

Chapter 9

Plant-Derived Compounds for Breast Cancer Therapy

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ABSTRACT

Breast cancer is the most commonly diagnosed but one of the aggressive cancers among the females worldwide. The currently employed treatments for breast cancers are invasive, painful and suffer from high costs. Plant kingdom is a rich source of diverse groups of therapeutic compounds and drugs which can serve as cost effective and less toxic alternative for the breast cancer therapy. Traditionally, Chinese Traditional Medicine (CTM) and Ayurveda systems have mention of effectiveness of many herbal drugs and formulations in breast cancer therapy. The preclinical studies have pointed out towards less explored potential of phytochemicals in breast cancer chemoprevention and treatment. Plant derived compounds exhibit strong antioxidant, anti-inflammatory, immuno-modulatory and anti-angiogenic activities which may be efficiently targeted for breast cancer therapy.

Breast Cancer is one of the most frequently diagnosed and fatal malignancies among women worldwide. The incidences of breast cancer are striking at an alarming rate and have become a major cause of mortality and morbidity. The probable reasons are combination of intrinsic and extrinsic factors like age, lifestyle, genetics, carcinogens, oncogenic viruses and post-menopausal hormonal changes etc. (Lukasiewicz, 2021, p. 4287). The existing therapies available for breast cancer include chemotherapy, surgery and radiation therapy etc, which suffer from high treatment costs, adverse drug reactions, tumour recurrence and sometimes partial or total treatment failure (Masoud, 2017, pp. 120-134). The breast cancer management involve three types of care; i) Primary care involve steps taken towards the prevention of developing cancer. ii) Secondary care includes the prevention of the malignant transformation into metastatic breast cancer iii) Tertiary care includes management of the advanced stages of breast cancer. The scrutiny of previously published research literature revealed that phytochemicals have demonstrated promising anti-breast cancer potential in a variety of ways such as protecting normal cells entering into the cancerous phase, preventing carcinogenesis, inhibiting angiogenesis, and avoiding metastatic transformation, boosting immunity, halting tumor growth and in enhancing the output of conventional

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anti-breast-cancer therapies. This warrants the investigation of plant-derived compounds as an alternative medicine for the breast cancer therapy.

Natural products have dominated the anticancer drug discovery domain as the earlier discovery of leucovorin in 1950 while screening phytochemicals for the treatment of cancer opened new avenues. This landmark discovery was successfully followed by the development of novel anticancer drugs of plant origin, such as vincristine, vinblastine, paclitaxel, irinotecan and etoposide etc. The vinca alkaloids are the first natural candidate to enter as a drug into anticancer drug trials (Huang, 2017, pp. 5-13). Compared to systemic toxicity issues of cytotoxic anticancer drugs, phytochemicals because of their low toxicity and high potency have attracted researchers working in domain of anticancer drug development. Many phytochemicals and dietary chemicals such as curcumin (turmeric), quercetin (vegetables and fruits), lycopene (tomatoes), resveratrol (grapes), emodin (aloe vera), xanthones (mangosteen), eugenol (clove), flavonoids (vegetables and fruits), indole-3-carbinol (broccoli) etc. may be targeted for breast cancer therapy. (Calvani, 2020, pp. 1936) The clinical trial data has demonstrated that these bioactive natural compounds induce cancer chemoprevention by decreasing the number of tumour cells enhancing apoptosis by increasing the degree of necrosis, inducing early and delayed apoptosis and also reduce cancer antigen levels with low cytotoxicity. Additionally, a variety of naturally occurring powerful antioxidants occur in plants and herbal sources. As a result, preclinical evaluations of the antioxidant or ROS scavenger potential of plant-derived compounds or herbal extracts are used to mitigate the side effects of chemotherapy medications have been conducted. Recent studies on plant-derived compounds have displayed synergistic effects, and improvement in the efficacy of chemodrugs thereby widening the therapeutic window of the chemotherapeutic medications and lowering the multi-drug resistance are the two objectives of incorporating natural substances into breast cancer chemotherapies (George, 2021, pp. 1455). As a result of herb-drug interactions between chemotherapeutic drugs and the bioactive compound in herbal medicines, natural products including single pure compound, herbal extracts and compositions have been reported to minimize the side effects involved in chemotherapy (Talib, 2021, pp. 1353).

Plant-derived compounds exhibit a wide array of pharmacological activities such as anticancer, anti-inflammatory, antibacterial, and antioxidative properties etc. The compounds of natural origin on virtue of their small molecular weight, and unique chemical architectures could better target signalling pathways in breast cancer. Recent studies involving the incorporation of natural compounds such as curcumin, vitamins and minerals have shown promising results in improving the efficiency and lowering the toxicity of cancer chemotherapy (Dehelean, 2021, pp. 1109). To reduce the life-threatening side effects of chemotherapy, improve overall health, control illness symptoms, and boost immune system performance, a majority of breast cancer patients prefer to incorporate herbal medication as an adjuvant to chemotherapy. Breast cancer is a disease mainly related to the immune system. Many phytochemicals, like sterols, stilbenes polysaccharides, lignans, alkaloids, flavonoids, lectins and glycosides, are used as immunomodulatory agents (Shu-Yi, 2013, pp. 302426). They have the ability to bind to the sites of proteins responsible for immune response. The plant based bioactive compounds, nutraceuticals, dietary chemicals, from herbs and medicinal plants act on multiple biological targets thereby enriching efficacy and lowering drug resistance to cancer chemotherapeutics. Natural compounds act by disrupting the microtubules, inhibiting topoisomerase, blocking DNA synthesis, causing cell cycle arrest and inducing apoptosis (Wamidh, 2020, pp. 5319). Hence, it is crucial to enhance the investigation of novel mechanisms of action and clinical trials of plant-derived compounds in future studies, and to enhance its toxicological research in order to conduct a more extensive evaluation of the anti-breast cancer properties of phytochemicals.

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