



Bulletin of Environment, Pharmacology and Life Sciences

Bull. Env. Pharmacol. Life Sci., Vol 2 (4) March 2013: 38- 44

©2013 Academy for Environment and Life Sciences, India

Online ISSN 2277-1808



Original Article

Comparative Nutritional and Phytochemical screening of the Leaves and Stems of *Acalypha fimbriata* Schum. & Thonn. and *Euphorbia hirta* Linn.

ESSIETT, U. A. AND OKOKO, A. I.

Department of Botany and Ecological Studies, Faculty of Science, University of Uyo, P.M.B. 1017, Uyo. Akwa Ibom state-Nigeria.

Corresponding Author: u.essiett@yahoo.com

ABSTRACT

Comparative phytochemical and nutritional studies of the leaves and stems of *Acalypha fimbriata* and *Euphorbia hirta* were investigated. The Phytochemical screening revealed the presence of tannins and flavonoids in both plant leaves and stems. Saponins were present in *E. hirta* leaves and stems and *A. fimbriata* leaves but absent in the stems. Alkaloids and anthraquinones were absent in both plants leaves and stems. Lieberman's and salkowski's test revealed the presence of Cardiac glycosides while keller-killiani test revealed the absent of Cardiac glycosides in both plants. Quantitative evaluation revealed moisture content of 13.5% and 10.3% for leaves and stems of *A. fimbriata*, 10.8% and 6.5% for leaves and stems of *E. hirta*, ash content of 18.66% and 21.50% for leaves and stems of *A. fimbriata* and 11.50% and 10.83% for leaves and stems of *E. hirta*. Acid-insoluble ash of 3.5% and 2.5% for leaves and stems of *A. fimbriata*, and 3.0% and 2.5% for leaves and stems of *E. hirta*. The nutritional values revealed Protein content of 9.5% and 3.0% for leaves and stems of *A. fimbriata* and 7.5% and 2.0% for leaves and stems of *E. hirta*. Fat content of 2.0% and 6.0% for *E. hirta* leaves and stems, 1.5% and 8.0% for *A. fimbriata* leaves and stems, Carbohydrate content of 20% and 11% for *E. hirta* leaves and stems, 25% and 14% for *A. fimbriata* leaves and stems respectively. The result of these studies indicates that *Euphorbia hirta* and *Acalypha fimbriata* leaves and stems extracts contains nutrients and bioactive compound which explains their therapeutic uses.

Keywords: *Euphorbia hirta*, *Acalypha fimbriata*, Phytochemical, leaves, stems, Euphorbiaceae.

Received 18/02/2013 Accepted 23/03/2013

©2013 AELS, INDIA

INTRODUCTION

In recent years, there has been a gradual revival of interest in the use of medicinal plants in developing countries because herbal medicines have been reported safe and without any adverse side effect especially when compared with synthetic drugs. Thus searches for new drugs with better and cheaper substitutes from plant origin are a natural choice. The medicinal value and nutritional value of these plants lies in some chemical substances that produce a definite physiological action on the human body [8].

Herbalism is a traditional medicine based on the use of plants and plant parts and the study of medicines derived from natural sources. Many plants synthesize substances that are useful to the maintenance of health in humans and other animal. According to World Health Organization [34] population presently use herbal medicine for some aspect of primary health care. The most important of these are bioactive constituents of plants.

Medicinal plants would be the best source to obtain a variety of drugs. Therefore, such plants should be investigated to better understanding their properties, safety and efficacy [19]. Since time immemorial man has used various parts of plants in the treatment and prevention of many ailments such as leaves, stems, flowers and roots, historically, all medicinal preparations were derived from plants whether in

the simple form of plant parts or in the more complex form of crude extracts, mixtures, etc. today, a substantial number of drugs are developed from plants [10] which are active against a number of diseases, such as respiratory ailments, cough, coryza, bronchitis, asthma, worm infestation, dysentery, gonorrhoea, jaundice, pimples, digestive toothache, earache, gastro-intestinal haemophysis and bleeding.

The genus *Acalypha fimbriata* Schum. & Thonn. and *Euphorbia hirta* L. belongs to the family Euphorbiaceae. *Acalypha* genus has about 462 species. It is the fourth largest genus in the family and is found in tropical and warm temperate region. Acalypheae is the largest tribe in the uniovulate subfamily Acalyphoideae (Angiosperm family Euphorbiaceae). It consists mainly on trees and shrubs distributed in Paleotropics. The tribe is made up of several economical, ecological and ornamental groups of plants [11]. Thirteen species are found in West tropical region and ten of the species are found in the South Western region of Nigeria out of which one is abundant and widespread throughout the region.

Euphorbia consists of 2008 species. *Euphorbia* is one of the most diverse genera in the plant kingdom, exceeded possibly only by scenario. Members of the family and genus are sometimes referred to spurge.

Acalypha fimbriata are monoecious or dioecious and are either herbs or shrubs, but rarely trees or lianas. The plant has contoured leaves which are curl shaped, olive green in colour with creamy margin, which is often copper red in colour. The leaves are succulent with sappy stalks which tend to lose sappiness with age, alternate, stipulate, characterized with serrated edges, obvious midribs and veins. The staminate flowers have four valuate sepals, four to eight stamens and vermiciform anther. The pistillate flowers are often prominently bracteates with 3(4,5) sepals (2) 3 carpels, 1 ovule per carpel and divided styles. The species share the characteristic of allomorphic pistillate flowers and fruits [17]. The stems are glabrous and long.

Euphorbia hirta L. are perennial, bushy, soft-woody small tree with a thin grayish brown bark, leaves palmately lobed with seven or more serrate lobes, flowers monoecious in terminal panniculate racemes with crowded male flowers on the upper half of the inflorescence and the pistillate at the basal half, fruits globose, explosively dehiscent, 3-seeded capsule, when young, it is green and covered with fleshy prickles, seed oblong with smooth, hard, mottled crustaceous testa with a white caruncle at the top enclosing oily and fleshy endosperm [18]. The stems are hairy and small.

Acalypha fimbriata are originated in Oceania now it has been spread all over the world and are found in the tropics of Africa, America and Asia while *Euphorbia hirta* are distributed throughout the hotter parts of India, Australia and Nigeria, often found in waste places along the roadsides [18].

Acalypha fimbriata and *Euphorbia hirta* are of economical importance in Nigeria. The cold extract of the leaves is used to bathe babies with skin infection. [30] In *A. fimbriata*, the flowers are used in the treatment of diarrhea while *E. hirta* is used traditionally for female disorders but is now more important in treating respiratory ailments, especially cough and asthma [23].

According to 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. It is also reported as increase in urine output, antidiarrheal, antispasmodic, anti-inflammatory etc. [24].

In Africa, the extracts of the plants are used in the treatment of asthma and respiratory tract inflammations. It is also used for coughs, chronic bronchitis and other pulmonary disorders in Malagasy. The plants are also widely used in Angola against diarrhea and dysentery, especially amoebic dysentery. In Nigeria, *E. hirta* and *A. fimbriata* are used to treat asthma, cough, coryza etc. The extract of the plants are also used as ear drops and in the treatment of boils, sore and promoting wound healing [7].

In India, *Euphorbia hirta* is used to treat worm infestations in children and for dysentery, gonorrhea, jaundice, pimples, digestive problems and tumors [16]. The decoction root of *E. hirta* are used to allay vomiting, chronic diarrheas and fevers, also for snake bite, while the cooked leaves of *A. fimbriata* are taken to relieve post partum pains and a root decoction as a laxative [5]. In Africa and Australia the leaf extracts of *E. hirta* is used to treat hypertension and edema while *A. fimbriata*, the leaves are compounded with the leaves of other drug-plants into a drug for children with rabies in Southern Nigeria [28].

Essiett and Okoko

The aim and of this research Project is to compare and establish the chemical constituents of the leaves and stems of *Acalypha fimbriata* and *Euphorbia hirta* which would eventually be useful in preparing a monograph on the plant for its identification (such as phytochemical and quantitative parameters of the crude drug) and the objective includes: To determine the different bioactive agents in the leaves and stems of *Acalypha fimbriata* and *Euphorbia hirta*. To determine nutritional value of the leaves and stems of *A. fimbriata* and *E. hirta*. To contribute useful information to the proper and easy identification of *A. fimbriata* and *E. hirta* thus providing a useful tool for the collection and preservation of these species. The significance of the studies is to prove that *Acalypha fimbriata* and *Euphorbia hirta* have various therapeutic uses for the synthesis of drugs and medicinal source in the developing countries.

Euphorbia hirta are useful in the treatment of ailment such as rheumatism, toothache, venereal disease, ulcer and wounds [21]. The families, Euphorbiaceae are also known to cure gonorrhea, urine-genital infections, jaundice and are used as diuretic and astringent [27]. The medicinal properties of a plant are due to the presence of certain chemical constituents. The use of plants in curing and healing is as old as man himself [13].

Oliver [21] reported that in Nigeria, a decoction of fresh leaves is taken orally against diarrhea and externally in cases of rectal prolapse. The powder of dried leaves is used for skin disease. The value of ethnomedicinal and traditional pharmacology in these days achieving great appreciation in modern medicine, as the search for new potential medicinal plants is frequently based on an ethnomedicinal basis [20].

World Health Organization [34] has estimated that at least 80% of the world population relies on traditional systems of medicine for their primary health needs. *Euphorbia hirta* L. and *Acalypha fimbriata* are one of the important local plants used by Vangajjars in the treatment of warts. Wart is a circumscribed cutaneous elevation due to hypertrophy of the papillae and hyperplasia of all the layers of the epidermis. They are used as edible and also used as tooth cleaners [9].

All plant parts of *Euphorbia hirta* L. are used in medicine. *Euphorbia hirta* is used for its antibacterial, antimarial, anti-inflammatory, galactogenic, antiamoebic, antiasthmatic, antidiarrheal, antioxidant, antifertility, and antifungal property. In addition, it has a therapeutic effect on urine output and electrolytes [15].

Euphorbia hirta and *Acalypha fimbriata* have been reported according to Etukudo [9] the uses of these 2 species as an antidote and pain relief of scorpion stings and snakebites and the use of latex to facilitate the removal of thorns from the skin are common which is also taken to induce milk production in nursing mothers.

The stem is used as a treatment for asthma, bronchitis and various other lung complaints and the whole plant is decocted and used in the treatment of athlete's foot, dysentery, enteritis and skin conditions [33]. It has been used in the treatment of syphilis. In Nigeria, extracts of the plant are used as ear drops and in the treatment of boils, sore, and promoting wound healing [15]. The aqueous extracts of leaves and stems of *Euphorbia hirta* and *Acalypha fimbriata* [32,33] revealed the presence of saponins, tannins, flavonoids, lieberman's, and both leaves and stems of *Euphorbia hirta* while alkaloids and keller-killiani are absence in both plants.

MATERIALS AND METHODS

The fresh leaves and stems of *Euphorbia hirta* and *Acalypha fimbriata* were collected from a bush in Afaha Idoro village and alongside road in Uyo Local Government Area of Akwa Ibom State. The plants were authenticated by Dr. (Mrs.) U. A. Essiett, a Taxonomist in the Department of Botany and Ecological Studies, University of Uyo, Uyo.

Preparation of the Extract

After collection and identification of the two plants, the leaves were separated from the stems, the fresh leaves and stems were sun dried and then reduced to powder with the aid of mortar and pestle. The powdered leaves were accurately weighed and then macerated cold in 400ml of 70% ethanol for 72 hours (3 days) in a maceration tank at room temperature following the method suggested by Sofowora [28]. The liquid extracts were recovered by filtration using cotton wool, glass and funnel. The filtrate obtained was concentrated in water bath at 40°C which yields semi-solid extract. The same is done with

the stems of these plants. The extract obtained was accurately weighed and then used for phytochemical screening.

Basic phytochemical screening was performed using suitable reagent to detect the presence or absence of secondary plant metabolites such as alkaloids, anthraquinones, tannins, saponins, etc, in the extract. The method of Trease and Evans [12, 28, 32] were used.

Quantitative Microscopy/Proximate Analysis

The moisture content of the powdered leaves and stems were determined by loss on drying method [2]. The ash value, acid insoluble ash, water-soluble ash and sulphated ash were determined as described [1, 4]. The water and alcohol extractive values were obtained using the method outlined [4, 6]. The fat (lipids), crude fibre, crude protein and carbohydrate were obtained using the method outlined [3, 22, 25].

RESULTS

The results of the phytochemical screening in the leaves and stems of *Acalypha fimbriata* and *Euphorbia hirta* shows the present of tannins and flavonoids in both plants leaves and stems. Saponins were present in *Euphorbia hirta* leaves and stems and *Acalypha fimbriata* leaves but absent in the stems. Alkaloids, anthraquinones were absent in both plants leaves and stems. Lieberman's and salkwoski's test revealed the presence of cardiac glycosides while keller-killiani's test revealed absent of cardiac glycosides in both plants.

Quantitative Evaluation

The result of the quantitative evaluation of *Euphorbia hirta* and *Acalypha fimbriata* shows moisture content of 13.5% and 10.3% for leaves and stems of *Acalypha fimbriata*, 10.8% and 6.5% for leaves and stems of *Euphorbia hirta*, ash content of 18.66% and 21.50% for leaves and stems of *Acalypha fimbriata* and 11.50% and 10.83% for leaves and stems of *Euphorbia hirta*, acid-insoluble ash of 3.5% and 2.5% for leaves and stems of *Acalypha fimbriata*, and 3.0% and 2.5% for leaves and stems of *Euphorbia hirta*.

Nutritional Analysis

The nutritional values revealed protein content of 9.5% and 3.0% for leaves and stems of *Acalypha fimbriata* and 7.5% and 2.0% for leaves and stems of *Euphorbia hirta*, fat content of 2.0% and 6.0% for *Euphorbia hirta* leaves and stems, 1.5% and 8.0% for *Acalypha fimbriata* leaves and stems, carbohydrate content of 20% and 11% for *Euphorbia hirta* leaves and stems, 25% and 14% for *Acalypha fimbriata* leaves and stems respectively.

Table 1: Result of the Phytochemical Screening of *Acalypha fimbriata* and *Euphorbi. hirta* Leaves and Stems.

TEST	OBSERVATION	INFERENCE			
		<i>Euphorbia hirta</i>		<i>Acalypha fimbriata</i>	
		Leaves	Stems	Leaves	Stems
Saponins	Frothing persisted for More than 10 minutes	+	+	+	-
Tannins	A blue-black colour was observed	++	++	+	+
Flavonoids	A red precipitate was observed.	+++	++	+	+
Alkaloids	A clear solution was observed	-	-	-	-
Anthraquinones	A clear solution was observed	-	-	-	-
Cardiac Glycosides:					
(a) Lieberman's	Pink colour was observed at the interphase	++	+++	+	+
(b) Salkwoski's	Reddish-brown colouration was observed at the interphase	++	+++	++	++
(c) Keller-killiani	A clear solution was observed	-	-	-	-

Key: - Absent, + = Trace, ++ = Moderate, +++ = Abundant.

Table 2: Results of the Quantitative Evaluation of leaves and stems of *Euphorbia hirta* and *Acalypha fimbriata*.

Parameters	Values (% W/W)			
	<i>Acalypha fimbriata</i>		<i>Euphorbia hirta</i>	
	Leaves	Stems	Leaves	Stems
Moisture content	10.8	6.5	13.50	10.30
Ash content	11.50	10.88	18.66	21.50
Acid-insoluble Ash	3.00	2.50	3.50	2.50

Table 3: Result of the nutritional values of *E. hirta* and *A. fimbriata* leaves and stems.

Parameters	Values (%W/W)			
	<i>Euphorbia hirta</i>		<i>Acalypha fimbriata</i>	
	Leaves	Stems	Leaves	Stems
Protein	7.5	2.0	9.5	3.0
Fat	20	11	25	14.0
Carbohydrate	2	6	1.5	8.0

DISCUSSION

The results of phytochemical screening revealed the presence of tannins, flavonoids, cardiac glycosides (lieberman's and salkowski's) while anthraquinones, keller-killiani and alkaloids are absence in both plants leaves and stems of *Acalypha fimbriata* and *Euphorbia hirta* but saponins are present in the leaves and stems of *Euphorbia hirta* and absent in the stems of *Acalypha fimbriata*. This compound have various therapeutic properties such as the astringent action of tannins in both the stems and leaves of the species studied makes the plants useful in the treatment of diarrhea and dysentery. Cardiac glycoside decocted in the extract has make these plant useful in the treatment of asthma [29, 33]. The presence of these compounds in *Acalypha fimbriata* and *Euphorbia hirta* stems and leaves confirms their usefulness to traditional medicine practitioners for their antibiotic properties. Saponins presence is responsible for its antifungal, antidote, antimicrobial, antiyeast and antiflammatory activities that believed the roles of saponins in the plants to protect against attack by potential pathogen [31].

The occurrence of anthraquinone in the plants is an indication that it can be used as a mild laxative. According to Trease and Evans [33], anthraquinones act on gastro intestinal tract to increase the peristalsis action. Flavonoids is a wide therapeutic activities such as anti-rheumatism, antihypertensive as well as antimicrobial as identified with flavonoids that containing in many plants parts are dieretic and the anti-oxidants, the leaf and stem of these plants can be equally applied in each cases which helps in health promoting disease preventing dietary compound which can recognize that diets rich in vegetables appears to be associated which reduced frequency of cancer for various organ system [26].

The quantitative evaluation is parameters in setting standard for crude drugs [33]. The results of the moisture content in *Acalypha fimbriata* and *Euphorbia hirta* that was not high indicates less chances of activities of the drug during storage because the excess moisture can results in the breakdown of important constituents by enzymatic activity and which may encourage the growth of yeast and fungi [2]. The low moisture contents of the leaves and stems would hinder the growth of micro-organisms and the storage of life would be high [1]. As such the moisture contents of 13.5% (leaves), 10.3% (stems) in *Acalypha fimbriata* and 10.8% (leaves), 6.5% (stems) in *Euphorbia hirta*. The general requirement for the moisture content in crude drugs was that, it would not be more than 14%, since it was normal and implies that *Acalypha fimbriata* and *Euphorbia hirta* leaves and stems can be stored for a longer time with lower chances of microbial and growth. The total ash value was 18.66% (leaves), 21.50% (stems) in *A. fimbriata* and 11.50% (leaves), 10.83% (stems) in *E. hirta*, since the accepted range was 22%, which implies that the plants that has normal complexes of inorganic and organic component [4] but the value of the acid insoluble ash are 3.50% (leaves), 2.50% (stems) in *A. fimbriata* and 3% (leaves), 2.50%

(stems) in *E. hirta* which implies that the normal acid insoluble ash has a portion of the ash contents which was acid soluble and hence may be physiologically important as salts in the body when consumed. It is also indicative of high digestibility of the plant when eaten [14]. Since all these values are within the accepted range it could also aid in proper identification and collection of plants. The proximate composition of leaves and stems of *A. fimbriata* and *E. hirta* established that they can be ranked as carbohydrate rich leaves and stems due to their relatively high carbohydrate content when compared with other components of the leaves and stems. The crude proteins of the leaves are 7.5% and 9.5% for *E. hirta* and *A. fimbriata* respectively. The value of the crude fat for the leaves of these two species were moderate for stems of *E. hirta* and leaves of *A. fimbriata* then trace in leaves of *E. hirta* and *A. fimbriata*. The nutritive values of plant species probably influence the decision to consume, as conveyed to herbivore through its senses.

CONCLUSION

In conclusion, the leaves and stems of *Euphorbia hirta* and *Acalypha fimbriata* are used for the treatment of asthma, rheumatism, hypertension and wound healing and also in the production of antidote and antibiotic drugs. The result shows that *Euphorbia hirta* and *Acalypha fimbriata* leaves and stems contain nutrients and secondary metabolites which could be responsible for its medicinal uses.

REFERENCES

1. Adeyeye, E. I. and Ayejugo, O. O. (1994). Chemical Composition of *Cola accuminata* and *Garcina kola* seeds grown in Nigeria. *Inter. J. food Sci. Nutr.*, 45:223-230.
2. African Pharmacopoeia (1986). General Methods of Analysis Pharmacopoeia, 11 (1st Ed.) P. 121-208.
3. AOAC (1990). Association of Official Analytical Chemists. Officials Methods of Analysis. Washington D.C. 15th Edition.
4. British Pharmacopoeia (1986). Ash Value, Acid Insoluble Ash, Water Soluble Extractive and Alcohol soluble Extractive, Vol. II, Appendix xii, Majesty's Stationary Office, London, P. 1276-1277.
5. Burkhill, H. M. (2002). The Useful Plants of West Tropical Africa, Second Edition, Vol. 4. Families S-Z, Addenda Royal Botanic Gardens, Kew: Richmond, United Kingdom. P. 689.
6. Brain, K. R. and Tuner, T. D. (1975). *The Practical Evaluation of Phytopharmaceuticals*, pp. 81 – 82. Wright Scientifica Bristol.
7. Chika O.C., Jude, N., Ifeanyi C.O., and Beatrice N.A. (2007). Antibacterial Activities and Toxicological Potentials of Crude Ethanolic Extracts of *Euphorbia hirta*. *J. Ameri. Sci.*, 3(3), 11-16.
8. Edeoga, H. O., Okwu, D. E. and Mbaebie, B. O. (2005). Phytochemical Constituents of some Nigeria Medicinal Plants. *Afr. J. Biotech.*, 4:685-688.
9. Etukudo, I. (2003). Ethnobotany: Conventional and Traditional uses of plants. 1st Ed. Nigeria Verdict Investment Ltd., Uyo. P. 191.
10. Fabricant D. S., Farnsworth N. R. (2001). The Value of Plants used in Traditional Medicine for drug discovery. *Environ. Health Pers.*, 109 (Suppl.1): 69-75.
11. Goveerts, R., Frodin, D. G. and Radcliffe-Smith, R. (2000). World Checklist and Bibliography of Euphorbiaceae (with Pandaceae). 1st Ed. Kew: Royal Botanic Gardens, P. 415.
12. Harborne, J. B. (1998). Phytochemical methods (3rd ED.) Chapman and Hall; Ltd, London. Pp.1 – 302.
13. Hedberg, I. (1987). Research on Medicinal and Poisonous plants of tropics: *Past, present and future in medicinal and poisonous plants of the tropics* (Eds. Leewenerg, A. J. M.). International Book distribution, Dehra Dun, India, P. 9-15.
14. Ibrahim, J., Ajaegbu, V.C. and Egharevba, H.O. (2010). Pharmacognostic and Phytochemical Analysis of *Commelina benghalensis* L. *Journal of Ethnobotanical Leaflets*, 14:610-615.
15. Igoli, J. O., Ogali, T. A., Tor-Anyiin, S. and Igoli, N. P (2005). *Traditional Medicine Practice amongst the Igede People of Nigeria*. Part II. *Afri. J. Traditional, Compl. Altern. Med.*, 2(2): 134-152.
16. Kirtikar, K.R., and Basu, B.D. (1991). *Indian Medicinal Plants*, Periodical Experts Books Agency, 2nd Edition. New Delhi. Vol. 3 P. 47-49
17. Levin, G. A., Morton, J. K. and Robbrecht, D. (2007). Two New Species of *Acalypha* (Euphorbiaceae) from tropical Africa and a Review of some Robyns names for cupricolous plants from democratic Republic of Congo. *Syst. Bot.*, 32:576-582.
18. Manorma, K. and Preety, S. (2011). Ethnobotanical Studies of the family Euphorbiaceae: A Review Seminar. *J. Curr. Sci.* 16(1): 75-78.
19. Mohammed, A. B. R., Zakaria, Z., Sreenivasan, S., Lachimanam, Y. L. and Santhanam A. (2010). Assessment of *Euphorbia hirta* L. leaf, flower, stem and root extracts for their antibacterial and antifungal activity and Brine Shrimp Lethality. *J. Ethnopharmacol.* 8:420-449.
20. Muthu, C., Ayyanar, M., Raja, N., and Ignacimuthu, S. (2006). Medicinal plants used by the Traditional healers in Kancheepuram District of Tamil Nadu, India. *J. Ethnobiol. Ethnomed.*, 2: 43-48.

Essiett and Okoko

21. Oliver, B. (1960). *Medicinal plants in Nigeria*. Nigerian College of Arts, Science and Technology, Lagos.
22. Okon, E. U. (2005). *Handbook of basic food and beverage analysis*. Etovin publ. AKS. Nigeria. pp 53-70.
23. Pandey, B. P. (2006). A Textbook of Botany: *Angiosperms, Taxonomy, Anatomy, Embryology (including tissue culture) and Economic Botany*, S. Chand and Co., Ltd., Ram Nagar, New Delhi. P: 1189.
24. Patil S.B., Nilofar S., Naikwade N.S., Magdum C.S. (2009). Review on Phytochemistry and Pharmacological Aspects of *Euphorbia hirta* Linn. *J. Pharma. Res. Health Care*. 1(1): 113-133.
25. Pearson, D. (1976). *Laboratory Techniques in Food Analysis*. The Butterworth Group, London, pp. 22 – 25.
26. Pietta, P. G. (2000). Flavonoids as Antioxidants. *Journal of Natural Product*. 63(7): 1035-1042.
27. Siwakoti, M. and Verma, S. K. (1996). Medicinal Plants of the Terai of Eastern Nepal. *J. Econ. Taxon Bot. Additional Series 12*, Maheshwari J. K. (Ed.) *Ethnobotany in South Asia*, Scientific Publishers, Jodhpur (India) 423-438.
28. Sofowora, A. (2008). *Medicinal Plants and Traditional Medicine in Africa*. 3rd Ed., Spectrum Books Limited, Ibadan, Nigeria. Pp. 199-204.
29. Sofowora, L. A., (1993). *Medicinal Plants and Traditional Medicine in Africa*. Spectrum Books Ltd, Ibadan, pp. 55-71.
30. Sofowora, A. (1982). *Medicinal Plants and Traditional Medicine in West Africa*. 1st Edition, John Wiley and Sons Ltd., New York, p. 256.
31. Sparg, S. G., Light, M. E. and Stadan, J. V. (2004). Biological activities and Distribution of Plant Saponins. *Journal of Ethnopharmacology*. 94:219-243.
32. Trease, G. E. and Evans, W. E. (1989). *Trease and Evans' Pharmacognosy*, 13th Edition, Bailliere Tindale London. P.832.
33. Upadhyay, B., Singh, K. P. and Kumar, A. (2010). Pharmacognostical and Antibacterial Studies of Different Extracts of *Euphorbia hirta* L. *Journal of Phytology*, 2(6): 55-60.
34. World Health Organization (1991) "Guideline for Assessment of the Herbal Medicines" Programme on Traditional Medicine. WHO, Gieneva: pp. 56-91.