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ETHNOBOTANICAL STUDIES AND PROBLEMS ASSOCIATED WITH REGENERATION OF HERBALS IN KOHAT REGION

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Abstract

Kohat Division comprises of around three distinct ecological zones with severe cold in winter and mild summers with snow covered peaks to the west and north west comprising of Parachinar and agencies like Orakzai and FATA areas. In the south lies a vast sandy terrain adjoining mountains comprising of stony soil inhabited by *Zizyphus* sp and other xerophytes. Summer temperatures usually shoot above 50^0C with mild winters. The central Kohat region exhibits a weather in between the above two extremes. As reported the flora is rich with herbals which have been over exploited resulting in deterioration of the habitat. As an alternate and to save the environment from further degradation, selected herbals were grown in the Medicinal Plants Farm of the University. This experience has been successful with increased biomass and medicinal ingredients production. The findings are reported in the following sections.

Introduction

Possibly plants, animals and human beings evolved parallel to one another and are still inter dependant upon one another. We all understand that human beings take care of both animals and plants by raring them in friendly environment ensuring their continuity and conservation. In return the food, forage and shelter, protection, continuity of the human and other requirements are met by both the flora and fauna inhabiting the same ecological niches (Kumar, 2006)., Welfare of one is dependant on the other. For example if an area is lush green and productive it will afford a healthy and prosperous animal and human development. Many examples can be quoted in support of this argument. Contrarily an imbalance in any of these components can lead to drastic environmental hazards. For example due to population explosion, which is a biotic interference, land resources are receding consequently affecting plant and animal density. Hence malnutrition, prevalent diseases, low standard of life etc. are on the rise in overpopulated regions of the world. This can be a direct attribute of habitat deterioration (Pence, 2003). Luckily green and gene revolution and advances in genetic engineering and biotechnology have to a large extant scavenged the situation from a total disaster and these efforts must continue for the survival of ever increasing world populace.

From times immemorial, plants have been used as a source of food, shelter, cure, condiments, aromas, perfumes and many other purposes (Trivedi, 2006; Anonymous, 2005). Food plants were domesticated very early and since then by meticulous breeding methods their production, tolerance to various stresses including diseases, higher production in the changing environment, improvement in quality i.e. nutrition is constantly being improved by the scientists. Similarly man has paid a lot of attention to animals for increased milk, meat, other dairy items etc production. However, he is helpless or unwilling to take note of the environment in which there is a coexistence of all

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the stakeholders. Proper attention must be paid for rehabilitation of the degraded environment (Benson, 2003; Pence, 2003).

It is a fact that in addition to be a source of staple and basic food, plants have been used for the treatment of various ailments and even presently are being researched upon to find cures for hepatitis, blood purification and various cardiac diseases. Moreover the three established systems of medicine viz. unani (traditional), homeopathic and allopathic substantially rely upon medicines obtained from plant resources (Eiseinberg *et al*., 1993). This development of knowledge was slow and gradual in the beginning utilizing the hit and trail method. However, recently all the systems have a scientific foundation and many research organizations are busy in inventing new cures to check the spread of many a fatal diseases. Relying upon ethnobotanic knowledge many a diseases are treated with plant extracts and after its potency is established then a search is directed to isolate the active compound and produce it on a large scale for curing the suffering mankind. Today's modern clinical pharmacology is based on herbal drugs. Different pharmacopoeia contain information regarding pure extracts and chemical analogues with foundation in herbal remedies e.g. digoxin, vincristine and now taxol. All these important and potent medicines are natural products (Anonymous, 2005; Miller, 2005; Katewa & Jain, 2006).

Medicinal plants used to grow on marginal lands with practically no economic inputs in the form of tilling, addition of fertilizers, irrigation etc. However, this trend is being altered as these marginal lands are now converted either into residences or with availability of water resources cultivation fields and pastures for more economic benefits. Hence reducing available space for establishment of valuable herbals.

Further, over exploitation and non-technical extraction has resulted in diminishing and extinction of many important herbals. Moreover, this trend has led to deterioration of habitat where these plants used to grow (Kumar, 2006). Hence it is imperative to cultivate herbals in farm lands following the pattern of crop plants. This practice will probably ensure an increase in herbal productivity and their conservation under suitable environmental conditions. References are available regarding identification of endangered medicinal plants and their cultivation under controlled environment (Chaudhari, 2007).

The surge in renewed popularity of herbal medicines is because these are safe, easy to administer and non-toxic. However, their usage requires expert administration after proper diagnosis (Eisenberg *et al*., 1993; Trivedi, 2006). In developing countries drug extraction is based on crude methods leading to loss in biomass production and habitat. This has to be checked by educating the entrepreneurs (Miller, 2005).

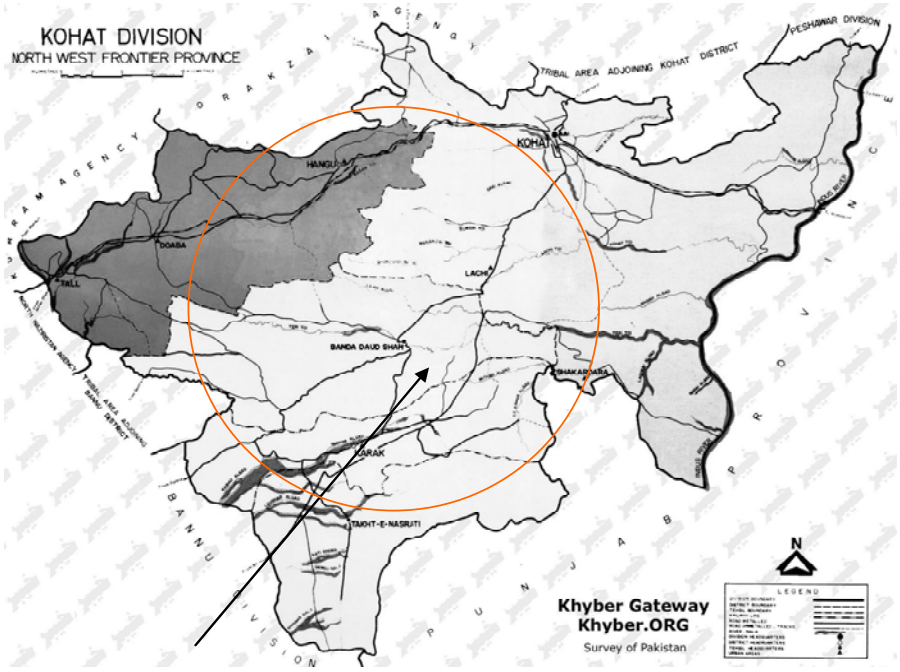
The present paper deals with a survey of Kohat division and adjoining tribal areas where a number of valuable herbals grow. This study reports regarding a general survey of the area for documentation of medicinal plants growing in the wild, collection of selected herbals based on ethnobotanic information, soil analysis of sites and then possible cultivation at a farm developed for the purpose. Sustainable harvesting at proper time and season will help in framing guidelines for enhanced extraction of active medicinals. Some of these results are reported in the following appropriate sections.

Materials and Methods

Plant and seed collection: A survey of different localities of study area was conducted in different seasons for collection of plants for study and the herbarium and seeds for

cultivation in the Medicinal Plants Farm. In addition numerous elders, and if possible hakims, dealers in herbals etc. were also interviewed for ethnobotanic information and to assess the medicinal biomass utilized locally and for export to other regions of Pakistan. Further information was provided regarding decrease in diversity and propensity of specific drugs by personnel of Education, Forest and Agriculture departments. To study germination and establishment of selected herbals, their seeds were sown in small beds of 10X10 feet. These beds were properly ploughed, fortified with organic matter and watered at regular intervals depending upon need. Fertilizers were added as recommended by Agriculture Dept. in a proportion as for other crop plants. Plant samples collected were identified and then deposited in the herbarium, while seeds were used for *ex situ* cultivation and conservation.

Map of Kohat Division



Soil analysis: Soil samples were also collected to understand the soil profile e.g. soil texture, organic component and various nutritional elements. Similarly representative plant material was also analyzed regarding absorption of various elements under different environments. These analyses were done at the Agricultural Research Institute, Tarnab and Central Research Laboratories of the University of Peshawar.

Active compound isolation: After collection from the wild habitat, the plant samples were dried in shade, then crushed and dissolved in various solvents ranging from methanol, chloroform, acetone etc. overnight for extraction of the active metabolites. The respective solvent was then filtered. The residue so obtained was again dissolved in sufficient solvent and allowed to stand for three hours. After filtration the residue was

again dissolved in the same solvent for three hours for the third time to ensure maximum extraction of the active ingredients. All the filtrates were combined and vacuum dried. A portion of the residue thus obtained was applied to a silica gel thin layer with the help of a Pasteur pipette. Reference compounds were also applied to the same silica gel plate and chromatography done in various solvent systems which are reported with individual plant species in the result section. Detection of the active compound was made using a uv source and spray with different reagents following Wagner & Bladt (2004). These results are reported in the following appropriate sections. Germination and growth of some plants was comparable with field grown plants. However, these results are reported in a separate communication to be followed.

Fig. 1: A view of the medicinal plants farm and establishment of important herbals

Results

The area under study was visited at different seasons of the year to collect some representative medicinal plants of the area. Help was also sought from local population and hakims for ethnobotanic information. There are over 100 medicinal plants growing in the area. These plants mainly belonged to *Apiaceae, Asteraceae, Poaceae, Rosaceae, Zygophyllaceae,* etc. In Orakzai and Hangu area olive and nanorhops were predominant, while in Kurram *Apiaceae, Poaceae, Asteraceae,* members were prevalent. In Kohat area *justicia, Withania, Rhazya, Aloe, Salvia* species grew in abundance. However, these were sparse because the soil is hard comprising of sandstone containing negligible organic

Table 1: A list of plants growing in the Karak (Semi-arid) area alongwith parts used and various medicinal uses

Botanical name	common name	part used	medicinal use
Accacia nilotica	kikar	leaves, bark, gum	asthma, diarrohea, demulcent
Achyranthus aspera	Apamarg, kurshaka	whole plant	Cough, cholera, gonorhoea, insect bite
Justicia adhatoda	Bakaer, tora baja	Whole plant	Diuretic, jaundice, antispasmodic
Alhagi sp		Whole plant	Laxative, diuretic
Aloe vera	Kawar ghandal, zargia	Whole plant	Stomach trouble & acidity, burm\ns, eruptions
Albizia procera	Sirin	bark, seeds	expectorant, inflammation
Amaranthus sp	jangli chuli, ranzaka	leaves	emollient, laxative
Capparis decidua	Ker, kira	fruits, branches	carminative, aphrodisiac, ulcer, cough, asthma
Calotropis procera	Aak, spalmaka	whole plant	tooth & stomach aches
Citrulus vulgaris	Tarkha marunge	Fruit, seeds	laxative
Datura stramonium	Datura, barbaka	leaf, seed	asthma, mouth, skin
Haloxylon sp		whole plant	tooth & stomach aches
Malva parviflora		leaves, seeds	tonic, wounds, swellings
Peganum harmella	Harmal, spelleny, sponda	whole plant, seeds	anti-microbial, colic, lumbago
Solanum surretense	Maraghone	whole plant	chest pain, vomiting, burning feet
Tribulus terrestris	Azghake, malkunda	whole plant	skin diseases, asthma, leprosy
Withania coagulens	paner doda	fruit, seeds	diuretic, asthma, allergy
Zizyphus mauritina *Z. nummularia*	ber	leaves, fruit, bark	digestive, blood purifier, sores, skin diseases

Table 2: Various parts of the medicinal plants used for treatment of different ailments

Part used	Percentage
Roots	29.6
Rhizomes	4.0
Leaves	5.8
Flowers	5.2
Fruits	10.3
Seeds	6.6
Stems	5.5
Bark	13.5
Wood	2.8
Whole plant	16.5

Table 3: Physio-Chemical Analysis of Soils collected from sites where different herbals were growing

Plant Species	Textural Class / Organic matters	Elements % (Major)				pH	Ec x 10^3	TSS %	Clay	Silt %	Sand	Micronutrients					
		C-$_a$CO$_3$	ppm									Al	Si	K	Ca	Fe	Mg
			N	P	K												
Kohat Soil	Sandy loam, medium textured 0.41	18.25	0.02	21.3	273	8.1	0.08	0.026	11.4	22.0	66.6	6.91	10.68	2.76	20.10	10.3	--
Withania coagulens	Sandy loam, N & organic deficient 0.79	17.00	0.039	64.0	209	7.8	0.11	0.035	9.4	24.0	66.6	4.91	16.68	1.66	15.39	8.53	--
Rhazzya stricta	Sandy loam, N & organic deficient 0.62	20.25	0.031	15.9	237	8.0	0.09	0.029	12.4	39.0	44.6	--	3.0	3.0	2.9	--	--
Peganum hermella	Loam, organic deficient 1.03	19.50	1.03	17.15	318	7.7	0.10	0.032	23.4	34.0	42.6	6.83	18.20	2.33	14.83	6.13	--
Tribulus terristeris	Clay, organic deficient 0.89	16.75	0.044	15.5	209	7.9	0.22	0.07	53.4	26.0	20.6	--	--	2.96	--	--	--
Seriphidium kurramense	Sandy loam, low in organic matter 1.03	14.50	1.03	26.02	106	7.9	0.06	0.019	6.4	40.0	53.6	--	1.36	1.34	--	--	--
Cistanche tubulosa	Sandy loam, calcareous 0.69	15.0	0.034	0.53	188	8.2	0.11	0.035	12.8	30.0	57.2	6.19	14.97	0.69	1.48	0.83	1.97

matter. Density of herbals was further affected by grazing and cutting. Species growing in semi-arid (desert) region of Karak are represented in Table 1. Locals of different areas used different plants for cure against a number of ailments, either signally or in various combinations. However the knowledge was crude and not based on scientific knowledge.

Further, various middlemen employed collectors for extraction of the herbals. These were processed by drying in shady places and then packed in bags for transportation to a central market for sale. All the labour force employed was unaware of the importance of these herbals, price, ultimate destination and utilization. The whole plants were usually uprooted regardless of the part used. The labourers are paid on the basis of biomass collected, which results in indiscriminate uprooting of valuable germplasm. Locals were of the opinion that over the years density of many a plants has declined e.g. that of *Seriphidium*, *Nanorhops*, *Artemisia* etc. due to a variety of reasons. As the plants are not

Table 4: Species Cultivated/ Transplanted at KUST Medicinal Plant Farm alongwith growth performance

Botanical Name	Cultivated/ transplanted	Local name	Collection place	Growth results
1. Justicia adhatoda	Transplanted	bakar	Local	90%
2. Glycerrhiza glabra	Transplanted	Mulathi	Botany Dept.	25%
3. Peganum harmala	Transplanted	Spelanae	Local	90%
4. Peganum harmala	Cultivated	Speleny	Local	90%
5. Calotropis procera	Transplanted	Spalmae, Aak	Local	90%
6. Hibiscus sp	Cultivated	Sadrifa	Qarshi	90%
7. Withania coagulans	Cultivated	Asgand	Local	50%
8. Withania coagulans	Transplanted	Asgand	Darra	Nil
9. Rhazya stricta	Transplanted	Ganderai	Local	Nil
10. Fagonia cretica	Transplanted	Spelazghaey	Local	Nil
11. Solanum surattense	Transplanted	-	Local	50%
12. Podophylum emodi	Cultivated	*Ban Kakri*	Qarshi	Nil
13. Cheiranthus cheiri L.	Cultivated	Todi surkh	Qarshi	Nil
14. Echinacocia purpurea	Cultivated	-	Qarshi	Nil
15. Holy Basil	Cultivated	-	Qarshi	Nil
16. Ocimum bascilicum	Cultivated	Niaz bo	Qarshi	90%
17. Mentha longifolia	Transplanted	Podeena	Local	50%
18. Mentha spicata	Transplanted	Podeena	Local	50%
19. Vinca rosea	Cultivated	Podeena	Local	90%
20. Malva salvitellensis	Cultivated	-	Local	25%
21. Withania somnifera	Cultivated	Paneer doda	Local	50%
22. Aloe vera (two sp.)	Transplanted	Kawar ghandal	Local	90%
23. Datura alba	Cultivated	Dathoora	Local	90%
24. Opuntia sp	Transplanted	-	Local	90%
25. Cactus (3 species)	Transplanted	-	Botany Dept.	90%
26. Cactus (1 species)	Transplanted	-	Local	90%

Table 5: Extraction and detection of active compounds from various plant species.

Plant species	Active compounds	Solvent system	Detection by
Artemisia annua	Absinthin, artemesin	dichloromethane:acetone 85: 15 toluene: ethyle acetate 93: 7	uv– 262-374nm 20% ethanolic H_2SO_4 HPLC
Justicia adhatoda	rychnophylline	ethyl acetate : isopropanol: NH_3(conc.)	uv-254nm Dragendorff reagent
Peganum harmella	Hermaline, harmine	chloroform : acetone : diethylamine 50:40:10 chloroform : methanol : 10% NH_3	uv-365nm
Seriphidium kurramense	santonin	dichloromethane:acetone 85: 15 toluene: ethyle acetate 93: 7	uv-370nm 10% ethanolic H_2SO_4 1% ethanolic vanillin
	thujone	dichloromethane:acetone 85: 15 toluene: ethyle acetate 93: 7	phosphomolybdic acid
Withania coagulens	free amino acids, fatty oils		ninhydrin test

allowed to reach maturity resultantly these produce less seeds and hence natural regeneration is impaired. Due to reduced vegetative cover there is soil erosion, formation of hard crust on soil surface and degeneration of the habitat which is being invaded by invasive species like prosopis, non palatable grasses etc.

As evident from Table 2 different parts of the herbals are used for treatment in all systems of medicine. When fruits, seeds, leaves etc. serve as the raw material for preparation there are enough chances of continuation and preservation of the herbals. However, when bark, stem, root, rhizome etc. are used then the whole plant is extracted for use hence leading to diminishing of the species. For example *Artemisia*, *Salvia*, *Hypericum* etc. were extracted as a whole and is the main reason of this decline. To overcome such a situation medicinal plants have to be grown in farms for sustainable extraction of the raw material. Kohat was found suitable for the growth of a number of medicinal plants, comprising of trees, shrubs and herbs. Cultivation of these plants in farms will further reduce burden of grazing, fire, over exploitation etc. Once the techniques for cultivation have been mastered, these will be disseminated to prospective farmers.

To achieve the above objectives, physico-chemical analysis of the farm site and other soils was conducted (Table 3) for comparison. As evident all the soils were deficient in organic matter and various nutritional elements. The soils were hard in some places due to predominance of clay and calcareous rocks. The farm was properly ploughed, enriched with organic matter and fertilizers added with frequent watering. The plants introduced in this farm are listed in Table 4 alongwith success / failure regarding their performance and establishment.

Fig.1 gives a view of some of the medicinal herbals established in the farm. Those prone to extreme weather conditions were grown in net houses. As the farm is only two years old, therefore, a complete assessment of all plants is impossible. However, some of the annuals exhibited excellent establishment and biomass yield was higher compared to plants growing in fields / wild habitats. Naturally higher biomass production will ensure

higher active medicinals synthesis. After the perennials have been established for a total period of four years, these will be harvested and detailed analysis regarding biomass and active ingredients synthesis carried out. These findings will be critically compared with yields of plants growing in wild habitats.

Detailed drug analysis of *Seriphidium kurramense, Artemisia annua, Peganum harmella* and *Withania coagulens* revealed a substantial concentration of important drugs (Table 5). Extraction of active components is underway for quantitative analysis and comparison with the plants growing in the nature. Further, a critical quantitative analysis of both field and farm grown plants will be made to compare secondary metabolite synthesis and possible domestication of important herbals. This will enable us to recommend protocols for cultivation of valuable herbals under controlled environmental conditions to the prospective farmers.

Discussion

Medicinal plants are used either as (i) traditional and alternate medicines, signally or in combinations dispensed by semi-literate hakims or (ii) commercial products manufactured by pharmaceutical industries under license and dispensed by prescriptions by skilled practitioners. Further, the medicinal plant drugs can be categorised for convenience sake into (a) essential oils and oleoresin and (b) phytopharmaceuticals.

Most of the modern day drugs were invented by studying the traditional use of certain herbs which led to the development of very important and valuable drugs like Codeine, digoxin, vinblastine, vincristine, phytol etc. (Lozoya, 1994). *Seriphidium kurramense* was used as vermifuge by locals of Kurram Agency (Qazalbash, 1942a) which then paved the way for santonin isolation (Qazalbash, 1942b; Kuroda, 1963a). The plant was then grown in green house in Japan with increased santonin content (Kuroda, 1963b). Increased biomass production and active constituent have been reported in the present paper for *Seriphidium* and other species.

Twenty five percent of the world population relies on herbal medicines and this trend is increasing due to the discovery of no side effects of natural medicines. In allopathic medicines a magic bullet, comprising of concentrated active ingredient is administered to the patient, while in homeopathic and local systems a less concentrated amount is administrated in a base solution having no side effects (Weiss, 1988). Further, herbal prescriptions comprise of a number of plant combinations which further reduce allergic risks. Eastern medicine recognises the preparation as a tonic, which has stimulating effect especially on the immune system and hence has a beneficial effect. Allopathic system has some disadvantages when the purified product is used. Thus a bridge is to be built between allopathic and eastern systems of medicine for the benefits of the patients (Miller, 2005). Moreover, herbal administration has an added advantage because when used for a single indication it can serve divergent uses (pluralism) (Huxtable,1992).

Due to above benefits demand for traditional medicines is increasing with over exploitation of the natural resources, resultantly endangering the survival of the species, denuding of the habitats with consequences of invasion by obnoxious species. This trend was noted in a number of places where even prosopis, acacias and other weeds have occupied space inhabited by important medicinal plants like *Seriphidium, Artemisia* in Kurram valley in the past. Depletion of organic matter due to sparse vegetation in certain

areas (Table 3) has led to impaired germination. Decline in nanorhops in Tall and Hangu areas has devoid the habitat from protection against various ecological factors, thus causing habitat degradation and reduction in herbals. To recoup the situation efforts have to be made for mass cultivation on a large scale in selected places of some important and valuable herbals close to their natural habitats. This domestication has led to increased active ingredients production has reported by Kuroda (1963 a & b). The experience with medicinal plants farming is successful at Kohat, Qarshi Industries, Hattar, Swat etc. Mentha cultivation in Mansehra, Rhazya sp in D.I khan, Jojoba and periwinkle in Punjab plains alongwith others are success stories and must be practiced on a large scale. Biotechnology has come to our rescue under such a situation (Benson, 2003), because improved herbals through conventional and modern techniques can be cultivated after proper adaptation.

Herbal medicines in Indo-Pak subcontinent is a family property /tradition and the ethnobotanic knowledge gained over the years is kept religiously secret. So very important knowledge/research is lost. However successes of Hakim Ajmal Khan, Hamdard Dawakhana and a few others are examples which must be followed by others. This knowledge is gaining importance in China, India, Korea (Katewa & Jain, 2006). Plants growing in marginal lands have proven metabolite production as evident from over results. These metabolites are produced as result of secondary metabolism which is enhanced by induction of any kind of stress (Bell, 1980). These processes have to be understood properly for economic benefits, because plants growing in nature are constantly experiencing a kind of stress.

With gain of scientific knowledge and controlled cultivation some of the endangered plants can be saved and environment degradation checked. This is in line with recommendations made by Chaudhary (2007). In addition to medicinals, plants are also a good source of carminatives and aromatic compounds (Skaria *et al*., 2007). Such plants are grown in Kohat as cash crops. The local population has to be educated and trained for sustainable cultivation and extraction of plants. Our country can benefit from this trade of herbals in future because of existence of diverse habitats and plants. As reported in the present studies, Kurram valley exhibits mild summers and severe winters and has a unique flora with herbals of the family Apiaceae, Asterace, Rosaceae. Karak is predominantly semi-arid with sand dunes and is abode to *Cistanche, Athalgi*, *Rhazya*, *Zizyphus* species etc. Around Kohat various herbals like *Peganum, Withania*, *Justicia*, and many others dominate which could be an extra source of earning for the locals and at the same time alleviate biological degradation. Some entrepreneurs are reaping the benefits by establishing private farms. They have to be encouraged, provided with appropriate knowledge and if possible funds.

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