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Diversity of medicinal plants used as male contraceptives: An initiative towards herbal contraceptives

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In the recent era, population control is a global issue as well as national community health concern. Plants are being used as a source of medicines by human beings since ancient times. This study highlights the collection, identification and diversity of medicinal plants concerning their traditional knowledge to get better access to the herbal male contraception. Local informants and traditional health practitioners were consulted for information about the local names, distribution, part used and mode of utilization of the medicinal plant. To select plants with high medicinal uses, different quantitative measurements i.e., Relative Frequency of Citation (RFC), Disease Consensus Index (DCI) and descriptive methods of Jaccard Index (JI) was performed. A total of 100 plant species (used for infertility by the local communities) belonging to 50 families and 91 genera were collected. Jaccard Index results showed that 28 plant species were reported for the first time used as male contraceptives in Pakistan. The frequency of citation (FC) value ranged from 35 to 56. Plants with high Relative frequency of citation (RFC) and Disease Consensus index (DCI) values showed a high consensus for the antifertility among informants and THPs. Our study is focused on the diversity and priority of medicinal plants as male contraceptives.

Keywords: Male contraceptive, Medicinal plants, Population, Traditional knowledge

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Surveys of medicinal plants showed their use in various cultures and regions for the shelter, food, medicines and religious custom[1]. From the start of mankind's history, plants have been used in different therapies to get relief from physical suffering[2]. In local communities, primary health care is usually treated with indigenous plants[3]. Out of 422,000 flowering plants, about 35,000 to 50,000 plants are being used for medicinal purposes[4]. WHO reported that the herbal products business in the international market is 62 Billion US $ and will reach 5 trillion US $ in 2050[5]. Ethnobotany is developing and progressing from simple documentation to producing advanced sustainable drugs. Indigenous medicinal plants offer several advantages because of safe use, easy availability, biocompatibility and cheap synthesis[6]. Worldwide, 25% of the prescribed drugs are obtained from plants[7]. Therefore, plant-mediated drugs are more common because of their safe applications against several disorders like diabetes and respiratory and mental disorders[8]. However, in rural communities, many plants are common for cytotoxicity, abortion and male contraception[9].

The rapid increase in the world population is one of the main causes of various environmental and social problems. United Nation (UN) reported in 2010 that in the world population about 78 million are increasing per year. Besides, the UN reported seven billion population in 2011 and approximately will reach eight billion in 2024[9]. The overgrowing population is one of the major causes of environmental pollution, economic instability, biodiversity loss and the emergence of new diseases[10-12]. Various contraception methods have

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been proposed by modern sciences, but these are beyond the access of most of the local communities due to high price or serious side effects[13,14]. Previously, attention has been paid to females' potency, while on the other hand only barrier method and vasectomy are considered for males. In this regard, the use of antifertility plants offers wide acceptability because of their safe use and traditional uses[9]. In the countryside regions, poor development and improper health treatment, old age people, women and local health experts are well aware of the use of medicinal plants against various disorders[10,15,16]. So, the application of safe and effective methods is a crucial requirement of population control.

Pakistan has rich plant diversity due to variable climatic conditions. The flora of Pakistan have approximately 6000 plant species, 1572 genera including 372 endemic species[17]. On another hand, the population of Pakistan is rising every day, which is also a threat to biodiversity in the future and causes environmental pollution. National Institute of Population studies Islamabad (2013) estimated 184.5 million population of Pakistan and ranked as the 6th most populous country in the world. Moreover, China, India, USA, Indonesia and Brazil are the top five populated countries in the world. Based on this report, a 2% increase in the Pakistan population reveals that Pakistan will be the 5th most populated country in the world in 2050. For decades, the government of Pakistan is investing a huge amount of budget in collaboration with international organizations for family planning, though the targeted results are not achieved because only women are focused. Several ethnobotanical studies have been conducted throughout the world for contraceptive purposes[9,18] especially in India[19,20]. As far as we could know from the literature survey, no reported studies showing ethnobotanical uses as male contraceptives covering whole Pakistan. To fulfill the requirements of population control, there is a dire need to explore potent male contraceptive plants. Therefore, the present study was designed with the aim, to document the present traditional knowledge including pharmacological active compounds of medicinal plants, used as male contraceptives in Pakistan.

Materials and Methods

Study area

Pakistan lies between 30º N latitude and 70º E longitude, sharing a border with China to the North, India to the East, Afghanistan to the Northwest and Iran to the West[1] . The Northern highlands, Indus River plains and Baluchistan plateau are the main geographical regions consist of far-flung plains to high mountains. Also, extreme climatic variation exists, which led to the diverse floristic composition from herbs to various kinds of trees. The annual precipitation ranges from 10-15 inches per year across the country[21].

Field interviews

Data was compiled during different field surveys in Khyber Pakhtunkhwa, federally administered tribal areas (FATA), Kashmir, Gilgit Baltistan, some remote areas of Sindh, Baluchistan and some parts of Punjab. To arrange the data, responses from local people (mostly above 50 years men) and traditional health practitioners (THPs) were interviewed and data were documented from June to November 2015. The repeated queries preparation and mode of utilisation were prepared to analyse their experience. A total of 180 informants were interviewed individually. The questionnaire prepared for field surveys includes two parts i.e., primary information about age, gender, education, earning source and family members, while another part contains plant vernacular names, utilisation method, recipe preparation, part used, plant distribution in local area and dosage[22].

Botanical identification and data authentication

Flora of Pakistan and Herbarium of Pakistan (ISL), Quaid-i-Azam University, Islamabad was followed to identify the plant specimens[23]. The species names were authenticated with Kew's online Medicinal Plant Names Services (MNPS) http://www.mpns,kew.org/ mpns-portal/ and The Plant list www.theplantlist.org, while previous ethnobotanical literature was searched to compare the documented data.

Ethical consideration

Keeping in view moral consideration, informants were already briefed that their information will be not disclosed, will be purely used for scientific purposes. Furthermore, informed consent was obtained by the botanical garden director at Quaid-i-Azam University, Islamabad, authorized persons and THPs of the indigenous areas. In addition, all informants were given a clear explanation of the study's goals, given the opportunity to provide informed consent (PIC) and had their interviews done in their native tongues.

Analysis of data

To determine the ethnobotanical data, use differences among roots, leaves and seeds of the

plant, utilisation method and most cited contraceptive families were assessed. For quantitative measurements, the following indices were considered to analyze the collected data.

Family importance value (FIV)

Consensus between informants of the most cited families and total informants of the survey was analyzed by calculating the percentage[24]. It provides information about important families for the proposed study.

Relative Frequency of Citation (RFC)

RFC was calculated by dividing the frequency of citation (FC) i.e., the number of informants cited the species on N that is the number of informants included in the survey[25].

$$\mathrm{RFC} = \mathrm{FC/N}(0 < RFC < 1)$$

The RFC was considered 1 if all informants agreed to plant as useful and remain 0 if one informant agreed to plant as useful.

Disease consensus index (DCI)

To assess plant recommendation against the treatment of specific diseases by local people DCI was calculated. DCI was used by applying the following formula[26].

$$\mathrm{DCI} = (\Sigma^{i=1}\mathrm{Vxi}/Cc.mVx)Pm^{-0.1}$$

Here x is attributed to a species included in this study. mVx is an equal number of ideal uses, ∑Vx represents the sum of all uses per species, Cc showed a number of the informants about a species included in the survey, Vxi is the number of questions divided by total question inquired from an informant, $Pm^{-0.1}$ is equal to the variation found in the traditional information about preparation method and part used.

Jaccard Index (JI)

It is the index used to find the similarity between the two regions. It can be calculated by using the following formula[27]

$$\mathrm{JI} = c \times \frac{100}{\mathrm{a+b-c}}$$

Where 'c' is the number of species shared between two regions and 'a' and 'b' are the number of species in each of the two regions.

Results

Demographic data

In the present study, we interviewed 180 informants (90%) and THPs (10%) of the selected areas of Pakistan, where most of the indigenous people rely on traditional therapy, especially the remote regions, which include 74.4% males and 25.6% vendors were interviewed (Table 1). In this survey, the age group 50-60 years old provided more information (38.9%) than the other age groups. The number of illiterate informants was high (51.7%), 21.7% informants completed 5 years of education, 7.8% informants completed 8 years of education, 7.2% informants completed 10 years of education and 11.7% completed above secondary (12 years)

Table 1 — Demographic data of informants

Variable	Characteristics	No. of Person (Total N=180)	Percentage (%)
Informant category	Traditional Health Practitioners	18	10
	Local people	162	90
Gender	Male	134	74.4
	Female	46	25.6
Age	Less than 30 years	8	4.4
	30-40 years	25	13.9
	40-50 years	44	24.4
	50-60 years	69	38.9
	60-70 years	20	11.17.8
	More than 70 years	14	
Education	Illiterate	93	51.7
	Completed 5 years of education	39	21.7
	Completed 8 years of education	14	7.8
	Completed 10 years of education	13	7.2
	Completed more than 12 years of education	21	11.7
Experience of traditional health practitioners	Less than 5 years	2	1.1
	5-10 years	7	3.9
	10-15 years	5	2.8
	More than 15 years	4	2.2

education. The highest number of informants were interviewed from Swat i.e., 14 (7.7%) including 10 males and 4 vendors, followed by 9 informants (5%) with 5 men and 4 women vendors from Gilgit Baltistan, 8 informants (4.4%) including 4 males and 4 vendors from Hazara Division, 8 informants (4.4%) with 5 males and 3 vendors from the salt range and remaining interviews were conducted from other areas (less than 4%). A total of 18 THPs was interviewed from studied areas (10%).

Botanical diversity

In this study, 100 medicinal plant species belonging to 50 families and 91 genera were reported as a male contraceptive by THPs and local informants (Supplementary Table 1). Fabaceae was found as the most dominant family with 10 species (10%) followed by Apiaceae with 7 species (7%), Apocynaceae with 5 species (5%), Asteraceae and Solanaceae each with 4 species (4%) (Fig. 1). Herbs were the most prominent life form with 47 reports (47%), followed by shrubs with 28 reports (28%), trees with 20 reports (20%) and climbers with 5 reports (5%) (Fig. 2).

Parts used, mode of preparation and utilization

Leaves were the most used plant part (22%) followed by seeds (17%), whole plant (15%), roots (11%), bark (8%), fruit (7%), while stem, flower, pod, rhizome, berries, shoot and inflorescence are less than 5% (Fig. 3). According to our results, powder (44.3%), juice (28.3%), decoction (22.6%), paste (2.8%), and oil (1.8%) were the dominant mode of preparation. The preferred way of utilisation was powder through oral administration by local informants (Supplementary Table 1; Fig. 4 & 5).

Phytochemical study

The documented plants showed the presence of alkaloids, flavonoids, terpenoids, essential oils, saponins, steroids, phenols, tannins[28] and their derivatives, record

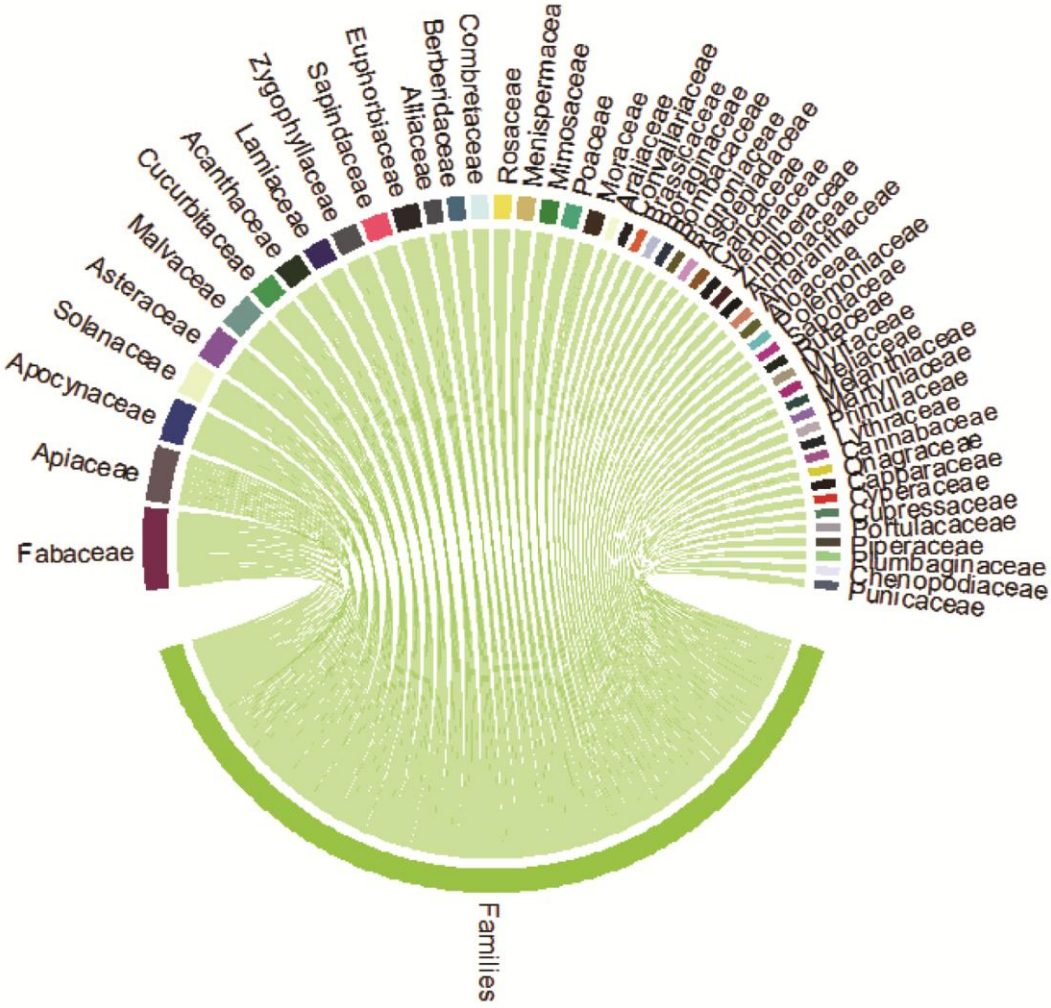

Fig. 1 — Family importance value FIV

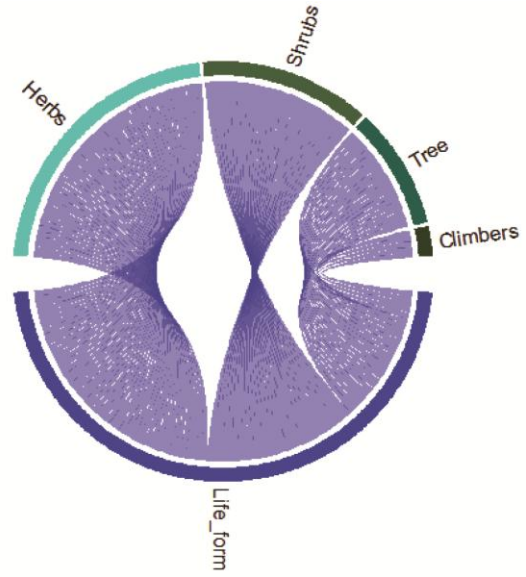

Fig. 2 — Life forms of medicinal plants

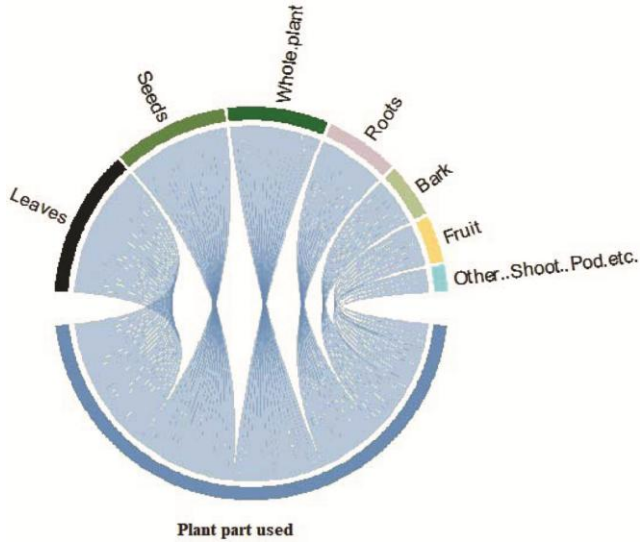

Fig. 3 — Plant part used in folk recipes for male contraception (Other in figure includes shoot, pod, inflorescence and barriers for each)

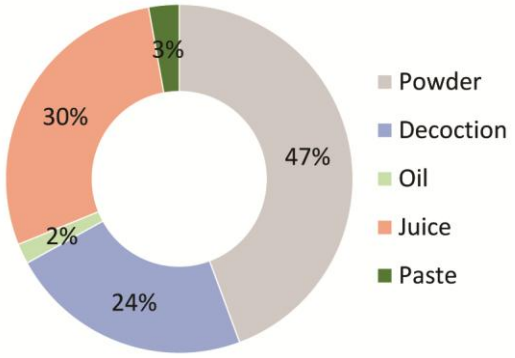

Fig. 4 — Mode of preparation used by local informants & THPs

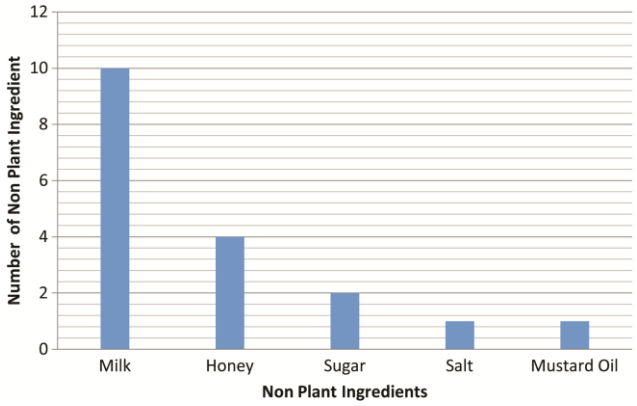

Fig. 5 — Non-plant ingredients added to plants used by THPs

obtained from a detailed literature survey[29]. In the previously published literature, active phytochemical constituents causing anti-fertility in males were hardly reported.

Quantitative analysis

Family Importance Value (FIV) and Relative Frequency Citation (RFC)

The FIV suggested that family Fabaceae revealed highest value (19%) followed by Apiaceae (13%), Apocynaceae (10%), Asteraceae, Solanaceae and Malvaceae (8%), Cucurbitaceae, Sapindaceae, Euphorbiaceae, Zygophyllaceae, Lamiaceae (6%), Alliaceae, Poaceae, Berberidaceae, Menispermaceae, Moraceae, Rosaceae, Combretaceae (4%) and rest of 30 families have FIV value (2%).

This index was used to calculate the most used medicinal plants for antifertility purposes in males. *Carica papaya* L. (Caricaceae), *Justicia adhatoda* L. (Acanthaceae), *Nicotiana tabacum* L. (Solanaceae) has the highest RFC value (0.31) followed by *Allium cepa* L. (0.3), *Punica granatum* L. and *Solanum surattense* Burm. f. (0.29), *Allium sativum* L., *Cannabis sativa* L., *Cichorium intybus* L. and *Dodonaea viscosa* (L.) Jacq. have (0.28) and *Thespesia populnea* (L.) Sol. Ex Correa (0.2) of family Malvaceae has the lowest RFC value (Table. 2). The high RFC value indicated those medicinal plant species which were well known among informants, so further phytochemical and pharmaceutical investigations are required to elicit the new herbal male contraceptives.

Disease Consensus Index (DCI)

The consensus of informants determined the most useful male contraceptive plant. The values were shown in (Supplementary Table 1) and range from

Table 2 — Comparison of the current study with previous publications at regional, neighboring and global level

Study Area	Year	Number of recorded plant spp. Of aligned areas	Plants with similar uses	Plants with dissimilar uses	Total spp. Common in both area	%age of plant spp. Common in both areas	Species enlisted only in aligned areas	Species enlisted only in the study area	% of spp. Enlisted only in the study area	% of plants with similar uses	% of dissimilar uses	Jaccard index (JI)	Citation
Jaipur Rajasthan, India	2006	105	43	0	43	40.95	62	57	57	43	0	56.57895	30
Jaipur Rajasthan India	2011	48	19	0	19	39.58	29	81	81	19	0	20.87912	10
Jaipur Rajasthan India	2015	70	27	0	27	38.57	43	73	73	27	0	30.33708	11
Jaipur Rajasthan India	2013	62	24	0	24	38.71	38	76	76	24	0	26.66667	37
Gujarat India	2011	22	6	3	9	40.91	13	91	91	6	3	9.473684	38
Tamil Nadu South India	2012	50	13	2	15	30	35	85	85	13	2	14.28571	39
Haryana India	2012	577	16	0	16	2.77	561	84	84	16	0	2.54372	31
Himalayan region, KP, Pakistan	2009	36	9	6	15	41.67	21	85	85	9	6	16.48352	18
MSR Nagar, Bangalore India	2015	195	49	7	56	28.72	139	44	44	49	7	44.09449	40
Keffi, Nigeria	2013	27	7	0	7	25.93	20	93	93	7	0	6.603774	41
Silchar, India	2014	55	11	8	19	34.55	36	81	81	11	8	19.38776	19
Kathiyavadi Village, India	2012	25	13	0	13	52	12	87	87	13	0	15.11628	42
Jaipur, India	1989	4	3	0	3	75	1	97	97	3	0	3.157895	43
Coimbatore, India	2013	19	5	1	6	31.58	13	94	94	5	1	5.940594	44
Jalandhar, India	2011	48	12	1	13	27.08	35	87	87	12	1	11.92661	45

0.83 to 0.47 representing high recommended plants used as male contraceptives. *N. tabacum* containing DCI value (0.83) followed by *S. surattense* (0.8), *A. cepa* (0.78), *C. papaya* (0.77) *P. granatum* (0.76), predicts the high potential species used as male contraceptives.

Novelty index and comparative analysis

To assess the novelty index, the final data obtained during field surveys were correlated with 15 published articles on antifertility (Table 2). The present evaluation revealed that 25% of plant species were reported as male contraceptives for the first time from Pakistan, while 3% of plant species were reported as women contraceptives and the remaining 72% plants were already documented for the proposed study (Fig. 6). The highest similarity was observed with a study conducted by Gupta and Sharma[30] with JI value 56.57 and 44.09 respectively. While the lowest similarity was found in the previous findings[31] with JI values 2.54 and 3.15 respectively (Table 2). The variation found among studies might because of

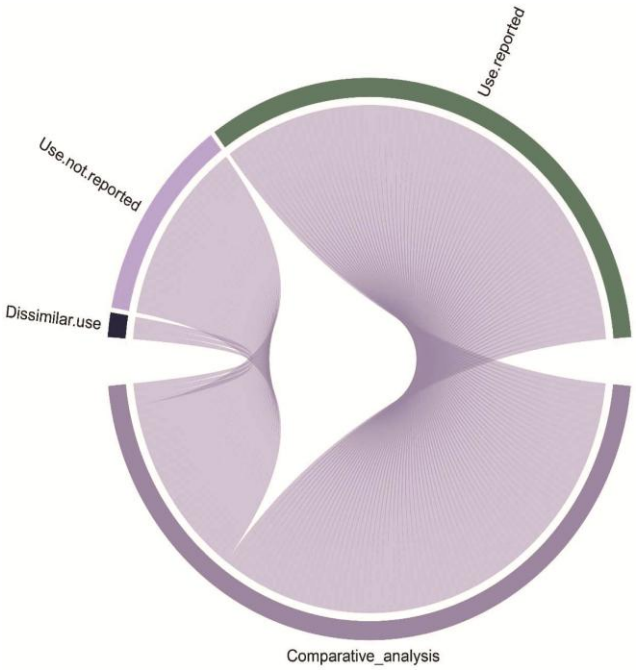

Fig. 6 — Percentages of plants species regarding their use reports

different area size, cultural variations, availability of plants like in some areas plant species is very common while in other areas are rare or difficult to access. The most authenticated plants were those which were highly cited in the previous study i-e., *Azadirachta indica* A. Juss., *Curcuma longa* L., *C. papaya*, *Aegle marmelos* (L.) Corrêa and *A. sativum*.

The comparative study expressed the considerable authenticity of documented data. It was also observed that no work has been done, neither ethnomedicinal nor statistically by applying RFC, DCI, FIV and JI on male herbal contraceptives from Pakistan. The new plants reported as traditional herbal male contraceptives are *Achillea wilhelmsii* K. Koch, *Berberis lycium* Royl, *Capparis decidua* (Forssk.) Edgew., *Cicer arietinum* L., *Cucumis sativus* L., *Cyperus esculentus* L., *Datura stramonium* L., *Dodonaea viscose* (L.) Jacq., *Fagonia indica* Burm.f., *Ficus racemosa* L., *Gossypium hirsutum* L., *Juniperus communis* L., *J. adhatoda*, *Madhuca longifolia* (J. Koenig ex L.) J.F. Macbr., *Mallotus philippensis* (Lam.) Müll. Arg., *Ocimumtenui florum* L., *Pluchea lanceolata* (DC.) C.B. Clarke, *Polemonium caeruleum* L., *Pyrus communis* L., *Raphanus sativus* L., *Cynanchum viminale* (L.) L., *Tinospora sinensis* (Lour.) Merr., *Tribulus pentandrus* Forssk., *Tribulus terrestris* L., *Trichodesma indicum* (L.) Lehm., *Trifolium alexandrinum* L., *Trillium govanianum* Wall. ex D.Don and *Zea mays* L.

Discussion

Population pressure is the most focused and serious issue in the world especially in developing countries[22]. This was the first reference documented study in Pakistan about male contraception by herbal methods. The demographic details about this study showed a total of 180 informants including local people (90%) and THPs (10%) out of which 74.4% males and 25.6% vendors. The number of male informants was high because of eagerness in a discussion about the use of plants as contraceptive while vendors were afraid in providing sharing information because of cultural restrictions in some regions, our results were inconsistent with the previous studies by Shinwari, Ahmad[1]. Furthermore, about 100 medicinal plant species belonging to 91 genera and 50 families were reported as male contraceptives in the present study. Fabaceae was found the most dominant family, the reason being the presence of essential phytochemicals i.e., different flavonoids, alkaloids and phenols compulsory for various metabolic activities and provide strength to defense system against various disorders[32]. These plants are the major source of health care systems for people of remote areas and traditional health practitioners (THPs). The members belonging to diverse families were new to ethnobotanical records about male contraceptives, while very few findings are previously documented in the literature. Herbs were found as the most used plant life form because of their easy accessibility and as a dominant vegetation type found everywhere and may be due to the presence of various phytochemicals, easy extraction and application recipes[33]. The most used plant part was leaves due to ease in practical applications. In traditional medicine, leaves were dominantly used partly because leaves are not only the major site for the photosynthetic process but also a reservoir of bioactive phytochemicals and are an easily accessible part[26].

Contraception is the demand of modern age so the best-preserved form for frequent use is needed which can be stored to ensure off-season availability[34]. Plant material is usually preserved by drying method[35]. In this study mostly, the dried plant part was used in powder form, in comparison with previous literature, where decoction was the dominant mode of utilization because it was considered a method that provides rich bioactive compounds and their synergistic activities[28]. On the other hand, the paste was prepared from fresh parts. Some fleshy fruits were eaten as such. Most of the traditional healers prescribed oral utilisation followed by topical use, infusion, inhalation method and others. During the survey, the interviewer found the local measuring units to document doses i.e., one teaspoon, half cup, one cup, one glass, taken how many times, daily or weekly. While THPs prescribed proper doses in standard unit i.e., milligrams, grams, milliliters, and liter. Out of 100 plants, 23 species (23%) were used with milk (10%) followed by honey (4%) and sugar, buttermilk, salt, mustard oil (less than 2%) (Fig. 5). Honey and sugar were used to make bitterness bearable and reduce toxicity and adverse effects of the plant[25]. Various quantitative indices results showed that those medicinal plant species were well known among informants. Overall results indicated that knowledge of ethnobotanical uses varies in different communities among healers and professionals. The priority of indigenous information knowledge exhibits correlation and variations of ethnobotanical surveys in different parts of the world[36]. Our results showed similarities and a high

level of novelty, which is required for the preparation of crude drugs, its further exploration and phytochemical assessment can lead to the discovery of reliable male contraceptives to control the population by the safe and cheaper method. The respondents were satisfied with the usage of these herbal drugs and got promising results as these were easily accessible and cheap. Based on our field survey, we confirmed the use of the same plant from several inhabitants for the same use in the local communities and their experiences about the plants were promising.

Conclusion

This is the first ethnomedicinal report comprising of the traditional usage of medicinal plants by the indigenous communities and THPs of different regions of Pakistan. By comparing with 15 published articles and applying Jaccard Index, it was concluded that 25% of plants are novel for the proposed study and 72% of plants were cited in previous literature while remaining 3% plants were documented previously for dissimilar use. Newly reported species should be investigated to determine their chemical constituents and biological activities based on RFC and DCI high values further assessment for detailed phytochemical screening, toxic components, and *in vivo* pharmacological applications to find new avenues in pharmaceutical sciences for the discovery of male contraceptive drugs.

Supplementry Data

Supplementry data associated with this article is available in the electronic form at http://nopr.niscpr.res.in/jinfo/ijtk/IJTK_21(03)(2022)_616-624SupplData.pdf

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Conflict of Interest

The authors declare that they have no competing interests.

Authors' Contributions

WZ, MA and MZ designed the study. WZ, HA and L collected the field data and wrote the manuscript. WZ, FU, AA, SS, SB and SP did data analysis. MA, FU and MZ helped with plant identification. WZ, FU, SS, AA, SB and SP helped in manuscript correction and analysis.

References

1 Shinwari S, Ahmad M, Luo Y & Zaman W, Quantitative analyses of medicinal plants consumption among the inhabitants of shangla-kohistan areas in northern-pakistan, *Pak J Bot*, 49 (2) (2017) 725-734.

2 Wondimu T, Asfaw Z & Kelbessa E, Ethnobotanical study of medicinal plants around 'Dheeraa'town, Arsi Zone, Ethiopia, *J Ethnopharmacol*, 112 (1) (2007) 152-161.

3 Bibi T, Ahmad M, Tareen R B, Tareen N M, *et al*., Ethnobotany of medicinal plants in district Mastung of Balochistan province-Pakistan, *J Ethnopharmacol*, 157 (2014) 79-89.

4 Hussain S, Hamid A, Ahmad K S, Mehmood A, *et al*., Quantitative ethnopharmacological profiling of medicinal shrubs used by indigenous communities of Rawalakot, District Poonch, Azad Jammu and Kashmir, Pakistan, *Rev Bras farmacogn*, 29 (5) (2019) 665-676.

5 Polat R & Satıl F, An ethnobotanical survey of medicinal plants in Edremit Gulf (Balıkesir–Turkey), *J Ethnopharmacol*, 139 (2) (2012) 626-641.

6 Cavero R Y & Calvo M I, Medicinal plants used for musculoskeletal disorders in Navarra and their pharmacological validation, *J Ethnopharmacol*, 168 (2015) 255-259.

7 Tribess B, Pintarelli G M, Bini L A, Camargo A, *et al*., Ethnobotanical study of plants used for therapeutic purposes in the Atlantic Forest region, Southern Brazil, *J Ethnopharmacol*, 164 (2015) 136-146.

8 Butt M A, Ahmad M, Fatima A, Sultana S, *et al*., Ethnomedicinal uses of plants for the treatment of snake and scorpion bite in Northern Pakistan, *J Ethnopharmacol*, 168 (2015) 164-181.

9 Ashidi J, Olaosho E & Ayodele A, Ethnobotanical survey of plants used in the management of fertility and preliminary phytochemical evaluation of *Abelmoschus esculentus* (L.) Moench, *J Pharmacogn Phytother*, 5 (9) (2013) 164-169.

10 Joshi S C, Sharma A & Chaturvedi M, Antifertility potential of some medicinal plants in males: An overview, *Int J Pharm Pharm Sci*, 3 (2011) 204-217.

11 Soni P K, Luhadia G, Sharma D K & Mali P C, Antifertility activities of traditional medicinal plants in males with emphasis on their mode of action: A review, *J Glob Biosci*, 4 (1) (2015) 1165-1179.

12 Jabeen T, Akhtar A, Shah A, Khan K, *et al*., Qualitative and quantitative ethnobotanical evaluation of plant resources of Kiwai, Kaghan valley, district Mansehra, Pakistan, *Indian J Tradit Know*, 20 (1) (2021) 141-153.

13 Vetriselvan V & Yoganandan G, Public perception towards homeopathy in Tamil Nadu, India, *Indian J Tradit Know*, 19 (3) (2020) 675-681.

14 Thakur S, Tashi N, Singh B, Dutt H C, *et al*., Ethnobotanical plants used for gastrointestinal ailments by the inhabitants of Kishtwar plateau in Northwestern Himalaya, India, *Indian J Tradit Know*, 19 (2) (2020) 288-298.

15 Çakılcıoğlu U, An ethnobotanical field study; traditional foods production and medicinal utilization of *Gundelia* L.

species in Tunceli (Turkey), *Indian J Tradit Know*, 19 (4) (2020) 714-718.

16 Kawarty A M A, Behçet L & Çakilcioğlu U, An ethnobotanical survey of medicinal plants in Ballakayati (Erbil, North Iraq), *Turk J Bot*, 44 (3) (2020) 345-357.

17 Ahmad M, Sultana S, Fazl-i-Hadi S, ben Hadda T, *et al*., An Ethnobotanical study of Medicinal Plants in high mountainous region of Chail valley (District Swat-Pakistan), *J Ethnobiol Ethnomed*, 10 (1) (2014) 1.

18 Shah G M, Khan M A, Ahmad M, Zafar M, *et al*., Observations on antifertility and abortifacient herbal drugs, *Afr J Biotechnol*, 8 (9) (2009).

19 Das B, Talukdar A & Choudhury M D, A few traditional medicinal plants used as antifertility agents by ethnic people of Tripura, India, *Int J Pharm Pharm Sci*, 6 (1) (2014) 47-53.

20 Sahu T, An Ethnobotanical study of Madhya Pradesh 1: Plants used against various disorders among tribal women, *Anc Sci Life*, 1 (3) (1982) 178-181.

21 Ahmad M, Khan M P Z, Mukhtar A, Zafar M, *et al*., Ethnopharmacological survey on medicinal plants used in herbal drinks among the traditional communities of Pakistan, *J Ethnopharmacol*, 184 (2016) 154-186.

22 Zaman W, Ahmad M, Zafar M, Amina H, *et al*., The quest for some novel antifertility herbals used as male contraceptives in district Shangla, Pakistan, *Acta Ecol Sin*, 40 (1) (2020) 102-112.

23 Nasir E, Ali S & Nasir Y J, Flora of West Pakistan, Vol. 1, 1970, University of Karachi.

24 Rashid S, Ahmad M, Zafar M, Sultana S, *et al*., Ethnobotanical survey of medicinally important shrubs and trees of Himalayan region of Azad Jammu and Kashmir, Pakistan, *J Ethnopharmacol*, 166 (2015) 340-351.

25 Tardío J & Pardo-de-Santayana M, Cultural importance indices: A comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain) 1, *Econ Bot*, 62 (1) (2008) 24-39.

26 Andrade-Cetto A & Heinrich M, Mexican plants with hypoglycaemic effect used in the treatment of diabetes, *J Ethnopharmacol*, 99 (3) (2005) 325-348.

27 Ijaz F, Iqbal Z, Rahman I U, Alam J, *et al*., Investigation of traditional medicinal floral knowledge of Sarban Hills, Abbottabad, KP, Pakistan, *J Ethnopharmacol*, 179 (2016) 208-233.

28 oni P, Siddiqui A A, Dwivedi J & Soni V, Pharmacological properties of *Datura stramonium* L. as a potential medicinal tree: An overview, *Asian Pac J Trop Biomed*, 2 (12) (2012) 1002-1008.

29 Anjum M I, Ahmed E, Sharif A, Jabbar A, *et al*., Phytochemical investigations on *Tribulus longipetalus*, *Asian J Chem*, 26 (4) (2014) 1086.

30 Gupta R & Sharma R, A review on medicinal plants exhibiting antifertility activity in males, *Nat Prod Rad*, 5 (5) (2006) 389-410.

31 Kumar D, Kumar A & Prakash O, Potential antifertility agents from plants: A comprehensive review, *J Ethnopharmacol*, 140 (1) (2012) 1-32.

32 Bolson M, Hefler S R, Dall E I, Chaves O, *et al*., Ethno-medicinal study of plants used for treatment of human ailments, with residents of the surrounding region of forest fragments of Paraná, Brazil, *J Ethnopharmacol*, 161 (2015) 1-10.

33 Ashfaq S, Ahmad M, Zafar M, Sultana S, *et al*., Medicinal plant biodiversity used among the rural communities of arid regions of Northern Punjab, Pakistan, *Indian J Tradit Know*, 18 (2) (2019) 226-241.

34 David M, Ain Q u, Ahmad M, Zaman W, *et al*., A biochemical and histological approach to study antifertility effects of methanol leaf extract of *Asplenium dalhousiae* Hook. in adult male rats, *Andrologia*, 51 (6) (2019) e13262.

35 Sood P, Modgil R & Sood M, *Berberis lycium*, a medicinal plant with immense value, *Indian J Pharm Biol Res*, 1 (1) (2012) 1-8.

36 Ullah S, Khan M R, Shah N A, Shah S A, *et al*., Ethnomedicinal plant use value in the Lakki Marwat District of Pakistan, *J Ethnopharmacol*, 158 (2014) 412-422.

37 Sharma P, Sharma A & Agarwal M, A review on antifertility efficacy of plants in males, *Int J Pharma Bio Sci*, 4 (4) (2013) 413-428.

38 Gediya S, Ribadiya C, Soni J S N & Jain H, Herbal plants used as contraceptives, *Int J Curr Pharm Res*, 2 (1) (2011) 47-53.

39 Priya G, Saravanan K & Renuka C, Medicinal plants with potential antifertility activity-A review of sixteen years of herbal medicine research (1994-2010), *Int J Pharm Res*, 4 (1) (2012) 481-494.

40 Azamthulla M, Balasubramanian R & Kavimani S, A Review on medicinal plants exhibiting antifertility activity, *World J Pharm Pharm Sci*, 4 (3) (2014) 243-272.

41 Mustapha A A, Ethno-medicinal field study of anti-fertility medicinal plants used by the local people in Keffi Local Government, Nasarawa State, Nigeria, *J Med Plant Res*, 2 (5) (2013) 215-218.

42 Sathiyaraj K, Sivaraj A, Thirumalai T & Senthilkumar B, Ethnobotanical study of antifertility medicinal plants used by the local people in Kathiyavadi village, Vellore District, Tamilnadu, India, *Asian Pac J Trop Biomed*, 2 (3) (2012) S1285-S1288.

43 Sinha R K & Nathawat G, Anti-fertility effects of some plants used by the street herbal vendors for birth control, *Anc Sci Life*, 9 (2) (1989) 66.

44 Umadevi M, Sampath K, Bhowmik D & Duraivel S, Medicinal plants with otential antifertility activity, *J Med Plants Stud*, 1 (1) (2013) 26-33.

45 Kaur R, Sharma A, Kumar R & Kharb R, Rising trends towards herbal contraceptives, *J Nat Prod Plant Resour*, 1 (4) (2011) 5-12