



Indian medicinal plants with potential antioxidant and anticancer properties: An insight

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Abstract

Plants are being used by Indian traditional healers for the treatment of various ailments including chronic disorders and diseases like cancer since historical age. Cancer is emerged as global threat during early 21st century and with the minimum or no side effects, plant derived herbal medicine is supposed to be the best for its treatment. Further, plant derived drugs are gaining increasing focus and playing vital role in routine healthcare systems and international trade. Medicinal plants with antioxidant and anticancer properties are still in use by various tribal communities and administered by traditional herbal healers and Vaidos. However, as the knowledge of traditional medicine is transferred from one generation to another generation orally, there is an unseen threat of its further long term existence. Secondly, due to rapid rate of deforestation, there are chances of extinction of some medicinally important plants. Thus, there is urgent need of documentation of these plants so that they can be conserved and used for the human healthcare. The present review is focused on the documentation of research on medicinal plants with antioxidant and anticancer properties from Indian subcontinent and further substantial advancement in obtaining drug molecules from these plants.

Keywords: antioxidant, anticancer, medicinal plants, traditional healers

Introduction

Cancer is a disease complex with more than 100 distinct disorders, involving abnormal cell growth which can invade or spread to other body parts and results in their dysfunction. It is considered as world's second largest killer after cardiovascular disease [1]. In the world census of cancer, 2015, about 90.5 million people were diagnosed with cancer and 14.1 million new cases every coming year. In 2015, 8.8 million deaths occur due to various type of cancer (GBD 2015 Disease and Injury Incidence and Prevalence Collaborators, 2016) [2]. As per data on cancer scenario in India over 8 lakh new cases and 5.5 lakh deaths occur every year in India [3].

Cancer and related disorders are, therefore, the prime focus of the medical field world over. For the time being cancer treatment is based on surgery, radiotherapy and drug therapy. This complex approach is capable of curing approximately half of the cancer patients. While the other half of the affected individuals may have only prolonged survival or even no benefit at all from the treatment [4]. However, the modern allopathic medicines might have certain side effects; therefore, plant based herbal treatment is considered as the best option to treat this complex disease.

Systemic study of cancer since early 20th century, it was confirmed that cancer may affect people of all ages, but risk was observed to increase with increasing age, due to the fact that aging DNA is more prone to damages. More than 63% cancer patients are over 65 years. Statistics indicate that men are largely plagued by lung, colon, rectum, and prostate cancer, whilst women increasingly suffer from breast, colon, rectal, and stomach cancer. In 2012, about 165,000 children below 15 years of age were diagnosed with cancer [5] and the probable reason for it was stated as changing life style and eating habits [6]. Similar case study was reported by White *et al* [7] from UK.

Despite many therapeutic advances in the understanding of the processes in carcinogenesis, overall mortality statistics are unlikely to change until, it is believed, there is a reorientation of the concepts for the use of natural products like herbal antioxidants and anticancer products as new chemo-preventive agents [8]. Plant derived herbal compounds used in medicine are mostly secondary metabolites with diverse structure and properties. These plants and plant products are playing vital role in routine healthcare systems of mankind worldwide [9]. The plants or plant compounds used as antioxidants and as anticancer agents are largely phenols or their derivatives. Even though there are number of synthetic antioxidants and anticancer drugs available in the market, a large number of bio-scientists working in the field of medicine and pharmaceuticals are searching for effective naturally occurring substitutes that would prevent, slowed down or reverse the development of these chronic disorders as they are considered as safer than synthetic drugs.

Scenario of plant derived antioxidants and anticancer agents

Recent findings suggested that most of the diseases and disorders in current era are due to oxidative stress that resulted from imbalance formation and neutralization of pro-oxidants. Oxidative stress is initiated by free radicals which tend to become stable by pairing with biomolecules in the body like proteins, lipids and nucleic acids leading their damage. These changes contribute more in the development of several diseases and disorders including different types of cancers [10]. Oxidative stress is closely related to cancer from carcinogenesis to tumor bearing state [11].

Traditionally, the herbal medicines are administered as whole plant or plant parts juices, extracts, decoctions, infusions for oral and oils and pastes for external application. The traditional healers might use these plants or plant products

alone or in combination with other plants material (polyherbal formulations) or material of inorganic or organic origin [12]. However, herbal drug development was found to be less flourished as compare to modern synthetic drugs, mainly because of the lack of scientific documentation in this field [13]. This review is an attempt to report the information gathered from earlier studies on Indian plants used as source of antioxidant and anticancer properties and proposed as probable anticancer drug candidates with their active ingredients. The reviewed literature was compiled in table 1 and table 2 showing the anticancer plants with their active ingredients and medicinal plants explored for their antioxidant and anticancer properties respectively.

Discussion and Conclusion

The plant based herbal drugs are most suited, safe, cost affordable and feasible approach for prevention and treatment of some chronic human disorders including cancer. However, there is no direct evidence that the herbal remedy alone could cure the cancer, but few of the medicinal plant showed antioxidant and anticancer properties, those could be further explore to obtain the active ingredients against this. Earlier Newman et. al., [14] reviewed the natural products as source of new drugs over the period of 1981-2002. Patel et. al., [15] screened some medicinal plants from Western Ghat of India for their antioxidant potential. In 2011, Nipun et al., [16] demonstrated the anticancer property of *Dendrophthoe falcata* a parasitic plant against carcinoma. In the same year Sakarkar and Deshmukh presented an account of traditional medicinal plants for anticancer activity. Later Shaikh et al. [17] evaluated anticancer, antioxidant and possible anti-inflammatory activities of some Indian traditional medicinal

plants. Allabakasha et al. [18] screened some Indian medicinal plants against breast, ovary and colon cancer cell lines. The scenario during recent past indicated that, the traditional knowledge regarding herbal treatment of various ailments which is supposed to be the backbone of Indian healthcare system is rapidly vanishing and is therefore urgent to document this ethnic wealth. Further, only a fraction of the explored knowledge regarding antioxidant and anticancer plants is converted into final product. Thus, it needs more serious scientific efforts to increase this productivity in this system to find our more drug candidate molecules so that, the herbal formulations would be easily available to needy peoples at affordable cost. The present article reviewed the progress made by Indian researchers in this sector so far.

In the current review bioactive compounds having effective antioxidant and anticancer potential isolated from different medicinal plants were presented (table-1). All these reports were in connection with Indian medicinal plants. Most of these isolated compounds are being used in modern medicines as antioxidant/ anticancer agents. Further table 2 represents the plants where their aqueous or organic extracts showed antioxidant or anticancer activities. Most of these were not analyzed in details to obtain the actual drug molecules from these plants. From the current analysis, it is clear that, phenolics, flavonoids, alkaloids, diterpenes, tannins and lactones from the plants are active against different disorders of cancer. Being multiple disorders complex, and rapid increase in number of cancerous patients, it is necessary to identify the alternative plant sources with high potential to prevent or/ and cure this deadly disease. It will also help to increase the list of antioxidant and anticancer agents of plant origin.

Table 1: Anticancer plants with their active ingredients (class) explored from India.

Sr. No.	Botanical Name of Plant	Family	Active ingredients (Class)	Reference
1	<i>Aegle marmelos</i> L.	Rutaceae	Lupiol (Triterpene)	[19]
2	<i>Allium cepa</i> L.	Liliaceae	Alicin, Alliin, quercetin, (Flavonoids); Vit. C & E.	[20]
3	<i>Allium sativum</i> L.	Liliaceae	Allicin, Alliin, diallyltrisulphate and methyl- allyltrisulphate (Flavonoids)	[21]
4	<i>Aloe barbadensis</i> Mill.	Liliaceae	Aloe-emodin, emodin, aloin acemannan, (Antraquinone glycosides)	[22]
5	<i>Andrographis paniculata</i> (Burm.f.) Wall ex. Nees	Acanthaceae	Andrographolide (Diterpene)	[20 & 23]
	<i>Anisomeles indica</i> L.	Lamiaceae	Apigenin, Ovatodioidide, quercetin, methylgallate. (Polyphenols)	[24]
6	<i>Annona squamosa</i> L.	Annonaceae	Acetogenin (Alkaloid)	[20 & 25]
7	<i>Azadirachta indica</i> Nees	Meliaceae	Liminoids, limbolide, (Triterpenoids)	[20]
8	<i>Catharanthus roseus</i> (L.) G. Don.	Apocynaceae	Vinblastine, Vincristine, Alstonine, Ajmalicine and Reserpine. (Alkaloids)	[26]
9	<i>Cleistanthus collinus</i> L.	Euphorbiaceae	Cleistanthin, Collinusin (Lignan)	[27]
10	<i>Colchicum luteum</i> L.	Liliaceae	Colchicines, demecolcine (Alkaloids)	[28]
11	<i>Curcuma longa</i> L.	Zingiberaceae	Tumerone, curcumine, (Phenolics)	[29, 30]
12	<i>Dysoxylum binectariferum</i> Hook. F.	Meliaceae	Rohitukine (Alkaloid)	[31]
13	<i>Embilica officinalis</i> Gaertn.	Euphorbiaceae	Ellagic acid, gallic acid, quercetin, emblicannins A and B (Tannins & Flavonoids)	[32]
14	<i>Elsholtzia communis</i> (Coll. and Hemsl.)	Lamiaceae	Phenolics and Flavonoid	[33]
15	<i>Fagopyrum esculentum</i> Moench	Polygonaceae	Amygdalin, Rutin (Tannin, flavonoid)	[34]
16	<i>Glycine max</i> (L.) Merr.	Fabaceae	Isoflavones, phytosterols, saponins & vitamins	[35]
17	<i>Justicia simplex</i> . D. Don.	Acanthaceae	Justicidin A, B (Lignans)	[36]
18	<i>Linum usitatissimum</i> L.	Linaceae	Cynogenetic glycosides, Lignans	[37]
18	<i>Mentha</i> species	Lamiaceae	Monoterpene ketones	[38]
19	<i>Morinda citrifolia</i> L.	Rubiaceae	Anthraquinones	[38]
20	<i>Nigella sativa</i> L.	Ranunculaceae	Thymoquinone, dithymoquinone	[20]

21	<i>Nothapodytes nimmoniana</i> L. (Graham)	Icacinaceae	Camptothecine	[39]
22	<i>Ocimum sanctum</i> L.	Lamiaceae	Eugenol, orientin and vicenin (Phenolics)	[20]
23	<i>Perilla frutescens</i> L.	Lamiaceae	Phenolics and Flavonoids	[33]
24	<i>Podophyllum emodii</i> L.	Berberidaceae	Epipodophyllotoxin (Alkaloid)	[40]
25	<i>Podophyllum hexandrum</i> L.	Berberidaceae	Podophyllin, Astragaline (Alkaloids)	[41]
26	<i>Psoralea corylifolia</i> L.	Fabaceae	Bavachinin and psoralen, psoralidin (Coumarins, Flavonoids)	[20 & 42]
27	<i>Rubia cordifolia</i> L.	Rubiaceae	Rubidianin, rubiadin, rosemary acids, purpurin, alizarin, xanthopurpurin (Anthraquinones)	[43]
28	<i>Salvia plebeia</i> R. Br.	Lamiaceae	Vanillic acid, Hispidulin, Naringinin (Phenolics)	[44]
29	<i>Solanum nigrum</i> L.	Solanaceae	Solamargine, solasonine, solanin, quercetin (Alkaloids, flavonoids)	[45]
30	<i>Taxus wallichiana</i> Zucc.	Taxaceae	Taxanes, taxol cephalomannine (Sesquiterpenes)	[46]
31	<i>Tinospora cardifolia</i> (Willd)	Menispermaceae	Berberine, Giloin, Tinosporin (Diterpenes)	[47]
32	<i>Withania somnifera</i> (L.) Dunal.	Solanaceae	Withanolides, Withaferin (Alkaloid, Lactones)	[48, 49, 50]
33	<i>Zingiber officinale</i> Roscoe.	Zingiberaceae	Curcumin, gingerenoneA, Gingeols, shogaols, zingerone	[51]

Table 2: Medicinal plants explored from India for antioxidant and anticancer properties

Sr. No.	Botanical Name of Plant	Family	Plant part extract	Reference
1	<i>Acacia catechu</i> (L. f.) Willd.	Mimosaceae	Methanol extract	[52]
2	<i>Achyranthes aspera</i> L.	Amaranthaceae	Leaf extracts	[53]
3	<i>Achyranthes aspera</i> L.	Amaranthaceae	Root extract	[54]
4	<i>Acorus calamus</i> L.	Araceae	Stem/ rhizome extract	[55]
5	<i>Adenantha pavonia</i> L.	Fabaceae	Methanol extract	[52]
6	<i>Albizia amara</i> (Roxb.) Bolv.	Fabaceae	Leaf extracts	[56]
7	<i>Allium cepa</i> L.	Liliaceae	Aqueous plant extract	[57]
8	<i>Allium sativum</i> L.	Liliaceae	Aqueous plant extract	[57]
9	<i>Allium wallichii</i> L.	Liliaceae	Whole plant extract	[58]
10	<i>Annona squamosa</i> L.	Annonaceae	Ethanol extract	[59]
11	<i>Bacopa monnieri</i> (L.) Pennell	Plantaginaceae	Ethanol whole plant extract	[60]
12	<i>Biophytum sensitivum</i> (L.) DC.	Oxalidaceae	Whole plant extract	[61]
13	<i>Capparis divaricata</i> Lam.	Capparaceae	Ethanol leaf extract	[62]
14	<i>Cassia auriculata</i> (L) Roxb.	Cesaliniaceae	Leaf extracts	[56]
15	<i>Cassia fistula</i> L.	Cesaliniaceae	Leaf extracts	[56]
16	<i>Curcuma zedoaria</i> (Christm.) Roscoe	Zingiberaceae	Rhizome Aqueous extract	[18]
17	<i>Datura stramonium</i> L.	Solanaceae	Leaf extracts	[56]
18	<i>Gloriosa superba</i> L.	Cochlicaceae	Rhizome Aqueous extract	[18]
19	<i>Gmelina arborea</i> Roxb.	Lamiaceae	Leaf extract	[15]
20	<i>Helicteris isora</i> L.	Sterculaceae	Organic extracts	[17]
21	<i>Hemidesmus indicus</i> (L.) R. Br.	Apocynaceae	Stem extract	[55]
22	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	Methanolic leaf extract	[63]
23	<i>Holarrhena antidysenterica</i> L.	Apocynaceae	Rhizome extract	[55]
24	<i>Holoptelea integrifolia</i> (Roxb) Planch	Ulmaceae	Methanol extract	[52]
25	<i>Hygrophilla spinosa</i> T. Anders.	Acanthaceae	Leaf extract	[64]
26	<i>Hypochaeris radicata</i> L.	Asteraceae	Methanolic leaf & root extract as	[65]
27	<i>Kigellia pinnata</i> L.	Bignoniaceae	Stem extract	[15]
28	<i>Lavandula bipinnata</i> L.	Lamiaceae	Organic extracts	[17]
29	<i>Leea indica</i> (Burm. f.) Merr.	Vitaceae	Ethanol & Methanol leaf extract	[66]
30	<i>Merremia gangetica</i> Dennst. Ex. Endl.	Convolvulaceae	Ethanol extract of areal part	[67]
31	<i>Plumbago zeylanica</i> L.	Plumbaginaceae	Root extract	[55]
32	<i>Rumex vesicarius</i> Linn	Polygonaceae	Ethanol and ethyl acetate leaf extract	[68]
33	<i>Soymida fimbriifuga</i> Roxb.	Miliaceae	Organic extracts	[17]
34	<i>Symplocos racemosa</i> Roxb.	Symplocaceae	Ethanol and ethyl acetate leaf extract	[68]
35	<i>Terminalia chebula</i> L.	Combretaceae	Nanoparticles	[69]
36	<i>Terminalia paniculata</i> Roth	Combretaceae	Ethanol extract	[52]
37	<i>Tinospora cordifolia</i> (Wild) Miers	Menispermaceae	Organic extracts	[17]
38	<i>Vitex negundo</i> L.	Verbanaceae	Ethanol leaf extract	[70]
39	<i>Withania somnifera</i> (L.) Dunal.	Solanaceae	Leaves, stem and root extracts	[71]
40	<i>Zanthoxylum alatum</i> L.	Rutaceae	Stem bark extract (Flavonoids)	[72]

References

- World Health Organization (WHO). Fight against cancer: strategies that prevent care and cure. http://who.int/cancer/publicat/whocancerbrochure2007.fina1web.pdf_2007
- GBD 2015 Disease and Injury Incidence and Prevalence Collaborators (2016). Global, regional and National incidence, prevalence and years lived with disability for 310 diseases and injuries, 1990-2015; a systematic analysis for the global burden on disease study, 2015. *Lancet*. 2016; 388(10053):1545-1602
- Ruckmani A, Geetha L, Madhavi E. Current scenario of cancer clinical trials in India. 9th Indo-Global summit on Cancer therapy, 2-4 November 2015, Hyderabad, India, 2015.

4. Sandor E. Recent progress in the development of anticancer agents. *Current medicinal chemistry - anti-cancer agents*. 2002; 2:419-439.
5. World Health Organization (WHO). World cancer report, 2014. Chapter 1.1. ISBN 978-9283204299.
6. Jamal A, Bray F, Center MM, Ferley J, Ward E, Forman D. Global Cancer statistic. *Ca*. 2011; 61(2):69-90. Doi:10.3322/caac.20107. PMID 21296855.
7. White MC, Holman DM, Boehm JE, Peipins LA, Grossman M, Henley SJ. Age and Cancer risk, a potential modifiable relationship. *Am J Prev Med*. 2014; 46(301):S7-15.
8. Abdulla M, Gurber P. Role of diet in cancer prevention. *Biofactors*. 2000; 12:45-51
9. Wink M, Alfermann AW, Franke R, Wetterauer B, Distl M, Windhovel J *et al*. Sustainable bioproduction of phytochemicals by plant in vitro cultures; anticancer agents. *Plant Gen. Resources*. 2005; 3:90-100.
10. Braca A, Tommasi ND, Bari LD, Pizza C, Politi M, Morelli I. Antioxidant principles from *Bauhinia terapotensis*. *J Nat Prod*. 2001; 64:892-895.
11. Noda N, Wakasuki H. Cancer and oxidative stress. *Japan Medical Association J*. 2001; 44(12):535-539.
12. Boadu AA, Asase A. Documentation of herbal medicine used for the treatment and management of human diseases by some communities in Southern Ghana. *Evidence-based Compl Alt Med*. 2017: Doi: 10.1155/2017/3043061.
13. Kalimuthu K, Vijayakumar S, Senthilkumar R. Antimicrobial activity of the biodiesel plant *Jatropha curcas*. *Int J Pharm Bio Sci*. 2010; 1(3):1-5.
14. Newman DJ, Cragg GM, Snader KM. Natural products as sources of new drugs over the period 1981-2002. *J Nat Prod*. 2003; 66:1022-1037.
15. Patel VR, Patel PR, Sushil SK. Antioxidant Activity of Some Selected Medicinal Plants in Western Region of India. *Adv Biol Res*. 2010; 4(1):23-26.
16. Nipun D, Vijay S, Jaykumar B, Kirti SP, Richard L. Antitumor activity of *Dendrophthoe falcata* against ehrlich ascites carcinoma in swiss albino mice. *Pharmaceut Crops*. 2011; 2:1-7.
17. Shaikh R, Pund M, Dawane A, Sayyed I. Evaluation of anticancer, antioxidant and possible anti-inflammatory properties of selected medicinal plants used in Indian traditional medication. *J Trad Compl Med*. 2014; 4(4):253-257.
18. Allabakasha MS, Shrivastava B, Apte KG, Parab PB, Sharma P, Navale SD *et al*. *In vitro* screening of some medicinal plants on breast, ovary and colon cancer cell lines. *Int J Pharm Bio Sci*. 2016; 7(2):11-17
19. Chockalingam V, Kadali SDVS, Gnanasambantham P. Antiproliferative and antioxidant activity of *Aegle marmelos* (Linn) leaves in Dalton's lymphoma ascites transplanted mice. *Indian J Pharmacol*. 2012; 44(2):225-229.
20. Pandey G. Some important anticancer herbs: a review. *Int Res J Pharma*. 2011; 2(7):45-50.
21. Nema R, Khare S, Pradhan A. Anticancer activity of *Allium sativum* (bulb) polyphenolic compounds. *Int J Pharma Rev Res*. 2014; 29(1):131-134.
22. Agrawal RC, Pandey S. Evaluation of Anticarcinogenic Activity of herbal Medicinal Plant *Aloe vera* in Swiss albino mice. *International Journal of Scientific and Research Publications*. 2013; 3(2):1-6.
23. Kumar RA. Anticancer and immunostimulatory compounds from *Andrographis paniculata*, *Journal of Ethnopharmacology*. 2014; 92(2, 3):291.
24. Baranwal VK, Irchhaiya R, Singh S. *Anisomeles indica*: an overview. *Int J Pharmacy*. 2012; 3(1):84-87.
25. Neha P, Dushyant B. Phytochemical and pharmacological review on *Annona squamosa* Linn. *Int J Res Pharmaceut Biomed Sci*. 2011; 2(4):404-412.
26. Arora R, Malhotra P, Mathur AK, Mathur A, Govil CM, Ahuja PS. Anticancer Alkaloids of *Catharanthus roseus*: Transition from Traditional to Modern Medicine. Chapter 21 in *Herbal Medicine: a chemopreventive and therapeutic perspective*, 2009.
27. Thirupati K, Krishna DR, Mohan GK, Mallaiah GK. Anticancer activity of *Cleistanthus collinus*. *Bio Med Rx*. 2013; 1(4):392-396.
28. Sakarkar DM, Deshmukh VN. Ethnopharmacological review of traditional medicinal plants for anticancer activity. *Int J Pharmatech Res*. 2011; 3(1):298-308.
29. Bhide SV, Nagabhushan M. Curcumin as an inhibitor of cancer. *J Am Coll Nutr*. 1992; 11:192-198
30. Donipati P, Sreeramulu SH. *In vitro* Anticancer Activity of *Curcuma longa* against Human Breast Cancer Cell Line MCF-7. *J Pharm Pharm Sci*, 2015; 4(11):1188-93.
31. Patel MK, Nambiar S, Vaidyanathan P, Bheemahally TR, Gudasalamani R, Kotiganahalli NG *et al*. *Dysoxylum binectariferum* Hook. F. (Meliaceae), a rich source of Rohitukine. *Fitoterapia*. 2010; 81:145-148.
32. Bhandari PR, Kamdod MA. *Emblca officinalis* (Amla): A review of potential therapeutic applications. *Int J Green Pharm*. 2012; 6:257-69
33. Khomdram SD, Singh PK. Polyphenolic Compounds and Free Radical Scavenging Activity in Eight Lamiaceae Herbs of Manipur. *Not Sci Biol*. 2011; 3(02):108-113.
34. Ratan P, Kothiyal P. *Fagopyrum esculentum* Moench (Common buckwheat) edible plant of Himalayas: A review. *Asian J Pharma Life Sci*. 2011; 1(4):426-442.
35. Sutar AC, Banavalikar MM, Biyani MK. Pharmacological activities of Genestein, an isoflavone from soy (*Glycine max*): Part-I- anticancer activity. *Indian J Expt Biol*. 2001; 39(6):511-519.
36. Joseph L, Shrinivasan KK. Promising anticancer activities of *Justicia simplex* D. Don. In cellular and animal model. *J Ethnopharmac*. 2017; 199:231-239.
37. Prasad K. Antioxidant activity of secoisolariciresinol diglucoside- derived metabolites, secoisolariciresinol, enterodiol and enterolactone. *Int J Angiol*. 2000; 9:220-225.
38. Sharma V, Hussain S, Gupta M, Saxena AK. *In vitro* anticancer activity of extract of menthe spp. against human cancer cells. *Indian J Biochem Biophys*. 2014; 51(5):416-419.
39. Patil A, Patil S, Mahure S, Kale A. UV, FTIR, HPLC Confirmation of Camptothecin an Anticancer Metabolite from Bark Extract of *Nothapodytes nimmoniana* (J. Graham). *Am J Ethnomed*. 2014;1(3):174-185
40. Damayanthi Y, Lown JW. Podophyllotoxins: Current status and recent developments. *Curr Med Chem*. 1998; 5:205-252.
41. Giri A, Narasu ML. Production of podophyllotoxin from *Podophyllum hexandrum*: a potential natural product for clinically useful anticancer drugs. *Cytotechnol*. 2000; 34(1, 2):17-26.

42. Khushboo PS, Jadhav VM, Kadam VJ, Sathe NS. *Psoralea corylifolia* Linn- Kustanashini. Pharmacognoc Rev. 2010; 4(7):69-76.
43. Patel PR, Ravel BP, Karanth HA, Patel VR. Potent antitumor activity of *Rubia cordifolia*. International J Phytomedicine. 2010; 2:44-46
44. Shirsat RP, Suradkar SS, Koche DK. Some phenolic compounds from *Salvia pleabeia* R. Br. Bioscience Discovery. 2012; 3(1):61-63.
45. Patel A, Biswas S, Shoja MH, Ramalingayya GV, Nandakumar K. Protective effects of aqueous extracts of *Solanum nigrum* Linn. Leaves in rat model of oral mucositis. Sci World J, 2014. doi: 10.1155/2014/345939
46. Chattopadhyay SK, Kumar TR, Maulike PR. Absolute configuration and anticancer activity of taxiresinol and related lignans of *Taxus wallichiana*. Bloorg Med Chem. 2003; 11(23):4945-4948.
47. Singh N, Singh SM, Shrivastava P. Effect of *Tinospora cordifolia* on the antitumor activity of tumor associated macrophages- derived dendritic cells. Immunopharmacol. Immunotoxicol. 2005; 27(1):1-14.
48. Singh N, Singh SP, Nath R. Prevention of urethane-induced lung adenomas by *Withania somnifera* (L.) Dunal in albino mice. Int J Crude Drug Res. 1986; 24:90.
49. Gupta YK, Sharma SS, Rai K, Katiyar CK. Reversal of paclitaxel induced neutropenia by *Withania somnifera* in mice. Indian J Physiol & Pharmacol. 2001; 45(2):253.
50. Nema R, Khare S, Jain P. Anticancer activity of *Withania somnifera* (leaves) flavonoids compound. Int. J. Pharm. Sci. Rev. Res. 2013; 19(1):103-106.
51. Katiyar SK, Agarwal R, Mukhtar H. Inhibition of tumor promotion in sencar mouse skin by ethanol extract of *Zingiber officinale* rhizome. Cancer Res. 1996; 56(5):1023-1030.
52. Rayasandra UA, Devihalli CM, Sreerange Gowda T, Kiragandur M. Antioxidant properties of some selected Indian medicinal plants: Their correlation with total phenolic content. Int J Green Pharma. 2013; 7(2):117-121.
53. Babule BB, Mahajan RP, More DH. Antioxidant activity of wood and leaf extracts of *Achyranthes aspera* using radical scavenging method. Int J Chem Sci. 2017; 15(04).
54. Singh S, Verma S, Singh S. In-vitro anticancer activity of *Achyranthus aspera* root extract against different human cancer cell lines, Int. J Biol Sci. 2017; 5(1):119-122.
55. Maryam Z, Farrukh A, Iqbal A. The *in vitro* antioxidant activity and total phenolic content of the four Indian medicinal plants. Int J Pharm and Pharmaceu Sci. 2009; 1(1):88-95.
56. Kumar S, Jawaid T, Dubey SD. Therapeutic plants of Ayurveda; A review on anticancer. Pharmacognosy J. 2011; 3(23):1-11.
57. Shrivastava S, Ganesh N. Tumor inhibition and Cytotoxicity assay by aqueous extract of onion (*Allium cepa*) & Garlic (*Allium sativum*): an *in-vitro* analysis. Int J Phytomed 2010; 2:80-84.
58. Bhandari J, Muhammad B, Thapa P, Shreshta BG. Study of phytochemicals, antimicrobial, antioxidant and anticancer properties of *Allium wallachi*. BMC Compl Altern Med. 2017; 17(1):102.
59. Veerakumar S, Safreen SDA, Ramanathan K. Anticancer efficacy of ethanolic extract from various parts of *Annona squamosa* on MCF-7 cell line. J Pharmacog Phytoter. 2016; 8(7):147-154.
60. Patil A, Vadera K, Patil D, Phatak A, Juvekar A, Chandra N. *In vitro* anticancer activity and phytochemical analysis of *Bacopa monnieri* (L.) Wettst. Int J Pharm Sci Res. 2014; 5(10):4432-4438.
61. Guruvayoorappan C, Kuttan G. Immunomodulatory and antitumor activity of *Biophytum sensitivum* extract. Asian Pac J Cancer Prev. 2007; 8:27-32.
62. Hirave RV, Kondawar MS. Anticancer activity of *Capparis divaricata* Lam. Leaves. Int Res J Pharm. 2016; 7(8):13-15.
63. Garg D, Shaikh A, Muley A, Marar T. In-vitro antioxidant activity and phytochemical analysis in extracts of *Hibiscus rosa-sinensis* stem and leaves. Free Radicals and Antioxidants. 2012; 2(3):41-46.
64. Muzumder UJ, Gupta M, Maiti S, Mukherjee M. Antitumor activity of *Hygrophilla spinosa* in Ehrlich ascites carcinoma and sarcoma-180 induced mice. Indian J Exp Biol. 1997; 35:473-477.
65. Jamuna S, Paulsamy S, Karthika K. Screening of *in vitro* antioxidant activity of methanolic leaf and root extracts of *Hypochoeris radicata* L. (Asteraceae). J Appl Pharmaceutical Sci. 2012; 02(07):149-154.
66. Ghagane SC, Puranik SI, Kumbar VM, Nerli RB, Jalalpure SS, Hiremath MB *et al.* *In vitro* antioxidant anticancer activity of *Leea indica* leaf extracts on human prostrate cancer cell lines. Integr Med Res. 2017; 6(1):79-87.
67. Karnan R, Subramani K. Antioxidant properties of certain South Indian medicinal plants. J Med Plants Studies. 2015; 3(2):58-60.
68. Manure JY, Naikwade NS. Evaluation of anticancer activity of leaves of *Rumex vesicarius* Linn and *Symplocos racemosa* Roxb. by brine shrimp lethality and (3-(4,5-dimethylthiazol-2-yl)-2,5diphenyltetrazolium bromide) methods. Int J Green Pharma. 2017; 11(4):S742-S749.
69. Bupesh G, Manikanandan E, Thanigaiarul K, Magesh S. Enhanced antibacterial, anticancer activity from *Terminalia chebula* medicinal plant rapid extract by phytosynthesis of silver nanoparticles core-shell structures. J Nanomed Nanotech. 2016; 7(1):1000355. 13
70. Chitra V, Sharma S, Kayande N. Evaluation of anticancer activity of *Vitex negundo* in experimental animal: an *in vitro* and *in vivo* study. Int J PharmTech Res. 2009; 1(4):1485-1489.
71. Yadav B, Bajaj A, Saxena M, Saxena AK. *In vitro* anticancer activity of root, stem and leaves of *Withania somnifera* against various human cell lines. Indian J Pharm Sci. 2010; 72:659-663.
72. Mukhija M, Singh M, Dhar KL, Kalia AN. Cytotoxic and antioxidant activity of *Zanthoxylum alatum* stem bark and its flavonoid constituents. J Pharm Phytochem 2015; 4:86-88.