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A REVIEW ARTICLE ON ANTIMICROBIAL ACTIVITY OF MEDICINAL PLANTS

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ABSTRACT

Currently, Increase is Antimicrobial resistance is the biggest threat worldwide. The multi- and pan-drug-resistant organisms (such as vancomycin-, methicillin-, extended-spectrum β-lactam-, carbapenem- and colistin-resistant organisms) spreading very rapidly, and put the world in a dilemma. The AMR resulting the health and economic burden associated with AMR on a global scale are very dreadful. The antimicrobials which are currently available have been misused and are almost ineffective against pathogenic microorganisms. Some of the antimicrobial drugs showed dangerous side effects in some individuals. Developing new, effective, and safe antimicrobial agents is one of the best way by which we can reduce Antimicrobial resistance. The microorganism s developed AMR against antimicrobial agents. There is renewed interest in antimicrobial activities of phytochemicals. For medicinal plants Nigeria boasts is huge Heritage. The lot of research work is carried out to screen antimicrobial activities of the plants. The scientific compilation of these studies could provide useful information on the antimicrobial properties of the plants. This information can be useful in the development of new antimicrobial drugs. This paper will provide information about the antimicrobial researches that have been undertaken on Nigerian medicinal plants.

Keywords: AMR, Antimicrobial, Medicinal plants

INTRODUCTION

Pneumonia and *tuberculosis* are the major infections of respiratory tract in humans which mostly affects the lungs. The bacterial pathogens which causes *Pneumonia* such as *Streptococcus pneumoniae, Staphylococcus aureus, Klebsiella pneumoniae, Escherichia coli, Acinetobacter species and Pseudomonas aeruginosa; of which S. aureus and S. pneumoniae (pneumococcus)* are the most common pathogens causing community-acquired pneumonia worldwide **[1, 2]**. It is acute respiratory tract infection that leads to inflammation in the alveoli of lungs which results in accumulation of pus and fluid, which causes difficulty in breathing. Pneumonia mainly affects more younger children as compared to adults causing annually 0.68–0.92 million deaths in children worldwide **[3]** . On the other hand Tuberculosis is caused by the *Mycobacterium tuberculosis*, that mostly affects the lungs, causing lung tuberculosis or pulmonary tuberculosis. In most cases, other body parts may also be affected that may leads to lung tuberculosis [**4**]. In developing countries like India, mostly in African & Asian continents, Tuberculosis is a dreadful infection probably due to their insufficient means for its treatment. Every year about 9 million people mostly children affected by Tuberculosis, which leads to approximately 2 million deaths annually [**3**, **5**] . These statistics related to pneumonia and tuberculosis deaths are likely to increase in future due to human immunodeficiency virus (HIV) infection and spread of multidrug-resistant bacterial strains **[6]**.

The plant species which are abundantly found in the forests that play a key role in the rural livelihood needs for food and medicines in South Asia. The diversity of medicinal plants in the Himalayan region leads to its abundant geographical, topographical, ecological, climatic and physiographical conditions. Earliest evidences and records of using Himalayan plants as medicines can be found in old texts of 'Rigveda' being written 6500 year ago **[7]**. The Local residents of the region have tremendous skills and knowledge in preparation of traditional medicines for treating various ailments. However, there is no exact figure about the number of the Himalayan medicinal plants being in use for primary health care and livelihood, however approximately 10 000 Himalayan medicinal plants are supporting tracing 600 million peoples in the region **[7, 8]**.

This review was designed with the main objective to gather fragmented literature (ethnomedicines, *in-vitro* efficacy and phytochemistry) on the medicinal plants being traditionally used to treat pneumonia

and tuberculosis. For example, there are several medicinal plant species, which are traditionally using against respiratory tract infections including pneumonia and tuberculosis by local people. This literature is, scattered on these medicinal plants in relation to their ethno medicinal use and phytochemical and pharmacological activity. There is no data are available on the comparative investigation of reported himalayan anti-pneumonial and anti-tuberculosis plants particular about their phytocompounds, *in-vitro* efficacy and toxicology. The comparative study of the reported medicinal plants will be helpful in the development of novel anti-pneumonial and anti-tuberculosis drugs. Moreover, this study will also provide baseline for future research work.

Recently there has been a rapid increase of interest in the therapeutic potential of medicinal plants as antioxidants in reducing free radical induced tissue injuries. Also many other plant species have been investigated in the search for novel antioxidants **[9-11]** but generally there is still a demand to find more information concerning the antioxidant potential of plant species. The plant extracts and phytochemicals are used as antimicrobial agents, having great significance in therapeutic treatments. In the last few years, a number of studies have been conducted in different countries to prove such efficiency **[14- 17]**. In this matter of view, production of new antimicrobial agents from plant sources would be an interesting area of study.

In developing and developed countries, antibiotic resistance is a problem that continues to challenge the healthcare sector in a large part of the world. The current antibacterial therapy is threatened by the emergence and spread of multidrug resistant pathogens. There is necessity for development of a new source of antimicrobial agents such as plants as they produce a wide variety of bioactive compounds of known therapeutic properties. Many medicinal plants are used commercially either as antioxidant or as nutritional supplements. The study has been conducted to evaluate the antimicrobial activity of different medicinal plant extracts against human pathogens including two reference strains **[18, 19, 20]**.

Some extracts exhibited a good antibacterial activity against different tested bacterial isolates, many plant extracts exhibited a limited antibacterial activity against the test bacterial isolates as judged by their MIC values.

The plant extracts of *O. corniculata has* showed maximum antimicrobial activity against five pathogens, *E. coli, S. Typhi,* MDR *S. Typhi*, *K. pneumoniae,* and *C. koseri*. The extracts also showed activity against *E. coli, K. pneumoniae,* and *C. koseri.* The result was similar to the result of other studies which reported antibacterial activity of methanolic extract of *O. corniculata* **[21]**. However, contrary to result, they also reported antibacterial activity against *S. aureus*. The difference in result could be due to the less concentration (50mg/ml) compared to that used by them (250 mg/ml) **[21]**. Mohan and Pandey also reported that *O. corniculata* is effective against *S. aureus*. This difference in result may be due to the use of different solvent system **[22]**. It has been widely observed and accepted that the medicinal value of plants lies in the bioactive phytocomponents present in the plants that dissolve in different solvent systems **[23]**. The significant activity shown by the extract of *O. corniculata* against pathogenic bacteria it could be an important alternative to fight against multidrug resistant organisms.

Plant extract from *C. tamala* showed antimicrobial activity against only one tested bacterium, *S. aureus* (ATCC 25293). Hassan Waseem *et al*. **[24]** detected the antimicrobial activity of *C. tamala* against a number of organisms. Different degrees of antimicrobial activity against all tested gram positive and gram negative bacteria contrary to our result where only *S. aureus* was found to be effective. Phytochemicals such as flavonoids, terpenoids, tannins, and alkaloids present in the extracts of *C. tamala* shows antihelminthic, antidiarrhoeal, and antimicrobial activities. MIC value shows that these plant extracts possess minimum antimicrobial activity.

In some studies, *A. adenophora* was reported to produce structurally diverse chemicals including (mono-, sesqui-, di-, and tri-) terpenoids, phenylpropanoids, flavonoids and alkaloids that show antibacterial activity **[25, 26]**. The extract of *A. adenophora* possess broad spectrum antimicrobial potential against *S. aureus,* MRSA, and *S. Typhi* & other strains of bacteria which was in accordance the results are similar to the study of Rajamani *et al*. **[27]**. The extract of *A. adenophora* showed a effective MIC value against *S. aureus* which signifies their importance signifying as potential alternative to control bacterial infection **[28].** The different nature of the cell wall makes gram positive bacteria more susceptible to different

compounds than gram negative bacteria due to difference in cell wall.

The extract of *A. vulgaris* showed activity against *S.aureus*. Some studies reported the antimicrobial property of *A. vulgaris* against *S. aureus* and *E. coli* which is similar to our findings **[29]**.

Although a certain number of extracts exhibited good antibacterial potency, in contrast to our expectation, a limited antibacterial potency of some plants suggests that there is no complete agreement between the traditional uses of medicinal plants in the crude form for the remedy of infectious diseases. Another factor for the limited antibacterial potency of plants may be due to the cold percolation extraction method and the use of crude extracts.

RESULTS & DISCUSSION

The findings of the present study showed the differences between the antibacterial activity of ethanolic extract of selected medicinal plants i.e. *B. pilosa, B. pinnatum* and *L. camara*.

This suggests that these plants have different antibacterial activity against different bacterial strains i.e. *B. subtilis* (MTCC-441), *P. aeuroginosa* (MTCC-1688) and *E. coli* (MTCC739). *Bidens pilosa* showed maximum inhibition activity against *P. aeuroginosa* whereas in previous study, the methanolic extract of Bidens pilosa shows minimum inhibitory activity against *B. subtilis* **[30]** and the leaf extract of *B. pilosa* showed very good activity against *Salmonella typhi*. **[31].** In *Bryophyllum pinnatum*, we found higher antibacterial activity against *E-coli* while in previous study, the methanolic extract of B. pinnatum showed inhibition against gram positive bacteria i.e. *Staphylococcus aureus* **[32]**. In *Lantana camara*, we observed that maximum inhibition against gram negative bacteria similarly, in contrast to previous study; the Lantana camara leaf and flower extract showed antibacterial property against gram negative bacteria i.e. *P. aeuroginosa* and *B. subtilis* **[33]**. The ethanolic extract yield of *Bidens pilosa* was 1.76 g whereas in previous study, the methanolic extract of *B. pilosa* was 2.86 g **[31]**. The ethanolic extract yield of *B. pinnatum* was 1.47 g and 8.03%. As we observed the results of MIC (Minimum Inhibitory Concentration, the *B. pilosa* shows minimum inhibitory concentration i.e. 0.3125 mg/ml value against *P. aeuroginosa*. In contrast leaves of *Lantana montevidensis* extract exhibited better result against *P. aeuroginosa* (MIC 8 µg/ml) **[31]**. In present study, the *Lantana camara* and *Bidens pilosa* have showed Minimum bactericidal activity whereas in previous study the MBC of leaf

extract of *Bidens pilosa* was 1.3 > 10 mg/ml **[31]**.

Plant based antimicrobial compounds have enormous therapeutical potential as they can serve the purpose without any side effects that are often associated with synthetic antimicrobials. The methanol, ethanol, ethyl acetate and chloroform and aqueous extracts of the leaves of *A. aspera, A. parviflora, A. indica, C. gigantean, L. inermis, M. pudica, I. coccinea, P. hysterophorus* and *C. odorata* were subjected to a preliminary screening for antimicrobial activity against two human pathogenic bacteria *E. coli* and *S. aureus* and two phytopathogenic bacteria *X. vesicatoria* and *R. solanacearum*. It was clear from the present results, that both methanol and chloroform leaves extracts of *C. odorata* posseses pronounced activity against all the tested four bacteria. The results show that the methanolic extract of *C. odorata* showed more inhibitory effect than the other plant extracts. This shows that the active ingredients of the plant parts are better extracted with methanol as compared to other solvents. The methanol extracts contain alkaloids, coumarins and tannin **[34]**. Coumarins and tannins have antibacterial and antihelminthic properties **[35]**, also **[36, 37]** found that methanol was more efficient than acetone in extracting phytochemicals from plant materials. The absence of antibacterial activity of chloroform, ethyl acetate and ethanolic extracts of *C. odorata* indicates the insolubility of the active ingredients in these solvents. In general the activities against tested bacterial culture used have shown good antibacterial activity when compared with standard antibiotics. In another research, dichloromethane and aqueous extracts from the leaves as well as ethyl acetate extracts from the flowers have shown antibacterial activity against *Staphylococcus aureus* **[38].** The minimum inhibitory concentration (MIC) for clinical bacteria was ranged between 0.35 to 4.0 mg/ml and 0.25 to 4.0 mg/ml for phytopathogenic bacteria when tested with all four solvent extracts of *C. Odorata*. Various investigators demonstrated that the extract of the leaves of *C. odorata* shows potential inhibitory activity at low concentration against (from 0.1 to 5 mg/ml) *Pseudomonas aeruginosa*, *E. coli, S. aureus and Neisseria gonorrhoea* **[39, 40]**. Chromolaena species (Asteraceae) have been chemically investigated; flavonoids and terpenoids are extensively reported in this genus **[41]**. The presence of these flavonoids in C. moritziana contributes to the observed antibacterial activity **[42]**. In the present investigation the antibacterial activity of *C. odorata* against phytopatho-genic bacteria

such as *Ralstonia solancearum* and *Xanthomonas vesicatoria* was reported. In case of human pathogenic *S. aureus*, maximum inhibition of 8 mm was obtained in aqueous extracts of A. indica. Similar observations were reported from nimbolide isolated from neem seed oil showing antibacterial activity against *S. aureus* and *Staphylococcus coagulase* **[43]**. Also antimicrobial effects of neem extract have been demonstrated against *Streptoco- ccus mutans and S. faecalis* **[45]**. These might be due to presence of triterpenoids, phenolic compounds, carotenoids, steroids, valavinoids, ketones and tetratriterpenoids azadirachtin (Kraus, 1995). **[45]** reported that *Rauvolfia tetraphylla* and *Physalis minima* leaf and callus extracted in chloroform were found to inhibit *E. coli* and *X. vesicatoria* at minimum inhibitory concentration (MIC) ranged between 0.25 to 6 mg/ml. Though, Parthenium hysterophorus is well known for its antimalarial **[46]** and antiamoebic **[48]** and allelopathic properties **[47]**, it failed to inhibit the tested bacteria except for *E. coli* where a fair to good inhibition was obtained. *C. odorata* methanolic extracts posseses a broad spectrum of activity against a panel bacteria responsible for the most common bacterial diseases. These primary extracts open the possibility of finding new clinically effective antibacterial compounds. C. odorata providing active extracts are found in different locations of Mysore and are well known plants as most of them are used for various medical purposes **[49]**. Continued further exploration of plant-derived antimicrobials is needed today. Further research is required to determine the antibacterial compounds from within these plants and also to determine their full spectrum of efficacy. However the present study of in vitro antibacterial evaluation of some plants forms a primary platform for further phytochemicals and pharmacological studies to discover new antibiotic drugs.

CONCLUSION

As we studied, we find that medicinal plants have antimicrobial properties so, we can use medicinal plants to made homeopathic medicines instead of allopathic drugs usually these are taken which may have side effects as homeopathic medicines are natural & don't have any side effects. So the conclusion the study is use of herbal medicines is much better as compared to allopathic drugs.

REFERENCES

[1] Jones RN. Microbial etiologies of hospital-acquired bacterial pneumonia and ventilator-associated bacterial

pneumonia. *Clin Infect Dis* 2010; **51**: 81– 87.

[2] Cilloniz C *et al*. Microbial etiology of pneumonia, epidemiology, diagnosis and resistance patterns. *Int J Mol Sci* 2016; **17**: 1– 18.

[3] Rabie H, Goussard P. Tuberculosis and pneumonia in HIV infected children: an overview. *Pneumonia* 2016; **8**: 1– 10.

[4] WHO. *Global tuberculosis control: Surveillance, planning and financing, WHO report*. Geneva, Switzerland: WHO, 2008

[5] Marais BJ, Pai M. Recent advances in the diagnosis of childhood tuberculosis. *Arch Dis Child.* 2007; **92**: 446– 452.

[6] Singh IP *et al*. Anti-HIV natural products. *Curr Sci* 2005; **89**: 269– 289.

[7] Amber R *et al*. A review on antiviral activity of the Himalayan medicinal plants traditionally used to treat bronchitis and related symptoms. *J Pharm Pharmacol* 2016; **69**: 1– 14.

[8] Sheng-Ji P. Ethnobotanical approaches of traditional medicine studies, some experiences from Asia. *Pharm Biol* 2001; **39**: 74– 79.

[9] Y. Chu, J. Sci. Food and Agricul. 80, 561 (2000).

doi:10.1002/(SICI)1097-0010(200004)80:53.0.CO;2-#

[10] H. Koleva, T. A. Van Beek, J. P. H. Linssen, A. de Groot, and L. N. Evstatieva, Phytochemical Analysis 13, 8 (2002). doi:10.1002/pca.611

[11] D. Mantle, F. Eddeb, and A. T. Pickering, J. Ethnopharmacol. 72, 47 (2000). doi:10.1016/S0378-8741(00)00199-9 11. J. M. Oke and M. O. Hamburger, African J. Biomed. Res. 5, 77 (2002).

[12] Y. Chu, J. Sci. Food and Agricul. 80, 561 (2000). doi:10.1002/(SICI)1097-0010(200004)80:53.0.CO;2-#

[13] H. Koleva, T. A. Van Beek, J. P. H. Linssen, A. de Groot, and L. A. Z. Almagboul, A. K. Bashir, A. Farouk, and A. K. M. Salih, Fitoterapia 56, 331 (1985).

[14] N. Evstatieva, Phytochemical Analysis 13, 8 (2002). doi:10.1002/pca.611

[15] D. Mantle, F. Eddeb, and A. T. Pickering, J. Ethnopharmacol. 72, 47 (2000). doi:10.1016/S0378-8741(00)00199-9

[16] J. M. Oke and M. O. Hamburger, African J. Biomed. Res. 5, 77 (2002).

[17] H. W. Boucher, G. H. Talbot, J. S. Bradley *et al*., "Bad bugs, no drugs: no ESKAPE! An update from the Infectious Diseases Society of America," *Clinical Infectious Diseases*, vol. 48, no. 1, pp. 1–12, 2009.

[18] H. W. Boucher, G. H. Talbot, J. S. Bradley *et al*., "Bad bugs, no drugs: no ESKAPE! An update from the Infectious Diseases Society of America," *Clinical Infectious Diseases*, vol. 48, no. 1, pp. 1–12, 2009.

[19] H. W. Boucher, G. H. Talbot, J. S. Bradley *et al*., "Bad bugs, no drugs: no ESKAPE! An update from the Infectious Diseases Society of America," *Clinical Infectious Diseases*, vol. 48, no. 1, pp. 1–12, 2009.

[20] M. P. Raghavendra, S. Satish, and K. A. Raveesha, "Phytochemical analysis and antibacterial activity of *Oxalis corniculata*; a known medicinal plant," *myScience*, vol. 1, no. 1, pp. 72–78, 2006.

[21] S. M. Mohan and B. Pandey, "Antimicrobial activity of Oxalis corniculata Linn," *International Journal of Science and Research*, vol. 5, no. 7, 2016.

[22] M. M. Cowan, "Plant products as antimicrobial agents," *Clinical Microbiology Reviews*, vol. 12, no. 4, pp. 564–582, 1999.

[23] W. Hassan, K. S. N. Zainab, H. Noreen, A. Riaz, and B. Zaman, "Antimicrobial activity of *Cinnamomum tamala* leaves," *Journal of Nutritional Disorders & Therapy*, vol. 6, no. 2, 2016.

[24] Q. S. Yan, J. Yang, H. M. Li *et al*., "Advances in the studies on the chemical components and bioactivity of *Eupatorium adenophorum Spreng* as an intruding species," *Journal of Beijing Normal University*, vol. 42, pp. 70–73, 2006

[25] Y. M. Li, Z. Y. Li, and M. Ye, "The chemical compositions and their bioactivities in the different parts of *eupatorium adenophorum spreng*," *Journal of Yunnan Agricultural University*, vol. 23, pp. 42–46, 2008.

[26] K. H. Kumar, M. Shanmugavadivu, R. R. Kumar, and S. Kuppsamy, "Antibacterial activity of leaf extracts of *Ageratina adenophora* L medicinal plants of Nilgiris Hill, Tamilnadu against human pathogens," *International Journal of Biosciences and Nanosciences*, vol. 1, no. 1, pp. 1–3, 2014.

[27] S. K. Hiremath, D. G. Kolume, and U. M. Muddapur, "Antimicrobial activity of *Artemisia vulgaris* Linn (Damanaka)," *International Journal of Research in Ayurveda & Pharmacy*, vol. 2, no. 6, pp. 1674-1675, 2011.

[28] A. Changhiz, M. Alireza, R. Ali, P. Mehrdad, and J. Behbood, "Antibacterial activity of methanolic extract and essence of Sagebrush (*Artemisia vulgaris*) against pathogenic

bacteria," *Bulletin of Environment, Pharmacology and Life Sciences*, vol. 3, no. 2, pp. 121–125, 2014.

[29] Dagawal, M.J. and D.S. Ghorpade (2011). Antimicrobial activity of an Ethnomedicinal Plant *Bidens pilosa* L. Int. J. Pharm. Sci. Res., 2(8): 22-

[30] Lawal, O.A., K.O. Amisu, S.K. Akinyemi, A.A. Sanni, M.B. Simelane, R.A. Mosa and A.R. Opoku (2015). In vitro antibacterial activity of aqueous extracts of *Bidens pilosa* L.(Asteraceae) from Nigeria. Microbiol. Res. J. Int., 525- 531.

[31] Akinsulire, O.R., I.E. Aibin, T. Adenipekun, T. Adelowotan and T. Odugbemi (2007). In vitro antimicrobial activity of crude extracts from plants *Bryophyllum pinnatum* and *Kalanchoe crenata*. Afr. J. Tradit Complem., 4(3): 338-344.

[32] Ganjewala, D., S. Sam and K.H. Khan (2009). Biochemical compositions and antibacterial activities of *Lantana camara* plants with yellow, lavender, red and white flowers. Eurasia J. Biosci., 3(1): 69-77.

[33] Okemo PO (1996). Antimicrobial efficacy of selected medicinal plants used by Kenyan Herbal doctors. Ph.D. thesis, Kenyatta University of Nairobi, pp. 173-90.

[34] Hedberg I, Hedberg O, Madati P, Mshigeni KE, Mshiu EN, Samuelsson G (1983). Inventory of plants used in traditional medicine in Tanzania. II. Plants of the family Dilleniaceae to Opiliaceae. J. Ethnopharm. 9: 105-128.

[35] Eloff JN (1998). Which extractan should be used for screening and isolation of antimicrobial components from plants. J. Ethnopharm. 60:1-8.

[36] Cowan MM (1999). Plant products as antimicrobial agents. Clin. Microbiol. Rev. 12: 564-582.

[37] Kameda K, Takaku T, Okuda H, Kamura Y, Hatano T, Agata T, Arichi S, (1987). Inhibitory effects of various flavonoids isolated from leaves of persimmon on angiotensin-converting enzyme activity. J. Nat. Prod. 50: 680-683.

[38] Irobi ON (1992). Activities of *Chromolaena odorata* (Compositae) leaf extract against *Pseudomonas aeruginosa* and *Streptococcus faecalis*. J. Ethanopharm. 37: 81-83.

[39] Caceres A, Menendez H, Mendez E, Cohobon BE, Samayoa E, Jauregui E, Peralta Carrillo G (1995). Antigonorrheal activity of plants used in Guatemala for the treatment of sexually transmitted diseases. J. Ethnopharm. 48(2): 85-88. Cowan MM (1999).

[40] Amaro-Luis JM, Delgado P (1993). Flavonoids from the leaves of *Chromolaena subscandens*. J. Nat.

Prod. 56: 610-612. Anonymous (1996). The Indian Pharmacopoeia. 3rd edition. Government of India, New Delhi. Ministry of Health and family welfare.

[41] Baez DH, de los Ryos C, Crescente O, Caserta A (1998). Antibacterial and chemical evaluation of *Chromolaena moritziana*. J. Ethnopharm. 59: 203-206.

[42] Nazma BSV, Rao JM (1977). Antifungal Activity of Gedunin. Curr. Sci. 46: 714-715.

[43] Almas K (1999). The antimicrobial effects of extracts of *Azadirachta indica* (Neem) and *Salvadora persica* (Arak) chewing sticks. Indian. J. Dent. Res. 10: 23-26.

[44] Shariff N, Sudarshana MS, Umesha S, Hariprasad P (2006). Antimicrobial activity of *Rauvolfia tetraphylla* and *Physalis minima* leaf and callus extracts. Afr. J. Biotech. 5(10): 946-950.

[45] Hopper M, Kirby GC, Kulkarni MM, Kulkarni SN, Nagasampagi BA, O'Neill MJ, Philipson JD, Rojatkar SR, Warhurst DC, (1990). Antimalarial activity of parthenin and its derivatives. Eur. J. Med. Chem. 25: 717-723. Irobi ON (1992).

[46] Kanchan SD (1975). Growth inhibitors from *P. hysterophorus*. Curr. Sci. 44: 358-361. Kapoor A (2001).

[47] Sharma GL, Bhutani KK (1998). Plant Based Antiamoebic Drugs; Part II. Amoebicidal Activity of Parthenin Isolated from Parthenium hysterophorus. Plant Med. 54: 120-121.

[48] Phan TT, Hughes MA, Cherry GW (2001). Effects of an aqueous extract from the leaves of *Chromolaena odorata* (Eupolin) on the proliferation of human keratinocytes and on their migration in an in vitro model of reepithelialization. Wound. Rep. Reg. 9: 305-313.