TPM Vol. 32, No. S3, 2025
ISSN: 1972-6325
https://www.tpmap.org/

ETHNOBOTANICAL INSIGHTS INTO MEDICINAL PLANT-BASED THERAPIES FOR SKIN CANCER IN QUETTA DISTRICT, BALOCHISTAN

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Abstract

Cancer remains a life-threatening disease worldwide, with skin cancer constituting a major public health concern. Despite advances in pharmaceutical research, medicinal plants continue to play a pivotal role in developing safer and more effective therapeutic options. The flora of Quetta District, Balochistan, is of particular ethnomedicinal importance, as local communities rely on these resources for generations in their primary healthcare practices. However, to date, no comprehensive documentation focused on medicinal plants traditionally used for skin cancer. This study represents the first systematic ethnobotanical documentation of medicinal plants employed against skin cancer in Quetta. Data were collected through open-ended questionnaires, free-listing techniques, and personal observations from 106 informants (66% female, 33% male). Quantitative ethnobotanical indices, including Use Value Citation (UVC) and Disease Consensus Index (DCI) were applied to assess the cultural importance and reliability of reported species. A total of 50 medicinal plants, belonging to 45 genera and 34 families, were recorded for their use in skin cancer treatment. The family Solanaceae was dominant, representing five species. Growth forms comprised herbs (53%), shrubs (30%) and trees (14%). Oral administration was the most common route (60%), followed by topical applications in the form of pastes (10%). Powder preparations were the most frequently reported method of herbal drug formulation (40%). Among the species, Azadirachta indica exhibited the highest UVC value (0.33), while Solanum nigrum had the lowest (0.01). Similarly, Silybum marianum demonstrated the highest DCI (0.19), whereas Ziziphus jujuba recorded the lowest (0.01). These findings underscore the critical need to preserve this indigenous knowledge, which is at risk of erosion due to cultural and environmental changes. Furthermore, the documented species should be subjected to detailed pharmacological, phytochemical and toxicological investigations to scientifically validate their therapeutic potential. This study will not only ensure efficacy and safety but will also

provide pharmaco-gnostic data that is essential for the correct identification and standardization of medicinal plants. Ultimately, this study highlights the ethno-therapeutic significance of Quetta's flora and offers a foundation for future drug discovery targeting skin cancer.

Keywords: Ethnobotany, Medicinal plants, Skin cancer, Use Value Citation (UVC), Disease Consensus Index (DCI), Pharmacognosy, Phytotherapy

INTRODUCTION

Skin cancer, encompassing both melanoma and non-melanoma types, poses a growing global health burden, owing to increasing exposure to ultraviolet (UV) radiation, environmental carcinogens, and rising life expectancy (Singh, Mukherjee, & Katiyar, 2014; Islam et al., 2020). In many low- and middle-income countries (LMICs), limitations in access to conventional therapies and their cost, along with treatment resistance, have intensified interest in complementary and alternative approaches, particularly the use of medicinal plants and plant-derived phytochemicals (Islam, Ahmed, Ahsan, Batool, & Lee, 2020; Khan, Adnan, Ali, & Bussmann, 2019). Ethnobotanical studies serve as a critical bridge between traditional knowledge and modern pharmacology by documenting local uses of plants for skin diseases and exploring which species or preparations may have anti-skin cancer potential (Malik, Ahmad, & Zafar, 2019; Alamgeer, Sharif, Asif, Younis, Riaz, & Bukhari, 2018). In northern Pakistan, a quantitative ethnobotanical study documented 106 plant species from 56 families used to treat various skin ailments; herbs were the dominant life form, the leaf was the most used part and powder was the most common preparation method (Malik et al., 2019). A review of ethnomedicinal plants in Pakistan identified 545 species from 118 families employed against skin diseases, with leaves, whole plants, and roots being among the key parts used, often in powder or paste forms (Alamgeer et al., 2018). Beyond documentation, there is accumulating evidence that certain phytochemicals from these medicinal plants exert anti-cancer effects in vitro and in vivo. Phytochemicals such as quercetin, curcumin, resveratrol, various flavonoids and terpenoids have shown anticarcinogenic effects via mechanisms including anti-oxidation, anti-inflammation, apoptosis induction, anti-proliferation, and inhibition of angiogenesis (Singh et al., 2014; Islam et al., 2020; "Complementary and alternative therapies in skin cancer," 2022). For instance, quercetin has been demonstrated to inhibit proliferation and induce apoptosis in melanoma cell lines, and to modulate signaling pathways involved in metastatic and redox regulation. These findings support the notion that ethnopharmacologically documented species may harbor compounds of relevance to skin cancer therapy. Ethno-pharmacological research in Pakistan has highlighted a wide range of medicinal plants used in traditional practices for cancer treatment beyond skin cancer. A study in Khyber Pakhtunkhwa recorded 154 plants from 69 families used by traditional healers for various cancers; Lamiaceae, Asteraceae and Solanaceae were among the most represented families. Species parts such as leaves and whole plants were commonly used, and applications such as decoction and powder predominate. However, this work was not limited to skin cancer. (Khan et al., 2022). A review of Pakistani anticancer medicinal plants found 108 species used in folklore to treat different neoplasms, but only a subset has been experimentally validated (Khan, Adnan, Ali, & Bussmann, 2019). Despite these advances, several critical gaps remain. First, though many studies document plants used for skin diseases, very few focus specifically on skin cancer ethno-therapeutic practices. Diseases such as eczema, wounds, acne, or fungal infections are much more commonly recorded than malignant or pre-malignant lesions in ethnobotanical surveys (Malik et al., 2019; Alamgeer et al., 2018). Second, quantitative indices such as use value (UV), relative frequency of citation (RFC), fidelity level (FL), or disease consensus indices are underutilized in many regional studies, limiting the ability to prioritize species for further phytochemical, pharmacological, or toxicological analysis (Malik et al., 2019; Khan et al., 2022). Third, there is limited evidence from the region on molecular mechanisms, bioavailability, safety, and in vivo tumor inhibition for plants reported in traditional use. While reviews (e.g., Islam et al., 2020) highlight the molecular pathways modulated by phytochemicals, translation to clinical trials remains scarce. This study aims to address these gaps in the specific context of Quetta District, Balochistan. By documenting medicinal plants used by the local community specifically for skin cancer, and by applying quantitative ethnobotanical measures such as Use Value Citation (UVC) and Disease Consensus Index (DCI), this research will enable systematic prioritization of species for pharmacological validation. Moreover, the floristic environment of Balochistan with significant plant diversity and unique species adapted to arid and semi-arid conditions offers potential novel species or chemotypes not previously documented in other regions. This ethnobotanical data combined with biochemical and molecular evidence suggest that medicinal plants and their phytochemicals hold promise both for prevention and treatment of skin cancer. Nevertheless, region-specific documentation, rigorous quantitative analysis, and downstream validation (phytochemical, pharmacological, toxicological) are essential to ascertain efficacy and safety. This study therefore contributes a novel dataset from Quetta, measures for consensus and use-value, and sets a

foundation for further drug discovery and conservation efforts in the ethno-therapeutic landscape of skin cancer.

Study Objectives

This study aims to document and quantitatively evaluates the ethnomedicinal use of plants for skin cancer in Quetta District, Balochistan, in order to identify culturally significant species with potential for pharmacological validation and conservation.

SIGNIFICANCE OF STUDY

This study provides the first systematic documentation of medicinal plants traditionally used for skin cancer in Quetta District, Balochistan, thereby preserving valuable indigenous knowledge at risk of cultural erosion. By applying quantitative ethnobotanical indices (UVC and DCI), it generates evidence-based prioritization of species with high therapeutic relevance. The findings not only highlight the dominant families, preparation methods, and culturally significant species but also establish a scientific foundation for future pharmacological, phytochemical, and toxicological investigations. Moreover, the outcomes contribute to biodiversity conservation, promote the sustainable use of local plant resources, and may facilitate the discovery of novel anticancer agents from ethnopharmacological leads.

MATERIALS AND METHODS

Geo-Ethnographic Profile of Quetta District

Balochistan, the largest province of Pakistan by area, covers nearly 44% of the country but has the smallest population (Government of Pakistan, 2023). Quetta, its capital, spans approximately 2,653 km² and lies at an elevation of 1,675 meters (5,500 ft), with a semi-arid to temperate climate supporting diverse vegetation. The district is bordered by Pishin to the north, Ziarat to the east, Mastung to the southwest, and Afghanistan to the west. Quetta is a culturally diverse city with a multilingual population. The majority are Brahui and Pashtun, while Baloch, Punjabi, Sindhi, Dehwari, Hindko, Seraiki, and Persian-speaking communities also reside in the region. Urdu serves as the common language for communication. This ethnic and linguistic diversity contributes to rich indigenous knowledge, including traditional medicinal practices that are central to local healthcare.

Socio-Economic Profile of the Study Area

Quetta is endowed with diverse flora, including a substantial number of medicinal plants. Rural communities continue to rely heavily on these plants for primary healthcare due to strong traditional beliefs. Agriculture remains the main source of livelihood in the region. Promoting sustainable use of wild flora and the cultivation of medicinal plants could have a significant positive impact on the socio-economic conditions of local communities.

Figure 1: Geographical map of the study area (Quetta District, Balochistan, Pakistan)

Data Collection and Ethnobotanical Survey

Ethnomedicinal data on plants used for skin cancer treatment were collected using a combination of free-listing and semi-structured interviews. Initially, random informants were approached for free-listing to identify commonly known medicinal plants, followed by in-depth interviews with key informants selected based on prior knowledge and local expertise. Questionnaires focused on traditional uses of plants for skin cancer, including local names, plant parts utilized, preparation methods, and routes of administration. All interviews were conducted in local languages to ensure accuracy and cultural appropriateness. A total of 106 informants comprising 80 community members and 26 traditional herbalists were surveyed across different age groups and genders (Table 1). Data were systematically categorized by species and medicinal use following standard ethnobotanical protocols (Cook, 1995), with comprehensive details presented in Table 3. Field surveys and plant collection were carried out across

various locations in Quetta during 2018–2019 to document endemic and regionally significant medicinal flora.

Demographic Profiling of Informants

Demographic characteristics of the informants were recorded through face-to-face interviews. Male informants were primarily interviewed in the field, whereas female informants were approached at their homes to ensure comfort and privacy. In addition, local herbalists and traditional healers were consulted to assess the current status and continuity of traditional medicinal knowledge within the study area.

Collection and Preservation of Plant Specimens

Medicinal plants from Quetta were collected during the 2018–2019 seasons, including summer, autumn, and winter, from various locations across the district. The specimens were carefully pressed, dried, and preserved following standard herbarium protocols (Jain & Rao, 1977). Each specimen was systematically organized and labeled to ensure accurate identification and long-term conservation for future reference.

Identification and Herbarium Deposition of Plant Specimens

Collected plant specimens were identified using the Flora of Pakistan series (Nasir & Ali, 1970–1979; Nasir & Ali, 1980–1989; Ali & Qaiser, 1992–2009). Plant names were further verified through the International Plant Names Index (IPNI: http://www.ipni.org) and Tropicos database (www.tropicos.org/project/Pakistan) to ensure taxonomic accuracy. Voucher specimens were systematically deposited in the Herbarium of the Department of Plant Sciences, Sardar Bahadur Khan Women's University, Quetta, Balochistan, for future reference and verification.

Quantitative Analysis of Ethnomedicinal Data

Disease Consensus Index (DCI)

The Disease Consensus Index (DCI) was employed to evaluate the perceived therapeutic effectiveness of each medicinal plant and the degree of agreement among informants regarding its use for specific diseases. This index provides a quantitative measure based on mathematical principles, comparing the reported responses of study participants (C_c) with the ideal use frequency for each species (V_z) (Andrade-Cetto et al., 2006). The DCI was calculated using the following formula:

$$\mathbf{DCI} = \frac{\mathbf{Cc}}{\mathbf{Vz}}$$

Where:

Cc = Number of informants who reported the use of a species for a particular disease

Vz = Total number of informants citing the species

A higher DCI value indicates greater consensus among informants about the therapeutic use of the plant, whereas lower values suggest less agreement.

Use value citation (UVC)

The Use Value Citation (UVC) provides a quantitative measure of the frequency with which a plant is mentioned during interviews, reflecting its relative importance within the local community. Higher UVC values indicate greater cultural significance and reliance on the species for medicinal purposes. The UVC for each species was calculated using the following formula (D'Albuquerque et al.,2007):

$$\mathbf{UVC} = \frac{\sum \mathbf{Ui}}{N}$$

Where:

U_i = Number of citations for a given species by each informant

N= Total number of informants

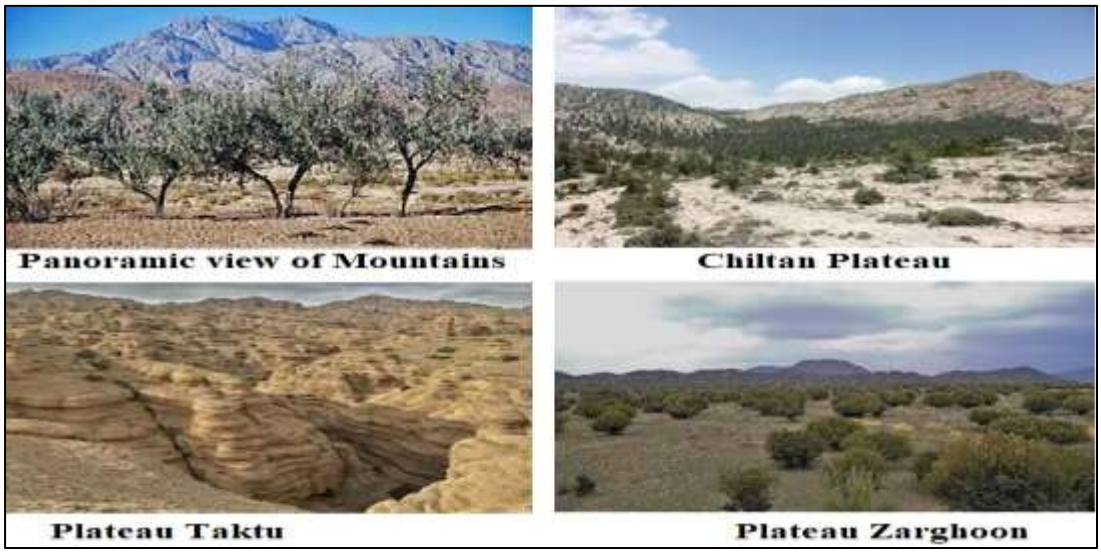

Figure2: Panoramic view of the mountainous landscape of Quetta, highlighting the Chiltan and Zarghoon ranges along with the Taktu Plateau.

Socio-Demographic Characteristics of Informants

A total of 106 informants from villages in Quetta District participated in the study, including 63% women and 33% men across five age groups: 37–43, 44–50, 51–57, 58–64, and 65–71 years. The sample included 18 male herbalists, 37 traditional healers, and 54 women. Most informants (60%) were illiterate, 16% had completed primary education, and 9% held higher educational qualifications (Table 1).

Ethnobotanical Diversity and Use of Medicinal Plants

A total of 50 plant species, belonging to 45 genera and 34 families, were documented from the study area. Detailed information, including botanical names, common names, family, life form, plant parts used, Use Value Citation (UVC), and Disease Consensus Index (DCI), is provided in Table 3. The dominant families were Solanaceae (5 genera, 5 species), Asteraceae (4 genera, 4 species), and Zygophyllaceae and Zingiberaceae, each represented by 4 species (Table 2). The remaining 28 families were represented by a single species each, all used locally for skin cancer treatment. These plant species constitute a primary source of healthcare for local communities. Some species, such as Colchicum luteum, Crocus sativus, Emblica officinalis, Triticum aestivum, Ananas comosus, and Fagonia cretica, were procured from local markets due to their absence in Quetta. Traditional healers predominantly utilize herbs (53%), followed by shrubs (30%), trees (14%), and climbers (2%) for the preparation of remedies (Figure 3), likely reflecting accessibility and cost-effectiveness compared to pharmaceutical drugs. These findings align with previous ethnobotanical studies reporting the widespread use of herbs for disease treatment (Saranzai et al., 2013; Pandy, 2011; Cragg, 2005; Bibi et al., 2015). Several plant species documented in this study have also been reported globally for skin cancer management. For instance, the fresh pulp of Aloe indica is used in Quetta for skin cancer, consistent with Pankaj et al. (2013). Similarly, leaves of Azadirachta indica are used as a decoction, corroborating reports by Nimila & Swati (2014) and Pradhan (2004). Infusions of Artemisia annua were applied locally and have been previously reported by Schwabe (2006), Ferreira et al. (2010), Rombouts & Heyrik (2015), and Singh et al. (2011). Seeds of Silybum marianum were employed to manage skin cancer, consistent with findings from Bhattacharya (2011) and Kaur et al. (2011) in India. Additionally, Allium cepa bulb paste was used in the study area, similar to reports by Iqbal et al. (2003).

Plant Parts Used, Routes of Administration and Preparation

METHODS

In Quetta, the whole plant (26%) was most frequently used, followed by leaves (23%) and seeds (13%) (Fig. 2), consistent with previous ethnomedicinal studies in the region (Bibi et al., 2014). The predominance of whole-plant use may reflect the mountainous terrain and scarcity of rainfall, which limits vegetation to mostly herbaceous and wild species, making decoctions, powders, and infusions common (Rehman et al., 2018). Leaves are widely utilized due to their abundance, renewability, and availability across plant types (Ngarivhume et al., 2015; Odonne et al., 2013). Oral administration was the main route (60%), followed by external application (10%). Remedies were most commonly prepared as powders (40%), decoctions (32%), and infusions (13%) (Fig. 3). Plant materials were typically stored as dried powders, while 10% of remedies involved direct application of fresh leaves or bulbs. Mixed-plant formulations were common, and pastes (2%) were prepared by pulverizing plant parts with water for topical use.

RESULTS

A total of 50 medicinal plant species, belonging to 34 families and 45 genera, were documented from Quetta for the treatment of skin cancer. Among these, the Solanaceae (5 species) and Asteraceae (4 species) were the most dominant families, while 28 families were represented by a single species each. Analysis of growth forms revealed that herbs constituted the majority (53%), followed by shrubs (30%), trees (14%), and a smaller proportion of climbers (3%). Regarding plant parts, the whole plant (26%) was the most frequently utilized, followed by leaves (23%) and seeds (13%), with roots, fruits, and bark reported less frequently. Traditional healers in the region employed diverse methods of preparation. The powdered form (40%) was most common, followed by decoctions (32%), infusions (13%), and fresh applications (10%), while pastes (2%) were less frequently reported. The oral route of administration (60%) predominated, complemented by topical applications (10%) and mixed practices in some cases. Several plant species exhibited particularly high ethnomedicinal relevance. Notable examples include Aloe indica, Azadirachta indica, Artemisia annua, Silybum marianum, and Allium cepa, which recorded the highest use values and disease consensus indices. These species represent the most trusted remedies among the local population for skin cancer management. Total, 106 informants participated in the study, comprising 63% women and 33% men, distributed across five age categories (37–71 years). Importantly, the majority were illiterate (60%), with only 16% educated to the primary level and 9% possessing higher education, underscoring the reliance on orally transmitted traditional knowledge. Within this cohort, 18 herbalists and 37 traditional healers provided detailed ethnomedicinal insights, reflecting the persistence

of indigenous practices in local healthcare. These findings highlight the rich ethnopharmacological heritage of Quetta, where medicinal plants continue to play a central role in primary healthcare and cancer management, particularly in underserved rural communities.

Parameter	Findings
Total species recorded	50 medicinal plant species (34 families, 45 genera)
Dominant families	Solanaceae (5 spp.), Asteraceae (4 spp.); 28 families with single species
Life forms	Herbs (53%), Shrubs (30%), Trees (14%), Climbers (3%)
Plant parts used	Whole plant (26%), Leaves (23%), Seeds (13%), Others (roots, fruits, bark)
Preparation methods	Powder (40%), Decoction (32%), Infusion (13%), Paste (2%), Fresh application (10%)
Route of administration	Oral (60%), Topical (10%), Others (30%)
Highly cited species	Aloe indica, Azadirachta indica, Artemisia annua, Silybum marianum, Allium cepa
Informants interviewed	106 total (63% women, 33% men, across 5 age groups)
Education level	Illiterate (60%), Primary (16%), Higher education (9%)
Traditional knowledge holders	18 herbalists (men), including 37 traditional healers

Table.1: **Demographic Characteristics of Participants Interviewed in Quetta**

Variable	**Demographic categories**	**Number of persons**	**Percentage**
Gender	Female	70	66
	Male	36	33
Experience	Local healers	75	37
	Local people	85	25
Age group	37-43	25	12
	44-50	14	17
	51-57	31	15
	58-64	45	22
	65-71	55	22
	Above 65		
	Illiterate	80	32
Educational	Primary	53	24
Background	Secondary	25	12
	Exta qualification	20	14
	Rulral	75	44
Residence	Urban	66	42
	Muslim	100	80
Religion	Hindu	4	1.6

Table 2: Dominant Ethnobotanical Families of the Study Area

Family Name	**Number of Taxa**
Solanaceae	4
Asteraceae	3
Zygophyllaceae	2
Ranunculaceae	2

Table3: **Ethnobotanical Record of Plants Used Against Skin Cancer by Local Communities**

Taxonomic name	Common name	Voucher name	Family name	Life form	Part used	Preparation	UVC	Cc = 45		
						Method		Vxi	mxi	DCI
Rhaza stricta	Aeshwark	SBKK 3221	Apocynaceae	Herb	Whole plant	Decoction	0.06	101.5	5.08	0.05
Decne										
Lycopesicon L.	Tumater	SBKK 222	Solanaceae	Shrub	Fruits	Directly applied	0.05	64.2	1.42	0.02
Fumeria indica	Shaitra	SBKK 223	Fumariaceae	Herb	Arial parts	Decoction	0.06	109	5.56	0.05
Parsa										
Chiraita swerta	Chirata	SBKK 4224	Gentiaceae	Herb	Whole plant	Decoction	0.05	79	1.48	0.03
Zizipus jujuba	Unaab	SBKK 225	Rhamnaceae	Tree	Pericarp , Seeds	Powder	0.04	102	4.3	0.01
Tephrosia purpuera .L	Surpooka	SBKK 322	Fabaceae	Shrub	Whole plant	Decoction	0.19	180.4	8.98	0.11
Withania somnifera	Panier dodi	SBKK 522	Solanaceae	Herb	Whole plant	Decoction	0.04	70.8	3.98	0.03
Dunal										
Nymphaca leibergii	Gul e nelofer	SBKK 3228	Nymphaeaceae	Shrub	Whole plant	Powder	0.06	160.5	13.48	0.05
Artemisia absinthium	Afnashin	SBKK 4229	Asteraceae	Herb	Whole plant	Infusion	0.05	150.5	12.45	0.03
Waldst & kitam										
Vibascum thapsus L.	Gul e gider	SBKK 630	Scrophulariaceae	Shrub	Leaves	Powder	0.06	160.5	13.54	0.05
Ephadra	Omman	SBKK 431	Ephedraceae	Shrub	Whole plant	Infusion	0.16	55.6	2.11	0.11
Schrenk&C.Amey										
Achillea santolinoids	Boe madran	SBKK 3232	Asteraceae	Herb	Whole plant	Decoction,Powder	0.19	180.5	8.98	0.15
C.(K.Koch)						Infusion				
Punica granatum	Anar na chilka	SBKK 233	Punicaceae	Tree	Fruits	Powder	0.16	55.6	2.11	0.11
Linn.										
Alkanna tinctoria	Yarling	SBKK 323	Boraginace	Herb	Whole plants	Infusion	0.19	180.5	8.98	0.15
Fogonia cretica L.	Dhamasa	SBKK 440	Combertaceae	Herb	Whole plants	Decoction	0.18	170.3	7.8	0.4
Matricaria chamomilla	Babuna	SBKK 551	Asteraceae	Shrub	Flower	Decoction	0.05	150.1	6.4	0.14
Linn. Gaertn										
Silybum marianum	Ount katara	SBKK 399	Asteraceae	Shrub	Leaves Flower	Powder	0.18	40.2	4.1	0.19
Linn.										
Rosa sinensis	Korgh	SBKK 436	Malvaceae	Shrub	Flower	Powder	0.19	180.1	8.78	0.15

Linn.										
Phyla nodifloria	Hafza booti	SBKK 599	Verbenaceae	Shrub	Leaves	Crushed	0.19	180.2	9.1	0.16
Zizipus numularia	Ber	SBKK 8444	Ranunculaceae	Herb	Leaves	Juice	0.02	60.5	5.6	0.04
(Burm F.) Weight & Arn										
Achyranthes aspera	Puth kanda	SBKK 8544	Amaranthaceae	Herb	Root	Infusion	0.05	150.2	6.8	0.06
Vitex negundo	Marwan	SBKK 4333	Liaminaceae	Herb	Whole plants	Decoction	0.22	200.4	19.8	0.18
Calotropis spp	Akk	SBKK 555	Apocynaceae	Herb	Whole plant	Decoction	0.02	79.9	3.15	0.04
(Wild.) R. Br										
Beta vulgaris	Gundam	SBKK 435	Betulaceae	Herb	Rhizome	Decoction	0.18	170	7.6	0.15
Allium cepa L.	Piyaz	SBKK 6555	Amaryllidaceae	Herb	Bulb	Paste	0.14	120	6.8	0.18
Aloe indica	Kunar gandal	SBKK 2333	Alliaceae	Herb	Leaves Plup	Paste	0.18	170	3.15	0.04
(Linn.) Burm.F										
Datura stamonium L.	Dhatura	SBKK 754	Solanaceae	Herb	Leaves	Powder	0.03	59.3	1.62	0.02
Ananas comosus	Ananas	SBKK 3555	Bromeliaceae	Tree	Fruit Bark	Powder	0.19	180	9.1	0.15
L(Merr).										
Emblica officinalis L.	Amla	SBKK 943	Euphorbiaceae	Tree	Leaves	Crushed	0.02	79.8	3.12	0.04
Crocus sativus L.	Zafran	SBKK 6798	Iridaceae	Shrub	Flower	Powder	0.05	64.2	1.42	0.06
Colchicum luteum	Phaphor	SBKK 7654	Ranunculaceae	Herb	Tuber	Powder	0.22	200.4	19.8	0.18
Fogonia arabica	Karhkawa	SBKK 4429	Zygophyllaceae	Herb	Flower Leaves	Decoction	0.05	64.2	1.42	0.06
Linn.										
Solanum nigrum	Tokhm e makko	SBKK 6005	Solanaceae	Herb	Seeds	Powder	0.01	22.8	1.54	0.03
Linn										
Peganum harmala	Kisankoor	SBKK 3033	Zygophyllaceae	Herb	Seeds	Powder	0.16	55.6	2.11	0.11
Lam.										
Curcuma longa	Haldi	SBKK 6622	Zingiberaceae	Herb	Rhizome	Powder	0.18	170.1	3.44	0.14
Linn.										
Cuminum cyminum	Zera safaid	SBKK 2398	Apiaceae	Creeping vine	Fruits	Powder	0.08	178.9	4.2	0.06
Aloe indica L.	Kunar / Gandal	SBKK 4561	Xanthoreaceae	Herb	Leaves Pulp	Paste	0.22	200.4	19.8	0.18

Allium sativum L.	Toom	SBKK 4494	Amaryllidaceae	Herb	Bulb	Paste	0.08	146.5	6.78	0.06
Zingiber officinale	Adrak	SBKK 566	Zingiberaceae	Herb	Bulb Rhizome	Paste	0.18	200.1	19.6	0.14
Rosc.										
Coffea arabica	Coffee	SBKK 844	Rubiaceae	Shrub	Leaves	Powder	0.05	110.4	4.5	0.06
Camellia sinensisL.	Black tea	SBKK 3988	Theaceae	Shrub	Leaves	Powder	0.08	146.5	6.77	0.06
Azadirachta indica	Nimoli	SBKK 5398	Meliaceae	Tree	Leaves	Decoction	0.33	180	9.1	0.18
A.Juss										
Vitis viniferaL.	Angoor na dany	SBKK 9231	Vitaceae	Tree	Seeds	Powder	0.16	200.5	9.17	0.05
Morus nigra L.	Shahtoot	SBKK 3456	Moraceae	Tree	Fruits	Dried	0.02	78.5	7.9	0.04
Thymus serphyllumL.	Kehwa	SBKK 7654	Liaminaceae	Shrub	Leaves	Dried	0.05	110.5	4.3	0.06
Nigella sativa	Kalonji	SBKK 7589	Ranunculaceae	Herb	Seeds	Powder	0.22	200.4	198	0.18
Linn.										
Ephadra intermedia	Naromb	SBKK 3578	Ephedraceae	Shrub	Whole plant	Infusion	0.02	78.6	7.6	0.04
Stapf										
Mentha longifolia	Mashana poorchink	SBKK 8547	Laminaceae	Herb	Whole plant	Decoction	0.22	200.2	18.9	0.18

Table 4: Ethnobotanical Formulations of Mixed Plants for Treating Skin Cancer

Plant name	Other ingredients	Recipe
Allium cepaL.	Mustard	Slightly muster warm paste of bulb in mustered oil is tightening over skin and leave for
Amaryllidaceae	oil	a night
Aloe indicaL.		Fresh pulp is layered for a day
Alliaceae		
Colchicum luteum	Cooking Oil	Powder of dried corms is mixed with ghee and this paste is applied topically
Ranunculaceae		
Datura stamoniumL.		Fresh leaves are crushed and applied directly
Solanaceae		
Emblica officinalisL.		Leaves are crushed and directly applied
Euphorbiaceae		
Artemisia absinthiumL.		Whole plant is used as purgative
Asteraceae		

Ephadra intermedia Schrenk&C.Amey			The decoction of stem is used									
Ephedraceae												
Zizipus jujuba			Fruit is used as tonic powder bark cure cancer									
Rhamnaceae												
Punica granatum			Fruit is used as tonic removes iron deficiency									
Punicaceae			powder bark is used in cure skin			canaer						
Beta vulgaris			Dried rhizome is used									
Betulaceae												
Curcuma longa		White vinegar	Safaid zera in powder form is mixed with									
Zingiberaceae			white vinegar	with mint applied daily								
Cuminum cyminum			three months									
Apiaceae												

Allium cepa L Ammonium chloride Crushed pyaz is mixed with ammonium chloride (noshader) half tea spoon and apply on skin

Amaryllidaceae

Table 5: Catalog of Medicinal Plants and Their Bioactive Phytochemicals Used in Skin Cancer Therapy

Plant Name	Family	Part use	Chemicals	References	
Silybum marianum L.	Asteraceae	Flower, Leaves	Silibinin	Jillia et al.(2013)	
Curcuma Longa L.	Zingiberaceae	Dried hizome ,Root	Curcumin	Jillia et al. (2013)	
Nigella sativa Lim	Ranunculaceae	Seeds	Thymoquinone	Govind (2014)	
Andrographis paniculata	Acanthaceae	Whole plant	Andrographolide	Kumar et al. (2004)	
Ginko biloba L.	Ginkgoaceae	leaves	Ginkgetin,ginkolide A&B	Jillia Millsop et al. (2013)	
Solanum nigrum L.	Solanaceae	leaves	Solamarine ,Solamargine	Al. Sinani et al. (2016)	
Vicia foba L.	Fabaceae	Seeds	Field bean protease inhibitors	Amin et al. (2016)	
Aegle mamelos L.Correa	Rutaceae	Bark, Root	Lupeol	Wal et al. (2015)	
Betula utillis Linn.	Betulaceae	Bark	Betulinic acid	Krol et al. (2015)	
Beorrhavia diffusa	Nyctaginaceae	Root	Punarnavine	Mishra (2014)	
Polygonum cuspidatum	Polygonaceae	Wole plant	Resveratrol	Al I & Branum (2014)	
Ziziphus rugosa Weight & Arn	Rhamnaceae	Pericarp and seed	Betulinic acid	Unnati et al. (2013)	
Podophyllium hexandrum	Apodophyllaceae	Root	Podophyllotoxin	Chatopodhaya et al. (2004)	
Aleo indica Linn Burm.F	Asphodelaceae	leaves	Alexin B, emodin	Jillia Millsop et al. (2013)	
Centella asiatica	Apiaceae	leaves	Asiatic acid	Keglevish et al. (2012)	
Liriodendron tulipifear	Magnoliaceae	Stem	Costunolide , tulipinolide	Wang et al. (2012)	
Plumbago zeylanica	Plumbaginaceae	Root	Plumbagin	Checker et al. (2010)	

Betula sp L.	Betulaceae	leaves	Betulinic acid	Cragg & Newman (2005)	-2012
Allium sativum L.	Liliaceae	Whole plant	Allixin ,Allicin	Cragg & Newman (2005)	-2012
Embica officinalis Gaertn.	Euphorbiaceae	leaves	Epigallocatechin gallate	Das et al. (2010)	
Curcuma zedoaria Christm	Zigiberaceae	Whole plant	Curciumin	Seo et al. (2005)	
Annona muricata L.	Annonaceae	leaves	Alkoloids, Phenols	Muriet (2003)	
Azadirachta indica A.Juss	Meliaceae	Whole plant	Asiatic acid	Sakarkar & Deshmuk 2011	
Glycine max Merrill	fabeaceae	Roots	Saponin, Genistein	Wang et al. (1991)	
Oroxylum indicum L.Kurz	Bignoniaceae	Bark, seeds	Barcalein	Imbort (1998)	
Vismia laurentii De.Wild	Guttiferae	Fruits, Seeds	Xanthones	Kuete et al. (2011)	
Withania somnifera Dunal	Solanaceae	Whole plant	Withanolides	Alam et al. (2013)	
Aegle marmebes L.Correa	Rutaceae	Fruits, Seeds	Lupeol	Govind (2011)	
Ailanthus attissima Swingle	Simaraubeace	Inner bark	Ailantenol, Ailn thanone	Chang (1992)	
Apium graveolens Linn	Umbelliferea	leaves , Seeds	Apigenin	Sultana Ahmed (2005)	
Aloe ferox Mill.	Xanthorrhoeaceae	Leaves	Aloe-emodin	Govind (2011)	
Alapinia galangal Wild.	Zingiberaceae	Seeds	Pinocembrin	Govind (2011)	
Ananas comosus L. Merr	Bromeliaceae	Fruits	Amooranin	Govind (2011)	
Astragulas membranaceus	Papilionaceae	Root	Swainsonine	Cragg (2005)	
Berberis vulgaris Linn	Berberidaceae		Berberine	Cragg (2005)	
Belula utilis L.	Betulaceae	Bark	Betulinic acid	Cragg (2005)	
Brucea antidysenterica	Simaraubeace		Bruceantin	Cragg (2005)	
Campotheca acuminate	Nyssaceae		Campothecin	Cragg (2005)	
Chlorella pyrenoidosa	Oocystaceae		Lysine	Kantrijian (2000)	
Cephalotaxus harringtonia	Cephalotaxaceae		Homoharringtonine	Cragg (2005)	
Podophyllum hexandrum Royle.	Podophyllaceae	Roots	Podophyllotoxin	Imbort (1998)	
Andrographis paniculata Wall.	Acanthaceae	Leaves	Andrographolide	Kumar et al. (2004)	
Chelidonium jajus	Papaveraceae	Fruits	Sanguinarine Berberine	Senchina et al. (2013)	
Colchicum luteum	Ranunculaceae	Seeds	Colchicines , Demecolane	Bruneton (1993)	
Croton lechleri	Euphorbiaceae	Whole plant	Taspine	Chavan et al. (2013)	

Diphylleia grayi	Berberidaceae	Dried rhizome ,Root	Diphyllin	Cragg (2005)	
Dysoxylum binectariferum	Meliaceae	Leaves	Rohitukeine	Cragg (2005)	
Echinops setifer	Asteraceae	Flowers	Echinopsine	Cragg (2005)	
Erythronium americanum	Liliaceae	Flowers	Lactone	Cavallito (1946)	
Euphorbia semiperfolioata Fiori	Euphorbiaceae		Jaterophane	Chavan et al. (2013)	
Fagopyrum esculentum Moench	Polygonaceae		Rutin	Bruneton (1993)	
Indigofera tinctoria Linn	Liguminosae		Indirubins	Cragg (2005)	
Ginko biloba Linn	Ginkgoaceae		Ginkgetin,ginkolide A&B	Tyler (1994)	
Glycyrrhiza glabra Linn	Leguminosae		Glycyrrhizin	Ambast 2000	
Gossypium barbadense Linn	Malvaceae	Cotton	Gosspol	Ambast 2000	
Hydrastis Canadensis Linn	Ranunculaceae		Berberastine	Ambast 2000	
Junchus effuses	Juncaceae		Isocamerine	Chavan et al. (2013)	
Larrea tridentate Sesse &Moc	Zygophyllaceae		Tera meprocol	Prajapati (2003)	
Lentinus edodes	Agaricaceae		Lentinan	Landanyi et al. (1993)	
Nigella sativa Linn	Ranunculaceae	Seeds	Thymoquinone	Govind (2011)	
Olea europea Linn	Oleaceae		Oleic acid	Panday (2009)	
Ocimum anctum Linn	Lamiaceae	Leaves	Eugenol, Oleonic acid	Govind (2011)	
Oldenlandia diffusa Roxb.	Rubiaceae	Whole plant	Ursolic acid	Govind (2011)	
Taxus Brevifolia Nutt.	Taxaceae		Taxanes	Prota et al. (2013)	
Ziziphus nummularia Burm.F	Rhamnaceae	Leaves	Betulinic acid	Sarek et al. (2005)	
Maclura pomifera C.Kschneid	Muraceae	Fruits	Phenolic	Pattanthu & Rohan (2015)	
Dereeis malacensis Burm.F	Fabaceae			Pattanthu & Rohan (2015)	
Aegle marmelos	Rutaceae	Leaves	Hydroalcoholic	Pattanthu & Rohan (2015)	
Ononis sicula	Fabaceae	Ariel parts	Alkoloids, terpinoids	Wamith & Talib (2010)	
Annona tribola	Annonaceae	Bark, seeds	Acetogenins	Qadir et al. (2009)	
Andrographis paniculata Burm.F	Acanthaceae	Whole plant	Andrographolide	Kumar et al. (2004)	
Bleekeria vitiensis	Brasicaceae	Leaves, flowers	Alkaloids	Qadir et al. (2009)	

Datura indica L.	Solanaceae	Seeds	Alkaloids	Davelli et al. (2012)	
Panax ginseng Mey	Araliaceae	Root	Saponin	Lee et al. (2003)	
Podophylum peltatum	Berberidaceae	Root, Rhizome	Alkaloids	Hu et al. (2016)	
Rubia cardifolia L.	Rubiaceae	Root	Anthraquinones	Patel et al. (2011)	
Zingiber officinale Rosc.	Zingiberaceae	Rhizome	Gingerrol	Habib et al. (2008)	
Achyranthes aspral L.	Amaranthaceae	Leaves, Stem	Saponin	Fikru et al. (2012)	
Artemisia douglasiana	Asteraceae	Whole plant	Artimisin	Shawi et al. (2011)	
Saphora flavescents	Fabaceae	Roots	Oxymatrine	Hu et al. (2016)	
Psychotria carthagenesis	Rubiaceae	Leaves	Flavonoids	Chang et al. (2013)	
Psychotria leiocarpa	Rubiaceae	Ariel parts	tanins	Chang et al. (2013)	
Psychotria capillacea	Rubiaceae	Seeds	Flavonoids	Chang et al. (2013)	
Psychotria deflexa	Rubiaceae	Stem	Flavonoids	Chang et al. (2013)	
Panax ginseng Mey.	Araliaceae	Whole plant	Ginsenosides	Blessing et al. (2018)	
Ononis hirta	Fabaceae	Ariel parts	Flavonoids, Terpenoids,Alkaloids	Blessing et al. (2018)	
Rubia cordifolia Linn.	Rubiaceae	Root	Rubidianin	Blessing et al. (2018)	
Salvia Pinardi	Fabaceae	Ariel parts	Retinoids	Blessing et al. (2018)	
Verbascum sinaiticum	Scrophulariaceae	Flowers	Mullein	Blessing et al. (2018)	
Magnolia sp	Mognoliaceae	Bark, leaves	Honokoil	Kumar (2014)	
Bauhinia variegata	Fabaceae	Whole plant	Flavonoids	Agrawal & Pandey (2009)	
Camellia sinensis L.	Theaceae	Leaves	Epicatechingallate	Renu et al.(2014)	
Crocus sativas	Iridaceae	Flowers	Terpen alcohol	Brown et al. (2010)	
Echinacea angustofolia	Asteraceae	Flowers , Root	Glycerin	Renu (2010)	
Sarco asoca	Caesalpinaceae	Flowers, stem, Bark	Flavonoids, Terpenoids	Cibin (2012)	
Lonicera japonica	Caprifoliaceae	Flowers	Luteolin	Habib et al. (2008)	
Mappia foetida	Cacinaceae	leaves , Flowers	Campothecin	Habib et al. (2008)	
Newbouldia laevis	Bignoniaceae	Flowers	2 acetyl fluro 1, 4 naphthoquinone	Habib et al. (2008)	
Olea europea	Oleaceae	Fruits	Oleanolic acid, Oleuropein	Habib et al .(2008)	
Aphanamixis polystachya Wall.	Meliaceae	Fruits	Amooranin , Terpene , Aphanamixin	Habib et al. (2008)	
Glycene max Merrill	Fabaceae	Seeds	Bowmen Brik inhibitors	Brown et al. (2010)	
Viscum album	Lorantheace	Whole plant	Lectin, Alkoloids	Renu (2010)	

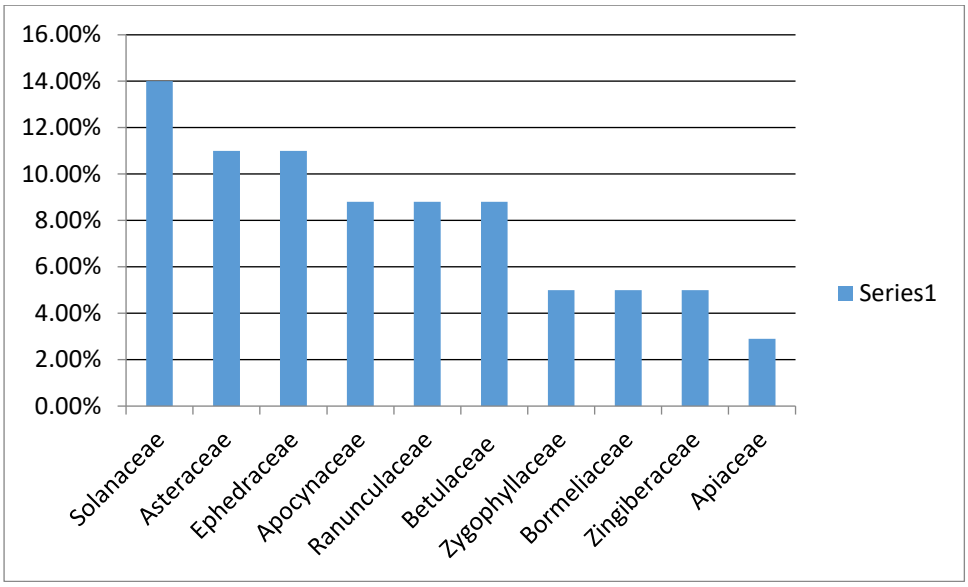

Figure 3: Relative Abundance (%) of Dominant Families in the Study Area

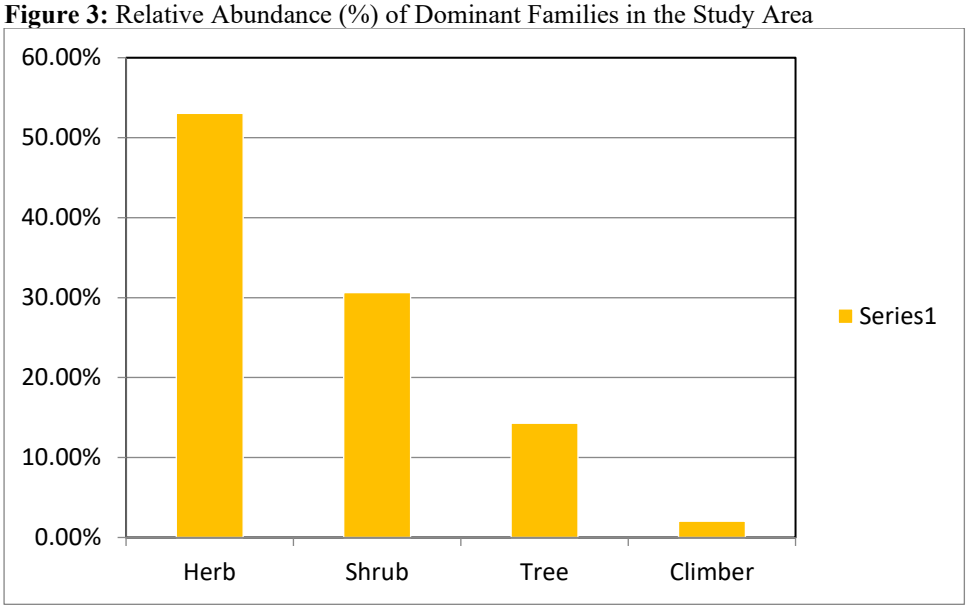

Figure 4: Life Form Categories and Their Percentage Contribution

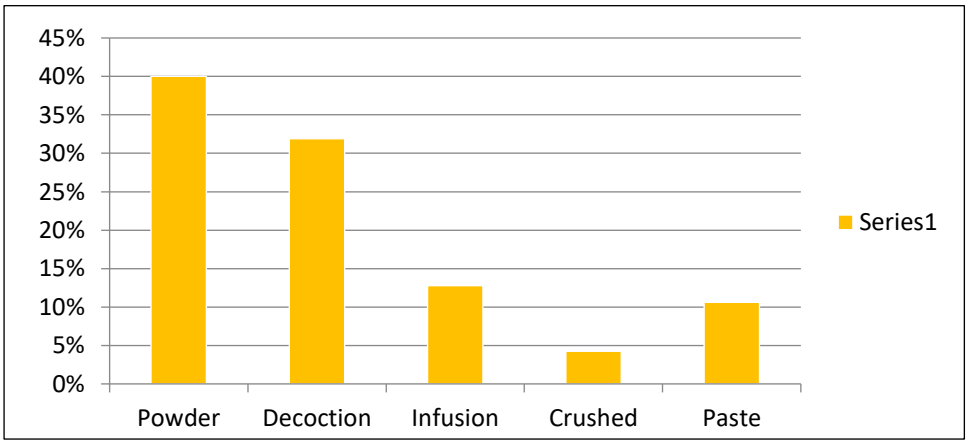

Figure 5: Relative Frequency (%) of Herbal Drug Preparation Methods

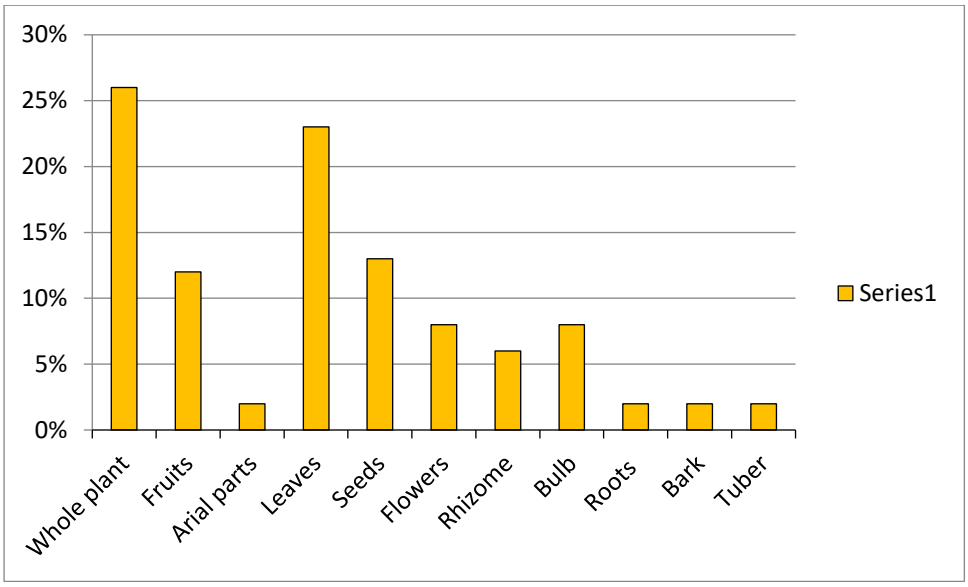

Figure 6: Parts of Plants Employed and Their Percentage Contribution

DISCUSSION

The present ethnobotanical investigation conducted in Quetta district highlights the significant role of traditional medicinal plants in the treatment of skin cancer. A total of 50 species belonging to 34 families were recorded, reflecting a high diversity of therapeutic flora in the region. Such richness in medicinal resources has also been observed in other parts of Pakistan, where local communities rely heavily on herbal remedies due to limited access to modern healthcare facilities (Shinwari, 2010). The predominance of families such as Asteraceae, Lamiaceae, and Solanaceae aligns with findings from neighboring regions, where these families are frequently cited for their anticancer properties (Malik et al., 2019; Abbasi et al., 2020). The dominance of herbs (53%) as the most commonly used life form indicates the ecological adaptation of local communities to easily accessible plants. Similar observations have been reported in ethnobotanical surveys in Murree Hills and Northern Pakistan, where herbs were consistently prioritized over shrubs and trees due to their availability, faster regeneration, and ease of collection (Arshad et al., 2021; Umair et al., 2019). The preference for whole plants (26%) and leaves (23%) in the preparation of remedies is also consistent with regional and global reports. For instance, studies from South Asia and sub-Saharan Africa highlight leaves as the most frequently harvested part, as they are abundant, renewable, and contain high concentrations of bioactive compounds relevant to dermatological disorders (Ngarivhume et al., 2015; Odonne et al., 2013). However, the frequent collection of entire plants raises concerns about ecological sustainability, especially in semi-arid ecosystems where natural regeneration rates are slow (Bano et al., 2014). Preparation methods in the current study showed that powders (40%), decoctions (32%), and infusions (13%) are the most prevalent. This finding mirrors ethnomedicinal data from other parts of Pakistan and India, where similar preparation techniques dominate due to their simplicity and effectiveness in extracting bioactive ingredients (Rahman et al., 2019; Ahmad et al., 2020). Oral administration was the primary route (60%), followed by topical applications (10%), reflecting the cultural perception that systemic administration is more effective for chronic illnesses such as cancer. These observations are in agreement with the findings of Kadir et al. (2018), who documented oral remedies as the dominant mode for cancer treatment in traditional medical systems across South Asia. Several plants recorded in this study, including Azadirachta indica, Curcuma longa, and Silybum marianum, are widely recognized for their pharmacological activities against skin malignancies. For example, Azadirachta indica has demonstrated chemopreventive effects through modulation of apoptotic pathways and inhibition of tumor promotion (Paul et al., 2011). Similarly, Curcuma longa contains curcumin, a polyphenolic compound extensively studied for its anti-inflammatory, antioxidant, and anticancer activities (Gupta et al., 2013). The hepatoprotective and photoprotective role of Silybum marianum has also been well documented, where silymarin effectively prevents UV-induced skin damage and reduces oxidative stress in experimental models (Deep & Agarwal, 2010). The overlap between ethnomedicinal prominence and pharmacological evidence reinforces the therapeutic validity of local knowledge. The socio-demographic profile of informants further contextualizes these findings. Elderly respondents and traditional healers were identified as the primary custodians of indigenous knowledge, which is transmitted orally across generations. This mirrors findings from rural ethnobotanical studies in South Asia and North Africa, where traditional ecological knowledge is highly vulnerable to erosion due to modernization, migration, and declining interest among younger generations (Gazzaneo et al., 2005; Benarba & Pandiella, 2014).

Preserving this knowledge through systematic documentation and community-based conservation strategies is therefore essential, particularly given the therapeutic potential of many reported species. Despite its strengths, the study also reveals critical challenges. The reliance on whole plants for remedy preparation poses threats to biodiversity conservation, especially in mountainous ecosystems of Balochistan, which already face pressures from overgrazing and climatic variability. Comparable concerns have been raised in ethnobotanical literature across Asia, highlighting that unsustainable harvesting could endanger several high-value species (Hamilton, 2004; Kala, 2005). Additionally, the lack of standardized dosage and preparation protocols among local healers poses potential risks of toxicity or therapeutic inconsistency, a concern that has been echoed by pharmacognosy researchers worldwide (Fabricant & Farnsworth, 2001). This study demonstrates that medicinal plants play a pivotal role in traditional healthcare practices in Quetta, particularly in the management of skin cancer. The findings resonate with national and international ethnobotanical evidence, while also adding novel insights specific to the ecological and cultural context of Balochistan. Integration of ethnomedicinal knowledge with pharmacological validation could pave the way for discovering new bioactive compounds with anticancer potential. Future research should prioritize phytochemical analyses of highly cited species, explore sustainable cultivation strategies, and conduct in vivo and clinical trials to validate efficacy and safety. Such interdisciplinary approaches will ensure the dual goals of conserving traditional knowledge and developing effective therapeutic agents.

CONCLUSION

This study provides a comprehensive ethnobotanical account of medicinal plants traditionally used for the treatment of skin cancer in Quetta, Balochistan. The documentation of 50 species across 34 families reflects the richness of indigenous knowledge and highlights the central role of plant-based therapies in local healthcare practices. Herbs, particularly whole plants and leaves, were the most frequently utilized, with powders, decoctions, and infusions serving as the primary modes of preparation. Such practices not only demonstrate the adaptability of local communities to their mountainous and resource-limited environment but also emphasize the cultural value of traditional healing systems. These findings confirm that several widely cited species, including Azadirachta indica, Curcuma longa, Silybum marianum, and Aloe indica, possess pharmacological potential that is consistent with global scientific evidence. This alignment between traditional knowledge and experimental validation strengthens the therapeutic credibility of ethnomedicinal practices. However, the reliance on whole plants for remedy preparation raises concerns about long-term ecological sustainability, underscoring the need for conservation strategies and cultivation initiatives. This study demonstrates that knowledge of medicinal plants is largely concentrated among elders and traditional healers, placing it at risk of erosion due to cultural shifts and modernization. Safeguarding this knowledge through systematic documentation and integrating it into formal research agendas can open new pathways for drug discovery, particularly for natural products with anticancer potential. Overall, this study underscores the dual significance of ethnomedicinal plants as both vital healthcare resources and potential leads for future pharmacological research. By bridging indigenous wisdom with scientific inquiry, these findings lay the foundation for sustainable use, conservation, and biomedical exploration of medicinal flora in Balochistan.

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