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REVIEW

A Gift of Good Health from Mother Nature: Presenting *Moringa oleifera*, a Plant with Multiple Anticancer Activities

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ABSTRACT

Moringa oleifera Lam. (Moringaceae) is a multifarious beneficial tree and widely cultivated in the tropical and subtropical regions all over the world. All parts of this plants are edible and used as a plentiful source of phytochemicals with high nutritional values. Since antiquity, this plant was recognized as a panacea for the treatment of several ailments in ethnomedicinal system. In last few decades, this fact is further reconfirmed by various scientific research works in which the plant was found to show broad spectrum of biological activities including antioxidant, anti-inammatory, antiurolithic, antimicrobial, anangesic, antidiabetic, antihypertensive, antiproliferative, hepatoprotective, cardioprotective, *etc.* Different parts of this plant exhibited significant inhibitory activity against a variety of cancer cells at moderate to low concentrations and also possess low toxicity in normal cells. This review mainly focuses a brief overview on the anticancer profile of this wonderful tree.

KEYWORDS

Moringa oleifera, Anticancer activity, Apoptosis.

INTRODUCTION

Plants provide innumerable bioactive compounds, which have been utilized as an important source of novel drug leads [1]. The World Health Organization estimates that ~80% people in the world rely almost entirely on plant-based medicines for their primary health care requirements [2,3]. It is reported in a recent article that over the last four decades, about 23.5% of newly approved drugs are either have natural products origin or derived from natural products, mostly from plants [4]. Cancer is one of the most dreaded maladies in human population all over the world. In next 20 years, cancer incidences are expected to increase by about 70% [5]. Chemotherapy is an indispensable weapon to fight against cancer and plant-derived anticancer drugs constitute a significant role in this battle may be due to their high efficacy and lower toxicity as compared to conventional anticancer drugs [6,7]. It is reported that about 35000 plant samples from different countries were collected by the National Cancer Institute and screened for their anticancer activity; out of which different extracts of more than 3000 plants were found to show activity against various cancer cells [8]. In fact, more than 65% of current anticancer drugs are developed from natural resources, mostly using the secondary plant meta-

bolites [9]. For example, paclitaxel and its synthetic analogue docetaxel are antineoplastic agents used in the treatment of lung, breast, ovarian cancer and Kaposi's sarcoma, derived from the bark of Pacific yew tree, *Taxus brevifolia* Nutt. (Taxaceae). Similarly, vinca alkaloids, camptothecin, podophyllotoxin, homoharringtonine are very popular clinically approved anti-cancer drugs, all of them have plant origins [10,11].

Our country, India has a rich heritage of flora and fauna due to its geographical diversity along with large variation of tropical climate. Plants have long been used as an outstanding reservoir for nutraceuticals and pharmaceuticals [12,13]. India is the second largest producer of medicinal herbs and sometimes is called as 'Botanical Garden of the World'. Our ancestors were well aware of these enormous resources of therapeutic benefits and multifarious utilities of various plants which were well documented in Charak sanghita, Sushrut sanghita, Ayurveda, *etc.* Since the ancient times, herbal medicine are used to treat various ailments of people [14]. We are enriched and enlighten by those experiences of our ancestors and there by continuously in search of versatile beneficial properties of these vast sources of plants [15,16]. One such plant, *Moringa oleifera* Lam. (Moringaceae), popularly known as "Miracle tree" is widely cultivated in the tropics and subtropics of western and sub-Himalayan regions of India [17,18]. It is an extremely significant medicinal plant with high nutritional and multipurpose medicinal values [19,20]. Different parts of this plants show broad spectrum of pharmacological activities, *viz.*, antifungal, antibacterial, antimalarial, anti-inflammatory, antipyretic, anti-diabetic, antitumour, antiulcer, analgesic, antioxidant, hypotensive, cardioprotective, anti-HIV, antihelmentic, hypolipidemic, hepatoprotective, *etc*. [21-27]. Some organizations have denominated *Moringa* as "natural nutrition for the tropics". In fact, almost all parts of this plant exhibit anticancer activity against a variety of tumour cells both *in vivo* and *in vitro* [28,29]. This short review highlights some of the recent research works on the anticancer properties of this plant.

Botanical description of *Moringa oleifera*

Cultivation, morphology and phytochemical constituents: *Moringa oleifera* Lam. (Fig. 1.) commonly known as drumstick tree or horseradish tree, is widely distributed in the tropical and subtropical regions of all over the world [30,31]. It is most abundant member of *Moringaceae* family which comprises twelve other species. It is a fast growing deciduous, perennial, dicotyledonous plant up to ~ 20 ft tall with a straight trunk having corky, gummy whitish barks. It has tuberous taproots, straight and brittle stems with drooping branches. The leaves are pale green, alternate, bi or tripinnate compound with elliptical leaflets. Pleasantly fragrant, white to cream coloured and yellow dotted based flowers are obliquely monosymmetric, produced axillary drooping panicles. The fruits, sometimes referred as pods are called 'drumsticks'. They are green pendulous, trilobed capsules with nine-ribbed tapering at both ends. Seeds are round with brownish semipermeable hull and also with three papery wings [32].

M. oleifera is a natural storehouse of numerous metabolites, which have enormous nutritional as well as medicinal significance. Phytochemical analyses have shown that all parts (leaves, fruits, pods, seeds, flowers, roots, stem, *etc.*) of this plant are rich and rare combination of several essential amino acids, carbohydrates (simple sugars as well as unique group called glucosinolates and isothiocyanates), vitamins, polyphenols, phenolic acids, polyunsaturated acids, flavonoids, steroids, terpenoid, alkaloids, highly bioavailable minerals,

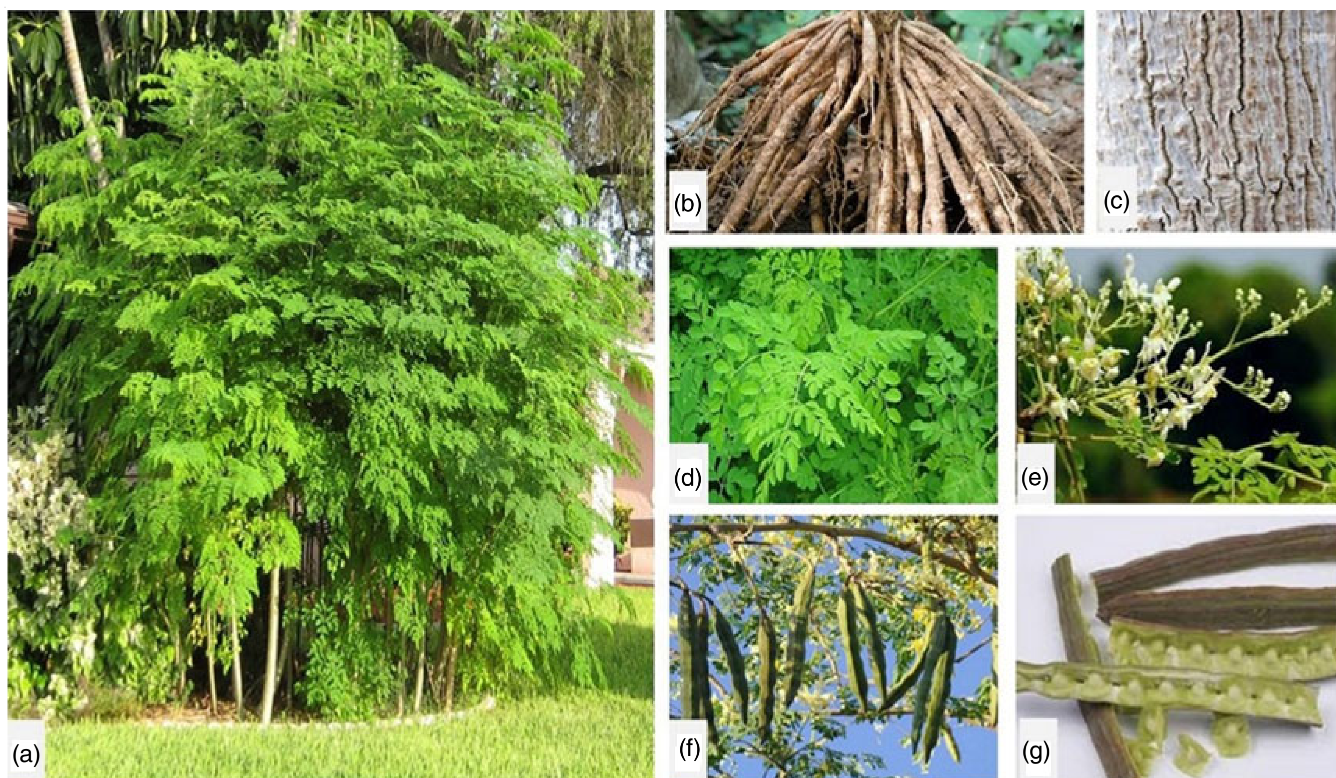

Fig. 1. Different parts of *Moringa oleifera* (a) plant; (b) roots; (c) stem barks; (d) leaves; (e) flowers; (f) pods; (g) seeds

antioxidants, *etc.* [33,34]. Some of them are responsible for the various pharmacological activities exhibited by this plant (Table-1 and Fig. 2.).

Anticancer activities of *Moringa oleifera*: It is already stated earlier that *M. oleifera* is called nature's 'medicinal cabinet' due to its multipurpose therapeutic benefits. Extensive research works on this plant showed that almost all parts (leaves, roots, seed, bark, fruit, flowers, immature pods, whole gum exudate, seed oil) have been exhibited anticancer activities against different cell lines. Some recent studies on various parts of *M. oleifera* against a panel of cancer cells are summarized in Table-2.

A number of studies reported that the growth inhibitory efficacy of different parts of *M. oleifera* is dose dependent. It is indicated from Table-2, leaf extracts were found to be most cytotoxic against all types of human cancer cell lines at very low concentrations and at the same time this part exhibited less toxicity or even nontoxicity in some cases when tested against normal human cells. To evaluate the oral toxicity of this plant, the aqueous leaf extract was administered orally to Wistar rats and several haematological, biochemical and histological parameters were estimated. Although some variations were observed at different tested concentrations (400, 800 and 1600 mg/Kg), yet no significant changes in all the examined organs were noticed and even also all the animals were survived at a dose of 2000 mg/Kg [66].

In recent years, nanobiotechnology is one of the emerging fields of research, which includes the green synthesis of nanoparticles and their applications in various biological systems [67,68]. Some groups of workers prepared silver, gold, nickel oxide and palladium nanoparticles by using the extracts of different parts of *M. oleifera* and also found remarkable *in vitro* anticancer activities (Table-2).

Apoptotic cell death is the main mechanistic pathway for inhibiting proliferation by *M. oleifera* [69,70]. The potency of *M. oleifera* to trigger apoptosis in cancer cells is mainly due to the presence of diverse secondary metabolites, most specifically antioxidant flavonoids, phenols, phenolic acids, carotenoids, *etc.* (some of which are listed in Table-1 and Fig. 1). It is noteworthy that extracts prepared with polar solvents like water or aqueous alcohols (methanol or ethanol) of this plant exhibited significant tumoricidal activity in most of the cases [48]. It is corroborated by the fact that all of the above ingredients from this plant, which were supposed to be responsible for showing anticancer activity can easily dissolved in these polar solvents also. These type compounds have a capability to scavenge free radicals or stabilize different reactive oxygen species and thereby prevent oxidative stress in the cellular environment, which is responsible for cancer [71]. These phytochemicals can regulate apoptotic signalling pathways to cause programmed cell death by activating pro-apoptotic proteins such as caspases (caspases 3 and 7), BAX, BAK, BAD, TRAIL, *etc.* and also inhibiting the action of anti-apoptotic proteins like BCL-2, BCL-XL, BCL-W, *etc.* In fact, these constituents alone or sometimes in the combination with other

TABLE-1
PHYTOCONSTITUENTS PRESENT IN DIFFERENT PARTS OF *Moringa oleifera*

Phytochemical constituents	Class of the compound	Part of the plant	Activity
4-(α-L-Rhamnopyranosyloxy)-benzylglucosinolate, benzylglucosinolate, procyanidins, aurantiamide acetate	Glucosinolate, flavonoid, dipeptide	Root	Anti-inflammatory, antiproliferative, hypotensive, spasmolytic, antimicrobial, analgesic
4-Hydroxymellein, vanillin, octacosanic acid, procyanidins β-sitosterone, β-sitosterol, 4-(α-L-rhamnopyranosyloxy)-benzylgluco, sinolate, moringine, moringinine	Phenols, fatty acid, flavonoid, steroids, glucosinolate, alkaloid	Stem, bark	Anticancer, antimicrobial
L-Arabinose, D-galactose, D-glucuronic acid, L-rhamnose, D-mannose, D-xylose, 4-[(α-L-rhamnosyloxy)benzyl] isothiocyanate, leucoanthocyanin	Carbohydrate, isothiocyanate flavonoid	Gum	Anticancer, antidiabetic, anti-inflammatory, antimicrobial
Niazirin, niazirinin,4-[4'-O-acetyl-α-L-rhamnosyloxy)benzyl]isothiocyanate, niaziminin A and B, marumoside A and B, gallic acid, ellagic acid, rutin, apigenin, astragalin, ferulic acid, caffeic acid, *o*-coumaric acid, chlorogenic acid, quercetin, kaempferol, α-linolenic acid, α and γ-tocopherols	Glycosides, isothiocyanate, alkaloid, phenolic acid, flavonoid, polyunsaturated acid, phenolic benzopyran	Leaf	Antioxidant, hypotensive, spasmolytic, antiproliferative
D-Mannose, D-glucose, polysaccharide protein, ascorbic acid, quercetin, kaempferol, α and γ-tocopherols	Carbohydrate, flavonoid, phenolic benzopyran	Flower	Antioxidant, antiproliferative
O-[2'-Hydroxy-3'-(2'-heptenyloxy)]-propylundecanoate, O-ethyl-4-[(α-L-rhamnosyloxy)-benzyl] carbamate, methyl-*p*-hydroxybenzoate, niaziridin, niazirin, β-sitosterol, 13-z-lutein, β-carotene, methionine, cystine, tryptophan and lysine	Glycoside, steroid, terpenoid, amino acid	Pod	Antiproliferative, antioxidant
Methionine, cysteine, lectin, 4-(α-L-rhamnopyranosyloxy)-benzylglucosinolate, benzylglucosinolate, 4(α-L-rhamnosyloxy)benzyl isothiocyanate, O-ethyl-4-[(α-L-rhamnosyloxy)-benzyl] carbamate, moringyne, niazimicin, quercetin-3-O-glucoside, β-sitosterol, mono-palmitic and di-oleic triglyceride, potassium, calcium, magnesium	Amino acid, protein, glycoside, flavonol glycoside, steroid, fatty acid, mineral	Seed	Anticancer, antioxidant, antibacterial, larvacidal
Vitamin A, β-carotene, palmitic acid, oleic acid, behenic acid, stigmasterol, β-sitosterol, campesterol, avenasterol, α-phellandrene, *p*-cymene	Terpenoid, fatty acid, steroid, terpenoid	Seed oil	Antioxidant, antimicrobial, anticancer

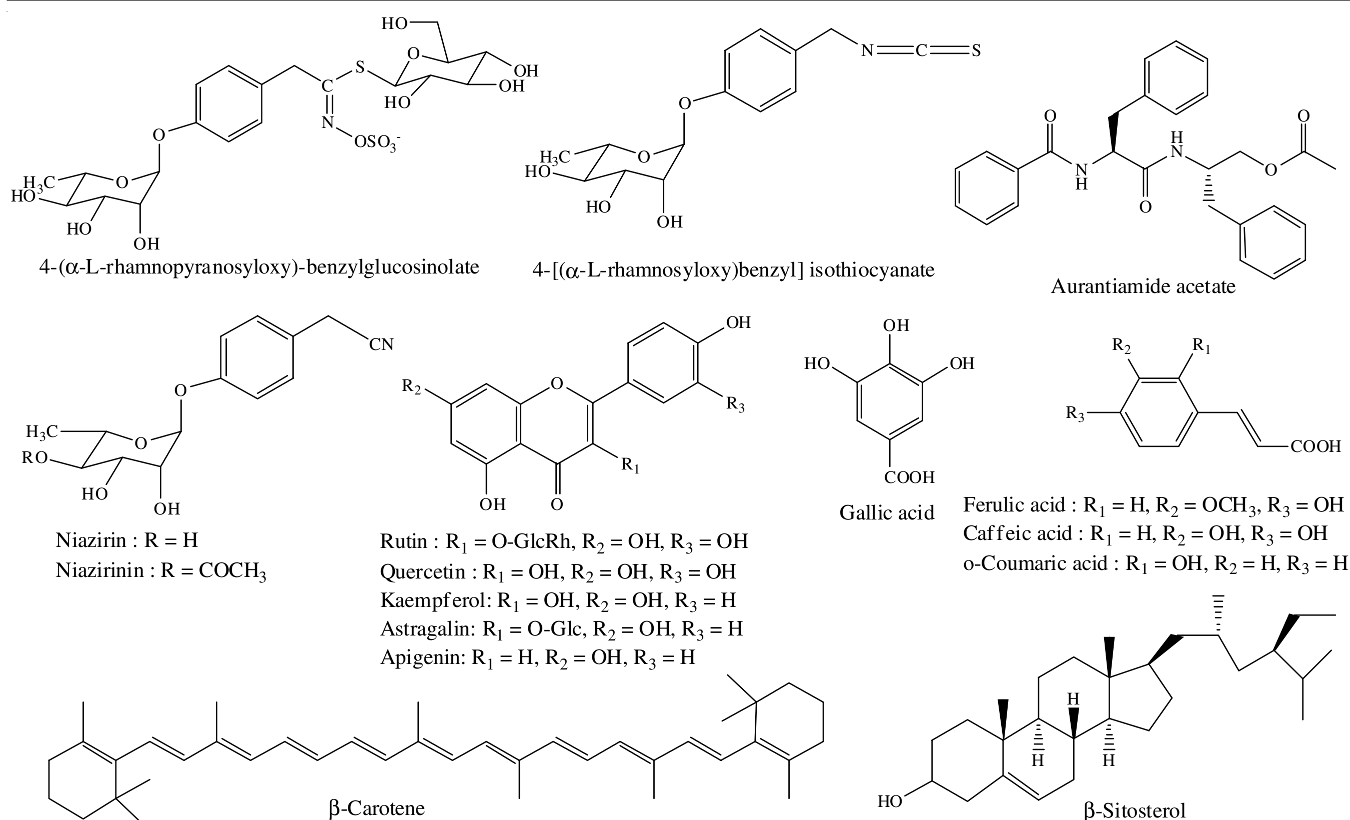

Fig. 2. Some anticancer compounds from *Moringa oleifera*

TABLE-2
ANTIPROLIFERATIVE ACTIVITY OF DIFFERENT PARTS OF *Moringa oleifera* AGAINST VARIOUS CANCER CELLS

Part of the plant	Solvent	Cancer cells	Activity	Remark	Ref.
1. Root bark	EtOH	U937 & K562 (leukemic cells)	IC_{50}: 30.22 µg/mL (U937); 28.29 µg/mL (K562), (1 × 10^5 cells/well for 72 h)	No toxicity up to 200 µg/mL in normal lymphocytes (1 × 10^5 cells/well for 24 h), Induction of apoptosis (DNA fragmentation)	[35]
2. Leaves and Bark	EtOH	MDA-MB-231 (breast cancer) and HCT-8 (colorectal cancer)	Range: 250-500 µg/mL (12 × 10^4 cells/well for 24 h)	Induce late apoptosis (G2/M phase arrest)	[36]
3. Leaves	H_2O	KB	IC_{50}: ~150 µg/mL (1 × 10^4 cells/well for 48 h)	Induction of apoptosis (inter nucleosomal DNA fragmentation & intracellular ROS generation)	[37]
4. Leaves	MeOH and DCM	a) HepG2 (hepatocarcinoma) b) Caco-2 (colorectal adenocarcinoma) c) MCF-7 (breast adenocarcinoma)	IC_{50}: a) 120.37 ± 2.55, b) 112.46 ± 3.74 c) 133.58 ± 2.47 µg/mL of DCM extract (1.0 × 10^3 cells/well for 48	No cytotoxicity on normal human dermal fibroblast cells Induction of quinone reductase activity by DCM extract on Hepa-1c1c7 (murine hepatoma) cells	[38]
5. Leaves	H_2O	a) A549 (lung adenocarcinoma), b) H23 (lung cancer), c) H358 (non-small cell lung cancer), d) MCF-7 (breast cancer), e) A431 (epidermal carcinoma), f) HT1080 (fibrosarcoma)	Range: 5-200 µg/mL (3.0 × 10^3 cells/well for 48 h)	Less cytotoxic in normal COS-7 (African green monkey kidney) cell line Induction of apoptosis by lowering the internal ROS level	[39]
6. Leaves	H_2O	A549 (lung cancer)	IC_{50}: 166.7 µg/mL (1.5 × 10^3 cells/well for 24 h)	Induction of apoptosis (DNA fragmentation & increasing oxidative stress)	[40]
7. Leaves	H_2O	A549 (lung cancer) HepG2 (hepatocellular carcinoma)	20% viability of HepG2 cells at 200 µg/mL (3 × 10^3 cells/well for 48 h) 44-52% reduction in HepG2 and A549 cell proliferation (oral administration)	Induction of apoptosis (DNA fragmentation)	[41]

8. Leaves	H_2O	SNO cells (oesophageal cancer)	IC_{50}: 389.2μg/mL (1.5 × 10^3 cells/well for 24 h)	Induction of apoptosis *via* oxidative stress and DNA fragmentation	[42]
9. Leaves	Aqueous EtOH	a) HEP-3B (hepatoma) b) MCF-7 (breast cancer) c) K-562 (myelogenous leukemia) d) DU-145 (prostate cancer) e) HCT-15 (colorectal cancer)	IC_{50}: a) 29.37 b) 24.76 c) 32.43 d) 42.74 e) 5.213 μg/mL (1 × 10^5 cells/well for 24 h)	No toxicity up to 1000 μg/mL in African green monkey kidney (VERO) cells. Apoptosis *via* DNA fragmentation	[43]
10. Leaves	H_2O	a) Panc-1 b) p34 c) COLO 357 (pancreatic cancer)	IC_{50}: a) 1.1 b) 1.8 c) 1.5 mg/mL (1.5 - 2 × 10^3 cells/well for 72 h)	Inhibits the NF-κB signalling pathway by increase in the sub-G1 cell population of the cell-cycle and reduced the expression of p65, p-IkBα and IkBα proteins	[44]
11. Leaves	*n*-Hexane, $CHCl_3$, Ethyl acetate & methanol	a) Hep-2 (epidermoid cancer) b) Dalton's lymphoma ascites model in mice	a) IC_{50}: 12.5μg/mL (one of the ethyl acetate fraction; (1 × 10^5 cells/mL for 24 h) b) LD_{50}: > 2000 mg/Kg (1 × 10^6 DLA cells i.p)	5.25 % ethyl acetate-dichloromethane fraction exhibits potential cytotoxic effect. All extracts and fractions showed a IC_{50} > 300 μg/mL in the Vero cell line.	[45]
12. Leaves	50% Aqueous ethanol	a) A549 (lung cancer) b) PC-3 (prostate cancer) c) MCF-7 (breast cancer) d) T47D ((breast cancer) e) HCT-16 (colon cancer) f) Colo-205 (colon cancer) g) THP-1 (leukemia) h) HL-60 (leukemia) i) K562 (leukemia)	IC_{50} (μg/mL): a) 13.2 ± 1.8 b) 22.2 ± 4.9 c)26.4 ± 5.7 d) 33.5 ± 2.5 e) 28.8 ± 2.2 f) 49.7 ± 0.8 g) 35.8 ± 1.7 h) 50.0 ± 1.0 i) 49.9 ± 1.7 (5 × 10^3 cells/well for 48 h)	Absence of apoptosis within the experimental duration, that means inhibited proliferation of cancer cells in cytostatic manner	[46]
13. Leaves	Hot H_2O	a) HCT116 b) HCT116P53-/-c) Caco2 (colon cancer)	IC_{50}: 0.02 - 0.05% (1 × 10^4 cells/well for 24 h)	Induction of apoptosis by ROS generation and cell cycle arrest at sub G1 phase	[47]
14. Leaves	i) Cold H_2O ii) Hot H_2O iii) 80% aqueous ethanol	a) AML (acute myeloid leukemia) b) ALL (acute lymphoblastic leukemia) c) HpG2 (Hepatocellular carcinoma)	IC_{50} (μg): a) i. 8.79, ii. 4.3, iii. 4.91 b) i. 7.52, ii. 6.31, iii. 4.59 c) i. 8.67, ii. 3.89, iii. 6.2 (3 × 10^3 cells/well for 24 h)	No significant toxicity in normal mononuclear cells	[48]
15. Leaves	H_2O	HeLa (cervical cancer)	IC_{50}: 70 μg/mL for 24 h (2 × 10^5 cells/well)	Non-toxic to the normal healthy lymphocytes, Induction of apoptosis by DNA fragmentation	[49]
16. Leaves and Fruits	Aqueous MeOH and MeOH	B16 F10 melanoma tumor cells (in Swiss albino mice)	Doses: 500 mg/kg body wt. and 1g/kg body wt. for 15 days (orally)	VDT (days): Untreated control 1.146 ± 0.4365; Treatment group 1.9 ± 0.122 to 3.42 ± 0.5, GD (days): 2.054 ± 0.21 to 4.05 ± 0.424, MST (days): Untreated control 25.33 ± 2.84; Treatment group 30.5 ± 2.53 to 39.42 ± 2.55, % ILS 12 to 64	[50]
17. Leaves, Seeds	H_2O partitioned by DCM	MCF7 (breast cancer)	IC_{50}: Leaves 25.3 μg/mL (24 h); 18.8 μg/mL (48 h); 6.25 μg/mL (72 h). Seeds 36.4 μg/mL (24 h); 24.1 μg/mL (48 h); 19.3 μg/mL (72 h). (5 × 10^4 cells/well)	P-38 MAPK – protein mediated apoptotic cell death	[51]
18. Seeds	H_2O, EtOH, Further partitioned with hexane, DCM, $CHCl_3$ & *n*-butanol	MCF7 (breast cancer)	IC_{50}:280 μg/mL (H_2O), 130 μg/mL (hexane) & 26 μg/mL (DCM) (5 × 10^4 cells/well for 72h)	IC_{50}: 70 μg/mL (H_2O), >400 μg/mL (hexane) & 25 μg/mL (DCM) in MCF 10A (non tumour breast cell)	[52]

19. Seeds	Methanol	AGS, SGC7901, MKN45 (gastric cancer)		Suppress epithelial-mesenchymal transition mediated migration and invasion of cancer cells by upregulating the tumor metastasis suppressor NDRG1	[53]
20. Essential oils from seeds	DMSO	a) HeLa (cervical cancer) b) HepG2 (hepatoma) c) MCF-7 (breast cancer) d) CACO-2 (caucasian colon adenocarcinoma) e) L929 (mouse fibroblast cell lines)	IC_{50}: a) 366.3 b) 604.3 c) 850.9 d) 721.7 e) 935.8 µg/mL (10^4 cells/100 µL/well for 24 h)		[54]
21. Flowers	80% Aqueous ethanol	PC3 cell (prostate cancer)	IC_{50}: 8.48 µg/mL for 24 h; 6.25 µg/mL for 48 h; (1×10^5 cells/mL)	Induction of apoptosis by interfering AKT pathway	[55]
22. Flowers	Ethyl acetate	HePG2 (liver cancer)	IC_{50}: 245.54µg/mL (1×10^5 cells/mL for 24 h)		[56]
23. Flowers	Methanol	PC3 cell (androgen-independent models of prostate cancer)	IC_{50}: 46.91µg/mL 5 - 10 × 10^3 cells/100 µL/well for 48 h	Non- toxic on normal Vero cell lines (derived from the kidney of African green monkey) upto 100 µg/mL	[57]
24. Leaves (nano composite), Root (core and outer part)	EtOH	HepG2 (hepatoma) MCF-7 (breast cancer) HCT 116 & Caco-2 (colorectal)	IC_{50} (of root): 32.2 & 39.5 µg/mL (Caco-2); 29.1 & 51.4 µg/mL (HCT 116); 29.1 & 53.9 µg/mL (HepG2); 46.2 & >100 µg/mL (MCF-7) (5×10^3 cells/well for 24 h)	Less cytotoxic in normal kidney BHK-21 cell, Root parts are more cytotoxic than leaves & leaves nanocomposites, Induction of apoptosis (root parts)	[58]
25. Seed oil nano micelle (*nano formulation of seed oil - water microemulsion*)	H_2O	a) MCF 7 (breast cancer) b) HCT 116 c) Caco-2 (colorectal cancer) d) HepG2 (hepatoma)	IC_{50} (µg/mL) a) 86.5 b) 49.1 Cell viabilty: 60% at 100 µg/mL of HepG2 cells (1×10^4 cells/well for 24 h)	Mitochondrial mediated apoptosis in breast and colorectal cancer cells; less harmful effects in HepG2 (liver cancer) and BHK-21 (normal kidney cells)	[59]
26. Silver nanoparticles using leaf extract	H_2O	A431 (epidermoid carcinoma)	IC_{50}: 83.57 ± 3.9 µg/mL (3×10^3 cells/well for 48 h)		[60]
27. Silver nanoparticles using stem bark extract	H_2O	HeLa (human cervical carcinoma)	94 % mortality rate at 250 µg/mL concentration of AgNPs (1×10^5 cells/mL for 24 h)	Induction of apoptosis *via* generation of reactive oxygen species	[61]
28. Gold nanoparticles using leaf extract	H_2O	a) A549 (lung cancer) b) SNO cells (oesophageal cancer)	IC_{50} (µg/mL): a) 98.46 b) 92.01 (2×10^4 cells/well for 24 h)	No cytotoxicity in normal PBMC cells; Induction of apoptosis in A549 cells by activating alternate splicing of caspase-9	[62]
29. Gold nanoparticles using flower extract	H_2O	A549 (lung cancer)	Cell viabilty: 71% at 1:25, 49% at 1: 10, 12% at 1:3 dilution (1×10^4 cells/well for 24 h)	No cytotoxicity in normal peripheral lymphocytes	[63]
30. Nickel oxide nanoparticles using leaf extract	H_2O	HT-29 (colon carcinoma)	IC_{50}: 125 µg/mL	Induction of apoptosis by ROS generation	[64]
31. Palladium nanoparticles using flower extract	H_2O	A549 (lung carcinoma)	88% cell viability at 1: 3 dilution 2×10^4 cells/well	Not induce toxicity in normal healthy peripheral lymphocytes	[65]

Abbreviations: Volume doubling time (VDT), growth delay (GD), MST: Mean survival time, ILS: Increase in life span, NDRG1:N-Myc Downstream Regulated 1, ROS : Reactive oxygen species, Nrf2: Nuclear factor-erythroid 2 p45-related factor 2, PARP-1: Poly (ADP ribose) polymerase

anticancer drugs (like doxorubicin) act as apoptosis inducer in several cancer cells by up regulating pro-apoptotic protein expression and also down regulating the expression of antiapoptotic proteins.

Conclusion

Moringa oleifera is not only an amazing tree with high nutritional values, but also a potential source of cytotoxic compounds for the treatment of various cancers. It is very unfortunate that there is no report on the clinical trial of the anticancer efficacy of the crude extracts of any part or isolated compounds from this plant. So, more extensive research works need to be done to isolate and characterize novel compounds from different parts of this plant which will have possible tumour inhibitory activity. These studies should be extended to molecular level to understand the exact mechanism of action of

individual components in cancer cells. Moreover, investigation should be done to unfold its toxic effects and also to establish the safe use of *Moringa oleifera* for the welfare of mankind as natural anticancer medicines either individually or in combination with other drugs used in cancer therapy.

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