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Collection and Data-Mining of Bioactive Compounds with Cancer Treatment Properties with reference to Lamiaceae Family

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Abstract : Objective: A huge reservoir of bioactive compounds exists in many species of plants, only a small percentage of which have been examined and continued to be an important source of anticancer agents. Finding new phytochemical compounds with anticancer activity is important to design new drugs. Thus the present study attempted to mine bioactive compounds with anticancer activity from plants comes under lamiaceae family.
Methods: The bioactive compounds and their scientific details were mined from publically available phytochemical databases.
Results: Lamiaceae family comprises about3200 plant species, among them, 4 plant species were reported to possess cancer treatment activity. They were *Mentha spicata*, *Plectranthus amboinicus*, *Tectona grandis* and *Ocimum sanctum.* These plants were reported to contain 28 bioactive compounds with cancer treatment properties. The reported activities were anticancer, anticarcinogenic, antitumor and cancer preventive activity. The important and mostly studied phytochemical compounds were beta carotene, tannin, ascorbic acid and luteolin. The results of the present study may provide a foundation for designing new drug for cancer.
Conclusion: Findings and identification of these compounds from the lamiaceae plants may provide a platform for designing new drug to ascertain the cancer preventive and chemotherapeutic from the plants of lamiaceae family.
Keywords : Anticancer activity; Bioactive compounds; Lamiacea family.

1. Introduction

Cancer is considered one of the most common causes of mortality in worldwide.[1]Chemotherapy is a major treatment modality for cancer and various anticancer drugs like taxol, vincristine, adiramycin, 5-flurouracil, etoposide are used for the treatment[2]. However, most of the drugs used in cancer chemotherapy exhibit cell toxicity and can induce genotoxic, carcinogenic, teratogenic effects in non–tumor cells [3]. Thus, there is an urgent need to develop new anticancer agents with minimum side effects [4]. Currently, Phytotherapy has a vital role in the prevention and treatment of cancer. Further it receives more attention due to their availability, low cost and safe[5]. With advanced knowledge of molecular science and refinement in isolation and structure elucidation techniques, various anticancer herbs has been identified, which execute their therapeutic effect by inhibiting cancer-activating enzymes and hormones, stimulating DNA repair mechanism, promoting production of protective enzymes, inducing antioxidant action and enhancing immunity of the body [6]. These are mainly due to the presence of phytochemicals present in these plants which are classified as primary and secondary metabolites [7]. Phytochemical compounds derived from medicinal plants such as Beta carotene, Fibre, Tannin, Ascorbic acid, Limonene and Niacin have played an important role in the development

of several clinically useful anticancer agents [8]. Despite this encouraging preamble and the abundant literature describing the molecular mechanisms triggered by phytochemicals to inhibit cell growth and induce apoptosis in cancer cells, only a few of them entered clinical trials[9]. So the present study carried out to identify phytochemical compounds with cancer treatment potential from the plants of family Lamiaceae which would be helpful to lead clinical trial.

2. Methods

2.1. Data-mining of Bioactive Phytochemicals

In the present study, the bioactive phytochemicals which are having potential of cancer treatment and cancer prevention were manually mining from publically available phytochemical databases (Dr. Duke's phytochemistry and ethnobotanical database www.ars-grin.gov/duke).

2.2. Collection and Mining of Literatures of Phytoresources as Therapeutic Agents

The literatures related to anticancer, antitumor, cancer preventive activities of phytoresources were collected from publically available online sources. The full texts of peer-reviewed scientific publications in a variety of journal were manually mining from the Google scholar (http://scholar.google.co.in/) and pubmed (http://www.ncbi.nlm.nih.gov/pubmed). The set journal was selected to capture the greatest quantity of high-quality data in a cost, and time-effective manner. From each publication, details of the compounds tested, the assays performed and any target information for these assays were abstracted.

3. Result and Discussion

Totally, 28 bioactive compounds were identified as lead for anticancer drugs from 4 plant species viz., *Mentha spicata*, *Plectranthus amboinicus*, *Tectora grandis* and *Ocimum sanctum* which belonging to Lamiaceae family. Among these phytochemical compounds, 17 compounds possess antitumor activity, 12 compounds possess cancer preventive activity, 4 compounds possess anticancer activity and 2 chemical compounds possess cancer preventive activity (Table 1).

Table 1. List of phytochemical compounds present in 4 plant species and their anticancer, antitumor, cancer preventive activities and anticarcinogenic activity.

S.No	Anticancer	Antitumor	Cancer preventive	Anticarcinogenic
1	Beta-carotene	Alpha – humulene	Ascorbic acid	Diosmin
2	Ursolic acid	Apigenin	Chrysoeriol	Luteolin
3	Betulinic acid	Benzaldehyde	Fiber	-
4	Tannin	Beta- Carotene	Niacin	-
5		Betalonone	Oleanolic acid	-
6		Butyric acid	Riboflavin	-
7		Caryophyllene	Beta-sitosterol	-
8		Eugenol	Eugenol	-
9		Fiber	Eugenol-methylether	-
10		Geraniol	Linoleic acid	-
11		Limonene	Mucilage	-
12		Luteolin	Oleic acid	-
13		Oleanolic-acid		-
14		Ursolic acid		-
15		Vanillin		-
16		Betulinic acid		-
17		Betulin		-
Total No. of compounds	4	17	12	2

Table 2. Percent distributions of cancer treatment phytochemical compounds in 4 species of family Lamiaceae.

S.No	Plant species name	Total no of compounds	Percentage
1	*Mentha spicata*	16	57.14
2	*Plectranthus amboinicus*	8	28.57
3	*Tectora grandis*	2	7.14
4	*Ocimum sanctum*	9	32.14

3.1.Mentha spicata

Mentha spicata is a herbaceious perennial plant. In this plant totally 16 compounds were identified in different parts (Table 2). Among them, 15 compounds possess antitumor activity and 2 compounds possess anticarcinogenic activity. The compound luteolin has combined activity of antitumor and anticarcinogenic. Potent cytotoxic effect of 80% methanolic extract and chloroform fractions of *Mentha spicata* has been reported against HeLa, Hep-2 and PC-3 cancer cell lines [10-11]. Aqueous extract of *Mentha spicata* leaves has cytotoxic effects on mouse fibrosarcoma cell line (wehi-164) as well as human monocytic leukemia (U937) cells [12].

3.2.Plectranthus amboinicus

Plectranthus amboinicus is a large succulent herb. It is commonly called Indian borage. It has totally 8 compounds. Among them, Beta-carotene and Ursolic acid possess anticancer activity and other 6 phytochemical compounds possess cancer preventive activity. The extract of *plectanthus amboinicus* were exhibited cytotoxic activity on HeLa cell line [13]. The combination of ethyl acetate extract of *plectranthus amboinicus* with doxorubicin could increase the cell cycle arrest, inducing apoptotic and decrease cyclin D1 and cox-2 expressions [14].Ethanolic extract of *Plectranthus amboinicus* showed singnificant anticancer activity against MCF-7 cancer cell line [15].

3.3.Tectona grandis

Tectona grandis is a large, deciduous tree. It is commonly called teak. It has 2 phytochemical compounds (Betulinic acid and Betulin) with cancer treatment properties.Betulinic acid possesses anticancer and antitumor activity and Betulin possess antitumor activity. *Tecona grandis*extracts demonstrated highly significant activity against cancerous tumors in rats [16].

3.4.Ocimum sanctum

Ocimum sanctum is an erect, much branched medicinal herb. It is commonly called holy basil. It has 9 phytochemical compounds with cancer treatment properties. Among them, 7 phytochemical compounds possess cancer preventive activity and 2 phytochemical compounds like Beta- carotene and Tannin possess anticancer activity. Phytochemical compounds of *O. sanctum* such as Eugenol, Linoleic acid, β-sitosterol prevented skin, liver, oral and lung cancersby increasing the antioxidant activity, inducing apoptosis, altering the gene expression and inhibiting metastasis [17].

Several authors reported the anticancer activity of *O.* sanctum on various cell lines. Srideviet *al*(2016) reported that *O. sanctum* extract showed anticancer activity by decreasing cell proliferation, increasing intracellular ROS, alternation in mitochondrial membrane potential and apoptosis in NC1- H460 cell line.*O. sanctum* exhibited anticancer activity on fibrosarcoma cells[19]. Methanolic extract of *Ocimum sanctum* possess cancer preventive activities through reduction of excess amount of nitric oxide [20]. Ethanolic extract of basil leaves found to produce significance reduction in tumor incidence (Papillomas) in the skin of albino mice [21]. This similar activity was observed in eugenol, which isolated from holy basil [22].

Conclusion

Lamiacea family consisted of 4 plants with cancer treatment properties. Among the 4 plants, *M. spicata has* possessed 58% of cancer treatment phytocompounds, followed by *O. sanctum* possessed 32% of

phytocompounds. The potential anticancer properties of a few phytochemical compounds of lamiacea have been shown by both cell culture (*invitro*) and animal (*invivo*) studies. However, most of the compounds of this family have not been experimentally proved their anticancer activities.Thus, the findings of these compounds by the present study may provide a platform for designing new drug to ascertain the cancer preventive and chemotherapeutic from the plants of lamiaceae family.

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