JPRHC

Review Article

REVIEW ON PHYTOCHEMISTRY AND PHARMACOLOGICAL ASPECTS OF EUPHORBIA HIRTA LINN.

SANDEEP B. PATIL*, MRS. NILOFAR S. NAIKWADE, CHANDRAKANT S. MAGDUM

For author affiliations, see end of text

This paper is available online at www.jprhc.com

ABSTRACT:

Medicinal herbs are the local heritage with global importance. Medicinal herbs have curative properties due to presence of various complex chemical substance of different composition, which are found as secondary plant metabolites in one or more parts of these plants. These plant metabolites according to their composition are grouped as alkaloids, glycosides, corticosteroids, essential oils etc. Euphorbia hirta, (family-Euphorbiaceae) is an herb found in many parts of the world. In Sanskrit it means "Dugadhika" According to the Doctrine of Signatures, the plant has a reputation for increasing milk flow in women, because of its milky latex, and is used for other female complaints as well as diseases of the respiratory tract. The plant has been reported as increase in urine output, antidiarrheal, antispasmodic, anti-inflammatory etc.

Key words: Phytochemistry, Pharmacological aspects, Euphorbia hirta linn.

INTRODUCTION:

Euphorbia hirta L. is a medicinal, rhizomatous herb distributed in Southern Western Ghats of India and Northern East Coast of Tamil Nadu (1). In East and West Africa extracts of the plant are used in treatment of asthma and respiratory tract inflammations. It is also used for coughs, chronic bronchitis and other pulmonary disorders in Malagasy. The plant is also widely used in Angola against diarrhoea and dysentery, especially amoebic dysentery. In Nigeria extracts or exudates of the plant are used as ear drops and in the treatment of boils, sore and promoting wound healing (2).

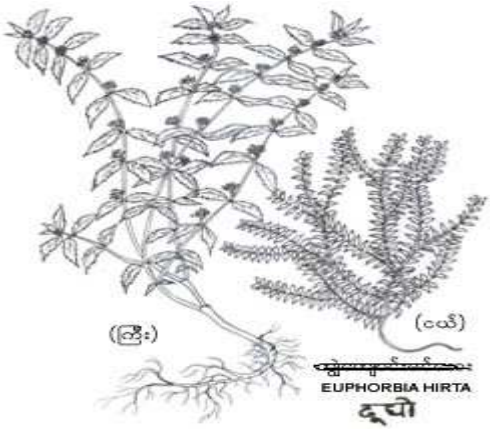
DESCRIPTION:

Euphorbia Hirta L. Family: (Euphorbiaceae)

Vernacular names: dudhani, dudhi

English name: snake weed

Morphology:



Habitat:

The plant is native to India but is a pan tropical weed, found especially on roadsides and wasteland.

Botanical description:

A small, erect or ascending annual herb reaching up to 50 cm, with hairy stems. The leaves are opposite, elliptical, oblong or oblong-lanceolate, with a faintly toothed margin and darker on the upper surface. The flowers are small, numerous and crowded together in dense cymes about 1 cm in diameter. The fruits are yellow, three-celled, hairy, keeled capsules, 1-2 mm in diameter, containing three brown, four-sided, angular, wrinkled seeds (3).**Parts used:** leaves, stem, flowers

ETHNOPHARMACOLOGY:

Traditional and modern usage:

The plant has been used for female disorders but is now more important in treating respiratory ailments, especially cough, coryza, bronchitis and asthma. In India it is used to treat worm infestations in children and for dysentery, gonorrhoea, jaundice, pimples, digestive problems and tumours (4).

Ethnoveternary usage:

The fresh milky latex is applied to wounds and warts and the root of the plant is used in sprains and inflammation, miscarriage, epilepsy, maggots in wounds and irregular growth of teeth (5).

PHYTOCHEMISTRY:

The aerial parts of plant are well investigated for chemical information (6).

Flavonoids: Euphorbianin, leucocyanidol, camphol, quercitrin and quercitol (7, 8).

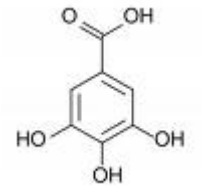
Polyphenols: Gallic acid, myricitrin, 3,4-di-O-galloylquinic acid,2,4,6-tri-O-galloyl-D-glucose, 1 ,2,3 ,4,6-penta-O-galloyl-β- D-glucose (9,10).

Tannins: Euphorbins A, B, C, D, E (11).

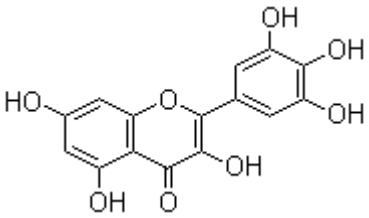
Triterpenes and phytosterols: β-Amyrin, 24-methylenecycloartenol, and β-Sitosterol (12).

Alkanes: Heptacosane, n-nonacosane and others (13).

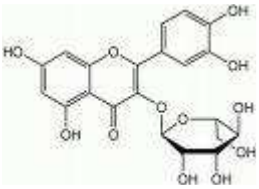
Chemical Structure:



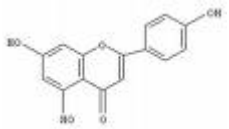
Gallic acid



Myricitrin



Quercitrin



Quercitol

PHARMACOLOGICAL ACTIVITIES:

Anti-inflammatory activity:

The n-hexane extract of the aerial parts of E. hirta and its main constituent triterpenes, β-amyrin, 24-methylenecycloartenol, and β-Sitosterol were evaluated for anti-inflammatory effects in mice. Both the extract and the triterpenes exerted significant and dose-dependent anti-inflammatory activity in the model of phorbol acetate-induced ear inflammation in mice. The lyophilized aqueous extract showed analgesic, antipyretic and anti-inflammatory activity in mice and rats. A central depressant activity, expressed by a strong sedative effect associated with anxiolytic effect, was also observed (14).

Sedative and Anxiolytic activity:

Lyophilized aqueous extract of Euphorbia hirta L. (Euphorbiaceae) has been evaluated for behavioral effects in mice. Sedative properties could be confirmed with high doses (100 mg of dried plant/kg, and more), by a decrease of behavioral parameters measured in non-familiar environment tests, whereas anticonflict effects appeared at lower doses (12.5 and 25 mg of dried plant/kg), by an enhancement of behavioral parameters measured in the staircase test and in the light/dark choice situation test. These findings validate the traditional use of E. hirta as a sedative and reveal original anxiolytic properties (15).

Antidiarrhoeal activity:

The antidiarrhoeal activity of a lyophilized decoction of the whole plant was investigated in mice. It demonstrated activity in experimental models of diarrhoea induced by castor oil, arachidonic acid and prostaglandin E. Quercitrin, a flavonoid glycoside isolated from Euphorbia hirta, showed anti diarrhoeal activity, at doses of 50 mg/kg, against castor oil- and PGE2-induced diarrhoea in mice, but not when magnesium sulphate was used as a cathartic agent. It also delayed small intestinal transit in the rat if this was accelerated with castor oil, but did not modify the fluid transport across the colonic mucosa when administered intraluminally. However, quercetin, the aglycone of quercitrin, increased colonic fluid absorption in the presence of secretagogue compounds, suggesting that the antidiarrhoeal activity of quercitrin is due to its aglycone, which is released by the glycoside in the intestine(16, 17).

Antibacterial activity:

Antibacterial effect of compounds extracted from Camellia sinensis L. and the methanol extract of Euphorbia hirta L. were studied against dysentery causing Shigella spp. using the Vero cell line. The antibacterial effects of a methanol extract of E. hirta was demonstrated in vitro using species of Shigella. The extract was non-cytotoxic and antibacterial (18).

Anticancer activity:

Cytotoxicity studies of the extracts were performed using the cell line and the non-cytotoxic concentration of the extract was tested for antibacterial activity against the

cytopathic dose of the pathogen. These extracts were found to be non-cytotoxic and effective antibacterial agentsExtracts of Euphorbia hirta have been found to show selective cytotoxicity against several cancer cell lines. The plant is useful in effective treatment of cancers, particularly malignant melanomas and squamous cell carcinomas (18).

Antidiarrhoeal activit :

Forty six aqueous extracts from 38 medicinal plant species belonging to different families were selected on the basis of their traditional medicinal use as antidiarrheal agents. Only 8 plant extracts (17.39%) proved as antidiarrheal agents by a triple pronounced antibacterial, antiamoebic and antispasmodic action. They include aqueous extracts from Euphorbia hirta whole plant, leaves of Psidium guajava and Tithonia diversifolia, root bark of Alchornea cordifolia, Heinsia pulchella, Paropsia brazzeana, Rauwolfia obscura and Voacanga Africana (19).

Diuretic activity:

The diuretic effect of the E. hirta leaf extracts were assessed in rats using acetazolamide and furosemide as standard diuretic drugs. The water and ethanol extracts (50 and 100 mg/kg) of the plant produced time-dependent increase in urine output. Electrolyte excretion was also significantly affected by the plant extracts. This study suggests that the active component(s) in the water extract of E. hirta leaf had similar diuretic spectrum to that of acetazolamide. These results validate the traditional use of E. hirta as a diuretic agent by the Swahilis and Sukumas (20).

Antimalerial activity:

Twenty extracts including ten EtOH and ten CH2Cl2 from different parts of nine African medicinal plants used in Congolese traditional medicine for the treatment of malaria, were submitted to a pharmacological test in order to evaluate their effect on P. falciparum growth in vitro. Of these plant species, 14 (70%) extracts including EtOH and CH2Cl2 from Cassia occidentalis leaves, Cryptolepis sanguinolenta root bark, Euphorbia hirta whole plant, Garcinia kola stem bark and seeds, Morinda lucida leaves and Phyllanthus niruri whole plant produced more than 60% inhibition of the parasite growth in vitro at a test concentration g/ml. Extracts from E. hirta, C. sanguinolenta and M. morindoides showedμ of 6 a significant chemosuppression of parasitaemia in mice infected with P. berghei berghei at orally given doses of 100-400 mg/kg per day (21).

Antiamoebic activity and Antispasmodic activity:

The polyphenolic extract of the whole plant inhibited the growth of Entamoeba histolytica with a minimum active concentration of less than 10 pg/ml.The same extract, at a concentration of 80 μg/ml in an organ bath, also exhibited more than 70% inhibition of acetylcholine and/or KCI solution-induced contractions on isolated guinea pig ileum (22).

Antiplasmodial activity:

The in vitro Antiplasmodial activity of seven EtOH extracts and twenty fractions from the partition of the initial ethanolic extracts from seven African medicinal plants used in the Democratic Republic of Congo for the treatment of malaria was evaluated.

The most active EtOH extracts (IC50 < g/ml) were those fromμ3 Euphorbia hirta whole plant and others four plants. The observed antiplasmodial activity may be related to the presence of terpenes, steroids, coumarins, flavonoids, phenolic acids, lignans, xanthones and anthraquinones (23).

Molluscicidal activity:

The aqueous stem bark and leaf extracts of plant Euphorbia hirta (family-Euphorbiaceae) have potent molluscicidal activity. Sub-lethal doses (40% and 80% of LC50) of aqueous stem bark and leaf extracts of this plant also significantly ($P<0.05$) alter the levels of total protein, total free amino acid, nucleic acids (DNA and RNA) and the activity of enzyme protease and acid and alkaline phosphatase in various tissues of the vector snail Lymnaea acuminata in time and dose dependent manner (24).

Galactogenic activity:

The powdered plant, given to female guinea pigs before puberty, increased the development of the mammary glands and induced secretion (25).

Antifertility activity:

Euphorbia hirta at a dose level of 50 mg/kg body weight reduced the sperm motility and density of cauda epididymal and testis sperm suspension significantly, leading eventually to 100% infertility (26).

Aflatoxin inhibition activity:

An aqueous extract significantly inhibited aflatoxin production on rice, wheat, maize and groundnut (27).

Anti-platelet aggregation and anti-inflammatory:

Aqueous extracts of Euphorbia hirta strongly reduced the release of prostaglandins I2, E2, and D2. Additionally Euphorbia hirta extracts exerted an inhibitory effect on platelet aggregation and depressed the formation of carrageenin induced rat paw oedema. The chemical nature of the active principle of Euphorbia hirta could be characterized as (a) compound(s) of medium polarity in the molecular weight range of 1000 to 3000 Da (28).

Anti-Helicobacter pylori activity:

The Euphorbia hirta possessed lower anti-Helicobacter pylori effects (29).

Repellent and antifeedant effect:

The ethanol extracts of Euphorbia hirta present the repellent and antifeedant effect. The antifeedant rates of diamondback moth (DBM) Plutella xylostella larvae were all more than 80.00% (30-31).

Immunomodulatory activity:

Aqueous and aqueous-alcoholic extracts, containing flavonoids, polyphenols, sterols and terpenes, demonstrated immunostimulant activity. The aqueous extract affected lectin-induced lymphoblast transformation in vitro(32).

Antifungal activity:

An ethanolic extract displayed antifungal activity when tested against the plant pathogens Colletotrichum capsici, Fusarium pallidoroseum, Botryodiplodia theobromae, Alternaria alternata, Penicillium citrinum, Phomopsis caricae-papayae and Aspergillus niger using the paper disc diffusion technique (33).

Larvicidal activity:

Larvicidal activity of ethyl acetate, butanol, and petroleum ether extracts of Euphorbiaceae plants, *Euphorbia hirta*, was tested against the early fourth instar larvae of *Aedes aegypti* L. and *Culex quinquefasciatus* (Say). The larval mortality was observed after 24 h of exposure. The LC_{50} value of petroleum ether extract of *E. hirta*, was 272.36 ppm against *A. aegypti* and 424.94against *C quinquefasciatus* (34).

Antioxidant activity:

Aqueous extract of *Euphorbia hirta* L. was prepared in hot water and crude extract yield (7%w/w) after lyophilization was used for antioxidant potential determination. The total antioxidant potential of crude extract was determined using phosphomolybdenum complex and ferric reducing power (FRAP) assays, which showed 185 µmol of ascorbic acid and 398 µmol Fe (II) equivalent per gram crude extract,

respectively. The crude extract exhibited significant free radical scavenging activity of 247 μmol Trolox equivalent per gram crude extract (35).

Antibacterial activity:

Euphorbia hirta L., Seem, for potential antibacterial activity against 5 medically important bacterial strains, namely Bacillus subtilis ATCC6633, Staphylococcus epidermidis ATCC12228, Pseudomonas pseudoalcaligenes ATCC17440, Proteus vulgaris NCTC8313 and Salmonella typhimurium ATCC23564. The antibacterial activity of aqueous and methanol extracts was determined by agar disk diffusion and agar well diffusion method. The methanol extracts were more active than the aqueous extracts. The plant extracts were more active against Gram-positive bacteria than against Gram-negative bacteria. The most susceptible bacteria were B. subtilis, followed by S. epidermidis, while the most resistant bacteria were P. vulgaris, followed by S. typhimurium(36).

Serum biochemistry:

The effects of the chromatographic fractions of *Euphorbia hirta* Linn were administered to rats in graded doses of 400mg/kg, 800mg/kg and 1600mg/kg orally for fourteen days. After fourteen days the serum biochemical parameters total protein, albumin, globulin, alanine aminotransferase (ALT), alkaline phosphatase (ALP), aspartate aminotransferase (AST), total bilirubin, creatinine, and blood urea nitrogen (BUN) significant increase in rats (37).

Antimicrobial activity (antiacne effect):

Propionibacterium acnes and *Staphylococcus epidermidis* have been recognized as pus-forming bacteria triggering an inflammation in acne. The present study was conducted to evaluate antimicrobial activities of Indian medicinal plant against these etiologic agents of acne vulgaris. Ethanolic extracts of *Euphorbia hirta* (roots) was tested for antimicrobial activities by disc diffusion and broth dilution methods. The results from the disc diffusion method showed that *Euphorbia hirta* could inhibit the growth of Propionibacterium acnes (38).

Anti-anaphylactic activity:

The Euphorbia hirta ethanolic extract (EH A001) was found to possess a prominent anti-anaphylactic activity. A preventive effect of EH-A001 given by oral route at dose from 100 to 1000 mg/kg was observed against compound 48/80-induced systemic anaphylaxis. At the same range of dose, EH-A001 inhibited passive cutaneous anaphylaxis (PCA) in rat and active paw anaphylaxis in mice. A suppressive effect of EH-A001 was observed on the release of TNF-α and IL-6 from anti-DNP-HAS activated rat peritoneal mast cells (39).

Anthelmintic activity:

The anthelmintic efficacy of the aqueous crude extract of *Euphorbia hirta* Linn was studied in 20 Nigerian dogs that were naturally infected with nematodes. Results of this study show that the aqueous crude extracts of *E. hirta* after its administration into local dogs produced a significant increase ($P< 0.05$) in PCV, RBC, Hb conc., TWBC and lymphocyte counts. The faecal egg counts also showed a remarkable and significant reduction in the levels of the identified helminths (40).

CONCLUSION:

Herbal drug which are used in various traditional medicine, needs detailed investigation with ethno-pharmacological approach. In the present review we have made to explorer the all details of the euphorbia hirta information its botany, habitat, ethno-veterinary, traditional and modern uses, it is commonly found as weed on way side and at waste places throughout India. Further studies going on the plant to elaborate the more activity in plant constitutes, therefore there are many plant uses are mentioned in ayurveda on that base go for further studies.

REFERENCES:

1) A. Abdul Rahuman, Geetha Gopalakrishnan, P. Venkatesan and Kannappan Geetha, Larvicidal activity of some Euphorbiaceae plant extracts against *Aedes aegypti* and *Culex quinquefasciatus* (Diptera: Culicidae), Parasitology Research 2007, 839-6.
2) C. Chika Ogueke , N.Jude, Ifeanyi C. Okoli And Beatrice N Anyanwu, Antibacterial Activities And Toxicological Potentials Of Crude Ethanolic Extracts Of Euphorbia hirta, Journal of American Science 2007, 3(3),11-16.
3) http://www.divineremedies.com/euphorbis_hirta.htm
4) K.R. Kirtikar, and B.D. Basu., Indian Medicinal Plants, Periodical Experts Books Agency, 2nd edition, Vol. 3, New Delhi 1991.
5) M.K. Jha The folk Veterinary system of Bihar a research survey. NDDB, Anand, Gujrat, 1992.
6) D. R.Gupta A chemical examination of Euphorbia hirta Linn., Bull Chem Soc Jpn 1966, 39(11), 2532-4.
7) P. Blanc, P. Bertrand, G. De saqui-Sannes Flavonoids of Euphorbia hirta. Plantes Med. Phytother1972, 6, 106-109.
8) M. Aqil Euphorbianin, a new glycoside from *Euphorbia hirta* Linn. *Global* Journal of Pure and applied science 1999, 5(3), 371.
9) L. Chen Polyphenols from leaves of Euphorbia hirta L, Zhongguo Zhong Yao Za Zhi 1991, 16(1), 38-9.

10) T. Yoshida, L Chen, Tannins and related polyphenols of euphorbiaceous plantsIV. Euphorbins A and B, novel dimeric dehydroellagitannins from euphorbia hirta L. Chemical and Pharmaceutical bulletin1988, 36 (8), 2940.

11) T. Yoshida, O. Namba T. Okuda, Hydrolysable tannin oligomers from euphorbiaceae. Tennen Yuki Kagobutsu Toronkai Koen Yoshishu 1989, 31, 601.

12) V. Martinz, Antiinflammatory compounds from the n hexane extract of euphorbia hirta, Reviews sociedad Quimica De mexico1999, 43, 103.

13) S. Gnecco Distribution pattern of n-alkanes in Chilean species from the Euphorbiaceae family. Boletín de la Sociedad Chilena de Química 1996, 41(3) 229.

14) M.C. Lanhers, J. Fleurentin, P. Cabalion, P. Dorfman, J.M. Pelt. Dorfman P, Mortier F. Analgesic, antipyretic and anti-inflammatory properties of Euphorbia hirta. Planta Medica 1991 , 57(3), 225-31.

15) M.C. Lanhers, J. Fleurentin, P. Cabalion, A. Rolland, P. Dorfman, R. Misslin, J.M. Pelt. Behavioral effects of Euphorbia hirta L.: sedative and anxiolytic properties. J Ethnopharmacol 1990, 29(2) 189-98.

16) J. Galvez, A. Zarzuelo, M.E. Crespo, J. Jiménez Antidiarrhoeic activity of quercitrin in mice and rats. J Pharm Pharmacol 1993, 45(2), 157-9.

17) J. Galvez, A. Zarzuelo, M.E. Crespo, M.D. Lorente, M.A. Ocete, J. Jiménez Antidiarrhoeic activity of Euphorbia hirta extract and isolation of an active flavonoid constituent. Planta Medica 1993, 59(4), 333-6.

18) K. Vijaya S. Ananthan, R. Nalini. Antibacterial effect of theaflavin, polyphenon 60 (Camellia sinensis) and Euphorbia hirta on Shigella spp a cell culture study. J Ethnopharmacol. 1995, 49(2), 115-8.

19) L. Tona, R.K. Cimanga, K. Mesia, C.T. Musuamba, T. De Bruyne, S. Apers, N. Hernans, S. Van Miert, L. Pieters, J. Totte, A.J .Vlietinck. Biological screening of traditional preparations from some medicinal plants used as antidiarrhoeal in Kinshasa, Congo. Phytomedicine 1999, 6(1), 59-66.

20) Patricia B. Johnson et al *Euphorbia hirta* leaf extracts increase urine output and electrolytes in rats, Journal of Ethnopharmacology 1999, 65, 63–69.

21) L. Tona, R.K. Cimanga, K. Mesia, C.T. Musuamba, T. De Bruyne, S. Apers, N. Hernans, S. Van Miert, L. Pieters, J. Totte, A.J .Vlietinck. Antimalarial activity of 20 crude extracts from nine African medicinal plants used in Kinshasa, Congo. J Ethnopharmacol 1999, 68(1-3), 193-203.

22) L. Tona, R.K. Cimanga, K. Mesia, C.T. Musuamba, T. De Bruyne, S. Apers, N. Hernans, S. Van Miert, L. Pieters, J. Totte, A.J .Vlietinck. Antiamoebic and spasmolytic activities of extracts from some antidiarrhoeal traditional preparations used in Kinshasa, Congo. Phytomedicine 2000, 7(1): 31-8.

23) L. Tona, R.K. Cimanga, K. Mesia, C.T. Musuamba, T. De Bruyne, S. Apers, N. Hernans, S. Van Miert, L. Pieters, J. Totte, A.J .Vlietinck. In vitro antiplasmodial activity of extracts and fractions from seven medicinal plants used in the Democratic Republic of Congo. J Ethnopharmacol 2004, 93(1), 27-32.

24) S.K. Singh, R.P. Yadav, S. Tiwari, A. Singh Toxic effect of stem bark and leaf of Euphorbia hirta plant against freshwater vector snail Lymnaea acuminata. Chemosphere 2005, 59(2), 263-70.

25) Blanc P et al Galactogenic properties of plants of the African flora: sersalisia djalionensis and E.Hirta. Annales de Biologic Clinique (Paris) 21 (10-12), 829.

26) A. Mathur, V.P.Dixit, M.P. Dobal, Antifertility plant product: Euphorbia hirta in males. (Proceeding of the international symposium on male contraception: present and future, New Delhi. 1995)

27) P. Singh K.K. Sinha, Inhibition of alfatoxin production on some agricultural commodites through aqueous plant extracts. Journal of Indian botanical society 1986, 65 (1), 30.

28) A. Hiermann et al, Influence of some traditional medicinal plants of Senegal on prostaglandin biosynthesis, J Ethnopharmacol 1994, 42(2), 111-6.

29) Y.C. Wang, T. L. Huang Screening of anti-Helicobacter pylori herbs deriving from Taiwanese folk medicinal plants. FEMS Immunol Med Microbiol 2005. 43(2), 295-300.

30) H. Wei, Y. Hou, G. Yang, J. Fu, M. You. Repellent and antifeedant effect of secondary metabolites of non-host plants on Plutella xylostella. Ying Yong Sheng Tai Xue Bao 2004, 15(3), 473-6.

31) H. Wei, Y. Hou, G. Yang, J. Fu, M. You. Evaluation of non-host plant ethanol extracts against Plutella xylostella population. Ying Yong Sheng Tai Xue Bao 2005, 16(6), 1086-9.

32) Tamas Szenasi E (Hung) E.Hirta extracts as Immunostimulants. German Patent DE 4102054 (1992).

33) S. Mohamed, S. Saka, S.H. EL-Sharkawy, A.M. Ali, S. Muid Antimycotic screening of 58 Malaysian plants against plant pathogens, Pesticide science,1996, 47(3), 259.

34) A. Abdul Rahuman, Geetha Gopalakrishnan, P. Venkatesan and Kannappan Geetha, Larvicidal activity of some Euphorbiaceae plant extracts against *Aedes aegypti* and *Culex quinquefasciatus* (Diptera: Culicidae), Parasitology Research 2007, 839-6.

35) Nilesh Kumar Sharma, Sreela Dey, Ramasare Prasad, In Vitro Antioxidant potential evaluation of *Euphorbia hirta* L. Pharmacologyonline 2007,1, 91-98.

36) Jigna Parekh, Darshana Jadeja, Sumitra Chanda, Efficacy of Aqueous and Methanol Extracts of Some Medicinal Plants for Potential Antibacterial Activity Turk J Biol, 2005, 29, 203-210.

37) A.A. Adedapo, M. O. Abatan, S.O. Idowu, O.O. Olorunsogo. Effects of chromatographic fractions of *Euphorbia hirta* on the rat serum biochemistry. African Journal of Biomedical Research 2005, 8, 185 – 189.

38) G.S. Kumar, Antimicrobial effects of Indian medicinal plants against acne-inducing bacteria, Tropical Journal of Pharmaceutical Research 2007, 6 (2): 717-723.

39) Youssouf M S. Anti-anaphylactic effect of Euphorbia hirta. Fitoterapia 2007, 78 535–539.

40) Adeolu Alex Adedapo, Anthelmintic efficacy of the aqueous crude extract of *Euphorbia hirta* Linn in Nigerian dogs, Veterinarski Arhiv 2005, 75 (1): 39-47.

CURRENT AUTHOR ADDRESSES:

SANDEEP B. PATIL

Appasaheb Birnale College of Pharmacy, Sangli

South Shivajinagar, Sangli – Miraj Road

Sangli – 416 416.

Maharashtra.

Phone no. 0233-2324360 Faxes: 0233-2325677
Mobile no. 09226765719
E-mail: sandeep_pharmacology@rediffmail.com