Saudi Pharmaceutical Journal 29 (2021) 1185–1204

Contents lists available at ScienceDirect

Saudi Pharmaceutical Journal

journal homepage: www.sciencedirect.com

Original article

Traditional medicinal knowledge of plants used for cancer treatment by communities of mountainous areas of Fez-Meknes-Morocco

Fatima Ez-Zahra Amrati [a,*], Mohammed Bourhia [b,*], Meryem Slighoua [a], Ahmad Mohammad Salamatullah [c], Abdulhakeem Alzahrani [c], Riaz Ullah [d], Amina Bari [a], Dalila Bousta [a]

[a] Laboratory of Biotechnology, Agrofood and environment (LBEAS), Faculty of Sciences Dhar El Mehraz, Sidi Mohamed Ben Abdellah University, Fez 30000, Morocco
[b] Laboratory of Chemistry, Biochemistry, Nutrition, and Environment, Faculty of Medicine and Pharmacy, University Hassan II, Casablanca, Morocco
[c] Department of Food Science & Nutrition, College of Food and Agricultural Sciences, King Saud University, P. O. Box 2460, Riyadh 11451, Saudi Arabia
[d] Department of Pharmacognosy (Medicinal Aromatic and Poisonous Plants Research Center), College of Pharmacy, King Saud University, P. O. Box 2457, Riyadh 11451, Saudi Arabia

ARTICLE INFO

Article history:
Received 19 July 2020
Accepted 11 September 2021
Available online 20 September 2021

Keyword:
Ethnopharmacology

ABSTRACT

Background: Since their existence on earth, humans have used herbal medicine to meet their requirements for medication. **The aim of the study:** This work refers to a study conducted to carry out an ethnopharmacological survey of medicinal plants used for the treatment of cancer in Fez-Meknes region of Morocco. **Material and Methods:** To achieve this goal, 300 informants including 237 local people and 63 herbalists. They were requested to fill a survey related questionnaire aiming at the collection of data - about the addressed objective. Informants were asked about the vernacular names, parts of medicinal plants used, mode of preparation, route of administration, reference area as well as the ecological distribution. The Relative Frequency of Citation (RFC) and Fidelity Level (FL) were calculated to identify the most effective plants recommended by informants for disease treatment. **Results**: The findings obtained in the present survey revealed that 94 species belonging to 47 families have been used for cancer treatment in the region of Fez-Meknes. Fruits, leaves, and seeds are the most commonly used plant parts, by the time powder and infusion arethe most common methods used fordrug preparations. **Conclusion**: This work may contribute towards the society as it provides interesting data on traditional medicinal knowledge of medicinal plantsused to fight cancer.

1. Introduction

Morocco is a Mediterranean country located in the North of Africa. It's geologically characterized by the presence of four large mountainous areas named the Rif, the Middle Atlas, the High Atlas, and the Anti-Atlas. Morocco is limited by the Mediterranean sea, the Atlantic Ocean on the north, and the west respectively as well as Sahara in the far south (El-Hilaly et al., 2003).

Morocco is known for its large variety of climatic conditions including both moderate humid and sub-humid climates (Born et al., 2009). The Moroccan flora is one of the richest and varied worldwide with about 4200 species. 22% of which are endemic to Moroccan soil. A large number of medicinal plants have been used by the Moroccan population to fight diseases and most of which got registered in Moroccan pharmacopeia (Rankou et al., 2013); (FENNANE and REJDALI, 2016).

Medicinal plants have widely been used as a natural source of remedies for curing multiple diseases including cancer. According to the World Health Organization (WHO), in developing countries, more than 80 % of people use herbal medicine in the treatment of different diseases (Benali et al., 2017).

Cancer remains one of the most common leading causes of death worldwide despite scientific advances in treatment options (World Health Organization, 2018). For this reason, researchers have a big interest in discovering new natural anticancer agents to mitigate this lethal disease. According to the World Health Organization, cancer was responsible for 9.6 million deaths in 2018. Moreover, about 70% of deaths from cancer occur in developing countries (World Health Organization, 2018).

* Corresponding authors.
E-mail addresses: fatima.ezzahra.amrati@gmail.com (F.E.-Z. Amrati), bourhia-mohammed@gmail.com (M. Bourhia).
Peer review under responsibility of King Saud University.

Production and hosting by Elsevier

https://doi.org/10.1016/j.jsps.2021.09.005
1319-0164/

Due to their accessibility and affordability, natural remedies are widely used in low-income countries to treat cancer (Kabbaj et al., 2012). Anticancer agents based herbal medicines play a crucial role in the daily routines of many urban and rural Moroccans lives. However, ethnopharmacological knowledge of some regions in Morocco, especially in Fez-Meknes region remains poorly known.

This survey aims at identifying the medicinal plants used for cancer treatment by the indigenous population of Fez-Meknes region of Morocco and to contribute towards society as it provides ethnopharmacological knowledge related to cancer treatment in the study area.

2. Materials and methods

2.1. Study area

The study was conducted in four sites within the Fez-Meknes region in Morocco (Fez, Moulay yacoub, Meknes, and Taounate) covering both rural and urban localities (Fig. 1) with the following coordinates; latitude 34 °022003 N□. Geographically, it approximately covers 40.075 Km^2 making 5.7% of the total land area of the national territory and populated with 4.236.892 people. The climate of the region ranges from the Mediterranean to the continental type, precipitation levels vary between 300 mm/year and 800 mm/a (la Direction Générale des Collectivités Locales, 2015).

Fez-Meknes region- Morocco is among the most recognized region in the country for use of traditional herbal medicine against diseases and, therefore, was selected for being a study area (Jouad et al., 2001); (Ammor et al., 2020).

2.2. Data collection

An ethnopharmacological survey was conducted from October 2016 until February 2017 in the Fez-Meknes region (Morocco). During this period, 300 informants including 237 local people (sellers, purchasers, consumers, cultivators, workers) and 63 herbalists living in different urban and rural areas were selected to be as informants. Afterward, informants were invited to respond to a face-to-face interview about the vernacular name of plants used to treat cancer, parts of plants used, methods of preparation, route of administration, frequency of use, plant- type of cancer treated, prescription, unique use of traditional medicine or combined of modern. Further questions on criteria of the selected informants including age, gender, education, healthcare choices were addressed in the survey. Afterward, the collected data was analysed and discussed according to the earlier literature.

Patients diagnosed with cancer in the study area, they use herbal medicines as an alternative treatment to fight cancer according to methods reported in the culture and knowledge inherited from previous generations either verbally or written. Based on the medical diagnosis that leads to the identification of cancer type, traditional healers recommend treatment protocols including natural preparations for patients according to the type of cancer diagnosed.

2.3. Data analysis

Data analysis as well as graphs were performed using Excel 10. Ethnobotanical data were calculated using quantitative indices such as the relative frequency of citation (RFC) and fidelity level (FL).

2.3.1. Relative frequency of citation

The relative frequency of citation (RFC) refers to the most commonly cited plants in the study area for use against diseases (Tardío and Pardo de Santayana, 2008). RFC was calculated according to the following formula:

RFC (%) = (FC /N) × 100

FC: Number of informants who use plant species against any disease

N: Total number of informants.

2.3.2. Fidelity level

Fidelity level (FL) was calculated to determine the most frequently used plant species to treat a particular disease.e. cancer in the study area (Friedman et al., 1986). Fidelity level (FL) was calculated according to the following formula:

FL (%) = Np/Ni*100

Np: Number of informants who claim the use of species to treat a particular disease

Ni: Total number of informants who claim the use of plant against any given disease

Plants have high FL values are considered the most preferred and effective species for the treatment of ailment categories (Friedman et al., 1986).

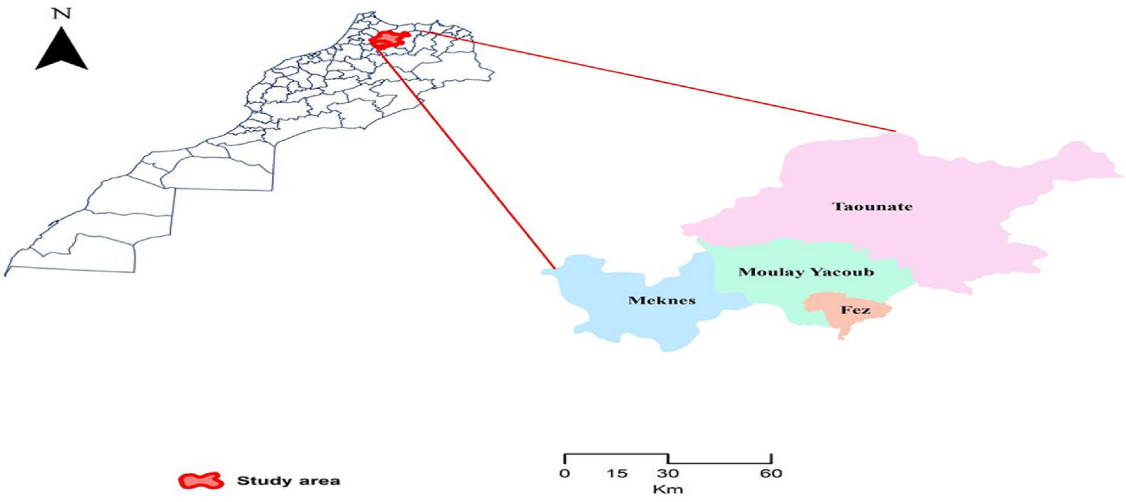

Fig. 1. Map of the study area (Fez- Meknes region- Morocco) with geographic boundaries.

Table 1
Medicinal plants used for the treatment of cancer in the region of Fez-Meknes Morocco.

Family Scientific name	Vernacular names	RCF (%)	FL %	Reference area(% of use)	Ecological distribution
Actinidiaceae					
Actinidia chinensis var. deliciosa (A.Chev.) A.Chev.	Kiwi	0.67	50	Fez (1) Meknes (1)	Cul
Aloaceae					
Aloe vera (L.) Burm.f	Sabar	2.67	57.14	Fez (6) Meknes (2)	Cul
Amaranthaceae					
Beta vulgaris L.	Barba	0.33	25	Meknes (1)	Cul
Annonaceae					
Annona cherimola Mill.	Chirimoya	1	33.33	Fez (3)	Imp
Apiaceae					
Petroselinum crispum (Mill.) Fuss	ma'adnūs	2.67	61.53	Meknes (2) Fez (5) Taounate (1)	Cul
Cuminum cyminum L.	Kemmūn	1	33.33	Fez (3)	Cul
Apium graveolens L.	Krāfes	1	60	Fez (3)	Sp/ Cul
Ammi visnaga (L.) Lam.	bešnīha	0.33	25	Fez (1)	Sp
Foeniculum vulgare Mill.	nāfa'	0.33	20	Taounate (1)	Sp/ Cul
Daucus carota L.	hizzu	1	37.5	Fez (2) Meknes (1)	Cul
Ammodaucus leucotrichus Coss.	kammūn eṣ-ṣōfi	0.33	33.33	Fez (1)	Sp
Pimpinella anisum L.	ḥabbat ḥalāwa	0.33	33.33	Taounate (1)	Cul
Thapsia garganica L.	Deryās	0.33	33.33	Fez (1)	Sp
*Magydaris panacifolia (*Vahl.) Lange	Frifra	0.33	50	Meknes (1)	Sp
Apocynaceae					
Apteranthes europaea (Guss.) Murb.	Daghmos	17.67	89.83	Taounate (3) Fez (40) Meknes (10)	Sp
Arecaceae					
Phoenix dactylifera L.	nnhel 'Jmar	0.33	20	Fez (1)	Sp
Aristelochiaceae					
Aristolochia longa L.	berezṭom	12	85.71	Fez (31) Meknes (3) Taounate (2)	Sp
Asteraceae					
Artemisia herba-alba Asso.	Chih	4	60	Fez (10) Meknes (1) Taounate (1)	Sp
Dittrichia viscosa (L.)	māgrāmān terhalā	1	60	Fez (2) Meknes (1)	Sp
Atractylis gummifera L.	Ddād	0.33	50	Fez (1)	Sp
Chamaemelum nobile (L.) All.	Bābnūj	0.33	14.28	Fez (1)	Cul
Cynara cardunculus L.	horšef	0.33	25	Fez (1)	Cul
Berberidaceae					
Berberis hispanica Boiss. & Reut.	Arġīs	3	64.28	Fez (6) Taounate (3)	Sp
Boraginaceae					
Borago officinalis L.	lisān aṯ-ṯūr	0.33	25	Fez (1)	Sp
Brassicaceae					
Lepidium sativum L.	ḥabb er-ršād	1.33	50	Fez (2) Meknes (1) Taounate (1)	Cul
Brassica oleracea L.	Suflur	0.33	50	Fez (1)	Cul
Brassica rapa L.	Left	0.33	33.33	Fez (1)	Cul
Raphanus raphanistrum subsp. sativus (L.) Domin	Lefjel	0.33	25	Taounate (1)	Cul
Sinapis alba L.	Khardal	1	50	Fez (1)	Sp /Cul
Cactaceae					
Opuntia ficus-indica (L.) Mill.	Hendi/zaaloul	1.33	50	Taounate (2) Meknes (2)	Sp/ Cul
Camelliaceae					
Camellia sinensis (L.) Kuntze	Atāy	1.67	41.66	Fez (4) Taounate (1)	Imp
Cannabaceae					
Cannabis sativa L.	l-kīf	0.33	25	Fez (1)	Cul
Capparidaceae					
Capparis spinosa L.	Kabār	2	60	Fez (2) Taounate (3) Meknes (1)	Sp
Caryophyllaceae					
Herniaria hirsuta L.	herras leḥjar	0.33	25	Meknes (1)	Sp
Cucurbitaceae					
Citrullus lanatus (Thunb.) Matsum. & Nakai	Hadja	0.33	25	Fez (1)	Sp

(*continued on next page*)

Table 1 (*continued*)

Family Scientific name	Vernacular names	RCF (%)	FL %	Reference area(% of use)	Ecological distribution
Cucumis sativus L.	hiyār	0.33	33.33	Fez (1)	Sp
Ephedraceae					
Ephedra alata Decne	l-a'lenda	0.67	40	Meknes (1) Fez (1)	Sp
Euphorbiaceae					
Euphorbia resinifera O.Berg	zakkūm /tikiūt ddaġmūs	0.33	25	Fez (1)	Sp
Fabaceae					
Vicia faba L.	Fūl	0.33	25	Fez (1)	Cul
Cicer arietinum L.	l-ḥommṣ	0.33	25	Fez (1)	Cul
Vicia ervilia (L.) Willd.	Kersenna	0.33	33.33	Fez (1)	Sp + cul
Trigonella foenum-graecum L.	l-ḥelba	4.67	53.84	Fez (12) Meknes(1) Taza(1)	Cul
Glycyrrhiza glabra L.	'arq as-sūs	0.33	16.66	Fez (1)	Sp
Fagaceae					
Quercus ilex L.	al-bellūṭ	0.67	28.57	Fez (1) Meknes (1)	Sp
Geraniaceae					
Erodium guttatum (Desf.) Willd.	Wadmi	1	13	Fez (1)	Sp
Lamiaceae					
Marrubium vulgare L.	merrīwut, merrīwa īfzi	7.33	62.85	Fez (14) Meknes (5) Taounate (2) My Yacoub (1)	Sp
Ajuga iva (L.) Schreb.	Sendgūra	1.33	44.44	Fez (3) Meknes (1)	Sp
Rosmarinus officinalis L.	Azīr	1.33	36.36	Fez (3) Taounate (1)	Sp + Cul
Origanum vulgare L.	Zaatar/Sahtar	1.67	33.33	Fez (3) Taounate (2)	Sp + Cul
Satureja granatensis (Boiss. & Reut.) Sennen & Mauricio	z'ītra	0.33	20	Taounate (1)	Sp
Salvia officinalis L.	Sālmiya	1.67	35.71	Fez (4) My Yacoub (1)	Cul
Origanum majorana L.	Merdedūš	1	33.33	Fez (3)	Cul
Lauraceae					
Cinnamomum camphora (L.) J.Presl	Kāfūr	0.33	33.33	Fez (1)	Imp
Liliaceae					
Allium sativum L.	ṯūm, ṯūma	9.33	63.63	Fez (19) Meknes (4) Taounate (5)	Cul
Allium cepa L.	l-beṣla hamra	3.33	55.55	Fez (5) Meknes(5)	Cul
Drimia maritima (L.) Stearn	Bsel l 'anṣal	0.67	33.33	Fez (2)	Sp
Allium ampeloprasum L.	Borrō	0.67	13	Fez (1) Meknes (1)	Cul
Linaceae					
Linum usitatissimum L.	zerrī'at l-kettān	2	60	Fez (2)	Cul
Malvaceae					
Malva sylvestris L.	l-hubbeyza	0.33	33.33	Taounate (1)	Sp
Meliaceae					
Rubia cordifolia L.	L'acajou	0.33	20	Meknes (1)	Cul
Mimosaceae					
Acacia raddiana Savi	ṭalḥ	0.33	20	Fez (1)	Sp
Vachellia seyal (Delile) P.J.H.Hurter	l-'alk	0.33	25	Fez (1)	Sp
Moraceae					
Ficus carica L.	qormīš	1.66	41.66	Fez (2) Taounate (3)	Cul
Myrtaceae					
Eugenia caryophyllata Thunb.	qoronfel	0.67	20	Fez (2)	Imp
Oleaceae					
Olea europaea L.	Zaytūn	2.67	42.10	Fez (7) Meknes (1)	Sp + Cul
Pedaliaceae					
Sesamum indicum L.	Jeljlān	0.67	25	Fez (2)	Cul
Pinaceae					
Cedrus atlantica (Endl.) Manetti ex Carrière	l-ārz	0.33	33.33	Taounate (1)	Sp
Pinus halepensis Mill.	Taydā	0.67	66.66	Fez (1)	Sp
Piperaceae					
Piper nigrum L.	l-yebzār	0.33	12.5	Fez (1)	Imp
Poaceae					
Hordeum vulgare L.	ša'īr	1	50	Fez (1)	Cul
Triticum aestivum L.	l-gemḥ	0.33	25	Fez (1)	Cul
Portulacaceae					

Table 1 (*continued*)

Family Scientific name	Vernacular names	RCF (%)	FL %	Reference area(% of use)	Ecological distribution
Portulaca oleracea L.	Rejla	0.33	50	Taounate (1)	Sp
Punicaceae					
Punica granatum L.	er-rummān	1.33	40	Fez (1) Taounate (2) Meknes (1)	Cul
Ranunculaceae					
Nigella sativa L.	Sānūj/ Haba Souda/ ḥabbet el baraka	10	71.42	Fez (18) Meknes (4) Taounate (4) My yacoub (4)	Cul
Rhamnaceae					
Ziziphus jujube Mill.	Nbak/Sadra	0.33	16.66	Taounate (1)	Sp
Rosaceae					
Fragaria × *ananassa* (Duchesne ex Weston) Duchesne ex Rozier	l-frez	0.33	50	Taounate (1)	Cul
Rutaceae					
Citrus aurantium L.	ḥāmmed beldī	1.33	40	Taounate (1) Fez (1)	Cul
Solanaceae					
Solanum lycopersicum L.	maṭīša	0.33	33.33	Fez (1)	Cul
Solanum tuberosum L.	bṭāṭa	0.33	50	Fez (1)	Cul
Urticaceae					
Urtica dioica L.	Horiga	0.67	40	Fez (2)	Sp
Vitaceae					
Vitis vinifera L.	Aanab	1	37.5	Taounate	Cul
Zingiberaceae					
Curcuma longa L.	harqum	2.67	57.14	Fez (8)	Imp
Zingiber officinale Roscoe	skenjbīr, skenjabīl	3	56.25	Fez (5) My Yacoub (1) Meknes (1)	Imp
Elettaria cardamomum (L.) Maton	qa'qolla	0.33	33.33	Fez (1)	Imp
Zygophylaceae					
Peganum harmala L.	Harmal	1.33	66.66	My Yacoub (3) Fez (1)	Sp

Sp: Spontaneous; Cul: Cultivated; Imp: Imported.
Informants provided data on plants used for the treatment of cancer in the fez Meknes region including methods of preparation, plant parts used as well as the administration mode. The obtained results are summarized in.

3. Results and discussion

Collected data on medicinal plants used for the treatment of cancer in the Fez- Meknes region was analysed based on the relative frequency of citation (RCF) and fidelity level (FL). RCF and FL values obtained in this work ranged from 0.33 % to 17.67 % and 12.5 % to 89.83 % respectively.

The present survey was carried out in the Fez Meknes region in 4 different locations (Fez, Moulay Yacoub, Meknes, and Taounate) in which it was recorded that 94 plant species belonging to 47 families have been used to fight cancer. These findings were partially in agreement with the earlier data which showed that 63 medicinal plants are traditionally used against cancer (Samouh et al., 2019).

The following medicinal plants were the most reported species in traditional use against cancer in the study area; *Apteranthes europaea* Guss (17.67 %), *Aristolochia longa* L. (12 %), *Nigella sativa* L. (10 %), *Allium sativum* L. (9.33 %) and *Marrubium vulgare* L. (7.33 %). On the other hand, our findings were in accordance with the earlier literature which reported that *Nigella sativa* L. and *Aristolochia longa* L. have been used for the treatment of cancer in two Moroccan regions; Rabat and Greater Casablanca (Samouh et al., 2019) (Table 1Table 2).

Fidelity level parameter permits the identification of the most abundant species used to treat cancer in the study area. Among 94 inventoried plants 14 species were identified with FL equal or greater than 60%.

In the current research study, it was reported that *Apteranthes europaea* Guss. (89.83 %), *Aristolochia longa* L. (85.71 %), *Nigella sativa* L. (71.42 %), *Peganum harmala* L. (66.66 %), *Pinus halepensis* Mill. (66.66 %), *Berberis hispanica* Boiss. & Reut. (64.28 %), *Allium sativum* L. (63.63 %) and *Marrubium vulgare* L. (62.85 %) were the most common medicinal plants used for cancer treatment in the Fez-Meknes region. Our study agrees with the earlier literature which showed that plants higher in FL values are recommended for cancer treatment (Tadesse et al., 2018).

The use of medicinal plants is more among women rather than men (67% vs. 33%) according to our survey (Fig. 2c). Women are more knowledgeable about the uses of medicinal plants. Apart from this, women of the region studied also impart knowledge to their wards either verbally or written. These results were in accordance with the earlier data (Samouh et al., 2019). In the current survey, it was reported that several informants were illiterate (Fig. 2.a). This finding was in agreement with other ethnobotanical studies (Kabbaj et al., 2012);(Ammor et al., 2020) . 69% of respondents prefer the use of modern medicine against cancer vs. 27 % prefer the use of herbal medicine. However, only 4 % of informants prefer the combination of both (Fig. 2.b). Reasons that make many people based in the study area using herbal medicines for medication against cancer have already been reported in the previous literature (Bourhia et al., 2019). The latter reported the effectiveness of traditional preparations in the treatment of cancer, less side effects compared to conventional drugs, inaccessibility to modern medicines for those living in rural areas, the high and rising cost of medical care for people with low income. However, many informants (69 %) as reported in our survey are no longer interested in using traditional medicine for medication against cancer. This result can be explained by the fact that several informants are

Table 2
Information about medicinal plants used alone for the treatment of cancer in the region of Fez-Meknes.

Scientific name Family	Parts used	Preparation Modes	Solvant/ Excipient	Administraion route	Cancer type
Actinidiaceae					
Actinidia chinensis var. deliciosa (A.Chev.) A.Chev.	F	Raw form	_	Oral	Colon
		Juice	Milk		
Aloaceae					
Aloe vera (L.) Burm.f	Ap	Powder	Water	Oral	Leukemia/ Liver
		Powder mixed with honey	_		
		Vegetable oil	_		
		Juice	Water		
		Raw form	_		
Amaranthaceae					
Beta vulgaris L.	F	Raw form	_	Oral	Leukemia
Annonaceae					
Annona cherimola Mill.	F	Raw form	_	Oral	Breast
Apiaceae					
Petroselinum crispum (Mill.) Fuss	Ap	Decoction	Water	Oral	Uterus
	L	Infusion	Water		
	St + L	Infusion	Water		
Cuminum cyminum L.	Sd	Powder	Water/ Oliveoil/ lemon juice	Oral	Stomach/ Liver
			_		
	F	Powder mixed with honey			
		Powder	Water		
Apium graveolens L.	L	Infusion	Water	Oral	Leukemia
Ammi visnaga (L.) Lam.	Fl	Decoction	Water	Oral	Colon
Foeniculum vulgare Mill.	Sd	Powder mixed with honey	_	Oral	Colon/ Breast/ Leukaemia
Daucus carota L.	F	Juice	Water	Oral	Leukaemia/ Colon/Lung
Ammodaucus leucotrichus Coss.	L + Fl	Powder	Water	Oral	Lung/ Leukemia
Pimpinella anisum L.	Sd	Powder	Water	Oral	Colon
Thapsia garganica L.	R	Infusion	Water	Oral	Breast/ Prostate/ Liver
		Mixed with honey	_		
*Magydaris panacifolia (*Vahl.) Lange	_	Mixed with honey	_	Oral	Breast
Apocynaceae					
Apteranthes europaea (Guss.) Murb.	Ap	Powder	Rancid butter Milk/ Water	Oral	Uterus/ Breast/ Lung/ Leukemia
			_		
		Powder mixed with honey			
			Lemon juice		
		Juice			
Arecaceae					
Phoenix dactylifera L.	F	Raw form	_	Oral	Liver
Aristelochiaceae					
Aristolochia longa L.	R	Powder	Rancid butter/ Olive oil / Water/ Milk _	Oral	Breast/ Uterus/ Colon/ Lung/ Bone/ Prostate/

Table 2 (*continued*)

Scientific name Family	Parts used	Preparation Modes	Solvant/ Excipient	Administraion route	Cancer type
		Powder mixed with honey	_		Ovary/ Stomach
		Raw form	Water		
		Decoction/ Infusion			
Asteraceae					
Artemisia herba-alba Asso.	L ; AP	Decoction/ Infusion	Water	Oral	Lung
		Powder mixed with honey	_		
Dittrichia viscosa (L.)	L	Powder mixed with honey	_	Poultice/ Oral Poultice	Colorectal
		Infusion	Water	Oral	
Atractylis gummifera L.	R	Incense	_	Inhalation	Lung
Chamaemelum nobile (L.) All.	F	Infusion	Water	Oral	Uterus
Berberidaceae					
Berberis hispanica Boiss. & Reut.	R/Ap/St	Powder	Milk	Oral	Breast
		Powder mixed with honey	_		
Borraginacees					
Borago officinalis L.	AP /Sd	Powder	Water	Oral	Breast
Brassicaceae					
Lepidium sativum L.	Sd	Decoction Mixed with honey	Water _	Oral	Lung/ Bone/Uterus
Brassica oleracea L.	Ap	Raw form	_	Oral	Breast
Raphanus raphanistrum subsp. sativus (L.) Domin	F	Raw forme	_	Oral	Leukemia
Sinapis alba L.	F	Powder	_	Oral	Colon
Cactaceae					
Opuntia ficus-indica (L.) Mill.	F	Raw form	_	Oral	Bone/ Prostate
	C	Raw form	_		
		Juice	Water		
Camelliaceae					
Camellia sinensis (L.) Kuntze	L	Decotion/Infusion	Water (Sugar free)	Oral	Breast/ Bone
Cannabaceae					
Cannabis sativa L.	Sd	Powder mixed with honey	_	Oral	Brain
Capparidaceae					
Capparis spinosa L.	F	Powder	Vegetable oil/ Water	Oral	Breast/Uterus
	L	Powder mixed with honey	_		
Caryophyllaceae					
Herniaria hirsuta L.	Ap	Powder	Water	Oral	Leukemia
Cucurbitaceae					
Citrullus lanatus (Thunb.) Matsum. &Nakai	F	Juice	Water	Oral	Breast/ Leukemia
Cucumis sativus L.	F	Raw form	_	Oral	Leukemia
Ephedraceae					
Ephedra alata Decne	Ap	Decoction	Water	Oral	Breast
Euphorbiaceae					
Euphorbia resinifera O.Berg	Ap/R	Powder mixed with honey	_	Oral	Breast/ Lung/ Uterus/
		Decoction + Maceration with *Cicer arietinum*	Water/water	Oral	Leukemia
Fabaceae					
Vicia faba L.	Sd	Powder mixed with honey	_	Oral	Breast
Cicer arietinum L.	F	Raw form	Water	Oral	Leukemia
Vicia ervilia (L.) Willd.	Sd	Powder	Milk	Oral	Breast
Trigonella foenum-graecum L.	Sd	Raw form	Water	Oral	Colon/ Breast/
		Powder infusion	Water	Oral	Uterus/ Colon/
		Powder mixed with honey	_		Lung/ Leukemia/ Stomach

(*continued on next page*)

Table 2 (*continued*)

Scientific name Family	Parts used	Preparation Modes	Solvant/ Excipient	Administraion route	Cancer type
Glycyrrhiza glabra L.	Ap	Powder mixed with honey	_	Oral	Breast/ Colon
Fagaceae					
Quercus ilex L.	F	Juice	Milk	Oral	Leukemia
		Steamed			
Geraniaceae					
Erodium guttatum (Desf.) Willd.	R	Powder	Milk	Oral	Bone
		Powder mixed with honey			
Lamiaceae					
Marrubium vulgare L.	Ap	Decoction/infusion	Water	Oral	Colon/ Breast/
		Powder	Water		Uterus/ Leukaemia/
		Powder mixed with honey	_		Stomach
Ajuga iva (L.) Schreb.	Fl	Powder mixed with honey	_	Oral	Breast
		Powder	Water		
	L				
Rosmarinus officinalis L.	L	Decoction/infusion	Water	Oral	Colon/ Breast/ Uterus/ Stomach
Origanum vulgare L.	Ap	Infusion	Water	Oral	Stomach
Satureja granatensis (Boiss. & Reut.) Sennen & Mauricio	Ap	Infusion	Water	Oral	Lung
Salvia officinalis L.	L	Infusion	Water	Oral	Lung/ Prostate
		Powder	Water		
Origanum majorana L.	L	Powder	Water	Oral	Breast
		Infusion			
			Water		
Lauraceae					
Cinnamomum camphora (L.) J.Presl		Powder	_	Oral	Uterus
Liliaceae					
Allium sativum L.	B	Cooked with chicken	Olive oil	Oral	Breast/ Uterus/ Colon/ leukemia / Prostate
		Juice			
		Maceration	Olive oil		
		Raw form mixed with honey	_		
Allium cepa L.	B	Cooked with chicken	_	Oral	Leukemia/ Breast/ Uterus/ Colon/
		Juice	Water		Lung/ Prostate/ Ovary
Drimia maritima (L.) Stearn	R	Maceration	Apple cider vinegar	Oral	Lung
			Water		
		Infusion			
Allium ampeloprasum L.	_	Infusion	Water	Oral	Breast
Linaceae					
Linum usitatissimum L.	Sd	Powder	Olive oil /Water	Oral	Breast/ Prostate/ Colon/
		Powder/ Raw form mixed with honey	_		Leukemia/ Ovary
			Water		
		Raw form			
Malvaceae					
Malva sylvestris L.	Ap	cooked (dish)	_	Oral	Leukemia/ Breast
Meliaceae					
Rubia cordifolia L.	N	Raw form	_	Oral	Leukemia
Mimosaceae					
Acacia raddiana Savi	Rs	Infusion	Water		Leukemia
Vachellia seyal (Delile) P.J.H.Hurter	Rs	Infusion	Water	Oral	Leukemia
Moraceae					
Ficus carica L.	F	Powder mixed with honey	_	Oral	Lung/ Prostate/ Breast/
		Maceration (One week)	Olive oil		Uterus

Table 2 (*continued*)

Scientific name Family	Parts used	Preparation Modes	Solvant/ Excipient	Administraion route	Cancer type
Myrtaceae					
Eugenia caryophyllata Thunb.	Sd	Powder	Water	Oral	Stomach
Oleaceae					
Olea europaea L.	F	vegetable oil	_	Oral	Breast/ Colon/ Stomach/
	L	Decoction	Water		Leukemia/ Uterus/ Lung/
Pedaliaceae					
Sesamum indicum L.	Sd	Powder mixed with honey	_	Oral	Lung/ Pancreatic
Pinaceae					
Cedrus atlantica (Endl.) Manetti ex Carrière	F	Powder mixed with honey	_	Oral	Lung
Pinus halepensis Mill.	St + L	Decoction/Infusion	Water	Oral	Lung
Piperaceae					
Piper nigrum L.	Sd	Powder (spice)	_	Oral	Breast/Colon
Poaceae					
Hordeum vulgare L.	Sd	Powder (Soup ; Bread)	Water + Milk	Oral	Colon
		Infusion	Water		
Triticum aestivum L.	Sd	Powder (Bread)	Water	Oral	Colon/ Stomach
		Infusion			
Portulacaceae					
Portulaca oleracea L.	Ap	cooked (dish)	_	Oral	Stomach
Punicaceae					
Punica granatum L.	E	Decoction/Infusion	Water	Oral	Breast
	M	Raw form	_		
Ranunculaceae					
Nigella sativa L.	Sd	Powder	Milk	Oral	Colon/ Breast/ Leukemia/ Uterus/ Lung
		Powder mixed with honey	_		
		Infusion	Water		
Rhamnaceae					
Ziziphus jujube Mill.	F	Powder mixed with honey	_	Oral	Breast
Rosaceae					
Fragaria × *ananassa* (Duchesne ex Weston) Duchesne ex Rozier	F	Raw form	_	Oral	Breast
Rutaceae					
Citrus aurantium L.	F	Juice	_	Oral	Breast/ Colon/ Lung
Solanaceae					
Solanum lycopersicum L.	F	Raw form	_	Oral	Prostate
Solanum tuberosum L.	_	Juice	Water	Oral	Breast
Urticaceae					
Urtica dioica L.	L	Infusion	Water	Oral	Leukemia
Vitaceae					
Vitis vinifera L.	F	Raw form	_	Oral	Breast/ Uterus/ Leukemia
Zingiberaceae					
Curcuma longa L.	R	Powder	tea/Milk/Water/ Spice	Oral	Breast/ Leukemia/ Uterus/ Colon/
	St	Decoction/ Mixed with honey	Water/ Lemon juice		Stomach/ Lung/ Bone
Zingiber officinale Roscoe	Ap	Decoction	Water	Oral	Breast/Colon/ Prostate/ Uterus
	R	Raw form	Water		
		Powder mixed with honey	_		

(*continued on next page*)

Table 2 (*continued*)

Scientific name Family	Parts used	Preparation Modes	Solvant/ Excipient	Administraion route	Cancer type
Elettaria cardamomum (L.) Maton **Zygophylaceae**	Sd	Powder	Orange juice	Oral	Breast
Peganum harmala L.	Sd/St	Powder/ mixed with honey	Pomegra nate juice / Apple juice	Oral	Lung / Breast

Ap : Aerial part ; B : Bulb; C : Cladode; E : Exocarp ; F : fruits; Fl : Flowers; L : Leaves;
M : Mesocarp ; N : Nut; Rs: Resin; R : Roots ; Sd : Seeds ; Sh : Shoot ; St : Stem ; T : Tubers ; Wp : Whole plant.

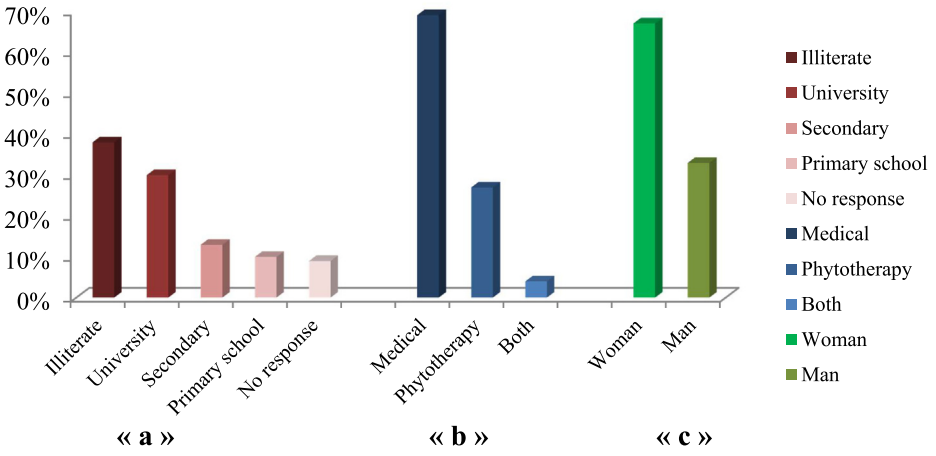

Fig. 2. General profile of informants (Fez-Meknes Region).

aware of side effects of the uncontrolled use of plants in the treatment, potential toxicities of plants, lack of scientific validity for plants randomly used in the treatment (González-Tejero et al., 2008).

« a »: Educational Level; « b »: Healthcare choices; « c »: Gender of informants

In the present research work, we found that the the mostely used plants for the treatment of cancer in the region are prepared into powder form 35 %, infusion 20 %, raw form 15 %, decoction 11 %, juice 6 %, maceration and cooking 3 %, vegetable oil 2 % and incense 1 % (Fig. 3). 95 % of remedies are taken orally (Fig. 4). Fruits are the mostely used plant parts with a percentage of 23.53 %, followed by leaves 18, 63 %, aerial parts, and seeds 15.69 % in each, roots 8.82 %, stems 5.88 %, flowers 3.92 %. However, Bulb, resin, cladode, mesocarp, exocarp, and nut are rarely used (Fig. 5).

F : fruits; L : Leaves; Ap : Aerial part ; Sd : Seeds; R : Roots ; St : Stem; Fl : Flowers; B : Bulb; Rs: Resin; C : Cladode; M : Mesocarp; E : Exocarp; N : Nut.

The most useful plant families for the treatment of cancer in the Fez-Meknes region are Apiaceae (10 species), followed by Lami-

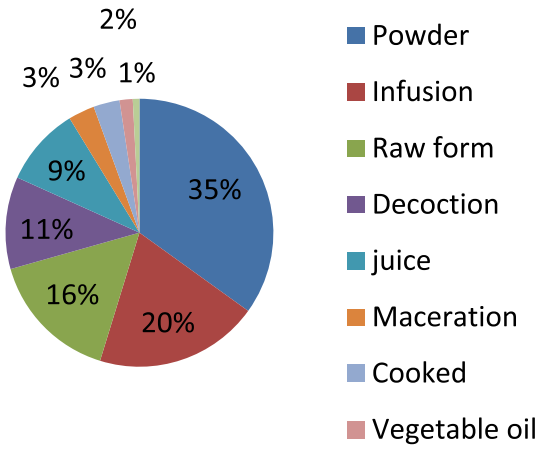

Fig. 3. Mode of preparation.

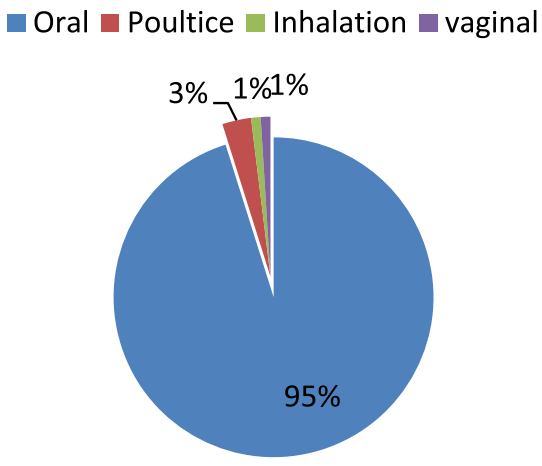

Fig. 4. Mode of administration.

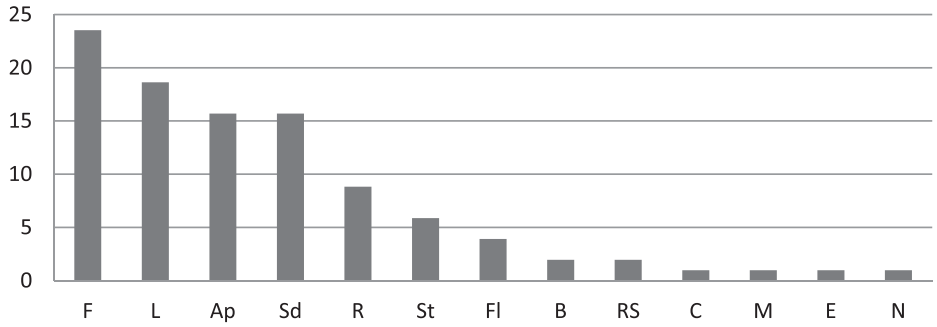

Fig. 5. Percentage of plant parts used for cancer treatment in the study area.

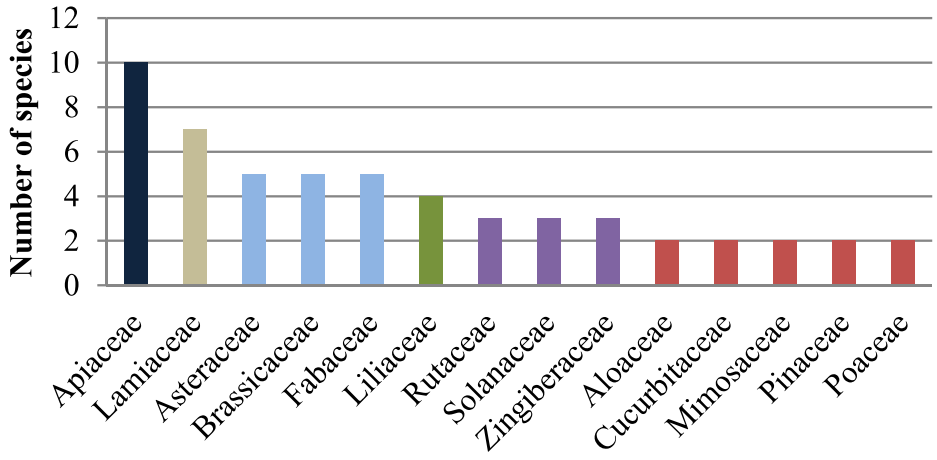

Fig. 6. Number of plant species per family.

Table 3
Distribution of informants according to age group.

Age range	Percentage %
[19–20]	2.33
[21–30]	31.67
[31–40]	23.33
[41–50]	17.33
[51–60]	15.33
greater than 60	73
No answer	

aceae (7 species), Asteraceae, Brassicaceae, Fabaceae (5 species in each), and Liliaceae (4 species) (Fig. 6). This ethnobotanical survey disagrees with another survey conducted in the Greater Casablanca region which reported that Aristolochiaceae is the most common plant families used in the traditional treatment of cancer (Bourhia et al., 2019).

The results of the present survey showed that 31.67 % of respondents were aged between 21 and 30 years, 23.33 % between 31 and 40 years, 17.33 % between 41 and 50 years, and 15.33 % between 51 and 60 years (Table 3). These results are in accordance with the earlier literature (Agyare et al., 2018).

The treatment of cancer with traditional medicines in the study area goes back to many decades ago according to the informant's response. The results of the present survey summarize the old traditional use of herbal medicine in fighting cancer in the Fez Meknes region (Table 4).

Anticancer activity of the main reported plants in our survey against breast, leukemic, cervical lymphoma, laryngeal, lung, liver, and kidney cancers has already been investigated in previous research works to have significant anticancer effects under both *in vitro* and *in vivo* conditions as shown in Table 5. *Apteranthes europaea* (Guss.), *Nigella sativa* L., *Zingiber officinale* Roscoe, *Petroselinum crispum* (Mill.) Fuss, and *Capparis spinosa* L. showed an antiproliferative activity on breast cancer cell lines (Amrati et al., 2020a); (Periasamy et al., 2016); (Rahman et al., 2011); (Farshori et al., 2013); (Aljaiyash et al., 2014), *Artemisia herba-alba* Asso, *Allium cepa* L., and *Olea europaea* L. on leukemic cell lines (Khlifi et al., 2013);(Votto et al., 2010);(Fares et al., 2011). *Marrubium vulgare* L. and *Linum usitatissimum* L. on cervical cancer cells (Zarai et al., 2011); (Joseph et al., 2020) by the time *Aristolochia longa* L. and *Curcuma longa* L. on lung cancer (Hinou et al., 1990); (Wu et al., 2010). *Trigonella foenum-graecum* L. found effective vs. T-cell lymphoma (Alsemari et al., 2014). *Berberis hispanica* Boiss. & Reut. vs. human laryngeal cancer cells Hep-2 (Boudjlida et al., 2019). *In vivo* tests showed an important effect of *Allium sativum* L. on the reduction of the frequency progression of colorectal adeno carcinoma and bladder cancers (Wargovich, 1987) (Table 5).

Some plant species are used against cancer in the study area despite their toxicities such as *Apteranthes europaea* Guss (Issiki et al., 2017), *Aristolochia longa* L. (Benarba et al., 2017), *Capparis spinosa* L. (Fanoudi et al., 2017), *Nigella sativa* L. (Zaoui et al., 2002), *Artemisia herba-alba* Asso. (Bertella et al., 2018), *Berberis hispanica* Boiss. & Reut. (Kheir et al., 2010), *Peganum harmala* L. (Lamchouri et al., 2002), *Origanum vulgare* L. (Yazdani et al., 2014), *Urginea maritima* (L.) Baker (Tuncok et al., 1995), *Citrus aurantium* L. (Arbo et al., 2009), and *Rosmarinus officinalis* L. (Anadón et al., 2008) (Table 5).

In the present survey, many respondents have little data regarding plant toxicities due to illiteracy (Fig. 2.a) and the limited understanding of product toxicity. Collected data reported some

Table 4
Recipes used to treat cancer in the fez-Meknes region.

Recipe	Scientific name	Preparation mode	Administration route
Jeljlān	*Sesamum indicum* L.	Powders mixed with olive oil	Oral
Sanouj lkhal	*Nigella sativa* L.		
Sanouj lhmar	*Lepidium sativum* L.		
Habat lhalwa	*Pimpinella anisum* L.	Powder	Oral
Fliyo	*Mentha pulegium* L.	Powder Powder Powder	
Zaatar	*Origanum vulgare* L.		
Z'ītra	Satureja granatensis (Boiss. & Reut.) Sennen & Mauricio		
Haba souda	*Nigella sativa* L.	Powder	Oral
Tūma	*Allium sativum* L.	Raw form (Mixed with honey)	
Merrīwut	*Marrubium vulgare* L.	Powder	Vaginal inhalation
Magraman	*Dittrichia viscosa* (L.)	Powder	
Khizou	*Daucus carota* L.	Maceration of the seeds in the water then mix with the banana juice	Oral
Hommṣ	*Cicer arietinum* L.		
Laft	*Brassica rapa* L.		
Kebbar	*Capparis spinosa* L.		
Jeljlān	*Sesamum indicum* L.		
Horiga	*Urtica dioica* L.	Raw form (Leaves) Raw form (Aerial part)	Oral
Marrîwet	*Marrubium vulgare* L.	(Mixed with olive oil)	
Zit Zaytūn	*Olea europaea* L.		
hiyār	*Cucumis sativus* L.	Juice	Oral
Kiwi	Actinidia chinensis var. deliciosa (A.Chev.) A.Chev.		
Ma'adnūs	*Petroselinum crispum* (Mill.) Fuss		
pBerraztem	*Aristolochia longa* L.	Powder	Oral
Lhaba souda	*Nigella sativa* L.	Powder (Mixed with honey)	
Tūma	*Allium sativum* L.	Raw form	Oral
Lhaba souda	*Nigella sativa* L.	Powder	
Bṭāṭa	*Solanum tuberosum* L.	Boiled and plucked	oral
hizzu	*Daucus carota* L.		
Barba	*Beta vulgaris* L.		
Krāfes	*Apium graveolens* L.		
ṯūma	*Allium sativum* L.	Raw form	oral
Skenjbīr	*Zingiber officinale* Roscoe	Powder (Mixed with eggs)	
ma'adnūs	*Petroselinum crispum* (Mill.) Fuss	Raw form	Oral
l-beṣla hamra	*Allium cepa* L.	Raw form	
Khorchf	*Cynara cardunculus* L.	Raw form	Oral
sekoum	*Euphorbia resinifera* O.Berg	(Steems) Powder (roots, steems) + Water	
borrō	*Allium ampeloprasum* L.	mixed with honey and lemon juice	Oral
ma'adnūs	*Petroselinum crispum* (Mill.) Fuss		

Table 5
Literature about medicinal plants used to fight cancer in the Fez-Meknes region.

Plants	The medical interest of the inventoried plants according to the literature	Ethnopharmacological use
Apteranthes europaea (Guss.) Murb.	Cytotoxic activity on MDA-MB-231 and MCF-7 lin cells of breast cancer (Amrati et al., 2020b).	Anti-inflammatory, ulcer, antidiabetic, and anti-bacterial (Adnan et al., 2014)
Aristolochia longa L.	Apoptogenic activity on Burkitt's lymphoma BL41 cells (Benarba et al., 2012). Cytotoxic activity against lymphocytic leukemia (P-388) and bronchial epidermoid carcinoma of human origin (NSCLCN6) (Hinou et al., 1990).	Abortifacient, sedative, analgesic, anti-inflammatory, anti-feedant, muscle relaxant, antihistaminic, and anti-allergic (Benarba and Meddah, 2014).
Nigella sativa L.	Anticancer activity on human breast cancer cells: MCF-7 (Periasamy et al., 2016). Anticancer effect on human lung carcinoma (A549), larynx epidermoid carcinoma (HEp-2), colon adenocarcinoma (HT-29), and pancreas carcinoma (MIA PaCa-2) (Rooney and Ryan, 2005).	Treatment of rheumatoid arthritis, diabetes, asthma, Obesity, and other metabolic disorders (Namazi et al., 2018).
Allium sativum L.	Reduction of the frequency progression of colorectal adeno carcinoma (Wargovich, 1987) Treatment of bladder cancer (Lamm and Riggs, 2000)	Prevention and treatment of atherosclerosis, cardiovascular, hyperlipidemia, thrombosis, hypertension, microbial infections, diabetes, and asthma (Lyantagaye, 2011).
Marrubium vulgare L.	Cytotoxic activity against the cervical cancer lines: HeLa cells (Zarai et al., 2011).	Neurosedative and anti-inflammatory (Sahpaz et al., 2002).
Trigonella foenum-graecum L.	Cytotoxic effect against T-cell lymphoma (Alsemari et al., 2014).	Antidiabetic, carminative, tonic, and antinociceptive (Hamza et al., 2012); (Javan et al., 1997); (Zia et al., 2001).
Artemisia herba-alba Asso.	Antiproliferative activity against P815 and BSR kidney carcinoma cell lines (Tilaoui et al., 2015). Anticancer activity against human bladder carcinoma RT112, and human myelogenous leukemia K562 (Khlifi et al., 2013).	Treatment of infectious diseases, inflammatory disorders (colds, coughing, bronchitis, diarrhea), diabetes, neuralgias, antiseptic and against skin diseases, scabies, syphilis, fever as well as menstrual and nervous disorders (Abu-Darwish et al., 2015).
Allium cepa L.	Cytotoxic activity vs. multidrug resistant erythroleukemic cell lines: (Lucena and K562) (Votto et al., 2010). Apoptosis and suppression of Bcl-2 through inhibition of PI3K/Akt Signaling Pathway in AGS human cancer cells (Lee et al., 2014).	Blood purifier, infectious diseases, digestive problems, skin diseases, metabolic disease, insect bites (Teshika et al., 2018).
Berberis hispanica Boiss. & Reut.	Apoptotic effect in human laryngeal cancer cells Hep-2 (Boudjlida et al., 2019).	Treatment of gastrointestinal affections, liver inflammation, and biliary disorders (el Hamsas el Youbi, 2011)
Zingiber officinale Roscoe	Ameliorate chemotherapy- induced nausea and vomiting (Jagetia et al., 2003). Anticancer activity against human breast carcinoma cell lines (MCF-7 cancer cells and MDA-MB-231 (Rahman et al., 2011). Effect on cancer cell growth of human Hela cancer cells (Cheng et al., 2011).	Treatment of airway infections, nausea, and spasm (Moghaddasi and Haddad Kashani, 2012), (Chang et al., 2013).
Petroselinum crispum (Mill.) Fuss	Induction cell death in MCF-7 cells (Farshori et al., 2013). Reduction of the cell viability of HepG2 (Human Hepatocellular Carcinoma Cells) (Farshori et al., 2014).	Treatment of gastrointestinal disorder, inflammation, halitosis, kidney stone, amenorrhoea, dermatitis, headcool, vision performance, hemorrhoid (Farzaei et al., 2013).
Olea europaea L.	Anti-proliferative activity on human leukemic cell line (Jurkat) (Fares et al., 2011). Anti-cancer effect on human BRAF melanoma cells (Ruzzolini et al., 2018).	Hypertension, inflammatory diseases, diabetes, diarrhea, respiratory and urinary tract infections, stomach, intestinal diseases, asthma, and rheumatism (Scheffler et al., 2008), (Song et al., 2019).
Curcuma longa L.	Cytotoxic activity against lymphocytes and Dalton's lymphoma cells (Kuttan et al., 1985). Anti-tumor activity against Ehrlich ascites tumour (Ruby et al., 1995). Induction of apoptosis in human cell lung cancer NCI-H460 cells 37 (Wu et al., 2010).	Biliary disorders, anorexia, cough, diabetic wounds, hepatic disorders, rheumatism and sinusitis (Kumar and Sakhya, 2013).
Linum usitatissimum L.	Anticancer effect against Human cervical cancer cell line: Hela cells (Joseph et al., 2020). Inhibition of Jeg3 cell growth by the phytoestrogens isolated from *Linum usitatissimum* L. (Abarzua et al., 2007).	Diarrhea, gastrointestinal infections, asthma, cough, bronchitis, pneumonia, renal colic, renal calculi, rheumatic swelling (Khan et al., 2017).
Capparis spinosa L.	Cytotoxic activity against both breast and colon cell lines: MCF-7 and HCT-116 (Aljaiyash et al., 2014).	The treatment of rheumatism, gout and abdominal pains (Maresca et al., 2016).
Erodium guttatum (Desf.) Willd.	No data	Wound healing (Helmstädter, 2017).
Camellia sinensis (L.) Kuntze	Suppression of the growth of prostate cancer (HH870 and DU145) and epithelial ovarian cancer cell lines (HH450 and HH639) (Ravindranath et al., 2006).	Stimulant, diuretic, astringent, heart health, flatulence, regulating body temperature and blood sugar, promoting digestion, and improving mental processes (Chopade et al., 2008).
Origanum vulgare L.	Anticancer activity against cervical cancer line: Hella cells (Koldaş et al., 2015). Apoptosis in human colon cancer caco2 cells (Savini et al., 2009).	Treatment of respiratory, cutaneous infections, igestive disorders, headaches, sore throats or colds (Vale-Silva et al., 2012), (de Torre et al., 2020).

(*continued on next page*)

Table 5 (*continued*)

Plants	The medical interest of the inventoried plants according to the literature	Ethnopharmacological use
Salvia officinalis L.	Cytotoxic activity on colon cancer: HCT-116 cells (El Hadri et al., 2010).	Treatment of emmenagogue, cold, throat infections, skin diseases, ulcers, laryngitis, inflammation, bronchitis and Alzheimer's disease (Sharma et al., 2019).
Peganum harmala L.	Antitumor effect on Lewis Lung, sarcoma180 and HepA tumor (Chen et al., 2005) Antiproliferative effect on leukemic cell line cells of Jurkat (Lamchouri et al., 2013)	Antihypertensive, blood purifier, Antidiarrheal, intestinal pain, Antispasmodic in colic, Against nervosity, Emmenagogue, antalgic, Antidiabetic, Anti-pyretic (Moloudizargari et al., 2013).
Lepidium sativum L.	Apoptosis in human breast cancer cells: MCF-7 cell lines (Mahassni and Al-Reemi, 2013).	Treatment of chronic liver and spleen complaints, inflammatory rheumatic pains, skin diseases, asthma, diarrhea (Divanji et al., 2011).
Opuntia ficus-indica (L.) Mill.	Anticancer activity on Ehrlich ascites carcinoma cells (Abou-Elella and Ali, 2014). Apoptosis activity in human chronic myeloid leukemia Cell line-K562 (Sreekanth et al., 2007).	Treatment of burns, wounds, edema, diabetes, obesity, indigestion, hyperlipidemy, viral and inflammatory infections (Kaur et al., 2012).
Rosmarinus officinalis L.	Antiproliferative effect on human ovarian cancer cells (A2780 and A2780CP70) (Tai et al., 2012). Anticancer Effect on CaCo-2 colon cancer cells (Moore et al., 2016).	Analgesic, anti-inflammatory, anti-rheumatic, spasmolytic, carminative and choleretic applications (Minaiyan et al., 2011).
Ficus carica L.	Anti-angiogenic activity on human umbilical vein endothelial cells (Mostafaie et al., 2011)	Treatment of gastrointestinal disorders (colic, indigestion, loss of appetite, and diarrhea), respiratory (sore throats, cough, and bronchial problems), inflammatory, and cardiovascular disorders (Mawa et al., 2013).
di *Punica granatum* L.	Induction of apoptosis in prostate cancer cell line (Sineh Sepehr et al., 2012). Anticancer activity on human cancer cell lines melanoma (A375), colon cancer (HCT116), and hepatocellular carcinoma (HepG2) (Joseph et al., 2013).	Treatment of atherosclerosis, diabetes,hypertension, hyperlipidemia, cancer, peptic ulcer and oral diseases (Ge et al., 2021).
Cuminum cyminum L.	Cytotoxic activity against colon cancer cells (502713, Colo-205, Hep-2, A-549, OVCAR-5, PC-5, SF-295) (Prakash and Gupta, 2014).	Treatment of asthma, bronchitis, rheumatism, hypolipidemia, cancer, diabetes and other inflammatory diseases (Mnif and Aifa, 2015), (Srinivasan, 2018).
Apium graveolens L.	Anticancer activity vs. rhabdomysarcom (RD) and murine (L20B) (AL-Jumaily, 2018).	Treatment of spasm, stomach problems, used also as diuretic, laxative, and sedative, and to lower the blood pressure (Al-Asmari et al., 2017).
Daucus carota L.	Antiproliferative effect on human Lymphoid Leukaemia Cells 67 (Zaini et al., 2012). Anticancer effect against human colon (HT-29, Caco-2) and breast (MCF-7, MDA-MB-231) cancer cell (Shebaby et al., 2013).	Treatment of gastric disorders, acidity and gastric ulcers (Nayeem et al., 2010)
Dittrichia viscosa (L.)	Antiproliferative and apoptosis effects on breast cancer cells (MCF-7) (Talib et al., 2012).	Wound healing, herniated disc, stomachache, anticancer, kidney pain, kidney stones, skin, hair, eye ailments and cancer (Sevgi et al., 2021).
Sinapis alba L.	Anticancer effect on colon cancer cell lines (SW480) (Yuan et al., 2011). Suppression of colonic cancer (Zhu et al., 2012).	Anti-tumor, antiviral, and analgesic agent (Mitrović et al., 2020).
Origanum majorana L.	Apoptotic and anti-proliferative activity on human lymphoblastic leukemic cell line (Jurkat) (Abdel-Massih et al., 2010).	Treatment of insomnia, gastritis, asthma and nervousness (Singla and Vasudeva, 2015).
Origanum vulgare L.	Anticancer activity on human lung cancer cell line (A549) (Sankar et al., 2013).	Digestive and circulatory stimulant, antispasmodic, calmative, carminative, diaphoretic, expectorant, stomachic agent (de Torre et al., 2020).
Hordeum vulgare L.	Inhibition of oxidative DNA damage and apoptosis (J. B. Jeong et al., 2009). Antitumor effect in mammary carcinogenesis (Kubatka et al., 2016).	Treatment of inflammatory, cardiovascular diseases, obesity, diabetes, circulatory disorders, arthritis, anemia, excessive cholesterol levels, renal difficulties, and cancer (Gul et al., 2014), (Thatiparthi et al., 2019).
Vitis vinifera L.	Anticancer effect on liver (HepG2) and cervical (HeLa) cancer cells (Apostolou et al., 2013).	Treatment of diarrhea, hepatitis and stomachaches (Aouey et al., 2016).
Ephedra alata Decne	Antiproliferative and pro-apoptotic potential against the MCF-7 breast cancer cell line (Danciu et al., 2018).	Treatment of allergies, asthma, colds, coughs, edema, fever, headaches, and nasal congestion (Mighri et al., 2019).
Drimia maritima (L.) Stearn	Cytotoxicity on lung cancer cell lines (A549) (Bozcuk et al., 2011).	No data
Pinus halepensis Mill.	Antiangiogenic activity on adenocarcinoma of human basal epithelial cells (A549), human colon adenocarcinoma (HCT15) and human myeloma (HL60) (Kadri et al., 2014).	Treatment of diarrhea, wounds, rheumatism, cough, gastrointestinal illnesses, hypertension, and hemorrhoids, used also as antiseptic, astringent, antifungal, and anti-tuberculosis (El Omari et al., 2021).
Urtica dioica L.	Antiproliferative activity on human prostate cancer cells (LNCaP, hPCPs) (Konrad et al., 2000).	Used as antihypertensive blood purifier, emmenagogue, diuretic, as well as to treat menstrual hemorrhage, rheumatism, and eczema (Testai et al., 2002), (Ilhan et al., 2019)
Citrus aurantium L.	Induction of G2/M phase arrest and apoptosis in human gastric cancer AGS Cells (Lee et al., 2012). Induction of the cell cycle arrest and apoptosis in lung cancer cells (A549) (Park et al., 2012). Cytotoxic effect on human colorectal carcinoma cell line (lim1863) (Odeh et al., 2012).	Treatment of influenza, insomnia, used also as tranquilizer, cardiovascular analeptic, and antispasmodic (Karthikeyan, 2014).

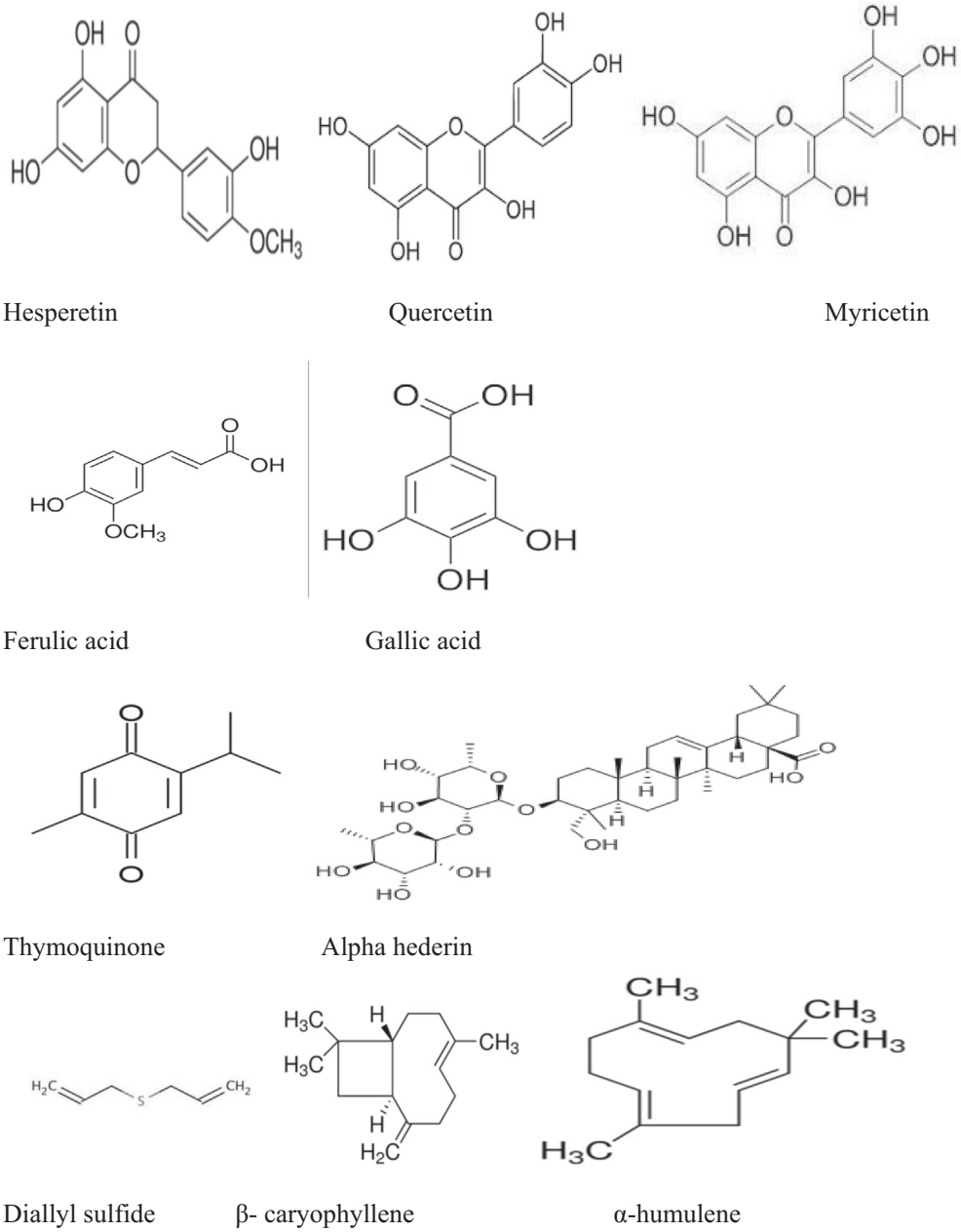

Fig 7. Chemical structures of compounds involved in the anticancer effect of some inventoried plant species.

contradiction in terms of the efficiency and toxicity of some reported plants .i.e. genus Aristolochia was highly recommended by the informants to treat cancer by contrast many scientific studies have demonstrated severe toxic effects with irreversible kidney tissue lesions induced by aristolochic acid contained in this genus. This phenomenon reflects some misunderstanding of traditional medicine based on traditions rather than sciences. It is thus researchers should work on creating awareness among people regarding the inconvenience of plant use without scientific validity.

The antitumor effect of some bioactive compounds contained in the inventoried plants was also discussed in the previous works. Previously published literature investigated the chemical compounds related to potential anticancer effects of some inventoried plant species in the current research such as hesperetin (Choi, 2007), quercetin, myricetin (Lu et al., 2006), ferulic acid (Yang et al., 2015), and gallic acid (Chen et al., 2009) contained in *Apteranthes europaea* (Guss.) Murb (Amrati et al., 2020a), (Amrati et al., 2021), aristolochic acid I (AAsI) and aristolactam la (ALIa) in *Aristolochia longa* L. (Hinou et al., 1990), thymoquinone, and alpha-hederin in *Nigella sativa* L.(Rooney and Ryan, 2005); (Adamska et al., 2019), diallyl sulfide in *Allium sativum* L.(Wargovich, 1987), β-caryophyllene and α-humulene components in Marrubium vulgare L.(Fidyt et al., 2016); (El Hadri et al., 2010) ; protodioscin in *Trigonella foenum-graecum* L. [31; 100] (Ma et al., 2019) ; (Alsemari et al., 2014) flavonoids and tannins in *Artemisia herba-alba* Asso (Khlifi et al., 2013), quercetin in *Allium cepa* L. (Votto et al., 2010), 6-gingerol, and 6-shogaol in *Zingiber officinale* Roscoe (C.-H. Jeong et al., 2009) ; (Wu et al., 2015) ; (Cheng et al., 2011) ; Oleuropein in *Olea europaea* L. (Ruzzolini et al., 2018), curcuminoids in *Curcuma longa* L. (Anto et al., 1995) ; (Hsiao et al., 2018) ; glabranine and naringenin in *Linum usitatissimum* L.

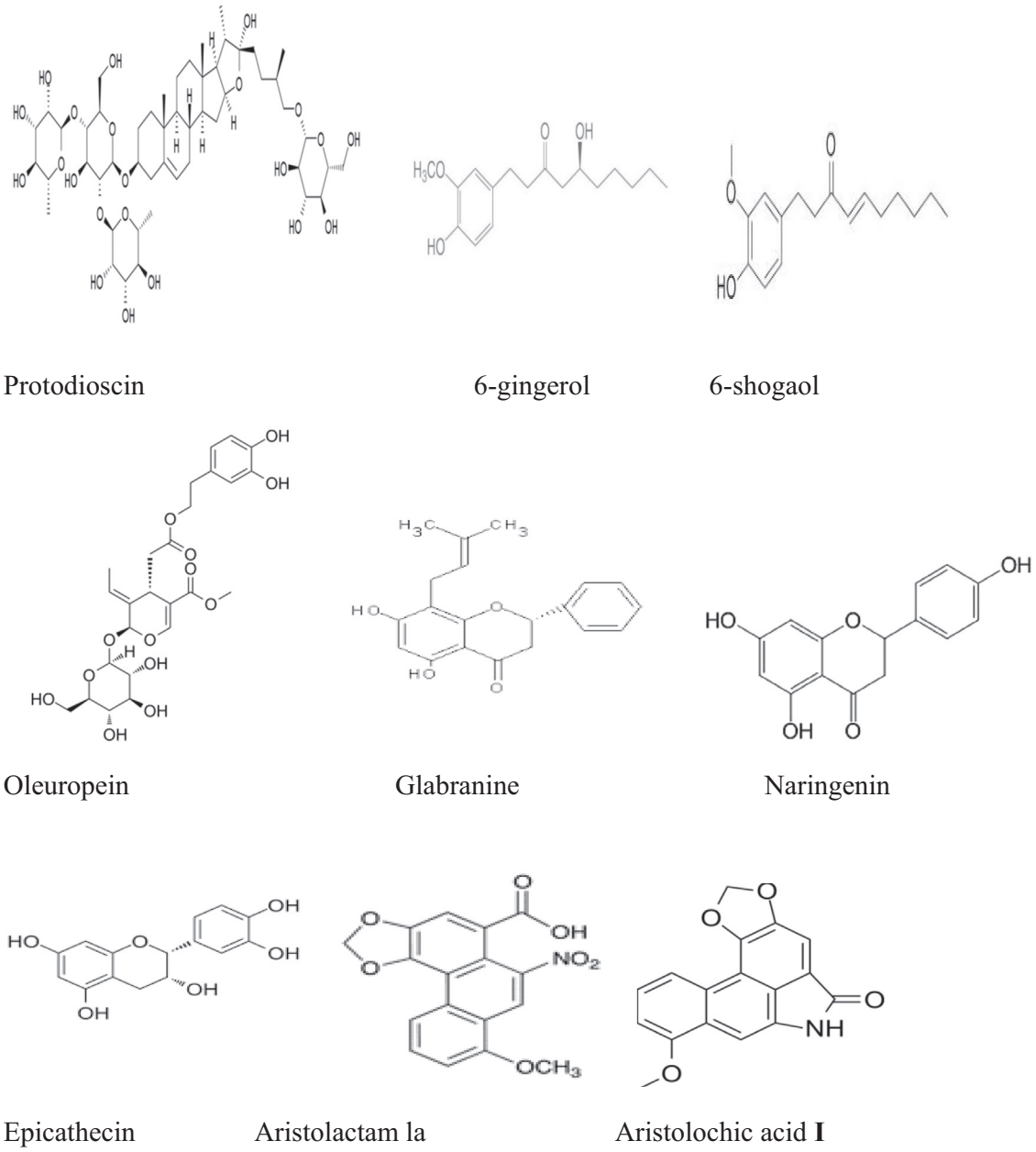

Fig. 7 (*continued*)

(Joseph et al., 2020), and Epicatechins in *Camellia sinensis* (L.) Kuntze (Ravindranath et al., 2006); (Bitu Pinto et al., 2015). The chemical structures of the mentioned compounds are presented in Fig. 7.

In the present survey, many respondents have little data regarding plant toxicities due to illiteracy and the limited understanding of product toxicity. Collected data reported some contradiction in terms of the efficiency and toxicity of some reported plants. i.e. genus Aristolochia was highly recommended by the informants to treat cancer by contrast many scientific studies have demonstrated severe toxic effects with irreversible kidney tissue lesions induced by Aristolochic acid contained in this genus. This phenomenon reflects some misunderstanding of traditional medicine based on traditions rather than sciences. For this reason, researchers should work on creating awareness among people regarding the inconvenience of plant use without scientific validity.

4. Conclusion

The present survey provides comprehensive data about the medicinal plant used in the Fez-Meknes region in Morocco for cancer treatment. The outcome of the present work showed that traditional medicines are still largely used among the rural and urban tribes of the region as a weapon to fight cancer. This study makes its way to contribute towards society as it provides a detailed study on the medicinal plants including plant parts used, mode of preparation, route of administration, as well as doses that find a place in cancer-fighting. This work hoping to constitute valuable data that can serve as medicines to develop natural anticancer compounds.

Author's contribution

F.E.Z,. M.B., M.S.: writing the original Draft. A.M.S., A.A., R.U.: reviewing, and editing. A.B.,D.B.: Supervision and data validation

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The authors extend their appreciation to the Deanship of Scientific Research at King Saud University for funding this work through research group.
no (RG-1441-360).

References

Abarzua, S., Szewczyk, M., Gailus, S., Richter, D., Ruth, W., Briese, V., Piechulla, B., 2007. Effects of Phytoestrogen Extracts from Linum usitatissimum on the Jeg3 Human Trophoblast Tumour Cell Line. Anticancer Res 27, 2053–2058.

Abdel-Massih, R., Fares, R., Bazzi, S., El-Chami, N., Baydoun, E., 2010. The apoptotic and anti-proliferative activity of Origanum majorana extracts on human leukemic cell line. Leuk. Res. 34, 1052–1056. https://doi.org/10.1016/j.leukres.2009.09.018.

Abou-Elella, F., Ali, R., 2014. Antioxidant and Anticancer Activities of Different Constituents Extracted fromEgyptian Prickly Pear Cactus (Opuntia ficus-indica) Peel. Biochemistry & Analytical Biochemistry 3, 158. https://doi.org/10.4172/2161-1009.1000158.

Abu-Darwish, M.S., Cabral, C., Gonçalves, M.J., Cavaleiro, C., Cruz, M.T., Efferth, T., Salgueiro, L., 2015. Artemisia herba-alba essential oil from Buseirah (South Jordan): Chemical characterization and assessment of safe antifungal and anti-inflammatory doses. J. Ethnopharmacol. 174, 153–160. https://doi.org/10.1016/j.jep.2015.08.005.

Adamska, A., Stefanowicz-Hajduk, J., Ochocka, J.R., 2019. Alpha-Hederin, the Active Saponin of Nigella sativa, as an Anticancer Agent Inducing Apoptosis in the SKOV-3 Cell Line. Molecules 24, 2958. https://doi.org/10.3390/molecules24162958.

Adnan, M., Jan, S., Mussarat, S., Tariq, A., Begum, S., Afroz, A., Shinwari, Z.K., 2014. A review on ethnobotany, phytochemistry and pharmacology of plant genus Caralluma R Br. J. Pharm. Pharmacol. 66, 1351–1368. https://doi.org/10.1111/jphp.12265.

Agyare, C., Spiegler, V., Asase, A., Scholz, M., Hempel, G., Hensel, A., 2018. An ethnopharmacological survey of medicinal plants traditionally used for cancer treatment in the Ashanti region, Ghana. J. Ethnopharmacol. 212, 137–152. https://doi.org/10.1016/j.jep.2017.10.019.

Al-Asmari, A.K., Athar, M.T., Kadasah, S.G., 2017. An Updated Phytopharmacological Review on Medicinal Plant of Arab Region: Apium graveolens Linn. Pharmacogn Rev 11, 13–18. https://doi.org/10.4103/phrev.phrev_35_16.

Aljaiyash, A., Gonaid, M., Islam, M., Chaouch, A., 2014. Antibacterial and cytotoxic activities of some Libyan medicinal plants. J. Nat. Product Plant Res. 4, 43–51.

AL-Jumaily, R., 2018. Evaluation of Anticancer Activities of Crude Extracts of Apium graveolens L. Seeds in Two Cell Lines, RD and L20B in vitro. Iraqi Journal of Cancer and Medical Genetics 3, 18–23.

Alsemari, A., Alkhodairy, F., Aldakan, A., Al-Mohanna, M., Bahoush, E., Shinwari, Z., Alaiya, A., 2014. The selective cytotoxic anti-cancer properties and proteomic analysis of Trigonella Foenum-Graecum. BMC Complement Altern Med 14, 114. https://doi.org/10.1186/1472-6882-14-114.

Ammor, K., Mahjoubi, F., Bousta, D., Chaqroune, A., 2020. Ethnopharmacological survey of medicinal plants used in the traditional treatment of kidney stones realized in Fez-Morocco. Ethnobotany Research and Applications 19, 1–12.

Amrati, F. ez-zahra, Bourhia, M., Slighoua, M., Ibnemoussa, S., Bari, A., Ullah, R., Amaghnouje, A., Di Cristo, F., El Mzibri, M., Calarco, A., Benbacer, L., Bousta, D., 2020a. Phytochemical Study on Antioxidant and Antiproliferative Activities of Moroccan Caralluma europaea Extract and Its Bioactive Compound Classes. Evidence-Based Complementary and Alternative Medicine 2020. 10.1155/2020/8409718.

Amrati, F. ez-zahra, Bourhia, M., Slighoua, M., Ibnemoussa, S., Bari, A., Ullah, R., Amaghnouje, A., Di Cristo, F., El Mzibri, M., Calarco, A., Benbacer, L., Bousta, D., 2020b. Phytochemical Study on Antioxidant and Antiproliferative Activities of Moroccan Caralluma europaea Extract and Its Bioactive Compound Classes [WWW Document]. Evidence-Based Complementary and Alternative Medicine. 10.1155/2020/8409718.

Amrati, F.E.-Z., Bourhia, M., Slighoua, M., Boukhira, S., Ullah, R., Ezzeldin, E., Mostafa, G.A.E., Grafov, A., Bousta, D., 2021. Protective Effect of Chemically Characterized Polyphenol-Rich Fraction from Apteranthes europaea (Guss.) Murb. subsp. maroccana (Hook.f.) Plowes on Carbon Tetrachloride-Induced Liver Injury in Mice. Appl. Sci. 11, 554. https://doi.org/10.3390/app11020554.

Anadón, A., Martínez-Larrañaga, M.R., Martínez, M., Ares, I., García-Risco, M., Señoráns, F., REGLERO, G., 2008. Acute oral safety study of rosemary extracts in rats. J. Food Protect. 71, 790–795. 10.4315/0362-028X-71.4.790

Anto, R., Kuttan, G., K V, D.B., Rajasekharan, K., Kuttan, R., 1995. Anti-tumour and antioxidant activity of natural curcuminoids. Cancer Lett. 94, 79–83. 10.1016/0304-3835(95)03827-J.

Aouey, B., Samet, A.M., Fetoui, H., Simmonds, M.S.J., Bouaziz, M., 2016. Anti-oxidant, anti-inflammatory, analgesic and antipyretic activities of grapevine leaf extract (Vitis vinifera) in mice and identification of its active constituents by LC–MS/MS analyses. Biomed. Pharmacother. 84, 1088–1098. https://doi.org/10.1016/j.biopha.2016.10.033.

Apostolou, A., Stagos, D., Galitsiou, E., Spyrou, A., Haroutounian, S., Portesis, N., Trizoglou, I., Wallace Hayes, A., Tsatsakis, A.M., Kouretas, D., 2013. Assessment of polyphenolic content, antioxidant activity, protection against ROS-induced DNA damage and anticancer activity of Vitis vinifera stem extracts. Food and Chemical Toxicology, Mechanisms involved in oxidative stress regulation 61, 60–68. https://doi.org/10.1016/j.fct.2013.01.029.

Arbo, M.D., Schmitt, G.C., Limberger, M.F., Charão, M., Moro, A., Ribeiro, G.L., Dallegrave, E., Garcia, S., Leal, M.B., Limberger, R.P., 2009. Subchronic toxicity of Citrus aurantium L. (Rutaceae) extract and p-synephrine in mice. Regul. Toxicol. Pharm. 54, 114–117.

Benali, T., Khabbach, A., Ennabili, A., Hammani, K., 2017. Ethnopharmacological prospecting of medicinal plants from the Province of Guercif (NE of Morocco). Moroccan J. Biol., 1–14

Benarba, B., Ambroise, G., Aoues, A., Meddah, B., Vazquez, A., 2012. Aristolochia longa aqueous extract triggers the mitochondrial pathway of apoptosis in BL41 Burkitt's lymphoma cells. Int. J. Green Pharm. (IJGP) 6. https://doi.org/10.22377/ijgp.v6i1.237.

Benarba, B., Meddah, B., 2014. Ethnobotanical study, antifungal activity, phytochemical screening and total phenolic content of Algerian Aristolochia longa. J Intercult Ethnopharmacol 3, 150–154. https://doi.org/10.5455/jice.20140826030222.

Benarba, B., Pandiella, A., Elmallah, A., 2017. Anticancer activity, phytochemical screening and acute toxicity evaluation of an aqueous extract of Aristolochia longa L. International Journal of Pharmaceutical and Phytopharmacological Research 6, 20–26. https://doi.org/10.24896/eijppr.2016614.

Bertella, A., Benlahcen, K., Abouamama, S., Pinto, D., Maamar, K., Kihal, M., Silva, A., 2018. Artemisia herba-alba Asso. essential oil antibacterial activity and acute toxicity. Ind. Crops Prod. 116, 137–143. https://doi.org/10.1016/j.indcrop.2018.02.064.

Bitu Pinto, N., da Silva Alexandre, B., Neves, K.R.T., Silva, A.H., Leal, L.K.A.M., Viana, G. S.B., 2015. Neuroprotective Properties of the Standardized Extract from Camellia sinensis (Green Tea) and Its Main Bioactive Components, Epicatechin and Epigallocatechin Gallate, in the 6-OHDA Model of Parkinson's Disease. Evid Based Complement Alternat Med 2015. https://doi.org/10.1155/2015/161092.

Born, K., Christoph, M., H. Fink, A., Knippertz, P., Paeth, H., E. Speth, P., 2009. Moroccan Climate in the Present and Future: Combined View from Observational Data and Regional Climate Scenarios | Semantic Scholar. Climatic Changes and Water Resources in the Middle East and North Africa 29–45. 10.1007/978-3-540-85047-2_4.

Boudjlida, A., Kaci, S., Karaki, S., Benayad, T., Rocchi, P., Smati, D., Bouguerra Aouichat, S., 2019. Berberis hispanica alkaloids extract induced cell death and apoptosis in human laryngeal cancer cells Hep-2. S. Afr. J. Bot. 125, 134–141. https://doi.org/10.1016/j.sajb.2019.04.006.

Bourhia, M., A Shahat, A., Almarfadi, O.M., Naser, F.A., Abdelmageed, W.M., Ait Haj Said, A., El Gueddari, F., Naamane, A., Benbacer, L., Khlil, N., 2019. Ethnopharmacological Survey of Herbal Remedies Used for the Treatment of Cancer in the Greater Casablanca-Morocco. Evidence-based Complementary and Alternative Medicine 1–9. 10.1155/2019/1613457.

Bozcuk, H., Özdoğan, M., Aykurt, O., Topçuoğlu, F., Öztürk, H., Ekĭncĭ, D., Karadenĭz, A., Mutlu, A., Burgucu, D., 2011. Urginea maritima (L.) Baker (Liliaceae) extract induces more cytotoxicity than standard chemotherapeutics in the A549 non-small cell lung cancer (NSCLC) cell line. Turk J Med Sci 41, 101–108.

Chang, J.S., Wang, K.C., Yeh, C.F., Shieh, D.E., Chiang, L.C., 2013. Fresh ginger (Zingiber officinale) has anti-viral activity against human respiratory syncytial virus in human respiratory tract cell lines. J. Ethnopharmacol. 145, 146–151. https://doi.org/10.1016/j.jep.2012.10.043.

Chen, H.-M., Wu, Y.-C., Chia, Y.-C., Chang, F.-R., Hsu, H.-K., Hsieh, Y.-C., Chen, C.-C., Yuan, S.-S., 2009. Gallic acid, a major component of Toona sinensis leaf extracts, contains a ROS-mediated anti-cancer activity in human prostate cancer cells. Cancer Lett. 286, 161–171. https://doi.org/10.1016/j.canlet.2009.05.040.

Chen, Q., Chao, R., Chen, H., Hou, X., Yan, H., Zhou, S., Peng, W., Xu, A., 2005. Antitumor and neurotoxic effects of novel harmine derivatives and structure-activity relationship analysis. Int. J. Cancer 114, 675–682. https://doi.org/10.1002/ijc.20703.

Cheng, X.-L., Liu, Q., Peng, Y.-B., Qi, L.-W., Li, P., 2011. Steamed ginger (Zingiber officinale): Changed chemical profile and increased anticancer potential. Food Chem. 129, 1785–1792. https://doi.org/10.1016/j.foodchem.2011.06.026.

Choi, E.J., 2007. Hesperetin Induced G1-Phase Cell Cycle Arrest in Human Breast Cancer MCF-7 Cells: Involvement of CDK4 and p21. Nutr. Cancer 59, 115–119. https://doi.org/10.1080/01635580701419030.

Chopade, V.V., Phatak, A.A., Upaganlawar, A.B., Tankar, A.A., 2008. Green tea (Camellia sinensis): Chemistry, Traditional, Medicinal uses and its Pharmacological activities- A Review. Pharmacognosy Review 2, 157–162.

Danciu, C., Muntean, D., Alexa, E., Farcas, C., Oprean, C., Zupko, I., Bor, A., Minda, D., Proks, M., Buda, V., Hancianu, M., Cioanca, O., Soica, C., Popescu, S., Dehelean, C. A., 2018. Phytochemical Characterization and Evaluation of the Antimicrobial, Antiproliferative and Pro-Apoptotic Potential of Ephedra alata Decne. Hydroalcoholic Extract against the MCF-7 Breast Cancer Cell Line. Molecules 24. 10.3390/molecules24010013.

de Torre, M.P., Vizmanos, J.L., Cavero, R.Y., Calvo, M.I., 2020. Improvement of antioxidant activity of oregano (Origanum vulgare L.) with an oral

pharmaceutical form. Biomed. Pharmacother. 129,. https://doi.org/10.1016/j.biopha.2020.110424 110424.
Divanji, M., G.L., V. shastry, Nagesh, S., Jain, V., H N, S., 2011. Ethnopharmacology of Lepidium Sativum Linn (Brassicaceae): A Review. Int. J. Phytothear. Res. 2, 1–7.
El Hadri, A., Gómez del Río, M.Á., Sanz, J., González Coloma, A., Idaomar, M., Ribas Ozonas, B., Benedí González, J., Sánchez Reus, M.I., 2010. Cytotoxic activity of Alfa-humulene and transcaryophyllene from Salvia officinalis in animal and human tumor cells. An. R. Acad. Farm 343–356.
el Hamsas el Youbi, A., 2011. In vitro immunomodulation effects of the aqueous and protein extracts of Berberis hispanica Boiss and Reut. (Family Berberidaceae). J. Med. Plants Res. 6. https://doi.org/10.5897/JMPR12.381.
El Omari, N., Ezzahrae Guaouguaou, F., El Menyiy, N., Benali, T., Aanniz, T., Chamkhi, I., Balahbib, A., Taha, D., Shariati, M.A., Zengin, G., El-Shazly, M., Bouyahya, A., 2021. Phytochemical and biological activities of Pinus halepensis mill., and their ethnomedicinal use. J. Ethnopharmacol. 268,. https://doi.org/10.1016/j.jep.2020.113661 113661.
El-Hilaly, J., Hmammouchi, M., Lyoussi, B., 2003. Ethnobotanical studies and economic evaluation of medicinal plants in Taounate province (Northern Morocco). J. Ethnopharmacol. 86, 149–158.
Fanoudi, S., Rakhshandeh, H., Afshari, A.R., Mollazadeh, H., Boroushaki, M.T., 2017. Nephrotoxicity and Hepatotoxicity of Capparis Spinosahydro-Alcoholic Extract in Mice. JOJ Urology Nephrol. 4. https://doi.org/10.19080/JOJUN.2017.04.555638.
Fares, R., Bazzi, S., Baydoun, S.E., Abdel-Massih, R.M., 2011. The antioxidant and anti-proliferative activity of the Lebanese Olea europaea extract. Plant Foods Hum Nutr 66, 58–63. https://doi.org/10.1007/s11130-011-0213-9.
Farshori, N., Al-Sheddi, E., Al-Oqail, M., Musarrat, J., Al-Khedhairy, A., Siddiqui, M., 2013. Anticancer Activity of Petroselinum sativum Seed Extracts on MCF-7 Human Breast Cancer Cells. Asian Pacific J. Cancer Prev. APJCP 14, 5719–5723. https://doi.org/10.7314/APJCP.2013.14.10.5719.
Farshori, N.N., Al-Sheddi, E.S., Al-Oqail, M.M., Musarrat, J., Al-Khedhairy, A.A., Siddiqui, M.A., 2014. Cytotoxicity assessments of Portulaca oleracea and Petroselinum sativum seed extracts on human hepatocellular carcinoma cells (HepG2). Asian Pac. J. Cancer Prev. 15, 6633–6638. https://doi.org/10.7314/apjcp.2014.15.16.6633.
Farzaei, M.H., Abbasabadi, Z., Ardekani, M.R.S., Rahimi, R., Farzaei, F., 2013. Parsley: a review of ethnopharmacology, phytochemistry and biological activities. J. Tradit. Chin. Med. 33, 815–826. https://doi.org/10.1016/S0254-6272(14)60018-2.
Fennane, M., Rejdali, M., 2016. Aromatic and medicinal plants of Morocco : Richness, diversity and threats. Bulletin de l'Institut Scientifique, Rabat, Section Sciences de la Vie, 27–42.
Fidyt, K., Fiedorowicz, A., Strządała, L., Szumny, A., 2016. β-caryophyllene and β-caryophyllene oxide—natural compounds of anticancer and analgesic properties. Cancer Med. 5, 3007–3017. https://doi.org/10.1002/cam4.816.
Friedman, J., Yaniv, Z., Dafni, A., Palewitch, D., 1986. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev desert, Israel. J Ethnopharmacol 16, 275–287. https://doi.org/10.1016/0378-8741(86)90094-2.
Ge, S., Duo, L., Wang, J., GegenZhula, Yang, J., Li, Z., Tu, Y., 2021. A unique understanding of traditional medicine of pomegranate, Punica granatum L. and its current research status. Journal of Ethnopharmacology 271, 113877. 10.1016/j.jep.2021.113877.
González-Tejero, M.R., Casares-Porcel, M., Sánchez-Rojas, C.P., Ramiro-Gutiérrez, J. M., Molero-Mesa, J., Pieroni, A., Giusti, M.E., Censorii, E., de Pasquale, C., Della, A., Paraskeva-Hadijchambi, D., Hadjichambis, A., Houmani, Z., El-Demerdash, M., El-Zayat, M., Hmamouchi, M., ElJohrig, S., 2008. Medicinal plants in the Mediterranean area: Synthesis of the results of the project Rubia. J. Ethnopharmacol. 116, 341–357. https://doi.org/10.1016/j.jep.2007.11.045.
Gul, S., Ahmed, S., Kifli, N., Uddin, Q.T., Batool Tahir, N., Hussain, A., Jaafar, H.Z., Moga, M., Zia-Ul-Haq, M., 2014. Multiple pathways are responsible for Anti-inflammatory and Cardiovascular activities of Hordeum vulgare L. J. Translational Med. 12, 316. https://doi.org/10.1186/s12967-014-0316-9.
Hamza, N., Berke, B., Cheze, C., Le Garrec, R., Umar, A., Agli, A.-N., Lassalle, R., Jové, J., Gin, H., Moore, N., 2012. Preventive and curative effect of Trigonella foenum-graecum L. seeds in C57BL/6J models of type 2 diabetes induced by high-fat diet. J. Ethnopharmacol. 142, 516–522. https://doi.org/10.1016/j.jep.2012.05.028.
Helmstädter, A., 2017. The botanical explorer's legacy: a promising bioprospecting tool. Drug Discovery Today 22, 757–760. https://doi.org/10.1016/j.drudis.2016.11.011.
Hinou, J., Demetzos, C., Harvala, C., Roussakis, C., 1990. Cytotoxic and Antimicrobial Principles from the Roots of Aristolochia longa. Int. J. Crude Drug Res. 28, 149–151. https://doi.org/10.3109/13880209009082801.
Hsiao, Y.-T., Kuo, C.-L., Chueh, F.-S., Liu, K.-C., Bau, D.-T., Chung, J.-G., 2018. Curcuminoids Induce Reactive Oxygen Species and Autophagy to Enhance Apoptosis in Human Oral Cancer Cells. Am. J. Chin. Med. 46, 1145–1168. https://doi.org/10.1142/S0192415X1850060X.
Ilhan, M., Ali, Z., Khan, I.A., Taştan, H., Küpeli Akkol, E., 2019. Bioactivity-guided isolation of flavonoids from Urtica dioica L. and their effect on endometriosis rat model. J. Ethnopharmacol. 243,. https://doi.org/10.1016/j.jep.2019.112100 112100.
Issiki, Z., Moundir, C., Marnissi, F., Seddik, N., Benjelloun, N., Zaid, Y., Oudghiri, M., 2017. Toxicological Evaluation of the Aqueous Extract of Caralluma europaea and Its Immunomodulatory and Inflammatory Activities. Pharmacognosy Res 9, 390–395. https://doi.org/10.4103/pr.pr_24_17.
Jagetia, G.C., Baliga, M.S., Venkatesh, P., Ulloor, J., 2003. Influence of Ginger Rhizome (Zingiber officinale Rosc) on Survival, Glutathione and Lipid Peroxidation in Mice after Whole-Body Exposure to Gamma Radiation. Radiat Res. 160, 584–592. https://doi.org/10.1667/RR3057.
Javan, M., Ahmadiani, A., Semnanian, S., Kamalinejad, M., 1997. Antinociceptive effects of Trigonella foenum-graecum leaves extract. J. Ethnopharmacol. 58, 125–129. https://doi.org/10.1016/S0378-8741(97)00089-5.
Jeong, C.-H., Bode, A.M., Pugliese, A., Cho, Y.-Y., Kim, H.-G., Shim, J.-H., Jeon, Y.-J., Li, H., Jiang, H., Dong, Z., 2009a. [6]-Gingerol Suppresses Colon Cancer Growth by Targeting Leukotriene A4 Hydrolase. Cancer Res 69, 5584–5591. https://doi.org/10.1158/0008-5472.CAN-09-0491.
Jeong, J.B., Hong, S.C., Jeong, H.J., 2009b. 3,4-dihydroxybenzaldehyde purified from the barley seeds (Hordeum vulgare) inhibits oxidative DNA damage and apoptosis via its antioxidant activity. Phytomedicine 16, 85–94. https://doi.org/10.1016/j.phymed.2008.09.013.
Joseph, A., Sridharan, S., Palanisamy, S., Ramalingam, S., Saravanan, R., 2020. Identification of anticancer compounds from Linum usitatissimum seed extract and their effect on HeLa cells. Pharmacognosy Magazine 16, 221. https://doi.org/10.4103/pm.pm_341_19.
Joseph, M.M., Aravind, S.R., George, S.K., Varghese, S., Sreelekha, T.T., 2013. A galactomannan polysaccharide from Punica granatum imparts in vitro and in vivo anticancer activity. Carbohydr Polym 98, 1466–1475. https://doi.org/10.1016/j.carbpol.2013.07.023.
Jouad, H., Haloui, M., Rhiouani, H., El Hilaly, J., Eddouks, M., 2001. Ethnobotanical survey of medicinal plants used for the treatment of diabetes, cardiac and renal diseases in the North centre region of Morocco (Fez–Boulemane). J. Ethnopharmacol. 77, 175–182. https://doi.org/10.1016/S0378-8741(01)00289-6.
Kabbaj, F.Z., Meddah, B., Cherrah, Y., Faouzi, M.E.A., 2012. Ethnopharmacological profile of traditional plants used in Morocco by cancer patients as herbal therapeutics | Request PDF. Phytopharmacology 2, 243–256.
Kadri, N., Khettal, B., Adjebli, A., Cresteil, T., Yahiaoui-Zaidi, R., Barragan-Montero, V., Montero, J.-L., 2014. Antiangiogenic activity of neutral lipids, glycolipids, and phospholipids fractions of Pinus halepensis Mill. seeds. Ind. Crops Prod. 54, 6–12. https://doi.org/10.1016/j.indcrop.2013.12.051.
Karthikeyan, V., 2014. Citrus aurantium (Bitter Orange): A Review of its Traditional Uses, Phytochemistry and Pharmacology. Int. J. Drug Discovery and Herb. Res. (ijddhr) 4, 766–772.
Kaur, M., Kaur, A., Sharma, R., 2012. Pharmacological actions of Opuntia ficus indica: a review. J. Appl. Pharm. Sci. 2, 15–18.
Khan, Z.J., Khan, N., Naseem, I., Nami, S.A.A., 2017. Therapeutics, phytochemistry and pharmacology of Tukhm-e-Katan (Linum usitatissimum L.). Int J Adv Pharm Med Bioallied Sci. 111, 1–15.
Kheir, M.M., Wang, Y., Hua, L., Hu, J., Li, L., Lei, F., Du, L., 2010. Acute toxicity of berberine and its correlation with the blood concentration in mice. Food Chem. Toxicol. 48, 1105–1110. https://doi.org/10.1016/j.fct.2010.01.033.
Khlifi, D., Sghaier, R.M., Amouri, S., Laouini, D., Hamdi, M., Bouajila, J., 2013. Composition and anti-oxidant, anti-cancer and anti-inflammatory activities of Artemisia herba-alba, Ruta chalpensis L. and Peganum harmala L. Food Chem. Toxicol. 55, 202–208. https://doi.org/10.1016/j.fct.2013.01.004.
Koldaş, S., Demirtas, I., Ozen, T., Demirci, M.A., Behçet, L., 2015. Phytochemical screening, anticancer and antioxidant activities of Origanum vulgare L. ssp. viride (Boiss.) Hayek, a plant of traditional usage. J. Sci. Food Agric. 95, 786–798. https://doi.org/10.1002/jsfa.6903.
Konrad, L., Müller, H.-H., Lenz, C., Laubinger, H., Aumüller, G., Lichius, J.J., 2000. Antiproliferative Effect on Human Prostate Cancer Cells by a Stinging Nettle Root (Urtica dioica) Extract. Planta Med 66, 44–47. https://doi.org/10.1055/s-2000-11117.
Kubatka, P., Kello, M., Kajo, K., Kruzliak, P., Výbohová, D., Šmejkal, K., Maršík, P., Zulli, A., Gönciová, G., Mojžiš, J., Kapinová, A., Murin, R., Péč, M., Adamkov, M., Przygodzki, R.M., 2016. Young Barley Indicates Antitumor Effects in Experimental Breast Cancer In Vivo and In Vitro. Nutr Cancer 68, 611–621. https://doi.org/10.1080/01635581.2016.1154577.
Kumar, N., Sakhya, S.K., 2013. Ethnopharmacological Properties of Curcuma Longa: a Review. IJPSR 4, 103–112.
Kuttan, R., Bhanumathy, P., Nirmala, K., George, M.C., 1985. Potential anticancer activity of turmeric (Curcuma longa). Cancer Lett. 29, 197–202. https://doi.org/10.1016/0304-3835(85)90159-4.
la Direction Générale des Collectivités Locales, 2015. Monographie de la région Fès-Meknès – Région Fès Meknès.
Lamchouri, F., Settaf, A., Cherrah, Y., Hamidi, M.N., 2002. Experimental toxicity of Peganum harmala seeds. Annales Pharmaceutiques Françaises 60, 123–129.
Lamchouri, F., Zemzami, M., Jossang, A., Abdellatif, A., Israili, Z., Badiaa, L., 2013. Cytotoxicity of alkaloids isolated from Peganum harmala seeds. Pakistan J. Pharm. Sci. 26, 699–706.
Lamm, D., Riggs, D., 2000. The potential application of Allium sativum (garlic) for the treatment of bladder cancer. Urologic Clinics 27, 157–162. https://doi.org/10.1016/S0094-0143(05)70243-3.
Lee, D.-H., Park, K.-I., Park, H.-S., Kang, S.-R., Nagappan, A., Kim, J.-A., Kim, E.-H., Lee, W.-S., Hah, Y.-S., Chung, H.-J., An, S.-J., Kim, G.-S., 2012. Flavonoids Isolated from Korea Citrus aurantium L. Induce G2/M Phase Arrest and Apoptosis in Human Gastric Cancer AGS Cells. Evidence-Based Complementary and Alternative Medicine. 10.1155/2012/515901.
Lee, W.S., Yi, S.M., Yun, J.W., Jung, J.H., Kim, D.H., Kim, H.J., Chang, S.-H., Kim, G., Ryu, C.H., Shin, S.C., Hong, S.C., Choi, Y.H., Jung, J.-M., 2014. Polyphenols Isolated from Allium cepa L. Induces Apoptosis by Induction of p53 and Suppression of Bcl-2

through Inhibiting PI3K/Akt Signaling Pathway in AGS Human Cancer Cells. J Cancer Prev 19, 14–22.
Lu, J., Papp, L.V., Fang, J., Rodriguez-Nieto, S., Zhivotovsky, B., Holmgren, A., 2006. Inhibition of Mammalian Thioredoxin Reductase by Some Flavonoids: Implications for Myricetin and Quercetin Anticancer Activity. Cancer Res 66, 4410–4418. https://doi.org/10.1158/0008-5472.CAN-05-3310.
Lyantagaye, S.L., 2011. Ethnopharmacological and Phytochemical Review of Allium Species (Sweet Garlic) and Tulbaghia Species (Wild Garlic) from Southern Africa. Tanzania J. Sci. 37. https://doi.org/10.4314/tjs.v37i1.
Ma, Y.-L., Zhang, Y.-S., Zhang, F., Zhang, Y.-Y., Thakur, K., Zhang, J.-G., Wei, Z.-J., 2019. Methyl protodioscin from Polygonatum sibiricum inhibits cervical cancer through cell cycle arrest and apoptosis induction. Food Chem. Toxicol. 132,. https://doi.org/10.1016/j.fct.2019.110655 110655.
Mahassni, S.H., Al-Reemi, R.M., 2013. Apoptosis and necrosis of human breast cancer cells by an aqueous extract of garden cress (Lepidium sativum) seeds. Saudi J Biol Sci 20, 131–139. https://doi.org/10.1016/j.sjbs.2012.12.002.
Maresca, M., Micheli, L., Di Cesare Mannelli, L., Tenci, B., Innocenti, M., Khatib, M., Mulinacci, N., Ghelardini, C., 2016. Acute effect of Capparis spinosa root extracts on rat articular pain. J. Ethnopharmacol. 193, 456–465. https://doi.org/10.1016/j.jep.2016.09.032.
Mawa, S., Husain, K., Jantan, I., 2013. Ficus carica L. (Moraceae): Phytochemistry, Traditional Uses and Biological Activities. Evidence-Based Complementary and Alternative Medicine 2013, e974256. 10.1155/2013/974256.
Mighri, H., Akrout, A., Bennour, N., Eljeni, H., Zammouri, T., Neffati, M., 2019. LC/MS method development for the determination of the phenolic compounds of Tunisian Ephedra alata hydro-methanolic extract and its fractions and evaluation of their antioxidant activities. S. Afr. J. Bot. 124, 102–110. https://doi.org/10.1016/j.sajb.2019.04.029.
Minaiyan, M., Ghannadi, A.R., Afsharipour, M., Mahzouni, P., 2011. Effects of extract and essential oil of Rosmarinus officinalis L. on TNBS-induced colitis in rats. Res Pharm Sci 6, 13–21.
Mitrović, P.M., Stamenković, O.S., Banković-Ilić, I., Djalović, I.G., Nježić, Z.B., Farooq, M., Siddique, K.H.M., Veljković, V.B., 2020. White Mustard (Sinapis alba L.) Oil in Biodiesel Production: A Review. Front. Plant Sci. 11, 1–22. https://doi.org/10.3389/fpls.2020.00299.
Mnif, S., Aifa, S., 2015. Cumin (Cuminum cyminum L.) from Traditional Uses to Potential Biomedical Applications. Chem. Biodivers. 12, 733–742. https://doi.org/10.1002/cbdv.201400305.
Moghaddasi, M., Haddad Kashani, H., 2012. Ginger (Zingiber officinale): A review. J. Med. Plants Res. 6. https://doi.org/10.5897/JMPR011.787.
Moloudizargari, M., Mikaili, P., Aghajanshakeri, S., Asghari, M.H., Shayegh, J., 2013. Pharmacological and therapeutic effects of Peganum harmala and its main alkaloids. Pharmacogn Rev 7, 199–212. https://doi.org/10.4103/0973-7847.120524.
Moore, J., Yousef, M., Tsiani, E., 2016. Anticancer Effects of Rosemary (Rosmarinus officinalis L.) Extract and Rosemary Extract Polyphenols. Nutrients 8, 731. https://doi.org/10.3390/nu8110731.
Mostafaie, A., Mansouri, K., Norooznezhad, A.H., Mohammadi-Motlagh, H.-R., 2011. Anti-Angiogenic Activity of Ficus carica Latex Extract on Human Umbilical Vein Endothelial Cells. Cell 12, 525–528. null.
Namazi, N., Larijani, B., Ayati, M.H., Abdollahi, M., 2018. The effects of Nigella sativa L. on obesity: A systematic review and meta-analysis. J. Ethnopharmacol. 219, 173–181. https://doi.org/10.1016/j.jep.2018.03.001.
Nayeem, K., Godad, A., Hashilkar, N., Joshi, R.K., 2010. Gastroprotective activity of the aqueous extract from the roots of Daucus carota L in rats. Int. J. Res. Ayurveda Pharm. (IJRAP) 1, 112–119.
Odeh, F., Rahmo, A., Alnori, A.S., Chaty, M.E., 2012. THE CYTOTOXIC EFFECT OF ESSENTIAL OILS CITRUS AURANTIUM PEELS ON HUMAN COLORECTAL CARCINOMA CELL LINE (LIM1863). J. Microbiol. Biotechnol. Food Sci. 1, 1476–1487.
Park, K.I., Park, H.S., Nagappan, A., Hong, G.E., Lee, D.H., Kang, S.R., Kim, J.A., Zhang, J., Kim, E.H., Lee, W.S., Shin, S.C., Hah, Y.S., Kim, G.S., 2012. Induction of the cell cycle arrest and apoptosis by flavonoids isolated from Korean Citrus aurantium L. in non-small-cell lung cancer cells. Food Chem 135, 2728–2735. https://doi.org/10.1016/j.foodchem.2012.06.097.
Periasamy, V.S., Athinarayanan, J., Alshatwi, A.A., 2016. Anticancer activity of an ultrasonic nanoemulsion formulation of Nigella sativa L. essential oil on human breast cancer cells. Ultrason. Sonochem. 31, 449–455. https://doi.org/10.1016/j.ultsonch.2016.01.035.
Prakash, E., Gupta, D.K., 2014. Cytotoxic Activity of Ethanolic Extract of Cuminum cyminum Linn against Seven Human Cancer Cell Line. Universal J. Agricult. Res. 2, 27–30. 10.13189/ujar.2014.020104.
Rahman, S., Salehin, F., Iqbal, A., 2011. In vitro antioxidant and anticancer activity of young Zingiber officinale against human breast carcinoma cell lines. BMC Complement Altern Med 11, 76. https://doi.org/10.1186/1472-6882-11-76.
Rankou, H., Culham, A., Jury, S.L., Christenhusz, M.J.M., 2013. The endemic flora of Morocco. Phytotaxa 78, 1–69. https://doi.org/10.11646/phytotaxa.78.1.1.
Ravindranath, M.H., Saravanan, T.S., Monteclaro, C.C., Presser, N., Ye, X., Selvan, S.R., Brosman, S., 2006. Epicatechins Purified from Green Tea (Camellia sinensis) Differentially Suppress Growth of Gender-Dependent Human Cancer Cell Lines. Evid Based Complement Alternat Med 3, 237–247. https://doi.org/10.1093/ecam/nel003.
Rooney, S., Ryan, M.F., 2005. Effects of Alpha-hederin and Thymoquinone, constituents of Nigella sativa, on Human Cancer Cell Lines. Anticancer Res 25, 2199–2204.
Ruby, A., Kuttan, G., Babu, D., Rajasekharan, K., Kuttan, R., 1995. Anti-tumour and antioxidant activity of natural curcuminoids. Cancer Lett. 94, 79–83. https://doi.org/10.1016/0304-3835(95)03827-j.
Ruzzolini, J., Peppicelli, S., Andreucci, E., Bianchini, F., Scardigli, A., Romani, A., La Marca, G., Nediani, C., Calorini, L., 2018. Oleuropein, the Main Polyphenol of Olea europaea Leaf Extract, Has an Anti-Cancer Effect on Human BRAF Melanoma Cells and Potentiates the Cytotoxicity of Current Chemotherapies. Nutrients 10, 1950. https://doi.org/10.3390/nu10121950.
Sahpaz, S., Garbacki, N., Tits, M., Bailleul, F., 2002. Isolation and pharmacological activity of phenylpropanoid esters from Marrubium vulgare. J. Ethnopharmacol. 79, 389–392. https://doi.org/10.1016/S0378-8741(01)00415-9.
Samouh, Y., Lemrani, A., Mimouni, H., Mohamad, J., Ait Haj Said, A., 2019. Ethnopharmacological Study of Herbal Medicines used to treat Cancer in Morocco. J. Phytopharmacol. 8, 135–141.
Sankar, R., Karthik, A., Prabu, A., Karthik, S., Shivashangari, K.S., Ravikumar, V., 2013. Origanum vulgare mediated biosynthesis of silver nanoparticles for its antibacterial and anticancer activity. Colloids Surf B Biointerfaces 108, 80–84. https://doi.org/10.1016/j.colsurfb.2013.02.033.
Savini, I., Arnone, R., Catani, M.V., Avigliano, L., 2009. Origanum Vulgare Induces Apoptosis in Human Colon Cancer Caco2 Cells. Nutr. Cancer 61, 381–389. https://doi.org/10.1080/01635580802582769.
Scheffler, A., Rauwald, H.W., Kampa, B., Mann, U., Mohr, F.W., Dhein, S., 2008. Olea europaea leaf extract exerts L-type Ca2+ channel antagonistic effects. J. Ethnopharmacol. 120, 233–240. https://doi.org/10.1016/j.jep.2008.08.018.
Sevgi, E., Dag, A., Kızılarslan-Hançer, Ç., Atasoy, S., Kurt, B.Z., Aksakal, Ö., 2021. Evaluation of cytotoxic and antioxidant potential of Dittrichia viscosa (L.) Greuter used in traditional medicine. J. Ethnopharmacol. 276,. https://doi.org/10.1016/j.jep.2021.114211 114211.
Sharma, Y., Fagan, J., Schaefer, J., 2019. Ethnobotany, phytochemistry, cultivation and medicinal properties of Garden sage (Salvia officinalis L.). J Pharmacogn Phytochem 8, 3139–3148.
Shebaby, W.N., El-Sibai, M., Smith, K.B.-, Karam, M.C., Mroueh, M., Daher, C.F., 2013. The antioxidant and anticancer effects of wild carrot oil extract. Phytother Res 27, 737–744. 10.1002/ptr.4776.
Sineh Sepehr, K., Baradaran, B., Mazandarani, M., Khori, V., Shahneh, F.Z., 2012. Studies on the Cytotoxic Activities of Punica granatum L. var. spinosa (Apple Punice) Extract on Prostate Cell Line by Induction of Apoptosis. ISRN Pharm 2012. 10.5402/2012/547942
Singla, P., Vasudeva, N., 2015. Origanum majorana L. -Phyto-pharmacological review. Indian Journal of Natural Products and Resources (IJNPR) [Formerly Natural Product Radiance (NPR)] 6, 261–267.
Song, C., Hong, Y.H., Park, J.G., Kim, H.G., Jeong, D., Oh, J., Sung, G.-H., Hossain, M.A., Taamalli, A., Kim, J.H., Kim, J.-H., Cho, J.Y., 2019. Suppression of Src and Syk in the NF-κB signaling pathway by Olea europaea methanol extract is leading to its anti-inflammatory effects. J. Ethnopharmacol. 235, 38–46. https://doi.org/10.1016/j.jep.2019.01.024.
Sreekanth, D., Arunasree, M.K., Roy, K.R., Chandramohan, R.T., Reddy, G.V., Reddanna, P., 2007. Betanin a betacyanin pigment purified from fruits of Opuntia ficus-indica induces apoptosis in human chronic myeloid leukemia Cell line-K562. Phytomedicine 14, 739–746. https://doi.org/10.1016/j.phymed.2007.03.017.
Srinivasan, K., 2018. Cumin (Cuminum cyminum) and black cumin (Nigella sativa) seeds: traditional uses, chemical constituents, and nutraceutical effects. Food Qual. Saf. 2, 1–16. https://doi.org/10.1093/fqsafe/fyx031.
Tadesse, A., Kagnew, B., Kebede, F., 2018. Ethnobotanical Study of Medicinal Plants used to treat Human Diseases in Enarj Enawga District, East Gojjam Zone, Amhara Region, Ethiopia. J. Pharmacognosy Phytother. 10, 64–75. https://doi.org/10.5897/JPP2018.0496.
Tai, J., Cheung, S., Wu, M., Hasman, D., 2012. Antiproliferation effect of Rosemary (Rosmarinus officinalis) on human ovarian cancer cells in vitro. Phytomedicine 19, 436–443. https://doi.org/10.1016/j.phymed.2011.12.012.
Talib, W.H., Zarga, M.H.A., Mahasneh, A.M., 2012. Antiproliferative, antimicrobial and apoptosis inducing effects of compounds isolated from Inula viscosa. Molecules 17, 3291–3303. https://doi.org/10.3390/molecules17033291.
Tardío, J., Pardo de Santayana, M., 2008. Cultural Importance Indices: A Comparative Analysis Based on the Useful Wild Plants of Southern Cantabria (Northern Spain). Econ. Bot. 62, 24–39. https://doi.org/10.1007/s12231-007-9004-5.
Teshika, J.D., Zakariyyah, A.M., Zaynab, T., Zengin, G., Rengasamy, K.R., Pandian, S.K., Fawzi, M.M., 2018. Traditional and modern uses of onion bulb (Allium cepa L.): a systematic review. Critical Reviews in Food Science and Nutrition.
Testai, L., Chericoni, S., Calderone, V., Nencioni, G., Nieri, P., Morelli, I., Martinotti, E., 2002. Cardiovascular effects of Urtica dioica L. (Urticaceae) roots extracts: in vitro and in vivo pharmacological studies. J. Ethnopharmacol. 81, 105–109. https://doi.org/10.1016/S0378-8741(02)00055-7.
Thatiparthi, J., Dodoala, S., Koganti, B., Kvsrg, P., 2019. Barley grass juice (Hordeum vulgare L.) inhibits obesity and improves lipid profile in high fat diet-induced rat model. J. Ethnopharmacol. 238,. https://doi.org/10.1016/j.jep.2019.111843 111843.
Tilaoui, M., Ait Mouse, H., Jaafari, A., Zyad, A., 2015. Comparative Phytochemical Analysis of Essential Oils from Different Biological Parts of Artemisia herba alba and Their Cytotoxic Effect on Cancer Cells. PLoS ONE 10,. https://doi.org/10.1371/journal.pone.0131799 e0131799.
Tuncok, Y., Kozan, O., Cavdar, C., Guven, H., Fowler, J., 1995. Urginea Maritima (Squill) Toxicity. J. Toxicol. Clin. Toxicol. 33, 83–86.
Vale-Silva, L., Silva, M.-J., Oliveira, D., Gonçalves, M.-J., Cavaleiro, C., Salgueiro, L., Pinto, E., 2012. Correlation of the chemical composition of essential oils from Origanum vulgare subsp. virens with their in vitro activity against pathogenic

yeasts and filamentous fungi. J. Med. Microbiol. 61, 252–260. https://doi.org/10.1099/jmm.0.036988-0.
Votto, A.P.S., Domingues, B.S., de Souza, M.M., da Silva Júnior, F.M.R., Caldas, S.S., Filgueira, D.M.V.B., Clementin, R.M., Primel, E.G., Vallochi, A.L., Furlong, E.B., Trindade, G.S., 2010. Toxicity mechanisms of onion (Allium cepa) extracts and compounds in multidrug resistant erythroleukemic cell line. Biol. Res. 43, 429–437. /S0716-97602010000400007.
Wargovich, M.J., 1987. Diallyl sulfide, a flavor component of garlic (Allium sativum), inhibits dimethyihydrazine-induced colon cancer. Carcinogenesis 8, 487–489. https://doi.org/10.1093/carcin/8.3.487.
World Health Organization, 2018. Cancer [WWW Document]. URL https://www.who.int/health-topics/cancer#tab=tab_1 (accessed 2.10.20).
Wu, C.-H., Hong, B.-H., Ho, C.-T., Yen, G.-C., 2015. Targeting Cancer Stem Cells in Breast Cancer: Potential Anticancer Properties of 6-Shogaol and Pterostilbene. J. Agric. Food Chem. 63, 2432–2441. https://doi.org/10.1021/acs.jafc.5b00002.
Wu, S.-H., Hang, L., Yang, J.-S., Chen, H.-Y., Lin, H.-Y., Chiang, J.-H., Lu, C.-C., Yang, J.-L., Lai, T.-Y., Ko, Y.-C., Chung, J., 2010. Curcumin induces apoptosis in human non-small cell lung cancer NCI-H460 cells through ER stress and caspase cascade- and mitochondria-dependent pathways. Anticancer Res. 30, 2125–2133.
Yang, G.-W., Jiang, J.-S., Lu, W.-Q., 2015. Ferulic Acid Exerts Anti-Angiogenic and Anti-Tumor Activity by Targeting Fibroblast Growth Factor Receptor 1-Mediated Angiogenesis. Int. J. Mol. Sci. 16, 24011–24031. https://doi.org/10.3390/ijms161024011.
Yazdani, E., Jalali Sendi, J., Hajizadeh, J., 2014. Effect of Thymus vulgaris L. and Origanum vulgare L. essential oils on toxicity, food consumption, and biochemical properties of lesser mulberry pyralid Glyphodes pyloalis Walker (Lepidoptera: Pyralidae). J. Plant Prot. Res. 54, 53–61. https://doi.org/10.2478/jppr-2014-0008.
Yuan, H., Zhu, M., Guo, W., Jin, L., Chen, W., Brunk, U.T., Zhao, M., 2011. Mustard seeds (Sinapis Alba Linn) attenuate azoxymethane-induced colon carcinogenesis. Redox report : communications in free radical research 16, 38–44. https://doi.org/10.1179/174329211X12968219310918.
Zaini, R., Brandt, K., Clench, M., Le Maitre, C., 2012. Effects of Bioactive Compounds from Carrots (Daucus carota L.), Polyacetylenes, Beta-Carotene and Lutein on Human Lymphoid Leukaemia Cells. Anti-Cancer Agents in Medicinal Chemistry (Formerly Current Medicinal Chemistry - Anti-Cancer Agents) 12, 640–652.
Zaoui, A., Cherrah, Y., Mahassini, N., Alaoui, K., Amarouch, H., Hassar, M., 2002. Acute and chronic toxicity of Nigella sativa fixed oil. Phytomedicine 9, 69–74. https://doi.org/10.1078/0944-7113-00084.
Zarai, Z., Kadri, A., Ben Chobba, I., Ben Mansour, R., Bekir, A., Mejdoub, H., Gharsallah, N., 2011. The in-vitro evaluation of antibacterial, antifungal and cytotoxic properties of Marrubium vulgare L. essential oil grown in Tunisia. Lipids Health Dis 10, 161. https://doi.org/10.1186/1476-511X-10-161.
Zhu, M., Yuan, H., Guo, W., Li, X., Jin, L., Brunk, U.T., Han, J., Zhao, M., Lu, Y., 2012. Dietary mustard seeds (Sinapis alba Linn) suppress 1,2-dimethylhydrazine-induced immuno-imbalance and colonic carcinogenesis in rats. Nutr Cancer 64, 464–472. https://doi.org/10.1080/01635581.2012.658948.
Zia, T., Hasnain, S.N., Hasan, S.K., 2001. Evaluation of the oral hypoglycaemic effect of Trigonella foenum-graecum L. (methi) in normal mice. J. Ethnopharmacol. 75, 191–195. https://doi.org/10.1016/S0378-8741(01)00186-6.