Some Phytochemicals Found in Medicinal Plants Used in Cancer - A Review

Vimla Kumari*, Kamini Kaushal, Ashwini K Sharma, Rajesh Chandra Mishra and Pradeep Soni
Department of Dravyaguna, Madan Mohan Malviya Government Ayurvedic College, Udaipur, Rajasthan, India

Abstract

In the last few decades, phytochemicals have potentially gained an importance place in cancer research. The interests for these compounds have grown by researchers, as these compounds have natural in origin and hence, no stipulated side effects are known. Currently, thousands of natural herbs based compounds have been screened for their novel efficiency to control cancer cell proliferation. Among these, a large number of natural compounds gained high preventive and therapeutic values against cancer and most potential compounds along of the are lupeol, saponins, flavanoids, curcumin, resveratrol, geneistein, gingerol, allyl sulfide, berberine, lycopene, bromelain, indole-3-carbinol and polyphenols. The recent research on phytochemicals towards evaluating the anticancer efficacy has been accelerated by development of biophysical technologies. However, several challenges still persist in cancer research like heterogeneity, development of novel phenotypes in cancer cell by therapeutic drugs and tumour recurrence. These challenges open a new dimension for cancer research, and also give weightage to explore the uses of specific phytochemicals in therapy. This review summarizes the latest research in cancer treatment using the bioactive components from medicinal plants.

Keywords:
Phytochemical; Medicinal plants; Cancer; Cell proliferation

Introduction

Phytochemicals, also known as phytonutrients, are natural non-essential chemical compounds found in plants (phyto is a Greek word meaning "plant"). They can occur in vegetables, grains, legumes, beans, fruits, herbs, nuts, roots, leaves and seeds. Phytochemicals are compounds that give plants their color, flavor, and smell. These compounds are thought to be largely responsible for the medicinal properties and health benefits of medicinal herbs. Some protect against cancer when isolated, some are not associated with cancer at all, and many have yet to be discovered. It is known that many phytochemicals, when kept in their natural food forms, can protect us from cancer as they interact with other phytochemicals and the cells in our bodies. This chemical acts as an antioxidant similar to vitamins A, C, and E, and may help protect the body from free radicals. It is also possible that phytochemicals fights cancer by reacting with carcinogens and changing their structure so they can no longer initiate tumors or by speeding the death of cancer cells that have already formed [1-6].

Cancer is one of the most severe health problems in both developing and developed countries, worldwide. Among the most common (lung, stomach, colorectal, liver, breast) types of cancers, lung cancer has continued to be the most common cancer diagnosed in men and breast cancer is the most common cancer diagnosed in women. The International Agency for Research on Cancer estimates of the incidence of mortality and prevalence from major types of cancer, at national level, for 184 countries of the world revealed that there were 14.1 million new cancer cases, 8.2 million cancer deaths, and 32.6 million people living with cancer (within 5 years of diagnosis) in 2012 worldwide. By 2030, it is projected that there will be 26 million new cancer cases and 17 million cancer deaths per year [7-13].

Cancer remains to be one of the leading causes of death in the United States and around the world. The advent of modern drug-targeted therapies has undeniably improved cancer patients’ cares. However, advanced metastasized cancer remains untreatable.

Functions of Phytochemicals

- Stimulate the immune system.
- Block substances we eat, drink and breathe from becoming carcinogens.
- Slow the growth rate of cancer cells.
- Help to regulate hormones.
- Reduce the kind of oxidative damage to cells that can spark cancer.
- Prevent DNA damage and help with DNA repair.
- Trigger damaged cells to commit suicide before they can reproduce.

Medicinal plants have been always an important source for the discovery of new therapeutics for human diseases. These sources may be a good candidate for the development of novel anticancer agents. Medicinal plants have been studied for cancer, only a small number of them pass in vitro experiments and animal studies and are under clinical trials. Based our literature search, lupeol, saponins, flavanoids, curcumin, resveratrol, geneistein, gingerol, allyl sulfide, berberine, lycopene, bromelain, indole-3-carbinol had satisfactory instances of clinical evidence for supporting their anticancer effects (Table 1). Therefore, it seems that they can be used as a complementary

*Corresponding author: Dr. Vimla Kumari, Department of Dravyaguna, Madan Mohan Malviya Government Ayurvedic College, Udaipur, Rajasthan, India, Tel: 0636865749; E-mail: kumarivimla1990@gmail.com

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S No | Phytochemical | Pharmacological Activity | Effect in Cancers
--- | --- | --- | ---
1 | Lupeol/ triterpene/ Fagarsterol | Anti-inflammatory, Anti-proliferative, Anti-tumour, Chemopreventive, Anti-microbial, Anti-invasive | Tumorigenicity of Prostate, skin, pancreatic, head and neck squamous cell carcinoma
2 | Saponin | Anti-hyperlipidemic Anti-inflammatory, expectorant, immune stimulating activity, anti-cancer, anti-oxidative, anti-diabetic, hepato-protective | Colon, lung cancer
3 | Phytosterols |  |  
A | Stigmasterol | Anti-hyper cholesteromic, Cytoxicity, Anti-osteoarthritis, Hypoglycemic, Anti-tumour, Anti-inflammatory | Skin cancer
B | Campsterol | Anti-tumour, Anti-osteoarthritis, Hypoglycemic, Antioxidant, Anti-inflammatory, Anti-hypercholesteromic | Breast, colon, lung cancer
C | Beta-sitosterol | Immunomodulatory effects, Anticancer, anti-atherogenic, reduced symptoms of enlarged prostate | Prostate cancer
4 | Flavonoids |  |  
A | Flavanoids- flavone, Isoflavanoids | inhibit inflammation and tumor growth; may aid immunity and boost production of detoxifying enzymes in the body | Human oral, rectal, prostate, Lung, leukemia, stomach, thyroid, colon, laryngeal, breast, Colorectal, kidney
B | Luteolin | Anti-oxidative, anti-inflammatory, Anti-microbial, Anti-tumour, inhibition of cell proliferation, metastasis and angiogenesis | Breast, gastric, prostate cancer,  
C | Genistein | Estrogenic effect, Antioxidant, Anticancer, cardioprotective | Leukemia, lymphoma, ovarian, cervical, gastric, pancreatic, breast, prostate
D | Quercetin | inhibits cell proliferation Anti-inflammatory, analgesic, anti-allergic, anti-cancer, chemopreventive, anti-oxidative | Breast cancer
E | Epigallocatechin gallate | Anticancer, chemopreventive, Antiproliferative | Brain, prostate, cervical, bladder, colorectal cancer
5 | Piperine | Anti-irritant, anti-inflammatory, anti-tumour, | Breast, prostate cancer
6 | Diallyl sulphide | Anti-proliferative, preventing bone loss, Anti-cancer, hepatoprotective, immune stimulating, Anti-oxidative, Anti-hypercholesteromic, Antiinflammatory, detoxification, antibacterial | Skin cancer
7 | Gingerol | Anti-oxidative, anti-inflammatory, anti-tumouragenic | Colon, breast, ovarian pancreas
8 | Crocin | Inhibited cancer cell proliferation, antioxidant effects, chemopreventive | Liver lung, pancreatic, skin, colorectal, breast cancer
9 | Curcumin (Diferuloylmethane) | Induce apoptosis in cancer cells without cytotoxic effects on healthy cells, Anti-inflammatory, Antioxidant | Colon, breast, lung metastases, brain tumor, liver, leukemia
10 | Indole-3-carbinol (natural anti-carcinogen) | Supports healthy estrogen metabolism, Improve hormone balance and fat burning, Promotes liver detoxification, prevent cancer | Stomach, breast, colon, cervical, endometrial
11 | Lycopene | Preventing cancer and heart disease, Antioxidant | Prostate, breast, endometrial, colon
12 | Rosmarinic acid | Anti-oxidant and anti-inflammatory effects, protect against various forms of cancers | Colon, skin cancer
13 | Fisetin | Chemoprevention of cancer, anti-inflammatory, Antioxidant, Anti-carcinogenic | Colon cancer

Table 1: Anti-cancerous phytochemical and its activity.

S No | Phytochemical | Medicinal Plants
--- | --- | ---
1 | Lupeol/triterpene (also known as Fagarsterol) | Amorphophallus campanulatus, Ficus lacor, Belula utilis, Jasminum auriculatum, Mimusops elengi, Bluea lacera, Pterocarpus marsupium, Diospyros lotensis, Schleichera trijuga, Ricinus communis, Soymlida febrifuga, Grewia asiatica, Ficus racemosa, Hololhorna antidysenterica, Crateva curvata, Salmalia malabarica, Bauhinia purpurea, Emblica officinalis, Benincasa hispida, Winglinga tinctoria
2 | Saponin | Asparagus adscendens, Curculigo orchioides, Costus speciosus, Malletus philippensis, Madhuca longiflora, Trigonella foenum graecum, Lufia echinata, Sapindus trifoliatus, Althaea officinalis, Nigella sativa, Achyranthes aspera, Crateva curveta, Nigella sativa, Hemidesmus indicus, Randia spinosa, Scirpus kysoro, Citrullus colocynthis, Pongamia pinnata, Alternanthera sessilis, Callicarpa macrophylla, Cajanus cajan, Clerodendron serrula, Coccinia indica, Luffa acutangula, Phaseolus radiates, Borringtonia acutangula, Ficus hispida, Vernonia cinerea, Streblus asper, Bombax ceiba, Alizzia lebbeck, Lagenaria siceraria, Tamarindus indica, Musa paradisiaca, Buchanania vazica, Vitex negundo, Aegle marmelos, Azadirachta indica, Aconitum heterophylum, Tinospora cordifolia, Crataeva transvaal, Ficus hispida, Albizzia lebbeck, Terminalia bellerica, Benincasa hispida, Centella asiatica, Anethum sowa, Ficus racemosa, Dioscoera bulbifera, Accacia sumo, Careya arborea, Costus speciosus, Caesalpinia bonducum, Smilax china, Gymnema sylvestre, Caesalpinia cristosa, Trichosanthes bracteata, Tribulus terrestris
3 | Phytosterols |  
A | Stanugaster-an unsaturated phytosterol | Ananas comosus, Ficus racemosa, Ficus religiosa, Eupatorium triplinerve, Eclipta alba, Amorphophallus campanulatus, Eugenia prostrata, Accacia sumo, Smilax china, Azadirachta indica, Ocrophorcarus longifolius, Tribulus terrestris
B | Campestrol | Aerva Ionata, Linum usitatissimum, Polyalthia longifolia, Ochrcorpus longifolius, Allium sativum, Paspalum acrobiculatum, Ochrcorpus longifolius, Tribulus terrestris
C | Beta-sitosterol | Terminalia arjuna, Saraca asoca, Clerodendrum phlomidis, Gmelia arborea, Boerhavia diffusa, Piper longum, Ficus glomerata, Abies webbiana, Curcuma longa, Aloe vera, Asparagus racemosus, Cyperus rotundus, Piper retrofructom, Polyalthia longifolia, Sismbrum inio, Raphanus sativus, Gynandropis gynandrom, Althaea officinalis, Grewia tenax, Linum usitatissimum, Allium sativum, Boswellia serrata, Vitil vinifera, Crotalaria verrucosa, Ficus rumphii, Ficus hispida, Abies webbiana, Curcuma longa, Aloe vera, Asparagus racemosus, Cyperus rotundus, Piper retrofructom, Polyalthia longifolia, Sismbrum inio, Raphanus sativus, Gynandropis gynandrom, Althaea officinalis, Grewia tenax, Linum usitatissimum, Allium sativum, Boswellia serrata, Vitil vinifera, Crotalaria verrucosa, Ficus rumphii, Ficus racemosa, Hololhorna antidysenterica, Crateva curvata, Salmalia malabarica, Bauhinia purpurea, Emblica officinalis, Benincasa hispida, Winglinga tinctoria

Table 2: Medicinal Plants with Anti-cancerous Phytochemicals.
therapeutics along with current chemotherapy drugs against various types of cancer. Although a number of other phytochemicals could be also added to this list, it is better to remain until more clinical trials support their anticancer effect (Table 2).

Conclusion

In literary review, the potential anticancer phytochemicals and dietary agents, their molecular targets, and their mechanisms of actions have been discussed. The understanding of molecular mechanism of a specific plant derived compound against a particular type of cancer will lead to the invention of novel drug and drug targets for therapeutic intervention. Therefore, for many of phytochemicals, it is too early to drawing conclusion for their anticancer actions. Moreover, much remains to be learned about pharmacokinetics, drug interactions, ideal dosages, long-term safety and adverse effects of phytochemicals proposed for cancer treatment. On the other hand, fortunately molecular mechanisms responsible for anticancer effect of several medicinal plants have been revealed by in vitro studies. These mechanisms include antioxidant, carcinogen inactivation, anti-proliferation, cell cycle arrest, induction of apoptosis, and inhibition of angiogenesis or a combination of these mechanisms. It is believed that herbal preparations containing multiple phytochemicals may have greater effects than the same phytochemical taken separately. Based on this belief, combinations of the anticancer phytochemicals may have more effect and yield more potent therapeutic agents for cancer.

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