to yield the therapeutic drug form against the infectious agents associated with clinical setup.

REFERENCES

[1]. Khare, C.P. (Ed.), 2007. Indian Medicinal plants, an illustrated dictionary. Springer science, Springer Verlag, Berlin/Heidelberg, Germany, pp. 113-114.
[2]. CSIR, 1992. The Wealth of India, Raw Materials, vol. 1. Publications and Information Directorate, CSIR, New Delhi, 1992, p. 78.
[3]. Kritikar, K.R., Basu, B.D., 1999, 2nd ed., In: Indian Medicinal Plants vol.3 International Book Distributors, Dehradun, India, p. 1610.

[4]. Sony J. Chundattu, Vijay Kumar Agrawal, N. Ganesh. Phytochemical investigations of Calotropis procera. Arabian Journal of Chemistry (2016) 9, S230-S234.
[5]. Moursy, L.E., 1997. Journal of Egyptian Society of Parasitology. 2, 505.
[6]. Markouk, M., Bekkouche, K., Larhsini, M., Bousaid, M., Lazrek, H.M., Jana, M.,2000. J. Ethnopharmacology. 22(2), 211.
[7]. Larhsini, M., Oumoulid, L., Lazrek, H.B., Wataleb, S., Bousaid, M., Markouk, M., Jana, M., 1999. Therapia 54(6), 763.
[8]. Sangraula, H. Dewan, S. Kumar, V.L., 2002. InflammoPharmacology 9, 257-264.
[9]. Rasik, A.M., Raghubir, R., Gupta, A., Shukla, A., Dubey, M.P., Srivastava, S., Jain, H.K., Kulshresth, D.K., 1999. Journal of Ethnopharmacology 6(8), 261-266.
[10]. Choedon, T., Mathan, G., Arya, S., Kumar, V.L., Kumar, V., 2006. World J. Gastroenterol. 12, 2517-2522.
[11]. Basu, A., Sen, T., Ray, R.N., Nag Chaudhuri, A.K., 1992. Fitoterapia 63, 507-514.
[12]. Mascolo N., Sharma, R., Jain, S.C. Ethnopharmacology of Calotropis procera flowers. Journal of ethnopharmacology. 1988; 22(2):211-221.
[13]. Smit, H.F., Woerdenbag, H.J., Singh, R.H., Meulenbeld, G.J., Labadie, R.P., Zwaving, J.H., 1995. J.ournal of Ethnopharmacology. 47(2), 75.
[14]. Sharma, P., Sharma, J.D., 1999. Journal of Ethnopharmacology. 68 (1-3), 83.
[15]. Ansari, S.H., Ali, M., 1999. Indian Journal of Medicinal and Aromatic Plants Science 21, 978.
[16]. Ansari, S.H., Ali, M., 2000. Indian Journal of Chemistry 39 (B), 287.
[17]. Gupta, A., Singh, I.R., Purwar, C., C hauhan, D., Singh, J., 2003. Indian Journal of Chemistry 42(B), 2030.
[18]. Khan, A.Q., Malik, A., 1989. Phytochemistry 28(10), 2859.
[19]. Israili A, A.H., Israr, R.K., 1978. Journal of Research and Education in Indian Medicine, 13(3), 120.
[20]. Seiber, J.N., Nelson, C.J., Lee M, S., 1982. Phytochemistry 21, 2343.
[21]. Lal, S.D., Kumar, P., Pannu, D.S., 1985. Journal of Scientific Research 7, 141.
[22]. Gupta, A., Siddiqui, I.R., Singh, J., 2000. Indian Journal of Chemistry 39(B), 941.
[23]. Kew, F. (1985): The useful plants of west tropical Africa. Royal botanical gardens publications, United states of America. Pp 219-224.
[24]. Anver, S. and Alam, M.M. (1992): Effect of latex seed dressing on interacting root-knot nematodes. Afro-Asian Journal of Nematology 1:182-185.
[25]. Oke, O.A., Afolayan, A.J. and Oyedeji, A.O. (2004): Validation of antibacterial potentials of Anacardium occidentale and Calotropis procera commonly used against cough symptoms. Journal of Research and review in Science 3:56-60.
[26]. Noatay, K.L. (2005): Aak, wild plant that has medicinal value. The Tribune, Chandigarh, India. http//www.tribuneindia.com/2003/2003: 1215/agro.tumHara CM, Brenner FW, Miller. Classification, identification, and clinical significance of Proteus, Providencia, and Morganella. Journal of Medicinal and Clinical Microbiology Reviews, 2000 Oct; 13(4):534-46.
[27]. Agharkar, S.P. (1991), Medicinal plant of Bombay presidency. Scientific publication, India 48-49.
[28]. Abhay, K., Srivastara, S. and Bilrart, L. (1997): Studies on bio fungicidal properties of leaf extracts of some plants. Indian Phytopathology 50(3):408-411.
[29]. Adoum, O.A., Akinniyi, J.A. and Omar, T. (1997): The effect of geographical location on the antimicrobial activities and trace element concentration in the root of Calotropis procera (Ait.) R. Br. Annals of Borno 13(14):199-207.
[30]. Awune, J.O. (2000): Studies on biofungicidal properties of fresh leaf extracts of Azadirachta indica, Calotropis procera and Thevetia nerrifolia using Aspergillus fumigatus and Aspergillus flavus. B.Sc. thesis (unpublished), Ahmadu Bello University, Zaria. 44pp.
[31]. Olasupo, N.A., Grillo, J.A., Obayori, O.S. and Smooth, S.I. (2004): Antibacterial activity of crude extract of Calotropis procera against food spoilage organisms. Journal of Research and Review in Science 3:92-96.
[32]. Vohra, R. (2004). Calotropis the medicinal weed. Online medical book store, India.
[33]. Warrier, P.K., Nambiar, V. P.K. and Mankutty, C (1994). Indian medicinal

plants, orient lonman; Chennai, India. 341-345.
[34]. Oudhia, P. (2001). Calotropis; useful weed. Society for panthenium management. Geeta Nagar, India.
[35]. Kuta, F.A. (2008). Antifungal effects of C. procera stem back on Epidermophyton floccosum and Trichophyton gypseum. African Journal of Biotechnology, 7(13):2116-2118.
[36]. Vibhuti Talsaniya, Twinkle Patel, Naznin Saiyad, Sharav Desai, Dhara Patel, Dhananjay Meshram. International Journal of Pharmaceutical Science Review and Research, 25(2), 2014, Article No. 45, Pages: 241 – 244.
[37]. Pusapati Madan Ranjit, T. Santhipriys, S. Nagasri, Y. A. Chowdary, Pasumarthy. N.V. Gopal. preliminary phytochemical screening and antibacterial activities of ethanolic extract of Calotropis procera flowers against human pathogenic strains. Asian Journal of Pharmaceutical and Clinical Research. Vol 5, Issue 3, 2012.
[38]. Hayat Bilal, Imdad Ali, Shahab Uddin, Ibrahim Khan, Anwar Said, Mahboob Ur Rahman, Abdual Majid khan, Abdul Bari Shah and Ayaz Ali Khan. Biological evaluation of antimicrobial activity of Calotropis procera against a range of bacteria. Journal of Pharmacognosy and Phytochemistry 2020; 9(1):31-35.
[39]. Varsha G Shetty, Meenakshi G Patil, Ambika S Dound. Evaluation of phytochemical and antibacterial properties of Calotropis procera (Ait) R. BR. Leaves. International Journal of Pharmacy and Pharmaceutical Sciences. Vol 7, Issue 4, 2015.
[40]. Kawo AH, Mustapha A, Abdullahi BA, Rogo LD, Gaiya ZA, Kumurya AS. Phytochemical properties and antibacterial activities of the leaf and latex extracts of Calotropis procera. AIT.F. Bayero journal of pure and applied science, 2009.
[41]. M. M. Mainasara, B. L. Aliero, A. A. Aliero and M. Yakubu. Phytochemical and antibacterial properties of root and leaf extracts of Calotropis procera. Nigerian Journal of Basic and Applied Science. March 2012, 20(1):1-6.
[42]. Shobowale, O.O., Ogbulie, N.J., Itoandon, E.E., Oresegun, M.O., Olatope, S.O.A. Phytochemical and antimicrobial evaluation of aqueous and organic extracts of Calotropis procera Ait leaf and latex. Nigerian Food Journal. 2013.
[43]. E. Gomah Nenaah and M. Essam Ahmed. Antimicrobial activity of extracts and latex of Calotropis procera (Ait.) and synergistic effect with reference antimicrobials. Research Journal of Medicinal Plants, 2011, 5(6):706-716.
[44]. P. O. Akindele, O. A. Fatunla, K. A. Ibrahim and C. O. Afolayan. Antibacterial and phytochemical screening of Calotropis procera leaf extracts against Vancomycin and Methicillin resistant bacteria isolated from wound samples in hospital patients. Journal of Complementary and Alternative Medical Research. 2(1): 1- 14, 2017.
[45]. Kareem, S.O., Akpan, I. and Ojo, O.P. (2008). Antimicrobial activities of Calotropis procera on selected pathogenic microorganisms. African Journal of Biomedical Research 11: 105 – 110.
[46]. Bhaskar VH, 2000, Antimicrobial Activity of Calotropis procera Seeds. Asian journal of chemistry 21 (7), 5788- 5790.