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REVIEW ARTICLE

Hepatic Damage Associated with Breast Cancer: Dual Protective Role of the Medicinal Plants

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ABSTRACT

The liver is damaged in breast cancer, especially when it spreads. Furthermore, the pertinent cancer chemotherapy drugs are hepatotoxic as well. Some medicinal plants may be intriguing candidates for dual-acting remedies because of their concomitant hepatoprotective and anti-breast cancer qualities. A narrative review of recent research on these medicinally important plants is furnished in this article. In this regard, circumventing the extant shortcomings, effective plant-based natural therapeutics to prevent hepatic damage linked with breast malignancies may be developed ahead, if the potential of these medicinal plants and their constituents is further explored.

Keywords: Breast cancer, Liver, Toxicity, Medicinal plants

INTRODUCTION

Breast cancer is a malignancy, chiefly affecting women, caused by uncontrolled growing of breast cells, and can metastasize. Breast cancer is frequently linked to hepatic complications, which may be brought on by the tumor's metastatic progression to the liver or precipitated by the systemic usage of anti-breast cancer chemotherapeutic drugs. There are several clinical and pathological manifestations of liver metastases of breast cancers which are fatal. Briefly, when breast cancer cells reach the liver, they can disrupt typical liver functions precipitating hepatotoxicity. Impairments in hepatic functions may also be found in non-metastatic breast cancers. The reasons why breast cancer can occasionally manifest as a disease that is liver dominant or that involves the liver disorders mainly as a late event in the course of the disease are not still well understood[1-4].

Although there are a number of available systemic therapeutic regimens, the adjunct therapies, remains the cornerstone of treatment for hepatic metastases. Despite these therapies, liver metastasis from breast cancer is associated with a poor prognosis. Certain anti-breast cancer chemotherapeutic medications like methotrexate, tamoxifen, doxorubicin,anastrozole, letrozole, ribociclib, trastuzumab etc., or pre-existing liver conditions also may aggravate hepatic complications in breast cancers. In order to lower

their occurrence and enhance outcomes when they do occur, it is hoped that continued study into the processes and tropism of liver metastasis from breast cancer will lead to more targeted therapeutics[3, 5]. On the other hand, search of alternative/adjunct therapies would circumvent the problems with minimal negative effects. The medicinal plants, in this connection, historically can play a leading role.

Several studies in phytopharmacology have demonstrated that, the medicinal plants can have anti-hepatotoxic and anti-cancer effects on breast cancers. In order to find viable treatments for preventing the invasion and spread of breast cancer cells to the liver and to alleviate the chemotherapy-induced liver toxicity, this review article looks at scientific research on medicinal plants that have both hepatoprotective and anti-breast cancer properties. This review attempts to shed light on the concomitant potential of medicinal plants in this context by exploring and summarizing the published literature on medicinal plants. The objective of the present narrative review is to gather the primary knowledge to facilitate the development of dual-acting therapies against liver damage related to breast cancer.

METHOD

Inclusion criteria

An internet-based scrutiny of scientific literature was conducted by probing through an array of online bibliographic databases, including Google, Scholar Google, PubMed, Toxnet, Wiley, Web of Science, EMBASE and Science Direct; by using key words and phrases such as ‘medicinal plants’ (their common or botanical names) against ‘breast cancer’ ‘mammary carcinoma’ and ‘liver toxicity’, ‘liver diseases (hepatic cirrhosis, fibrosis, stasis, injury, damage)’, ‘hepato-toxicity’ or ‘hepatoprotective’, ‘antihepatotoxic’ in feasible combinations. This endeavour involved searching the full-text scientific research articles published online in peer-reviewed scientific journals during the last 25 years (2000 – 2025). The preclinical and clinical research on higher plants that were both effective against breast cancers and liver toxicity/diseases in animal system/tissues and were published in English was selected.

Exclusion criteria

The articles that were taken into consideration were those written exclusively in English. Articles that were not subjected to peer review but were hosted on particular web portals as pre-prints were excluded. Published but later retracted articles were also rejected. Grey literature was not considered. Current collation and discourse do not cover the use of medicinal plant combinations, used with other agents or tested in plant systems.

RESULTS AND DISCUSSION

The present study collates the scientific literature on medicinal plants that have concomitant hepatoprotective and anti-breast cancer effects. It was found that, 66 (sixty six) medicinal plant extracts, demonstrated preclinical evidence of effectiveness against both breast cancers and liver complications, based on the foregoing criteria. The exercise is summarised in Fig. 1. Table. 1 enumerates all of the information succinctly[6-202]. Newer such reports may continually appear in the scientific literature. Most of them are well-recognized traditional dietary/medicinal plants with several traditional and contemporary medicinal usage.

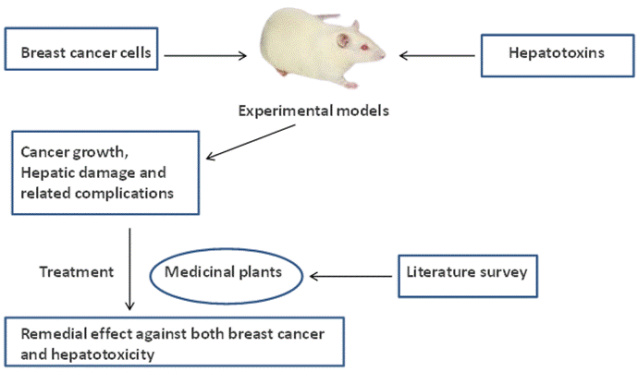

Fig. 1:Curative effect of medicinal plants against breast cancer and hepatotoxicity

Breast cancer is one of the major malignancy increasingly affecting woman’s health worldwide[203]. Human breast cancer MCF-7 cells were the most commonly used breast cancer model followed by MDA-MB-231 cells. Drugs (paracetamol, rifampin, bleomycin, doxorubicin etc.), chemicals (carbon tetrachloride, ethanol, thioacetamice etc.) and heavy metals (lead, cadmium, arsenic etc.) induced hepatic disorders, principally induced in rodents were the experimentally invoked liver complications used for the hepatoprotective assessments. Generally estimated physiological parameters were cytotoxicity, cell proliferation, cell viability, mitotoxicity, apoptosis and genotoxicity in the cases of anti-breast cancer evaluations. On the other hand, haematological and liver function parameters along with lipid profile, antioxidant and anti-inflammatory biomarker parameters were evaluated to measure hepatic protection property of the same plants. In the majority of such cases, histopathological analyses of liver tissues were also carried out for corroboration. Preservation of liver structure, modulation of hepatic functions and oxidative stress-inflammatory pathways were the principal mechanisms of antihepatotoxic effect. These are the preclinical studies.

The observed pre-clinical anti-breast cancer mechanisms included: cytotoxic, anti-proliferative, antitumor, apoptopic, estrogenic, anti-genotoxic, anti-angiogenesis, antimetastatic, antimitotic/cell cycle arrest, autophagy, antioxidant, anti-carcinogenic/chemopreventive etc.; whereas, the pre-clinical hepatoprotective mechanisms deduced are: cytoprotective/antihepatotoxic, antioxidative, anti-

inflammatory, apoptopic, anti-fibrotic, anti-hyperlipedemic/hypolipedimic, detoxifying, free radical scavenging etc. by modulating multiple pathophysiological processes/pathways pertaining to both the breast cancer and liver structure/functions.

Only one clinical study involving 30 patients with non-metastatic breast cancer participated in a randomized, triple-blind, placebo-controlled study evaluated the preventive benefits of oral treatment of standardized seed extract (silymarin) from milk thistle plant (*Silybum marianum*), against the liver injury brought on by its breast cancer chemotherapy -doxorubicin/cyclophosphamide-paclitaxel treatment regime[204]. It is pertinent to mention here that, *Silybum marianum* (milk thistle) seed has already been reported to possess both hepatoprotective and anti-breast cancer effects at the pre-clinical stages Table. 1.

Hepatotoxicity is a common yet serious recognized complication of the extant cancer chemotherapy. As mentioned in the introduction section, anti-breast cancer medications pose noxious effects to the liver health. Moreover, breast cancer while metastasis, affects liver or there may be pre-existing hepatic diseases which may aggravate during cancer. Hence, in the several ways, the liver, the cardinal mammalian organ of metabolism and detoxification, becomes quite vulnerable towards serious damage in breast cancer; leading to gross physiological deterioration of a breast cancer patient. Medications, in novel/alternative ways, should therefore be devised to counteract both neoplasm and hepatic damage in breast cancer patients with less adverse effects.

The dietary and medicinal plants are known to serve as a classical source of extant antineoplastic drugs and hepatoprotective medications, in particular for the later purpose, in these days also[197, 205]. The pleiotropic pharmacological effect that enables medicinal plants and their constituents to act through multiple stages and pathways is well recognized[206, 207]. The present study reveals the medicinal plants have the concomitant potentiality to counteract breast cancer as well as hepatotoxicity. Newer site/target-specific targeted drug delivery systems like nanotechnology can improve the pharmacokinetic and pharmacodynamic efficacy of putative phytochemicals[208]. Nevertheless, one should be more cautious in extrapolating these preclinical findings to clinical set up, as the foregoing studies suffer from certain gross limitations which are summarized in the next section.

LIMITATIONS

Having being a narrative review, the current work has explicit limitations. Except one, the research studies selected are pre-clinical studies that are stand-alone in nature, often in different experimental models and different plant parts/extracts, performed with uncharecterized/partially charecterized crude plant extracts/fractions. Some issues need to be addressed. How can a single plant extract be both "cytotoxic" (against cancer cells) and "cytoprotective" (to hepatocytes)? What are the active phytoconstituents responsible for dual activity in same model? Are the anti-cancer and hepatoprotective doses compatible? Are there any conflicting findings? Further definitive studies are necessary to unveil the phytochemistry, shared pathways, molecular targets with deeper analysis of mechanisms, drug-herb interactions or synergistic mechanisms and bioavailability and toxicological issues with dose-response relationships that could provide novel scientific insights for their molecular basis of dual action in the same model in pre-clinical stage, for possible clinical translation.

Table 1: Medicinal plants with concomitant hepatoprotective and anti-breast cancer effects

Sl. No.	Botanical name	Part used	Experimental model/cell line	Reported effects	References
1	*Ammi visnaga* (Apiaceae)	Aerial parts	Human breast cancer T47D cells	Cytotoxic effect	6, 7
		Aerial parts	HuH-7 cells	Hepatoprotective and apoptopic effects	8
2	*Artemisia absinthium* (Asteraceae)	Flower, root	Human breast cancer MCF-7 cells	Cytotoxic effect.	9
		Aerial parts	CCl_4 induced mice and and diclofenac-induced rats	Hepatoprotective, nephroprotective, antioxidant and immunomodulatory activities	10, 11
3	*Avicennia marina* (Acanthaceae)	Aerial parts	Human breast cancer cell lines viz. BT-20, MDA-MB 231	Cytotoxic effect.	12, 13
		Leaf	CCl_4 induced rats	Hepatoprotective and antioxidative effects	14, 15

Sl. No.	Botanical name	Part used	Experimental model/cell line	Reported effects	References
4	*Citrullus colocynthis* (Cucurbitaceae)	Leaf cucurbitacin fraction	Human breast cancer cell lines viz. ER(+) MCF-7 and ER(-) MDA-MB-231	Cell cycle arrest at G2/M phase	16
		Fruit, seed	Paracetamol and CCl_4 induced rats	Hepatoprotective and antioxidant activity.	17, 18
5	*Crocus sativus* (Iridaceae)	Stigma	Human breast cancer MCF-7 cells	Cytotoxic and anti-angiogenesis effect	19
		Petal, stigma	Paracetamol and CCl_4 induced rats	Hepatoprotective and antioxidant effects	20, 21
6	*Curcuma longa* (Zingiberaceae)	Rhizome	Human T47D breast cancer cell line	Antiproliferative and telomerase inhibitory effects	22
		Rhizome	Thioacetamide-induced liver cirrhosis, CCl_4 induced toxicity in rats; bleomycin and paracetamol induced hepatotoxicity in mice.	Hepatoprotective antioxidant and anti-inflammatory activities	23-26
7	*Glycyrrhiza sp.* (Fabaceae)	Root	Human MCF-7 breast cancer cell line	Antiproliferative effect with apoptosis induction	27, 28
		Root	Ethanol-induced fatty liver in mice, CCl_4 induced rats	Hepatoprotective, anti-inflammatory, antihyperlipidemic and antioxidant role	29, 30
8	*Medicago sativa* (Leguminosae)	Leaf	Human breast cancer MCF-7 cell line, rats	Estrogenic effect	31, 32
		Leaf	CCl_4 induced rats	Hepatoprotective and antioxidant effect	33
9	*Myrtus communis* (Myrtaceae)	Essential oil	Human MCF-7 breast cancer cell line	Cytotoxic effect.	34
		Flower, leaf	CCl_4 and monosodium glutamate induced rats	Hepatoprotective effect modulating apoptosis, DNA fragmentation, cell cycle arrest	35-37
10	*Nigella sativa* (Ranunculaceae)	Seed	Human MCF-7 breast cancer cell line	Cytotoxic effect. IC_{50} value: 11.5 µg/ml	38
		Seed	CCl_4 and acetaminophen-induced rats	Alleviation of hepatotoxicity and oxidative stress	39, 40
11	*Peganum harmala* (Nitrariaceae)	Seed	Human MDA-MB-231 breast cancer cell line	Decreaed cancer cell growth by multimodal induction of apoptosis	41
		Seed	Ethanol-induced rats.	Hepatoprotective effect	42
12	*Thymus vulgaris* (Lamiaceae)	Stem	Human MCF-7 and MDA-MB-231 cell lines, mice, rats	Antiproliferative and pro-apoptotic effects in cell lines and chemopreventive chemotherapeutic effect in rodents	43
		Leaf	Ethanol-induced rats, dexamethasone-induced rats, sodium nitrite-induced mice.	Hepatoprotective, hypolipidemic and antioxidant activities	44-46
13	*Trigonella foenum-graecum* (Fabaceae)	Seed	Human MCF-7 breast cancer cell line	Estrogenic effect	47
		Seed	Sodium nitrite-induced rats, ethanol-induced human liver cells (HepG2 and Huh7)	Hepatoprotective and nephroprotective potential	48, 49

Sl. No.	Botanical name	Part used	Experimental model/cell line	Reported effects	References
14	*Catharanthus roseus* (Apocynaceae)	Aerial parts	Human (MCF) and murine (EAC) cancer cell lines	Decreased cancer cell viability, increased life span, decreased tumour volume and viable tumor cell count of the tumor bearing mice.	50
		Aerial parts	CCl_4 induced rats	Hepatoprotective, hypolipidemic effects	51
15	*Zingiber officinale* (Zingiberaceae)	Rhizome	Human MCF-7 and MDA-MB-231 breast cancer cell lines	Cytotoxic effect.	52
		Rhizome	Different drugs and chemicals induced rodents	Hepatoprotective, antioxidant and anti-inflammatory properties	53
16	*Acacia nilotica* (Fabaceae)	Wood, lignin enriched extract	Human MCF-7 breast cancer cell line	Antiproliferative and antioxidant effect	54
		Aerial parts, bark	Acetaminophen-induced rats, H_2O_2 induced rats	Hepatoprotective and antioxidant activities	55, 56
17	*Vernonia amygdalina* (Asteraceae)	Leaf	Human breast cancer cell lines MCF-7 and MDA-MB-231	Antiproliferation, G1/S phase cell cycle arrest, caspase dependent apoptosis	57
		Leaf	Acetaminophen-induced mice, CCl_4 induced chickens, doxorubicin-induced rats	Hepatoprotective and nephroprotective effects	58-60
18	*Vitellaria paradoxa* (Sapotaceae)	Stem bark	Human MCF-7 breast cancer cell line	Cytotoxic and antioxidant effect	61
		Leaf, root	Sodium arsenite-induced rats, phenylhydrazine-induced jaundice in rats	Hepatoprotective, nephroprotective and apoptotic properties	62, 63
19	*Anacardium occidentalis* (Anacardiaceae)	Leaf extract nanoparticle	Human MCF-7 breast cancer cell line	Antiproliferative effect	64
		Leaf, fruit	CCl_4 induced rats, paracetamol-induced rats	Hepatoprotective activity	65, 66
20	*Annona senegalensis* (Anonaceae)	Leaf	Human MDA-MB-231 breast cancer cells	Cytotoxic effect	67
		Leaf	7, 12-dimethylbenz[a]anthracene induced rats, aflatoxin B1-induced rats	Hepatoprotective and antioxidant effect	68, 69
21	*Psidium guajava* (Myrtaceae)	Leaf monoterpenoid enriched faction	Human MCF-7 breast cancer cell line and murine EAC breast cancer cell line	Antiproliferative, antitumor and estrogen-like activity	70
		Leaf, leaf triterpenoid enriched faction	CCl_4 induced rats, acetaminophen exposed mice and rats	Hepatoprotection with alleviation of oxidative and inflammatory stress	71-73
22	*Moringa oleifera* (Moringaceae)	Leaf, bark	Human MDA-MB-231 breast cancer cell line	Antitumor effect, cell cycle arrest at the G2/M phase.	74
		Leaf	Lead acetate and acetaminophen induced rats	Obviation of hepatotoxicity, genotoxicity and oxidative stress.	75-77
23	*Hymenodictyon excelsum* (Rubiaceae)	Bark	Human MCF-7 and MDA-MB-231 cell lines	Cytotoxic activity	78
		Bark	Paracetamol-induced rats	Hepatoprotective and antioxidant role	79
24	*Lactuca sativa* (Asteraceae)	Leaf	MCF-7 breast cancer cell lines	Antiproliferative effect	80

Sl. No.	Botanical name	Part used	Experimental model/cell line	Reported effects	References
		Leaf	CCl_4 induced rats	Alleviation of hepatotoxicity and reproductive toxicity	81
25	*Capparis spinosa* (Capparaceae)	Whole plant	MCF-7 breast cancer cell line	Antiproliferative, cytotoxic and apoptopic effect.	82, 83
		Whole plant	Tert-butyl hydroperoxide induced mice	Hepatoprotective and antioxidant role	84
26	*Litchi chinensis* (Sapindaceae)	Fruit pericarp	Human MCF-7 and MDA-MB-231cell lines	Cytotoxic and antitumor potential	85
		Leaf	Paracetamol-induced rats, CCl_4 induced mice	Hepatoprotective and anti-inflammatory activity	86, 87
27	*Calotropis procera* (Apocynaceae)	Latex, leaf	Human MCF-7 breast cancer cell line	Cytotoxic and pro-oxidant effect with induced apoptosis and autophagy	88, 89
		Root bark	CCl_4 and diethylnitrosamine induced rats	Hepatoprotective and antioxidant effect	90, 91
28	*Caralluma europaea* (Apocynaceae)	Aerial parts	Human breast cancer cell lines namely MCF-7, MDA-MB-231	Antiproliertative effect	92
		Stem	CCl_4 and acetaminophen induced rats	Hepatoprotective and immunomodulator effect	93, 94
29	*Mangifera Indica* (Anacardiaceae)	Peel, seed kernel and leaf	7,12-dimethylbenz[a]anthracene-induced breast cancer in rats	Antitumor, apoptopic, estrogenic and antioxidant effects	95, 96
		Leaf, seed	Mercuric chloride and acetaminophen induced mice, CCl_4 induced rats	Hepatoprotective and antioxidative role	97-99
30	*Momordica charantia* (Cucurbitaceae)	Aerial parts, fruit	Human MCF-7 MDA-MB-231 and primary mammary epithelial cells	Cytotoxic and tumor inhibitory activities by modulation of cell cycle and apoptosis.	100, 101
		Leaf	CCl_4 induced rats	Antihepatotoxic effect	102
31	*Morus nigra* (Moraceae)	Fruit	Human MCF-7 breast cancer cell line	Antiproliferative and apoptopic effects.	103
		Leaf	Paracetamol induced mice, methotrexate induced albino rats and human HepG2 cells	Hepatoprotective activity	104, 105
32	*Aegle marmelos* (Rutaceae)	Leaf, root, fruit	Human MCF7 and MDA-MB-231 breast cancer cell lines, EAC cell line in mice	Antiproliferative and Antineoplastic activity	106-108
		Fruit, leaf	CCl_4 induced rats	Hepatoprotective and antioxidant effect	109, 110
33	*Camellia sinensis* (Theaceae)	Green tea	4T1 breast cancer cell line in mice	Antitumor and antimetastatic effects with apoptosis induction.	111
		Green tea, white tea	Thioacetamide and cisplatin induced rats	Hepatoprotective and antioxidant effect	112, 113
34	*Achyranthes aspera* (Amaranthaceae)	Leaf alkaloid extract	Benzopyrene induced breast cancer in mice	Antitumor and apoptopic effect	114

Sl. No.	Botanical name	Part used	Experimental model/cell line	Reported effects	References
		Seed	CCl_4, high cholesterol induced rats	Improvement of liver functions, dyslipidemia and histopathology	115, 116
35	*Allium sativum* (Liliaceae)	Bulb	Human MCF-7 and MDA-MB-231 cells	Antitumor and apoptopic effects	117
		Bulb	CCl_4, paracetamol, thioacetamice, gentamycin induced rodents	Hepatoprotective and antioxidant, anti-inflammatory activities	118
36	*Aloe vera* (Asphodelaceae)	Leaf	Human MCF-7 breast cancer cell line	Cytotoxic effect.	119
		Leaf	Ischemia-reperfusion and cadmium-induced rats	Hepatoprotective, anti-inflammatory and antioxidant effects	120, 121
37	*Artemisia herba-alba* (Asteraceae)	Aerial parts	Human MCF-7 breast cancer cell line	Cytotoxic and chemopreventive effects	122
		Aerial parts	Nickel induced rats	Obviation of oxidative liver damage	123
38	*Averrhoa bilimbi* (Oxalidaceae)	Fruit	Human MDA-MB-231 breast cancer cell lines	Cytotoxity by cell cycle arrest and apoptopic effect	124
		Leaf, fruit	Ethanol, CCl_4-induced rats	Hepatoprotective, anti-inflammatory activity	125, 126
39	*Bidens Pilosa* (Asteraceae)	Aerial parts	Human MCF-7 cell line and EAC bearing mice	Cytotoxic and antitumor effects with improved survival	127
		Aerial parts, leaf	Cholestatic liver disease and steatosis in rats	Improved liver functions, fibrosis, steatosis, dyslipedemia	128, 129
40	*Biophytum sensitivum* (Oxalidaceae)	Whole plant	Human MCF-7 breast cancer cell line	Cytotoxic and apoptopic effects.	130
		Leaf	CCl_4-induced rats	Hepatoprotective effect	131
41	*Cassia auriculata* (Caesalpinaceae)	Leaf	Human MCF-7 breast cancer cell line	Antiprofliferative effect via cell cycle arrest and apoptosis induction	132
		Leaf	CCl_4 and ethanol-induced rats	Hepatoprotective and antioxidant effects	133, 134
42	*Streblus asper* (Moraceae)	Bark	Ehrlich ascites carcinoma in mice	Antitumor and antioxidant effects.	135
		Leaf	CCl_4 -induced rats	Hepatoprotective effect	136
43	*Cichorium intybus* (Asteraceae)	Aerial parts	Human MCF-7 breast cancer cell line	Antitumor effect, decreased cell viability.	137
		Aerial parts	CCl_4, lead, nickel induced rats	Restoration of hepatic damage, fibrosis and oxidative stress.	138-140
44	*Coriandrum sativum* (Apiaceae)	Leaf	Human MCF-7 breast cancer cell line	Cytotoxicity, mitotoxicity, genotoxicity and apoptosis	141
		Leaf	CCl_4 and ischemia-reperfusion induced rats	Hepatoprotective effect by modulating inflammation, oxidative stress and apoptosis.	142, 143
45	*Gongronema latifolium* (Asclepiadaceae)	Leaf	Human MCF-7 breast cancer cell line	Cytotoxic effect.	144
		Leaf, root	Acetaminophen-induced rats	Hepatoprotective activity.	145, 146

Sl. No.	Botanical name	Part used	Experimental model/cell line	Reported effects	References
46	*Lepidium sativum* (Brassicaceae)	Seed	Human MCF-7 breast cancer cells	Cytotoxic, antiproliferative and apoptotic effects.	147, 148
		Seed	CCl_4 and D-galactosamine/ lipopolysaccharide induced rats	Hepatoprotective effect by modulating inflammation, oxidative stress and apoptosis.	149, 150
47	*Ocimum gratissimum* (Lamiaceae)	Leaf	Human MDA-MB-435 and MDA-MB-231 breast cancer cell lines.	Inhibition of cancer cell proliferation, growth and angiogenesis	151
		Leaf	CCl_4, atorvastatin and clopidogrel-induced rats	Hepatoprotective and antioxidant effects	152, 153
48	*Origanum vulgare* (Lamiaceae)	Aerial parts	Human MDA-MB-231 breast cancer cell line	Cytotoxic and antiproliferative property.	154
		Aerial parts	CCl_4, and doxycycline - induced rats	Antihepatotoxic and antioxidant effects.	155, 156
49	*Tamarindus indica* (Caesalpinaceae)	Seed	Human MCF-7 breast cancer cell line	Cytotoxic and genotoxic effect	157
		Bark	Isoniazid and rifampicin-induced rats	Improvement of hepatic functions.	158
50	*Tinospora cordifolia* (Menispermaceae)	Stem	Human MDA-MB-231 and MCF-7 breast cancer cell line	Cytotoxic and apoptotic activities. Suppression of tumor proliferation and migration.	159, 160
		Leaf, stem and root	CCl_4 and paracetamol - induced rats	Hepatoprotective activity	161, 162
51	*Hamelia patens* (Rubiaceae)	Leaf	Human MCF-7 breast cancer cell line	Cytotoxic effect	163
		Leaf, stem	CCl_4-induced HepG2 cells	Hepatoprotective and antioxidant capacity	164
52	*Trichosanthes dioica* (Cucurbitaceae)	Root	Murine EAC cell line, EAC bearing mice	Antimitotic, antiproliferative, antitumor and antioxidant effects	165, 166
		Root, fruit	Arsenic-induced rats	Hepatoprotective and antioxidant effect	167, 168
53	*Terminalia arjuna* (Combretaceae)	Leaf	EAC bearing mice	Antitumor and antioxidant activities	169
		Leaf	Paracetamol-induced rats	Hepatoprotective and antioxidative effects	170
54	*Terminalia chebula* (Combretaceae)	Fruit	Human breast cancer cell line (MCF-7) and 7,12-dimethylbenzanthracene (DMBA)-induced mammary carcinoma of rats.	Antiproliferative, antitumor and antioxidant effects.	171
		Fruit	tert-butylhydroperoxide (t-BHP)-induced mice, ethanol-induced rats	Hepatoprotective, antioxidant and anti-inflammatory effects	172, 173
55	*Dregea volubilis* (Asclepiadaceae)	Fruit	EAC bearing mice	Antitumor effect	174
		Fruit	Paracetamol-induced rats	Hepatoprotective and antioxidant effects	175
56	*Phyllanthus emblica* (Phyllanthaceae)	Fruit	Human breast cancer cell line (MDA-MB-231)	Cytotoxic and apoptopic effect	176
		Fruit	CCl_4-induced rats	Hepatoprotective, antioxidant, anti-inflammatory, and antifibrotic effects.	177

Sl. No.	Botanical name	Part used	Experimental model/cell line	Reported effects	References
57	*Azadirachta indica* (Meliaceae)	Leaf	Murine 4T1 breast cancer bearing mice, human breast cancer cell line MDA-MB-231	Cytotoxic, apoptopic and antitumor effects	178, 179
		Leaf	Rifampin-induced rats	Hepatoprotective, antioxidant and anti-inflammatory effects	180
58	*Sansevieria roxburghiana* (Agavaceae)	Rhizome	EAC induced mice	Antitumor and antioxidant effects	181
		Rhizome	CCl_4-induced rats	Hepatoprotective potential	182
59	*Ocimum sanctum* (Lamiaceae)	Leaf	Human breast cancer cell lines viz. MCF-7 and T47D.	Antiproliferative and apoptopic activities	183
		Leaf	Paracetamol-induced rats	Antihepatotoxic effect	184, 185
60	*Swietenia mahagoni* (Meliaceae)	Seed	Human T47D cell line	Cytotoxic potential	186
		Bark	Paracetamol-induced rats	Hepatoprotective effect	187
61	*Andrographis paniculata* (Acanthaceae)	Aerial parts	Human MCF-7 breast cancer cell line	Antiproliferative effect	188
		Aerial parts	Paracetamol and thioacetamide-induced rats	Hepatoprotective,, apoptopic and antioxidant effect	189, 190
62	*Withania somnifera* (Solanaceae)	Root	Human MDA-MB-231, MCF-7 and T47D breast cancer cell lines	Cytotoxic, antiproliferative, apoptopic and anti-metastasis effects	159, 191
		Leaf	CCl_4-induced rats	Antihepatotoxic effect	192, 193
63	*Rubia cordifolia* (Rubiaceae)	Root	Human MDA-MB-231 breast cancer cells	Cytotoxic effect	194
		Root	CCl_4-induced rats	Hepatoprotective effect	193
64	*Silybum marianum* (Asteraceae)	Seed	Human BT-474, SK-BR-3, MDA-MB-231 and MCF-7 cells	Antiproliferative and apoptopic effects	195, 196
		Seed	Various liver disease models	Hepatoprotective, antifibrotic and antioxidant effects	197
65	*Centella asiatica* (Apiaceae)	Whole plant	Human MCF-7 cells	Cytotoxic, mitotoxic, genotoxic and apoptopic effect	198
		Whole pant	Acetaminophen-induced mice	Hepatoprotective, antioxidant and anti-inflammatory effects	199
66	*Panax ginseng* (Araliaceae)	Root	Human MDA-MB-231, MCF-10A and MCF-7 breast cancer cells	Cytotoxic and apoptopic effects	200, 201
		Root	Various liver toxicants	Regulation of liver functions and disorders	202

CONCLUSION

To the best of the present author's knowledge, this is the first report of this kind. The specific dual properties of cytotoxicity (against breast cancer) and cytoprotection (in case of liver damage) with mechanisms thereof should be much explored further in order to develop an effective dual-acting plant-derived natural therapeutics against hepatic damage associated with breast cancers by arresting pathogenesis of both the disorders with less toxicity. More definitely designed mechanistic pre-clinical studies and clinical studies could be the way ahead to circumvent the limitations and explore their concrete translational potential. Both pre-clinically and clinically ratified phytoconstituent like silymarin from milk thistle plant may be a right druggable candidate here. The present preliminary synoptic

report is a first-time of such compilation which may serve as a primary database for understanding and benefitting future researchers in this progressive field aiding to combat cancer, protecting the vital organs.

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