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Chapter 5

Anticancer Plants in Islamic Traditional Medicine

Behjat Javadi, Milad Iranshahy and Seyed Ahmad Emami

Additional information is available at the end of the chapter

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Abstract

Islamic Traditional Medicine (ITM) is a holistic and comprehensive medical school that has antecedents over 12 centuries ago.

In ITM, cancer was a known disease with many options for treatment. Razi (Razhes; 865-925 AD), Ahwazi (Haly Abbas; 930-994 AD), Avicenna (980-1037AD), Jorjani (1042-1136 AD), and Aqili Khorasani (18th century) are among eminent physicians who discussed different types of cancers and their management in their books. They used a large number of plant species for treatment of different tumors.

Although modern medicine has made tremendous advances in cancer control, the effectiveness of its therapeutic approach is often limited by toxic effects on other organs. Moreover, a large number of people in the world have limited or no access to cancer treatment services. Accordingly, benefiting from traditional medicine schools and effective natural medicines to prevent and control cancer would be valuable. In addition, using the teachings of such schools can lead to the discovery of new bioactive compounds and therapeutic methods.

In this chapter, a brief history of Islamic medicine and its approach to treat cancer as well as anticancer medicinal plants have been discussed. Out of 107 ITM suggested plant species, 59 plants or their chemical compounds have proven to possess cytotoxic and antitumor activities using pharmacological investigations. These findings show the profound insight of ITM physicians into cancer treatment.

Keywords: Anticancer Plants, Cancer treatment

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1. Introduction

Islamic Traditional Medicine (ITM) is a holistic system of medicine which flourished during the Islamic Golden Age (750-1258 AD). It was practiced and taught throughout the Islamic territory. In that era, Muslim and non-Muslim medical scholars, especially Iranian physicians and pharmacists, translated the scientific knowledge which they inherited from ancient Greece and Iran. They endeavored to revive and develop this medical knowledge, remove superstitious ideas and faults from it, and establish an authentic medical school. Although most ITM scientists were not Arabs, the majority of their books are written in Arabic, the lingua franca of the Islamic civilization. Razi (Razhes; 865-925 AD), Ahwazi (Haly Abbas; 930-994 AD), Avicenna (980-1037AD), Jorjani (1042-1136 AD), and Aqili Khorasani (18th century) are eminent Iranian physicians who had the most contributions to ITM promotion.

Although significant progress has been made in cancer control in the last few decades, the effectiveness of modern therapeutic approach is often limited by toxic effects on other organs. Moreover, a large number of people in the world have limited or no access to cancer treatment services. Accordingly, utilizing information from traditional medicine systems to identify alternative methods to prevent and control cancer would be desirable. Furthermore, use of traditional medicine can lead to the discovery of new bioactive compounds as well as available, safe and affordable drugs.

In Islamic medicine, cancer was a known disease with many options for treatment. In the majority of ITM textbooks there is a chapter dedicated to cancer definition, symptoms, etiology, diagnosis, prevention, and management.

In this chapter we will discuss cancer, its etiology and management in the view of Islamic Traditional Medicine. In addition, ITM medicinal plants used to treat different types of cancers and modern pharmacological data confirming their traditional usage will be inserted in tables.

2. Cancer definition from ITM point of view

ITM is based on the theory of humorism which posits that the human body consists of four basic fluids, namely humors. The four humors are blood, phlegm, yellow bile, and black bile and each one corresponds to paired qualities: blood is hot and wet, phlegm is cold and wet, yellow bile is hot and dry, and black bile is cold and dry. A proper balance between humors is essential to maintaining health. Accordingly, all diseases and disabilities including cancer result from an excess or putridity of these humors.

According to ITM, cancer is a kind of black bile swelling which is accompanied by pain, pulsation, inflammation, and angiogenesis [1]. Blood vessels surrounding a tumor are overfilled and stiff and contain a dark and black blood [2]. The reason for the appellation "cancer" is due to the similarity between the shape of a cancerous tumor affecting an organ and a crab grasping its prey. It may also due to the spherical shape and darkness of tumor and origination of blood vessels from its milieu which resembles crab's feet [3]. Cancer frequently

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affects soft and porous organs and for this reason, it mainly involves breast and innervated organs (such as uterus) in females, and throat, larynx, testicles and penis in males [1].

Initially, cancer is the size of a broad bean or smaller, hard, spherical, mobile, dark, and slightly warm [3]. It will then begin to grow gradually and reach to the size of a walnut or larger. It might be curable during its early stages of development, but diagnosis is difficult in these stages. On the other hand, upon progression and appearance of clinical manifestations, treatment of cancer would be difficult or even impossible [1].

Ocular, nasal cavity, breast, uterine, liver, and other visceral organs and skin cancers are among the most frequently mentioned cancers in ITM texts. Cancers are divided into two main types: ulcerative and nonulcerative cancers.

Some cancerous tumors are easily ulcerated but some others are not. Cancerous wounds usually spread centripetally and their discharges are purulent. Use of appropriate medications can prevent the ulceration of susceptible tumors. In contrast, some cancerous tumors that are not prone to ulceration would be ulcerated following the administration of improper drugs [1].

Advanced and large tumors are very sensitive and painful, with a distinctive red to yellow color and a caustic and burning pain. Such tumors might erupt spontaneously and a purulent and bloody discharge may appear on wound surface. The resulting wounds are very sensitive and can produce corrosion in surrounding tissues [2].

3. Cancer etiology

According to ITM, excessive accumulation of abnormal black bile in a body site is the main cause of cancer. Aging, prolonged stress exposure, consuming cold and dry food items and hardwork are leading causes of increasing black bile production [1]. In some cases, hemorrhage (such as menstruation, abnormal uterine hemorrhage, or hemorrhoids bleeding) is a defending mechanism against the accumulation of bad humors in the body. Therefore, completely stopping the bleeding by surgical procedures and other medications can result in a black bile accretion and consequently increasing the risk of cancer and other diseases originating from excessive black bile (including cancer, melancholia, liver problems, psoriasis, etc.) [2].

4. Cancer management

Islamic traditional medicine suggested multiple strategies to the control and treatment of cancer. Surgical manipulation, venesection, diet adjustment, and use of natural medicines including solid, semisolid, and liquid dosage forms with oral and external route of administration are among these methods.

4.1. Surgery and manipulation

Surgery is used to eradicate tumors in their early stages of development. Small tumors which are distant from vital organs are good candidates for surgery. The tumor should be cut from

its origin and some parts of adjacent nonaffected tissues should be excised as well. In addition, bleeding should be allowed until large blood volumes come out and surrounding tissue should be pressed in order to expel blood mixed with black bile thoroughly. Afterwards, the injured site should be salved or cauterized. However, if the cancerous tumor is located in the vicinity of sensitive and vital organs, surgical procedure and cauterization would be very dangerous and may change the cancer to a nonhealing ulcer [2, 4].

Regular venesection is also suggested during the initial phases of cancer, to withdraw black bile blood from body.

4.2. Nutrition therapy

In Islamic traditional medicine, dietary recommendations have been proposed to slow the progression of advanced tumors that cannot be manipulated due to metastasis concerns. In these cases, nutritional care would increase the longevity of patients. Food items with wet temperament which produce high-quality blood like beer, almond oil, fresh small fishes, soft-boiled egg yolk, lamb, bird meat, ripe and sweet apples, sweet plums, bananas, raisin, black gram (*Vigna mungo* (L.) Hepper), spinach (*Spinacia oleracea* L.), pumpkin, light wine, and fresh cow's milk and dough are administered [1]. On the other hand, excessive intake of foodstuffs which induce black bile production in the body (such as eggplant (*Solanum melongena* L.), lentil (*Lens esculenta* Moench), date (*Phoenix dactylifera* L.), cabbage (*Brassica oleracea* L.), beef, black and thick wine, and salt-cured meat) is severely restricted [5].

4.3. Pharmacotherapy

As mentioned above, from the Islamic Traditional Medicine point of view, an excess of abnormal black bile in various body sites can lead to cancer formation. In order to treat cancer, black bile should be expelled from the body by using an appropriate purgative, and then preventing the generation and accumulation of black bile in vessels as far as possible [2]. For this purpose, many single and compound medications of herbal, animal, and mineral origin have been recommended.

The essential point in pharmacotherapy of cancers and tumors is avoiding the use of caustic and irritant medications to prevent further stimulation and ulceration [2].

Cancer medications can be administered internally (oral, enemas, vaginal douches, etc.) or applied topically (cataplasms, topical oils, liniments, lotions, dusting powders, etc.) [1, 3]. Administration of local anticancer drugs has the following purposes: cancer eradication, metastasis prevention, preventing ulceration, and healing ulcerated tumors.

5. Mechanisms of action of anticancer drugs

Anticancer drugs act through different mechanisms:

i. **Black bile purgatives** are common anticancer drugs which can facilitate elimination of abnormal black bile from whole body. Purgatives should be administered fre-

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quently. From the ITM point of view, clover dodder (*Cuscuta epithymum* Murr.) is the most valuable black bile purgative, which is commonly used to treat diseases caused by a surplus or imbalance of this humor such as all types of cancer, melancholia, leprosy, vitiligo, etc. For this purpose, a mixture of clover dodder with cheese whey or hydromel should be administered frequently. A decoction of the plant in oxymel is also prescribed [3]. Common polypody (*Polypodium vulgare* L.), French lavender (*Lavandula stoechas* L.), colocynth [*Citrullus colocynthis* (L.) Schrad.], and black hellebore (*Helleborus niger* L.) are other potent black bile purgatives.

ii. **Antiulcer drugs** can inhibit ulceration of tumors. *Urtica pilulifera* L. and *Aloe vera* (L.) Burm.f. are examples of such plants.

iii. **Wound-healing medications** accelerate healing of cancerous wounds. *Althaea officinalis* L., *Brassica oleracea* L., and *Viola odorata* L. have wound-healing activity.

iv. **Analgesic drugs** relieve cancer pain. *Parietaria officinalis* L. and *Solanum nigrum* L. are plants with analgesic effect.

6. Anticancer plants

One hundred and seven plant species from 53 families have been mentioned to be effective in the management and curing of different types of cancers. Plants Latin and Arabic names, their families, medicinal parts, dosage forms, and routes of administration are given in Table 1.

Scientific name	Family	Arabic common name	Part used	Cancer type	Administration and locality	Ref.
Acacia nilotica (L.) Delile syn. *Acacia arabica* (Lam.) Willd.	Fabaceae	samgh	G	eye	ocular suppository	[3]
Allium ampeloprasum L. syn. *Allium porrum* L.	Liliaceae	korrath	Le	all types	decoction(O)	[6]
Aloe vera (L.) Burm.f.	Liliaceae	sabr	Sa	uterus ulcerating tumor internal organs	unguent powder(E) decoction(O) pill(O)	[1, 3]
Alpinia officinarum Hance	Zingiberaceae	khawlanjan	Rh	all types	electuary(O)	[8, 9]
Althaea officinalis L.	Malvaceae	khatmi	R	all types uterus	liniment cataplasm vaginal bath	[1, 3] [2, 7]
Alyssum homalocarpum (Fisch. & C. A.Mey.) Boiss.	Brassicaceae	tudari urisimun	Se	internal organs skin	cataplasm	[2, 5, 9-11]

Scientific name	Family	Arabic common name	Part used	Cancer type	Administration and locality	Ref.
Amaranthus blitum L.	Amaranthaceae	baghlat al-yamaaniah	Ap	uterus	cataplasm	[7]
Anchusa azurea Mill. syn. *Anchusa italica* Retz.	Boraginaceae	lesan al-thawr	Le	all types	syrup	[7]
Anethum graveolens L.	Apiaceae	shebeth	Ap	uterus	unguent topical oil	[1, 3]
Beta vulgris L.	Chenopodiaceae	salq	Le	all types	decoction(O)	[6]
Boswellia sacra Flueck. syn. *Boswellia carteri* Birdw.	Burseraceae	kondor	Ogr	eye	condensed smoke as collyrium	[2, 3, 5, 8, 9]
Brassica oleracea L.	Brassicaceae	karnab	Le Fl	uterus all types skin	unguent decoction(E) vaginal bath cooked(O) cooked (E)	[1, 3, 7] [6, 8, 9]
Capparis spinosa L.	Capparaceae	kabar	Rb	uterus all types	unguent cataplasm	[3] [1, 5]
Carthamus tinctorius L.	Asteraceae	moasfar	Se	all types	raw seeds(O)	[6]
Carum carvi L.	Apiaceae	kerawia	Se	all types	raw seeds(O)	[6]
Cassia fistula L.	Fabaceae	khiar shanbar	Lg	tongue ulcerated cancer uterine	extract (E)	[3] [12]
Chamaemelum nobile (L.) All.syn. *Anthemis nobilis* L.	Asteraceae	babunaj	Fl	uterus	unguent topical oil decoction(E)	[1, 3, 7, 12]
Cicer arietinum L.	Fabaceae	homs	Se	skin all types ulcerating tumor	cooked(O) infusion(E) cataplasm	[8, 9] [2]
Cichorium intybus L.	Asteraceae	hindeba	Le	uterus all types ulcerating tumor	extract(E) cataplasm extract(O) cataplasm	[1, 6, 8] [7]
Cinnamomum cassia (L.) J.Presl	Luraceae	salikhah	Br	liver	electuary	[2]
Cistus creticus L. syn. *Cistus ladaniferus* Curtis	Cistaceae	ladan	Fl	all types	oil (E)	[3]

http://dx.doi.org/10.5772/61111

Scientific name	Family	Arabic common name	Part used	Cancer type	Administration and locality	Ref.
Citrullus colocynthis (L.) Schrad.	Cucurbitaceae	hanzal	Fr	internal organs	decoction(O) pill(O)	[1]
Commiphora mukul (Hook. ex Stocks) Engl.	Burseraceae	moql	Ogr	uterus	unguent	[1, 3, 7]
Convolvulus pseudoscammonia C. Koch	Convolvulaceae	saqmunia	Rdj	internal organs	decoction(O) pill(O)	[1]
Cordia myxa L.	Boraginaceae	debgh	Fr	uterine cancer	decoction(O)	[12]
Coriandrum sativum L.	Apiaceae	kozborah	Le Se	eye uterus skin all types	extract(E) cataplasm vaginal douche cataplasm extract (E)	[1] [1, 3] [2, 7, 9] [8, 9] [6, 7]
Crocus sativus L.	Iridaceae	za`afaran	St	eye uterus metastatic ulcerating tumor liver	cataplasm cataplasm cataplasm electuary	[3] [1, 2, 11, 13] [12] [2]
Cucurbita maxima Duchartre, *Cucurbita pepo* L.	Cucurbitaceae	qar`a	Fr	internal organs	cooked (O) extract lotion	[1, 6-8]
Cuscuta epithymum (L.) L.	Cuscutaceae	aftimun	Ap	all types ulcerating tumor	powder(O) decoction(O)	[1-4, 6, 8-10]
Cymbopogon schoenanthus (L.) Spreng.	Poaceae	ezkher	Fl	liver	electuary	[2]
Cynara scolymus L.	Asteraceae	kankarzad	G		cataplasm	[2]
Dorema ammoniacum D. Don	Apiaceae	oshaq	Ogr	all types	unguent	[3, 8, 14]
Dracunculus vulgaris Schottsyn. *Arum dracunculus* L.	Araceae	luf al-hayyah	Be Se	nose breast testicle	extract decoction(E)	[2, 3, 5, 8-10] [2]
Ecballium elaterium (L.) A. Rich.	Cucurbitaceae	qetha al-hemar	Fr	all types	liniment(E)	[1, 3]
Erysimum × *cheiri* (L.) Crantz syn. *Cheiranthus* ×*cheiri* L.	Brassicaceae	kheiri	Fl	all types uterus	oil(E)	[3, 7] [12]
Ferula gummosa Boiss.	Apiaceae	ghennah	Ogr	all types	unguent	[8]
Ficus carica L.	Moraceae	teen	Fr	tongue all types	cooked(E) cooked (O)	[3] [6]

Scientific name	Family	Arabic common name	Part used	Cancer type	Administration and locality	Ref.
				ulcerating tumor uterus	cataplasm cataplasm	[12, 13] [7]
Glycyrrhiza glabra L.	Fabaceae	sous	R	all types uterus	syrup vaginal douche	[7, 15]
Helleborus niger L.	Ranunculaceae	kharbaq aswad	R	internal organs	decoction(O) pill(O)	[1, 7, 10]
Hordeum vulgare L.	Poaceae	sha`eer	Se	all types	decoction(O)	[1, 3, 6, 7]
Inula helenium L.	Asteraceae	rasan	R	skin	lotion	[14]
Iris × germanica L. syn. *Iris ×florentina* L.		irsa	R	uterus	unguent	[3]
Jasminum sambac (L.) Aiton *Aegle marmelos* (L.) Corrêa ex Roxb.		razeqi	Fl	uterus	unguent topical oil	[3]
Juglans regia L.	Juglandaceae	Jawz	G	ulcerating tumor	dusting powder(E)	[2, 14]
Lactuca sativa (L.) Mill.	Asteraceae	khas	Le	all types uterus	extract(E) cataplasm	[1, 3] [6, 7]
Laurus nobilis L.	Lauraceae	hab al-ghar	Se	tongue uterus	cataplasm cataplasm	[1, 3] [7]
Lavandula stoechas L.	Lamiaceae	ostokhoddus	Ap	internal organs	decoction(O) pill(O)	[1]
Lawsonia inermis L	Lythraceae	henna	Le	uterus	unguent oil(E)	[3]
Lens culinaris Medik. syn. *Lens esculenta* Moench	Fabaceae	adas	Se	uterus ulcerating tumor	vaginal douche cataplasm	[3] [7]
Lilium candidum L.	Liliaceae	susan	Fl	uterus	unguent oil (E)	[1, 3]
Linum usitatissimum L.	Linaceae	katan	Se Mu	all types uterus	unguent oil (E) vaginal bath decoction (E)	[3] [1, 2, 7]
Liquidambar orientalis Mill.	Altingiaceae	mi`a	Ba	all types	unguent	[3]
Lycium afrum L	Solanaceae	hozoz	Le Fs	uterus	extract vaginal douche	[15]
Malva pusilla Sm. syn. *Malva rotundifolia* L.	Malvaceae	khabaazi	Fl	uterus	vaginal bath cataplasm	[7]
Melilotusofficinalis (L.) Pall.	Fabaceae	eklil al-malek	pod	eye	cataplasm	[1, 3]

http://dx.doi.org/10.5772/61111

Scientific name	Family	Arabic common name	Part used	Cancer type	Administration and locality	Ref.
				uterus		[2]
Melissa officinalis L.	Lamiaceae	badranjbuyeh	Le	all types	syrup	[7]
Myrtus communis L.	Myrtaceae	as	Se Le	all types	topical oil extract enema	[14]
Narcissus tazetta L.	Amaryllidaceae	narjes	Fl	uterus	unguent topical oil	[1, 3]
Olea europaea L.	Oleaceae	zeytun	Fr	uterus metastatic cancerous wounds	topical oil oil sediment (E) cataplasm	[1, 3] [13]
Opopanax chironium W.D.J.Koch	Apiaceae	jawshir	Ogr	all types	unguent	[3, 14]
Origanum syriacum L. syn. *Origanum maru* L.	Lamiaceae	mormahur	Ap	metastatic cancerous wounds	cataplasm	[13]
Papaver somniferum L. var. *album* (Mill.) M.A. Veselovskaya	Papaveraceae	khashkhash	Se Sa	eye uterus	ocular suppository cataplasm	[3] [1-3, 5, 12]
Parietaria officinalis L.	Urticaceae	hashishatah al-zojaj	Le	all types	extract(E)	[5]
Phoenix dactylifera L.	Arecaceae	tamr	Fr	tongue	decoction(E)	[3]
Physalis alkekengi L	Solanaceae	kaknaj	Fr	all types uterus	extract(E) unguent	[7] [15]
Pinus gerardiana Wall. ex D.Don	Pinaceae	jalghuzah	N	all types		[6]
Pinus spp.	Pinaceae	ratinaj	Re	uterus	cataplasm	[7]
Pistacia atlantica Desf. *Pistacia terebinthus* L.	Anacardiaceae	elk al-anbat	Ogr	uterus all types	unguent	[1, 3, 6, 8]
Pistacia lentiscus L.	Anacardiaceae	mastaki	Ogr	all types	unguent oil(E)	[1, 3] [6]
Plantago indica L. syn. *Plantago psyllium* L.	Plantaginaceae	bazr qotuna	Se Mu	ulcerating tumor intestine all types	liniment enema	[3, 8] [14]
Plantago major L.	Plantaginaceae	lesan al-hamal	Se Mu Le	uterus ulcerating tumor	vaginal douche cataplasm	[1-3, 7, 12]
Plantago ovata Forssk.	Plantaginaceae	isbaghul	Se Mu	all types uterus	vaginal douche	[1, 6] [7]

Scientific name	Family	Arabic common name	Part used	Cancer type	Administration and locality	Ref.
syn, *Plantago ispaghula* Roxb. ex Fleming						
Platanus orientalis L.	Plantanaceae	dolb	Le	skin	decoction (E) vaginal bath	[2]
Polygonum aviculare L	Polygonaceae	asa al-ra`ee	Ap	uterus	unguent extract (E)	[7, 15]
Polypodium vulgare L.	Polypodiaceae	basfayaj	Rh	internal organs	decoction(O) pill(O)	[1, 7]
Polyporus officinalis (Vill.) Fr.	Polyporaceae	ghariqun		all types	decoction(O)	[4, 7]
Portulaca oleracea L.	Portulaceae	rejlah	Le	ulcerating tumor all types uterus	extract liniment enema extract(O)	[3, 8] [1] [6] [7]
Prunus dulcis (Mill.) D.A.Webb	Rosaceae	samgh al-llawz	G So Se	uterus all types	unguent oil (O)	[1, 3, 6, 12]
Punica granatum L.	Punicaceae	romman	Fr Fp	nose ulcerating tumor	juice(O)	[1] [7]
Raphanus raphanistrum subsp. *sativus* (L.) Domin syn. *Raphanus sativus* L.	Brassicaceae	fojl	tro	all types	decoction(O)	[6]
Rhus coriaria L.	Anacardiaceae	sumaagh				
Ricinus communis L.	Euphorbiaceae	kherwa`a	Se	uterus	unguent oil (E)	[1, 3]
Rosa × *damascena* Herrm.	Rosaceae	ward	Fl	eye uterus ulcerating tumor	oil(E) cataplasm vaginal douche oil	[1] [2, 3, 7, 12]
Salix aegyptiaca L.	Salicaceae	khelaf	W	skin	dusting powder(E)	[2]
Sempervivum tectorum L.	Crassulaceae	hay al-alam	Fl	all types	extract liniment	[3, 7]
Sesbania bispinosa (Jacq.) W. Wight	Fabaceae	sisban	Le		cataplasm	[9]
Sisymbrium officinale (L.) Scop. syn. *Erysimum officinale* L.	Brassicaceae	arismun, khabbe	Se	hard swelling cancer nonulcerating tumor	cataplasm cataplasm cataplasm cataplasm	[8, 9] [2]

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Scientific name	Family	Arabic common name	Part used	Cancer type	Administration and locality	Ref.
				ear breast testicle		
Smilax china L.	Smilacaceae	khashab sini	R	skin	decoction(O)	[8]
Solanum americanum Mill. syn. *Solanum nigrum* L.	Solanaceae	enab al-tha`alab	Le	uterus all types skin	cataplasm extract cataplasm	[1-3, 6, 7] [7] [5, 8-10]
Spinacia oleracea L.	Chenopodiaceae	esfanakh	Le	internal organs	cooked (O)	[1, 6]
Tamarix gallica L.	Tamaricaceae	tarfa	Le R Sh	all types spleen	decoction(O)	[5]
Tanacetum parthenium (L.) Sch.Bip.	Asteraceae	oqhowan	Fl	skin uterus	extract cataplasm unguent oil(E)	[9] [1, 3]
Terminalia bellirica (Gaertn.) Roxb.	Combretaceae	amolaj	Fr	all types	liniment	[7]
Terminalia chebula Retz.	Combretaceae	ehalilaj kaboli	Fr	internal organs	decoction(O) pill(O)	[1]
Trigonella foenum-graecum L.	Fabaceae	holbah	Se mu	tongue uterus all types	infusion(E) oil(E) decoction(E)	[3] [1, 6, 7]
Triticum spelta L.	Poaceae	khondorus	Se	all types	baked(O)	[6]
Urtica pilulifera L.	Urticaceae	anjorah	Se Le	all types skin ulcerating tumor	cataplasm ash dusting powder(E)	[3, 8, 9, 11, 13] [2]
Valeriana celtica L.	Valerianaceae	sonbol	R	liver	electuary	[2]
Vigna mungo (L.) Heppersyn. *Phaseolus mungo* L.	Fabaceae	maash	Se	internal organs	cooked(O)	[1, 6]
Viola odorata L.	Violaceae	banafsaj	Ap	uterus	decoction(E) vaginal bath	[7, 15]
Vitis vinifera L.	Vitaceae	enab	Urf verjuice Rf Fr Fl	all types tongue all types skin	cataplasm concentrated juice(O) raw Fr(O) cataplasm	[3, 6, 7] [6] [6, 10] [10] [12]

Scientific name	Family	Arabic common name	Part used	Cancer type	Administration and locality	Ref.
				ulcerating tumor uterine cancer uterus	decoction(E) unguent	
Zingiber officinale Roscoe	Zingiberaceae	zanjabil	Rh	liver skin	electuary lotion	[2] [14]
Ziziphus jujuba Mill. syn. *Ziziphus vulgaris* Lam.	Rhamnaceae	onnab	Fr	ulcerating tumor uterus	decoction(O)	[12]

Use: E = external use, O = oral use. Part used Ap = aerial parts, Ba = balsam, Be = berries, Br = bark, Ff = fresh fruit, Fl = flowers, Fp = fruit pericarp, Fr = fruit, G = gum, Gre = gum resin, Le = leaves, Mu: mucilage, N = nuts, O = oil, Ogr = oleo-gum resin, Ore = oleoresin, R = root, Rb = root bark, Re = resin, Rdj = Root dry juice, Rf = Ripe fruit, Rh = rhizome, Se = seeds, Sh =shoots, So = seed oil, St = stigma, Tap root = Tro, Sa = sap, Urf = Unripe fruit, W = wood, Wp = whole plant.

Table 1. Medicinal plants mentioned in Islamic Traditional Medicine textbooks effective in the management of cancer.

7. Anticancer and cytotoxic activities of ITM plant species

Many ITM-suggested plants have been shown to exert anticancer activities with different mechanisms such as cytotoxic, antitumor, antiproliferative, cytostatic, and cell-migration-inhibiting effects. Pharmacological data reinterpreting ITM evidence of cancer phytotherapy are given in Table 2.

Species	Plant part(s)/compound	Solvent	Activity	Cell line	Ref.
Aegle marmelos (L.) Corrêa ex Roxb.	Stem bark	ethanol	cytotoxic	K-562, Raji, Jurkat, HEL, Colo38, HL-60, CEM, B-16, MCF-7 and MDA-MB-231	[16-18]
		methanol, ethyl acetate and n-hexane		Brine shrimp	[19]
	Stem bark, roots and leaves/Zeorin, dustanin, aegeline, epilupeol, lupenone and marmin	-		CEM-SS	[20]
	1-hydroxy-5,7-dimethoxy-2-naphthalene-carboxaldehyde (marmelin)	-	antitumor	HCT-116 colon cancer cell tumor xenograft in nude mice	[21]
Allium porrum L.	Bulbs/12-keto-porrigenin and 2,3-seco-porrigenin	-	antiproliferative	J774, WEHI 164, P388 and K3R-1	[22]

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Species	Plant part(s)/compound	Solvent	Activity	Cell line	Ref.
	Bulbs/Porrigenins A and B	-		IGR-1, J774, WEHI 164 and P388	[23]
	Saponins	-		J774 and WEHI 164	[24]
	Leaves	aqueous ethanolic extract (70%)	cytotoxic	K562	[25]
	Flavonoids	-		MCF-7	[26]
	Di(2-ethylhexyl)phthalate	-		K562, HL60 and U937	[27]
Aloe vera (L.) Burm.f.	Aloe-emodin	-	cytotoxic and antitumor	Neuroblastoma cells (IMR-32, IMR-5, AF8, and SJ-N-KP), pPNET cells (TC32) and Ewing's sarcoma cells (TC106)	[28]
				PC3	[29]
			cytotoxic	MCC	[30]
				U-373MG and U87 glioma cells	[31, 32]
				T24 human bladder cancer cells	[33]
				Gastric cancer cells	[34]
				MCF-7	[35]
			antitumor	Ehrlich ascitis carcinoma (EAC)	[36]
Anthemis nobilis L.	Sesquiterpene lactones	-	cytotoxic	HeLa and KB	[37]
Beta vulgris L.	Root extract and betanin	water	cytotoxic and antitumor	MCF-7, PC3 and HepG2	[38-41]
Boswellia carteri Birdw.	α and β-boswellic acid acetate from resin	-	cytostatic-inhibits cell migration	KB, HCT-8, A2780 and B16F10	[42]
			cytotoxic	HT-1080	
	Triterpene acids from resin			IMR-32, NB-39 and SK-N-SH	[43]
	Frankincense oil			The bladder carcinoma J82	[44]
	Verticilla-4(20),7,11-triene			Hep-G2	[45]
Brassica oleracea L.	Sulforaphane	-	cytotoxic	MDAH 2774 and SkOV-3	[46]
	Erucin			CACO-2, HL60, K562 and LNCaP	[47]
	Leaves	acidified methanol		HeLa and HepG2	[48]
	2-Pyrrolidinone reach extract			PC3 and HeLa	[49]
	Brassinin	-		PC3	[50]

Species	Plant part(s)/compound	Solvent	Activity	Cell line	Ref.
Capparis spinosa L.	Polysaccharides and alkaloids from fruits	water	cytotoxic and antitumor	HepG2 and transplanted ascites tumor H22	[51, 52]
Carthamus tinctorius L.	*Carthamus tinctorius* and *Panax ginseng*	-	cytotoxic and antitumor	MDA-MB-231 breast cancer cell and normal human mammary gland cell lines	[53]
	Polysaccharide	-	antitumor	T739 lung cancer and S180 Sarcoma in mice	[54]
	Not mentioned	methanol	cytotoxic	HT-29	[55]
Carum carvi L.	Thymoquinone from seeds	-	cytotoxic	TNBC cells	[56]
Cassia fistula L.	Rhein from flowers	-	cytotoxic	COLO 320 DM	[57]
	Stem bark	methanol			[58]
	Furanoflavones from stem bark	-		NB4, A549, SHSY5Y, PC3, and MCF7	[59]
	Fistulaquinone A from fruits			NB4 and PC3	[60]
Cicer arietinum L.	C-25 protein	-	cytotoxic	KB cell line	[61]
Cichorium intybus L.	Leaves	chloroform	antiproliferative	HeLa, MCF7 and A431	[62]
	Lactucin and 13,14-seco-stigma 9(11),14(15)-dien-3alpha-ol	-	cytotoxic	A2780	[63]
Cinnamomum cassia (L.) J.Presl	Cinnamaldehyde	-	cytotoxic	HL60	[64]
	Bark	methanol/hexane/ethyl acetate		HeLa, A549, SK-OV-3, SK-MEL-2, XF-498 and HCT-15	[65]
		aqueous		SiHa	[66]
	2'-Benzoyloxycinnamaldehyde	-		LNCaP, PC-3 and DU145	[67]
	Coumacasia			HL60 and A549	[68]
Cistus creticus L.	Labdane-type diterpenoids from leaves	-	cytotoxic	KB, P-388; and NSCLC-N6	[69]
				CCRF-CEM, MOLT3, H33AJ-JA-13, HUT78, H9, KM3, NAMALWA, JIYOYE, DAUDI, SDK, K562, HL60 and U973	[70-72]
	Shoot	ethanol		HeLa, MDA-MB-453 and FemX	[73]
Commiphora mukul Engl.	Guggulsterones	-	cytotoxic	PC3, HL60 and U973	[74]
Coriandrum sativum L.	Linalool	-	antitumor	Sarcoma-180 solid tumor	[75]
	Leaves	ethanol	cytotoxic	HT-29	[76]

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Species	Plant part(s)/compound	Solvent	Activity	Cell line	Ref.
Crocus sativus L.	Stigma	ethanol	antitumor	Sarcoma-180 (S-180), Ehrlich ascites Carcinoma (EAC) and Dalton's lymphoma ascites (DLA)	[77]
				HeLa, A549 and HepG2	[78, 79]
	Crocin, crocetin, safranal and picrocrocin	-	cytotoxic	HeLa, MCF-7, PC3, k562 and HepG2	[80-86]
	Crocin		antitumor	C26 colon carcinoma	[87]
Cucurbita maxima Duchartre,	Seeds	methanol	cytotoxic	Brine shrimp	[88]
	Aerial parts		antitumor	Ehrlich ascites Carcinoma	[89]
	Triterpenes	-	cytotoxic	HL60 and P388	[90]
Cucurbita pepo L.	Leaves	hydroalcoholic	cytotoxic	HepG2 and CT26	[91]
Cuscuta epithymum Mur.	Aerial parts	chloroform and hydroalcoholic	cytotoxic	HeLa, HT29 and MDA-MB-46	[92]
Ecballium elaterium (L.) A. Rich.	Cucurbitacin E	-	cytotoxic	ZR-75-1, COLO 679, OV_95_CC3 and PC-3	[93, 94]
	Fruits	water		AGS and KYSE30	[95]
	Cucurbitacin-D	-		NSCLC-N6	[96]
Ficus carica L.	Leaves, fruits and latex	ethanol, ethyl acetate and dichloromethane	cytotoxic	HeLa	[97]
Glycyrrhiza glabra L.	Root		cytotoxic	4T1	[98]
Inula helenium L.	Root	methanol	cytotoxic	HT-29, MCF-7, Capan-2 and G1	[99]
		ethanol	cytotoxic	MDA-MB-23	[100]
Jasminum sambac (L.) Aiton	Leaves	ethanol	cytotoxic	Brine shrimp	[101]
Juglans regia L.	Juglanin A and B	-	cytotoxic	Hep G2	[102]
	Leaves	chloroform		BHY, MCF7, and HT-29	[103]
	Juglanones A and B	-		A549, MCF-7, BEL-7402, HeLa, COLO205, BGC-823, and SK-OV-3	[104]
	5,7-Dihydroxy-3,4′-dimethoxyflavone and regiolone			MCF-7 and BHY	[105]
Lactuca sativa (L.) Mill.	Sesquiterpene lactones	-	cytotoxic	HeLa and HCT-116	[106]
Laurus nobilis L.	Leaves	n-hexane	cytotoxic	Brine shrimp	[107]
	Sesquiterpene lactones	-		Jurkat	[108]

Species	Plant part(s)/compound	Solvent	Activity	Cell line	Ref.
				, HL-60 and LoVo	
				A2780	[109]
	Essential oil	-		C32, ACHN, LNCaP, and MCF-7	[110]
Lawsonia inermis L.	Bicoumarin, biflavonoid, and biquinone compounds from flowers	-	cytotoxic	MCF-7, Hela, HCT-116, and HT-29	[111]
Linum usitatissimum L.	Secoisolariciresinol and anhydrosecoisolariciresino l	-	cytotoxic	MCF-7 and MDA-MB-231	[112]
Melissa officinalis L.	Essential oil	-	cytotoxic	A549, MCF-7, Caco-2, HL-60, K562 and B16F10	[113]
	Aerial parts	ethanol		HCT-116	[114]
	Leaves	water	cytotoxic and antitumor	MCF-7, MDA-MB-468 and MDA-MB-231; DMBA-induced mammary tumors	[115]
	Citral and essential oil	-	cytotoxic	GBM	[116]
Myrtus communis L.	Phloroglucinols	-	cytotoxic	MT-4 cells, HepG2 and DU145	[117]
Narcissus tazetta L.	Alkaloids	-			[118]
	Stems and leaves	alkaloid extraction	cytotoxic	HL-60, K562, KT1/A3, and A3	[119]
Olea europaea L.	Erythrodiol	-	cytotoxic	HL-60	[120]
	Hydroxytyrosol rich extract from leaves	methanol/water		MCF-7	[121]
	Maslinic acid	-		HT29	[122]
	Tyrosol esters			MCF10A	[123]
Papaver somniferum L. var. *album* (Mill.) M.A.	Noscapine	-	anticancer	Refractory Multiple Myeloma, Non-Hodgkin's Lymphoma and Chronic Lymphocytic Leukemia	[124]
Physalis alkekengi L.	5α-Hydroxy-25,27-dihydro-4,7-didehydro-7-deoxyneophysalin A	-	cytotoxic	PC-3 and LNCaP	[125]
	Physalin			HT1080 and A375-S2	[126, 127]
Pistacia atlantica Desf.	Polyphenol-rich extract	ethanol/water	cytotoxic	HT29	[128]
Pistacia lentiscus L.	Gum extract	hexane	cytotoxic	HCT116	[129]
Plantago major L.	Leaves	hot water	cytotoxic	Antileukemia and anticarcinoma	[130]

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Species	Plant part(s)/compound	Solvent	Activity	Cell line	Ref.
	Luteolin-7-*O*-β-glucoside	-		TK-10, MCF-7 and UACC-62	[131]
Platanus orientalis L.	Flavonoids	-	cytotoxic	Human leukemic cell lines and skin cancer cell lines	[132-136]
Polygonum aviculare L	Aerial parts	methanol	cytotoxic	MCF-7	[137]
Portulaca oleracea L.	Triterpenoids	-	cytotoxic	HepG2	[138]
	Not mentioned	methanol		CNE-1, HeLa and HT-29 and MCF-7	[139]
	Seed			HepG2	[140]
	Alkaloids	-		K562, A549, MCF-7 and MDA-MB-435	[141]
Punica granatum L.	Genistein and extract	not mentioned	cytotoxic	MCF-7, MMTV-Wnt-1,	[142]
	Polyphenols	juice	cytotoxic and antitumor	BT-474 and MDA-MB-231	[143]
	Fruit rind extract and fowers	methanol	cytotoxic	A549 and MCF-7	[144-146]
	Galactomannan polysaccharide	-	cytotoxic and antitumor	A375, HCT116, and HepG2; DLA and EAC murine ascites and EAC solid tumor mouse models	[147]
Raphanus sativus L.	4-(Methylthio)-3-butenyl isothiocyanate	-	cytotoxic	murine leukaemia cell line (L1210)	[148]
	4-Methylthio-butanyl derivatives	-	cytotoxic	A549, SK-OV-3, SK-MEL-2, and HCT-15	[149]
Ricinus communis L.	Leaves	volatile oil	cytotoxic	SK-MEL-28 and HeLa	[150]
Rosa × damascena Mill.	Flowers	volatile oil	cytotoxic	SW742	[151]
Smilax china L.	Phenylpropanoid glycosides	-	cytotoxic	KB, HeLa, DLD-1, MCF-7, A-549 and Med	[152]
	Kaempferol-7-O-beta-D-glucoside			A375 and HL60	[153]
	Polyphenols			MCF-7 and MDA-MB-231	[154]
Solanum nigrum L.	Steroidal glycosides	-	cytotoxic	HT-29, HCT-15, LNCaP, PC-3, T47D, HepG2, NCI-H460, MCF-7, SF-268 and MDA-MB-231	[155, 156]
	Glycoprotein			MCF-7, HCT-116 and HT-29	[157-160]
	Aerial parts	methanol	cytotoxic	HeLa and Vero	[161]
	Leaves	water		AU565	[162]
	Not mentioned	hydro-alcoholic		HepG2 and CT26	[91]

Species	Plant part(s)/compound	Solvent	Activity	Cell line	Ref.
	Solamargine	-		K562	[163]
	Polyphenol rich extract	water		PZ-HPV-7	[164]
	Berries	ethanol		Jurkat and HL-60	[165]
Tanacetum parthenium L.	Parthenolide	-	anticancer	Leukemia	[166]
Terminalia chebula Willd. ex Flem.	Tannins	-	cytotoxic	A-549, SK-OV-3, SK-MEL-2, XF-498 and HCT-15	[167]
	Fruits	methanol		HOS-1	[168]
Trigonella foenum-graecum L.	Seeds	water	cytotoxic	HL-60	
				TCP, B-cell lymphomas, FRO and MCF7	[169]
	Diosgenin	-		A549	
Viola odorata L.	Cyclotides	-	cytotoxic	MCF-7 and MCF-7/ADR	[170]
Vitis vinifera L.	Resveratrol	-	cytotoxic	3T6 and HL60	[171]
	Seed extract	methanol		KB cells	[172]
	Viniferin-enriched extracts	ethanol/water		HCC1954, HCC1500 and MCF7	[173, 174]
Zingiber officinale Roscoe	[6]-Paradol and structurally related compounds	-	cytotoxic	KB	[175]
	Gingerols and diarylheptanoids	-		HL-60, A431, K562, HeLa, HCT-116, HT-29 and K562/ADR	[176-181]

Table 2. Anticancer activities of ITM plant species.

8. Conclusion

Taken together, it can be concluded that what physicians of Islamic medicine used for cancer treatment is proven through modern research. Out of 107 plant species which are introduced in Islamic Iranian medicine for cancer treatment, 59 plants or their chemical compounds have proven to possess cytotoxic and antitumor activity in recent investigations and some have entered clinical trials and their effectiveness has been evaluated on humans.

These findings show the profound insight of Islamic physicians on cancer treatment. In spite of the lack of modern facilities and developed equipment, they introduced anticancer plants that have shown cytotoxic properties in new researches. The correlation between these findings signifies the originality of past experiences and studies, representing a worthwhile fund and valuable science dating back more than twelve centuries. This heritage is based on the experiences of thousands years of Greek, Indian and ancient Iranian physicians and relies on immense number of clinical trials on thousands of people. Furthermore, the application of traditional medicinal knowledge reinterpreted by modern data can lead to more effective and

evidence-based use of medicinal plants, which can contribute to therapeutic decisions on different illnesses.

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