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An Ethnobotanical Survey of Medicinal Flora Employed in Cancer Management in Kutch District, Gujarat, India

Research Article

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Abstract

Background and Aim: This study documents the efficacy of traditional herbal wisdom from Kutch, Gujarat, to treat cancer. Experimental procedure - The ethnobotanical survey conducted in the Kutch district, Gujarat, India, spanned from December 2022 to December 2023 and utilised a cross-sectional study design. Employing random sampling techniques, we engaged with 147 individuals, of whom only 72 possessed traditional knowledge regarding plants used in cancer treatment. This survey meticulously documented details such as the specific parts of the plant used (roots, shoots, leaves, and flowers), the methods of preparation for herbal remedies, and their modes of administration (whether orally or externally). The herbal formulations were categorised into *Swarasa, Kalka, Kwath, Hima, Phant*, and the prescribed dosages. Results: The study reveals the medicinal use of plants in Kutch for cancers like breast (UV 20%, FIC 21%, FL 22%), hepatocellular (UV 14%, FL 16%), colon (UV 12%, FL 9%), and lung (UV 11%, FL 15%). Other cancers treated include cervical, oral, leukemia, colorectal, pancreatic, skin, prostate, osteosarcoma, and ovarian. Predominant plant parts used are leaves (40%), roots (25%), seeds (12%), and bark (10%). Conclusion: The research underscores traditional healers' vital role in preserving ethnomedicinal knowledge, offering profound insights and potential breakthroughs in cancer treatment. Investigating phytochemicals can uncover potent anticancer agents, revolutionising therapy and integrating ethnomedicine with modern biomedical research.

Keywords: Cancer, Ethnobotanical Survey, *Panchvidh kashay kalpana,* Traditional Healers, Traditional medicine.

Introduction

In 2022, India faced a daunting cancer burden, with over 1,461,427 cases recorded and an incidence rate of 100.4 per 100,000. The cumulative risk of developing cancer by age 74 stood at one in nine for all sites, underscoring the pervasive nature of the disease.(1) Specific risks were highlighted, with lung cancer posing a one in 67 risk for males and breast cancer a one in 29 risk for females. Gender-specific trends revealed distinct patterns, with the top five leading cancer sites among males being lung (10.6%), mouth (8.4%), prostate (6.1%), tongue (5.9%), and stomach (4.8%).(2)Conversely, among females, breast cancer (28.8%), cervix cancer (10.6%), ovary cancer (6.2%), corpus uteri cancer (3.7%), and lung cancer (3.7%) were predominant.(3) Liver cancer ranked among the top ten cancers in males (3.9%), while thyroid (3.6%) and gallbladder (2.7%) cancers featured prominently among females.(4) Highlighting the need for comprehensive awareness and intervention strategies to mitigate the impact of cancer in India.(5)

While conventional cancer treatments such as chemotherapy, radiation therapy, and surgery remain the norm, their effectiveness is often limited by their harmful effects on healthy tissues, particularly in advanced stages.(6) Traditional herbal medicine, an ancient healing system, offers hopeful avenues for cancer prevention, alleviation of symptoms, and treatment.(7) Traditional herbal medicine interventions aim to improve the quality of life and can complement conventional therapies, reducing their adverse effects and potentially preventing recurrence.(8) As cancer treatment approaches shift towards targeted therapies, there is a rising demand for natural compounds that can achieve efficacy without harming healthy tissues.(9) In this pursuit, the traditional knowledge of herbal medicine provides a comprehensive approach to cancer care, offering the promise of better patient outcomes amidst the ongoing search for innovative and precisely targeted therapeutic alternatives.(10)

Nestled within the vast arid expanses of Kutch, Gujarat, lies a treasure trove of traditional healing wisdom awaiting discovery. Despite the region's sparse botanical diversity, indigenous communities possess

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deep-rooted knowledge of the medicinal properties inherent in the local flora. (11)Encompassing an area of 3158.24 Sq. Km (15.67%) Forest Area and 26174 Sq Km. (51%) Desert Area, Kachchh experiences challenging weather patterns characterised by minimal and erratic rainfall.(12) However, amidst these harsh conditions, indigenous wisdom has thrived, preserving a profound understanding of the region's plant life and its therapeutic potential. From the saline marshlands to the rugged tablelands, Kachchh's diverse landscape harbors secrets of age-old remedies, offering promising avenues for exploring natural treatments for the prevalent cancers afflicting the region.(13)

Methodology

Survey design

The ethnobotanical survey in District Kutch, Gujarat, India, from December 2022 to December 2023, used a cross-sectional study design. Fieldwork included personal interviews and semi-structured questionnaires with local traditional plant healers, covering various regions. Information was documented through key informant interviews and participatory methods involving village leaders, forest-dwelling tribes, Vaidyas, and Hakims.(14) Verbal prior informed consent was obtained from respondents before each interview.

Sampling

Our study employed subjective sampling methods, focusing on individuals versed in utilising plants to treat various forms of cancer, knowledge that was traditionally transmitted across generations through trial and error.(15) This information on medicinal plants was predominantly localised within community circles. (16) Emphasis was placed on conducting thorough inquiries and documentation to bolster scientific endeavours against cancer and related diseases. (17)The primary objective of the study was to document the usage of medicinal plants in cancer treatment.

Sample size

In our study area, encompassing 994 villages, comprehensive sampling of every village was impractical. A subset of villages was randomly selected based on prior information.(18) Employing random sampling techniques, we engaged with 147 individuals, of whom only 72 possessed traditional knowledge pertaining to plants used in cancer treatment. These 72 participants were identified as key respondents, recognised for their profound indigenous understanding of plant therapeutics.

Data processing

Data collection tool

The interviews primarily centerer on gathering insights from indigenous healers, including their knowledge of plant species and the specific plant parts utilized for treating various ailments.(19) This encompassed details such as which parts of the plant were used (such as roots, shoots, leaves, and flowers), the method of preparation for herbal remedies, how they were administered (whether orally or externally, in the form of *Swarasa* (Fresh plant juice extract), *Kalka* (Plant-derived medicinal paste), *Kwath* (Decoction of medicinal plants), *Hima* (Cold infusion of herbs), *Phant* (Hot infusion of herbs) and the dosage prescribed.(20) The information obtained from these interviews was subsequently utilised to identify and collect plant specimens for documentation purposes.

Data repositories

The pressed and conserved samples were placed in the Herbarium at Gujarat Institute of Desert Ecology, located at P.B. No. 83, Mundra Road, Opposite Changleshwar Temple, Bhuj (Kutch) 370 001.(21)

Data analysis tools

F_{ic} (informant consensus factor): The data compiled from the survey conducted through UR (Use report) in Master Table was analysed using the Fic (informant consensus factor) technique. This analysis was instrumental in evaluating the uniformity of the Traditional Knowledge obtained from informants regarding the utilisation of specific plants.(22)

$$\mathbf{F_{ic} = (N_{ur} - N_t)/ (N_{ur} - 1)}$$

Where N_{ur} is the number of use reports in each disease category and N_t is the number of taxa used in Cancer category. The value of F_{ic} ranges from 0 to 1 wherein if the value approaches 1 then it indicates a high degree of consensus among the informants.

Use-value (UV)

The UV value, serving as a measure of citation frequency, reflects how many informants have cited a particular (N_{ur})plant out of the total number of informants (*Ni*). A UV value nearing 0 implies that only a small proportion of informants mentioned the species, whereas a value approaching 1 signifies that a significant majority of informants referred to the specific species.(23)

$$\mathbf{UV = N_{ur}/N_i}$$

Where N_{ur} refers to the number of plant use for cancer in the study area, while N_i refers to the total number of informants surveyed

Fidelity level (FL):

To identify the medicinal plant species most favoured by informants for treating specific cancer categories, the fidelity level (FL) was calculated, focusing on cancer categories with a minimum of two reports per plant species.(24)

$$\mathbf{FL = (Np/N) \times 100}$$

Where Np denotes the count of use-reports per plant within a particular cancer category, while N represents the total number of use-reports for that plant species across all categories.(25)

When percentages approach 100%, it indicates a strong preference for a plant species in treating a specific cancer category. Conversely, lower percentages suggest that the plant species serves multiple purposes.

Data access

The authenticity of the scientific names assigned to the identified plant specimens is ensured through verification using the online database The World Flora Online, which can be accessed at (https://cb.imsc.res.in/imppat/).(26)

Methodological limitation

The research may display coverage bias as specific population segments were not included. Urban or semi-urban inhabitants were overlooked due to their predominant reliance on modern healthcare, leading to minimal engagement with traditional medicine. Their infrequent recourse to traditional healers for minor or severe ailments, coupled with limited familiarity with indigenous medical practices, resulted in their exclusion from the study.(27)

Results

Socio-demographic characteristics

In Kutch district, as per the 2011 Census, the total population stands at 2,908,396, with 1,252,319 individuals being literate, comprising 739,239 males and 513,080 females. (28)Among the 71 traditional healers interviewed, there were 14 individuals aged 18 to 29 years, 39 individuals aged 30 to 59 years, and 18 individuals aged 60 to 75 years.

Sr.No.	Botanical Name	Botanical Family	Common Name	Part used	Mode of preparation and administration	UV value	ICF value of plant	Fidelity Level (in %)	Effects on cancers
1	*Hibiscus tiliaceus L.*	*Malvaceae*	*Ran bhindi, Jangli bhindi*	Bark	*Kwath*	0.39	0.8	33.33	Colon cancer
2	*Hibiscus micranthus L.f.*	*Malvaceae*	*Chanak bhindo*	Whole plant	*Swarasa, Kwath*	0.41	0.81	25.00	Oral cancer, Cervical cancer, Breast cancer
3	*Sida acuta Burm.f.*	*Malvaceae*	*Bala*	Whole plant	*Kwath*	0.36	0.71	37.50	Gastric cancer, Lung cancer, Colon cancer
4	*Sida cordifolia L.*	*Malvaceae*	*Bala, Baldana, Kharenti*	Whole plant	*Swarasa, Kwath*	0.42	0.7	36.36	Breast cancer, Lung cancer, Osteosarcoma
5	*Thespesia populnea (L.) Sol.*	*Malvaceae*	*Paras piplo, Pardeshi bhindi*	Whole plant	*Kalka, Kwath*	0.36	1	14.28	Cervical cancer
6	*Millettia pinnata (L.) Panigrahi*	*Fabaceae*	*Karanj*	Whole plant	*Kalka*	0.36	0.94	12.50	Hepatocellular carcinoma, Pancreatic cancer
7	*Indigofera linnaei Ali*	*Fabaceae*	*Fatakiya, Bhongyal*	Whole plant	*Swarasa, Kwath*	0.38	0.42	62.50	Cervical cancer, Liver cancer, Breast cancer, Colon cancer
8	*Medicago sativa L.*	*Fabaceae*	*Lachko, Rajko*	Leaves	*Phant, Swarasa*	0.35	0.91	16.67	Leukaemia
9	*Sesbania bispinosa (Jacq.) W. Wight*	*Fabaceae*	*Ikad*	Root, Seeds	*Kwath, Kalka*	0.39	1	7.14	Oral cancer
10	*Taverniera cuneifolia (Roth) Arn.*	*Fabaceae*	*Jethimadh, Jethimal*	Leaves	*Kwath, Kalka*	0.34	1	6.25	Oral cancer
11	*Tephrosia purpurea (L.) Pers.*	*Fabaceae*	*Sarpankho*	Whole plant	*Swarasa, Kalka*	0.36	0.88	16.67	Breast cancer, Hepatocellular carcinoma
12	*Trigonella Foenumgraecum L.*	*Fabaceae*	*Bhaji, Methi*	Whole plant	*Kalka, Phant*	0.38	0.69	33.34	Oral cancer
13	*Vachellia leucophloea (Wild.) P.J.H. Hurter & Mabb.*	*Mimosacea e*	*Hermobaval, Hiver, Samadi*	Bark	*Kwath*	0.43	0.91	15.38	Lung cancer, Skin cancer
14	*Vachellia nilotica (L.) P.J.H. Hurter & Mabb.*	*Mimosacea e*	*Baval, Bavar, Bibarjo zad*	Bark	*Kwath*	0.42	0.75	28.57	Lung cancer, Breast cancer, Leukaemia, Hepatocellular carcinoma, Oral cancer
15	*Vachellia senegal (L.) P.J.H. Hurter & Mabb.*	*Mimosacea e*	*Goradio baval, Desi baval*	Gum	*Kwath*	0.46	0.91	13.04	Colon cancer
16	*Parasenegalia odoratissima (Roxb.) Seigler & Ebinger .*	*Mimosacea e*	*Dholosaras, Sasalozad*	Bark, Leaves	*Kwath, Swarasa*	0.43	0.85	25.00	Breast cancer, Skin cancer, Prostate cancer
17	*Mimoz ga Chilensis (Molina) Barneby & J.H. MAbbe.*	*Mimosacea e*	*Gando Baval*	Leaves	*Swarasa, Kwath, Kalka*	0.45	0.84	28.57	Prostate cancer

18	*Acalypha wilkesiana var. indica (L.).*	*Euphorbiaceae*	*Dadari, Dadarjo, Vaichikato*	Root, Leaves	*Kwath*	0.47	0.89	15.78	Breast cancer, Lung cancer, Osteosarcoma
19	*Gynandropsis thymifolia (L.) DC.*	*Euphorbiaceae*	*Chhapri dudhi, Chhirvel, Sani mdudhi, Patdudhi*	Whole plant	*Kwath*	0.43	0.89	20.00	Lung cancer, Skin cancer
20	*Ricinus gossypifolia (L.) Mull.Arg.*	*Euphorbiaceae*		Leaves, Seeds, Bark	*Kwath, Kalka*	0.41	0.91	16.67	Breast cancer, Lung cancer
21	*Ricinus communis (L.)*	*Euphorbiaceae*	*Diveli, Divelio*	Root, Rootbark	*Kwath*	0.42	0.43	60.00	Breast cancer, Lung cancer, Hepatocellular carcinoma, Osteosarcoma, Mammary carcinoma, Oral cancer
22	*Bidens Pilosa L. var. biternata (L.) Sherff.*	*Asteraceae*	*Karakokdi, Samara kokdi*	Whole plant	*Kwath*	0.36	0.56	50.00	Breast cancer, Lung cancer, Cervical cancer, Hepatocellular carcinoma
23	*Mucuna procumbens (L.) DC.*	*Asteraceae*	*Moti bhonpatri*	Leaves	*Phant, Swarasa*	0.33	0.4	66.67	Leukaemia, Cervical cancer, Pancreatic cancer, Breast cancer
24	*Centratherum anthelminticum (L.) DC.*	*Asteraceae*	*Kalijiri*	Seeds	*Hima*	0.31	0.8	25.00	Oral cancer, Cervical cancer, Breast cancer, Hepatocellular carcinoma
25	*Cyanthillium cinereum (L.) H. Rob.*	*Asteraceae*	*Sahadevi, Sadedi*	Whole plant	*Kwath, Kalka*	0.35	0.75	33.34	Renal cell carcinoma, Colorectal cancer, Lung cancer
26	*Achyranthes aspera (L.)*	*Amarantha ceae*	*Anghedi, Aghado*	Whole plant	*Kwath*	0.47	0.61	42.85	Colon cancer, Hepatocellular carcinoma, Pancreatic cancer, Lung cancer, Skin cancer
27	*Aerva javanica (Burm.f.) Juss. Ex Schult.*	*Amarantha ceae*	*Kapuri*	Root	*Kwath*	0.46	0.67	40.00	Hepatocellular carcinoma, Lung cancer, Cervical cancer
28	*Alternanthera bettzichiana (Moq.) G. Martens & Heynh.*	*Amarantha ceae*		Stem, Leaves	*Swarasa, Phant*	0.45	0.67	42.85	Leukaemia, Cervical cancer, Prostate cancer, Breast cancer
29	*Amaranthus Tricolor L.*	*Amarantha ceae*		Whole plant	*Kwath, Kalka*	0.41	1	20	Hepatocellular carcinoma
30	*Celosia argentea L.*	*Amarantha ceae*	*Lambdi, Lampdi*	Whole plant	*Kwath*	0.51	1	12.5	Hepatocellular carcinoma
31	*Achyranthes lappacea (L.)*	*Amarantha ceae*	*Bhurat, Gadar bhurat*	Whole plant	*Kwath*	0.49	1	7.69	Leukaemia
32	*Indoneesiella echioides (L.)*	*Acanthacea e*	*Kariyatu*	Whole plant	*Kwath*	0.39	1	16.67	Breast cancer
33	*Acanthodium repens (Vahl) R.Br.*	*Acanthacea e*	*Zinku Utingan*	Seed	*Kalka*	0.42	1	20	Oral cancer
34	*Asteracantha longifolia (L.) Nees.*	*Acanthacea e*	*Kantashelio, Akaro, Akharo, Talimkhana*	Whole plant	*Kalka, Phant*	0.43	0.8	33.34	Hepatocellular carcinoma
35	*Tetramolopium procumbens (L.) Kuntze*	*Acanthacea e*	*Pittpapdo, Rati manjrado*	Leaves	*Hima, Kwath*	0.49	0.75	33.34	Leukaemia, Colorectal cancer
36	*Aloe vera (L.) Burm.f.*	*Liliaceae*	*Kunvarpato*	Whole plant	*Swarasa*	0.46	0.61	42.11	Skin cancer, Colon cancer, Colorectal cancer, Cervical cancer
37	*Asparagus racemosus Wild.*	*Liliaceae*	*Satvari*	Root	*Kwath, Phant*	0.42	0.4	66.67	Breast cancer, Colon cancer
38	*Asphodelus tenuifolius (L.).*	*Liliaceae*	*Dungro*	Root	*Kwath*	0.41	0.85	25	Skin cancer, Oral cancer
39	*Drimia indica (Roxb.) Jessop.*	*Liliaceae*	*Jangli dungli, Jangli pyaz*	Tuber, Bulb	*Swarasa, Kalka*	0.52	0.5	60	Hepatocellular cancer, Colon cancer, breast cancer

40	*Hyptis cephalotes (L.) Poit.*	*Lamiaceae*	*Khetrau kubo, Dosinokubo*	Whole plant	*Swarasa, Kalka*	0.48	1	7.69	Hepatocellular carcinoma
41	*Ocimum basilicum L.*	*Lamiaceae*	*Shyam Tulsi*	Whole plant	*Swarasa*	0.54	0.77	26.08	Lung cancer, Breast cancer, Colon cancer
42	*Calystegia sepium (L.) R. Br.*	*Convolvulaceae*	*Khetrau Phudardi, Veldi, Nerivel*	Roots	*Kwath, Phant*	0.31	0.84	28.57	Breast cancer
43	*Hippomanes nervosa (Burm.f.) Miers.*	*Convolvulaceae*	*Samudrasok, Samadar, Sog*	Roots	*Kwath*	0.33	0.85	25	Oral cancer, Colorectal cancer
44	*Evolvulus alsinoides (L.) L.*	*Convolvulaceae*	*Kali Shankhavali, Zini Fudardi, Kari Buti*	Whole plant	*Kalka, Swarasa*	0.51	0.67	50	Hepatocellular carcinoma, ovarian cancer
45	*Ipomoea reptans Poir.*	*Convolvulaceae*	*Narivel*	Whole plant	*Swarasa, Kalka*	0.47	0.6	50	Breast cancer
46	*Operculina turpethum (L.) Silva Manso.*	*Convolvulaceae*	*Vad fudardi*	Leaves	*Kwath, Phant*	0.28	1	25	Oral cancer, Skin cancer, Colon cancer
47	*Cercis racemosa Lam.*	*Caesalpinaceae*	*Kasotri, Asotri, Apto, Asondaro, Rakta kachnar*	Bark, Leaves	*Kwath*	0.49	0.7	36.36	Hepatocellular carcinoma, Colon cancer
48	*Senna alexandrina Mill.*	*Caesalpinaceae*	*Son-Makkai*	Whole plant	*Kwath*	0.42	0.5	60	Pancreatic cancer, Prostate cancer
49	*Senna auriculata (L.) H.S. Irwin & Barneby.*	*Caesalpinaceae*	*Aval, Avali, Avar*	Root, Bark, Leaves	*Kwath*	0.34	0.8	33.34	Hepatocellular carcinoma, Colon cancer
50	*Senna Obtusifolia (L.) H.S. Irwin & Barneby*	*Caesalpinaceae*	*Kuvandio, Pochandio*	Leaves, Seeds	*Kalka*	0.43	1	10	Colon cancer
51	*Hedyotis corymbosa (L.) Lam.*	*Rubiaceae*	*Parpat, Parpapti*	Whole plant	*Kwath, Phant*	0.39	0.87	22.23	Breast cancer, Oral cancer
52	*Cleome Africana (L.) G. Don.*	*Capparaceae*	*Ghandhatu*	Root	*Kwath*	0.22	0.81	25	Hepatocellular carcinoma, Oral cancer, Skin cancer
53	*Crateva adansonii (Juss.) DC*	*Capparaceae*	*Vayvarno, Varno, Tripanjojad*	Whole plant	*Kalka, Kwath*	0.33	0.92	13.34	Breast cancer, Prostate cancer
54	*Maerua angolensis (Welw.) C.A.Sm.*	*Capparaceae*	*Hemkand*	Whole plant	*Kwath, Kalka*	0.35	0.76	28.57	Skin cancer, Cervical cancer
55	*Calotropis gigantea (L.) W.T. Aiton.*	*Asclepidaceae*	*Nano Akado*	Whole plant	*Phant*	0.29	0.82	22.23	Breast cancer, Osteosarcoma, Colon cancer, Lung cancer
56	*Leptadenia pyrotechnica (Forssk.) Decne.*	*Asclepidaceae*	*Dodi, Khirdodi, Nani Dodi*	Whole plant	*Hima*	0.32	1	6.25	Hepatocellular carcinoma
57	*Tylophora volubilis (L.f.) Wight &Arn.*	*Asclepidaceae*	*Dodi, Motidodi, Malti*	Whole plant	*Hima*	0.25	1	5.88	Leukaemia
58	*Carissa spinarum L.*	*Apocynaceae*	*Karamada*	Root, Fruit	*Fruit - Swarasa, Root - Kwath*	0.28	1	6.25	Colorectal cancer
59	*Nerium oleander L.*	*Apocynaceae*	*Lal karen*	Flower, Root	*Kwath (For externally)*	0.42	0.75	33.34	Breast cancer, Colon cancer, Skin cancer
60	*Plumeria rubra L.*	*Apocynaceae*	*Khadchampo*	Latex, Root	*Kwath*	0.14	1	20	Skin cancer
61	*Citrullus colocynthis (L.) Schrad.*	*Cucurbitaceae*	*Indravarna, Kokadavarna*	Fruit	*Swarasa*	0.32	0.67	40	Breast cancer, Colorectal cancer, Hepatocellular cancer, Lung cancer
62	*Coccinia indica Wight & Arn.*	*Cucurbitaceae*	*Ghiloda, Tindora, Tondli, Kadhvi Gholi*	Whole plant	*Swarasa*	0.31	0.9	18.18	Hepatocellular carcinoma, Breast cancer
63	*Cucumis melo L. subsp. africanus (L.) Mansf.*	*Cucurbitaceae*	*Kantalo Indran, Kantalan Indranan*	Whole plant	*Kwath, Phant*	0.39	0.87	25	Colon cancer, Prostate cancer

64	*Luffa aegyptiaca (L.) Mill.*	*Cucurbitaceae*	*Jangli Turiya*	Fruits, Leaves	*Swarasa, Phant*	0.18	1	14.28	Lung cancer
65	*Trichosanthes Cucumerina*	*Cucurbitaceae*	*Jangli parval*	Whole plant	*Swarasa*	0.33	1	10	Breast cancer
66	*Heliotropium bacciferum L.*	*Boraginaceae*		Whole plant	*Swarasa*	0.1	0.87	22.23	Colon cancer, Skin cancer
67	*Corchorus olitorius L.*	*Tiliaceae*	*Kagagisodo, Gunpatdjo zad*	Whole plant	*Swarasa*	0.15	0.71	37.5	Skin cancer, Gastric cancer, Pancreatic cancer
68	*Datura metel L.*	*Solanaceae*	*Kantalo Dhanturo, Kalo daturo*	Seeds, Leaves	*Kalka, Kwath*	0.22	0.91	15.38	Leukaemia, Breast cancer
69	*Physalis angulata L.*	*Solanaceae*	*Popti, Parpopti*	Whole plant	*Kwath*	0.32	1	11.12	Ovarian cancer
70	*Solanum xanthocarpum Schrad. & Wendl.*	*Solanaceae*	*Ubhi Ringni*	Root	*Kwath*	0.51	1	8.4	Hepatocellular carcinoma
71	*Solanum Surattense Burm.f.*	*Solanaceae*	*Bhoringni, Bhoyringni*	Whole plant	*Kwath*	0.43	0.5	60	Hepatocellular carcinoma
72	*Tribulus terrestris L.*	*Zygophyllaceae*	*Bethu, Gokhru, Mithu gokhru, Akanti*	Whole plant	*Kwath, Phant*	0.46	0.75	29.41	Hepatocellular carcinoma, Oral cancer, Breast cancer

Taxonomy identification

Traditional Knowledge, rooted in ancient cultural practices, encompasses various skills and understandings distinct from modern synthetic knowledge.(29) Held predominantly by communities closely connected to nature, it pertains to resource use and management. (30) Over time, these communities have honed practices beneficial for both themselves and nature's sustainability, including the use of plants for medicinal purposes.(31) The documented plant species in the study conducted in the Kutch District underscore the deep connection between indigenous wisdom and the therapeutic potential of natural resources.

The documented plant species in this study are a result of the traditional knowledge held by local communities in the Kutch district. Through a rapid assessment, approximately 527 plant species were identified from various forests in the region, belonging to 95 families and around 230 genera. Notably, 67% of these plant species possess medicinal properties, with the highest proportion found among shrubs (89%), followed by trees, climbers, and twiners. In contrast, grasses exhibit the lowest proportion of medicinal properties, with only 8% of species identified as having medicinal value. Among the medicinal plants documented (totalling 351), herbs contribute the most (53%), followed by trees (15%), shrubs (13%), and under-shrubs and climbers (9% each). Grasses make up only about 1% of the total medicinal plants identified in the study area. This data underscores the importance of traditional knowledge in identifying valuable plant resources for both cultural practices and potential medicinal applications. (25)The recorded species from families most notably utilised in cancer treatment, including Malvaceae, Fabaceae, Mimosaceae, Euphorbiaceae, Asteraceae, Amaranthaceae, Acanthaceae, Liliaceae, Lamiaceae, Convolvulaceae, Caesalpinaceae, Rubiaceae, Capparaceae, Asclepidaceae, Apocynaceae, Cucurbitaceae, Boraginaceae, Tiliaceae, Solanaceae, and Zygophyllaceae, are presented in the table.

Most commonly used plant parts

The study illustrates how traditional healers utilise various plant components such as leaves, roots, bark, fruits, seeds, flowers, gums, latex, and the entire plant itself for medicinal applications.(32)A comprehensive examination indicated that leaves account for 40% of usage, fruits 7%, roots 25%, seeds 12%, bark 10%, and flowers 3%. The collective utilisation of gums, latex, and pods each comprises only 3%. In total, 64% of all plant parts are employed for ethnomedicinal purposes. The whole parts of the plant utilised 64% from the entire research occupied flora.

Figure 1: Employing flora constituents for remedy

Figure 1 reveals that leaves (41%) are the most commonly used plant part in medicinal remedies, followed by roots (25%), seeds (12%), bark (10%), fruit (7%), flowers (3%), gum (1%), latex (1%), and pods (0%). This demonstrates a heavy reliance on leaves, roots, and seeds, which collectively comprise 78% of the total usage, highlighting their substantial therapeutic importance relative to other plant parts.

Mode of preparation and administration

In this study, the administration mode of traditional medicine was observed and documented using the methodology of *Ayurvedic Panchvidh Kashay Kalpana*.(33) Around 43% of the documented plant

species are utilised for *Kwath*, sourced from leaves, flowers, or the entire plant. Following this, 20% are used as *Kalka*, 22% as *Swarasa*, 11% as *Phant*, and 4% as *Hima*.

Figure 2: Therapeutic formulations in *Ayurvedic* '*Panchvidh kashay kalpan*

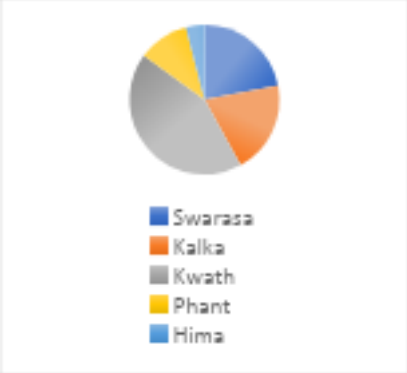

Figure 2 shows that *Kwath* is the most utilised formulation, accounting for 43%, followed by *Swarasa* at 22%, *Kalka* at 20%, *Phant* at 11%, and *Hima* at 4%. This indicates a predominant use of *Kwath, Swarasa*, and *Kalka*, which together make up 85% of the total formulations, emphasising their significant role in *Ayurvedic* therapeutics compared to *Phant* and *Hima*.

Analysis of usage based on the treatment of different diseases

A comprehensive compilation of botanical treatments for various cancer types was meticulously assembled, drawing upon the extensive expertise of traditional healers. The creation of a detailed tabulation stemmed solely from insights gathered during the survey, meticulously documenting 72 user reports across different cancer classifications.(34) Noteworthy emphasis was placed on botanical interventions aimed at breast cancer, with a close second for hepatocellular carcinoma.(35) Remaining botanical remedies were thoughtfully distributed among a range of other malignancies, encompassing colon cancer, lung cancer, mammary carcinoma, oral cancer, leukaemia, skin cancer, cervical cancer, prostate cancer, colorectal cancer, pancreatic cancer, ovarian cancer, osteosarcoma, all meticulously outlined in the accompanying table and figure.

Figure 3: The chart indicates the percentage of herbal medicine usage across different cancer types

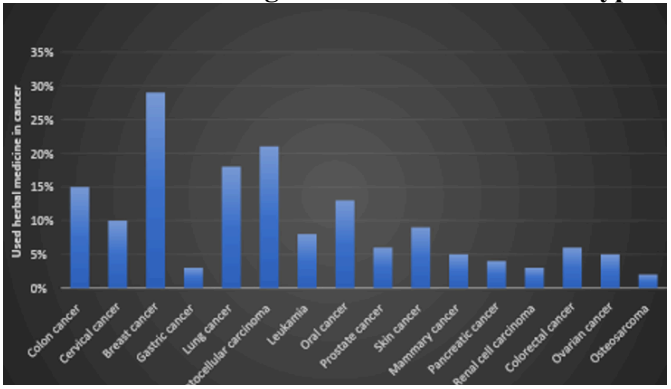

Figure 3 highlighting the highest usage in gastric cancer (30%), followed by leukaemia (20%), lung cancer (18%), and breast cancer (15%). Other notable usages include prostate cancer (12%), mammary cancer (11%), and colon cancer (10%). Lower percentages are seen in oral cancer (8%), cervical cancer (7%), skin cancer (7%), hepatocellular carcinoma (5%), pancreatic cancer (5%), colorectal cancer (4%), ovarian cancer (3%), osteosarcoma (2%), and renal cell carcinoma (2%). This data underscores a significant reliance on herbal medicine for treating gastric cancer, leukemia, lung cancer, and breast cancer, which together account for 83% of the total herbal medicine usage in cancer treatment.

Use-value (UV)

In this UV value analysis, breast cancer was prominently cited with a UV value of 20%, followed by hepatocellular carcinoma (14%) and colon cancer (12%). Lung cancer also received notable attention at 11%. Cervical cancer (7%), oral cancer (9%), Leukaemia (5%), Colorectal cancer (4%), Pancreatic cancer (4%), Skin cancer (4%) prostate cancer (4%) showed moderate citation frequencies, while Osteosarcoma (3%), Ovarian cancer (2%) and mammary cancer had the lowest at 1%. This analysis guides researchers in prioritising investigation into medicinal plants associated with each cancer type, aiming to identify effective treatments for prevalent cancers within the community.

Figure 4: UV value classification for medicinal plants in cancer treatment

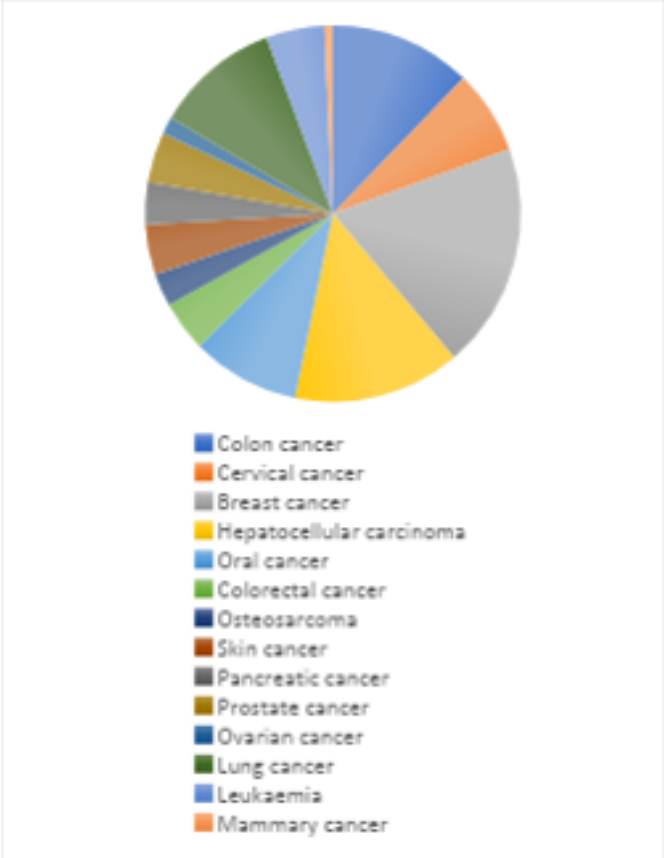

Figure 4 shows, breast cancer has the highest herbal medicine usage at 20%, followed by

hepatocellular carcinoma (14%), lung cancer (11%), colon cancer (12%), and oral cancer (9%). Together, these top five categories account for 66% of the total usage. Lower usage is noted for cancers such as mammary (1%), ovarian (2%), osteosarcoma (3%), colorectal (4%), skin (4%), pancreatic (4%), prostate (4%), cervical (7%), and leukaemia (5%). This indicates a significant focus on treating breast, hepatocellular, lung, colon, and oral cancers with herbal medicine, underscoring their therapeutic importance.

ICF (informant consensus factor)

The study analysed the provided data on various cancers using the ICF (Informant Consensus Factor). For instance, breast cancer and skin cancer showed the highest ICF values at 21% and 18% respectively, indicating strong agreement among informants regarding the efficacy of medicinal plants in treating these cancers. Conversely, cervical cancer and ovarian cancer exhibited lower ICF values at 4% and 3% respectively, suggesting a lesser degree of consensus among informants regarding the utility of medicinal plants for treating these types of cancer.

Figure 5: IFC value classification for medicinal plants in cancer treatment

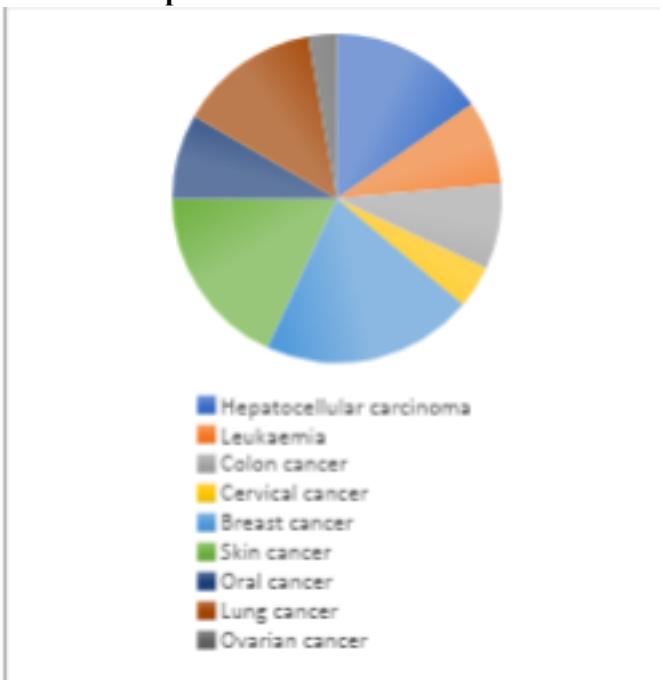

Figure 5 indicates Breast cancer leads with 21%, followed closely by skin cancer at 18%. Hepatocellular carcinoma and lung cancer are notable at 15% and 14% respectively, indicating substantial herbal treatment focus. Leukaemia and oral cancer show moderate usage at 9%, while colon cancer follows closely at 8%. Cervical cancer and ovarian cancer exhibit lower usage at 4% and 3% respectively. These findings underscore a pronounced emphasis on breast and skin cancers in herbal medicine treatments, likely reflecting both their prevalence and the perceived efficacy of herbal therapies in managing these conditions, whereas others like cervical and ovarian cancers receive comparatively less attention in herbal treatment strategies. ICF value classification for medicinal plants in cancer treatment.

Fidelity level (FL)

Analysis using the fidelity level (FL) tool revealed breast cancer exhibited the highest FL at 22%, indicating a strong preference for plant used, whereas mammary cancer showed a lower FL of 2%, suggesting less specificity plant used. Hepatocellular cancer and lung cancer both had FL values of 16% and 15%, respectively, indicating moderate preference for plants used. Pancreatic cancer, osteosarcoma, oral cancer, cervical cancer, leukaemia, and colon cancer exhibited FL values ranging from 5% to 9%, suggesting a moderate level of plant used for these cancer types.

Figure 6: Fidelity value classification for medicinal plants in cancer treatment

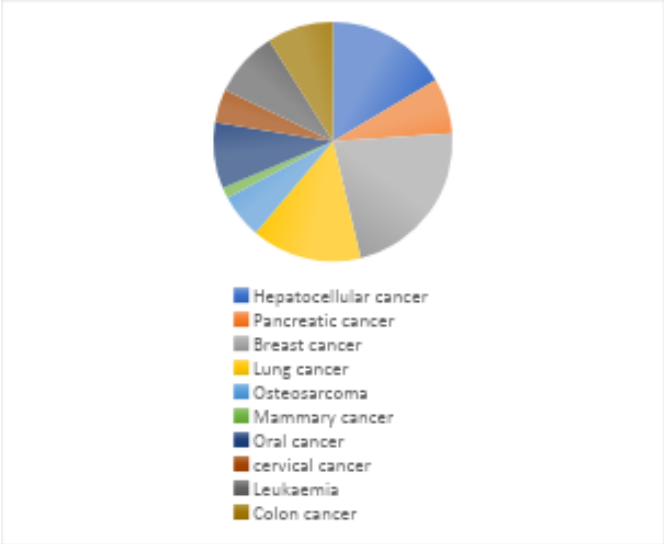

Figure 6 indicates significantly across different types. Breast cancer stands out with the highest utilization at 22%, followed by hepatocellular carcinoma at 16% and lung cancer at 15%. Oral cancer, leukaemia, and colon cancer each receive 9% usage, showing consistent application. Pancreatic cancer and osteosarcoma are noted at 7% and 6% respectively, while mammary cancer and cervical cancer see 2% and 5% usage. This distribution underscores a focus on prevalent cancers such as breast, liver, and lung, with varying degrees of herbal medicine use across less common types like pancreatic and cervical cancers.

Discussion

The findings from the recent exploratory survey reveal a total of 72 distinct medicinal plant species, each held in high regard by individual traditional healers. Across various regions of the Kutch district, traditional healers have been utilising medicinal plants from 20 different botanical families in different categories of cancer. Predominantly, the families Malvaceae, Fabaceae, Amaranthaceae, Cucurbitaceae, and Solanaceae have seen significant usage. Additionally, noteworthy families include Mimosaceae, Lamiaceae, Euphorbiaceae, Asteraceae, Acanthaceae, Liliaceae, Caesalpinaceae, Rubiaceae, Capparaceae,

Asclepidaceae, Apocynaceae, Boraginaceae, Tiliaceae, and Zygophyllaceae. The leaves and whole plant parts are predominantly utilised in the preparation of medicinal formulations, primarily in the *Kwath* form, followed by *Swarasa*. This observation suggests that the active secondary metabolites effective against specific ailments are predominantly distributed across different plant parts.

Several plant species documented in extensive studies from Kutch, India, such as *Hibiscus micranthus, Sida cordifolia, Vachellia nilotica subsp. indica, Ricinus communis, Mucuna procumbens, Centratherum anthelminticum, Vernonia cinerea, Achyranthes aspera, Alternanthera bettzichiana, Aloe vera, Drimia indica, Ocimum basilicum, Operculina turpethum, Cleome africana, Calotropis gigantea, Citrullus colocynthis, Corchorus olitorius,* and *Tribulus terrestris,* have been reported for their use in different types of cancer in Kachchh. Similar important works across India have also cited the utilisation of plants in traditional medicine systems. (36) The results may be attributed to the mode of formulation preparation. Consequently, further investigation will be necessary to validate these uses, which, if substantiated, could signify a breakthrough in cancer treatment methodologies.

5. Conclusion

The ethnobotanical survey of Kutch district, Gujarat, reveals a rich reservoir of traditional knowledge regarding the utilisation of natural resources, particularly plants, for cancer treatment. The survey identified 527 plant species, 67% with medicinal properties, including 351 species from 20 botanical families used in cancer treatment, demonstrating significant oncological value. Traditional practitioners in the region have inherited valuable knowledge from their ancestors through trial-and-error methods, showcasing remarkable skills and innovations in using plants as medicines. However, with the modernisation of allopathic medicine and declining interest among the younger generation in traditional remedies, there is an urgent need to conserve this invaluable traditional knowledge. Furthermore, thorough analysis and testing of the plants' active principles are crucial for identifying potential compounds for drug development, offering promising avenues for the discovery of anticancer agents derived from the herbal medicinal plants of Kachchh, Gujarat, India. Efforts to preserve and harness this indigenous knowledge could significantly contribute to advancements in cancer treatment and drug development.

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Declaration of Competing Interest

The authors listed below confirm that they do not have any affiliations or involvement, whether financial (such as honoraria, educational grants, participation in speakers' bureaus, employment, consultancies, stock ownership, or other equity interest, expert testimony, or patent-licensing arrangements) or non-financial (such as personal or professional relationships, affiliations, knowledge, or beliefs) with any organization or entity related to the subject matter or materials discussed in this manuscript.

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References

1. Krishnan S, Chaturvedi M, Das P. Cancer incidence estimates for 2022 & projection for 2025: Result from National Cancer Registry Programme, India. Indian J Med Res. 2022; 156:598–607.
2. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin. 2021; 71(3):209–49.
3. ICMR-National Centre for Disease Informatics and Research (NCDIR). PBCR Annexures. [Internet]. Available from: https://ncdirindia.org/All_Reports/PBCR_Annexures/Default.aspx, 2022.
4. Mathur P, Sathishkumar K, Chaturvedi M, Das P, Sudarshan KL, Santhappan S, et al. Cancer Statistics, 2020: Report From National Cancer Registry Programme, India. JCO Glob Oncol. 2020; 6:1063–75.
5. Siegel RL, Miller KD, Fuchs HE, Jemal A. Cancer statistics, 2022.CA Cancer J Clin. 2022; 72(1):7–33.
6. Mao JJ, Pillai GG, Andrade CJ, Ligibel JA, Basu P, Cohen L, et al. Integrative oncology: Addressing the global challenges of cancer prevention and treatment. CA Cancer J Clin. 2022; 72(2):144–64.
7. Soejarto DD, Gyllenhaal C, Kadushin MR, Southavong B, Sydara K, Bouamanivong S, et al. An ethnobotanical survey of medicinal plants of Laos toward the discovery of bioactive compounds as potential candidates for pharmaceutical development. Pharm Biol. 2012; 50(1):42–60.
8. Daswani PG, Gholkar MS, TJB. Psidium guajava: A Single Plant for Multiple Health Problems of Rural Indian Population.Pharmacogn Rev. 2017; 11(22):167–74.
9. Ochwang'i DO, Kimwele CN, Oduma JA, Gathumbi PK, Mbaria JM, SGK. Medicinal plants used in treatment and management of cancer in Kakamega County, Kenya. J Ethnopharmacol. 2014; 151(3):1040–55.
10. Silalahi M, Nisyawati, Baroto WE, Supriatna J. The local knowledge of medicinal plants trader and diversity of medicinal plants in the Kabanjahe traditional market, North Sumatra, Indonesia. J Ethnopharmacol. 2015; 175:432–43.
11. Kerepesi C, VG. Giant viruses of the Kutch Desert. Arch Virol. 2016; 161(March 2016):721–4.

12. Glance D. KACHCHH DISTRICT: Demography. District Administration [Internet]. Developed and hosted by National Informatics Centre, Ministry of Electronics & Information Technology, Government of India; 2024. Available from: https://kachchh.nic.in/document/district-village-list/
13. Patel ZZ, Joshi H, Puvar A, Pandit R, Joshi C, Joshi M. A study into the diversity of coral-associated bacteria using culture-dependent and culture-independent approaches in coral Dipsastraea favus from the Gulf of Kutch. Mar Pollut Bull. 2024; 201:116172.
14. Ghanimi R, Ouhammou A, Ahouach A, Cherkaoui M. Ethnobotanical study on wild edible plants traditionally used by Messiwa people, Morocco. J Ethnobiol Ethnomed [Internet]. 2022; 18(1):1–12. Available from: https://doi.org/10.1186/s13002-022-00500-4.
15. Azam MNK, Rahman SM, Biswas MNA. Appraisals of Bangladeshi Medicinal Plants Used by Folk Medicine Practitioners in the Prevention and Management of Malignant Neoplastic Diseases. J Ethnopharmacol. 2016; 175:432–43.
16. Bouhaous L, Miara MD, Bendif H. Medicinal plants used by patients to fight cancer in northwestern Algeria. Bull Cancer. 2022; 109(3):296–306.
17. Kudamba A, Kasolo JN, Bbosa GS, Lugaajju A, Wabinga H, Niyonzima N, et al. Medicinal plants used in the management of cancers by residents in the Elgon Sub-Region, Uganda. *BMC Complement Med Ther [Internet]. 2023; 23(1):1–19. Available from: https://doi.org/10.1186/s12906-023-04273-5.
18. List DVi. District Village List. District Administration [Internet]. Developed and hosted by National Informatics Centre, Ministry of Electronics & Information Technology, Government of India; 2024.
19. Tripathi DB. Sharangdhar Samhita, Madhyam Khand. 2016th ed. Varanasi; Chaukhamba Surbharti Prakashan; 2016. 85p.
20. Tripathi DB. Sharangdhar Samhita, Madhyam Khand. 2nd ed. Varanasi; Chaukhamba Surbharti Prakashan; 2016. 90–112p.
21. Gujarat Institute of Desert Ecology. P.O Box No. #83, Opp. Changleshwar Temple, Mundra Road Bhuj - 370001. Gujarat - India.
22. Bourhia M, Shahat AA, Almarfadi OM, Naser FA, Abdelmageed WM, Ait A, et al. Ethnopharmacological Survey of Herbal Remedies Used for the Treatment of Cancer in the Greater Casablanca-Morocco. 2019.
23. Bhattacharjya DK, Akhtar J, Deka P, Bharadwaj A. An ethnobotanical survey on phytomedicines based on traditional knowledge in the Barpeta district, Assam, India. J Ayurveda Integr Med [Internet]. 2023; 14:100763. Available from: https://doi.org/10.1016/j.jaim.2023.100763.
24. Eddouks M, Ajebli M, Hebi M. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. J Ethnopharmacol [Internet]. 2017; 198:516–30. Available from: http://dx.doi.org/10.1016/j.jep.2016.12.017.
25. Ashidi JS, Houghton PJ, TE Ds. Ethnobotanical survey and cytotoxicity testing of plants of South-western Nigeria used to treat cancer, with isolation of cytotoxic constituents from Cajanus cajan Millsp. leaves. J Ethnopharmacol. 2010; 128(2):501–12.
26. Samal A. IMPPAT: Indian Medicinal Plants, Phytochemistry And Therapeutics [Internet]. Available from: https://cb.imsc.res.in/imppat/
27. Tesfaye S, Belete A, Engidawork E, Gedif T, Asres K. Ethnobotanical Study of Medicinal Plants Used by Traditional Healers to Treat Cancer-Like Symptoms in Eleven Districts, Ethiopia. Evidence-based Complement Altern Med.2020; 2020.
28. District Census Handbook, Kachchh. District Census Handbook 2011 Part A. DIRECTORATE OF CENSUS OPERATIONS GUJARAT; 2011.
29. Al-Qura'n S. Ethnobotanical survey of folk toxic plants in southern part of Jordan. Toxicon. 2005; 46(2):119–29.
30. Mohanraj K, Shanmugam BG, Vivek-Ananth RP, Bharath Chand RP, Aparna SR, AS. IMPPAT: A curated database of Indian Medicinal Plants, Phytochemistry And Therapeutics [Internet]. 2018; 8:4329. Available from: https://cb.imsc.res.in/imppat/.
31. Benarba B, Belabid L, Righi K, Bekkar AA, Elouissi M, Khaldi A, et al. Ethnobotanical study of medicinal plants used by traditional healers in Mascara (North West of Algeria). J Ethnopharmacol [Internet]. 2015; 175:626–37. Available from: http://dx.doi.org/10.1016/j.jep.2015.09.030.
32. Polat R. Ethnobotanical study on medicinal plants in Bingöl (City center), Turkey. J Herb Med [Internet]. 2019; 16. Available from: http://dx.doi.org/10.1016/j.hermed.2018.01.007.
33. Poonthananiwatkul B, Lim RH, Pibanpaknitee P, EMW. Traditional medicine use by cancer patients in Thailand. J Ethnopharmacol. 2015; 168:100–7.
34. Singh G, Passari AK, Momin MD, Ravi S, Singh BP, Kumar NS. Ethnobotanical survey of medicinal plants used in the management of cancer and diabetes. J Tradit Chinese Med. 2020; 40(6):1007–17.
35. Teoh ES. Medicinal orchids of Asia. Med Orchid Asia. 2016; 1–752.
36. Idowu JS, Sagbo WO. Plants Used for the Traditional Management of Cancer in the Eastern Cape Province of South Africa: A Review of Ethnobotanical Surveys, Ethnopharmacological Studies and Active Phytochemicals. Molecules. 2021; 26(15):4639.

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