



Research article

Ethnobotanical survey of medicinal plants used in management of breast cancers in Qatar

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ABSTRACT

Breast cancer is a global health concern, including in Qatar, where it impacts women significantly. The complexity of breast cancer requires diverse treatment approaches influenced by tumor characteristics and biology. Despite advancements, current treatments still fall short of providing definitive solutions, particularly for triple-negative breast cancer. Complementary and Alternative Medicine (CAM), including herbal remedies, is increasingly popular among cancer patients, including those in Qatar. In Qatar, herbal medicine is widely used by the population, including breast cancer patients, yet preserving this knowledge faces significant challenges. This study aimed to document herbalists' ethnobotanical practices concerning breast cancer treatment in Qatar and corroborate any identified plant remedies' anticancer use with the literature. Thirteen herbalists were identified in Doha, Qatar, and surveyed using an ethnobotanical questionnaire between October and November 2022. Herbalists' demographic data and their herbal recommendations for breast cancer treatment were collected through structured interviews. Descriptive statistics and the Relative Frequency Citation (RFC) were employed for data analysis. The current study aimed to document herbalists' practices for breast cancer management in Qatar and validate the anticancer potential of the identified plants through existing literature. The present study documented the ethnobotanical knowledge of 13 herbalists in Qatar regarding breast cancer treatment, revealing the use of various plant species from ten different families. *Saussurea costus* (Falc.) Lipsch. (Al Qist Al Hindi), *Zingiber officinale* Roscoe (Ginger) (zanjabel) and *Nigella sativa* L. (Black seeds) (habit elbaraka) were the most recommended plants.

Literature searches revealed that many of these plants possess compounds with potential anticancer properties as sesquiterpenes, flavonoids, thymoquinone, volatile terpenic compounds and anthocyanin. The sources of these plants were primarily India and Iran due to their historical trade relations with Qatar. Herbalists predominantly use plant underground parts but could consider integrating leaves with proven anticancer properties. Each reported plant was scrutinized for its anticancer potential, by collecting the published research about its anticancer uses, revealing significant cytotoxicity against breast cancer cells. The literature survey also uncovered that most plants are reported to induce apoptosis through specific pathways, while others showed chemo-sensitization effects and cancer-induced mutation prevention. Moreover, some of the recommended plants have advanced to clinical studies. Beyond cancer, these plants displayed promise in addressing diabetes and inflammation. In conclusion, our study on herbalists'

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recommendations for breast cancer documents the traditional practices for patient therapy in Qatar. *Saussurea costus* (Falc.) Lipsch. (Al Qist Al Hindi) emerged as a commonly prescribed plant, with the roots being predominantly used. Overall, our findings describe the current traditional practices for handling breast cancer in Qatar and offer insights into integrating traditional practices with modern medicine for enhanced breast cancer management.

1. Introduction

Breast cancer (BC) ranks as the second leading cause of cancer-related fatalities among women worldwide, constituting the most prevalent non-epidermal malignancy. Analogous to global trends, breast cancer holds a substantial prevalence among women in Qatar, accounting for 39.41 % of cancer cases in women. This pervasive presence poses a formidable challenge for healthcare practitioners. The disease bears noteworthy implications for women's well-being, leading to both economic and societal repercussions [1]. The spectrum of therapeutic approaches encompasses various categories, including surgery and hormonal and targeted therapy. The choice of treatment is contingent on a multitude of factors, encompassing the molecular composition and biology of the tumor. Continuous research efforts continue to illuminate aspects of the disease, encompassing tumor classification and biomarkers for diagnosis and prognosis [2,3]. However, despite these advancements, many of the existing breast cancer treatments cannot be regarded as definitive solutions due to the inherent risk of recurrence, metastasis, and other complications associated with the therapy employed. Moreover, triple-negative breast cancer treatment is complex because of its aggressiveness, poor clinical prognosis, and propensity for relapse [4]. Moreover, developing more effective treatments for TNBC has been challenging because of the lack of actionable targets [5].

Complementary and Alternative Medicine (CAM) diverges from mainstream conventional medicine. The World Health Organization (WHO) categorizes CAM into pharmacological (including botanical drugs, also called herbs, animal-derived components, or minerals) and non-pharmacological methods (like acupuncture, manual therapies, or spiritual interventions) [6]. In the rest of this manuscript, we refer to herbs as "botanical drugs" which is the adopted term to describe plant-derived products with medicinal use [8]. Notably, WHO asserts that plant-derived traditional medicine is a vital healthcare component in developing nations, with botanical drugs being the primary sources of bioactive metabolites, including anticancer chemotherapy drugs [7]. Globally, CAM's popularity has been on the rise, especially among cancer patients. Within the Middle East, studies indicate CAM utilization in cancer treatment ranges from 35 % to over 90 % [8].

In Qatar, the belief in the potency of herbal medicine remains strong among the Qatari population, with herbal remedies being sustained as a vital resource for health and treatment [9]. Despite the widespread availability of modern pharmaceuticals and the limited local supply of herbal medicines, the use of herbal treatments remains pervasive in Qatar for ailments like diabetes, cardiovascular disease, and bronchial-pulmonary conditions [10,11]. Traditional herbal remedies are also commonly used by breast cancer patients, though previous studies have not systematically documented the range of medicinal plants employed for breast cancer treatment in Qatar. Challenges such as the side effects, high costs, and limitations of conventional cancer therapies, along with cultural traditions and the success of plant-derived anticancer drugs like Paclitaxel, drive individuals to seek alternative treatments from herbalists [12]. This reliance on medicinal plants persists despite modern medical advances, reflecting both a cultural preference for natural remedies and a belief in their therapeutic potential. As such, the preservation of such knowledge faces significant challenges stemming from the absence of a written repository detailing remedies prescribed for breast cancer patients, combined with the limited inheritance of traditional practices among family relatives, limiting the dissemination of such knowledge. The primary aim of this study was twofold: first, to document the ethnobotanical knowledge of herbalists in Qatar regarding the treatment of breast cancer through an ethnobotanical survey, and second, to conduct a literature review to present available evidence supporting the anticancer efficacy of the identified plant remedies. This combined approach aimed to systematically capture traditional practices while validating them through scientific research. In this study, 13 herbalists who prescribe herbal remedies in Qatar were identified and interviewed for the botanical drugs they recommend for breast cancer patients.

1.1. Methodology

1.1.2. Study design and location

The study employed a mixed-method approach consisting of two main components: an ethnobotanical survey and a literature review. The ethnobotanical survey involved structured interviews with 13 herbalists in Qatar (identified through personal contacts within the community and networks associated with traditional medicine) to gather demographic data and document the plant species they recommend for breast cancer treatment. Descriptive statistics and the Relative Frequency Citation (RFC) method were used to analyze the data. The literature review then corroborated the anticancer properties of the identified plants by examining existing scientific studies on their efficacy. This dual approach combined qualitative insights from traditional knowledge with quantitative and scientific validation.

The study was primarily conducted in Doha, the vibrant capital city of Qatar, which spans an area of approximately 132 square kilometers. As the epicenter of Qatar's cultural, economic, and social activities, Doha attracts a diverse population of residents and visitors. With more than 80 % of the nation's population residing in Doha, it serves as a bustling hub where various communities converge, enriching the city's blend of traditions and modernity.

2 Study population:

Traditionally, herbal shops in Qatar are concentrated in the Souq Waqif market, located at the heart of Doha. This renowned marketplace, steeped in Qatari traditions and culture, serves as a natural hub for herbalists and their trade, with over 80 % of herbal practitioners having shops in this area. A comprehensive survey was conducted across all herbalists operating in Qatar, resulting in the identification of 13 herbalists: eleven located in Souq Waqif, one in Souq Khamis Joumaa in Doha, and one in Al Wakrah, South of Qatar.

- **Sample Size:** No sample calculations were performed since all identified herbalists were included in the study.
- **Eligibility Criteria:** Eligibility criteria for inclusion in the study were as follows: Herbalists must operate a herbal store in Qatar, and possess expertise in dispensing herbal remedies to the public.

3 Data Collection:

The survey was conducted between October and November 2021 employing established ethnobotanical practices [13]. The herbalists were interviewed using a questionnaire approved by Qatar University Institutional Review Board (QU-IRB 1586-E/21). Written consent was voluntarily obtained from each of the 13 participating herbalists prior to conducting the interviews. Interviews were conducted in the Arabic language. The questionnaire comprised two main sections. The first section encompassed questions regarding demographic details such as age, educational background, and expertise in medicinal herbs. The second section consisted of questions pertaining to the focus of our study, including inquiries about the herbs primarily recommended for breast cancer patients, their methods of use, and the observed effects of these prescriptions in treating the disease. A crucial element in ensuring the accuracy of plant identification was the on-site verification of familiar plant species during the field tour. Notably, a collaborative approach was adopted, with multiple herbalists corroborating the identification of the reported plants. Additionally, to substantiate botanical scientific names, the nomenclature at the Royal Botanical Gardens- Kew (Plants of the World Online database; <https://powo.science.kew.org/employed>, ensuring precision in nomenclature. Plants' scientific names and authority were listed according to the Plants of the World Online database as well. For plants that satisfied the requirement for deposition at the herbarium, Dr. Elsayed Alazazi, plant biotechnology expert at Agricultural Research Section, Qatari Ministry of Municipality (MME), confirmed plant identification and deposited a voucher sample at the MME herbarium (Table S1).

4 Data analysis:

Descriptive statistics were performed and presented as mean values, with their standard deviations and proportions representing continuous and categorical variables, respectively. The Relative Frequency Citation (RFC) for each plant was computed to determine the number of herbalists who reported prescribing this specific plant for treating breast cancer. RFC was calculated by dividing the number of herbalists reporting the prescription of a particular plant for treating BC over the total number of herbalists involved in the study, and its values range from 0 to 1. Statistical analysis was performed using the Statistical Analysis Package for Social Sciences (SPSS), version 24.0 (SPSS Inc., Chicago, IL, USA).

5 Review of medicinal plants used in management of breast cancers:

Table 1
Demographic characteristics of study participants (n = 13).

Characteristics	Percentage response, %(n)
Age (in years)	
Mean \pm SD	43.1 \pm 12.8
Range	23, 66
Education, N (%)	
Elementary	2 (15.4)
High school	3 (23.0)
Diploma	4 (30.8)
Bachelor	4 (30.8)
Herbalist as only job, N (%)	
Yes	8 (61.5)
No	5 (38.5)
Years of experience	
Mean \pm SD	17.5 \pm 15.7
Range	2, 50
Source of information about the profession, N (%)	
Study	1 (7.7 %)
Expert	5 (38.5 %)
Family and friends	7 (53.8 %)
Willingness to cooperate with governmental or non-governmental entities to preserve medicinal plants	
Yes	13 (100 %)
No	0 (0 %)

Table 2

List of reported Medicinal Plants prescribed by herbalists in Qatar for breast cancer treatment.

Plant Family & Scientific name	Local Name	Part used	RFC	Preparation & administration.	Amount consumed/day	Phytochemical compounds with potential anticancer effect	Literature reports supporting anticancer efficacy.
Amaryllidaceae <i>Allium sativum</i> L.	Garlic Clove (Al thoom EL Yemeni)	Bulb	0.23	One clove consumed in the morning.	One clove	Sulfur-containing compounds, such as allicin, diallyl sulfide, diallyl disulfide, diallyl trisulfide, alliin, S-allylcysteine, and S-allylmercaptocysteine	[14–19]
Asteraceae <i>Artemisia herba alba</i> L.	Artemisia (Al sheeh)	Leaves	0.08	Consumed as a hot drink with water	About 1g/100 ml water	Polyphenols, tannins, flavonoids and anthocyanins	[20–28]
<i>Saussurea costus</i> (Falc.) Lipsch.	Saussurea costus (Al Qist Al Hindi)	Roots	0.46	Added to water and consumed	About 0.5g/100 ml water	Sesquiterpenes, flavonoids, and essential oils	[29–36]
<i>Silybum marianum</i> (L.) Gaertn.	Milk thistel (shok el gamal)	Whole	0.08	Grounded and soaked in water for overnight and consumed	1g/200 ml water	Silandrin Silybin silychristin Silydianin Silymarin Silymonin Dithiolane	[37–45]
Apiaceae <i>Ferula asafoetida</i> L.	Asafoetida (Halteet)	Roots	0.15	Mixed with honey and consumed.	0.25g in one tablespoon honey		[46–53]
Burseraceae <i>Boswellia sacra</i> Flück.	Frankincense (allaban)	Tree resins	0.08	2 to 3 small pieces soaked in normal-temperature water	About 0.25g/300 ml water	Boswellic acid	[54–60]
<i>Commiphora myrrha</i> (T. Nees) Engl.	Myrrha	Tree resins	0.15	2 to 3 small pieces soaked in normal-temperature water	About 0.25g/300 ml water	Cycloartane triterpenoids	[61–68]
Ephedraceae <i>Ephedra sinica</i> Stapf	Al Alaanda	Stem and roots	0.23	Consumed as a hot drink with water	0.5g/200 ml water	Alkaloids, flavonoids, tannins, polysaccharides	[69–76]
Lamiaceae <i>Origanum majorana</i> L.	Marjoram (Mardaquoush)	Leaves	0.15	Consumed as a hot drink with water	1g/100 ml water	Essential oils, phenolic acids, terpenoids, flavonoids, alkaloids, vitamins, enzymes and minerals	[77–84]
<i>Salvia officinalis</i> L.	Common Sage (myrameyah)	Leaves	0.15	Soaked in normal temperature water and consumed.	1g/100 ml water	Essential oil	[85–92]
<i>Lavandula angustifolia</i> Mill.	Lavender	Flowers	0.08	Soaked in normal temperature water and consumed.	1g/100 ml water	Essential oils	[93–101]
Ranunculaceae <i>Nigella sativa</i> L.	Black seeds (Habat albaraka)	Seeds	0.08	Mixed with Asafoetida, tahini, and honey and consumed as one spoon during the day and one spoon at night	0.25g seeds, 0.15g Asafoetida, small teaspoon tahini and one table spoon honey	Thymoquinone	[102–110]
Rosaceae <i>Prunus armeniaca</i> L.	Prunus Armeniaca (bthor el msh msh)	Seeds	0.08	Eatable	5-10 seeds	Amygdalin	[111–118]
Rutaceae <i>Citrus x aurantifolia</i> L.	Black lime (loomi aswad)	Whole	0.08	Soaked in normal temperature water and consumed	1-2 pieces in 300 ml water	Naringin	[119–125]
Zingiberaceae <i>Alpinia galanga</i> (L.) Willd.	Alpinia (kholnjan)	Stem	0.08	Grounded and mixed with hot water or honey	0.15g/100 ml water	Phenyl propanoids, lignans, flavonoids and essential oil	[126–134]
<i>Curcuma longa</i> L.	Turmeric (male) korkom zakar	underground stems/ rhizomes	0.23	Added to hot water and consumed	0.2mg/200 ml water	Curcumin	[45, 135–143]
<i>Zingiber officinale</i> Roscoe	Ginger (zanjabel)	underground stems/ rhizomes	0.08	Consumed as a hot drink with water	0.15g/200 ml water	Volatile terpenic compounds, anthocyanin, phenolic compounds, ginger essential oil	[144–155]

The clear research question guiding this part of the study was: What is the potential anticancer impact of the identified medicinal plants on breast cancer cell lines, animal models, or patients? To address this question, a systematic literature search was conducted using specific keywords, including "anticancer," "breast cancer," and the names of the individual plants identified during the ethnobotanical survey. Comprehensive searches were performed across prominent international databases such as ScienceDirect, PubMed, Google Scholar, Web of Science, and Scopus, aiming to locate scientific evidence substantiating the possible anticancer effectiveness of these plants. Data collection involved extracting relevant information from the identified studies, focusing on study design, plant parts used, dosages, methodologies, and outcomes related to anticancer efficacy. The analysis included a qualitative synthesis of the gathered literature to assess the overall findings regarding the anticancer properties of the identified plants, evaluating mechanisms of action such as cytotoxicity and apoptosis induction. This thorough approach ensured a comprehensive understanding of the scientific evidence supporting the traditional use of these plants in managing breast cancer.

2. Results

2.1. Demographic characteristics of study participants

In the current study, thirteen herbalists operating in Qatar who specialize in providing medicinal plants and botanical drugs were recruited. These herbalists constitute almost all of the herbalists population in Qatar. All herbalists were males, and their average age was 43 years. Most have attained more than high school education (Table 1). Interestingly, several herbalists disclosed that they obtained their knowledge about medicinal plants by inheritance from elders in their families who were practitioners of traditional healing techniques. Other herbalists acquired their expertise from experienced herbalists outside of their family circles. The average years of practice of the herbalists was approximately 17 years (ranging between 2 and 50 years). Importantly, every single herbalist (100 %) expressed keenness and willingness to collaborate with biomedical researchers and medical professionals to advance the field of CAM (see Fig. 1).

Interviews with the herbalist revealed that 17 plants were recommended by the herbalists for breast cancer patients. The 17 plants fell into 10 distinct taxonomic families (Table 2 and Fig. 2). Plants from Asteraceae (3 species, 18 %), Lamiaceae (3 species, 18 %), and Zingiberaceae (3 species, 18 %) families were the most frequently recommended. Two of the plants (11 %) were from the Burseraceae family. Each of the remaining plants belonged to a separate family (Fig. 2 A). *Saussurea costus* Falc. Lipsch. had the highest frequency of mentions by the herbalists, with an RFC value of 0.46. It was closely followed by *Allium sativum* L., *Ephedra sinica* Stapf, and *Curcuma longa* L., each of which had an RFC of 0.23 (Table 2). Data in Table 2 and Fig. 2 aligns with numerous previous research studies on the anticancer properties of these plant species.

The herbalists mainly used underground plant parts (roots and rhizomes) in their herbal preparations for breast cancer patients (14 out of 17 reported plants, 84 %). Plant leaves of 45 % of the reported plants were employed by the herbalists. Comparatively, flowers or fruits had a limited presence, featuring in only 2 out of the 17 plants (12 %) (Fig. 2 B).

The question about the origin of the reported plants revealed that most were imported into Qatar (65 %). Over 80 % of the plants (15/17 plants) were exported from India, reflecting a significant reliance on Indian botanical resources. Plants originated in Iran closely followed (64 % of the plants, 11 plants). Moreover, other countries such as Sri Lanka (35 %), Jordan (41 %), Syria (47 %), Saudi Arabia (11 %), and Qatar (approximately 35 % or 6 plants) contributed to the diverse pool of plant sources (depicted in Fig. 3).



Fig. 1. Map of study area in Qatar.

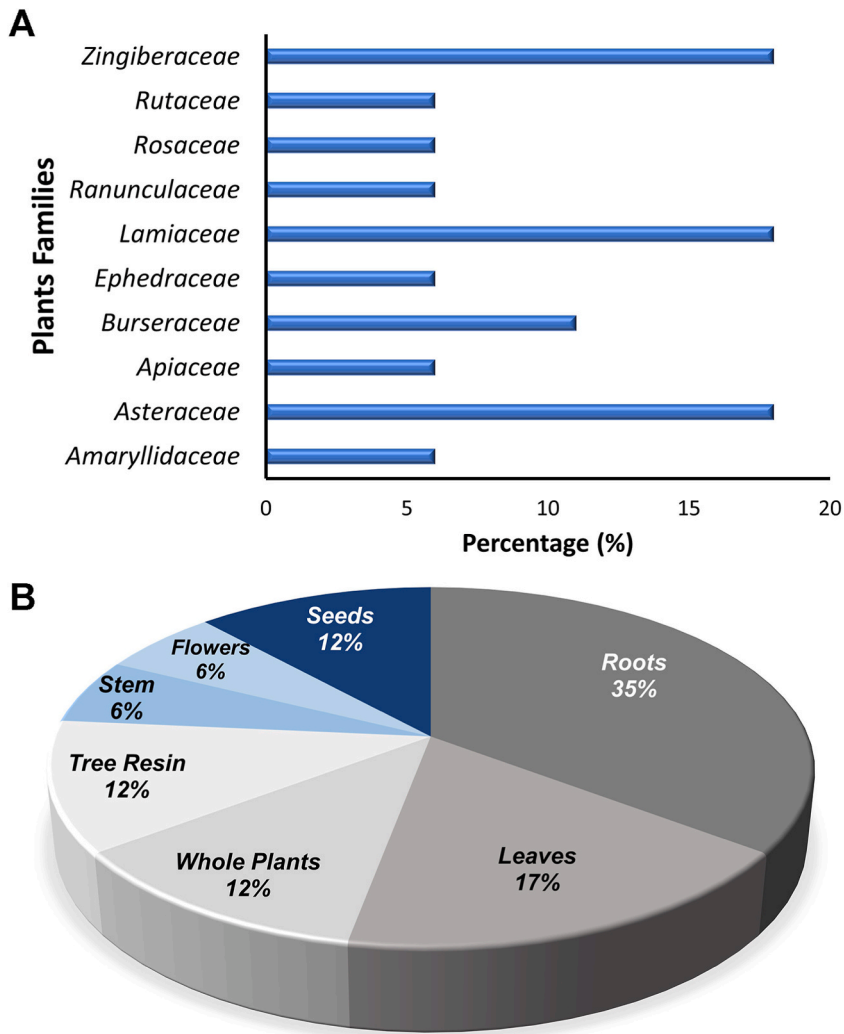


Fig. 2. Medicinal plants prescribed by herbalists in Qatar for breast cancer patients. **A:** Percentage of the plants under each taxonomical family. **B:** Percentage usage of plant parts of the 17 medicinal plants reported by herbalists for breast cancer in Qatar.

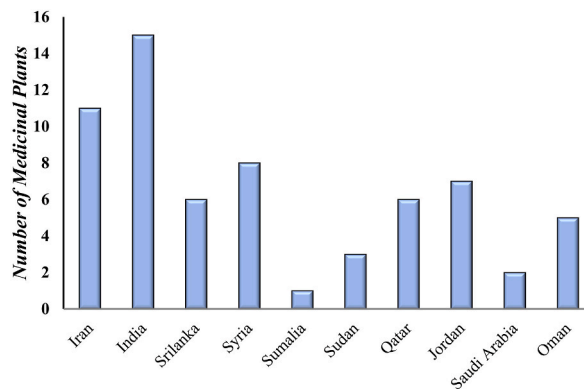


Fig. 3. Sources of the medicinal plants provided by the herbalists in Qatar for breast cancer patients.

The interviews also revealed that herbalists prescribed the reported plants for breast cancer patients for a variety of reasons. Most of these remedies were recommended with the primary goal of boosting the immune system, alleviating pain, and managing side effects. Additionally, only one plant *Saussurea costus* (Falc.) Lipsch. (Al Qist Al Hindi) was explicitly prescribed for cancer treatment, among other uses (Fig. 4).

Of notable significance was the examination of the connection between the recommended plants and the documented literature regarding their anticancer properties. Interestingly, an extensive review of the literature demonstrated that each of the mentioned plants has been scientifically reported to exhibit anti-breast cancer activity. The reported findings included either *in vitro* studies (on cancer cell lines), *in vivo* experiments (using animal models), or clinical trials. Clinical trials were mainly conducted on curcumin (*C. longa*) and have consistently shown that curcumin has a substantial anticancer potential. Table 1 summarizes some of the evidence reported in the literature concerning the anticancer properties of these plants. Interestingly, many of these plants were found to induce apoptosis in cancer cells, thereby corroborating their potential as therapeutic agents targeting cancer. Moreover, the 17 plants had other medicinal applications, including antidiabetic, antimicrobial, and anti-inflammatory effects (Table S1).

3. Discussion

In this study, we present the findings of an ethnobotanical survey focusing on the use of CAM of botanical origin among breast cancer patients in Qatar. To our knowledge, this is the first study in Qatar that documents the utilization of traditional medicinal plants prescribed by herbalists for the management of breast cancer. Many of the studies exploring the application of CAMs among cancer or breast cancer patients in different countries, such as Turkey, Canada, China, the USA, Germany, and Saudi Arabia, have relied mainly on questionnaires targeting patients [156–162], unlike this study which focused on the herbalists supplying the botanical drugs. Additionally, there have been investigations into traditional medicinal practices employed by herbalists for cancer treatment in various contexts [163]. There have also been studies exploring herbalists' recommendations for conditions other than cancer, such as hemorrhoids and AIDS/HIV [164,165].

Based on our survey findings, the botanical drugs utilized in Qatar are sourced from various countries. Using these plants in Qatar enriches the diversity of bioactive metabolites used in Qatar and expands the traditional knowledge that can be harnessed for cancer treatment. Different regions worldwide have unique flora with medicinal properties and have been used for centuries in local traditional medicine. By studying the botanical drugs specific to each country, researchers can explore novel compounds with potent anticancer effects. For example, herbs and plants from countries like Iran, known for their rich history of herbal medicine, may offer unique bioactive compounds that could effectively combat diseases, including cancer. Similarly, plants from regions like the Middle East, with a long tradition of therapeutic use, may contain compounds with anticancer properties that have not been extensively studied.

Indeed, the literature confirms that diverse plant-derived substances, including polysaccharides and polyphenols and other phytochemicals, could bolster the immune system and demonstrate anticancer attributes [142–144].

The significance of this study lies in the scarcity of studies on the types of remedies that herbalists recommend to breast cancer patients. Such traditional treatments have been associated with potentially adverse side effects and, in a few instances, fatal outcomes [166,167]. This highlights the importance of understanding and documenting these practices to improve patient safety and well-being. The study's identification of 17 plant species from 10 distinct families used for breast cancer management in Qatar highlights the importance of traditional medicine in the region. Notably, the families Asteraceae, Lamiaceae, and Zingiberaceae exhibited significant prominence, collectively constituting 54 % of the total representation. This dominance suggests that these families may possess valuable therapeutic properties or have long-standing cultural relevance in breast cancer treatment practices. These findings underscore the need for further pharmacological research into these plant families to explore their potential in breast cancer therapies. Moreover, understanding the local use of these plants can help bridge traditional knowledge with modern medicine, potentially leading to the discovery of new treatment strategies. (Table 2). A notable observation was the prevalence of *Saussurea costus* (Al Qist Al Hindi) as the most frequently prescribed plant by herbalists for breast cancer patients, similar to its usage by Ayurvedic practitioners in

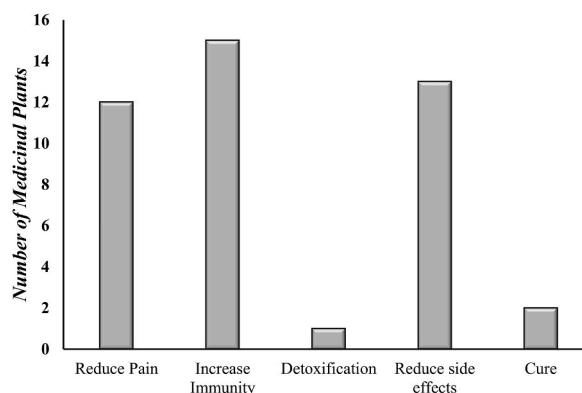


Fig. 4. Key objectives for prescribing medicinal plants by herbalists in Qatar for breast cancer patients.

India and Traditional Chinese Medicine in China [168]. A study in Saudi Arabia focusing on breast cancer patients demonstrated a different trend, wherein the most commonly used ethnomedicinal remedies included honey, olive oil, antioxidants, and *Nigella sativa* (Black seeds; habit elbaraka) [160], which this study found that it is also prescribed by herbalists in Qatar for breast cancer patients. In fact, our findings indicated that *Nigella sativa* and *Zingiber officinale* (zanjabel) ranked among the predominantly recommended plants for breast cancer patients in Qatar.

Furthermore, our investigation spotlighted two additional remedies frequently endorsed by herbalists in Qatar for breast cancer management: *Curcuma longa* (male Turmeric; korkom zakar) and *Ephedra sinica* (Al aanda). Remarkably, these medicinal plants have been recognized for their use in cancer therapy in other countries, including Sri Lanka and Palestine, establishing a cross-cultural consistency in their potential medicinal application [169,170].

Exploring the origins and sources of the plants present at the herbalists' shops and subsequently prescribed to patients revealed that a significant portion of these plants were exported from India and Iran. Both countries lie in the geographical vicinity of Qatar and are known to have old commercial exchanges with Qatar via sea routes. Qatar, characterized by its arid climate and its geography of sand dunes and salty flat deserts, has robust historical trade relations with neighboring nations such as Iran and India [171], explaining the reliance on the utilization of medicinal plants from these countries in traditional medicinal practice.

Notably, our investigation also unveils the tendency among herbalists in Qatar to predominantly employ underground parts (for more than 80 % of the plants reported) in their ethnobotanical practices. This aligns with previous studies that have reported similar findings where the underground parts are rich in alkaloids and other bioactive compounds and have the potential for application in cancer research [140,141]. On the other hand, leaves are a rich source of plant phytochemicals and metabolites and have been extensively used in traditional medical systems worldwide. Relatedly, *Saussurea costus* and *Zingiber officinale* leaves have been associated with apoptosis induction in breast, liver, and colon cancer cells [29,151]. These findings call for the integration of various plant parts as botanical drugs for therapeutic purposes, therefore aligning traditional practices with modern scientific insights. To conserve medicinal plants used for their roots, strategies like selective harvesting, promoting cultivation, and educating communities about sustainable practices are essential. Encouraging the use of alternative plant parts and implementing regulations on endangered species can help prevent overharvesting. Engaging local communities in conservation and documenting traditional knowledge will support the identification of at-risk species. Collaborating with conservation organizations can further enhance biodiversity initiatives, ensuring the balance between plant use and preservation for future generations.

Interestingly, our survey revealed that every ethnomedicinal plant documented and employed by herbalists for breast cancer treatment has been reported to have anticancer potential in scientific literature (Table 1). A comprehensive literature search unveiled noteworthy anti-tumor effects associated with these plants. Numerous *in vitro* studies using breast cancer cell lines explored a range of extracts, including water and alcohol extracts and oils of the 17 plants. Examples of these plants included *Artemisia herba alba* L. (Al sheeh), *Saussurea costus*, *Salvia officinalis* L. (Common Sage; myrameyah), and *Ferula assa-foetida* L. (Asafoetida; Halteet). Other than breast cancer, some of the plant extracts were reported to be tested for their antitumor activities against other cancers such as leukemia, liver, prostate, colon, and lung cancers [20,29,38,46,151,172].

Moreover, some studies delved into uncovering the mechanisms underpinning the cytotoxic effects of certain plants. For instance, *Saussurea costus* (Falc.) Lipsch. was found to induce apoptosis via the Caspase-3 dependent intrinsic pathway [33,173], while *Silybum marianum* (L.) Gaertn. influenced the MAPK pathway [174], and *Prunus armeniaca* L. triggered mitochondrial-mediated apoptosis and autophagy [112]. Beyond inducing cancer cell death, certain plants exhibited remarkable secondary effects on cancer cell viability. For instance, *Origanum majorana* L. exhibited inhibitory effects on cancer cell metastasis and invasion [175,176], and Milk Thistle enhanced tumor cell sensitivity to chemotherapy (chemo-sensitization) and prevented cancer-induced mutations [177].

Notably, some of the 17 plants were experimentally tested for their *in vivo* antitumor efficacy. Plants such as *Ferula assa-foetida* L., *Salvia officinalis* L., *Zingiber officinale* Roscoe, and *Origanum majorana* L. demonstrated significant therapeutic anticancer effects in these *in vivo* investigations. More interestingly, a select few of these plants have already progressed to testing in clinical studies. *Curcuma longa* L. and *Nigella sativa* L. underwent clinical trials and have served as starting points for developing drugs and anticancer compounds. Noteworthy, several studies ventured beyond cancer treatment to explore other potential therapeutic applications of these plants, such as their potential antidiabetic and anti-inflammatory efficacy.

This study highlights the significant role of herbal medicine in breast cancer management in Qatar by documenting the knowledge of 13 herbalists, who represent nearly the entire herbalist population in the country. The predominance of plant families like Asteraceae, Lamiaceae, and Zingiberaceae suggests valuable therapeutic properties that warrant further pharmacological research. The willingness of herbalists to collaborate with biomedical researchers indicates an opportunity to bridge traditional practices with modern scientific inquiry.

The study had limitations, including a small sample size of herbalists, which may affect generalizability. This was addressed by including all identified herbalists in Qatar. Self-reported data could introduce bias, but structured interviews ensured consistency. The focus on specific markets might overlook other practitioners, although a diverse range of plant species was documented. Finally, the literature review was limited to available studies, but extensive searches across multiple databases improved the overall findings.

In summary, our investigation unveiled that herbalists in Qatar recommend numerous botanical drugs for breast cancer patients. These botanical drugs have demonstrated anticancer properties *in vitro* and/or *in vivo* without notable adverse effects. Furthermore, these botanical drugs have additional therapeutic benefits.

4. Conclusion

In conclusion, our study offers a unique perspective on the recommendations of herbalists for breast cancer treatment in Qatar,

complementing previous research on complementary and alternative medicine (CAM) usage among cancer patients. We identified a diverse range of plant species recommended for breast cancer patients, with *Saussurea costus* emerging as the most frequently prescribed, consistent with its historical usage in cancer therapy. Other commonly recommended plants included Ginger and Black seeds.

Our investigation also provided insights into the origins of these plants, with many sourced from countries with historical trade relations with Qatar. Interestingly, herbalists predominantly employed underground parts in their practices, although certain leaves showed significant anticancer potential. Each reported plant was scrutinized for its anticancer properties through a comprehensive literature search, revealing notable anti-tumor effects and mechanisms. Several plants have progressed to pre-clinical and clinical studies, demonstrating therapeutic efficacy in cancer and other diseases such as diabetes.

Overall, our study contributes valuable insights into the utilization of traditional medicinal plants for breast cancer management in Qatar, underscoring the potential for integrating these practices with modern medicine to enhance patient care and treatment outcomes. The identification of 17 plant species with documented anticancer properties reinforces the potential for discovering new therapeutic compounds, particularly from regions with rich herbal traditions such as India and Iran. Furthermore, the focus of herbalists on immune support and side effect management highlights the importance of incorporating these practices into supportive cancer care. This study lays the groundwork for future research that could enhance treatment strategies for breast cancer and facilitate the integration of traditional medicine into mainstream healthcare.

CRediT authorship contribution statement

Rasha.S.Abo El Alaa: Writing – review & editing, Writing – original draft, Resources, Investigation. **Hend Al-Jaber:** Writing – review & editing, Writing – original draft. **Fatima Al Zahraa Chokor:** Writing – review & editing, Formal analysis, Data curation. **Abdullah A. Shaito:** Writing – review & editing, Writing – original draft, Supervision. **Layla Al-Mansoori:** Writing – review & editing, Writing – original draft, Supervision, Project administration.

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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.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2025.e42541>.

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