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Editorial

In recent years there is an impressive degree of acceptance of herbal medicinal products (HMPs), and this reality renders rigorous research into their safety and efficacy – an ethical, legal and scientific imperative. People are often misled into believing that anything natural must also be safe. Clearly this is an illusion that is naïve at best and dangerous at worse. Further, this too is an illusion that herbal medicine that have been used for millennia must be efficacious. This does not, however, amount to saying that traditional use of herbal drugs and experience is of no value at all. Therefore, there is a need to investigate the information on the therapeutic effects of herbs with more clinical, scientific and evidence – based approach in an effort to validate them and prove their medical efficacy and safety. It is in this context a large number of traditional drugs have been investigated in recent years for their pharmacological activity and bioactive constituents in an effort to discover new therapeutic agents of natural origin.

Unani system of medicine, although originated in Greece, is one of the recognized systems of medicine of the country. Although, the Unani medicine have been in use for centuries and are known for their therapeutic efficacies, there is a need to scientifically establish their efficacy and safety in order to achieve global acceptance. Organized research work in this system was, therefore, a need of the hour. In post independent era, Central Council for Research in Unani Medicine, through its clinical, drug research, literary research, survey & cultivation of medicinal plants programme is contributing significantly for last three decades. *Vitiligo, Sinusitis, Filariasis, Eczema, Malaria, Infective Hepatitis, Asthma,* are some of the conditions where Unani therapies have earned recognition after scientific validation.

The Council has been publishing the peer reviewed *Hippocratic Journal of Unani Medicine* (HJUM), mainly to bring out fundamental and applied aspects of Unani Medicine. The journal also publishes recent advances in other related sciences and traditional medicines as well as different streams of medical sciences, which have bearing on validation and scientific interpretation of various concepts and strengths of Unani medicine.

In view of an overwhelming response, the journal earlier published twice a year, its periodicity has now been changed to quarterly w.e.f. January 2008 to accommodate more articles for quick dissemination of research data among scientific community. The journal has sufficient room for invited articles from luminaries of modern medicine and sciences as well as scholars of Unani medicine. The broad areas being covered include clinical research on single and compound Unani drugs, validation of regimental therapy, Clinical and experimental pharmacological studies, standardization of single and compound drugs, development of standard operating procedures, ethnobotanical studies, experimental studies on medicinal plants and development of agro-techniques thereof, and literary research on classics of Unani medicine. The journal is also open for studies on safety evaluation of Unani and other herbo-mineral drugs, nutraceuticals, cosmotherapeutics, aromatics, oral health, life style disorders, sports medicine etc. and such other newer areas which are the outcome of modern day living.

The current issue of this journal provides 12 original and review papers in the areas of *clinical research, drug standardization, pharmacology, ethnobotanical surveys* and allied disciplines contributed by eminent scholars in their respective fields. It is hoped that data presented will contribute significantly in R&D sector of traditional drugs and prove to be an excellent exposition of current research efforts of scientists in this direction. Council acknowledges the authors for their contributions included in this issue and hope for their continued support in this endeavor. We wish to ensure the readers to bring out the future issues of the journal on time.

We at the CCRUM have been constantly striving to reach to higher standards and make HJUM the leading journal of Unani Medicine and related sciences. In this context, we thank our learned reviewers for their invaluable inputs in improving the manuscripts. We sincerely hope and trust that the mission can be accomplished with active partnership of quality-conscious individuals and institutions. Through these lines we seek your cooperation and support in materializing our dreams about the HJUM. In this regard, we request you for your as well as your colleagues' contributions for publication in and subscription to the journal. Further, we will appreciate if the journal is introduced far and wide. We would also welcome esteemed suggestions for achieving the highest standards of quality for the journal.

(Prof. S. Shakir Jamil)
Editor-in-Chief

A Study of Relation Between Meals and Body Temperature in Patients of *Diqqe Rewi* (Pulmonary Tuberculosis)

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Abstract

Tuberculosis is a specific infectious disease caused by *Mycobacterium tuberculosis.* Despite the modern facilities, the sufferers are investing month-long duration in shopping for diagnosis. The best control measures are early detection and prompt treatment. Keeping in view the above considerations, the study was conducted. It was non-randomized control study in which diagnosed patients of pulmonary tuberculosis were taken from D.O.T.S. centre, N.I.U.M. Hospital, Bangalore and 50 healthy volunteers were taken for comparison. Temperature of both the groups was recorded before and after 1, 2 and 3 hours after meals for 1 week. It was found that at night inter group mean differences before and after 1, 2 and 3 hours of meals were found to be 0.642 °F, 1.114°F, 1.354 °F and 1.512 °F respectively. Elevation of temperature for more than three hours after meal coincides with the statement of Unani physician. It may be used as a diagnostic tool to detect the pulmonary tuberculosis.

Key Words: Tuberculosis, Diagnosis, Body Temperature, Unani Medicine.

Introduction

Diq is one of the oldest diseases known to human beings (Armstrong,1999). It is a chronic specific infectious disease caused by bacillus known as *Mycobacterium tuberculosis* (Park, 2007). The bacilli predominantly attacks lungs and cause pulmonary tuberculosis, which constitutes about 70% of active tuberculosis cases. The remaining 30% of active tuberculosis is extra pulmonary, which can affect lymph nodes, tissue surrounding the lungs and heart, meninges, kidneys, fallopian tubes, bones and joints, ears, throat and skin. Although tuberculosis can infect other organs in the body, the lungs are the organs, frequently attacked by the bacteria, which is characterized by a chronic cough, significant weight loss, loss of appetite, evening rise temperature, night sweat, chest pain and shortness of breath (Andreoli, 2004; Shah, 2003; Hunter, 2004).

When *Hararat Ghariba* dries the *Rutoobat Gharizia*, it results into *Diq.* In patients of *Diq* temperature is low grade and intermittent. On taking meal, fever rises till the completion of *Hazm Salis* (third digestion) or *Hazm Rabe'* (fourth digestion) (Ibn Zohar, 1986; Tabri, 2002; Majoosi, 1889). Pulse of tuberculosis patients is *zaeef* (weak) and *sulb* (hard) (Tabri, 2002) and *zanbulfar* (like tail of rat) i.e. irregularly irregular (Ibn Sina, 2007). Temperature is the gradient of

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pulse rate, on increasing 1º Fahrenheit there is increase in 10 beats per minute (18 beats per degree Celsius)(Guyton, *et al.,* 2006).

Because of limitations in case finding with existing screening tools, there is need to evaluate a new method. Moreover, present screening tools, especially sputum examination for acid fast bacilli may yield false positive or false negative results, whatever may be the reason. The case detection is not as simple as it should be for successful screening. Diagnosis has always been on rational and pathology based. Unani system of medicine is excellent in this field, every Unani physician has emphasized for correct diagnosis before starting the treatment and their diagnosis is evidence based as well as explained on pathological background. In case of *Diq* they have mentioned that when *Rutoobaate Badan* (body fluids) especially that of *Aazae Aslia* become depleted, every type of diet results in elevation of temperature during third/fourth stage of digestion and this temperature elevation is described as definite sign of *Diq* (Ibn Sina,2007; Jurjani,1996). So for screening purpose this parameter can be used even by a layman in suspected cases after its validation.

Materials and Methods

The present study entitled as “A study of relation in between meals and body temperature in patients of *Diqqe Rewi* (pulmonary tuberculosis)” was conducted to evaluate the relation between meal and elevation of body temperature and to find a safe and economic diagnostic tool for provisional diagnosis of *Diqqe Rewi.* It was non-randomized case control study. The patients were enrolled from D.O.T.S. centre, National Institute of Unani Medicine, Bangalore. Before starting the study, an ethical clearance was obtained from Institutional Ethical Committee. After that, this physiological study was started by enrolling eligible patients in test and healthy volunteers in control groups and temperature of both the groups was recorded before and after 1, 2 and 3 hours after meals for 1 week. The study was a non-randomized control trail with sample size of 50 patients in test and 50 healthy volunteers in control groups. The duration of study was 1 year.

Criteria for Selection of Cases

Inclusion Criteria

- Diagnosed cases of pulmonary tuberculosis of all the three stages of either sex of age group 15-60 years on anti-tubercular treatment not for more than 1 month.

Exclusion Criteria

- Patients with malignant disease in lungs
- Patients with extra pulmonary tuberculosis
- Patients of pulmonary tuberculosis taking anti-tubercular treatment for more than 1 month

Selection of Subjects

Already diagnosed patients were selected from the directly observed treatment, short course chemotherapy (D.O.T.S.) Centre, I.P.D. of National Institute of Unani Medicine (NIUM), Bangalore. The diagnosed patients, if fulfilled all the terms of inclusion criteria, were selected for the study. Similarly healthy volunteers from NIUM Campus were selected as control group.

Investigation

The patients included in this study were already diagnosed by sputum for acid fast bacilli (AFB) examination supplemented with X-ray of chest wherever necessary.

Informed Consent

Patients and healthy volunteers, who fulfilled the inclusion criteria were given the information sheet mentioning details regarding the study, they were given the opportunity to ask any question. If they agreed then they were asked to sign on consent form.

Method of Temperature Recording

The sterilized digital thermometer was used to record the oral temperature of the patients. For good results, the patients were asked to keep the mouth closed for 5 minutes before recording. It was kept in mouth under tongue till the beep sound was heard.

Method of Sterilization of Thermometer

It was sterilized keeping it in solution of 5 ml savlon and 10 ml water for 12 hours. For every patient and healthy volunteers separate thermometer was used. Every time before and after application, it was washed in running water and then wiped with sterilized cotton.

Schedule of Temperature Recording of Test Case Group

Patients were given meal at different times and temperature was recorded before meal and after 1, 2 and 3 hours of meal. They were not allowed hot drinks/meals during the study period.

Schedule of Temperature Recording of Control Group

By the same method, temperature of control group was recorded.

Statistical Analysis

The difference in temperature of the patients and healthy volunteers before and after 1, 2 and 3 hours of meal was subjected to statistical analysis to observe the significance of observed difference. Unani physicians claimed the difference as pathognomically diagnostic. The difference in mean of the body temperature of Test Group and Control was analyzed by paired 't' test, using instant graph pad at 5% level of significance ($p<0.05$).

Results and Discussion

According to thermodynamics, human beings are open system isothermal machine that works in non-equilibrium in which both matter and energy are exchanged (Roy, 1999). Human calorimetry is unique because of its endothermic nature (Ganong, 1986). *Tabiyat* is the supreme controller of all the body functions (Kabeeruddin, 2007). *Quwat Mudabbirae Badan* has been bestowed by such power that up to certain limitations, can control and coordinate the body functions. When these limitations are crossed, *Tabiyat* is unable to control the functions, the *Mizaj* of person becomes *Sue*. Due to *Mizaji* obligations, deviations in *Mizaj* (*Sue Mizaj*) results in functional abnormalities and consequently structural deformities result (Zaidi *et al*.,1999). In *Diqqe Rewi,* fluids are dried up due to *Asbab Sabiqa* and *Badia*. This results into functional and structural deformities. Due to persistence of *Sue Mizaj Har* in the organs, the food reaching there shows the *Mizaji* resemblance and organ gains *Hararat Ghariba* from this food. Hence, body temperature elevates and remains elevated up to three hours (Ibn Rushd, 1987).

Right diagnosis is the most effective and valuable asset of journey while travelling in the entangled valley of treatment. For tuberculosis, early detection is the most effective mode of intervention.

The present study was conducted to evaluate the relationship between meals and body temperature and to find out a safe, simple, cheap and cost effective

method of diagnosis for pulmonary tuberculosis cases. It was non-randomized control study in which 50 diagnosed patients and 50 healthy volunteers were selected and temperature of the both groups was recorded before and after 1, 2 and 3 hr of meals for seven days in morning, afternoon and at night. The data of inter group were statistically analyzed by paired 't' test.

It was found that in healthy controls rise in temperature was not found more than 0.10 °F after three hours of meals but in Test Group, it was found to be 0.6 °F to 1.0 °F. Mean temperature of Test patients and healthy volunteers before and 1, 2 and 3 hr after meal were significantly different with p-value <0.0001 except in the morning, before meal, the mean difference was with p-value >0.05 which is not considered significant. This significant difference may be due to persistence of *Sue Mizaj Har* in the organs, the food reaching there shows the *Mizaji* resemblance and organ gains *Hararat Ghariba* from this food. Hence body temperature elevates and remains elevated up to three hours. It was found that mean temperature increases in correspondence to pulse rate.

Table 1 : Mean Differences between Test Group and Control Group in Morning

(n = 100)

Mean Difference between	Test Group (n = 50)	P value	Control (n = 50)	P Value
TBM (temperature before meal) and 1 Hr AM (after meal) in °F	0.680	P<0.001	0.156	P<0.001
TBM (temperature before meal) and 2 Hr AM (after meal) in °F	0.952	P<0.001	0.1840	P<0.001
TBM (temperature before meal) and 3 Hr AM (after meal) in °F	0.848	P<0.001	0.052	p>0.05

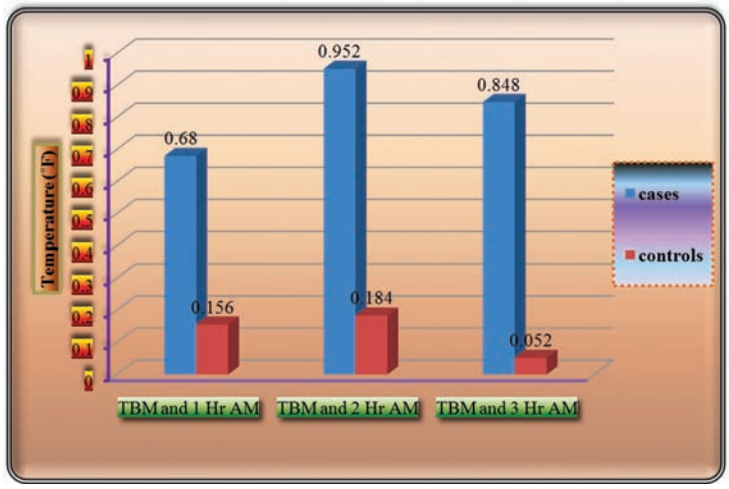

Fig. 1 : Mean Differences between Test Group and Control Group in Morning

Table 2 : Mean Differences between Test Group and Control Group in Afternoon

(n = 100)

Mean Difference between	Test Group (n = 50)	P value	Control (n = 50)	P Value
TBM (temperature before meal) and 1 Hr AM (after meal) in °F	0.612	P<0.001	0.21	P<0.001
TBM (temperature before meal) and 2 Hr AM (after meal) in °F	0.956	P<0.001	0.144	P<0.01
TBM (temperature before meal) and 3 Hr AM (after meal) in °F	0.784	P<0.001	0.086	p>0.05

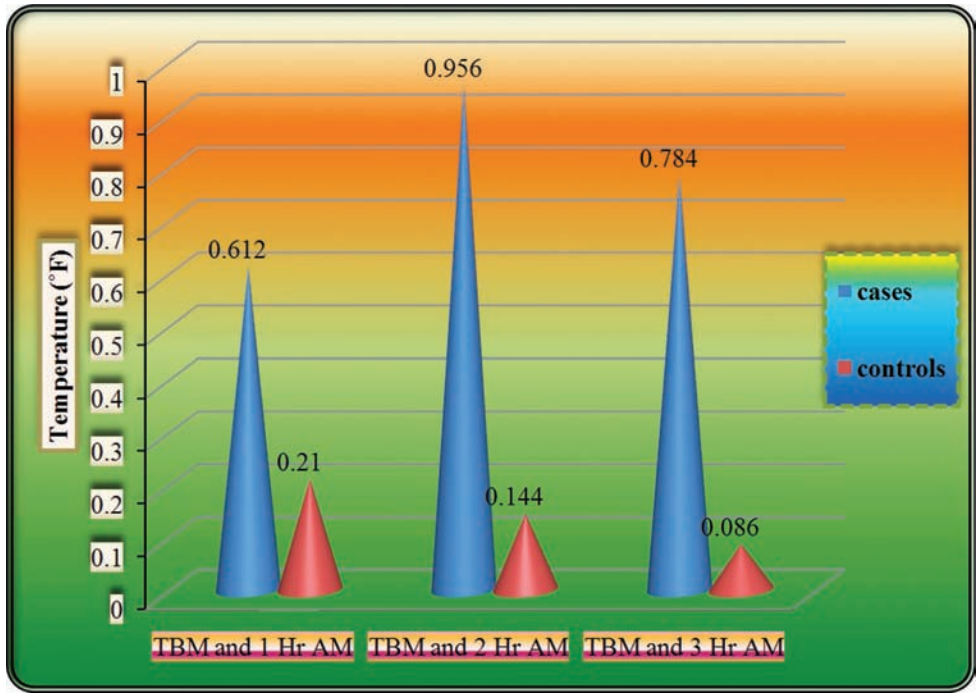

Fig. 2 : Mean Differences between Test Group and Control Group in Afternoon

Table 3 : Mean Differences between Test Group and Control Group at Night

(n = 100)

Mean Difference Between	Test Group (n = 50)	P value	Control (n = 50)	P Value
TBM(temperature before meal) and 1 Hr AM (after meal) in °F	0.684	P<0.001	0.2140	P<0.001
TBM(temperature before meal) and 2 Hr AM (after meal) in °F	0.96	P<0.001	0.2480	P<0.001
TBM (temperature before meal) and 3 Hr AM (after meal) in °F	0.856	P<0.001	0.0140	p>0.05

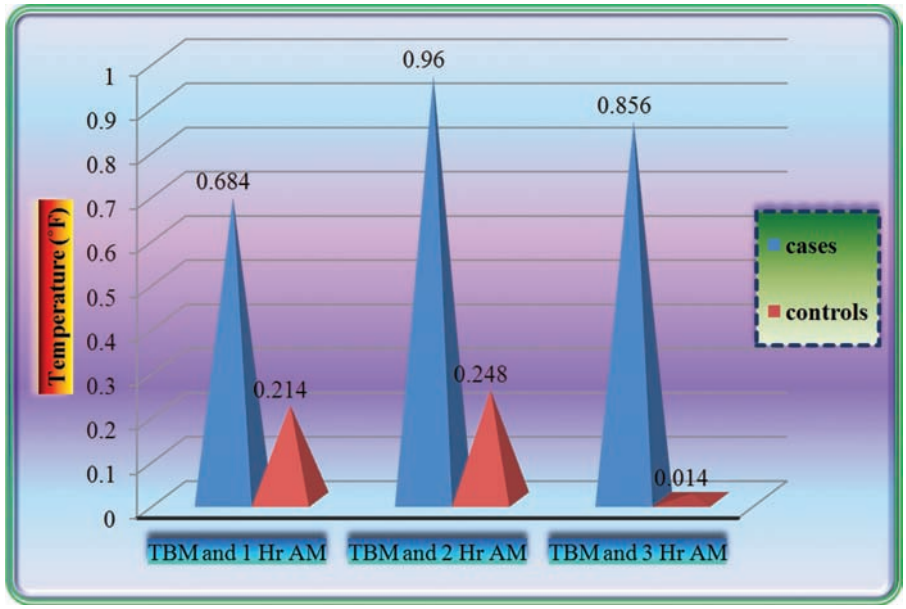

Fig. 3 : Mean Differences between Test Group and Control Group at Night

Table 4 : Mean Temperature of Test Group and Control Group in Morning

(n = 100)

Mean Temperature in °F	Test Group (n = 50)	Control (n = 50)	Mean difference	p-value
BM (Before meal)	98.33	98.004	0.3260	>0.05
1Hr AM (after meal)	99.010	98.16	0.850	<0.0001
2Hr AM (after meal)	99.282	98.188	1.094	<0.0001
3Hr AM (after meal)	99.178	98.056	1.122	<0.0001

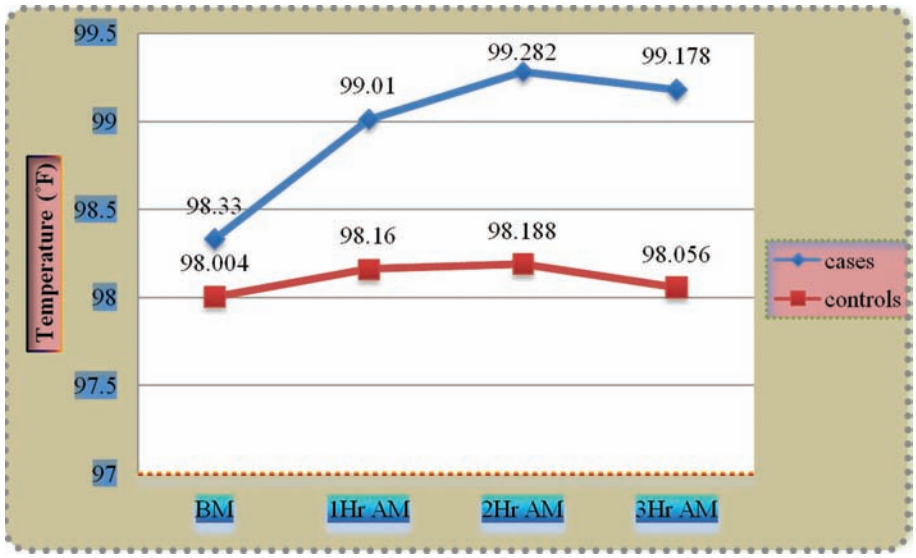

Fig. 4 : Mean Temperature of Test Group and Control Group in Morning

Table 5 : Mean Temperature of Test Group and Control Goup in Afternoon

(n = 100)

Mean Temperature in °F	Test Group (n = 50)	Control (n = 50)	Mean difference	p-value
BM (Before meal)	98.698	98.254	0.6940	<0.0001
1Hr AM (after meal)	99.310	98.464	0.8460	<0.0001
2Hr AM (after meal)	99.654	98.398	1.256	<0.0001
3Hr AM (after meal)	99.482	98.168	1.314	<0.0001

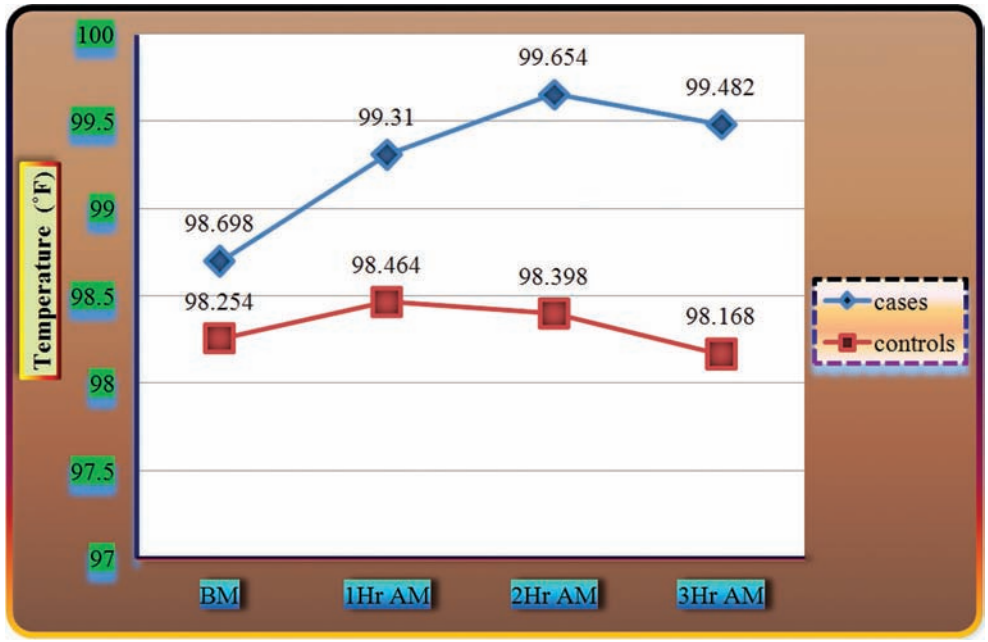

Fig. 5 : Mean Temperature of Test Group and Control Goup in Afternoon

Table 6 : Mean Temperature of Test Group and Control Group at Night

(n = 100)

Mean Temperature in °F	Test Group (n = 50)	Control (n = 50)	Mean difference	p-value
BM (Before meal)	98.918	98.276	0.6420	<0.0001
1Hr AM (after meal)	99.602	98.49	1.114	<0.0001
2Hr AM (after meal)	99.878	98.524	1.354	<0.0001
3Hr AM (after meal)	99.774	98.262	1.512	<0.0001

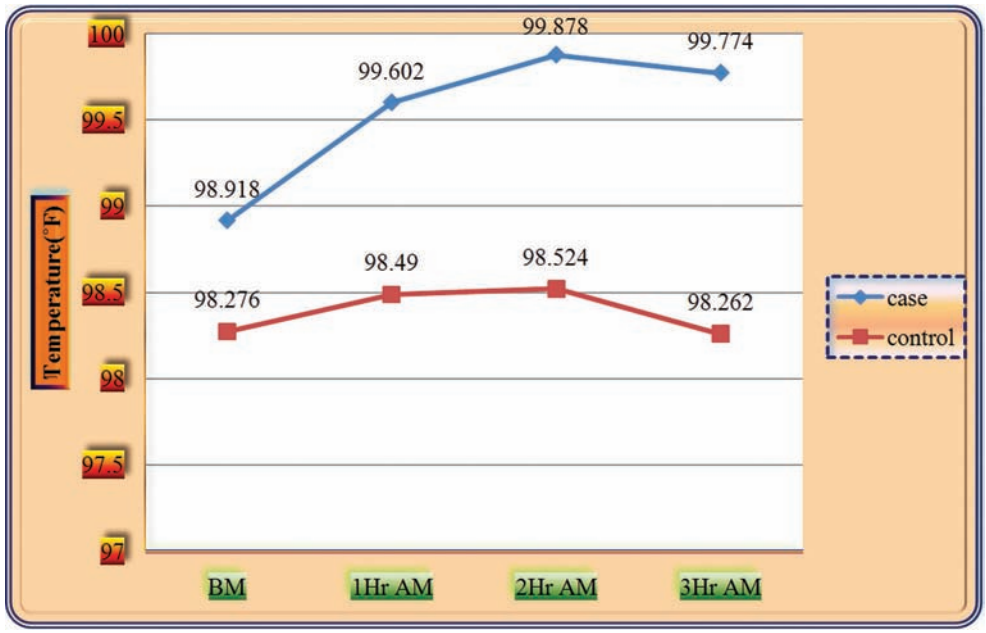

Fig. 6 : Mean Temperature of Test Group and Control Group at Night

Table 7 : Mean Temperature and Mean Pulse Rate of Test Group and Control Group in Afternoon (n = 100)

	Mean Temperature of Test Groupin °F (n = 50)	Mean Pulse Rate per minute of Test Group	Mean Temperature Control in °F (n = 50)	Mean Pulse Rate per minute of Control
BM (Before meal)	98.698	79.26	98.254	71.84
1Hr AM (after meal)	99.310	86.6	98.464	74.22
2Hr AM (after meal)	99.654	91	98.398	73.02
3Hr AM (after meal)	99.482	87.94	98.168	68.56

Conclusion

In the light of above results and observations, it may concluded that rise in temperature from 0.60 °F to 1.0 °F with symptoms may be suggestive of pulmonary tuberculosis. Elevation of body temperature after meals should be considered as a diagnostic tool for provisional diagnosis of the disease. It will help to detect the cases in the field as well as to diagnose the individual in the clinic to know both the hidden and apparent part of the iceberg of disease. Its importance is like to stamp out the spark rather than calling the fire brigade to put out the fire caused by it.

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Determination of Temperament of Mufrad (Single) Unani Drugs with the Help of an Inventory Exemplifying Their Organoleptic and Physical Attributes

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Abstract

The physical nature to the concept of *Mizaj-e-Advia* (temperament of drugs) warrants its critical evaluation, which is possible only when the physical correlate of *Mizaj* is made comprehensive and empirical. This work is a preliminary attempt towards this goal. In the context of the importance of organoleptic characters and physical properties of drugs for *Mizaj* assessment, Ibn Rushd in *Kitab-ul Kulliyat* emphasizes on the need for further evaluation of the physical correlates of *Mizaj*. From the basic rules of stating the nature of drugs as hot, cold, moist or dry from its organoleptic characters and physical properties as stated in the classical texts, an inventory was developed consisting of a battery of tests *Mufrad* drugs were subjected to. The score obtained through inventory is correlated to the classical description of *Mizaj* and *Darjae Mizaj* for its reliability. From the definition of the *Darjate Mizaj* and its correlation with acute toxicity (LD_{50}) appears a suitable criterion for its validity for classical *Mizaj* description as well as inventory scores. The inventory showed fair accuracy when applied to a group of drugs. In view of these attributes of reliability and validity, this instrument may be useful to determine the temperament of single drugs.

Key Words: Mizaj-e-Advia, Mufrad drugs, Darjae Mizaj, LD_{50}, Inventory, Organoleptic characters

Introduction

The practical implementation of Unani medicine mainly depends upon identification of drugs, knowledge of their general and specific actions, knowledge of dosage of drugs and information of their quality standards. Unani medicine has its own method of evaluating and predicting the action of drugs which have been procured fron plant mineral and animal sources. A priori drug is subjected to *Mizaj* assessment by the method of analogy. Once the temperament is established the drug is further studied to ascertain the effect predicted in it on account of having specific temperament. Pre assessment of *Mizaj* by analogy is carried out on the basis of organoleptic characters of drug and by its physicochemical properties. However, the assessment of these characters have greater component of subjectivity. This makes it difficult to decide about the actual *Mizaj* of such drugs. The experiment can give us an authentic account of the potency of a drug on observing certain specific rules. The difficulty inherent in obtaining consistency and adequate objectivity

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in the process of determination of *Mizaj* of drugs is obvious and understood. The low inter agreement of physicians on *Mizaj* of certain drugs and their arguments, result in assigning different *Mizaj* to drugs by different people. All this called for the development of objective, measurable, and verifiable criteria of determination of *Mizaj* of drugs. There exists high correlation between *Darjae Mizaj* of drugs and their LD_{50} (Mudasir and Sofi, 2013) which had been indicated by the very definition of the *Darjae Mizaj* in Unani literature (Ibn Rushd, 1987), so LD_{50} as an external criterion was employed for validation of this inventory.

Therefore the present work is directed towards development of a more objective *Mizaj* inventory, so that we may be able to deal with *Mizaj* assessment of those drugs whose *Mizaj* is controversial and also to determine *Mizaj* of new drug by testing them on the *Mizaj* inventory. In addition, this inventory may be applied to any substance intended for human use for its *Mizaj* determination. This study will also help to understand the role of organoleptic characteristics of drugs in respect of their *Mizaj* assessment.

Material and Methods

Selection of drugs

Sixty-one *Mufrad* (single) drugs selected from different categories of *Mizaj* were included in the study. Feasibility of procuring the drug samples from authenticated nurseries and herbal gardens was kept in mind. For this purpose, we collected drug samples from herbal garden and the pharmacy of National Institute of Unani Medicine, Bangalore. Whole plants were collected and dried in shade before investigating the actual plant parts used as drugs.

Documentation of Mizaj and LD_{50} of drugs

Mizaj of the drugs was sorted out from various classical Unani books (Al-Magrabi, 2007; Ghani, YNM; Ibn Baitar, YNM; Hakim, 2001). The difference of opinion about *Mizaj* of certain drugs was resolved by adhering to the most favoured statements in the books. The LD_{50} value of the selected drugs was documented from available journals (Mudasir and Sofi, 2013) and FDA approved books (Ross, 2003; Duke, 2003). The LD_{50} values of extracts were extrapolated to get appropriate values of LD_{50} in animals. The LD_{50} of crude drug was calculated from the yield percentage of extract of crude drug. The value of crude drug thus calculated was used to determine the LD_{50} of human being by the formulae devised by Ghosh (2008).

Selection of domain for construction of inventory

Classical Unani authors have described various properties of drugs to assess their *Mizaj*. These properties include the organoleptic characters like taste, smell and colour and other physical properties like flammability, dissolution, fluidity, thickness, stickiness etc. The share of each attribute in terms of its contributory importance deciding the temperament was fixed after evaluating the description contained in classical books. The items or the questions were accordingly framed under two domains-Organoleptic characters and physico chemical properties as emphasized in Unani literature.

Scaling and scoring of the selected items

Scale for assessing the organoleptic characters was developed from the rules specified in the classical literature (Al-Magrabi, 2007; Ibn Rushd, 1987; Ibn Sina, YNM; Baghdadi, 2005). Taste, smell and colour were assigned scores in the ratio of 6:2:1 in accordance of the relative emphasis laid down in classical literature. The scoring of the rated items was carried out by summation of the individual rate score separately for organoleptic domain and the physical property domain. Total score for the inventory was then calculated from weighted mean of the scores of two domains.

Administration of the inventory

The inventory was administered to the drugs by taking into account the total score obtained by a drug. *Darjae Mizaj* (degree of temperament) was calculated by dividing the maximum possible range of total score into four equal intervals (Singh, 1986) starting from *Darjae* I to *Darjae* IV. The comparison of *Mizaj* attained by the drug based on its total score was made with its *Mizaj* mentioned in the classical literature.

Assessment of Classical determinants of Mizaj

Organoleptic characters

Colour

The drugs were assigned to different types of colours after comparing them with the help of a colour strip that indicated the seven chosen colours on it. Scoring pattern of the colours is shown in the appendix.

Smell

The drugs were crushed and smelled independently by two persons. A standard drug for each smell category was chosen from the examples given in classical books. The drugs under study were assigned different smell categories with agreement of the two persons tested the smell. The scoring was done in accordance of the Unani description about the role of colours in deciding the temperament.

Taste

Nine discrete tastes have been well described in relation to type and degree of *Mizaj*, in the Unani literature. We chose a standard reference drug to represent each taste category, amongst the examples given in literature. All drugs were tasted by two persons independently and by their agreement were ascribed different tastes by comparing them with the reference examples. The weightage and scoring of each taste was given in accordance with the Unani description.

Physical properties

Injemad (condensation)

This property applies to liquid and semisolid forms of drugs and some of the mineral origin drugs such as salts etc. Drugs were subject to heat, cold and air treatment alternately and the process of condensation was observed. Assessment of condensation was carried out by noting down the mobility (flow) of the drugs on a glass slide and firmness of texture felt by touching the drug. We subjected each drug to four types of treatments and noted the thickening effect induced by them- heat alone, cold followed by air, heat followed by cold and cold alone. The rating was assigned in corroboration with the rules guiding condensation of the drugs (Ibn Rushd, 1987).

Ratoobat (moisture)

We divided the drugs into five categories based on the rough estimation of amount of moisture. The moisture of the drugs was most often felt by naked eye and by touch, however in case of doubt the drug was crushed and checked for any release of moisture. The drugs were categorized as having high moisture content, low moisture content, little moisture content, dry and very dry.

Tahallul (dissolution)

For the assessment of *Tahallul*, we put each drug in water-filled Petri dishes and kept it overnight. It was heated in the morning for fifteen minutes then the dissolution and softening of the drug and release of colour into the water was observed.

Lozoojat (stickiness)

Based on stickiness we classified the drugs into sticky, mild sticky and non-sticky ones, by assessing the resistance allowing the index finger and thumb apart after taking a pinch full of the drug.

Sakhafat (brittleness)

The assessment of brittleness or breakability was done by noting the ability of the drug to be broken into pieces by applying ceratin degree of mechanical pressure.

Latafat (softness)

Texture of the drugs was assessed through their softness on touch and ease of compressibility.

Ihteraq (flammability)

The property of *Ihteraq* was assessed by keeping the drug near the flame of a spirit lamp for few seconds and the ease and duration of catching fire was noted.

Takhalkhul (Sponginess)

The sponginess is the property drug marked by the ability of a substance to shrink and expand under pressure or when submerged in to water. The sponginess is attributed to the presence of air spaces within a substance and this was assessed by noting the absorption of water and swelling of a drug when dipped in water. Elasticity, compressibility and light weightiness was also considered to assess the sponginess.

Wazan (weight)

Categorization of drugs into heavy, moderate and light was carried, based on their behavior in water. This was assessed by putting the drug in water; floating

drug was considered of light weight while the drug which settled down to the bottom, was considered as heavy. Drug, which remained suspended, or sub immersed in the water was given zero score. A score of +0.25 and -0.25 was given to light and heavy drugs, respectively.

The scoring pattern of all the above properties is shown in the *Mizaj* Inventory given in appendix.

Reliability and validity of the inventory

The reliability of the inventory was established by comparing the *Mizaj* scores interpretations by the inventory with the *Darjae Mizaj* described in Unani literature by more than three classical books were referred for the purpose. Correlation coefficient greater than 0.6 between the two scores was considered as sufficient agreement of the two methods for *Mizaj* assessment (Cureton, 1965). Internal reliability was calculated by correlation coefficient between the two domains, namely total score for organoleptic domain and total score for physical property domain. Correlation of LD_{50} and *Darjae Mizaj* formed the basis for external criterion validity of the inventory (Rosenthal and Rosnow, 1991). Validity coefficient of more than 0.7 is considered sufficient for the validation of the inventory (Cureton, 1965).

Statistical analysis

The statistical procedures were carried out by using SPSS (Version 17) and Graph pad In Stat. Percentile LD_{50} of each drug was computed and assigned the *Daraje Mizaj* from the classical text. Correlation matrix of individual hot and cold drugs was found using Spearman's rank correlation coefficient separately. Correlation for reliability and validity was also estimated by using different methods of correlation. Significance of the correlation was also mentioned by the same statistical software package (Siegel, 1956).

Results

The total inventory score was formed as combined score for the domain I and domain II. For the development of the inventory the weighted mean for maximum score was calculated by adding the maximum scores for each item from domain I and domain II and dividing it with the number of total items (12). As the maximum combined score for all items was found as 7.25, so the maximum weighted mean came to be 0.6041. Similarly weighted mean for minimum score was calculated which came to be equal to zero. The maximum range of the weighted mean was found as 0.6041. The maximum range of total

score was converted into equal interval scale (Singh, 1986) and divided into four intervals to correspond with four degrees of *Mizaj*. The four equal intervals corresponding to different *Darjae Mizaj* are as 0 to 0.15 (1st degree*)*; 0.16 to 0.31 (2nd degree*);* 0.32 to 0.47 (3rd degree*)* and score greater than 0.47 corresponds to 4th degree of *Mizaj.* Weighted mean was calculated from the total score obtained by each drug under the two domains and assigned *Darjae Mizaj* by noting the range score in which it lie. This way *the Mizaj* of each drug was obtained from the inventory.

The correlation coefficient between the *Mizaj* based on our inventory and the classical sources calculated to be 0.6323 (excluding four mineral drugs); it was 0.4336 when mineral drugs were included. Reliability coefficient between two domains, TSOC (total score for organoleptic characters) and TSPP (total score for physical characters) was 0.49; between SPP-B (score for group B physical properties) and TSOC it was 0.5084. The maximum index of correlation (Singh, 1986) calculated from the correlation coefficient between MC and MI, was found as 0.79. Results are shown in table 1.

The validity coefficient between classical *Darjae Mizaj* (MC) and LD_{50} was 0.7186. The correlation between *Darjae Mizaj* by inventory (MI) and LD_{50} was -0.4340, which was found to be significant. Results are summarised in table 2.

Table 1 : Values of LD_{50}, MC, MI and score for organoleptic characters and physical properties of drugs

Sl. No.	Name of drug	Mizaj type	MC	LD_{50} (gm)	TSOC	SPP-A	SPP-B	M I
1	*Linum usitatissimum*	Hot	1	166.20	1	-0.25	-0.25	1
2	*Azadirachta indica*	Hot	1	100.85	2.375	+0.25	1	2
3	*Glycirrhiza glabra*	Hot	1	124.12	2.25	0	1	2
4	*Valeriana jatamansi*	Hot	1	77.58	2.25	0	1	2
5	Cocos nucifera	Hot	2	55.41	1	+0.25	-1	1
6	*Ruta graveolense*	Hot	2	55.41	3	+0.25	1	2
7	*Vitex negundu*	Hot	2	34.91	3.25	-0.5	0.5	2
8	*Aloe vera*	Hot	2	55.41	3.75	0.25	-0.5	2

Sl. No.	Name of drug	Mizaj type	MC	LD_{50} (gm)	TSOC	SPP-A	SPP-B	M I
9	*Cassia fistula*	Hot	1	51.20	1.5	0	-0.5	1
10	*Psidium guajava*	Hot	1	44.33	-0.25	0	-1	1
11	*Artimesia absinthium*	Hot	2	38.70	2.875	+0.25	0.5	2
12	*Tinospora cordifolia*	Hot	1	33.24	2.125	-0.25	0.5	1
13	*Writia wrightia*	Hot	2	33.24	1	0	1	1
14	*Piper longum*	Hot	2	55.40	2.5	0	1.25	2
15	*Pimpinella anisum*	Hot	2	29.92	2.625	0	1.25	2
16	*Jatropha curcus*	Hot	2	27.50	1.75	-0.5	0	1
17	*Psoralea corylifolia*	Hot	2	22.01	3	-0.25	1	2
18	*Mangifera indica*	Hot	1	22.24	1.5	+0.25	-0.75	1
19	*Bacopa monnieri*	Hot	2	22.00	1.875	+0.25	+0.5	2
20	*Sesamum indicum*	Hot	1	22.00	1.125	-0.25	0	1
21	*Myristica fragrance*	Hot	2	20.00	2.5	0	+1	2
22	*Crocus sativus*	Hot	2	20.00	2.75	+0.75	1.25	3
23	*Mirabilis jalapa*	Hot	3	15.51	1.75	+0.25	+0.5	2
24	*Sassurea lappa*	Hot	3	15.51	3	-0.25	+1.25	3
25	Cinnamom zeylanicum	Hot	3	15.51	2.75	+0.25	+1.25	3
26	*Anacyclus pyrethrum*	Hot	3	15.51	3.75	0	+1.25	3
27	*Morus alba*	Hot	1	15.51	1	+0.25	-1.5	1
28	*Ficus carica*	Hot	1	15.51	1.75	0	-1	1
29	*Nigella sativa*	Hot	2	13.11	3.25	-0.5	0	2

Sl. No.	Name of drug	Mizaj type	MC	LD_{50} (gm)	TSOC	SPP-A	SPP-B	M I
30	*Catharanthus roseous*	Hot	2	11.12	1.5	+0.25	+0.25	2
31	*Matricaria chamomile*	Hot	2	11.08	2.5	+0.25	+0.25	2
32	*Curcuma longa*	Hot	3	11.08	2.5	+0.5	+0.75	2
33	*Mentha piperita*	Hot	2	9.000	2.875	+0.25	1	3
34	*Abrus precatorius*	Hot	3	7.75	2.5	-0.5	+0.75	2
35	*Zingiber officinale*	Hot	2	7.75	4	+0.5	-0.5	3
36	*Allium sativam*	Hot	3	11.82	4.125	+0.75	0	3
37	*Withania somnifera*	Hot	3	9.77	2.5	-0.25	+0.75	2
38	*Calotropis procera*	Hot	4	4.14	2.75	0.25	-0.75	2
39	*Clitora ternatia*	Hot	4	10.08	2.5	+0.25	0.5	2
40	Copper sulphate	Hot	4	3.33	-0.875	+0.50	0	1
41	Ferrus sulphate	Hot	4	2.61	-0.125	0	0	1
42	*Nux vomica*	hot	4	1.93	3.25	-0.75	+.75	2
43	*Rauwolfia serpentina*	cold	3	1.08	4	-0.25	0	2
44	Arsenics oxide	Hot	4	0.31	-0.5	+0.25	0	1
45	Musa sapientum	Hot	1	38.79	1.25	+0.25	-1.25	1
46	*Punica granatum*	Cold	1	55.41	-0.25	+0.25	-1	1
47	*Tamarindus indica*	cold	1	55.41	-1.5	0	-1.5	2
48	*Asparagus racemosus*	Cold	1	35.46	0.875	0	-0.25	1

Sl. No.	Name of drug	Mizaj type	MC	LD_{50} (gm)	TSOC	SPP-A	SPP-B	M I
49	*Terminalia bellerica*	Cold	2	32.97	-0.75	+0.25	-0.5	1
50	*Citrus limon*	Cold	2	22.27	-3	+0.25	-0.75	2
51	*Solanum nigrum*	Cold	2	22.16	0.25	+0.25	0	1
52	*Ananas cosmos*	Cold	2	22.16	-0.5	+0.25	-1.5	1
53	*Viola odorata*	Cold	1	22.16	1.375	+0.25	0.5	1
54	*Emblica officinalis*	Cold	1	22.16	-2	-0.25	-1	2
55	*Bixa orellena*	Cold	1	22.16	0.25	+0.25	0	1
56	*Saraca indica*	Cold	1	15.51	-0.5	0	0	1
57	*Lawsonia inermis*	Cold	1	15.51	2.175	+0.25	1	2
58	*Cinnamomum camphora*	Cold	3	10.16	2.5	0	+0.75	3
59	Litharge	Cold	3	6.93	-0.5	-0.75	0	1
60	*Santalam album*	Cold	3	5.54	3.65	+0.5	0	3
61	*Conium maculatum*	Cold	4	2.64	3.25	+0.25	0	3

MC = *Darjae Mizaj* by classical sources; MI = *Darjae Mizaj* by Inventory; TSOC = total score for organoleptic characters; SPP-A = total score for physical properties including condensation, dissolution, brittleness and texture; SPP-B = total score for physical properties including weight, flammability, sponginess, moisture and stickiness. The LD_{50} values shown in table 1 show absolute values of LD_{50} (in grams) of the drugs, corresponding to an adult human being of 70kg body weight (extrapolated from animal values).

Table 2 : Correlation matrix for *Mizaj* Classical (MC), *Mizaj* by Inventory (MI) and LD_{50}

Parameter	MC	MI	LD_{50}
MC	—	0.6323	- 0.7186
MI	0.6323	—	-0.4340
LD_{50}	-0.7186	-0.4340	—

Inventory for Mizaj determination

Parameters	Score
I. Organoleptic character	
A. Colour	
1. White	-0.5
2. Creamy white	-0.25
3. Yellowish white	-0.125
4. Yellow	0
5. Green	+0.125
6. Red	+0.25
7. Dark red	+0.5
B. Smell	
1. Sour(*khatta*) smell	-1
2. Soothing	-0.5
3. No smell	0
4. Dull	+0.25
5. Fragrant /aromatic	+0.5
6. Sharp	+0.75
7. Pungent	+1
C. Taste	
1. Iffs	-3
2. Hamiz	-2
3. Kabiz	-1
4. Tuffa	0
5. Dasmi	+ 0.5
6. Sweet	+1
7. Maleh	+1.5
8. Murr	+2
9. Hareef	+3
II. Physical property	**Score**
A. Condensation	
1. Condensing due to heat	+0.25
2. Condensing due to cold	+0.25
3. Condensing by cold, previously thickened by heat	+0.25
4. Condensed by cold but not thickened by heat	-0.25
5. Condensing by both	0
B. Moisture	
1. High moisture content	-0.50
2. Less moisture content	-0.25
3. Some moisture	0
4. Dry	+0.25
5. Very dry	+0.50

C.	**Dissolution**	
1.	Soluble in cold medium	+0.25
2.	Partially soluble	0
3.	Not soluble in cold medium	-0.25
4.	Stickiness	
5.	Sticky	-0.25
6.	Mild stickiness	0
7.	Non-sticky	+0.25
8.	Brittleness	
9.	Friable	+0.25
10.	Moderate	0
11.	No friability	-0.25
12.	Softness	
13.	Soft	+0.25
14.	Firm	0
15.	Hard	-0.25
16.	Flammability	
17.	Highly flammable	+0.50
18.	Flammable	+0.25
19.	Moderately flammable	0
20.	Less flammable	-0.25
21.	Least flammable	-0.5
22.	Shrinking/expansion	
23.	Muttakasif	-0.25
24.	Moderate	0
25.	Mutakhalkhal	+0.25
26.	Weight	
27.	Light	+0.25
28.	Moderate (submersed)	0
29.	Heavy	-0.25

(-) means *Barid* and (+) means *Ha'ar*

Scoring

Total max score for organoleptic characters = 4.5

Total minimum score for organoleptic characters = 0

Total maximum score for Physical Properties = 2.75

Total maximum score for Physical Properties = 0

Weighted mean for maximum score = $\frac{4.5+ 2.75}{12}$ = 0.6041 (12 = total number of items)

Similarly, calculating weighted mean for minimum score is zero

Therefore Maximum possible range of score = 0.6041

Interpretation

Thus 4 point equal interval scale will be formed by dividing the range by total number of *Darjae Mizaj* (4) = 0.15

Degree of *Mizaj*	Score range
1st degree	0 to 0.15
2nd degree	0.16 to 0.31
3rd degree	0.32 to 0.47
4th degree	> 0.47

For each drug, total score for both the domains need to be converted to weighted mean score and compared as above to describe its *Mizaj* and *Darjae Mizaj*.

Discussion

The organoleptic characters are considered as important indicators of the *Mizaj* of drugs in Unani system of medicine. Amongst the organoleptic characters, the taste is considered the strongest indicator. The scoring of different tastes was done in accordance with statements in classical literature. For example the *Hirreef/pungent* taste is considered hottest than all other tastes, so it was given a score of +3 to indicate severe heat. The Afis / *kaseela* taste is considered coldest of all, so a score of -3 was given. *Tuffa* or tastelessness is considered as an indicator of moderate temperament, therefore a score of zero was given to it. The tastes indicating hotness of a drug in decreasing order are; *Hareef* > *Murr* > *Maleh* > *Hulw* > *Dasim.* The tastes indicating coldness in increasing order is as; *Qabiz* < *Hamiz* < *Afis* (Ibn Rushd, 1987; Baghdadi, 2005; Qureshi, 1995).

Smell is the next important indicator of *Mizaj* while colour is considered as weakest evidence amongst the three organoleptic characters (Baghdadi, 2005; Al-Magrabi, 2007). There are different types of general smell categories described in classical literature. Generally, pungent and sharp smells are considered hot while cooling and soothing smells are considered cold in nature.

Amongst the colours, whiteness indicates cold and as the colour darkens, the coldness decreases. Yellow colour is considered moderate, while green, red and black colours indicate hotness of temperament (Baghdadi, 2005). Therefore keeping in view all these classical statements, the scoring of the three organoleptic characters was given in the ratio of 6:2:1 for taste, colour and smell respectively. The negative and positive signs to the scoring numbers indicate cold and hot temperament, respectively.

As there is no accurate measurement strategy for various properties described under the two domains, and these properties are entirely based and measured on classical methods therefore their measurement was entirely dependent on

the expertise of the individual scholars notwithstanding the descriptions and measurement have an element of subjectivity. However, we tried to reduce the subjectivity in measuring these parameters by adopting the methodology, which included simple physical tests in accordance with the textual meaning as described in Unani literature. The tests employed were used to assess accurately the extant of physical property of individual drug. The scoring for physical properties was almost uniform, with maximum score of ±0.25 and minimum score of zero, except for the property of *Ihteraq* and *Ratoobat*, which had maximum score of ±0.5. The higher score for these two properties was given in view of the greater emphasis laid down for them in classical literature (Al-Magrabi, 2007).

The reliability coefficient between *Mizaj* by inventory and *Mizaj* by classical sources was 0.6323, which is promising but needs further improvement for validating the inventory. The reliability coefficient between the two domains; domain I of organoleptic characters and domain II based on physical properties was found moderate (0.49) which may be improved by devising objective and accurate measurement procedures for the organoleptic and physical properties of drugs. In spite of this significant level of correlation between the two domains, we may still not consider this part of the reliability assessment as conclusive. However, these properties along with the organoleptic characters may show more promising results on further evaluation. This work is although of preliminary nature but may serve as a lead for further studies.

Validity coefficient between LD_{50} and MC was 0.7186, and between MI and $LD_{50,}$ it was 0.4340. Significant correlation exists between the *Mizaj* by classical sources and the *Mizaj* assessed through the inventory. It was observed that the organoleptic characters are better indicators of *Mizaj* of drugs than the physical properties. Moderate correlation exists between the organoleptic scores and scores for physical properties of drugs.

In the light of the above, it may be concluded that this inventory may be used to assess the temperament of single Unani drugs.

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Standardization of Qurs-e-Ghafis: A Polyherbal Unani Formulation

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Abstract

Qurs-e-Ghafis (QG) is a compound formulation (tablet) of Unani medicine, mainly used in hepato-biliary disorders. It contains three drugs of plant origin that are described in Unani literature to possess hepatoprotective effect. In experimental studies QG and its ingredients have shown to possess hepatoprotective effect. Studies for the identity and quality assurance of the ingredients have also been conducted but the compound drug as such has not been standardized on physico- chemical and phytochemical parameters so as to ensure its quality. Therefore, in the present study QG was studied on certain physic-chemical and phytochemical parameters to determine the standards of its quality and purity. The parameters and protocol recommended for testing the AYUSH drugs were followed in this study.

Key Words: *Qurs-e-Ghafis,* Standardization, Phytochemical, Unani drugs, Quality control.

Introduction

Qurs-e-Ghafis (QG) is a pharmacopoeial preparation described to be hepatoprotective and useful in a number of liver diseases (Khan, 1921). It contains extract of *Gul-e-Ghafis (Agrimonia eupatoria),* Dried Rhizome of *Sumul-ut-teeb (Nardostachys jatamansi) and Tabasheer* (a silicasious matter collected from *Bambusa arundinasea)* in the ratio of 5:2.5:1 and prepared in tablet form. In an experimental study QG has been shown possess significant hepatoprotective effect (Anas, 2010). Its ingredients though have been studied on physic chemical parameters but, the compound drug has not been studied so far on the parameters of standardization therefore no physico-chemical standards are available to assess its purity and quality. The data of individual ingredients cannot be extrapolated as a matter of principle, to set the standards of compound formulation. Therefore the standardization of compound drug (the dosage form of tablet) is necessary. In view of the above therefore present study has been designed to fix the various physico-chemical standards to assess the quality the formulation.

The physico-chemical attributes selected for the purpose of standardization included the determination of (i) Weight; (ii) Diameter and Thickness of tablet; (iii) Disintegration Time; (iv) Friability; (v) Successive Extractive Values; (vi) Water and Alcohol Soluble Contents by Cold and Hot Method; (vii), Moisture Contents; (viii) Ash values; (ix) Loss of weight on drying; (x) pH of 1%

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and 10 % solution; (xi) Thin layer chromatography (TLC) and; (xii) Qualitative analysis for various chemical constituents. The methodology was devised following the guidelines suggested for herbal and AYUSH drugs (Anonymous, 1968; 1970; 1989).

Materials and Methods

Ingredients of *Qurs-e-Ghafis*

As described in *Ilajul-Amraz* (Khan, 1921) QG contains following ingredients:

Agrimonia eupatoria	(Extract of *Gul-e-Ghafis*)	70 g
Nardostachys jatamansi	(Dried Rhizome *of Sumul-ut-teeb*)	35 g
Bambusa arundinasea	(*Tabasheer*, a silicasious matter)	14 g

Collection of raw materials

The crude drugs were procured from local market (Bara Dwari) of Aligarh. Pharmacognosy section of Department of Ilmul Advia, Aligarh Muslim University, Aligarh confirmed the identity and purity of the drug samples. Water extract of *Gul-e-Ghafis* was prepared with the help of Soxhlet apparatus.

Preparation of the Qurs

All the ingredients, except the extract of *Gul-e-Ghafis,* were powdered in an electric grinder. The powders of the two ingredients were mixed together along with extract of *Gul-e-Ghafis* and granules were prepared from it. The dried granules were passed through the compressing machine to get the tablets of 500 mg (Anonymous, 1968; 1970). The tablets were prepared at Dawakhana Tibbiya College, AMU, Aligarh with the help of a semi automatic tablet making machine.

Physicochemical Parameters

Weight and diameter variation test of tablet was conducted by the method of Dandagi *et al* (2006), while determination of disintegration time and friability test were carried out by the method mentioned in “Food and Drug Regulations” Ministry of Health, U.S.A (Anonymous, 1989) and by Vijay and Mishra (2006), respectively. Extractive values, water and alcohol soluble contents, loss of weight on drying, ash values (total ash, water soluble ash, acid insoluble ash) and pH of 1% and 10% aqueous solution were determined by the methods prescribed in British Pharmacopoeia and Physico-chemical Standards of Unani

Formulations, respectively (Anonymous, 1968; 1987). Moisture content was determined by the method of Jenkins *et al*., 1967.

Thin Layer Chromatography (TLC)

Thin layer chromatography was carried out on T.L.C. aluminium plates pre-coated with silica gel 6 of 254 (layer thickness 0.25mm) for two extracts of QG viz. Pet. ether and chloroform. Chromatography was conducted using different organic solvent systems. The solvent systems used for petroleum ether extract and chloroform extract were Petroleum ether + Diethyl ether (3:2) and Chloroform + Benzene (4:1), respectively. The plates were later sprayed by different spraying reagents. The *Rf* values of the spots were calculated by the following formula:

R_f value = Distance travelled by the spot / Distance travelled by the solvent (Anonymous, 1968).

Qualitative Analysis of Chemical Constituents

The qualitative analysis of different chemical constituents likely to be present in *Qurs-e-Ghafis* was carried out according to the scheme proposed by Bhattacharjee and Das (1969). Various tests for the qualitative estimation of alkaloids, glycosoids, amino acid, flavonoids, phenols, proteins, resins, sterols/ terpenes, sugars, tannins were carried out by standard methods.

Observations and Result

The data is based on multiple observations.

The colour of QG was found to be blackish brown. Its shape was round flat and appeared like a tablet. It had a hard texture, bitter taste and agreeable smell (Table 1).The mean value of weight of QG was measured to be 500.1 ± 3.37 mg (Table 2). The mean values of the diameter and thickness were 13.50 ± 0.03 mm and 4.50 ± 0.03 mm, respectively (Table 3). The mean values of disintegration time in water and in a medium simulating with gastric fluid were found to be 16 ±0.57 seconds and 12.33 ±0.88 seconds, respectively (Table 4). The mean percentage of friability was 1.80 ± 0.02 (Table 5). The mean percentage of alcohol and water soluble contents was 34.49 ± 0.28 and 22.94 ± 3.79, respectively (Table 6)**.** The mean of the pH value of 1% and 10% solution was found to be 5.38 ± 0.36 and 5.37± 0.01, respectively (Table 7). The mean percentage of the moisture content was 7.53± .14 (Table 8). The mean percentage of total ash, acid insoluble ash and water soluble ash was

12.48 ± 0.27, 8.01 ± 0.06 and 2.14 ± 0.09 (Table 9). The mean percentage of loss of weight on drying was 7.43 ± 0.69 (Table 10). The mean percentage of successive extractive values were recorded as 2.46 ± 0.082.59 ± 0.08, 1.43 ± 0.06, 0.74 ± 0.06, 2.21 ± 0.04 and 8.06±0.39 with petroleum ether, diethyl ether, chloroform, benzene, alcohol and water, respectively (Table 11).

The R_f values calculated after visualizing the spots of each plate have been recorded in Table 12 while the TLC plates have been shown in Fig 1.

The qualitative analysis showed that QG contained alkaloids, amino acid, protein, glycoside, flavonoid, phenol, resin, terpene and tannin (Table 13).

Table 1 : Organoleptic Description of *Qurs-e-Ghafis*

Colour	Blackish brown
Appearance	Tablet
Texture	Hard
Taste	Bitter
Smell	Agreeable

Table 2 : Weight Variation of *Qurs-e-Ghafis*

S. No.	Weight (mg)
1	501
2	501
3	497
4	502
5	501
6	500
7	500
8	500
9	499
10	499
Mean ± SE	500.1 ± 3.37

Table 3 : Thickness and Diameter of *Qurs-e-Ghafis*

S. No.	Thickness (mm)	Diameter (mm)
1	5.40	13.25
2	5.45	13.35
3	5.50	13.30
Mean ± SE	4.50 ± 0.03	13.50 ± 0.03

Table 4 : Disintegration time of *Qurs-e-Ghafis*

Sl. No.	Disintegration time in the water (seconds)	Disintegration time in simulated gastric fluid (seconds)
1	14	11
2	16	11
3	14	13
Mean ± SE	16 ±0.57	12.33 ±0.88

Table 5 : Friability Test of *Qurs-e-Ghafis*

S. No.	Friability (%)
1	1.90
2	1.80
3	1.85
Mean ± SE	1.80 ± 0.02

Table 6 : Alcohol and water soluble contents of *Qurs-e-Ghafis*

S. No.	Alcohol Soluble Content (%)	Water Soluble Content (%)
1.	33.933	28.46
2.	34.86	15.66
3.	34.69	24.70
Mean ± SE	34.49 ± 0.28	22.94 ± 3.79

Table 7 : pH values of 1% and 10% solution of *Qurs-e-Ghafis*

S. No.	1% solution	10% solution
1.	5.80	5.35
2.	5.70	5.40
3.	4.65	5.36
Mean ± SE	5.38 ± 0.36	5.37 ± 0.01

Table 8 : Moisture content of *Qurs-e-Ghafis*

S. No.	Moisture %
1.	7.3
2.	7.8
3.	7.5
Mean ± SE	7.53± 0.14

Table 9 : Ash values of *Qurs-e-Ghafis*

S. No.	Total ash %	Acid insoluble ash %	Water soluble ash %
1.	11.94	8.01	2.12
2.	12.79	7.89	2.32
3.	12.73	8.12	1.98
Mean ± SE	12.48±0.27	8.01±0.06	2.14±0.09

Table 10 : Loss of weight on drying of *Qurs-e-Ghafis*

S. No.	Loss on drying %
1.	8.73
2.	6.8
3.	6.5
Mean ± SE	7.43± 0.69

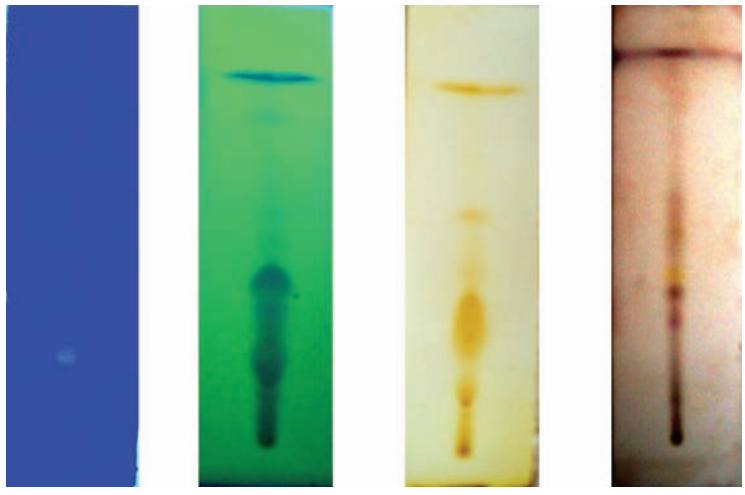
Table 11 : Successive Extractive Values of *Qurs-e-Ghafis*

S. No.	Petroleum ether %	Diethyl ether %	Chloroform %	Benzene %	Alcohol %	Water %
1	2.60	2.71	1.53	0.88	2.30	7.92
2	2.50	2.65	1.32	0.70	2.14	8.81
3	2.30	2.43	1.45	0.65	2.20	7.45
Mean ± SE	2.46 ± 0.08	2.59 ± 0.08	1.43 ± 0.06	0.74 ± 0.06	2.21 ± 0.04	8.06 ± 0.39

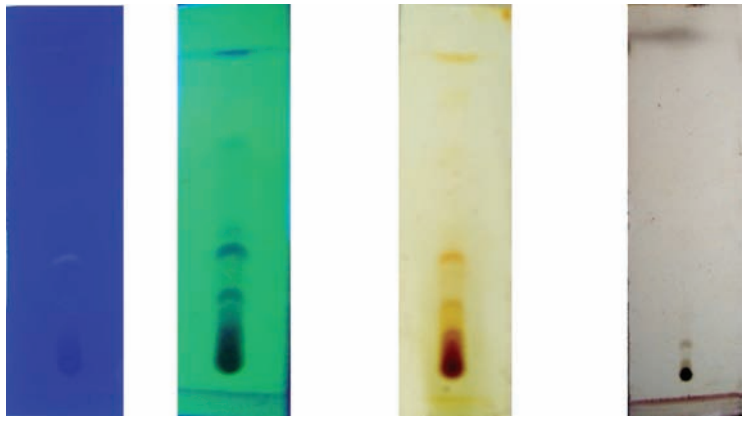
Table 12 : TLC Profile of *Qurs-e-Ghafis* extract

Extract	Solvent System	Detection / Observations		
		Visible	Number of the spots	Rf value
Chloroform	Chloroform: Benzene (4 : 1)	UV, Short	1	0.3
		UV, Long	5	0.05, 0.08, 0.18, 0.31
		Iodine	2	0.05, 0.08
		10% per chloric acid	2	0.05, 0.08

Extract	Solvent System	Detection / Observations		
		Visible	Number of the spots	Rf value
Petroleum ether	Petroleum ether : Diethyl ether (3:2)	UV short, Florescent	1	0.53
		UV, Long	5 6 6	0.10, 0.33, 0.44, 0.54, 0.61
		Iodine		0.10, 0.33, 0.44,0.54, 0.61, 0.87
		10% per chloric acid		0.11, 0.15, 0.29, 0.31, 0.44, 0.61



Petroleum ether extract



Chloroform extract

Fig. 1. TLC Profiles of *Qurs-e-Ghafis*

Table 13 : Qualitative tests for various chemical constituents in *Qurs-e-Ghafis*

Sl. No.	Test	Result
1.	Alkaloid	+ve
2.	Amino acid	+ve
3.	Protein	+ve
4.	Glycoside	+ve
5.	Flavonoid	+ve
6.	Phenol	+ve
7.	Resin	+ve
8.	Sugar (Reducing)	+ ve
9.	Sugars (Non-reducing)	+ ve
10.	Sterol/Terpene	+ve
11.	Tannin	+ve

Discussion

Physicochemical standardization is a pre-requisite in quality control of Unani drugs, both single as well as compound formulations. The efficacy of a drug mainly depends upon its physical and chemical properties therefore, the determination of physic-chemical characters to ascertain the authenticity of a drug is necessary before taking it up for pharmacological studies. The data generated in this study will help to assure the quality of this pharmacopoeal preparation.

For establishing the physicochemical standards of tablets weight variation test was conducted because a good quality tablet should be accurate and uniform in weight. The mean value of weight of ten tablets of test drug was found to be 500.1 ± 3.37 mg which is almost equal to the desired weight of 500 mg. The diameter of a tablet can vary without any change in its weight due to certain variation in procedures adopted during the processing of crude drug and shaping it to specific dosage form. The means of the diameter and thickness were found to be 13.50 ± 0.03 mm and 4.50 ± 0.03 mm, respectively, while no significant difference was observed between different samples. It has been considered desirable that after administration, the tablet should disintegrate readily as the fast dissolving tablets apart from having quick onset of effect are thought to be suitable for treatment compliance. Therefore, the tablets were subjected for the evaluation of disintegration time. The mean values of disintegration time in water and in simulated gastric fluid were found to be 16 ± 0.57 seconds and 12.33 ± 0.88 seconds, respectively. It has been reported that plain tablets / pills pass the test if each of the six plain uncoated tablets disintegrates in not more than 45 minutes (Anonymous, 1989). The test drug showed relatively less disintegration time in a medium simulating with the

gastric fluid in terms of pH, as compared to water suggesting that it can be easily and readily dissolved in the stomach leading to an early onset of effect.

Friability test is conducted to evaluate the ability of tablets to withstand abrasions under defined conditions. It is a phenomenon whereby the surface of a tablet is damaged when it is subjected to mechanical shock. A tablet should be indurate enough to withstand the attrition or shock. A loss of less than 1% however is considered acceptable by industrial standard. The mean percentage of friability in present study was found to be 1.80 ± 0.02 which is a bit more than the acceptable limit. It is warranted therefore that certain measures should be adopted to make the tablet little harder to defy the defined level of shock so as to bring the friability to 1% or less.

The extractive value is a parameter used to detect the adulteration in any drug. The amount of the extract that the drug yields in a solvent is often an approximate measure of the amount of certain constituents that the drug contains. Therefore, for establishing the standards of any drug the extractive values play an important role, as the adulterated or exhausted drug material will give different values rather than the extractive percentage of the genuine one (Jenkins *et al* ., 1967). The mean percentage of successive extractive values of QG in different organic solvents was found to be 2.46± 0.08, 2.59± 0.08, 1.43± 0.06, 0.74±0.06, 2.21± 0.04, 8.06±0.39 with petroleum ether, diethyl ether, chloroform, benzene, alcohol and water, respectively. The mean percentage of alcohol and water soluble contents by cold method were found to be 34.49 ± 0.28 and 22.94 ± 3.79, respectively. The mean percentage of the moisture content was found to be 7.53± 0.14. Ash value is the residue that remains after complete incineration of the drug. Ash value is considered an important parameter to ascertaining the standard of a drug. The dust, earthy and non-required matters are generally added in the stock of drug to increase its weight. In such a case the higher ash percentage will be found in the residue. Therefore, the ash value determination furnishes the basis of judging the identity and cleanliness of a drug and give information related to its adulteration with inorganic matter (Jenkins *et al.,* 1967). The mean percentage of the Total ash, acid-insoluble ash and water soluble ash may be a useful measure to assure the standard of QG.

Percentage of loss in weight on drying at 105^{o}C indicates the loss of volatile substances along with water which is determined by subtracting the moisture content of the drug from the loss in weight on drying. The mean percentage of loss of weight on drying found to be 7.43± 0.69 was within the normal limits. The pH value of the drug is also an important parameter of standardization of a drug. Further it also decides the kinetics of the drug when it is administered through oral route (Gilman *et al*., 2001). The mean of the pH value of 1% and

10% solution was found to be 5.38± 0.36 and 5.37± 0.01, respectively which is about two degree higher than the gastric pH. This will again help in early dissolution of the drug.

Thin layer chromatography is one of the important parameters used for detecting the adulteration for evaluating the quality of the drugs. The different kinds of chemical components are separated on TLC plate and appear in the form of spots. The calculation of R_f values after detecting the spots give an index of identity, purity and strength. If the drug is adulterated there might be the appearance of other compounds present as adulterant and in turn the number of spots may increase. On the other hand the exhausted or deteriorated drugs may lose the components and the number of spots appeared might be less. Keeping this in mind TLC studies of different extracts of test drug obtained in different organic solvents were conducted, and R_f values of various spots appeared in different solvents system were noted as a mark of identity and purity.

Qualitative phytochemical analysis of the tablet was also carried out for the determination of the presence of alkaloids, amino acids, flavonoids, phenols, proteins, resins, sterols/terpenes, sugars, glycosides and tannins. The therapeutic properties of the crude drugs are mainly due to physiologically active chemical constituents present in the drugs. The lower percentage of chemical constituents may be an important cause of less therapeutic values. Therefore, our findings recorded in this study will be helpful in predicting the biological activity of the drug.

Standardization and quality assurance of single drugs are in vague and a number of drugs of Unani medicine including the ingredients of QG have been standardized on physico-chemical and analytical parameters, but findings of single drugs cannot be extrapolated on compound drugs in order to establish their quality standard. The ingredients taking part in formation of a compound may lose at least partially, their physico-chemical properties under the influence of the operating procedures used to prepare the combination; the combination formulated may possess an entirely new entity. The present study will help to ensure and maintain the quality of QG and thereby it's biological and therapeutic effect.

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Standardization of Qurs-e-Mafasil Jadeed

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Abstract

Qurs-e-Mafasil Jadeed mentioned in Qarabadeen-e-Majeedi, is a compound preparation used in joint diseases, but has not been standardized so far. In the present study the standardization on the basis of physico-chemical and analytical parameters, laid down by Unani Pharmacopoeial Committee was carried out. The parameters studied included Organoleptic properties (colour, texture, taste and smell) of tablet, Disintegration time, Friability, Alcohol and water soluble content, Moisture content, Loss of weight on drying, Ash values, pH values and TLC. Thus, the present study determined the value of the parameters of standardization for the Unani, pharmacopoeal compound preparation, Qurs-e-Mafasil Jadeed for the first time. The disintegration time and friability were found to be within acceptable limits. This data can be pooled with the study of other samples in order to propose the pharmacopoeal standards for the Qurs-e-Mafasil Jadeed.

Key Words: Qurs-e-Mafasil Jadeed(Q.M.J.), Physico-chemical standardization, Unani compound formulation.

Introduction

The efficacy of a drug depends upon the authenticity and purity of the ingredients and also the Good Manufacturing Practices (GMP) followed in the preparation of the finished products. The standardization of the drug is necessary to protect the batch to batch variation of the drugs. The addition of adulterated or exhausted drug material will give different values of physic-chemical parameters and this phenomenon is very frequent in herbal drugs (Jenkins *et al*., 1967). Since Qurs-e-Mafasil Jadeed is a herbal drug and no physicochemical standards are available to assess the quality of this formulation, the present study was designed to fix the various physicochemical standards that can be used as quality control tools. Qurs-e-Mafasil Jadeed (Q.M.J.) is mentioned in Qarabadeen-e-Majeedi and used in Arthritis and other types of joint pain (Anonymous, 1986).

Materials and Methods

Preparation of Test Drug

(i) Raw Materials

The ingredients of the tablets, as mentioned in Qarabadeen-e-Majeedi are

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Suranjan Talkh (*Colchicum luteum* Baker*)* 25 g; Haldi (*Curcuma longa* Linn.*)* 25 g. and Samagh-e-Arabi/Gum acacia (*Acacia arabica* Lam.*)* 5 g. Two drugs Suranjan talkh and Haldi were procured from the local market and after confirmation of purity and identity of the ingredients by the Pharmacognosy section of the Department of Ilmul Advia, AMU, Aligarh, were powdered separately at 80 meshes. The market sample of powder of Gum acacia (SD. Fine Ltd.) was used.

(ii) Preparation of Tablets

All the powdered ingredients were made into paste (lubdi) by adding sufficient quantity of bacterial free purified water. The heavy metals were also tested in water to avoid the contamination. The "lubdi" after semidrying was passed through granulator to form granules of about 16 mesh. The granules were pressed in tablet making machine using a die that produce 500 mg tablets (Anonymous, 1968; 1986).

Physico-chemical Studies

(i) Weight, Diameter and Thickness of Tablets

For measuring the weight, diameter and thickness of tablets, the average weight of 10 tablets were determined using electronic balance. The diameter and thickness were measured using digital vernier callipers of 10 tablets and the average measurement was noted (Dandagi *et al.,* 2006).

(ii) Determination of Disintegration Time

The rate of disintegration was determined by using a Disintegration Testing Machine. Two media (Pure water and simulated gastric fluid) were selected for determination of disintegration. Simulated gastric fluid, without enzymes (pH about 1.2) was prepared by dissolving 1 g. of NaCl in 500 ml of deionised water, adding 7 ml of concentrated HCl and adjusting the volume to 1000 ml with water (Anonymous, 1989).

(iii) Friability Test

Friability test of the tablets was carried out by using a Friabilator of Macro Scientific Works, Delhi. This device subjects the tablets to the combined effect of abrasions and shock in a plastic chamber revolving at 25 rpm and dropping the tablets at a height of 6 inches in each revolution. Pre-weighed sample of tablets was placed for 100 revolutions. Tablets were de-dusted using a soft muslin cloth and weighed after completion of revolution, the friability (*f*) was calculated by the following formula:

$$f = (1 - W/W_0) \times 100$$

Where, W is the weight of the tablets before the test and W_0 is the weight of the tablet after the test (Vijaya and Mishra, 2006).

(iv) Determination of Solubility, Moisture Content, Ash Values and pH

Solubility in alcohol and water was determined according to the method given in British Pharmacopoeia (Anonymous,1968). Extractive values of drug in different solvents were carried out using a soxhlet apparatus (Anonymous, 1968; 1987). Total ash, water soluble ash and acid insoluble ash were determined by applying the usual methods (Anonymous, 1968; Afaq *et al.*, 1994). The loss of weight on drying and pH values for 1% and 10% aqueous solution were also carried out (Afaq *et al.*, 1994; Anonymous 1987; 1991; 2006). For determination of moisture content toluene distillation method was used (Jenkins *et al*., 1967).

(v) Thin Layer Chromatography (TLC)

The ethanolic extract of the tablets were subjected to TLC Studies using aluminium plates (pre-coated with silica gel 6o F 254, layer thickness 0.25mm). The most suitable mobile phase was Chloroform: Acetic Acid (4:1). The developed plates were observed in day and UV light. The Rf values of the spots that appears were calculated.

Table 1: Physico-chemical parameters of Qurs-e-Mafasil Jadeed

S. No.	Parameters	Observations ± SE
1.	Colour	Yellow
2.	Appearance	Tablet
3.	Texture	Hard
4.	Taste	Bitter
5.	Odour	Agreeable
6.	Weight variation (mg)	504.6 ± 1.59
7.	Diameter (mm)	13.44 ± 0.01
8.	Thickness (mm)	4.75 ± 0.01
9.	Disintegration in Water (minutes)	11.57 ± 0.47
10.	Disintegration in Simulated gastric fluid (minutes)	3.35 ± 0.33

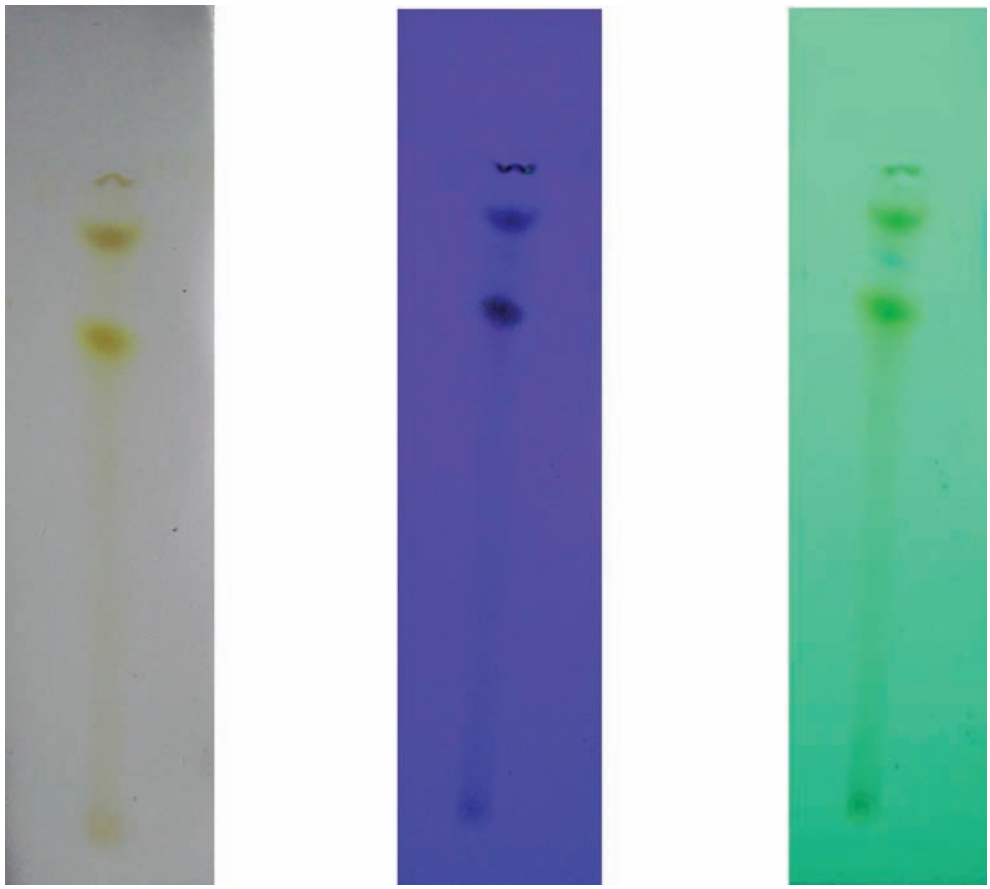
S. No.	Parameters	Observations ± SE
11.	Friability (%)	0.59 ± 0.03
12.	Alcohol Soluble Content (%)	3.18 ± 0.05
13.	Water Soluble Content (%)	16.74 ± 0.14
14.	pH (1% solution)	8.02 ± 0.06
15.	pH (10% solution)	7.80 ± 0.01
16.	Moisture Content (%)	3.47 ± 0.24
17.	Total Ash (%)	7.15 ± 0.06
18.	Acid Insoluble Ash (%)	3.47 ± 0.33
19.	Water Soluble Ash (%)	2.75 ± 0.13
20.	Loss in Drying (%)	4.94 ± 0.06

Table 2 : Successive Extractive values of Qurs-e-Mafasil Jadeed in different Solvents

S. No.	Solvents	Observations ± SE
1.	Petroleum Ether	1.02 ± 0.08
2.	Di-Ethyl Ether	3.09 ± 0.19
3.	Chloroform	0.30 ± 0.02
4.	Benzene	0.15 ± 0.01
5.	Ethanol	0.65 ± 0.06
6.	Distill Water	26.89 ± 1.75

Table 3 : TLC Profiles of Ethanolic extract of *Qurs-e-Mafasil Jadeed* in Chloroform: Acetic Acid (4:1) solvent system

Medium	No. of Spots	Colour of Spots	Rf Value
Daylight	2	(1)Y (2)Y	0.74, 0.89
UV Longwave	3	(1)BB (2)LB (3)DB	0.74, 0.8, 0.89
UV Shortwave	3	(1)G (2)LG (3)DG	0.74, 0.8, 0.89



Y = Yellow, BB = Blackish Blue, LB = Light Blue, DB = Dark Blue
G = Green, LG = Light Green, DG = Dark Green

Results and Discussion

The Yellow colour tablet was hard and bitter with agreeable odour. All the tablets passed weight variation test as the percentage of weight variation was within the pharmacopoeial limits of ± 7.5% (Dandagi et al., 2006). The average weight of tablet was found to be 504.6 ± 1.59 mg, the average diameter was 13.44 ± 0.01 mm and the average thickness was 4.75 ± 0.01 mm (Table1). The disintegration time in water and in simulated gastric fluid were found to be 11.57 ± 0.47 minutes and 3.35 ± 0.33 minutes respectively (Table1). This shows that the tablets will be available to the body just about in 4 minutes after consuming. It is mentioned that plain tablets pass the test if each of the six plain uncoated tablets disintegrate in not more than 45 minutes (Anonymous, 1989). It was also noticed that as the medium was changed from water to simulated gastric fluid the time taken for disintegration was reduced hence in

the gastric media the tablets will be available to the body much earlier. Friability of tablets were found below 1 % indicating a good mechanical resistance of tablets (Vijaya and Mishra, 2006). All the tablets were found well within the approved range (< 1%) in the samples. Mean percentage loss of weight was found to be 0.59 ± 0.03 (Table-1). Alcohol and water soluble content, pH of 1% solution, 10% solution, moisture content, total ash, acid insoluble ash, water soluble ash and loss of weight on drying were 3.18 ± 0.05, 16.74 ± 0.14, 8.02 ± 0.06, 7.80 ± 0.01, 3.47 ± 0.24, 7.15 ± 0.06, 3.47 ± 0.33, 2.75 ± 0.13 and 4.94 ± 0.06 respectively (Table-1). Successive extractive values of drug in different solvents were 1.02 ± 0.08, 3.09 ± 0.19, 0.30 ± 0.02, 0.15 ± 0.01, 0.65 ± 0.06 and 26.89 ± 1.75 respectively (Table-2). On TLC plates two spots were visible in daylight where as three spots were visible in short as well as long wave UV light. The Rf values and colour of spots are given in Table 3. In day light, two yellow colour spots appear with the Rf of 0.74 & 0.89. In long wave UV light, three spots one with blue black (Rf 0.74), one light blue (Rf 0.8) and one dark blue colour (Rf 0.89) appear, whereas in UV short wave one green colour (Rf 0.74), one light green (Rf 0.8) and one dark green colour spot (Rf 0.89) appear. The Rf values indicate that all the three spots appear in both types of UV light are same.

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Revitalizing Medicinal Plants Sector in India – Opportunities and Challenges*

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Abstract

India is bestowed with unique diversity of ethnic culture, natural resources and bioedaphic and topographical features. Owing to the rich plant biodiversity, particularly the medicinal plants and ancient cultural background, India ranks one of the few countries in the world which is utilizing the enormous indigenous medicinal plant wealth in a big way since vedic era. The importance of herbals both as medicine, cosmetics, dye etc. and as food supplements, has been overlooked for quite sometime. However, in the recent past, with the advent of herbal revolution, the medicinal plants are looked upon not only as a source of affordable health care but also as a source of income developing in to an industry itself. The extensive use of medicinal plants from wild has brought about its serious depletion in nature.

Medicinal plants sector in India is vast and complex because of the rich plant biodiversity, multidimensional usage, large number of stakeholders from various fields in GOs. and NGOs. etc. The continuous use of medicinal plants through illicit harvesting and trade from the wild, shortage, volatile prices, lack of regulations, quality control etc. has further complicated the problem. As such the medicinal plants sector though developing day by day is totally unorganized and needs urgent attention of all the major stakeholders including the GOs. and NGOs., before it is too late.

In the present communication, based on information procured from multiple sources, an attempt has been made to putforth a glimpse of the vast Medicinal Plants Sector in the country and discuss some important aspects. While presenting a brief background, data on domestic and global scenario, source, conservation/cultivation, the users, trade (including export/import), herbal heist, constraints and government initiatives, remedial measures etc. have been discussed briefly.

Introduction

The instinct to collect and use a plant drug for healing is as old as human civilization. This fact has been well substantiated in one of the oldest repository '*Atharvaveda*' (2500 -5000 B.C.), where there is a reference stating "A Kirat tribal girl digging drug on high ridges with lustrous shovel" (Atharvaveda - 0/4/14). India has glorious tradition of health care system, which dates back to the Vedic era. 'Rigveda', which is the oldest known repository of human

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knowledge and wisdom (5000 - 2500 B.C.), mentions about hundred medicinal plants used by the Aryans while in Atharva veda (2500 - 2000 B.C.) elaborate description and properties of medicinal plants are given. Later in 'Samhita' period, the science of life was established on scientific footing. The other ancient traditional systems like Greek, Persian, Roman, Unani, Chinese, Tibetan etc, also have a long history of using plants as an integral part of their traditional healing systems. However, these ancient systems including the Chinese had borrowed generously from the Materia Medica of India. Pupil from countries like China, Cambodia, Indonesia and Baghdad used to come to ancient Universities of Takshila (700 BC) and Nalanda (500 BC) in India to learn Ayurveda. There were regular trade between and by these countries with India mainly to obtain the precious drugs and spices. These medical systems were popularly practiced and the experience of healing was recorded, documented and became part of Materia medica of these countries. The Indian systems of medicine (ISM) particularly Ayurveda, Siddha and Unani during earlier period have achieved high level of growth and development. This period can be remembered as the Golden period in the history, particularly the Samhita period.

The colonial period particularly 18th and 19th centuries in India saw a popular preference, particularly in urban areas for the western system of medicine called 'allopathy', using mostly chemicals for healing. It became popular because of fast action, quick relief, palatability and western patronage. Introduction of western medicine largely damaged the ISM and was considered as a third grade system equated with witchcraft. Fortunately, the ISM particularly Ayurveda/ Siddha/ Unani survived not only in the rural areas in India but also in other parts of the world. However, after a lapse of nearly 200 years, post independent India paid attention for the revival of the ISM because of the hazardous - effects of antibiotics, cortisones etc. As on today, the ISM particularly Ayurveda has attracted global attention, because of the holistic approach to human healing and the use of safe, cheap herbal medicines. The plants are now extensively used not only as pharmaceuticals, but also as neutraceuticals, cosmetics, galenicals etc.

The use and cultivation of medicinal plants in the past was a part of our culture and therefore not much importance was given earlier. Now it is a new concept to use them variously and cultivate them on large scale. It is not only looked upon as a source of affordable health care but also as an industry and a source of income. The enormous use of medicinal plants in the recent past from the wild source has brought about depletion and extinction of some of the medicinal plants. It has become a serious matter of concern for the ISM,

which mainly rely on rich medicinal plant biodiversity and bioresources. The unregulated harvesting, trade, fluctuating prices etc. has largely affected the medicinal plants sector in the country. Presently the medicinal plants sector is unorganized without any forceful policy and regulation. In the present communication an attempt has been made to peep in to different facets of this vast, complex and very important Medicinal plants sector. This sector has direct impact on the manufacture of the life saving drugs, health care system and also economy of our country.

Medicinal Plants Sector (Domestic Scenario)

Medicinal Plants Wealth

India is one of the 12 mega-biodiversity countries harbouring two unique 'biodiversity hot-spots' out of 18 hot spots in the world. It is rich in all the three levels of biodiversity i.e. species diversity, genetic diversity and habitat diversity. It has all known types of agro-climatic, ecological and edaphic conditions with unique biogeographical areas having all known types of eco-systems ranging from coldest place, the dry cold desert of Ladakh (Nubra Valley with -57°C), to temperate, alpine and sub-tropical regions of north-west and trans-Himalayas; rain forests with high rainfall; wet evergreen humid tropics of Western ghats, arid and semi-arid regions of peninsular India; dry desert conditions of Rajasthan and Gujarat to the tidal mangroves of Sunderban (Anony. 2000). Under such unique and varied agroclimitic/ bioedaphic conditions variety of medicinal plants grow. Out of 17,000 flowering plants, 8,000 species (MoEF, AICRPE-report) are used medicinally in local health traditions and codified systems of medicines. The intraspecific variability of the flowering plants found in the country make it one of the highest in the world. In Ayurveda, Siddha and Unani systems of medicine about 2,000 plants are used in various formulations. We have yet to explore and exploit medicinal properties of unexplored remaining species. Large sector of communities in the rural areas, which constitute about 75% of the Indian population, inhabitating in about 5,76,000 villages located in different climatic conditions, utilize medicinal plant around them. The village folk have their own diverse systems of health management known as Local Health Tradition (LHT). This vast section of the population of the folk practitioners including tribals are using about 5,000 - 8,000 species of plants for medicinal purpose. There is however no systematic inventory/documentation about the folk remedies of India. Such enormous use of medicinal wealth is rather unique in the world.

Regarding medicinal properties, it has been postulated in Ayurveda that "there is no substance (including plants) in the universe which can not be used as drug when used rationally and with definite objective." (CS *{Sutra sthan* 12), Ashtang Sangrah (*Sutra sthan* 17), Ashtanga Hridaya *(Su. sthan* 9). It is needless to say that the medicinal plant or "Dravya" is one of the most important pillars or components, out of the four pillars (Chatushpad) recognized in Ayurveda, required for 'Chikitsa'/treatment (Ashtanga Hridaya *Su. sthan* 1/27).

Medicinal plants as part of culture

The ancient Indigenous systems of Medicines particularly Ayurveda, Unani and Siddha and also the LHT in rural and Tribal areas are based on herbal drugs for treatment and health care. In the villages elderly people have knowledge they prepare medicine from local herbs based on their experience. As such the medicinal plants/herbs have become a part of our culture. It is evident that the Indian people have tremendous passion for medicinal plants and use them for wide range of health related problems from common cold, memory improvement and treatment of poisonous snake bite to care for muscular dystrophy and enhancement of general immunity etc. In the oral traditions local communities in India has one of the richest plant medical culture in the world. This unique culture of health management not only provide health security to millions of people but it can also provide new and safe herbal drugs to entire world. There are estimated to be around 25,000 effective plant based formulations used in folk medicine by the rural communities of the country, besides around 10,000 designed formulations available in indigenous medical texts. (Anony, 2000).

Source/Distribution of medicinal plants

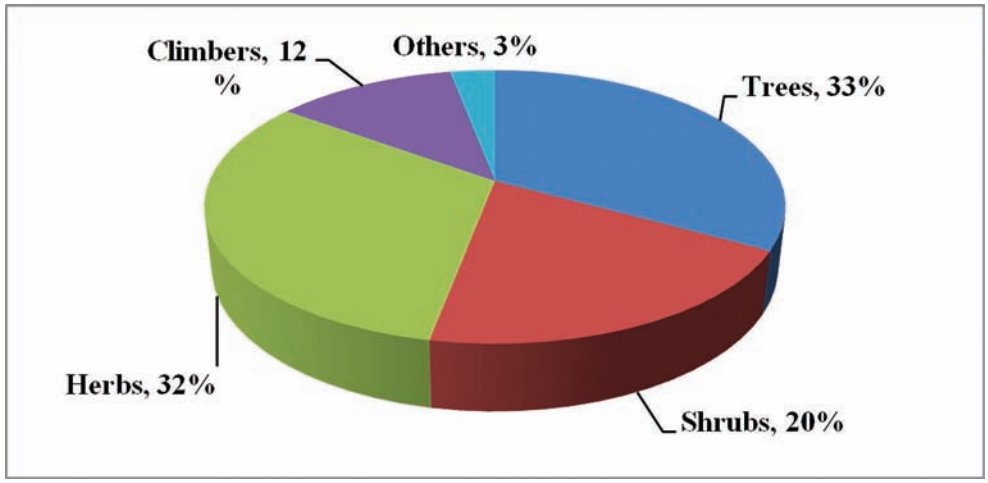
The rich flora and fauna of the country harbouring medicinal plants is about 7% of the world biodiversity. It has 16 major forest types distributed in varied bioedaphic and agro-climatic conditions from alpine to temperate Himalayas, subtropical forest, desert, scrubs and mangroves along the coast. The recorded forest area (76.5 million ha.) is 23.3% of the total geographical area of the country. However, the actual forest cover is 66.34 million ha. out of which 31.85 million ha. is degraded. The vegetation / forest cover, besides, other habitats constitute the Source of various wild medicinal plants in the country. The other main source is from cultivation and other *ex situ* means.

Nearly 8000 species of medicinal plants distributed in 386 families and 2200 genera of flowering plants are the main source of Raw drugs. Macro-analysis

of distribution of medicinal plants show that they are distributed in various diverse habitats. Around 70% of the medicinal plant are found in tropical areas particularly in dry and moist deciduous forest areas in different geographical regions of the country including the Himalayas, Western/Eastern ghats, Vindhyas, Aravallies, Chotta Nagpur plateau etc. Around 30% medicinal plants are found in higher altitudes including the temperate and alpine areas, however, they include species of high medicinal value.

An analysis of habits of medicinal plants given below indicate, that the majority of them are higher flowering plants comprising of 33% trees followed by herbs, shrubs, climbers etc. A small percentage of about 3% medicinal plants are from lower group of plants like Ferns, Algae, Fungii.

Distribution of Medicinal Plants by Habits



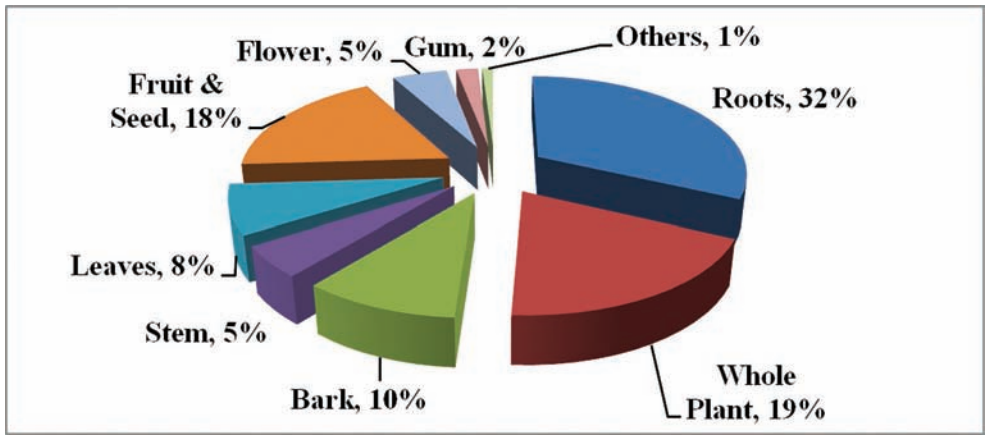
Source : Report of Task Force (GOI, 2000)

Raw drugs

The various parts of medicinal plants used for preparation of medicines are the Raw-drugs or Crude drugs. These along with the phytochemicals forms the basic material used in the pharmaceutical industry in the medicinal plants sector. Raw drugs required for the production of various formulations are usually dried parts of medicinal plants such as root, stem, wood, bark, leaves, flowers, seed, fruits, whole plants etc. They infact constitute the starting material for the formulations of ISM&H (Ayurveda, Siddha, Unani etc.), Tibetan and other systems of medicine including the folk/ ethnomedicines. The crude drugs are also used to obtain therapeutically active chemical constituents by specialized methods of extraction, isolation, purification etc. and are used as phytochemicals for production of modern allopathic medicines or phyto-medicines. The unsustainable and extensive use of raw drugs particularly the

root, whole plant and fruit/ seeds has resulted in depletion of medicinal plants. The break-up of usage of various parts of raw drugs is given below :

Break-Up of Usage of Medicinal Plants by Parts



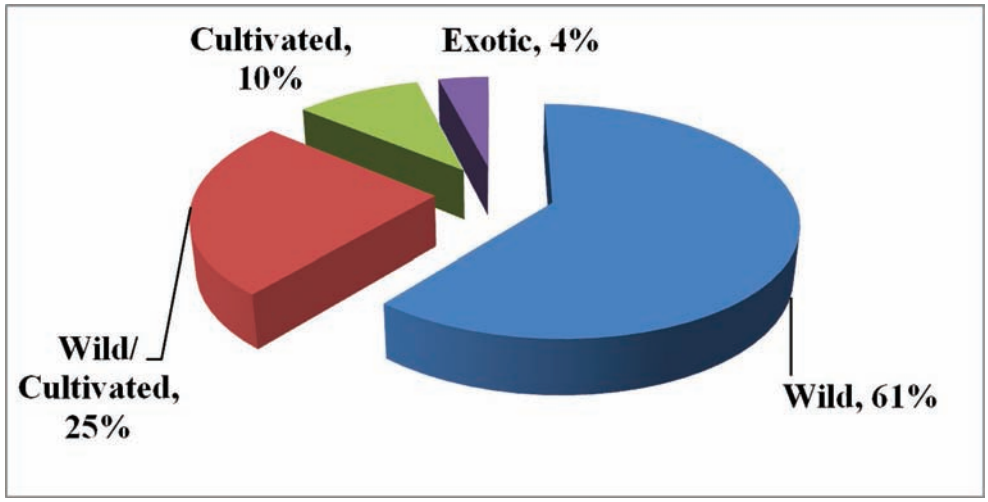
Source : FRLHT, Trade Database, 2003

It appears from above data that the bulk of plant material is obtained from the roots, whole plant, fruits/seeds and bark,which are vital for the survival and regeneration of medicinal plants in nature. Their unsustainable and destructive harvesting has brought about depletion and scarcity of medicinal plants.

Medicinal plants resource and collection

The rich biodiversity (narrated earlier) distributed in the forests and other areas all over the Country is the wild resource base (nearly 61%). Medicinal plant wealth is living repairable resource, exhaustible if over used and sustainable if used with care and wisdom. Owing to harvesting of nearly 95% collection of medicinal plants from wild in unsustainable way, there has been a depletion in the resource base. It has also been confirmed through many studies that pharmaceutical companies are also responsible for inefficient, imperfect, informal and opportunistic marketing of medicinal plant. As a result the raw material supply situation is shaky, unsustainable and exploitative. There is also problem in the availability of genuine medicinal plants and due to this problem the use of substitutes in place of genuine resource base started. As a result practice of adulteration is becoming common. The true source of crude drugs in such cases can only be detected after chemical/ pharmacological analysis. The medicinal plants are obtained from the wild, wild & cultivated, cultivated and exotic sources. In the diagram below percentage-wise sources of medicinal plants used in trade is given:

Source of Medicinal Plants Traded in India



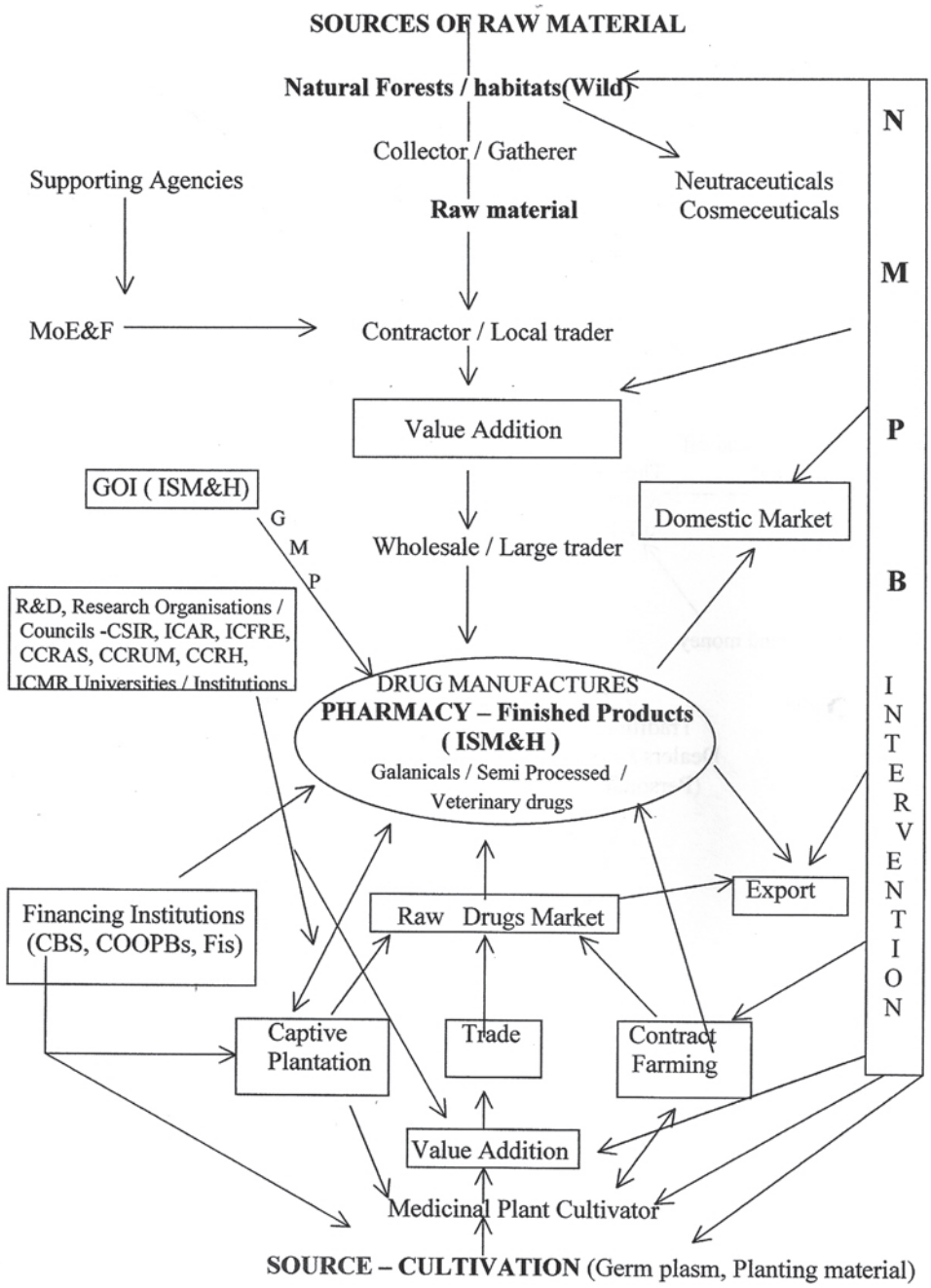
Source : FRLHT, Trade Database, 2003

The quality of resource material of medicinal plants depends on geographical origin, time and stage of the growth of the plant at the time of collection and post harvesting handling. The collection in most of the cases is done unsustainably by unskilled villagers/tribals etc. without paying any attention with regards to their identity, maturity, season of collection, proper drying, storage etc. The quality of the collected material in such cases is often degraded. Collection of non-timber forest produce (NTFP), which includes medicinal plants, is a way of life with the tribal and rural communities in and around the forest. In rural and tribal areas NGOs and GOs have encouraged to form co-operatives for collection of raw drugs. The prices paid to the gatherers/collectors tend to be very low they often extensively collect the natural resources indiscriminately, unsustainably with a view to generate maximum income. Several medicinal plants have been assessed endangered, vulnerable/rare due to unskillful over harvesting from the wild source. Habitat destruction in the form of deforestation is an added danger, due to such over exploitation.

The other main source of medicinal plant is from cultivation. Cultivated material though costly is definitely preferred in production of medicine since the quality of the crude and processed drug is maintained. Because of the higher cost of cultivated material contractual cultivation is preferred. Recently the growers have set up co-operatives for cultivation of medicinal plants. Of late, organic farming is gaining wide acceptance due to demand particularly in developed countries for organically grown crops.

Trade

Trading of medicinal plants is complex and unorganized The trade in wild medicinal plants at various levels is vast, secretive and mostly unregulated in working. It continues to grow in absence of serious policy/ regulation in environmental planning. The crude drugs trade is based on local names as



Medicinal Plants Sector – At a Glance

the supply chain starts from unskilled, illiterate collector to the contractor/ local trader to the larger trader/wholesaler or the manufacturers. The raw material is procured by the pharmacy from the drug dealers in the regional market of the cities like Mumbai, Delhi, Kolkatta, Chennai, Hyderabad, Amritsar, Patna, besides many small cities of the country. The drug dealers of small cities procure the material from the so called 'unknown sources' (being a secret trade). 90% of the material ultimately come from the various parts of the forests in the country, collected by unskilled forest dwelling communities and purchased by the contractors at nominal price. These supply chain often extends to be 3-4 tiers without much value addition but with increasing sale price (70 - 100%) at each level up to the pharmacy. Many times the same crude drug is available in various grades with major traders having considerable difference in price, for example various grades of 'Safed Musali' are available at varying prices of Rs. 800 - 1200 per kg depending on the source of origin and other factors.

Crude drug trades in certain states like Kerala, Andhra Pradesh, Maharashtra, M.P., Rajasthan etc. operates through Tribal Co-operative Societies established to ensure fare price for tribals who collect the crude drugs. However, operation of many of these organizations is unsatisfactory, hence tribal prefers to sale their produce to middlemen for getting quick payment in cash. Most of the pharmacies of ISM have long standing relationship with large traders through generations often at personal level. The users satisfaction level is quite high. The pharmacy prefers crude drugs originating from a specific geographical region. Thus pharmacy also becomes the ultimate part of the supply chain.(see diagram-med. plants sector at a glance)

Traditional to modern technology (value addition)

The medicine for internal use prepared in traditional manner involve simple methods such as hot / cold water decoction (extraction), juice, powder, pastes administered through vehicle such as water, oil, honey etc. The traditional medicines are prepared using age old methods usually by the practitioners himself after correctly identifying the plant. This practice of self dispensing is gradually shifted to profit oriented herbal drug stores. There is no guarantee of the authenticity and quantity of plant material used in such preparations. Thus traditional methods have many disadvantages, which could be modified and corrected by selecting suitable technologies to make them more effective, stable and in requisite dosage forms etc., which can be easily transported. Use of sophisticated modern technology for the production of quality drugs is necessary to maintain the quality standards at national and international levels.

The value of medicinal plant for fetching foreign exchange from developing countries depends on the use of authentic value added plants as raw materials in pharmaceutical industries. These raw materials are used to:1.Isolate pure active compounds for formulation in to drugs, 2. Isolate intermediates for production of semi synthetic drugs, 3. Prepare standardized galenicals (extracts, powders, tinctures etc.).

Quality assurance and standard preparations

The production of traditional medicine for local use does not require stringent standards. The control of quality of raw materials, processes and finished products is an absolute necessity, if it is required for world market and human consumption. International standards specifications exist for some processed products and some countries and buyers have their own requirements. The quality requirement for medicinal plant preparations are stringent in terms of content of active principles and toxic materials. There is need to develop modern technology to ascertain that the medicinal plants used are non-toxic. Standard preparations of Traditional drugs are required to be developed for their quality, efficacy and potency.

Quality has to be built into steps as management systems, the whole process is strictly controlled beginning from the selection of propagation material to the final product reaching the consumer. All elements of the Total Quality Management (TQM) have to be introduced in any industrial project. The requirements for ISO 9000 certification and GMP norms have to be introduced and followed. The personnel are trained so that enterprises could introduce the proper systems needed for certification. ISO 14000 leading to Eco-labeling through eco-audit procedures will also be required for safeguarding and environmental damage.

Property rights

Medicinal plant represents not only available part of India's biodiversity but also source of great traditional knowledge. In the past, the knowledge widely transmitted even to neighboring countries was regulated by an ethical code of conduct which is **a** part of tradition of teaching called '*Guru Shishya parampara'.* This teaching tradition was provided open access of the knowledge to 'worthi seekers', it was never viewed as commodity to be bought and sold. However, in the modern times, the idea of "private intellectual property" has been given a legal status and trade in intellectual property is a part of current day commerce. Thus India is forced to put market value to

traditional knowledge and regulate its access to commercial users based on International norms. There has also been problem of bio-piracy, which refers to the theft of traditional knowledge, and it's appropriation through filing of false 'patent claim' for rights of ownership. A need for 'protection and promotion of traditional knowledge' was therefore felt. The major problem confronting India is how to apply patent law for formulations and products which have been developed over thousands of years ago.

The department of ISM & H, Govt, of India has initiated a national project called 'traditional knowledge digital library (TKDL)', with a view to prevent bio-piracy. The primary objective of TKDL is to prevent a grant of (false) patent on the traditional knowledge of the country. Currently TKDL focuses on the codified traditional medical knowledge systems. It also plan to use it for documenting orally transmitted local health traditional practices in the country.

Marketing

According to CHEMEXCIL, National Pharmaceutical market is of the order of Rs. 12500 cr. inclusive of Ayurvedic market, which is of Rs. 2500 crore. Out of this Rs. 2000 crore is of OTC range and only Rs. 500 crore is of ethical range. The rate of growth of the market is approx. 20% per year. However, in absence of any systematic survey no authentic data of Ayurvedic market is available.

Marketing is a complex problem affecting the development of plant based industry of medicinal plant sector in developing countries. Marketability will be a crucial factor in determining the failure or the success of these industries. The market out lets can be for domestic (local) use and for export. Some of the products for local use reach the consumer directly while others have to be further processed or used as secondary components in other industrial products. Hence user industry have to be promoted so that locally produced extracts can be used to save foreign exchange needed for import of such additives. Further, the processing to yield value aided products will have to be produced at prices to be competitive in the world market. Market promotion is crucial to penetrate the world market. A holistic management action plan is essential to formulate management of the resource based harvesting, processing, trade, marketing etc.

Global Scenario (Alternate Medicine Market)

With the advent of recent herbal revolution, consumption of plant based products in phyto-medicine has increased considerably throughout the world. The various traditional medical systems including Ayurveda, Siddha, Unani

etc. under the ISM & H have been internationally recognized under Alternate systems of medicine. China and India are the two great producers of medicinal plants having more than 40% of global biodiversity. China earns US$ 5 billion per year from herbal trade. According to an estimate (TAS-ITC) India ranks 3rd after China and USA among the leading exporters of medicinal plant of the world. Thus, there is enormous scope for India also to emerge as major player in global herbal products based medicine.

According to the Report prepared by Mc Alpine Thorpe and Warrier Limited, U.K., for Common Wealth Secretariat in 1997, the global herbal market is estimated to be Rs.51, 000 crores. Out of this, Indian export is only Rs. 280 crores, which is 0.5% of total export market while share of China exports of total market is 35.3%. Present estimate is that China exports Rs. 22,000 crores while India's export is only Rs. 480 crores. According to the WHO, the global market for medicinal herbs and herbal products is estimated to touch by the yr. 2050 US$ 5 trillion. Percentage of population using Traditional Medicine at least once in different countries is as under:

Australia 48%, Canada 50%, USA 42%, Belgium 40%, France 75%, UK 90%. 46 % of Swiss doctors use complementary alternative medicine mainly Homeopathy and Acupuncture. 40% of General practitioners in UK offer access to complementary or alternative medicine. In USA the use of traditional medicine by doctors increased from 34 % in 1990 to 42 % in 1997.

In Africa more than 80% of the population uses traditional medicine. In several African countries more than 60% of children with high fever are treated at home with traditional medicines. They are interested in low cost option based on Indian medicine. In Japan 60 - 70% of Medical doctors prescribe Kompon medicine. In Malaysia, Chinese and Indian medicine is extensively used. In China, traditional medicine accounts for more than 40% of the drugs provided by the healthcare system. 71 % of population in Chile and 40% of population in Columbia accepts traditional and complementary medicine.

Govt. Initiatives for Conservation & Development

Programs of Ministry of Environment and Forests (MoEF)

A Centrally Sponsored Scheme for the Development of National Parks and Sanctuaries has been under operation through the MoEF since the Sixth Five Year Plan. The main objective of the scheme is to support protection and conservation measures in the National Parks and Sanctuaries. The Eighth Five Year Plan and the outlay for the Ninth Plan is Rs. 110.00 crores. Under the

National Afforestation and Eco-development Board (NAEB), documentation of the Sacred Groves have been carried out by the Regional centers. The NAEB is also implementing a Centrally sponsored Scheme of Minor Forest Produce since the year 1988-1989 with 100% central assistance to the States covering various activities including cultivation of medicinal plants like *Rauwolfia* spp., *Dioscorea* spp. and of rosha grass/ lemon grass to augment the rising demand and to offset the scarcity because of unscientific exploitation. During the Ninth Five Year Plan the scheme has been extended to 25 States with an outlay of Rs.80.50 crores.

Ban on exports of medicinal Plants

The habitat loss by export of medicinal plants collected from wild sources may lead to severe and irreplaceable loss of genetic stock of many of these species. The Ministry of Environment and Forests has, therefore, notified 29 species, Which are banned (wild source) for export from India.

Externally aided projects

The Foundation for Revitalization of Local Health Traditions (FRLHT), Bangalore has been implementing a UNDP Country Cooperation Program -assisted Sub-programme on “Medicinal Plants Conservation and Sustainable Utilization” since December, 1999. This is basically a demonstration project aimed at replicating the activities being carried out in the States of Andhra Pradesh, Karnataka, Kerala, Maharashtra and Tamil Nadu. The activities include survey and inventorisation of medicinal plants in the selected areas and Identification of the sites for *in-situ* conservation. The United Nations Development Programme (UNDP) operates the Small Grants Programme (SGP) on behalf of Global Environmental Facility (GEF). Under this programme there are 11 projects on medicinal plants covering the States of Assam, Gujarat, Himachal Pradesh, Kerala, Meghalaya, Rajasthan and Uttar Pradesh. These projects are being executed by NGOs at the grass root level.

Programmes of Department of Ayurveda, Yoga, Unani, Siddha and Homoeopathy (DoAYUSH)

The DoAYUSH (fomerlyDoISM&H) started a Central Sector Scheme on Development and Cultivation of Medicinal Plants in the year 1990-1991 with the objective of developing medicinal plants gardens and agro-techniques for important species of medicinal plants through the Government and Semi-Government organizations. The medicinal plants garden set up under the

scheme are to serve as demonstration centers for those intending to take up this activity commercially and also to create awareness about medicinal plants. In an another Central Scheme for Development of Agro Techniques and Cultivation of Medicinal Plants Used in Ayurveda, Siddha, Unani and Homoeopathy with effect from the year 1997-1998, central assistance is provided to specialized scientific institutions (Govt./Semi-Govt.) on project basis (3 years duration) for development of agro-techniques for about 126 medicinal plants.

Task Force on Medicinal Plants (Planning Commission)

The planning Commission constituted a Task Force in June, 1999 under the Chairmanship of Dr. D.N. Tiwari, Member Planning Commission to provide policy directives, identify measures for sustaining the resource base, evolve suitable marketing strategy besides facilitating protection of patent rights and intellectual property rights on these plants.

Some of the important action programmes suggested by the Task Force on Conservation and Sustainable Use of Medicinal Plants are as follows :-

1. To establish 200 Medicinal Plants Conservation Areas (MPCA).in the country.
2. About 100 medicinal plants classified as endangered or rare or threatened should be grown in well-established gardens of the country.
3. Three gene banks created at CIMAP, Lucknow, NBPGR, New Delhi and TBGRI, Trivandrum. .
4. Attempt should be made to establish 200 “Vanasapti Van” in forest areas for commercial supply of crude drugs.
5. Forest Departments should effectively regulate extraction and transport of medicinal plants from wild.
6. About 50 NGOs (including agricultural universities) technically qualified may be identified for improving awareness, availability of seeds and planting material of medicinal plants for people interested in their cultivation.
7. Twenty five species, which are in great demand, may be encouraged for cultivation. Contract and organic farming should be encouraged.
8. Quality and pharmaceutical standards of herbal drugs should be finalized.

9. A “National Medicinal Plants Board” should be established.

10. All efforts to `be coordinated to ensure export of herbal products to earn Rs. 3000 crores by 2005.

Report of SAC to Cabinet

The Scientific Advisory Committee to the Cabinet (SAC-C) Govt. of India conducted a study entitled “Herbal Products- current status, vision and action Plan”, supported by Technology Information, Forecasting and Assessment Council (TIFAC), New Delhi (2001). The committee suggested 45 plants for over all development of the sector on priority. They recommended and short-listed 7 potentially important medicinal plants for the next five year (2001 -2005) for more concentrated focused attention.

Programmes of Department of Agriculture and Cooperation

The Department of Agriculture and Cooperation, Ministry of Agriculture launched a Central Sector Scheme on Development of Medicinal and Aromatic Plants during the Eighth Five Year Plan with an outlay of Rs.5.00 crores. Programmes for development of quality planting material, establishment of herbal gardens, establishment of regional analytical laboratories were taken up.

Significant achievements of the schemes are

- 53 hectares were covered under herbal gardens.
- 14 nurseries for medicinal plants were established.
- 164 hectares developed for production of quality planting material of aromatic plants.
- 5 Regional analytical laboratories were established.
- 936 demonstration plots were laid.

Programmes of Department of Family Welfare

Under Reproductive Child Health Care Programme of the department, two schemes viz. creation of ‘Vanaspati Van’ and Medicinal Plants Nursery for creating awareness are functioning with the collaboration of Deptt. of ISM & H. So far 9 Vanaspati Vans have been constituted.

Projects of Deptt. of Biotechnology (DBT)

A number of projects on medicinal plants have been under taken by the Deptt of Biotechnology on various aspects. The project on “Inventorising the Medicinal Plants Resources of India” coordinated by NBRI (2001) is worth mentioning.

Medicinal Plants Board

The Department of AYUSH has constituted a Medicinal Plant Board in the year November 2000. It is functioning under the Chairmanship of Union Minister for Health & Family Welfare with representatives from concerned Ministries/ Departments. The objectives of setting up of the National Medicinal Plants Board (NMPB) is to create a body, which shall be responsible to look after matters on all related aspects of medicinal plants sector as a whole. With a view to develop, conserve and promote various activities the National board has identified and prioritized 93 medicinal plants for the development of the sector. Depending upon their scanty availability in nature and subsidy these plants are grouped in to 3 categories, i.e. 45 plants with 20% subsidy, 32 plants with 50% subsidy and 16 plants with 75% subsidy.

Schemes

The NMPB has been implementing following schemes for the overall development of the Medicinal Plants sector in the country:

1. Central Sector Scheme of Conservation Development and sustainable Management of Medicinal Plants.

   It focuses on the promotional activities like resource documentation, *in-situ* conservation of rare and Endangered species. Support to Joint Forest Management Committee (JFMC) for value addition , capacity building and Training etc.

2. The centrally sponsored scheme of “National Mission on Medicinal Plants”. The mission located in NMPB DoAYUSH and will have 2-tier structure – National and State.

   a) The Mission supports over all cultivation, activities in all respects and to promote standardization and QA of AYUSH products.

   b) Support setting up Processing zones/ Clusters covering relevant activities.

c) Adopt Mission mode approach and promote partnership among stake holders involved in R & D, processing and marketing in public/ private sectors at National, Regional, State and sub-state levels.

The schemes will cover the following areas of Medical Plants sector in general:

Survey and inventorization of medicinal plants; *In-situ* conservation and ex-situ cultivation of medicinal plants;Production of quality planting material; Extension activities - Information, Education and Communication(IEC); Study, demand, supply, position and marketing of medicinal plants for domestic and global market; Import/Export, IPR-issues; Research and Development in medicinal plants sector; Strengthening capabilities of NMPB. (For details visit-www. nmpb.@nic.in)

Important Issues And Problems

Conservation and Cultivation

The World conservation strategy (IUCN, UNEP & WWF, 1980) defines conservations as "the management of human use of the biodiversity so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations". The above definition invokes two complementary components **"Conservation"** and **"Sustainability".** Conservation is one of the important areas of medicinal plants sector. Conservation of medicinal plants, particularly the threatened species, is therefore considered to be the most important responsibilities of all biodiversity rich nations. Medicinal plants are potential renewable natural resources. Therefore, conservation and sustainable utilization of medicinal plants must necessarily involve long term, integrated, scientifically orientated action programme. A holistic and systematic approach envisaging interaction between social economic and ecological systems will be a more desirable one. The most widely accepted scientific technologies of biodiversity conservation are *in situ* and *ex situ* methods.

Threat status

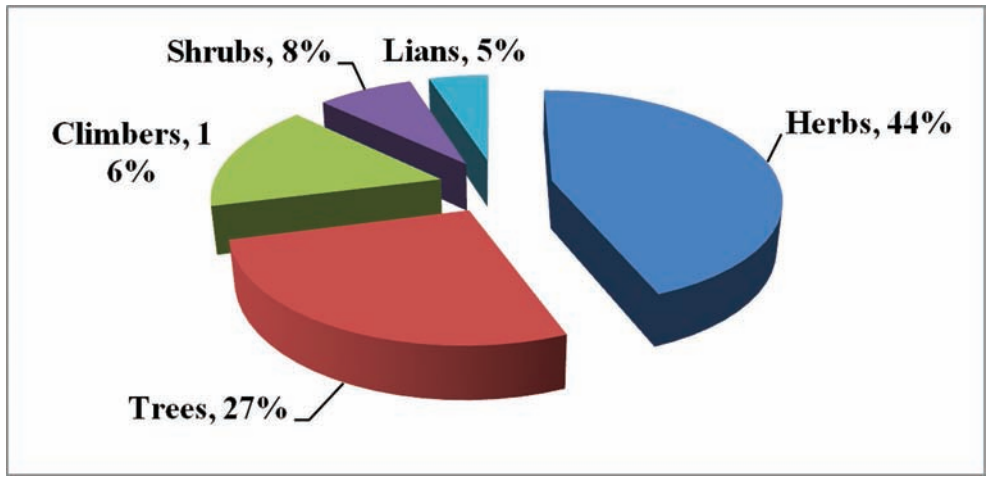
It is understood that the medicinal plants are threatened continuously due to over exploitation. There is no data available on the threat status and extent of threat of . medicinal plants. However, an assessment of selected species of medicinal plants of peninsular India and north India, covering states of Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra, Himachal Pradesh and Jammu & Kashmir, for their threat status based on Categories

of IUCN (now World Conservation Union), revealed that there are 100 traded species (from wild sources) that are under various degrees of threat, study conducted by FRLHT (Trade Database - 2003). Fourteen species have been identified to be threatened globally as these are endemic to India and deserve higher conservation priority. On the regional scale(in different states - Andhra Pradesh, Jammu & Kashmir, Himachal Pradesh, Kerala, Karnataka, Maharashtra, Tamil Nadu), threat status analysis revealed that 16 were recorded to be Critically Endangered (CR), 30 Endangered (EN) and 39 Vulnerable (VU).Habit wise break up of threat status of threatened species is given below:

In situ conservation

In situ conservation means-conservation of plants in their natural habitats - this include setting up of Biosphere reserves, Sanctuaries (1,15,903 Sq. km. area) and National parks (34,819 Sq. Km. area). The Ministry of Environment & Forests, Govt, of India has established eight biosphere reserves (out of 14 sites identified), 85 national parks and 448 sanctuaries are under the Wild life protection Act of 1972.

Threat status of Traded Medicinal Plants – Habit wise



Source : FRLHT, Trade Database, 2003

One of the systematic and pioneering conservation efforts in the country has been initiated in 1993, only in one out of the ten biogeographic regions of the country. The pro gramme was initiated in the three Southern states (Kerala, Tamil Nadu and Karnataka) and a comprehensive programme for establishing a **network** of 33 *in situ* forest reserves each one around 200 ha. size, covering different vegetation types, for conserving the medicinal plant biodiversity of the

region. The mega conservation strategy underlying this program is simple, yet elegant based on the fact that forest are natural gene banks. It is also most cost effective way of conserving the inter and intra specific diversity. Since 1998, this program has been extended to Andhra Pradesh and Maharashtra adding 21 more medicinal plant forest reserves to the network, thus a network of 54 forest reserves have been established. The State governments of the five peninsular states have decided to provide a separate chapter on the conservation and sustainable use of medicinal plants in their respective working plan of the State. They have also established 54 forest gene banks along with a chain of decentralized medicinal plants nurseries networking. The effectiveness and results of such conservation are yet to come and needs to be observed for further modification and adoption in other states.

Ex situ conservation

Ex situ means conservation outside natural habitats by cultivating and maintaining plants in botanical garden/parks and other suitable sites, besides through long term preservation of plant propagules in gene banks (seed/ pollen banks, DNA libraries etc.) and in plant tissue culture repositories by cryo-preservations. Of these cultivation is one of the important means of *ex situ* conservation. India has a network of about 140 botanical gardens including 33 gardens in the Universities and also the garden / herbal farms developed by the research councils (CSIR, ICAR, CCRAS etc.). But only few University botanical gardens have active programs on conservation, however, conservation of the endangered species *Commiphora wightii* at Guggulu herbal farm at Mangliawas (Ajmer) under CCRAS (Now under National Institute of Ayurveda, Jaipur) is worth mentioning. Herbal gardens are an important component of *Ex situ* conservation, they infact represent the species diversity and regional medicinal flora of a particular region. Herbal Gardens have also been jointly established by the State forest Deptt. and Ayurveda Deptt. in several States like Gujarat, Karnataka, H.P. etc. It has multifold advantages besides conservation. Tropical Botanical Garden and Research Institute (TBGRI), Trivandrum under Field Gene Bank program (1992-1999) has set an excellent example of *ex situ* conservation of medicinal and aromatic plants diversity. This program is essentially a blend of *ex situ* and *in situ* situations.

Biology offers a whole range of techniques for germ plasm conservation, particularly to the recalcitrant seeds or species that do not set seeds, through *in vitro* banks. Department of Biotechnology (DBT) under G-15 countries program of Govt, of India has established three National Gene banks for Medicinal and Aromatic plants at Central Institute of Medicinal & Aromatics

Plants, Lucknow, National Bureau of Plants Genetic Resources, Delhi and Tropical Botanical Garden & Research Institute, Trivandrum. These essentially take care of the different *ex-situ* methods of conservation of medicinal plants of India including cryo-preservation of medicinal species. DBT has also launched a program on molecular taxonomy of selected endemic and important medicinal plants of India.

Cultivation

There has been an enormous increase in the popularity of alternate medicine and herbal products all over the world; as such the demand is increasing day by day. During last decade number of Govt, organizations - institutions and schemes of ICAR, CSIRj NBPGR, Agriculture Universities and Deptt. of ISM, Family welfare, Deptt. of Agriculture Co-op., Forest Deptt. Govt, and some of NGO's have initiated development of Agro-techniques and cultivation of medicinal and Aromatic plants. Looking to the demand of vast medicinal plant sector, present efforts of cultivation of medicinal plant in the country is quite insufficient. The area of medicinal plants cultivation is estimated to be around 111000 ha. (FRLHT - Trade database,2003), which is 25% of the size of progress in China. In China the acreage under medicinal plant cultivation was reported around 450000 ha. In India 61% of medicinal plant in trade are still harvested from the wild and only 34% are only partially cultivated. Cultivation; program in India is not sufficiently supported with good agricultural practices like organic cultivation, sustainable harvest, period of harvesting, season of collection etc. besides suitable habitat, agro-techniques.

A review on the status of scientific information on the propagation and the agro-technology for 880 traded species (FRLHT - Trade Database, 2003) indicated that propagation methods for only 313 species are known and information on agro-techniques along with economics is known only for 108 species. This available information needs more detailed site specific and multi central trials besides other data required for the purpose. An analysis for sources of procurement of the 880 traded medicinal plants revealed that 538 of this species occur only in the wild with no known cultivation (FRLHT - Trade Database, 2003), where as 88 species are procured only from cultivation as no wild population exist 212 species are procured both from the wild as well as cultivation and 42 of this believed to be imported from other Countries. Among 48 exported species, out of 880 traded species, 5 are purely cultivated, 14 harvested from the wild and 24 species are found both in wild and cultivated sources and the remaining are exotic which are imported, semi processed and

exported. Most of the produce of cultivated medicinal and aromatic plants is exported as crude drugs. The details of cultivation are given below:

Psyllium *(Plantago ovata)*	in 50,000 ha.	Northern Gujarat, Western Rajasthan
Senna leaves *(Cassia senna)*	in 10,000 ha.	Rajasthan, Taniil Nadu
Opium *(Papaver somniferum)*	in 18,000 ha.	M. P., Rajasthaq, U. P,
Asgandh *(Withania somnifera)*	in 4,000 ha.	M.P. (Neemuch-Ratlam belt)
Saffron *(Crocus sativus)*	in 3,000 ha.	Kashmir (Pampore& Bhadarwah),

Apart from these species *Chrysanthemum cinerarifolium, Foenicum vulgare* and *Lawsonia inermis* are also cultivated and exported.

In the recent past cultivation of Safed Musali, Brahmi and few other species have also been extensively taken up mostly by the NGO's and fanners. There are no reliable data available, based on field studies about the total area and extent of commercial cultivation of medicinal plant.

Recognizing the trend many larger pharmacies like Dabur, Zandu, Himalaya drugs, AVS, Kottakal, Shree Dhootpapeshwar etc. have started promoting contract farming of medicinal plants to meet their demand. The modern pharmaceutical industries like Cipla, Natural remedies, Core Health Care, Cadila Health Care, Bio-Med Pharma etc. who specialize in production of a few speciality drugs/chemicals firom plant sources are also involved in contractual cultivation to supplement their requirements. They enter into *buy-back* arrangements with the growers and employ modern product standardization techniques. Established traders of crude drugs also feel that promotion of cultivation of medicinal plants is a step in right direction. (Annony. 2000).

Factors affecting cultivation

Cultivation of medicinal plants is profitable for some of the species like Safed Musali, Senna etc. but in most of the cases it is not cost effective. This is mainly because of the fact that the cost of production and sale price of cultivated plants is higher than that of wild produce. The farmers therefore are at loss. Some of the factors affecting cultivation are briefly given hereunder:

1. Lack of price parity with wild produce.
2. Lack of information on Agro-techniques, post harvest techniques and economics on cultivation.
3. Lack of quality planting material/elite Germ plasm.
4. Differences in properties of produce from wild and cultivated sources.

5. Lack of good Agricultural practices and organic farming.
6. Lack of information on market prices/Linkages.
7. Lack of support from financial Institutions

Domestic Users & Raw Material Requirements

The manufacturing sector consumes the highest volume of medicinal plants, apart from the practitioners and other users of ISM&H. The over all domestic turnover of the 8,000 licensed pharmacies in the manufacturing sector is estimated around Rs.4,200 crore per annum while the export turnover for the finished herbal products was estimated to be around Rs.239 crore per annum (2001-2002) while it was around Rs.634 crore in respect to export of crude drugs and plant extracts. There is also a large segment of non commercial users generally based on regional ecosystems. There is,' However, no reliable data available on the extent of consumption of specific raw materials. The estimation of actual or even fairly estimated demand of raw material is a difficult task because the basic data on source, consumption and the demand per annum of the raw drugs is usually not provided by the traders and manufacturers. If at all it is provided, it is far from realistic.

In order to assess the raw material requirement of medicinal plants by domestic commercial users three sources can be referred namely: a) Report "Demand study for selected Medicinal Plants" prepared by Center for Research, Planning and Action (CERPA), New Delhi, (2001-2002) commissioned by Govt, of India (GOT), DoISM&H, with a view to generate baseline information, b) Report of the Task force "On conservation & sustainable use of Medicinal Plants" commissioned by Planning Commission, GOI (2001). c) Interpolations carried out by foundation for Revitalization of Local Health Traditions (FRLHT) based on the annual turnover of herbal industry.

The data on domestic use of medicinal plants is given below:

Estimated Demand for Medicinal Plants

Source - Particular	Basis of Study (No. of Plants & year)	Domestic Demand (in tonnes)	Value (Rs. crore)
a) Study Commissioned by DoISM&H, GOI, Report "Demand study for selected Medicinal Plants" prepared by CERPA, New Delhi (2001-2002)	Total 1200 Plants (1999-2000)	198054-71	1099.18

Source - Particular	Basis of Study (No. of Plants & year)	Domestic Demand (in tonnes)	Value (Rs. crore)
	Plants not included in the study (1999-2000)	7723741	428.68
	162 Plants Studied (1999-2000)	120816.80-	670.50
b) Task Force on Conservation and Sustainable Use of Medicinal Plants-Planning Commission, GOI, March 2000		2,40,000	Not given
c) Estimates prepared by FRLHT (basedon National Draft Policy on ISM, 2001 and DGCIS data	Plant raw material for domestic/ industrial consumption + Exports excluding extracts	1,28,000	384 + 463 384 + 463 - Total 847

Source: Compiled from above sources.

Projected Data

Source - Particular DoISM&H - Demand study report (CERPA), GOI (2001 - 2002)	Domestic Demand (in tonnes)	Value, (Rs. crore)	Annual Rate of Growth
Demand of 162 Plants under study (1999-2000)	120816.80	670.50	‘
Demand of 162 Plants under study (2001-2002)	160541.6	88560.4	15.1% *
Demand of 162 Plants under study (2004-2005)	272617.8	145328.1	16.70%

The data given by each source agency provide different estimates and can not be reconciled. The CERPA and Task force report are based on very small number of pharmacies and species of plants. However, FRLHT basis though partially realistic needs further substantiation.

Domestic User's Profile

Manufacturing Units

The major users of the medicinal plants are the manufacturing units and the practitioners. The exact data regarding number of licensed pharmacies and their structural break up in terms of large medium and small companies are not available at single place since it is available in the respective states. The information gathered through secondary sources is given in following the table:

Sr. No.	Source	User Category	Numbers
1	CERPA Report and ISM Policy of GOI, 2002	Manufacturing Units	8343
2	CERPA Report and ISM Policy of GOI, 2002	Codified practitioners (licensed)	5,00,000
3	LSPSS Reports	Folk Practitioners	1,00,000

Source: Reports cited above

The number 8343 of ISM manufacturing units is dominated by Ayurveda (7149) manufacturing units followed by Homeopathy (615), Siddha (309) and Unani (270). According to an estimate there are 6965 small/ very small manufacturing units (turnover Rs. 1-5 crore); 25 under the category of medium manufacturing units (turnover Rs. 5-50 crore) and 10 large pharmacies with over Rs. 50 crore turnover. The state wise distribution of registered manufacturing units in the following table indicate that large proportion of units are located in U.P. followed by Tamil Nadu, Kerala, Gujarat and Maharashtra.

State-wise Distribution of Registered Manufacturing Units in India

Name of State	Mfg. Units	Number of Large Units
Uttar Pradesh	2133	38
Andhra Pradesh	785	18
Tamil Nadu	710	10
Kerala	670	34
Gujarat	623	22
West Bengal	603	15
Maharashtra	515	26
Rajasthan	447	6
Madhya Pradesh	406	14
Bihar	344	12
Haryana	272	2

Karnataka	235	4
Orissa	196	3
Delhi	118	10
Punjab	117	3
Himachal Pradesh	65	8
Assam	47	4
Daman & Diu	21	0
Dadra Nagar Haveli	13	4
Goa	7	0
Jammu & Kashmir	7	1
Chandigarh	4	0
Pondicherry	4	1
Tripura	1	0

Source: Demand Study for Select Medicinal Plants, vol (1-a) Dept. of ISM&H, Govt, of India

The requirement of individual pharmacy varies depending upon the total number of quantity of high and low values of medicinal herbs used by them. For example Gufic, Mumbai requires annually 49.5 tones of raw material out of 49 species while Shree Dhootapapeshwar Ltd., Mumbai requires 204 tones of material of 30 species, Ms. Sandu Brothers Ltd., Mumbai need 1760 tones of 156 species per annum. The average requirement for eight pharmacies is 1291.8 tones per annum of 130 species costing about Rs. 4,07,52,184. The total crude drug demand of govt, and pharmacies (1998-99) vary from 60 tones for M.P. to 2300 tones for Kerala. Based on the data available through published sources and quick assessment survey conducted by the Group on Pharmacy Linkages, it is estimated that the current demand of medicinal plants is about 2.4 lakh tons annually and it is growing at the rate of about 20 % per year. This demand pertains to the internal consumption only. (Task Force Report, 2001).

The unsustainable ways of harvesting and unrestricted marketing have led to the reduction in population of some of the high demand species leading to sudden price rise and short supply in the market. Some of the major pharmaceuticals like Dabur, Zandu, Himalaya drugs, AVS, Kottakal etc. have started promoting contract farming to meet their demand.

Due to growing levels of public awareness in herbal products both in domestic and global markets and projected growth 20-30% of the industry, quality control and standards have become very important. In view of this Govt, of India, Ministry of Health & F.W. (DoISM&H) in the year 1997 notified and published Good Manufacturing Practice (GMP). It is now mandatory for all manufacturers to obtain GMP certificates from Drug Controlling Authority of government.

Registered Practitioners and Folk healers

Practitioners are another major category of users of medicinal herbs after the manufacturing units. Though their use of herbs by converting them into medicinal preparations is declining (as several practitioners use ready made medicines prepared by manufacturing units), however, there still are thousands of traditional practitioners, who believe in processing the plants themselves and preparing the medicines for the patients. The number of registered practitioners in the ISM&H is given below:

Registered ISM Practitioners in India

Indian System of Medicines	No. of Practitioners
Ayurveda	427504
Siddha	16599
Unani	42445
Naturopathy	429
Homeopathy	194147
Total	681124

Source: National Policy on ISM&H, 2002, Govt of India

In the following table Medical System - wise usage of medicinal plant/ raw materials being used is given :

System wise Usage of medicinal plants

System	Percentage
Ayurveda	81.70%
Folk	67.97%
Homoeopathy	14.90%
Modern	06.38%
Siddha	56.72%
Tibettan	23.77%
Unani	52.29%

Folk Practitioners

There are estimatedly around 1 million folk practitioners inhabiting 6 lakhs odd villages of India, apart from the licensed practitioners. They in fact form the non-commercial users of medicinal plants primarily depending on the ecosystem using locally available approx. 8000 species of plants for their

health care needs. Such noncommercial users include housewives/ mothers, traditional birth attendants, bone setters, herbal healers, Vish Vaidyas and other specialists.

Import and Export

Global Trade in Medicinal Plants

The medicinal plants export share of India is nearly 13% in the global market, which is estimated at US $ 1.03 billion. However, in the global herbal market (incl. medicines, food supplements, cosmetics etc.), which is estimated to be US $ 62 billion, Indian share is negligible. According to the trade analysis systems of ITC, Geneva/ UNCTAD, leading exporters of medicinal plants are China, USA, India, Germany and Korea. Top ten exporting countries accounted for 85% of global exports. China is the leading player with 26% of global exports while India is a third major exporter with nearly 9% of global exports in 2000. Leading importers of medicinal plants are Hong Kong, USA, Germany, Japan, France, Korea Republic, Italy, China, Malaysia and Singapore. These top ten countries together accounted for over 70 percent of global imports.

Import

All the raw materials used by the Pharmacies are not of indigenous origin. Considerable supplies are received from Nepal, Bhutan, Bangladesh, Pakistan, Afganistan, Singapore etc., often through informal routes. For instance most of the 'Chirata' and other Himalayan medicinal plant / crude drugs come from Nepal and Bhutan, 'Oleoresin gugul of best quality from Pakistan, 'Liquorice' from Afganistan and good quality of 'Banshalochan' from Singapore. According to the data 'received from CHEMEXCIL, of the total estimated annual demand of 31,780 tons of raw herbal material of pharmaceutical industries, 7180 tons is met with through import. The requirements of Akkalkada-*Anacclus pyrethrum,* Jestimadh - *Glycirrhiza glabra* (Pakistan, Iran, Afganistan), Dalchini-*Cinnamomum zeylanica* (China) etc. are mostly met through imports. About 90% requirements of Gugul *(Commiphora wightii)* is received from Pakistan. The data of CHEMEXCIL however, doesn't include any information in respect of import of medicinal plants of foreign origin and finished products thereof, such as Ginko biloba, Ginseng, St. John's Wort, Selimarine and such other items.

Leading importers of medicinal plants are Hong Kong, USA, Germany, Japan, France, Korea Republic, Italy, China, Malaysia and Singapore. These top ten countries together accounted for over 70 percent of global imports. Hong

Kong and USA together accounted for more than 30 percent of global imports. The analysis of importing pattern of major countries reveals that Hong Kong sourced more than one-third of its imports from China. Other major source countries include USA, Canada, Korea and Japan. USA has primarily sourced its medicinal plants and products from India and China. These countries together accounted for over 50 percent of USA's imports. (Trade Analysis Syst. ITC, Geneva)

Export

Export opportunities of natural products are tremendous, as the world market is looking towards natural sources for the purposes of therapeutic use as well as nutritional dietary supplements. The global herbal remedies market can be classified into five strategic areas viz. i) Phyto-Pharmaceuticals ii) Medicinal Botanicals/ Botanical Extracts/ Herbal or Dietary Supplements iii) Nutraceuticals iv) Cosmeceuticals v) Herbal raw material. Herbal raw material market is very large but no definite estimates are available to quantify its size in dollar terms. Immense opportunities for Indian herbal industries exist in global herbal market in view of its vast herbal resources.

Apart from domestic requirement of medicinal plants for internal consumption, India exports crude drugs mainly to developed countries, viz, USA, Germany, France, Switzerland, UK and Japan, which share between them 75 to 80 percent of the total export of crude drugs from India. The principal herbal drugs that have been finding a good market in foreign countries are species of *Aconite, Aloe, Belladona, Acorus,Cinchona, Cassia (tora), Dioscorea, Digitalis, Ephedra, Plantago* (Isabgol), *Cassia* (Senna) etc. The total value of export of crude drugs, has increased from Rs.394 crores in 1996-97 to Rs. 446 crores in 1998-99. (Source: Planning Commission - Task Force Report, 2000).

The available international information (Trade Analysis Syst., ITC, Geneva, 2000) on exports of medicinal plants by India revealed that India exported around US $ 80 million worth of medicinal plant to the world in the year 2000. Leading markets for India are USA, Japan, Germany, UK, Taiwan, Italy, France, Indonesia, Pakistan and Hong Kong. However, the statistical analysis released by Directorate General of Commercial Intelligence Statistics (DGCIS) showed that India exported medicinal plant valued at US $ 98 million in the year 2001-02.

Sizeable number of medicinal plants used in ISM&H medicines all over India are exported and also imported from other countries. In the following tables

habit-wise Exported/ Imported medicinal plants and their percentage used in various medical systems and Leading exporters of medicinal plants is given:

Export/Import Analysis of Traded Plants Habit-wise

- Out of 880 traded species
- Exported from India 44 Spp.
- Species imported from foreign countries 42 Spp.

	Exported	Imported
Herbs	23 Spp. (49%)	14(33%)
Trees	17 Spp. (35%)	16(39%)
Shrubs	4 Spp. (8%)	19 (21%)
Climbers	4 Spp. (8%)	3(7%)

Source : FRLHT, Trade Database, 2003 and DGCIS.

Medical Systems-Wise medicinal Plants Exported / Imported

Exported (%)	Systems	Imported (%)
88.58	Ayurveda	65.66
78.16	Folk	40.47
67.75	Siddha	32.33
46.91	Tibetan	13.28
31.25	Homeopathy	30.95
28.16	Modern	22.80
	Unani	56.14

Source: FRLHT, Nomenclature Browser, 2003

Leading Exporters of Medicinal Plants

(SITC Code 2924 - Plants and parts of plants primarily used for pharmacy, perfumery and insecticides: fresh, dried, powered-US $ million).

Exporting Countries	1999	2000	2001	%
China	211874	216526	199702	23.8
USA	104294	105215	76344	11.6
India	44151	79454	NA	8.76
Germany	65564	55514	52555	6.12

Exporting Countries	1999	2000	2001	%
Korea Rep.	58624	54944	47832	6.06
Singapore	42689	44559	42098	4.92
France	45823	54344	53031	6.00
Canada	32777	29761	46818	3.28
Chile	28899	20463	22990	2.25
Poland	20843	18419	14817	–
All Countries	903954	906004	759305	–

Source: Trade Analysis System of ITC–Geneva

Major Foreign Exchange Earning Item (Crude Drugs and Extracts)

Of the selected 59 items, the major value earners are Psyllium husk, saps and extracts, Kambodge extracts, extracts N.E.S., Henna powder, Ayurvedic and Unani herbs N.E.S., other crude drugs Senna leaves and pods, Sandal wood chip and Karaya gum. In the classification of the items under the categories; Ayurvedic and Unani herbs/crude drugs etc. no clue regarding the plant source is given. However, 48 species have been identified as export item from DGCIS statistics. The data of top 10 medicinal plants is given in the following table:

Export of Top 10 Medicinal Plants and Extracts (2001-2002)

Sl. No.	Item Code ITC	Items		Value (US $ Million)
1	12119015	Psyllium Husk (Isobgul husk)	25581.75	50.55
2	13021100	Saps and Extracts of Opium	192.14	16.82
3	13021908	Cambodge Extract	920.89	9.27
4	13021919	Extracts, N.E.S.	628.73	8.16
5	14041013	Henna Powder	6732.89	7.20
6	12119026	Ayurvedic and Unani Herbs N.E.S.	7451.64	6.67
7	12119049	Other Crude Drugs	3861.83	5.90
8	12119022	Senna leaves and Pods	8237.85	5.79
9	12119018	Sandal wood chips and Dust	471; 42	3.77
10	13019006	Karaya Gum	169.38	3.56
		Total Above	55695.52	117.69
		Grand Total (57 items)	67270.22	133.28

(Source: Indian Trades, CMIE, and Statistics of the Foreign Trade of India by countries, DGCIS, GOI, Calcutta, 2001-02)

Apart from these India has also exported extract totaling US$ 36 million in the same year. An analysis of 59 crude drugs and extracts exported from India in 2001-02 showed that high value crude drug represents 60% of the total export income while herbal extracts (incl. Garcinia/ Kambodge, liquorice etc.) accounts for 27% of the export earnings and other low value crude drugs (Neem leaves, seed, *Vinca rosea* etc.)represents 13% of exports (DGCIS, 2001-02).

Most of the developed countries like USA, UK, Japan, Germany and France are the major markets for the botanicals like Senna, Psyllium husk, Henna etc. Out of the 10 widely traded items Henna powder is one of the top export items exported to West Asian region (UAE, Syria, Saudi Arabia and Turkey). The, laxative items are primarily exported to developed countries.

Major Markets of India

The top 10 markets for India for exports pf plants and plant based products is given in the table below. USA is by far, the leading importer of crude drugs and extracts accounted for 50% of India's medicinal plants export earnings followed by Japan, France, UK, UAE and Germany.

Top 10 Markets for India for Export of Plants and Plant Based Products

Sl. No.	Country	Quantity (tons)	Value (US$ Million)
1	U.S.A.	21322.01	67.63
2	Japan	6251.27	9.59
3	France	3343.81	4.71
4	U.K.	2128.86	4.00
5	UAE	1861.01	3.46
6	Germany	2375.87	3.16
7	Indonesia	1095.04	2.97
8	Spain	1335.45	2.65
9	Taiwan	4688.16	2.44
10	Australia	923.89	2.16

Source: India Trades, CMIE, and Statistics of the Foreign Trade of India by countries, DGCIS, GOI, Calcutta, (2001-2002).

Export Earnings/Trends

An analysis of exports of plants, extracts and crude drug from India reveal that the highest earnings of Rs. 463 crore is from crude drugs followed by

finished products (Rs. 240 crore) and extracts (Rs. 171 crore). The trends in exports of medicinal plants indicate an increasing trend over the last three years. As regards the region specific export trends the analysis indicates that India increased its exports to North America significantly in the year 2001-02. However, India has lost export opportunities moderately in all other regions, except Africa. The exports to Africa increased from US $ 1.15 million in 2000-01 to US $ 1.73 million in 2001-02.

Herbal Markets Profile in USA

According to an estimated information (Commerce Deptt, US Bureau) in 2001. USA has imported US $ 604 million worth of herbal products (as defined by HTS) which includes herbal tea, herbal infusions, vegetable saps, extracts, pectates, ginseng etc. India was the largest US supplier of herbal products with shipments to totaling US $ 121 million (20% import market share), followed by China 14%, Australia 9% and Denmark 7%. India has an edge in the US market for herbal products over other suppliers such as China, while for some products such as Opium and Psyllium husk practically India is the only supplier. There is substantial scope for export. Export data of some of the herbal products to USA is given here under:

U.S. Imports of Vegetable Saps, Extracts, Pectates etc. (HTS # 1302)

Major Suppliers		Millions of U.S. Dollars		% Share	
		2000	2001	2000	2001
Rank	World	450.13	455.15	100	100
1	India	95.67	81.73	21.25	17.96
2	Australia	33.86	51.35	7.52	11.28
3	Denmark	31.22	41.75	6.94	9.17
4	China	44.83	39.90	9.96	8.77
5	France	32.45	34.85	7.21	7.66

(Source: US Department of Commerce, Bureau of the Census)

The table shows that India is on the top of the U.S. import market for herbal products in 2001 exporting vegetable sap, extracts and pectates.

In the export of Opium India cornered the entire 100% U.S. market worth US $ 39 million in 2001. There were nil exports from Turkey. Another major export item Guar gum (*Cyamopsis tetragonoloba*) is primarily valued for its seed gum, which is emulsifier and stabilizer used in food products, cosmetics and pharmaceuticals. It's cultivation in U.S. may affect its export potential from India. India has topped in the export of Guar gum in 2001 followed by Pakistan.

It has nearly 70% share in the over all export of Guar gum to U.S.A. The export data are given here under.

U.S. Imports of Pectates : Mucilages/Thickners from Guar Seed (HTS # 1302.32.0020)

Major Suppliers		Millions of U.S. Dollars		% Share	
		2000	2001	2000	2001
Rank	World	53.70	38.93	100	100
1	India	39.70	26.98	73.92	69.31
2	Pakistan	8.19	6.71	15.25	17.23
3	France	1.33	1.31	2.48	3.36
4	Morocco	1.45	0.91	2.7	2.34
5	UK	0.88	0.80	1.63	2.05

(Source: US Department of Commerce, Bureau of Census)

In the export of the plants for pharmacy, perfumes, insecticides etc. in 2001 India again led with export worth US$ 38 million followed by China US$ 36 million as given here under:

U.S. Imports of Plants etc., for Pharmacy, Perfume, Insecticides etc. (HTS # 1211)

Major Suppliers		Millions of U.S. Dollars		% Share	
		2000	2001	2000	2001
Rank	World	132.52	137.44	100	100
1	India	28.78	37.75	21.72	27.47
2	China	39.28	35.80	29.64	26.05
3	Germany	6.48	7.19	4.89	5.23
4	Italy	4.24	6.19	3.20	4.50
5	Hong Kong	6.69	6.06	5.05	4.41

(Source: US Department of Commerce, Bureau of Census)

The Psyllium seed husk better known in India as Isabgol is another item in which India has topped among exporters to U.S.A. market which is known for its natural bulking ability. India exported US$ 31 million worth Isabgol to U.S.A. in 2001 (see table below). As there is no competitor for India over this item, the scope for growth is considerable and further growing.

U.S. Imports of Psyllium seed husks, fresh or dried, having

Anesthetic, Prophylactic or Therapeutic properties and Principally used as medicaments or ingredients (hts # 1211.90.8020)

Major	Suppliers	Millions of U.S. Dollars		% Share	
		2000	2001	2000	2001
Rank	World	24.63	31,39	100	100
1	India	24.62	3139	99.96	100
2	Canada	0.01	0.00	0.04	0

(Source: US Department of Commerce, Bureau of the Census)

The herbal/convenience iced teas comprising of mixed herbs is one of the item in which India has topped the export list with 18.48% share followed by China 17.18% as given in the table below.

U.S. Imports of Herbal Teas and Herbal Infusions Comprising Mixed Herbs – NESOI (HTS # 2106.90.9987)

Major	Suppliers	Millions of 1	U.S. Dollars	% Share	
		2000	2001	2000	2001
Rank	World	8.86	11.08	100	100
1	India	0.30	2.05	335	18.48
2	China	1.96	1.90	22.11	17.18
3	Canada	1.35	1.48	15.21	13.38
4	South Korea	0.78	0.99	8.76	8.97
5	UK	0.74	0.81	8.4	7.35

(Source: US Department of Commerce, Bureau of the Census)

Potentials Herbs

As per information from local pharmacies, herbal products based on the following herbs have a good market potential in U.S.

1. Echinacea *(Echinacea purpurea)* used as an immuno-stimulant in the treatment or prevention of colds, flu, bacterial and fungal infections, cancer, arthritis etc. However, it is not recommended for long term, continuous use.

2. Garlic *(Allium sativum)* - One of the most versatile medicinal plants. Scientific studies have shown its beneficial effect for coronary heart

disease patients, lowering blood pressure and regulating the circulatory system. There is a good market for garlic based herbal products in USA.

3. Ginger *(Zingiber officinale)* Said to have positive effects on heart tissue, to be useful in treatment of arthritis, as well as motion sickness and nausea. There is a good and growing market in USA for ginger based products.

4. Maidenhair tree *(Ginkgo biloba)* products are among the most popular herbal dietary supplements in the US. It is touted here as a way to beat life's aging process, normal body deterioration and useful in vascular diseases. Its market is already large and growing. In Germany, the extract from *Ginkgo biloba* leaves has been prescribed for circulatory system disorders and its retail sales are over US$ 700 million annually.

Strategies for Export Promotion

In view of the rich biodiversity, traditional knowledge heritage and fast growth of herbal global market, India needs to improve pattern of export and should develop 'gold standards' through organic cultivation, effective post harvesting, storage technologies and better extraction methodologies. In 2001, India topped among the exporters of certain items to USA as given above. It is necessary for Indian manufacturers and policy makers to identify the "best Indian plants" (along with associated spp.), most traditionally reputed products for exports in each of the different global market segments. Some of the criteria for promotion or selection of species could be the following:

1. Identification of highly reputed products based on Indian traditional knowledge for such health care applications which can cater to the universal set up of health needs.

2. Associated knowledge product should be identified for: i. Human use preventive, promotive, curative ii. Veterinary care iii. Cosmeceuticals iv. Neutraceuticals and v. Agricultural use.

3. Selection of species which can be easily grown/ cultivated by households in wide range of habitats and agro-climates.

4. Selection of species should preferably be herbs/ tuberous herbs, grasses, climbers, shrubs and lastly trees.

5. The final selection of products should be based on market survey to match the acceptance of the Indian products to consumer needs in different global market segments.

The Inner Story – The Trade of Medicinal Plants

Survival on the Forests

It is an accomplished fact that owing to rich vegetation and forests of our country over 90% population live traditionally in rural areas, in and around forests since ages and utilize forest produce for their day to day needs including medicines. Even now dependency on forests and forest produce is size-able. According to some studies and estimation** given below, a large section of rural population, including tribals, depend on the forests and the forest produce for their survival. The data is just on two states of the country, forest dependency number may even be more.

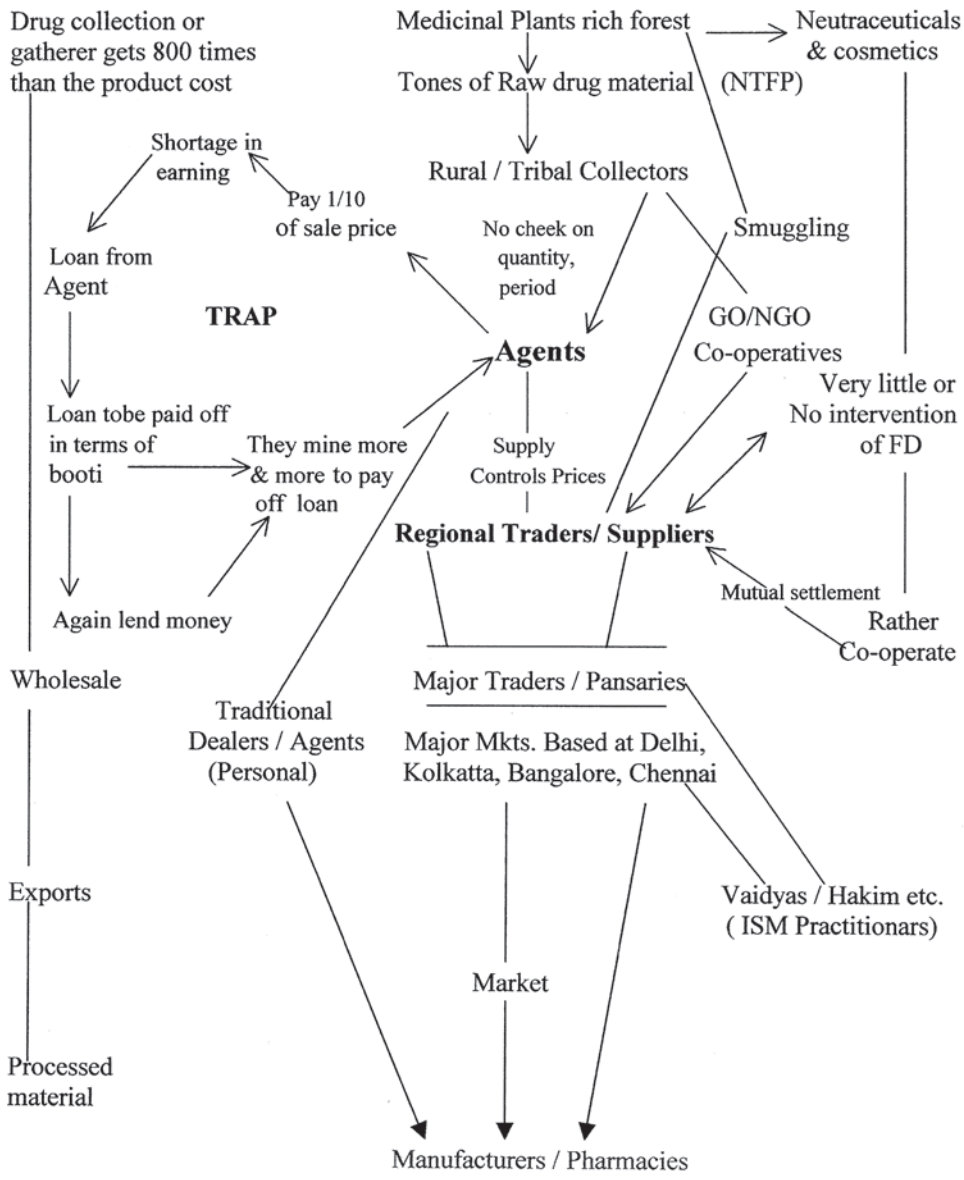
No. of people live in and around forest and rely on NTFP for survival:	-	50 million
Poor and under employed people rely on Collection and processing of medicinal plants yield Annual employment	-	Over 35 million work days
No. of persons (average) enter in forests of Tamil Nadu State each day to collect forest produce including medicinal plants :	-	1 million
No. of people in Rajasthan sustain themselves Through collection/processing and marketing of NTFP (incl. raw drugs):	-	5 million

National Center for human settlements and Envronment, Bhopal.'Down to Earth' Jan. 2001.

The resource base or the base material, for pharmacies in the Medicinal Plants Sector is the biodiversity rich forests distributed in various types of Habitats. Local poor Tribals or rural gatherers (forest dwellers), are in fact the collector and carrier of the raw drugs for the Industry. They depend on herb gathering for their survival. They collect all types of whole plant or different parts of (high & low value) herbs for their Agent who in turn pay Rs.350-400 to them, the amount little less than what is actually required i.e.Rs.500/- per week/family for their lively hood (i.e. food, liquor, Tobacco etc.). Thus, the family is now short of Rs. 100-150/- before they start work for the next week in the forest. The herb gathering knowledge of the tribals is exploited by the monopolistic agent/ local forest officials. The poor gatherer need money for their sustenance, The agent now trap the poor gatherer and offer a loan, which is to be paid in terms of collection of herbs along with next week's collection. The vicious circle is set, the loan is never paid in full and keep on mounting and gatherer are always

under pressure to collect more and more. They never come out of the deadly clutches of the agent. Thus the agents and traders through exploitation of local people strip the forests off their medicinal wealth. The forest deptt express their helplessness. The exploited species of plants become endangered and the list of threatened plants keep on increasing, while some of them are heading towards extinction.

The Inner Story (The Herbal Heist)



The supply chain of medicinal herbs starts from the local people herb gatherers, mostly tribals. They being poor and needy, are rather forced to mine the drugs more and more, at a very nominal cost for their survival and to pay-

off loans to the Agent. The Agent sells to the local Traders who in turn sale it further to the regional traders or directly to the major traders or pharmacies. The forest department (FD) officials are silent spectators or have mutual understanding with the agents/ traders. The major markets for these items at the national level are Khari Baoli, Delhi; Bara Bazar, Kolkata; Avenue Rd., Bangalore and GBN Street Chennai.

Legal Aspects

Some of the species like Kuth (*Sassurea costus*) and many others which are prohibited from wild for exports by CITES are also being collected and traded. Export and import (Exim) of medicinal plants in India is regulated by the Exim policy of GOI and CITES (Convention on International Trade in Endangered species of wild flora and fauna). For export of the species in Append. - H of CITES list, a certificate of cultivation is required. But for traders it is not a problem, they can bribe officials or by forging document, they manage. The Govt, in their recent order (MoEF) has barred just 114 species and freed export of all medicinal plants from wild. It is a welcome decision for the traders, opening everything for trade from wild without any supporting conservation/ cultivation mechanism, and it is only going to denude the forests. Moreover, there is no parallel domestic legalization that curbs illicit exploitation of herbs in wild. In domestic trade it is not compulsory to indicate source/ origin of plant, wild or cultivated, except in NTFP list, which is not forceful.

The FD maintain that there is no illegal trade in their region (and along International border) and also no shortage of staff. At times seizures are carried out as a face saving exercise by the FD, as was reported to be done in Sept 1999 in Raxaul in West Bengal. A consignment of 7114 kg. of Sarpagandha *(Rauwolfia serpentina)* was seized at the Kolkata dock, but only a small penalty was imposed. Like wise the collection of banned item, high altitude Himalayan species *Saussurea lappa* root in thousands of kg and of *Taxus baccata* 450314 Kg. which was transported illegally, without any check all the way from the Himalayan ranges to South India and was seized in Tamil Nadu, is an interesting example of the on going Herbal heist. (Chakrabarty & Varshney 2001).This is just a small part of the Inner Story of Herbal Trade in Medicinal plants sector of our country.

Trade across International Borders

The border stretch between India, Nepal and Bhutan particularly along the West Bengal and Bihar are free - for - all herb trade areas. The number

of critically endangered species in high demand such as Mamira *(Coptis teeta),* Agar wood *(Aquilaria malaccensis),* Sarpagandha and 'Talis-patra' etc. find their way from the East and North eastern parts including Nepal, China, Mayanmar and Bhutan to Kolkata market, usually illicitly. According to Hiraknandy Consultant, WWF - Kolkata, some of the herbs in gunny bags are brought into India or taken to Nepal etc., or some times hidden within unbanned items in trucks or in materials of daily use and pass it on the villages on other side of the border. Sometimes the collection from Assam and Arunchal Pradesh forests are smuggled in to Nepal from where it is re-exported to India with a certificate of cultivation. Such practice is done by bigger traders, wholesalers etc. visiting personally to the site.

The above facts have been further supported in an interesting survey by "Down to Earth" team - Leena Chakrabarti and Vibha Varshne(2001) in an attempt to find out the effects of illegal trade on ISM and why cultivation of these valuable plant is still not a business. The survey gave interesting first-hand information on details of *modus operandi* on the exploitation of the plant collectors, smuggling raw drugs from the forests etc. was conducted in some parts of India, including Madurai area in Tamil Nadu and Dehradun area (U.P.).

Madurai area : In the rich forests of Shenbaha Thopu, 24 families of Pallyan community are involved traditionally in collecting non-timber forest produce (NTFP). This community has now been exploited of their raw drug collecting knowledge by an agent Selvam, master of the area and local forest officials, Nearly 197 species of medicinal plants are collected and smuggled out of the forests. The tribal people who are in the clutches of the agent have to collect the required herbs for their lively hood and to repay the unending loans. The agent Selvam never rejects a loan. Similar is the story in a near by forest area Thaniparai in Rajapalyam with 1660 ha of protected forest. The range forest officer is usually absent for months and the office is occupied by the forest Guard. Here also the situation is no different from Shenbaha, here the monopolistic agent is Sundaram. Like Selvam, he also lends money to the needy tribal people whenever they need. They repay by selling their collection of herbs. To pay back the loans and also the interest, the gatherers keep going deeper into the forests. They do not have direct access to traders and even if they try to sale directly to traders, Sundaram's men and forest officials threaten them to harm physically. About the 'law' and forest officials, he says - "What Laws? There are no laws here." He has a warehouse for storing medicinal plants. According to him this help him to control flow of herbs to the market and regulate the prices. As regards exploitation of gatherers, he denies that they are exploited. According to him he pays quarter of the profits he gets after

selling the plants to the traders. However, the survey of *Down to Earth* reveals that the tribals get very little i.e. one tenth of the amount Sundaram gets from traders.

According to an oral agreement with the FD, a NGO, Society for Tribal Development (STD) is authorized for collection of 10 species. But usually 20 times more collection is done for smuggling purpose. The STD is unable to affect the Sudaram's strong hold over the gatherers.

Material and Market

As regards selling price, the species like *Gymnema sylvestre* (Gurmar) an endangered species in the area is sold to the agent for Rs. 10/- per kg while the agents sale them in the market for Rs. 40/- per kg. Similarly there is a vast difference between the amount paid to gatherer for a raw material and subsequent prices for the processed material derived out of it, as given in the table here under for 3 species :

The Herb Gatherer is Paid Almost 800 Times less than the price the product Fetches in the Market

Species	Gatherer (Rs.)	Wholesale (Rs.)	Exporter (Rs.)	Processed material (Rs.)
Solanum xanthocarpum	1.5	7	15	1,200
Phyllanthus niruri	0.75	4.5	08	1,900
Centella asiatica	15	30	38	1,940

Note : The gatherer price is for one kg of the material and the price of the final product is what is derived from one kg of the material.

Source: K. Kamraj, *et.al* 1997, 'Value addition industries of Madurai', Dissertation for American College, Madurai, April.

According to an estimate during 1997-98, 188 varieties of raw drugs measuring about 250 metric tones of dry materials derived from 169 species were traded in Madurai market alone. About 10000 drug gatherers are employed for collecting raw drug material for 10 odd major traders. The collection from the forests of Shenbaha Thopu and Thaniparai finally reaches Virudhnagar and Madurai markets from where it is exported out side country through Tuticorn port.

Himalaya - Dehradun area U.P. : In one of the incidents (April, 1999) 12 truck loads carrying various quantities of medicinal plants, not listed in NTFP (banned material), waiting at the check post, were tipped off by the Director

of a reputed environmental NGO in Dehradun. The trucks were forced to halt due to strike. He tried to gather support from various quarters, including forest Dept. (FD) to take action, but to no avail. When the strike ended the trucks left for their destination, unchecked. This is just one incidence of the kind, tones of plants are smuggled every day from the Himalayan area, which can be called as herbs Smuggler's paradise.

Of late, over a decade, in U.P. (presently Uttaranchal) collection of certain herbs (not banned) from the forest land is being done through the agency of 'Bhesaj Sangh' on contractual basis, whose members include forest-dependent local persons. The FD's role ends after the contract is signed. "How they execute is their sole prerogative" says the Dy. Conservator of forest, Dehradun circle to the 'Down to earth' team. The problem starts there after. How and in what quantity, through how many routes, the collection of medicinal wealth goes out, there is no check or regulation. The money paid to the drug collectors by the Co-operative is much less than the rates offered by private traders. For example, for collection 'Kutki' *(Picrorhiza kurroa)* Rs. 22.25 per kg is paid by the co-operative while the traders offer Rs. 56/-; per kg., to encourage gathers to sell through illegal channels. Survey in Arunachal Pradesh showed that the gatherer gets Rs. 4/- for 1 kg of 'Talis patra' *(Taxus wallichiana)* while it is sold for Rs. 35/- kg in the near by market. The price multiplies at each level.

A study conducted by Traffic-India showed that among the traded species availability of 'Ativisha' *(Aconitum heterophyllum)* and *Podophyllum hexandrum* is decreasing at the rate of 26 - 50% annually.

In Kerala also there is vast differences i.e. 767 - 1757 percent, between the prices offered by Girijan Co-operative Society (managing collection of 120 NTFP) and the local traders. This fact has been reported by an International Development Research Center, Kerala based on a study conducted around Trivandrum, Kerala in their report, the data on 9 drugs are given here under:

The Price Offered by Co-operative and Local Traders varies by as much as 1,757 percent

Species	Price offered by cooperatives (Rs)	Price offered by traders (Rs)	Percentage of variation in price
Adhatoda vasica	1.40	13.75	882
Eclipta alba	1.00	8.67	767
Clerodendron serratum	1.90	28.00	1,374

Species	Price offered by cooperatives (Rs)	Price offered by traders (Rs)	Percentage of variation in price
Cyperus rotundus	1.90	12.75	571
Syzigium cumini	1.40	16.67	1,091
Tragia involucrata	4.75	29.88	529
Helicteres isora	1.15	10.50	813
Phyllanthus amarus	1.00	18.57	1,757
Momordica dioca	3.30	37.67	1,042

Note: The study was conducted in and around Trivandrum, Kerala.

Source: J. Holley and K. Cherla, 1998. The Medicinal Plants Sector in India, International Development Research Centre, New Delhi, p 44.

Chaotic Situation

The situation is very serious, the trade is going on, while the precious medicinal species from the forests whether in South, East, West or North India are stripped off their treasure. One can collect any amount of the medicinal herbs paying very little amount to the drug collector, who is in the clutches of the trader. Every day tons of truck loads of raw drug material, worth millions of rupees is collected by hundreds of Veerappan like agents/ traders and is smuggled from the forests to markets within and out of Country. The vicious nexus of the traders directly with the manufacturers is also in practice. In short the unorganized, unregulated illicit harvesting and trade in medicinal plants sector is a 'free for all' zone. Under these circumstances, what will be the fate of ISM drug manufacturing industry in the Country? This is the Inner Story behind our tall and great claims of rich biodiversity/ boosting exports and quality drugs.

***** Plants, Plant portions and their derivatives and extracts obtained from the wild prohibited for exports

1. Cycas *beddomei* (Beddom's cycad)
2. *Vanda coerulea* (Blue vanda)
3. *Saussurea costus*
4. *Paphiopedilium species* (Ladies slipper orchid)
5. *Nepenthes khasiana* (Pitcher plant)
6. *Renanthera imschootiana* (Red vanda)

7. *Rauvolifia serpentina* (Sarpagandha)
8. *Ceropegia species*
9. *Frerea indica* (Shindal Mankundi)
10. *Podophyllum hexandum* (emodi) Indian Podophyllum)
11. *Cyatheaceae species* (Tree ferns)
12. *Cycadacea species* (Tree ferns)
13. *Dioscorea deltoidea* (Elephants Foot)
14. *Euphorbia species* (Euphorbias)
15. *Orchidaceae species* (Orchids)
16. *Pterocarpus santalinus* (Redsanders)
17. *Taxus wallichiana* (Common Yew or Birmi leaves)
18. *Aquilaria malaccensis* (Agarwood)
19. *Aconitum species*
20. *Coptis teeta*
21. *Coscinium fenestrum* (Calumba wood)
22. *Dactylorhiza hatagirea*
23. *Gentiana kuroo* (Kuru, Kutki)
24. *Gnetum* species
25. *Kampheria galenga*
26. *Nardostachys grandiflora*
27. *Panax pseudoginseng*
28. *Picrorhiza kurrooa*
29. *Swertia chirata* (Chirayata)

** List of Prioritized Plants for Development and Cultivation Under Scheme of NMPB

Plants Eligible for 20% subsidy

#	Botanical Name	Common Name	Eligible subsidy (%)	Remark
1.	Acorus calamus Linn.	Vach	20	
2.	Aloe vera (Linn.) Burn.	Ghritkumari	20	

#	Botanical Name	Common Name	Eligible subsidy (%)	Remark
3.	Andrographis paniculata (Linn. Burn	Kalmegh	20	
4.	Artemisia annua (Linn.)	Artemisia	20	
5.	Asparagus racemosus Willd.	Shatavari	20	
6.	Azadirachta indica A. Juss	Neem	20	
7.	Bacopa monnieri (L.) Pennell	Brahmi	20	
8.	Boerhaavia diffusa Linn.	Punarnava	20	
9.	Cassia angustifolia vahl.	Senna	20	
10.	Caesalpinia sappan Linn.	Patang	20	
11.	Centella asiatica (Linn.) Urban	Mandookparni	20	
12.	Chlorophytum borivillianum Sant.	Shwet Musali	20	
13.	Cinnamomum verum Presl C. tamala and C. camphora	Dalchini, Tejpat, Kapoor	20	
14.	Coleus barbatus Benth.	Pather Chur	20	
15.	Coleus vettiveroides K.C. Jacob	Hrivera	20	
16.	Convolvulus microphyllus	Shankhpushpi	20	
17.	Cryptolepis buchanani Roem & schult	Krsna sariva	20	
18.	Digitalis purpurea Linn.	Foxglove	20	
19.	Dioscorea bulbifera Linn.	Rotalu, Gethi	20	
20.	Embelia ribes Burm. f.	Vai Vidang	20	
21.	Emblica officinalis Gaertn.	Amla	20	
22.	Garcinia indica Choisy	Kokum	20	Commercial Crop
23.	Ginkgo biloba	Ginkgo	20	
24.	Gymnema sylvestre R. Br.	Gudmar	20	
25.	Hedychium spicatum Buch-Ham.ex Smuth	Kapur kachari	20	

#	Botanical Name	Common Name	Eligible subsidy (%)	Remark
26.	Hemidesmus indicus R.Br.	Anantmool, Indian Sarsaparilla	20	
27.	Holarrhena antidysenterica Wall.	Kurchi/Kutaj	20	
28.	Ipomoea petaloidea Choisy	Vrddhadaruka	20	
29.	Ipomoea turpethum R. Br.	Trivit	20	
30.	Litsea glutinosa	Listea	20	
31.	Lepidum sativum Linn.	Chandrasur	20	
32.	Mucuna prurita Linn.	Konch	20	
33.	Ocimum sanctum Linn.	Tulsi	20	
34.	Phyllanthus amarus Schum & Thonn.	Bhumi amlaki	20	
35.	Piper longum Linn.	Pippali	20	
36.	Pluchea lanceolata (DC) CB Clark.	Rasna	20	
37.	Solanum nigrum Linn.	Makoy	20	
38.	Stevia rebaudiana	Madhukari	20	Export Potential
39.	Terminalia arjuna (Roxb.) Wt. & Arn.	Arjuna	20	
40.	Terminalia bellirica Gaertn.	Behera	20	
41.	Terminalia chebula Retz.	Harad	20	
42.	Tinospora cordifolia Miers	Giloe	20	
43.	Vitex negundo	Nirgundi	20	
44.	Withania somnifera (Linn.) Dunal	Ashwagnadha	20	
45.	Woodfordia fruitcosa Kurtz.	Dhataki	20	

Plants eligible for 50% subsidy

#	Botanical Name	Common Name	Eligible subsidy (%)	Remark
46.	Aegle marmelos (Linn.) Corr.	Beal	50	LG, Root

#	Botanical Name	Common Name	Eligible subsidy (%)	Remark
47.	Albizzia lebbeck Benth.	Shirish	50	LG, Bark
48.	Alstonia scholaris R.Br.	Satvin, Saptaparna	50	LG, Bark
49.	Altingia excelsa Noronha	Silarasa	50	
50.	Anacyclus pyrethrum DC.	Akarkara	50	
51.	Atropa belledona	Atropa	50	
52.	Coscinum fenastratum (Gertn) Colebr.	Peela Chandan	50	
53.	Crataeva nurvala Buch – Ham.	Varun	50	LG, Bark
54.	Dactylorhiza hatagirea (D.Don) Soo	Salampanja	50	
55.	Gloriosa superba Linn.	Kalihari	50	
56.	Glycyrrhiza glabra Linn.	Licorice Roots, Mu	50	
57.	Gmelina arborea Linn.	Gambhari	50	LG, Root
58.	Hippophae rhamnoides Linn.	Seabuckthorn	50	
59.	Inula racemosa Hk.f.	Pushkarmool	50	
60.	Leptadenia reticulata (Retz) Wt. & Arn.	Jivanti	50	
61.	Mesua ferrea Linn.	Nagakeshar	50	LG
62.	Panax pseudo-ginseng	Ginseng	50	
63.	Parmelia perlata Ach.	Saileya	50	HA, SG
64.	Piper cubeba Linn. f.	Kababchini	50	
65.	Plumbago zeylanica Linn.	Chitrak	50	
66.	Pueraria tuberose DC.	Vidarikand	50	
67.	Premna integrifolia Linn.	Agnimanth	50	HA, Root
68.	Pterocarpus marsupium Roxb.	Beejasar	50	
69.	Rauwolfia serpentina Benth. ex Kutz	Sarpagandha	50	MG, Root
70.	Salacia reticulata, salacia oblongata	Saptachakra (Saptar)	50	

#	Botanical Name	Common Name	Eligible subsidy (%)	Remark
71.	Saraca asoca (Roxb.) De Wilde	Ashok	50	LG, Bark
72.	Smilax china Linn.	Hrddhatri (Madhu Chob Chini Lokhan)	50	
73.	Stereospermum suaveolens DC.	Patala	50	LG, Root
74.	Tacomella undulata (Sm.) Seem.	Rohitak	50	
75.	Tylophora asthmetica	Damabooti	50	
76.	Taxus wallichiana Linn.	Thuner, Talispatra	50	
77.	Uraria picta (Jacq.) Desv.	Prishnaparni	50	

Plants eligible for 75% subsidy

#	Botanical Name	Common Name	Eligible subsidy (%)	Remark
78.	Aconitum ferox Wall./A. balfouri	Vatsnabh	75	HA
79.	Aconitum heterophyllum Wall. ex. Royle	Atees	75	HA
80.	Aquilaria agallocha Roxb.	Agar	75	HA, LG, Endangered
81.	Berberis aristata DC.	Daruhaldi	75	HA, Root
82.	Commiphora wightii (Am.) Bhandari	Guggal	75	HA, Root
83.	Ferula foetida Regel.	Hing	75	LG, Resin from base of stem
84.	Gentiana kurroo Royle	Trayamana	75	HA
85.	Nardostachys jatamansi DC	Jatamansi	75	HA, Rhizome
86.	Oroxylum indicum Vent.	Syonaka	75	LG, Root
87.	Picrorhiza kurroa Benth. ex Royle	Kutki	75	

88.	Podophyllum hexandrum Royle.	Bankakri, Indian podophyllum	75	HA, LG
89.	Polygonatum cirrhifolium Wall.	Mahameda	75	
90.	Pterocarpus santalinus	Raktachandan, Red sanders	75	LG, Wood
91.	Santalum album Linn.	Chandan	75	LG, Wood
92.	Saussurea costus C.B. Clarke	Kuth, Kustha	75%	
93.	Swertia chirata Buch-Ham	Chirata, Charayatah	75	HA

HA - High Altitude
LG – Long Gestation
MG – Medium Gestation
SG – Short Gestation
Uni - Universal

Suggestions

The medicinal plants sector in the country has to address diverse issues to a large number of varied stakeholders, which comprise of both Government and Non government organizations (GOs & NGOs). Following are some of the stakeholders:

i. Ministries and Deptts. of Government of India / State Govt, particularly Deptt. of Agriculture, Environment, Forests, Health and Commerce & Industries,

ii. Traders and Manufacturers.

iii. Collectors / Middle men and Cultivators / Growers of Medicinal plants,

iv. Relevant NGOs engaged in various activities of the sector,

v. Scientists / Researchers and Research Institutions and Laboratories,

vi. Consumers - Commercial and non-commercial,

vii. Ecosystem dependent communities — Traditional / Folk healers.

viii. National / International organizational networks related with Medicinal plant sector.

Medicinal plants sector in India operates in **policy vacuum**. Immediate action is needed to regulate various components of the Sector including wild harvesting, conservation, cultivation, trade and marketing, domestic production etc. Immediate steps are required to be taken before it is too late.

In order to streamline the unorganized medicinal plant sector, there is a need, and responsibility of all the stakeholders, to act jointly in right direction. The GOs, NGOs and Corporate sector will have to make combined focused approach for streamlining and developing the sector in framing suitable policies, Planning and if necessary, amending the drugs and cosmetics act/ wild life acts or even introducing new legislatures. The National Medicinal Plants Board (NMPB) has to play a pivotal role for the development of the sector in all the spheres . Some of the suggestions are given here under:

1. NMPB and SMPB(State Medicinal Plants Board) has to be strengthen and given more power. A separate agency under NMPB consisting of representatives of three major players i.e. DoAYUSH, MoEF, Ministry of Agriculture could be constituted for policy framing implementation and regulation for medicinal plants sector.

2a. Need to have a separate medicinal plants Division or Cell in MoEF and in State forest departments, exclusively to monitor various activities, conservation measures, sustainable harvesting from the wild and transit of medicinal plants (NMPB intervention).

2b. Similarly, a separate agency or department for Medicinal Plants (MP) is needed in Agriculture ministry / State Agriculture department for Monitoring and addressing issues of MP cultivation all over the country (NMPB intervention).

3. Lack of coordinated approach - A need to avoid duplication/overlapping of schemes/projects and work related to MP, within and outside. government departments like MoEF, DoAYUSH, DST and Min. Agri., DBT, Universities etc.

4. Implementation of the issues after modifications if required, recommended by the Task Force GOI, (2000) for the stakeholders like MoEF, Min. Agri. (ICAR), DoAYUSH, DoFW, DBT, DSIR, DST, Pharmacies and Medicinal Industries, NGOs.

5. Forceful and honest implementation of MP regulations and policies. To regulate prices and to reduce disparity between the prices of wild and cultivated raw materials.

6. Issues like : i. Policy and Institutional arrangements for sustainable utilization of MP. ii. Focus on environment and biodiversity conservation of different habitats, iii. Systematic cultivation of MP as per International norms, iv. Quality control and Standard finished products of MP v. Organizing market trade and exports, requires focused attention.

Other Important Issues

7. State-wise inventorisation of collectors (gatherers), growers, traders (agents) and manufacturers (category wise) of MP.

8. State-wise **registration** of collectors (gatherers), growers, traders (agents) and manufacturers (category wise) of MP.

9. Encourage cultivation of MP in a big way - like " Green revolution"

10. Establishment of **network of monitoring agency** for end to end check on flow of MP.

11. Mechanism for **quality control** from sale (raw material), processing up to finished products for domestic and export purposes.

12. Harvesting **from wild** - The FD (MoEF) and State FD together with NMPB has to formulate a System and Regulations for wild harvesting of MP with a special reference to following issues:

    i. Collection of MP, plant parts sustainably, region wise by identified agencies.

    ii. Only authorized, registered, trained gatherers of identified agencies be allowed to collect MP.

    iii. Cash payment of wages to collectors based on material, quantity etc. to avoid exploitation,

    iv. End to End monitoring mechanism for harvesting, certification, transportation, storage, distribution and sale with a check at every level of supply chain up to the pharmacy.

    v. For each and every collection of MP identity, source, quantity (plant part), period of collection/ expiry, collecting and transporting agencies including certificate from monitoring agencies should be mandatory,

    vi. Only sealed or packed, certified harvested raw materials indicating above parameters be allowed for sale (mandatory),

vii. The pharmacy should also have detailed record of source(s) material.

viii. Check on harvested MP material. Penalty for over exploitation of MP by act or law.

ix. Mechanism for conservation / regeneration of harvested material. The harvesting agency may be involved in the mechanism.

x. Monitoring flow and distribution of the harvested material to regulate prices.

13. Organize Trading community of the Medicinal plants sector and need to strengthen the regulations and linkages with Govt & Scientific organizations.

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Fingerprint Analysis of *Psoralea corylifolia* Linn. Seeds (Babchi) by Ultra Performance Liquid Chromato-graphy with Photodiode Array Detector

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Abstract

chemical fingerprint method for methanolic extract of seeds of *Psoralea corylifolia* Linn. was developed for Quality Control analysis by Ultra Performance Liquid Chromatography with Photodiode Array Detector (UPLC-PAD). *Psoralea corylifolia* Linn., seeds collected from Pharmacy, Central Research Institute of Unani Medicine, Hyderabad and extract was analyzed by using a reverse-phase Waters Acquity BEH C_{18} column (50 mm × 2.1 mm, 1.7 µm). Among mobile phases investigated such as methanol-water, acetonitrile-water, and acetonitrile-buffer (containing Orthophosphoric acid), the water (A) - acetonitrile (B) system was the ultimate choice. Gradient elution was essential with gradient mobile phase consisted of 0.1%OPA in (water: Acetonitrile : 10:1) (A) and acetonitrile (B) using a gradient program at a flow rate of 0.5 mL/min with detection at a wavelength of 254 nm. The chromatographic fingerprints showed different chemical constituents qualitatively in *Psoralea corylifolia* Linn. seeds, out of which psoralen peak identified corresponding to the retention time of standard Psoralen and further confirmed by UV spectrum. The Psoralen content in seeds extract of *Psoralea corylifolia* Linn. which is an active principle is accurately determine corresponding to that of standard Psoralen with shorter analysis time.

Key Words: Fingerprint, *Psoralea corylifolia*, Seeds, Ultra Performance Liquid Chromatography (UPLC)

Introduction

Today the world is impending on herbal medicine and attracting considerable attention because of its excellent qualities such as low toxicity and less side effects, proven medical effects and rare drug tolerance (Wang *et al*., 2010; Kong *et al*., 2009; Feng *et al*., 2006). It is well known that medicinal plants collected at different harvesting times and from different regions may considerably differ in types and quantities of chemical components, which results in affect of quality of pharmaceutical products and in standardization of herbal medicine (Wang *et al*., 2009; Caballero-Ortega *et al*., 2007; Zhang *et al*., 2009). Correct identification and quality assurance of the starting material is, therefore, an essential prerequisite to ensure reproducible quality of herbal medicine, which contributes to its safety and efficacy (Straus, 2002; De Smet, 2002).

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The quality assessment and control of herbal medicine is an important concern for both the health authorities and the public (Eisenberg *et al*., 1998; Xu *et al*., 2005; Cardeal *et al*., 2008). Most investigations focused on several markers or pharmacologically active constituents to assess the quality and potency of the herbal medicine or preparations, which cannot stand for the overall quality of herbal drugs. Therefore, developments of reliable, comprehensive quality assessment methods are necessary for herbal drugs (Gu *et al*., 2004). The fingerprint technique, which emphasized on the whole characteristics of samples' compositions and focuses on identifying and assessing the stability of the samples, was accepted by WHO, (Anonymous, 2000). High Performance Liquid Chromatography (HPLC) played the most important role among all the fingerprint techniques (Zhou *et al*., 2009). However, the traditional HPLC fingerprints cannot meet the requirements of high throughput analysis due to the low column efficiency and long analysis time with generally more than an hour (Ye *et al*., 2009; Xu *et al*., 2009a, Xu *et al*., 2009b). In recent years, UPLC has been reported as a viable technique for quantitative and chemical fingerprint analysis of herbal medicines, prior to HPLC analysis (Wang *et al*., 2010; Kong *et al*., 2009; Liu *et al*., 2007).

Psoralea corylifolia L. is a widely used medicinal plant in India and Asia (Yadav and verma, 2005). The seeds of *P. corylifolia* L. exert antioxidative, antimicrobial and anti-inflammatory activities (Haraguchi *et al*., 2002; Karsura *et al*., 2001; Ferrandiz *et al*., 1996). *Psoralea corylifolia* Linn. seeds have been used for the treatment of various kinds of skin disorders such as vitiligo, Psoriasis, eczema, asthma, cough, nephritis, and calvities (Anonymous, 1985). The effective components of the herb are coumarins. Psoralen and isopsoralen are the major components. Pharmacological test revealed that they have antitumor (Wu *et al*., 1998), antibacterial and antivirus activities and can affect metabolism of some remedy (Mi, *et al*., 1998). Psoralen is used as reference standard in the quality control of *Psoralea corylifolia* Linn., seeds. So the isolation and purification of psoralen and isopsoralen are of great interest. Psoralen (7H-Furo (3, 2-g) (1) benzopyran-7-one) is the major and most active furanocoumarin present in *Psoralea corylifolia* which promotes pigmentation (Sebastian, 2006; Khastgir *et al*., 1959). Psoralen has been found to intercalate into DNA, where they form mono and di adducts in the presence of long wavelength UV light and thus are used for the treatment of hypo-pigmented lesions of the skin like leucoderma (Vaidya, 2006). In this paper, a UPLC chemical fingerprinting method was developed for quality control of the *Psoralea corylifolia* Linn. seeds.

Materials and Methods

Standards and reagents

Standard Psoralen (purity ≥ 99%) was purchased from Sigma Aldrich (Bangalore). LC grade water, acetonitrile and methanol were purchased from Fischer Scientific (India). AR grade Ortho Phosphoric acid (purity 88%, Himedia) as buffer used in preparation of mobile phase.

Plant materials

Psoralea corylifolia Linn. seeds sample collected from Pharmacy, Central Research Institute of Unani Medicine, Hyderabad as shown in figure 1. Authentification and identification of sample based on morphological characteristics is done from the same institute. For the chemical fingerprinting analysis, sample is pulverized to obtain a uniform powder for extraction used for the study.

Sample preparation

Sample powder (5.0 g) was accurately weighed and extracted with 30mL methanol under ultrasonic water bath for 60 min at 25°C with 17 W and 60 Hz of power (Oscar ultrasonic, India). After cooling, methanol was added for the lost weight. Then the solution was filtered through a 0.2µm membrane filter and 1µL was injected for UPLC analysis.

Preparation of Standard Solution

Standard solution of Psoralen (1000 µg/mL) was prepared by dissolving in 10ml methanol and the aliquots is used for UPLC analysis. The concentrations of standard Psoralen used for calibration were 50, 100, 150 and 200 µg/mL. The standard curve was calibrated using the linear regression equation derived from the peak areas.

UPLC equipment and conditions

Experiments were performed on a Waters Acquity UPLC-H Class system (Waters, USA) equipped with a Quaternary solvent pump, an auto sampler and a PDA detector, and connected to Waters Empower software. The mobile phase consisted of 0.1%OPA in (water: Acetonitrile :: 10:1) (A) and acetonitrile (B) using a gradient program of 80% A in 0-1 min, 80-20% A in 1-7 min, 20% A in 7-8 min. The flow rate was 0.5 mL/min. The detection wavelength and column temperature were 254 nm and 40°C respectively. UV spectrums were acquired in the range 190-400 nm (2 nm resolution).

In this paper the chromatographic profile of psoralen stdandard and *Psoralea corylifolia* Linn. methanolic extract of seeds were analyzed using a binary gradient. Psoralen Characteristic peaks in the chromatogram was obtained at retention time 1.743 min was used as a reference for sample. Correspondingly retention time for Psoralen in the sample was obtained at Rt 1.745

Table 1 : Peak list of Psoralen standard with Retention time.

S. No.	Name	Retention Time	Area	% Area	Height
1	Psoralen	1.743	573051	100.00	200984

Table 2 : Peak list of seeds extract of *Psoralea corylifolia* Linn. with Retention time.

S.No.	Name	Retention Time	Area	% Area	Height
1	Psoralen	1.745	36660	0.24	12940
2	-	3.886	1848366	12.12	1126124
3	-	3.975	216896	1.42	135609
4	-	4.101	258318	1.69	152435
5	-	4.327	347683	2.28	210248
6	-	4.413	250444	1.64	133268
7	-	4.446	206645	1.36	125826
8	-	4.565	265653	1.74	163843
9	-	4.925	194197	1.27	67260
10	-	5.110	422359	2.77	243099
11	-	5.301	361982	2.37	194443
12	-	5.510	1182168	7.75	589662
13	-	6.074	397830	2.61	205156
14	-	6.773	9257610	60.72	3148375

Figure 1: *Psoralea corylifolia* Linn. Seeds sample

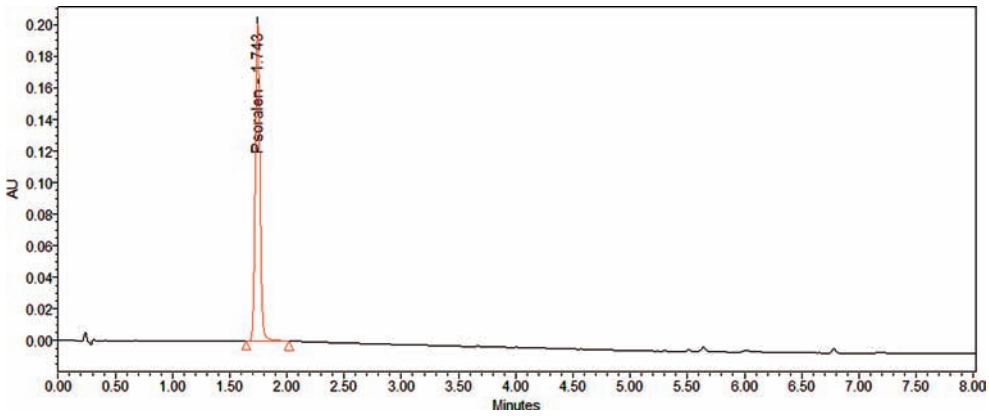

Figure 2: UPLC Chromatogram of standard Psoralen.

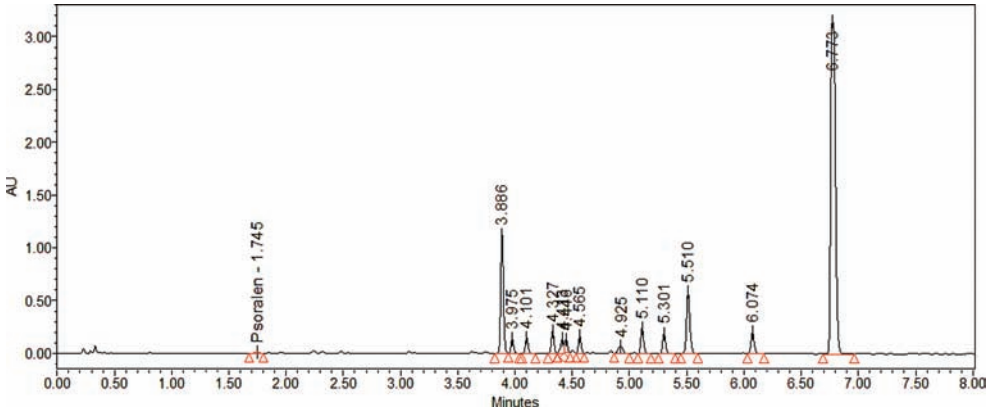

Figure 3: UPLC Chromatogram of seeds extract of *Psoralea corylifolia* Linn.

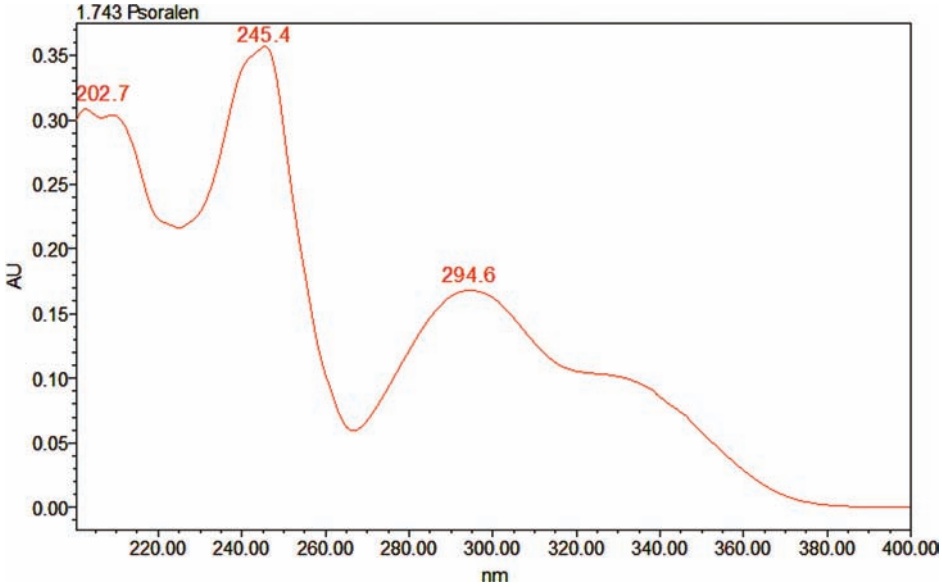

Figure 4: UV spectrum of standard *Psoralea*.

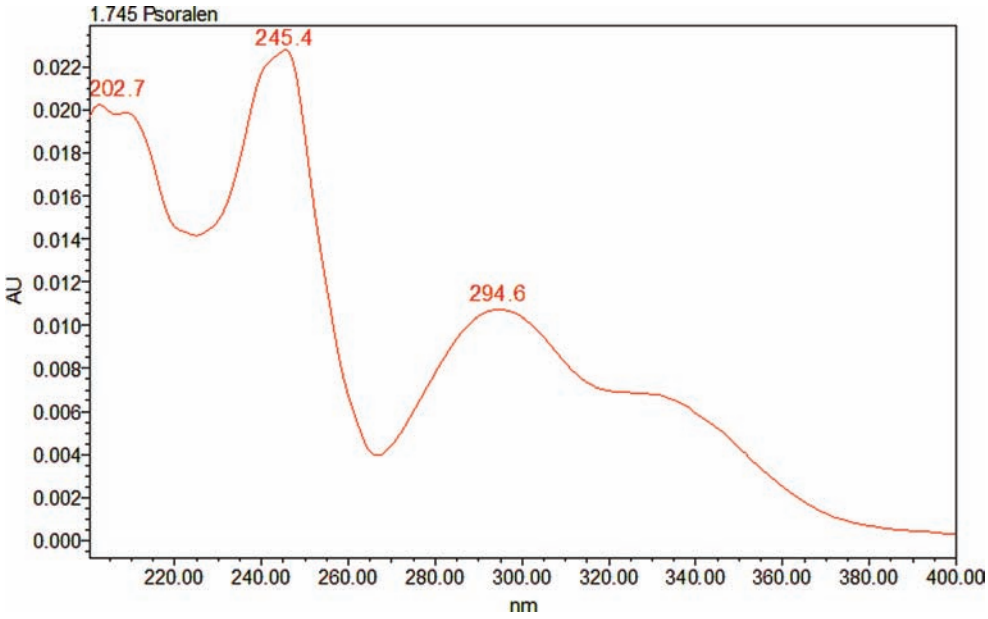

Figure 5: UV spectrum of Psoralen peak in seeds extract of *Psoralea corylifolia* Linn.

Results and Discussion

Optimization of UPLC conditions

Conditions such as the mobile phase, flow rate, column temperature and detection wave length were investigated to get the best resolution for psoralen in *Psoralea corylifolia* Linn. seeds.

Mobile phase was thought to be the main effect on the resolution when the column was selected with Waters Acquity BEH C_{18} columns (50 mm × 2.1 mm, 1.7 µm). Among mobile phases investigated such as methanol-water, acetonitrile-water, and acetonitrile-buffer (containing Orthophosphoric acid), the water (A) - acetonitrile (B) system was the ultimate choice. Gradient elution was essential for the separation. The gradient time, gradient polarity and initial composition of the mobile phase were taken into consideration. The gradient program was finally designed as 80% A in 0-1 min, 80-20% A in 1-7 min, 20 % A in 7-8 min. Column temperature of 40°C and flow rate of 0.5mL/min was resulted good separation. Besides, wave length of maximum absorption has been determined by a photodiode array detector and four wave lengths at 254, 275, 290, 310 nm were selected and compared. Wave length of 254 nm was selected to obtain the lowest baseline noise, a sufficiently large number of detectable peaks and better resolution in the chromatograms. Under the optimal conditions, almost all the components in the extracts of *Psoralea*

corylifolia Linn. seeds were well separated with high peak capacity within 8 min.

UPLC fingerprints development of Psoralea corylifolia Linn. seeds and identification of peaks:

Chromatographic fingerprints obtained for standard Psoralen and for seeds of *Psoralea corylifolia* Linn. are shown in figure 2. In the present study, Psoralen Standard consisting of Peak at Rt 1.743 in the chromatogram having total peak area of 573051 corresponding to 100% area as shown in table 1 whereas methanolic extract of seeds of *Psoralea corylifolia* Linn. consisting of 14 peaks in chromatogram shown in figure 3 whose peak area, area%, height and Rt are shown in table 2. The psoralen peak has been identified in the sample chromatogram by comparison of UV spectrum obtained from the PDA spectrum and extracted at 254nm and the UV spectrum of psoralen standard and psoralen in sample extract are shown in figure 4 and 5 which are identical confirming the peak to be psoralen. The amount of Psoralen content estimated in the sample corresponding to peak area of standard psoralen and was found to be 0.1279 µg%. A UPLC method was developed for the quantification of psoralen in *Psoralea corylifolia* seeds. The analysis of sample can be completed within 8 min. This method possesses the advantages of simplicity, sensitivity and good reproducibility and will be applicable to the quality control of seeds of *Psoralea corylifolia* Linn.

Conclusion

A method of UPLC was developed for chemical fingerprint analysis obtained for seeds extract of *Psoralea corylifolia* Linn. The chromatograms of standard psoralen and the sample containing Psoralen was compared for the identification of psoralen in the sample and its content determined by the UPLC fingerprints method which proved that the established method was suitable for fingerprint analysis of quality control of *Psoralea corylifolia* Linn. Based on the result obtained the content of Psoralen in the sample corresponding to standard psoralen was found to be 0.1279 µg% in the seeds within the shorter run time of 8min. The results also showed that UPLC possessed the advantages of shorter analysis times, higher column efficiency and less solvent consumption for the quality control of seeds of *Psoralea corylifolia* Linn. These superiorities make UPLC an attractive alternative to conventional HPLC technique in herbal medicine fingerprinting analysis. Therefore, the method developed in this study would provide an important reference to establish the quality control method for other related herbal single drugs or preparations.

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A Monographic Profile of Halela Zard – An Official Unani Drug

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Abstract

erminalia chebula Retz. is widely used as drug in Unani, Ayurvedic and Siddha System of medicine. The drug is an excellent antioxidant, astringent, laxative, diuretic and antacid. In Ayurvedic System of Medicine *Terminalia chebula* Retz. is one of the major ingredients of well known formulation "Trifala churna". The present studies deal with detailed pharmacognostic studies and review the related medicinal aspects of drug.

Key Words – *Terminalia chebula* Retz., Drug Standardization, Quality Specifications.

Introduction

The pericarp of mature fruits *of Terminalia chebula* Retz. (Family-Combretaceae) is commonly known as Halela Zard in Unani System of Medicine and widely used in the preparation of many formulations like Itrifal Kishneezi, Itrifal Zamani, Itrifal-e-Ustukhuddus, Itrifal-e-Shahtra etc. The plant is found throughout the greater part of India, Barman and Ceylon. The popular and Sanskrit name of the drug (*Terminalia chebula* Retz.), *Haritaki* is rich with meaning, referring to the yellowish dye (harita) that is contains, as well as indicating that it grows in abode of the God Shiva (Himalayas). There is a legend, that when God Indra was drinking Amruta a drop of it fell down on the earth. From that one drop seven types of Haritaki were produced. There are various varieties of *Terminalia* are described depending on colour, shape as well as harvested of the fruit. At present time, two varieties only are recognized, large ripe fruit is *haritaki,* and unripe dried fruit is *jangi haritaki* is the vernacular. *Terminalia chebula* (black myrobalan) one of the most valuable Indian tanning materials. The fruit is dry and heating; laxative, stomachic, tonic and alternative.

Methodology

Drug samples were collected from different places with a view to find out any significant difference present within the same species. For studying powder, Jackson and Snowdon (1992) was followed. To determine physico-chemical constants, Indian Pharmacopoeia (Anonymous, 1966) was consulted and for fluorescence study schedules mentioned by Trease and Evans (1972) were followed. Colours were named by consulting Rayner (1970). Standard

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prescribed procedures for histochemical studies (Johanson, 1940; Youngken, 1951; Cromwell, 1955; Trease and Evans, 1978), organic group detection (Robinson, 1963); U.V. Spectrophotometry (Willard *et al*., 1965) and Chromatography (Shellard, 1968; Stahl, 1969; Smith and Feinberg, 1972) were adopted. The informatics is complied by reviewing the available literature.

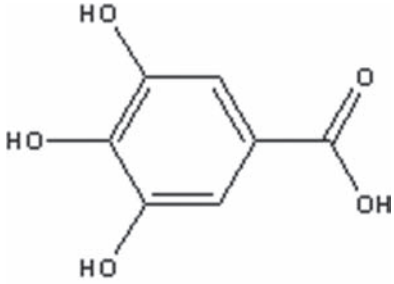
Systematics

Terminalia chebula Retz. (family : Combretaceae) is a moderate sized or large deciduous tree attaining a height of up 30 m. with a cylindrical bole, rounded crown and spreading branches. Leaves7-20 cm by 4-8 cm in height, ovate or elliptic, glabrous above with a yellowish pubescence, margin entire, acute, alternate; petioles 2.5 cm. long, pubescent, usually with two glands near the top. Flowers are monoecious, sessile, dull white to yellow, with a strong unpleasant odour, borne in terminal spikes, usually in short panicles. Fruit is glabrous, ellipsoid to ovoid drupes, more or less 5-ribbed, when dry yellowish green; containing single angled, bony and very thick stone. *Terminalia chebula* Retz. is found throughout the greater part of deciduous forest of the Indian subcontinent, Burma and Ceylon, up to 5,000 ft. in the outer Himalayan and up to 6,000 ft. in Travancore. A large, deciduous tree, commonly found in North India from Kumaon to West Bengal. It is found also in Maharashtra, Tamil Nadu and above the Ghats in Kanara in South India.

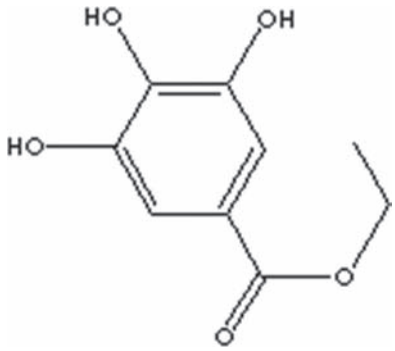
The plant is known by different vernacular names e.g. Haritaki (Bengali), Haritaki (Gujarati), Harra, Har, Harara, Harad (Hindi), Katukka (Malayalam), Habra, Hirada, Hirda (Marathi), Katukkay, Amagola, Arabi, Aridadi, Attan, Kadu (Tamil), Karakkaya, Karaka, Nallakaraka, Resaki (Telugu), Haejarad (Urdu) and Chebulic myrobalan, Black Myrobalan (English), etc.

Chemical Constituents

So many numbers of glycosides isolated from *Terminalia*, including the triterpenes arjunglucoside I, arjungenin add chebulosides I & II. Other constituents include acoumarin conjugated with gallic acid called chebuli, as well as other constituents include amino acid, fructose, succinic acid, and beta sitosterol. Other phenolic compounds ellagic acid, 2, 4- chebulyl-β-D-glucopyranose, chebulinic acid, ethyl gallate, punicalagin, terflavin A, terchebin, luteolin and tannic acid (Dermaderosia & Beuller, 2002; Coldecott & Tierra, 2006).



Gallic acid



Ethyl gallate

Pharmacology

Halela Zard has been used as an aphrodisiac, diuretic and for earaches. It work best when blood supply to the heart is compromised as in ischemic heart disease or angina and also reduce cholesterol levels. It increasing awareness, and has a nourishing restorative effect on the central nervous system. *Terminalia* has diuretic and digestive properties, its improves digestion, promotes the absorption of nutrients and regulates colon function, so it is excellent to improve digestion, remove waste and impurities from the body, and stimulate the regeneration of tissues. It also plays a role as an anti-antherogenic, antifungal, antiviral and antiseptic activities (Dermaderosia & Beuller, 2002).

Therapeutic and non-therapeutic Uses

The pericarp of mature fruits of Halela Zard is laxative, stomachic, tonic and alternative. It used in fever, typhoid, cough, asthma, urinary diseases, piles, intestinal worms, chronic diarrohea, costiveness, expectorant, anthelmintic, antidysenteric, flatulence, sore throat, thirst, vomiting, hiccup, heart disease, bladder , vesicular calculi, bleeding piles, enlarged spleen and lever, acsites, eye diseases, skin diseases etc (Duke *et al.,* 2002).

The pericarp of mature fruits of Halela Zard has been used as an aphrodisiac, diuretic, and for earaches. In Indian medicine it used to treat digestive problems, also used in mouthwash/gargle, a fruit powdered used as dentifrice and used in carious teeth, bleeding and ulceration of gum. As an alternative tonic for promoting strength, preventing the effect of age and prolonging life. A decoction of the fruit is a good astringent wash.

The fruit is also used as a dye and tanning material, with iron salts it is employed in making country ink, and mixed with ferruginous mud it makes a black paste employed by harness and shoe makers as well as by dyers.

Classical Formulations

Unani System of Medicine

Itrifal Kishneezi, Itrifal Zamani, Itrifal-e-Ustukhuddus, Itrifal-e-Shahtra, Itrifal-e-Sagheer, Itrifal Mulaivin, Itrifal-e-Kabir, Majoon-e-Kundur, Majoon-e-eKhabs-ul-Hadeed, Kohal-ul-Jawahir (UPI Vol.I)

Ayurvedic System of Medicine

Abhyarishtam, Triphaladichurnam, Agastyarasayananm, Dashamula-haritaki, Haritaki churna, Chandrodaya vati, Triphalaadya ghrita II, Dhanvantara ghrta, Amrita Bhallatak avaleha, Agastya Haritaki Rasayana, Citraka haritaki, Brahma Rasayana, Triphalaadya tail, Achaia liana, Danti haritaki, Abhaya lavana, Pathyadi lepa etc. (API Vol. I I&II).

Siddha System of Medicine

Carapunka Vilvati Ilakam,Karunai Ilakam, Manturati Ataik Kutinir, Pavanakkatukkai, Talicati Curanam, Tiripalaic Curanam (SPI Vol. I).

Adulterations and Substitutes

Terminelia citrine is the adulterant of Halela Zard. Small pieces of Baheda (*Terminelia bellerica*) fruits were also commonly mixed in this species. The sole objective of the traders to mix cheap, similar looking material in hard fruits is to enhance the volume of fruit.

Regulatory Status

An official drug in –

i. Ayurvedic Pharmacopoeia of India, Part I, Vol. I.

ii. Ayurvedic Formulary of India, Part I & II.

iii. Indian Pharmacopoeia, 2010.

iv. Unani Pharmacopoeia of India Part, I & Vol. I.

v. National Formulary of Unani Medicine, Part I, Vol.V.

vi. Siddha Pharmacopoeia of India, Part I, Vol. I.

vii. Siddha Formulary of India, Part-I.

Observations

I. Organoleptic Characteristics

Entire Drug- The pericarp of mature fruits is yellowish brown, ovoid 20-35 long, 13-25 mm wide wrinkled and ribbed longitudinally (Fig. 1 B,C).

Powdered Drug – The powder is brown in colour; taste, astringent, (Fig. 1 D).

II. Micro-morphological Characteristics

Powdered Drug - The epicarp single layer epidermal cells; mesocarp, 2-3 layers of collenchymas. The parenchymatous cells containg simple rounded or oval starch grains.Fibers with peg like out growth and simple pitted walls; sclereids are various shapes and sizes, mostly elongated. The crystals of calcium oxalate also present in powder (Fig. 2).

III. Histochemistry

Micro – Chemical Tests and Behaviour of specific reagents towards Plant/Drug Tissues – Observations and results pertaining to micro-chemical tests and behaviour of specific reagent towards plant tissues are presented in Table-1.

Table 1 : Micro-chemical Tests and behaviour of specific reagents towards plant tissues and cells contents.

Sl. No.	Reagent	Test for	Inference	Histological zone/ cell contents responded.
1.	Dragendorff's reagent	Alkaloid	_	Not Responded
2.	Marme's reagent	Alkaloid	_	Not Responded
3.	Wagner's reagent	Alkaloid	_	Not Responded
4.	Potassium hydroxide solution (5% w/v)	Anthocynin	_	Not Responded
5.	Sulphuric acid (66% v/v)	Anthocynin	_	Not Responded
6.	Acetic acid	Calcium oxalate	+	Calcium oxalate crystals in mesocarp region
7.	Potassium hydroxide solution (5% v/v) + Hydrochloric acid	Calcium oxalate	+	Same as above
8.	Sulphuric acid	Calcium oxalate	+	Same as above
9.	Kedde reagent	Cardiac glycoside	_	Not Responded

Sl. No.	Reagent	Test for	Inference	Histological zone/ cell contents responded.
10.	Iodine Solution followed by Sulphuric acid	Cellulose	_	Not Responded
11.	Sudan III	Fixed oil and fats	+	Mesocarp cells
12.	Chlor-zinc-Iodine Solution	Latex	_	Not Responded
13.	Aniline sulphate Solution followed by Sulphuric acid	Lignin	+	Sclereids from mesocarp
14.	Phloroglucinol HCl	Lignin	+	Same as above
15.	Lugol's solution	Protein	_	Not Responded
16.	Millon's reagent	Protein	_	Not Responded
17.	Picric acid	Protein	_	Not Responded
18.	Heating with KOH (5% w/v) + H_2SO_4	Suberin	_	Not Responded
19.	Sudan III	Suberin	_	Not Responded
20.	Weak Iodine solution	Starch	+	Starch grains in mesocarp cells
21.	Potassium hydroxide solution (5% w/v)	Starch	+	Same as above
22.	Sulphuric acid	Starch	+	Same as above

Indications: '-' Absence and '+' presence of constituent.

Organic Groups of Chemical Constituents – The extracts of the drug were tested for presence of different organic groups and results are presented in Table – 2.

Table 2 : Major Group of Organic Chemical Constituents of Drug.

Sl. No.	Organic Groups of Chemical Constituents	Reagents / Tests	Inference
1.	Alkaloid	Dragendorff's and Mayer's reagents	_
2.	Anthraquinone	Borntrager reaction	+
3.	Coumarin	Alcoholic potassium hydroxide	+
4.	Flavonoid	Shinoda reaction	+
5.	Glycoside	Mollisch's test	+

6.	Protein	Xanthoprotein test	_
7.	Resin	Ferric chloride regent	+
8.	Saponin	Libermann-Burchard reaction	_
9.	Steroid	Salkowski reaction	_
10.	Tannin	Gelation test	+

IV. Identity, Purity & Strength

Physico-Chemical Constants – The analytical values in respect of physico-chemical constant of drug were established and results are reported in Table-3.

Table 3 : Analytical Values of Physico-chemical Constants-

Sl. No.	Physico-Chemical Constants	Analytical values
	Moisture content, % w/w	12.0
	pH	7.2
	Total Ash, % w/w	6.0
	Acid insoluble ash, % w/w	5.0
	Alcohol soluble extractive % w/w	35.0
	Water soluble extractive % w/w	52.0
	Essential oil, %, v/w	_

V. Fluorescence & Spectroscopy

Fluorescence Characteristic of Powdered drug under Ultra-Violet Light – Powdered drug was screened for fluorescence characteristic with or without chemical treatment. The observations pertaining to their colour in daylight and under ultra-violet light were noticed and are presented in Table-4.

Table 4 : Fluorescence Characteristic of Powdered Drug under Ultra-Violet Light.

Sl. No.	Treatments	Terminalia chebula Retz.	
		Colour in day light	Nature of colour in fluorescence
1.	Powder as such	Dark khaki	Dark brown
2.	Powder with		
	Carbon tetra chloride	Brown	Brown
	Ethyl acetate	Brown	Dark brown

Sl. No.	Treatments	Terminalia chebula Retz.	
	Hydrochloric acid	Brown	Brown
	Nitric acid + water	Brown	Reddish brown
	Sodium hydroxide + methanol	Dark brown	Dark brown
	Sodium hydroxide + water	Dark brown	Dark brown
	Sulphuric acid + water	Brown	Brown
	Buffer- pH 5	Brown	Brown
	Buffer- pH 7	Brown	Reddish brown
	Buffer- pH 9	Brown	Reddish brown

Ultra-Violet Spectroscopy – The data related to Ultra-Violet Spectrophotometric characteristics as computed in Table-5.

Table 5 : Ultra-Violet Spectrophotometer characteristic of drugs.

Sl. No.	Specifications	Data
1.	Tincture dilution ml/ml	1
2.	Maximum absorption peak	1.359 1.209 2.884
3.	l Maxima at, nm	275.05 266.90 221.80

VI. Chromatographic profile

Thin-Layer Chromatography – Best separation for TLC fingerprinting were obtained by using different layers and solvent systems. Inferences are shown in Table–6.

Table 6: TLC fingerprinting data

Drug	Mobile Phase/ Solvent System	Derivatizing Reagents	Visualizations	No. of Spots	Rf Values of bands
Terminalia Chebula Retz.	Toluene: Ethyl acetate (9:1) v/v	Anisaldehyde-Sulphuric Acid	Under UV 254 nm	3	0.09, 0.16 and 0.22 (all grey)
			Under UV 366 nm	4	0.09 (blue), 0.22 (red), 0.25 (red) and 0.40 (red)

Table 7 : Regulatory Specifications for fruits of *E. officinalis* Gaertn. in different regulatory compendium.

Quality Specification	Ayurvedica Pharmacopoeia of India (API)	Unani Pharmacopoeia of India (UPI)	Siddha Pharmacopoeia of India (SPI)	India Pharmacopoeia 2007, 2010
Official Title	Haritaki	Halela Zard	Katukkai	Haritaki, Haritaki Extract
Botanical Species	Terminalia chebula Retz.	Terminalia chebula Retz.	Terminalia chebula Retz.	Terminalia chebula Retz.
Morphological part/Official part	Pericarp of mature fruits	Pericarp of mature fruits	Pericarp of mature fruits	Pericarp of mature fruits
Description	I. Macroscopic II. Microscopic III. Powder	I. Macroscopic II. Microscopic III. Powder	I. Macroscopic II. Microscopic III. Powder	I. Macroscopical II. Microscopical
Identity, Purity & Strength				
Foreign Matter	1.0 %, Not more than	1.0 %, Not more than	1.0 %, Not more than	2.0 %, Not more than
Total Ash	5.0 % Not more than	5.0 % Not more than	5.0 % Not more than	6.0 % Not more than
Acid insoluble ash	5.0 % ,Not more than	5.0 % ,Not more than	0.5% ,Not more than	3.0 %, Not more than
Alcohol soluble extractive	40.0% ,Not less than	40.0% ,Not less than	40.0% ,Not less than	35.0% ,Not less than
Water soluble Extractive	60.0%, Not less than	60.0%, Not less than	60.0%, Not less than	_
Heavy metals	_	_	_	Compliance with prescribed limit
Loss of drying	_	_	_	12.0% ,Not less than
Microbial contamination	_	_	_	Compliance with prescribed limit
Thin layer chromatography	_	_	TLC profile	TLC profile

(A) Fruiting Plant

(B) Fruits

(C) Dried Fruits (Magnified)

(D) Fruit Powdered

Fig. 1 : Halela Zard (*Terminalia chebula* Retz.)

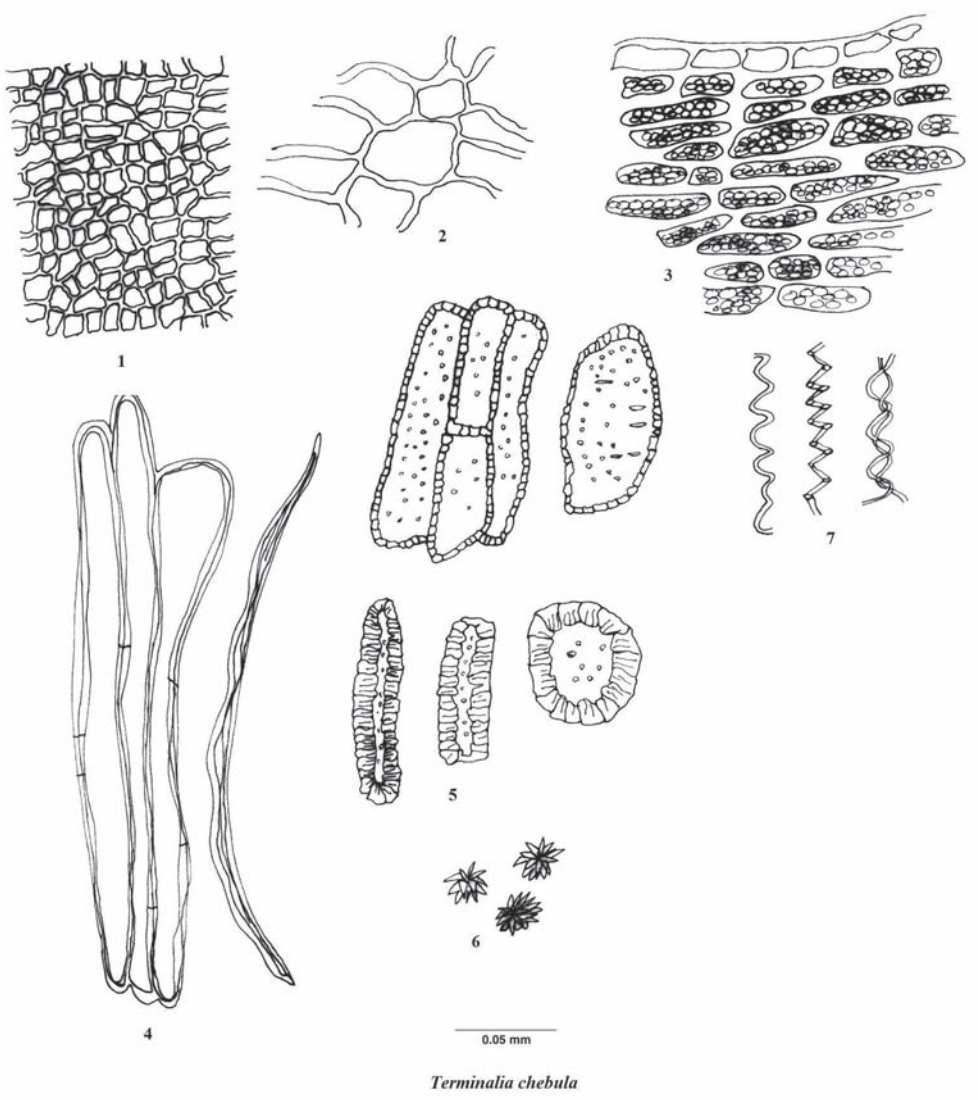


Fig. 2 : 1. Epicarp cells, 2. Mesocarp cells, 3. Parenchymatous cells containing starch grains, 4. Fibers cells, 5. Stone cells, 6. Crystals of calcium oxalate, 7. Xylem vessels.

Discussion

The fruits of *Terminalia chebula* Retz. are used in a number of Unani classical and patent and propertiery formulations and also most commonly used as a spice. Pharmacopoeia provides its specification in respect of macro-morphology, micro-morphology, physico-chemical constants (total ash value, alcohol insoluble, water soluble extractive and alcohol soluble extractive), assay (essential oil limits) and Thin layer chromatography. In the present study pharmacognostic standardization of pericarp of mature fruit of *Terminalia chebula* Retz. is carried out which can be employed in quality control of *Terminalia chebula* Retz. used either as drug or spice or as other commodity in

commerce. The monographic profile on *Terminalia chebula* Retz. also reviews the information on different aspects of drug.

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Native Phytotherapy for Filariasis from Odisha, India

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Abstract

Filariasis is one of the common health problems in coastal belt of India. The disease is prevalent largely in Balasore, Bhadrak, Puri and Ganjam districts of Odisha lying on the eastern coast. Thus far, there is no satisfactory cure of the disease in modern system of medicine. Diethyl Carbamazine (DEC) is however the only drug of choice. But its side effects and relapse etc eludes complete cure of the disease. The search is, therefore, on at various levels for suitable anti-filarial herbal drugs which may be cost effective, easily available and free from side effects.

In an attempt to search antifilarial drugs from herbal resources, survey of different districts of Odisha was undertaken during last 20 years. The outcome of plants used in the treatment of filariasis by the natives of Odisha is presented in this communication with details of uses. The data presented are supported by chemical and / or pharmacological reports wherever available and may provide clue for further research on some of these folk herbal remedies and discover new antifilarial drugs of natural origin.

Key Words : Filariasis, Ethno-botanical studies, Phytotherapy, Odisha

Introduction

With ideal combination of the vast forest, the rich flora and the large tribal population comprising as many as 60 different tribal communities, Odisha is an important state for the study of ethnobotany. The type of herbal remedies, the way in which they are administered and the disease for which they are used varies from tribe to tribe and place to place. Thus, there is a great scope for ethnobotanical studies in the state.

Among mosquito borne diseases, filariasis is the major health problem in Odisha According to an estimate, out of total population of 26.27 million in the state, 18.24 million rural population is exposed to the risk of filariasis (Mohanty, 1985). Diethyl Carbamazine (DEC) is the only drug widely used, so far, for the prevention and treatment of filariasis in the modern medicine, without much success (Singh and Ram, 1988).

There is, therefore, an urgent need to find out a suitable herbal drug for the treatment of filariasis. However, concerted efforts have been going on at various centers of Unani medicine and other organizations to come-up with suitable remedy.

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In the present study an attempt has been made to bring on record herbal remedies used by native inhabitants of Odisha for prevention and treatment of Filariasis.

Materials and Methods

The data presented here is based on larger ethnobotanical surveys conducted between 1982 and 2000. First hand information on medicinal uses of plants was collected from native health practitioners and other knowledgeable persons of either sex in different localities of the area surveyed. The data were cross checked from other groups / localities wherever possible. The method for collection of plant samples and obtaining information on medicinal uses followed for the study was that of Jain (1967). Materials collected during medico-ethnobotanical survey from various districts of Odisha were processed, identified and equated with correct botanical names, classical Unani name and local names. Voucher specimens are housed in unit herbarium of Regional Research Institute of Unani Medicine, Bhadrak (Odisha), for future reference and study.

Medicinal species used as antifilarial drugs are enumerated in the following order : botanical name, family in parenthesis, Unani name, local name and locality followed by medicinal uses, voucher specimen number and names of key informants in bracket. Data is supplemented with phyto-chemical and pharmacological reports from published literature, wherever available, to justify or contradict the information provided.

Antifilarial medicinal plants

1. *Abrus precatorius* L. (Fabaceae); Gungchi; Kaincho; Hatuapada. Crushed leaves with castor oil is applied locally to subside filarial swellings – 4416 (Kol).

Tribals of Sagar district in Madhya Pradesh and lodha of Midnapur district in West Bengal use this plant in swelling (Bhalla *et al*., 1982; Pal & Jain, 1989). Abruquinones A,B,D and F showed strong anti-inflammatory activity (Kuo *et al.*, 1950). Seeds contain Abrin A which is toxic to cell free protein synthesis (Rastogi & Mehrotra, 1993)

2. *Andrographis paniculata* (Burm.f.) Wall. (Acanthaceae); Bhuineem; Bhuinimbo; Akhuapada. Leaf juice mixed with honey (one teaspoon, three times daily) is advised to drink for about one month to subside oedematous swelling in filariasis – 4819 (Singh).

Plant is used as antifilarial herbal drug (Mukherjee & Singh, 1994). Whole plant is reported in the treatment of filariasis from east Godavari district of Andhra Pradesh (Sudhakar and Rolla, 1985).

Plant contains andrographolide, kalmeghin, sitosterol, glycosides, neo andrographolide, tannins and traces of volatile oil (Jain *et al.*, 1991).

Andrographolide exhibited antipyretic, analgesic and anti ulcerogenic activity (Madav et al, 1995). Plant extract showed antipyretic and anti-inflammatory activities (Vedavathy and Rao, 1991). Three subcutaneous injections of the extract injected into infected dogs at 0.06ml/g weight, reduced the number of microfilaria in blood by more than 85 percent (Mukherjee and Singh, 1994).

Out of 32 cases treated with *Andrographis paniculata,* 24 showed reduction in filarial swelling (Mukherjee and Singh, 1994).

3. *Caesalpinia bonduc* (L.) Roxb. (Caesalpiniaceae) ; Karanjwa; Gil ; Paliabindha.

A handful of seeds (without seed coat) boiled in sufficient cow's milk, washed repeatedly to remove its toxic effects, sundried and powdered. Powdered drug (3-5 g two times daily) is given orally for three months to treat symptoms like filarial fever and swelling - 3518 (Panda).

Rural people in Bhadrak district of Odisha use plant extract in filariasis (Girach *et al.*, 1996). Ointment made from the roasted seeds with castor oil forms an excellent application to glandular swellings. Seeds are useful for dispersing swelling (Nadkarni, 1976). Ayush- 64, consisting *Caesalpinia bonduc* as one of the ingredients of composite drug, (2 tablets three times daily) given for 14 days, was found effective in the treatment (Mukherjee and Singh, 1994).

Seeds contain bounducin, Phytosterinins, Phytosterols, caesalpin –F and bonducellin (Chatterjee & Pakrashi, 1992) Fattyacid triglycerides have been identified as the macrofilaricidal principles from the seed kernel of *Caesalpinia bonduc* (Rastogi *et al.*, 1996).

4. *Clerodendrum viscosum* Vent. (Verbenaceae); Angusti; Hantuapada. Leaves (warm) with castor oil is applied locally on filarial swelling - 4440 (Sabaro).

Root is prescribed to subside swellings by paharia tribes of Santal pargana in Bihar (Goel *et al.*, 1984). The leaves are used to alleviate fever in Northeastern states of India (Jain, 1991).

5. *Elephantopus scaber* L. (Asteraceae) ; Morchulia; Jugsai patna Root paste with paste of rasna is applied on oedematous swelling to cure filarisis - 1037 (Bathuries)

Root paste is applied on oedematous swellings by Ho tribe of Singbhum district in Bihar (Girach & Aminuddin, 1994). Root is used in filariasis in Chhatarpur district of Madhya Pradesh (Datt, 1996) and by tharus tribe in Kheri district of Uttar Pradesh (Maheshwari *et al.*, 1990). Asurs of Netarhat Plateau in Bihar practiced the root in swellings (Gupta, 1981). Plant extract contains glycosides (Girach *et al.*, 1994).

6. *Ficus bengalensis* L. (Moraceae); Bargad; Baro; Kaupur. Milky latex is directly applied on glandular swelling of lymphnodes and inflammed veins to subside swelling, 4779 (Barik). Plant extract contains saponin, flavonoid, glycoside and steroids (Karnick, 1981).

7. *Jatropha gossypifolia* L. (Euphorbiaceae) ; Kodajhaji ; Padampur. Leaf paste is applied locally to subside swelling - 4737 (Naik).

Stem bark contains bitter, amorphous, alkaloids, jatrophin which is similar to quinine in properties. The latex is poisonous and contains 2.5% alcohol soluble matter (Anonymous, 1980-81). Plant exhibited antibacterial and anti-inflammatory activities (Anonymous, 1987).

8. *Litsea glutinosa* (Lour.) Robins (Lauraceae); Meda Lakri; Gobindagaradu; Gopinathpur. Stem bark pounded together with three black pepper is made into pills of pea size. Two pills, two times daily are prescribed for one month to treat clinical manifestations of filariasis - 5671 (Kol). Stem bark is used to subside swellings (Maheshwari *et al*., 1980).

9. *Mimosa pudica* L. (Mimosaceae); Lajjalu; Lajkoli; Deoil. Root of Lajkoli together with stembark of semel (*Bombax ceiba*) in equal quantity made into paste with hukka water is applied locally on odematous swelling and tied with Banana leaves, 745 (Bathuries).

Tribals of Jalpaiguri district in West Bengal use this plant in swellings (Chaudhri *et al.*, 1982).

10. *Pedilanthus tithymaloides* (L.) Poit. (Euphorbiaceae); Hemsagar; Kolai. Root bark mixed together with sindhaluno (black salt) is made into paste with starch water. The paste is uniformly applied on filarial oedema to subside swelling - 5015 (Ojha).

Plant latex exhibited anti-inflammatory activity (Dhar *et a.l*, 1988).

11. *Streblus asper* Lour. (Moraceae) ; Sahada ; Sahada; Chingdipur. Powdered stembark (5-10 g two times daily) is given for 15-20 days to control recurrent attacks, alleviate fever and subside glandular swelling of Lymphnodes - 4963 (Kar).

Powdered stem bark is used in Ayurveda for treatment of filariasis (Anonymous, 1991). Powdered stem bark is also popularly used in filarial belts of several eastern districts of U.P. (Singh & Ram, 1988). Plant is used for glandular swelling and elephantiasis. (Hussain, *et al.*, 1992).

Plant contains anti filarial cardinolides such as strebloside, asperoside and unidentified cardinolide K 030B (Pal *et al.*, 1995). Screening of plant extract showed Potential antifilarial activity using *Setaria cervi* as test organism (Parveen *et al.*, 1992). Alcoholic and aqueous extract has found to exhibit ant-filarial activity (Singh et al., 1991). The crude extract killed microfilaria as well as adult worms. The filaricidal activity was due to two glycosides reported from the plant (Anonymous, 1991). Therapeutic efficacy of the drug has been clinically established (Singh & Ram, 1988).

12. *Vernonia cinerea* (L.) Less. (Asteraceae) ; Sahadevi ; Harsingpur. Powdered plant (10-20 g) is advised to be taken with 125 ml milk (mixed with 5-7 cardamom and 10 g sugar candy) once every morning, empty stomach for about three months – 5613.

Whole plant contains alkaloids and saponin (Joshi & Sabnis, 1989). Plant exhibited antipyretic activity (Varghese, 1996).

Discussion

In the present communication 12 plant species used by the native inhabitants in the treatment of filariasis have been reported. Scrutiny of published literature reveals that only three species viz., *Andrographis paniculata, Elephantopus scaber* and *Streblus asper* have been reported for the treatment of filariasis (Jain, 1991; Singh & Ram, 1988). *Caesaipinia bonduc* (Karanjwa) seeds are reportedly used for filariasis in Unani system of medicine (Anonymous, 1992). Rest of the plant species are little known for their use in filariasis, treatment.

Fatty trigycerides from *Caesalpinia bonduc* (Rastogi *et al.*, 1996) and *Streblus asper* contain anti-filarial cardinolides such as strebloside and unidentified

cardinolide KO30B (Pal *et al.*,1995). Phytochemical screening for other plant species reported as regards antifilarial agent is suggested.

Abrus precatorius (Kuo *et al*., 1995), *Andrographis paniculata* (Anonymous, 1987) and *Pedilanthus tithymaloides*, (Dhar *et al*., 1988) exhibited antiinflammatory activity. While *Andrographis paniculata*, (Vedavathy & Rao, 1991) and *Vernonia cinerea* (Varghese, 1996) exhibited antipyretic activity. *Caesalpinia bonduc* and *Streblus asper* both are popular for their use in filariasis. The former is commonly used in Unani medicine while the later is frequently used in Ayurvedic system of medicine as well as in several eastern districts of Uttar Pradesh. The work on *Streblus asper* as an anti-filarial drug has been undertaken at CDRI, Lucknow with encouraging results (Anonymous, 1991).

Conclusion

The data presented in the paper provides clue for further research. Based on the present findings it may be suggested that *Streblus asper* may be taken up for preliminary clinical trials. The other species may be screened for their phyto-chemical and / or pharmacological activity, so as to assess suitable criteria for their use in the treatment of filariasis.

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Ethnomedicinal Uses of Plants by Malayali Tribal Community in Kolli Hills of Namakkal District, Tamil Nadu

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Abstract

An ethno-pharmacological survey was carried out in 2012 to document the status and uses of the folk medicinal plants of Kollihills and adjacent areas of Namakkal district, Tamil Nadu. The information on folk medicinal plants and their uses for treating various ailments have been gathered from the Malayali tribal people, inhabitant of Kolli hills and adjacent areas are presented. The study mainly focused on the wild plants used by the tribal and local peoples to cure various ailments. The Kollihills is mainly occupied by the tribal community called Malayalis. The present study provides information on 41plant species belonging to 37 genera and 26 families used by the Malayali tribal community of Kollimalai or Kolli hills and adjacent areas of Namakkal district, Tamil Nadu. Moreover the knowledge on the folklore uses of the medicinal plants used by the Malayali tribes may provide lead for the discovery of new drugs of plant origin.

Key Words: Ethnomedicine, Tribal, Traditional Knowledge, Kolli Hills

Introduction

India has a rich tradition plant and plant based knowledge on health care. A large number of plants or plant based extracts or decoctions or pastes are equally used by the tribal peoples in different region of India for the treatment of various ailments. (Sivalingam Ramamoorthy *et al.*, 2012). Documenting the indigenous knowledge through ethno botanical studies is important for the conservation and utilization of biological resources.According to the WHO as many as 80%of the world's people depend on traditional medicine for their primary healthcare needs (Arunachalam *et al.,* 2009). Indian sub-continent is being inhabited by over 53.8 million tribal people in 5000 forest dominated villages. The tribal communities in the Indian subcontinent comprising 15% of the total geographical area of Indian landmasses representing one of the greatest emporia of ethnobotanical wealth (Kuru Suresh *et al.*, 2011). There are 400 different tribal and other ethnic groups in India constituting about 7.5%of India's population. The Malayali tribal is one such little studied tribe of Kolli Hills in Eastern Ghats of Tamil Nadu, India. More over the information on the plant species used by the Malayali tribal group and their herbal knowledge should be documented because it may lose under the influence of modernization (Francis Xavier *et al.*, 2011).The tribal community of Malayalis is believed to have migrated from Conjeeveram probably in 1962 A.D. They are

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Tamil speaking hill tribes and are mostly agriculturists. Their population can be seen in Kollihills, Yercaud, Javadhuhills, Yelagiri, and Bodemalai (Kuru Suresh *et al.,* 2011).

Medicinal plant sector has traditionally occupied an important position in the socio-cultural spiritual and medicinal arena of rural and tribal of Tamil Nadu. Millions of rural households use medicinal plants in self-help mode. Over 20,000 practitioners of Indian Systems of Medicine (ISM) in the oral and codified streams use medicinal plants in preventive and curative applications in Tamil Nadu. In view of the current rate of deforestation and concurrent loss of biodiversity, there is a need for accurate documentation of the knowledge and experience of the traditional herbalists (Grierson, 1999). Moreover plant exploration studies have been carried out in the Eastern Ghats region (Dwarkan *et al.*, 1994; Anand *et al.*, 2005; Udayan *et al.*, 2005; Sekar *et al.*, 2011) particularly on the folk medicinal plants and their uses. Considering the above facts, a study has been conducted to document the status and uses of the folk medicinal plants of Kolli hills of Namakkal district. In the present study the information on folk medicinal plants and their uses for treating various ailments gathered from the Malayali tribal people of Kolli hills and adjacent areas have been presented and may lead to new vistas of research in the clinical studies and discovery of new herbal medicines.

The Study Area

Namakkal district is consist of 5 taluks, namely, Namakkal, Rasipuram, Kollimalai, Tiruchengode and Paramathivelur and located between 11^0 00' and 11^0 360' North latitude and 77^0 280' and 78^0 300' East longitude. Namakkal forest division consists of 4 forest ranges, namely, Namakkal, Rasipuram, Kollimalai and Mullukurichi forest ranges. Kollihills or Kollimalai is a small mountain range located in the South Eastern part of Namakkal district, Central Tamil Nadu. It is part of Eastern Ghats of South India. The hill slopes are quite narrow with deep valleys. The average annual rainfall is about 1200mm and the temperature varies between 10° to 35° c. The vegetation of Kollihills is predominantly dry deciduous, evergreen, sholas, and scrub jungles. The other forest ranges are mostly covered with deciduous and scrub vegetations. The Kollihills is mainly occupied by the tribal community called Malayalis (Fig. 1).

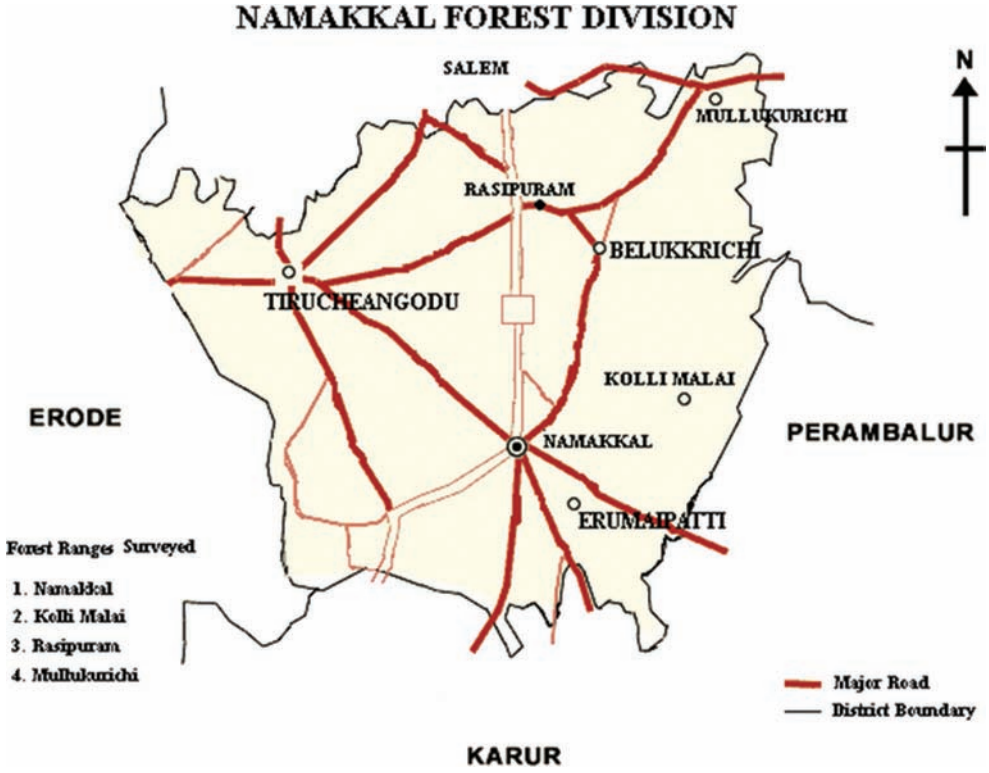

Fig. 1 : The study area

Ethnomedicine of the Malayali Tribal Community of Kolli Hills, Tamil Nadu

Fig. 1 & 2 : Survey team collecting ethno-medicinal informations from Malayali tribal peoples

Fig. 3 : *Asparagus racemosus* Willd

Fig. 4 : *Helicteres isora* L.

Fig. 5 : *Anogeissus latifolia* (Roxb. ex DC.) Wall.

Fig. 6 : *Catunarega spinosa* (Thunb.) Triv.

Methodology

An ethno-pharmacological survey was conducted in July-August 2012 to document the status and uses of the folk medicinal plants of Kolli hills and adjacent areas of Namakkal district, Tamil Nadu. During the study the information such as medicinal uses, local names, recipe and mode of application on various plants were collected. The plants which are having folk medicinal uses were collected. All the plant species are taxonomically identified through the modern floras (Gamble, 1928; Mathew, 1983; Nair, 1983) and herbarium consultation in Botanical Survey of India, Coimbatore. All the specimens have been processed for herbarium documentation. Information on folk medicinal claims provide botanical name, family, local name, part used and mode of applications (Table 1).

Table 1 : Medicinal Plants Used by Malayali Tribal Community in Kolli Hills, Tamil Nadu, India

Sl. No.	Botanical Name	Family	Local Name	Part used and Mode of application
1	*Acalypha indica* L. (10662)	Euphorbiaceae	Kuppaimeni	Fresh leaves are made into paste with turmeric and externally applied on Scabies.
2	*Adhatoda zeylanica* Medicus. (10539)	Acanthaceae	Adhathoda	50 ml of decoction of the dried leaves are orally given for cough twice daily.

Sl. No.	Botanical Name	Family	Local Name	Part used and Mode of application
3	*Aerva lanata* (L.) Juss. (10507)	Amaranthaceae	Poolaipoo	50 ml of decoction of whole plant is orally given twice daily for urinary irritations.
4	*Andrographis paniculata* (Burm.f.)Wall.ex Nees (10642)	Acanthaceae	Siriyanangai	10 ml decoction of leaves orally given for fever twice daily.
5	*Anogeissus latifolia* (DC.) Wall ex Bedd. (10533)	Combretaceae	Vekkali	50ml of decoction of bark is orally given twice daily for urinary infections.
6	*Artocarpus heterophyllus* Lam. (10496)	Moraceae	Pala	Nut resin externally applied on foot for foot crack.
7	*Asclepias curassavica* L. (10468)	Asclepiadaceae	Rathapoo	5 ml of leaf extraction is orally given twice daily for dysentery.
8	*Asparagus racemosus* Willd. (10495)	Liliaceae	Thaneervitan kizhangu	5 g of powder of tubers are orally given along with milk at bed time for general weakness.
9	*Boerhaavia diffusa* L. (10505)	Nyctanginaceae	Mukkarattai	Leaf paste is externally applied on swellings due to tumor.
10	*Caesalpinia crista* L. (10534)	Caesalpiniaceae	Kalachikai	5 g of powder of seed kernel is orally given along with hot water on empty stomach for diabetics.

Sl. No.	Botanical Name	Family	Local Name	Part used and Mode of application
11	*Calotropis gigantea* (L.) R. Br. (10497)	Asclipiadaceae	Erukku	Leaf paste is mixed with coconut oil and externally applied on leucoderma patches.
12	*Cardiospermum halicacabum* L. (10439)	Sapindaceae	Mudakathan	10g of leaf paste mixed with garlic paste is orally given for gastric problems.
13	*Cassia fistula* L. (10483)	Caesalpiniaceae	Amaltas	50 ml of decoction of fruit is orally given twice daily for urinary infections.
14	*Cassia occidentalis* L.(10503)	Caesalpiniaceae	Kosondi	Leaves made into paste along with turmeric and externally applied on skin diseases (Scabies).
15	*Catharanthus roseus* (L.) G. Don. (10482)	Apocynaceae	Nithyakalyani	10 g of leaf powder is orally given with hot water in empty stomach for leukemia. 5 g of flower are orally given twice daily for diabetics.
16	*Catunarega spinosa* (Thunb.) Trive. (10498)	Rubiaceae	Karai	Fruits are made in to paste with neem oil and externally applied on skin diseases (Itching).

Sl. No.	Botanical Name	Family	Local Name	Part used and Mode of application
17	*Centella asiatica* (L.) Urban. (10457)	Apiaceae	Vallarai	5 ml of leaf extract is orally given as general tonic for children.
18	*Cleome gynandra* L.(10508)	Cleomaceae	Naivelai	Leaf paste is externally applied on swellings due to rheumatism.
19	*Croton lacciferus* L. (10479)	Euphorbiaceae	Tepadi	Leaf paste externally applied on boils.
20	*Datura metal* L. (10523)	Solanaceae	Oomathai	Leaf paste mixed with gingili oil is externally applied on swellings.
21	*Drynaria quercifolia* (L.) J.Sm.	Polypodiaceae	Mudavan Attukaal	Dried rhizome is used one of the ingredients in the preparation of the herbal soup which is very commercial in Kolli hills by the tribal peoples.
22	*Eucalyptus globulus* Labill. (10538)	Myrtaceae	Thilamaram	Leaves are boiled in water before to take bath for body pain.
23	*Euphorbia hirta* L. (10544)	Euphorbiaceae	Ammanpachai	Equal part of leaves of *Piper nigrum* L. and *Cuminum ciminum* L. are made into paste and 10 gms orally given along with hot water for indigestion.

Sl. No.	Botanical Name	Family	Local Name	Part used and Mode of application
24	*Gymnema sylvestre* (Retz.) R. Br. ex. Roemer & Schultes (10486)	Aslepiadaceae	Sirukurinjan	Equal part of leaves and bark powder of *Terminalia chebula* Retz. is orally given in empty stomach for diabetic.
25	*Helicteres isora* L. (10696)	Sterculiaceae	Idampuri Valampuri	Fruit powder mixed with gingili oil and 5 gms orally given along with hot water thrice daily for indigestion.
26	*Lawsonia inermis* L. (10543)	Lythraceae	Maruthani	Leaf paste externally applied on foot cracks and wounds.
27	*Mimosa pudica* L. (10522)	Mimosaceae	Thottasurungi	Leaves are made into paste with turmeric and externally applied on cut injuries.
28	*Moringa oleifera* Lam. (10572)	Moringaceae	Murungai	10 g of Resin powder/flower powder mixed with cow milk is orally given at bed time for general weakness.
29	*Plumbago zeylanica* L. (10509)	Plumbaginaceae	Kodiveli	10ml of the decoction of root is orally given for indigestion.
30	*Pongamia pinnata*(L.) Pierre. (10537)	Fabaceae	Pungam	Fruit paste is externally applied on skin diseases.

Sl. No.	Botanical Name	Family	Local Name	Part used and Mode of application
31	*Psidium guajava* L. (10449)	Myrtaceae	Koiya	10 g of young leaves are orally given for diabetics twice daily. Fruits are orally given for indigestion.
32	*Ricinus communis* L. (10443)	Euphorbiaceae	Amanakku	Seed oil is applied on hair and covered with the palmate leaves of *Ricinus communis* L. to reduce heat.
33	*Santalum album* L. (10562)	Santalaceae	Santhanam	Paste of the Heart wood is externally applied on skin diseases. The paste is also applied on fore head for head ache.
34	*Solanum nigrum* L. (10540)	Solanaceae	Manathakkali	Leaves cooked as green vegetable and orally given for ulcers. 10 ml of leaf extract is orally given for intestinal ulcers.
35	*Solanum torvum* Sw. (10452)	Solanaceae	Sundai	Decoction of fruit is orally given for stomach pain.
36	*Stachytarpheta jamaicensis* (L.) Vahl (10504)	Verbanaceae	Vettukayachedi	Leaf paste is externally applied on cut injuries.
37	*Tamarindus indica* L. (10526)	Caesalpiniaceae	Puli	50 ml of decoction of leaves is orally given in empty stomach for bleeding piles.

Sl. No.	Botanical Name	Family	Local Name	Part used and Mode of application
38	*Terminalia bellirica*(Gaertn.) Roxb. (10542)	Combretaceae	Thandri	50 ml of decoction of fruit is orally given for asthma.
39	*Terminalia chebula* Retz. (10525)	Combretaceae	Kadukai	5g of fruit powder is orally given at bed time with hot water for constipation.
40	*Vitex negundo* L. (10502)	Verbenaceae	Notchi	Leaf extract boiled with coconut oil and externally applied on forehead for head ache.
41	*Wrightia tinctoria* (Roxb.) R.Br. (10559)	Apocynaceae	Veppalai	Latex and leaf paste is externally applied on wounds. Leaf paste is kept up on the aching teeth for tooth ache.

Results and Discussion

During the ethno-botanical survey 41 plant species belonging to 37 genera and 26 families were identified as medicinally important and used in the tribal community for their primary health care needs and few of them are exemplified (Fig.1-6). The most common forms of preparing crude drugs from plants are fresh juice, powder, paste and decoction. Moreover the diseases such as skin diseases, stomach related diseases (indigestion, gastric problems, constipation etc.), wounds, cuts and injuries, are found common among the tribal people of the Kolli hills. Apart from this the diseases like tooth problems, urinary disorders and general weakness are also recorded from the tribal community of the study areas. The study clearly revealed that most of the peoples inhabiting Kolli hills depends on the traditional folk medicines for their health care problems. These traditional technology of the treatment based on the medicinal plants are still an important part of their life. The survey indicated that the

study area was rich in medicinal plants useful to treat a wide range of human ailments. The study also revealed that the tribal people of the area possess good knowledge of herbal drug preparations and their uses to cure various ailments. Such studies may produce valuable information to phytochemists and pharmacologists in an efforts to develop new drugs for various human ailments.

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Pharmaco-botanical Studies on *Piper longum* L.

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Abstract

Piper longum L. is used as drug in Unani, Ayurvedic and Siddha System of medicine. The drug (dried fruit) is aromatic, stomachic, carminative, expectorant, digestive and antiseptic and also used as spice in commerce. Very few, clinical studies have been conducted on this drug. The present studies deal with detailed pharmacognostic studies and reviews related information on this drug.

Key Words – *Piper longum* L, Drug Standardization, Quality Specifications

Introduction

Piper longum L. (Family- Piperaceae) is commonly known as Pippali, it is widely used as a pungent spice. The fruit of the pippali plant is a common ingredient in many recipes. It rehabilates vitiated vata and kapha, the dried spikes are acrid, mildly thermogenic, stomachic, carminative, expectorant, tonic, laxative, digestive and antiseptic. It native of the Indo Malya region. Pippali is a slender aromatic climber; it grows in mountain valleys and coastal areas of tropical as well as sub-tropical regions. The plants are found as creepers or root climbers with fastigate branches and are considered as indigenous to the hotter parts of India. It is found growing wild in the west coast as undergrowth in the evergreen forests of the Western Ghats.It is also occasionally cultivated in large scale especially in West Bengal and Southern states (Shah and Qudry, 1990-91)

Pippali is one of the ingredients of the Ayurvedic drug “Trikatu” .There is a mention of 4 types of Pippali in Rajnighantu, namely pippali, vanapippali, saimhali and gajapippali. Sharma (1983) has equated the former 3 with *Piper longum*, *Piper sylvaticum* Roxb. and *Piper retrofractum* vahl. respectively of this *Piper sylvaticum* is a Himalayan species and *Piper retrofractum* is an indeterminable taxon as mentioned by Hooker (1872).

Methodology

Drug samples were collected from different places with a view to find out any significant difference present within the same species. For studying powder, Jackson and Snowdon (1992) was followed. To determine physico-chemical constants, Indian Pharmacopoeia (Anonymous, 1966) was consulted and for fluorescence study schedules mentioned by Trease and Evans (1972)

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were followed. Colours were named by consulting Rayner (1970). Standard prescribed procedures for histochemical studies (Johanson, 1940; Youngken, 1951; Cromwell, 1955, Trease and Evans, 1978), organic group detection (Robinson, 1963); U.V. Spectrophotometry (Willard *et al*., 1965) and Chromatography (Shellard, 1968; Stahl, 1969; Smith and Feinberg, 1972) were adopted. The informatics is complied by reviewing the available literature.

Systematics

Piper longum L. (Family: Piperaceae)

Plant is a slender aromatic climber, rooting at the nodes, the branches erect subscandent, swollen at the nodes; leaves alternate, lower ones broadly ovate, cordate, upper ones oblong oval all entire, smooth, thin with reticulate venation, flowers in solitary spikes, fruits berries small, red when ripe completely sunk in solid fleshy spike. (Fig 1 A). The plant is widely distributed in India. This plant grows is moist deciduous to evergreen forests. It is found Ceylon, Malay Peninsula, Malay Islands, and hotter provinces of India. In India *Piper longum* cultivated in Bihar, Assam, Khasia hills.

Drug Specification

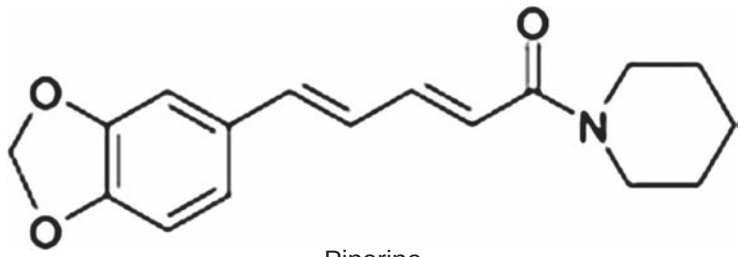
The drug consists of dried, greenish-black to black, immature, catkin-like long fruits with bracts.

Nomenclature

The plant is known by different vernacular names e.g. Lindi peeper, Pipali (Gujarati), Pipar (Hindi), Pippali (Malayalam), Pimpali, Lendi Pimpali (Marathi), Pipali, Pippali (Oriya), Arisi Tippali, Thippili (Tamil), Pippalu (Telugu) and Filfil Daraz (Urdu) etc.

Chemical Constituents

Piperine is the major and active constituent of long pepper (*Piper longum*). Pippali fruit contain volatile oil, resin, isobutylamides (retrofractamide, brachystamide longamide),lignans (sesamin, pulviatiol, fargesin), esters and alkaloids (Piperine, Piperlongumine, Piperlonguminine etc), a waxy alkaloid N-isobutyl, deca trans-2-trans-4-dienamide and a turpenoid substance. Other substances such as calcium, phosphorus and iron also present in pippali powder (Shah and Qudry *el.*, 1990-91).



Piperine

Pharmacology

It is rejuvenative for the lungs, encourages vasodilatation and increase circulation, specifically to the lungs. It has the anthelmintic qualities, used to kill worms, amoebas and parasites and hepatoprotective effect that benefit in fibrosis. It shows anti-bacterial activity against *B. cereus, B. subtilis, M. tuberculosis, Staph. Albus, Esch. Coli etc.* It also has anathematic, anti-inflammatory, hepatoprotective, hypoglycemic, antispasmodic and insecticidal activity (Satyavati *et al.*, 1987).

Therapeutic and non-therapeutic Uses

Charak has described the medicinal properties of the plant as an appetizer, stimulant, antipolice, antitussive, and inducing resistance to infections. *Piper longum* is in widespread use for various ailments for many centuries. The dried fruits are acrid, mildly thermogenic, stomachic, aphrodisiac, carminative, expectorant, febrifuge, tonic, laxative, digestive, emollient and antiseptic. They are useful in anorexia, dyspepsia, flatulent colic, asthma, bronchitis, gastropathy, epilepsy, fevers, gonorrhea, hemorrhoids, vitiated conditions of Vata, Gout and Lumbago.

Pippali is widely used remedy in Ayurvedic medicine and it's also used as a simple home remedy in treatment of disorders such as dyspepsia, coryza, thirst, fever, abdominal disease, bronchitis, diabetes and worms etc. Powdered of pippali , administered with honey, to relieve cough, asthma, hoarseness, hiccup and sleeplessness (Georgeking *et al*., 1989).

Classical Formulations

Ayurvedic- Gudapippali, Amrtarista, Ayasakrti, Asvaganshadyarista, Kumaryasava, Candanasava, Cayavanaprasa avaleha, Siva Gutika, Kaisora Guggulu (API)

Siddha - Attatic Curanam, Civanar Amirtam, Kakkuvan Ilakam, Kunmak Kutorri Meluku, Palacancivi Mattirai, Tippili Iracayanam (SPI).

Regulatory Status

Piper longum L. is an official drug in following pharmacopoeias and formularies of India:-

i. Ayurvedic Pharmacopoeia of India, Part I, Vol. IV.

ii. Ayurvedic Formulary of India, Part I & II.

iii. Indian Pharmacopoeia, 2007, 2010.

iv. National Formulary of Unani Medicine Part I-V.

v. Siddha Pharmacopoeia of India, Part I, Vol. I.

vi. Siddha Formulary of India, Part-I.

Observations

I. Organoleptic Characteristics

- Entire Drug-Fruit elongated cylindrical, catkin-like spikes of immature individual fruit; fused together in spirals. Spike is ovoid-oblong erect, 2.5-5 cm, blunt, greenish black to black in colour, and shining.
- Powdered Drug-The Powder colour is greyish-black; odour aromatic and taste, pungent, (Fig. 1 B,C)

II. Micro-Morphological Characteristics

Powdered Drug The epicarp is polygonal-shaped cells, sclereids from mesocarp with adhering epicarp containing pigment and calcium oxalate crystals in surface. A hypodermis with elongated stone cell; sclereids from the mesocarp. An endocarp of elongated, porous, sclerechymatous cells; cells of the endocarp in surface view with underlying pigment layer and hyaline layer of testa.Perisperm cells densely packed with mass of starch granules. Endosperm and fibro-vascular tissue are also present (Fig. 2).

III. Histochemistry

Micro – Chemical Tests and Behaviour of specific reagents towards Plant/Drug Tissues – Observations and results pertaining to micro-chemical tests and behaviour of specific reagent towards plant tissues are presented in Table-1.

Table 1 : Micro-chemical Tests and behaviour of specific reagents towards plant tissues and cells contents.

Sl. No.	Reagent	Test for	Inference	Histological zone/ cell contents responded.
1.	Dragendorff's reagent	Alkaloid	+	Perisperm cells
2.	Marme's reagent	Alkaloid	+	Perisperm cells
3.	Wagner's reagent	Alkaloid	+	Perisperm cells
4.	Potassium hydroxide solution (5% w/v)	Anthocynin	_	Not Responded
5.	Sulphuric acid (66% v/v)	Anthocynin	_	Not Responded
6.	Acetic acid	Calcium oxalate	+	Prismatic calcium oxalate in mesocarp cells
7.	Potassium hydroxide solution (5% v/v) + Hydrochloric acid	Calcium oxalate	+	Same as above
8.	Sulphuric acid	Calcium oxalate	+	Same as above
9.	Kedde reagent	Cardiac glycoside	_	Not Responded
10.	Iodine Solution followed by Sulphuric acid	Cellulose	_	Not Responded
11.	Sudan III	Fixed oil and fats	+	Perisperm cells
12.	Chlor-zinc-Iodine Solution	Latex	_	Not Responded
13.	Aniline sulphate Solution followed by Sulphuric acid	Lignin	+	Sclereids from mesocarp
14.	Phloroglucinol HCl	Lignin	+	Same as above
15.	Lugol's solution	Protein	_	Endosperm cells
16.	Millon's reagent	Protein	_	Same as above
17.	Picric acid	Protein	_	Same as above
18.	Heating with KOH (5% w/v) + H_2SO_4	Suberin	_	Not Responded
19.	Sudan III	Suberin	_	Not Responded
20.	Weak Iodine solution	Starch	+	Starch grains in perisperm cells
21.	Potassium hydroxide solution (5% w/v)	Starch	+	Starch grains in perisperm cells
22.	Sulphuric acid	Starch	+	Starch grains in perisperm cells

Indications: '-' Absence and '+' presence of constituent.

Organic Groups of Chemical Constituents – The extracts of the drug were tested for presence of different organic groups and results are presented in Table – 2.

Table 2 : Major Group of Organic Chemical Constituents of Drug.

Sl. No.	Organic Groups of Chemical Constituents	Reagents/Tests	Inference
1.	Alkaloid	Dragendorff's and Mayer's reagents	+
2.	Anthraquinone	Borntrager reaction	+
3.	Coumarin	Alcoholic potassium hydroxide	+
4.	Flavonoid	Shinoda reaction	_
5.	Glycoside	Mollisch's test	_
6.	Protein	Xanthoprotein test	+
7.	Resin	Ferric chloride regent	+
8.	Saponin	Libermann-Burchard reaction	_
9.	Steroid	Salkowski reaction	_
10.	Tannin	Gelation test	+

IV. Identity, Purity & Strength

Physico-Chemical Constants – The analytical values in respect of physico-chemical constant of drug were established and results are reported in Table-3.

Table 3 : Analytical Values of Physico-chemical Constants

Sl. No.	Physico-Chemical Constants	Analytical values
	Moisture content, % w/w	11.0
	Total Ash, % w/w	5.0
	Acid insoluble ash, % w/w	0.50
	Alcohol soluble extractive % w/w	10.5
	Water soluble extractive % w/w	23.50
	Essential oil, %, v/w	—

V. Fluorescence & Spectroscopy

Fluorescence Characteristic of Powdered drug under Ultra-Violet Light – Powdered drug was screened for fluorescence characteristic with or without chemical treatment. The observations pertaining to their colour in daylight and under ultra-violet light were noticed and are presented in Table-4.

Table 4 : Fluorescence Characteristic of Powdered Drug under Ultra-Violet Light.

Sl. No.	Treatments	Coriandrum sativum	
		Colour in day light	Nature of colour in fluorescence
1.	Powder as such	Yellowish brown	Brown
2.	Powder with		
	Carbon tetra chloride	Brown	Brown
	Ethyl acetate	Light brown	Brown
	Hydrochloric acid	Greenish brown	Greenish brown
	Nitric acid + water	Light brown	Brownish
	Sodium hydroxide + methanol	Yellowish brown	Brown
	Sodium hydroxide + water	Greenish brown	Brown
	Sulphuric acid + water	Light brown	Greenish brown
	Buffer- pH 5	Light brown	Brownish
	Buffer- pH 7	Light brown	Brownish
	Buffer- pH 9	Light brown	Brownish

Ultra-Violet Spectroscopy – The data related to Ultra-Violet Spectrophotometric characteristics as computed in Table-5.

Table 5 : Ultra-Violet Spectrophotometer characteristic of drugs.

Sl. No.	Specifications	Data
1.	Tincture dilution ml/ml	1
2.	Maximum absorption peak	0.911 1.525 1.493
3.	l Maxima at, nm	331.35 259.50 215.45

VI. Chromatographic Profile

Thin-Layer Chromatography – Best separation for TLC fingerprinting were obtained by using different layers and solvent systems. Inferences are shown in Table–6.

Table 6 : TLC fingerprinting data

S. No.	Drug	Mobile Phase/ Solvent System	Derivatizing Reagents	Visualizations	No. of Spots	R_f Values of bands
1.	*Piper longum* L.	Toluene: Ethyl acetate (9:1) v/v	Anisaldehyde-Sulphuric Acid	Under UV 254 nm	4	0.10, 0.19, 0.26 (all dark grey and 0.63 (grey)
				Under UV 366 nm	4	0.10 (blue), 0.20 (blue), 0.34 (light blue) and 0.63 (blue)
				After derivatization	6	0.10, 0.19 (both brown), 0.26 (violet), 0.37 (brown), 0.63 (blue) and 0.85 (grey)

Table 7 : Regulatory Specifications for fruits of *P. longum* L. in different regulatory compendium.

Sl. No.	Quality Specification	Ayurvedica Pharmacopoeia of India (API)	Siddha Pharmacopoeia of India (SPI)	India Pharmacopoeia IP 2007, 2010
1.	Official Title	Pippali	Tippili	Pippali, Large
2.	Botanical Species	*Piper longum* L.	*Piper longum* L.	*Piper retrofractum* Vahl.
3.	Morphological part/ Official part	Dried immature fruits	Dried immature fruits	Fruit Spike
4.	Description	I. Macroscopic II. Microscopic III. Powder	I. Macroscopic II. Microscopic III. Powder	I. Macroscopical II. Microscopical

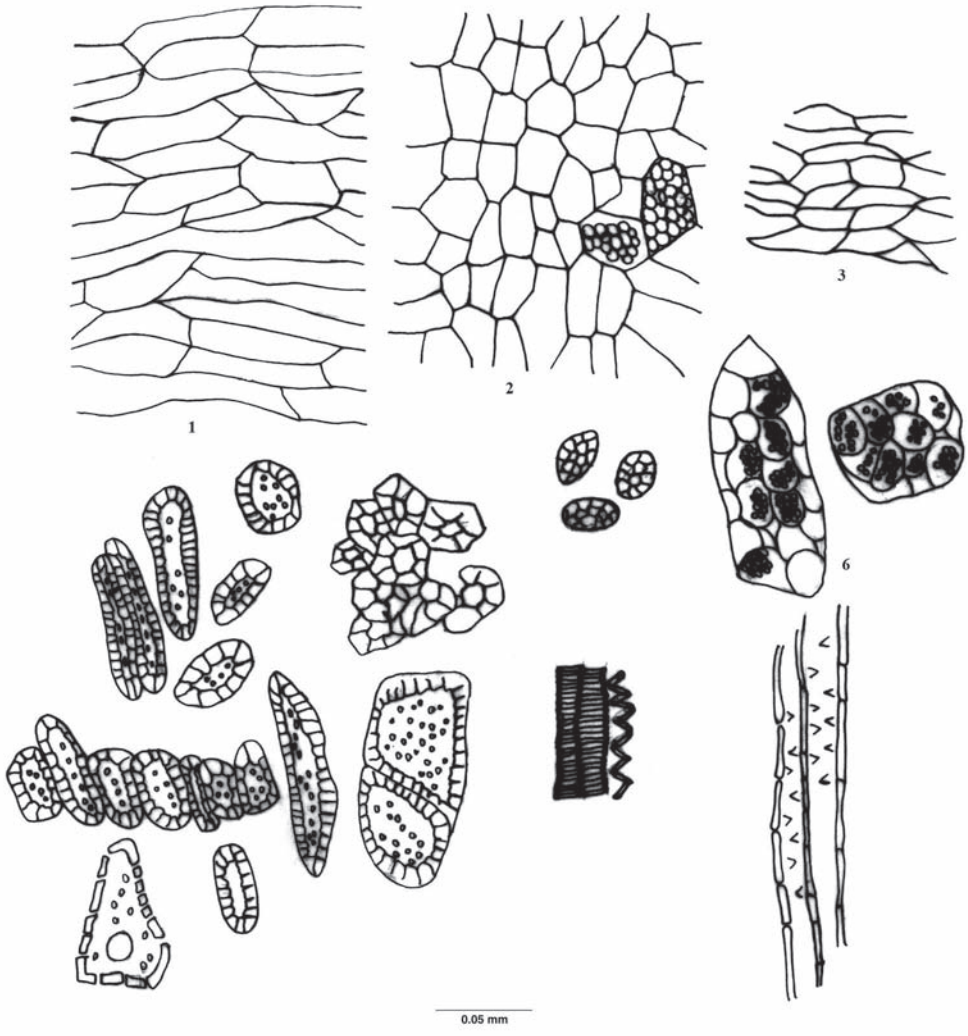
5.	Identity, Purity & Strength			
	Foreign Matter	2.0%, Not more than	2.0 %, Not more than	2.0%, Not more than
	Total Ash	7.0% Not more than	7.0% Not more than	8.0%, Not less than
	Acid insoluble ash	0.5%, Not more than	0.5%, Not more than	3.0%, Not more than
	Alcohol soluble extractive	5.0%, Not less than	5.0%, Not less than	8.0%, Not less than
	Water soluble Extractive	7.0%, Not less than	7.0%, Not less than	10.0%, Not less than
	Loss on Drying	---	---	12.0% , Not more than
6.	Assay	---	---	1.0% piperine, not less than
7.	Heavy metals	---	---	Compliance with prescribed limit
8.	Microbial contamination	---	---	Compliance with prescribed limit
9.	Thin layer chromatography	TLC profile	TLC profile	TLC profile

B. Fruits

A. Fruiting Plant

C. Fruits (Magnified)

D. Fruit Powdered



Piper longum

1. Outer layer of seed-coat, 2. 3. Epicarp in surface view showing starch granules in some of the cells, 4. Stone cells, 5. Endosperm cells containing starch granules, 6. Xylem vessels, 8. Tracheids.

Figure-1

Discussion

The fruits of *Piper longum* L.are used in a number of classical and patent and propertiery formulations of Unani, Ayurveda and Siddha preparation. It is also most commonly used as a spice. Pharmacopoeia provides its specification in respect of macro-morphology, micro-morphology, physico-chemical constants (total ash value, alcohol insoluble, water soluble extractive and alcohol soluble extractive), assay (essential oil limits) and Thin layer chromatography. In the present study pharmacognostic standardization of ripe fruit of *Piper longum* L. is carried out which can be employed in quality control of *Piper longum* L. used either as drug or spice or as other commodity in commerce. It also provide review on different aspects of drug.

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Development of Quality Standards of a Single Unani Drug - Habb-e-Balsan

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Abstract

abb-e-Balsan consists of dried fruits of *Commiphora opobalsamum* (L.) Engl. belongs to family Burseraceae. Unani medicines are prepared using different parts of the plant materials such as seeds, fruits, flowers, stems, bark, wood, leaves, roots and gums etc., The dried fruits of the drug in Unani System of Medicine are used as expectorant and emmenagogue and also to cure diseases of the urinary tracts and neurological disorders. The present study deals with pharmacognostical (to identify), physico-chemical (purity) and WHO parameters (safety) of the samples of Habb-e-Balsan procured from Chennai and Hyderabad. Pharmacognostical studies show the presence of epidermal cells with occasional anomocytic stomata, mesocarpic parenchyma cells, stone cells up to 100µ, druses of calcium oxalate crystals up to 35µ and cotyledonary parenchyma cells. Physico-chemical data obtained included moisture content (8.68% & 7.95%), total ash (8.52% & 8.31%), acid in-soluble ash (1.37% & 1.41%) and solubility in alcohol (10.08% & 9.93%) and water (20.01% & 20.43%). TLC studies of chloroform and alcohol extracts showed identical spots at 254nm, 366nm and in visible light (Vanillin Sulphuric acid reagent). WHO parameters such as microbial content (TBC, TFC, Enterobacteriaceae, Salmonellae and *Staphylococcus aureus*) and the heavy metals (As, Cd, Pb and Hg) were found within the permissible limit. The aflatoxins B_1, B_2, G_1 and G_2 were not detected from the drug samples Habb-e-Balsan.

Key Words: Habb-e-Balsan, Microscopy, Powder microscopy, Physico-chemical, TLC and WHO parameters

Introduction

Pharmacopoeial study of a single drug is the systematic study which involves official title or vernacular names, biological sources and family, geographical sources, collection, processing, macroscopical characters, microscopical characters, chemical test and quality control parameters (Kokate *et al*., 2000).

Habb-e-Balsan consists of dried fruits of *Commiphora opobalsamum* (L.) Engl. (Syn. *Balsamodendron opobalsamum* Kunth., *B. gileadensis* Kunth., & *C. gileadensis* (L.) Engl.,), (Family : Burseraceae). The dried fruit is also called as *carpobalsamum*. The fruit is reddish grey, and in the size of a small pea, with an agreeable and aromatic taste; the seeds of the fruits are solitary, yellow and grooved down one side (Hooper, 1937). The dried fruit of the plant contains

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various organic constituents such as linoleic, oleic, stearic and palmitic acids, sitosterol, stigmasterol, cholesterol, campesterol and α-spinasterol (Rastogi and Mehrotra, 1993).

In Unani medicine the fruits of the drug is used as Mudir-e-Haiz (Emmenagogue), Munaffis-e-Balgham (Expectorant) (Khare, 2007), Mujaffif (Desiccant / Siccative), Mulattif (Demulcent), Kasir-e-Riyah (Carminative), Moharrik (Stimulant), Muqawwi-e-Meda wa Ama (Stomachic and Intestinal tonic), Zimad (Liniment) and also in neurological affections (Ahmed *et al*., 2005; Nadkarni, 1976). The drug Habb-e-Balsan is used in the preparation of compound formulations viz. Jawarish-e-Kamooni Kabir, Jawarish-e-Kafoor and Habb-e-Barmak (Anonymous, 2006 & 2007). The present study was aimed to evaluate the pharmacopoeial standards of the fruit of Habb-e-Balsan using standard protocol.

Materials and Methods

a. Pharmacognostical study

Macroscopic study: The dried fruits were collected from the local raw drug dealers of Chennai and Hyderabad. The fruits were identified using the available literature of Flora of Tropical East Africa (Gillett, 1991).

Microscopic study: The free hand sections of the fruit (T. S) were taken, stained with safranin and mounted in glycerine. Hand diagrams were made using Camera Lucida (Khandelwal, 1998).

Powder microscopy: The coarse powder of the dried fruit was treated with various chemical reagents like phloroglucinol + HCl and Jeffrey's reagent (Johansen, 1940) for clearing the tissues to study the various elements.

b. Chemical analysis

Physico-chemical studies like total ash, acid insoluble ash, alcohol and water solubility and loss on drying at 105ºC were carried out as per the standard methods (Anonymous, 1987).

c. Thin layer chromatography

Preparation of extract: Powders of the fruits (2g) were extracted with 20ml of chloroform and alcohol solvents separately. The extracts were concentrated and made up to 5ml in volumetric flask and used for thin layer chromatographic studies.

Thin Layer Chromatography profile: TLC profile of chloroform and ethanol extracts were performed using the solvent systems of toluene: ethyl acetate, 9 : 1 and 1 : 1.3 respectively on pre-coated silica gel 60 F_{254} TLC plate (E. Merck) as adsorbent. After drying, the plates were examined under UV – 254nm and 366nm and observed the spots. Then plates were dipped in vanillin-sulphuric acid reagent and heated at 105ºC till appeared the bright spots (Wagner *et al*., 1984).

d. Quality control parameters

The quality control parameters viz. microbial load by serial dilution, heavy metals by Atomic Absorption Spectrophotometer and aflatoxins by High Pressure Liquid Chromatography were carried out using the standard methods of WHO (Anonymous, 1998) & AOAC guidelines (Anonymous, 2000).

Results and Discussions

a. Pharmacognostical Study

Macroscopic: Fruits reddish brown dehiscent drupe (Fig. 1), ovate somewhat compressed, 10mm long and 7mm wide with a pointed smooth nut marked on one side by a longitudinal furrow; the fleshy pericarp splitting into 2 values disclosing a 2 locular 1-2 seeds stone usually surrounded at the base by a brightly coloured fleshy pseudoaril; pericarp composed of fused epicarp and mesocarp (Fig. 2); cotyledons flat or plicate, entire as broad as long; odour agreeable and aromatic taste.

Microscopic: T. S. of fruit shows (Fig.3) an epicarp with epidermis single layered, consisting of small thick walled polygonal parenchyma cells covered with a thin layer of cuticle; mesocarp consisting of three different regions, outer region consisting of 3 to 4 layers of rectangularly elongated polygonal parenchyma cells, middle region consisting of big cells of oval to rectangular polygonal parenchyma cells followed by inner region consisting of few layers of smaller parenchyma cell; a few resinous canals, vascular bundles and numerous druses of calcium oxalate crystals found scattered in the mesocarpic region; endocarp (Fig. 4) consisting of two regions, outer region consisting of 2 to 4 layers of thick walled sclereids or stone cells followed by inner region consisting of 5 to 7 layers of thick walled sclereids or stone cells separated by a single layer of thin walled parenchyma cells.

T. S. of the seed shows (Fig. 5) testa and cotyledons; testa consisting of outer layer of thick walled epidermal cells with druses and inner layer of small thin

walled parenchyma cells in between the two 3 to 4 layers of parenchyma cells with vascular tissues; endosperm present with a single layer of polygonal parenchyma cells filled with starch grains; cotyledons plicate, epidermis of the cotyledons consisting of single layer of polygonal parenchyma cells on both the surfaces; 3 to 4 layers of polygonal parenchyma cells followed by a single layer of palisade parenchyma cells on the lower side of cotyledons.

Powder microscopy: Epidermis of the fruit in surface view with occasional anomocytic stomata; mesocarpic parenchyma cells in surface view; vessels with spiral thickening upto 20µ; druses of calcium oxalate crystals upto 35µ; sclereids of stone cells upto 70m; stone cells with wavy walls in surface view; outer layer of testa in surface view with druses; inner layer of small thin walled parenchyma cells; outer layer of cotyledons (epidermis) in surface view and cotyledonary parenchyma cells (Fig. 6).

b. Chemical analysis

Analytical data of both the samples shows 8.68% & 7.95% of moisture content. Total Ash contents of the samples were 8.52% & 8.31% and 1.37% & 1.41% of acid in-soluble ash shows the siliceous matter in the drug. Alcohol soluble extractive (10.08% & 9.93%) represents the extraction of polar constituents like phenols, tannins, glycosides, alkaloids and flavonoids. The water soluble extractive (20.01% & 20.43%) denotes the presence of inorganic contents. The results of physico-chemical parameters are shown in Table (1).

c. Thin Layer Chromatography

The R_f values of the samples of chloroform and alcohol extracts are shown in Table-2 and 3. The plates were visualized using vanillin-sulphuric acid reagent and heated at 105º till appeared the colored spots (Fig. 7 and 8).

d. Quality control parameters

The microbial content and heavy metals in the drug samples were found within the permissible limit (Table–4 and 5). The aflatoxins were not detected from the drug samples (Table–6).

Habb-e-Balsan

Commiphora opobalsamum (L.) Engl.

Fruit

Fig. 1 - Fruit
Surface View

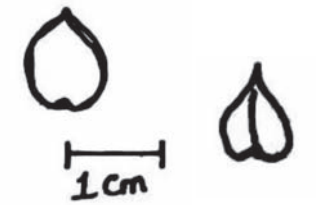


Fig. 2 - T.S of fruit
A Diagrammatic sketch

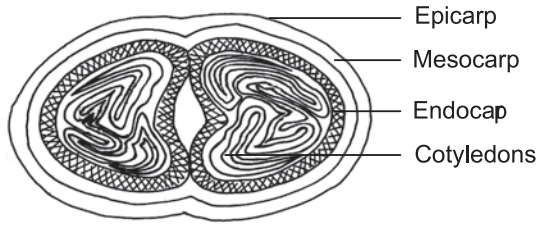


Fig. 3 - T. S. of Fruit (Epicarp & Mesocarp)

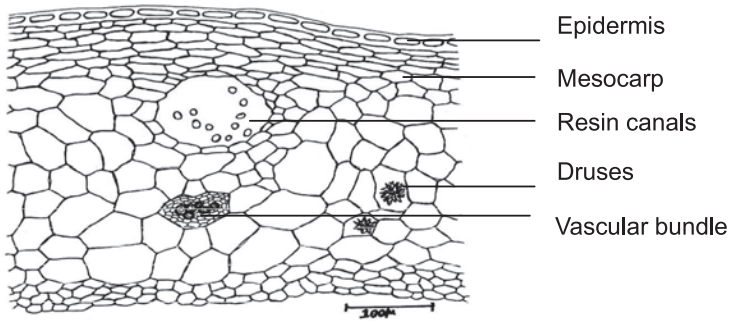


Fig. 4 - T. S. of Fruit (Endocarp)

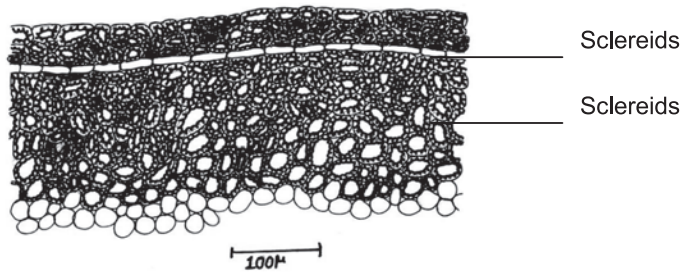
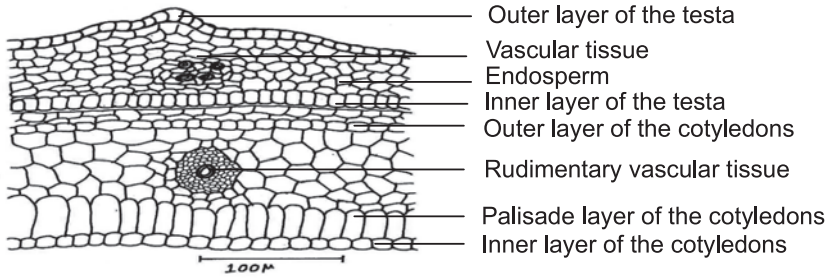


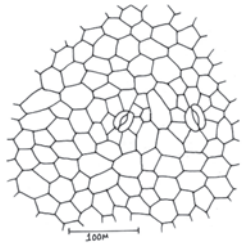
Fig. 5 - T. S. of Seed (Testa & Cotyledons)



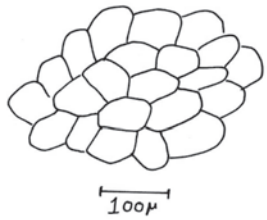
Habb-e-Balsan
Commiphora opobalsamum (L.) Engl.
Fruit

Fig. 6 – Powder Microscopy

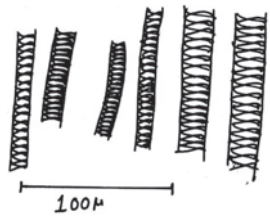
Epidermal cells of the fruit in surface view with occasional anomocytic stomata



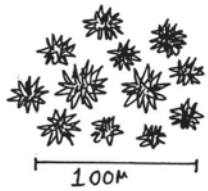
Mesocarpic parenchyma cells in surface view



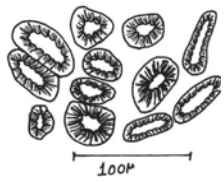
Vessels with spiral thickening



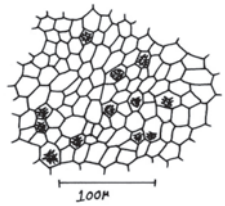
Druses of calcium oxalate crystals



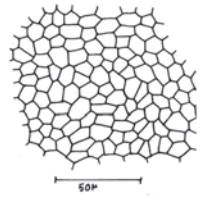
Sclereids



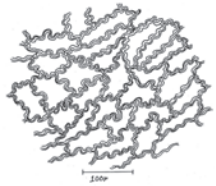
Outer layer of the testa in surface view with druses



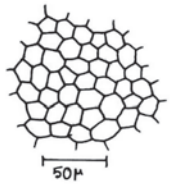
Inner layer of the testa in surface view



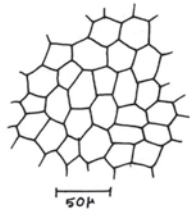
Stone cells with wavy walls in surface view



Epidermis of the outer layer of cotyledonary parenchyma cells

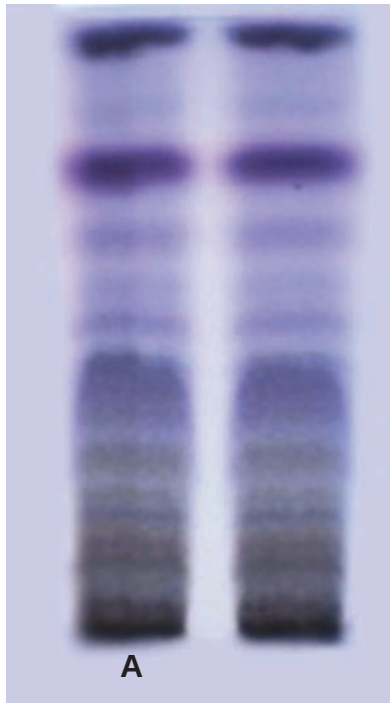


Cotyledonary parenchyma cells



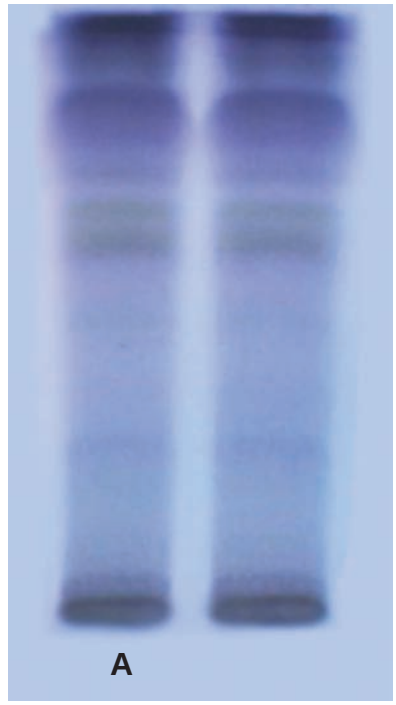
Thin Layer Chromatography

Fig. 7



Chloroform extract
Solvent system: Toluene : Ethyl acetate
(9 : 1)
Detector: V. S. Reagent

Fig. 8



Alcohol extract
Solvent system: Toluene : Ethyl acetate
(1 : 1.3)
Detector: V. S. Reagent

A = Chennai & B = Hyderabad

Table-1 : Physico-chemical parameters

S. No.	Parameters	Results (n = 3) + S.D.	
		Chennai	Hyderabad
1.	Foreign matter (%)	1.29	1.09
2.	Loss on drying at 105ºC (%)	8.68	7.95
3.	Ash (%)	8.52	8.31
4.	Acid insoluble ash (%)	1.37	1.41
5.	Alcohol soluble extractives (%)	10.08	9.93
6.	Water soluble extractives (%)	20.01	20.43

Table-2 : TLC data of the chloroform extract

Solvent system	R_f Values		
Toluene : Ethyl acetate (9 : 1)	UV 254 nm	UV 366 nm	V. S. Reagent
	0.57 Light pink	0.52 Greenish blue	0.84 Grey
	0.48 Light pink	0.32 Light blue	0.75 Pink
	0.37 Light pink	0.23 Light blue	0.65 Violet
	0.26 Pink		0.56 Violet
	0.19 Pink		0.48 Violet
	0.15 Pink		0.41 Blue
			0.29 Brown
			0.19 Blue
			0.12 Brown

Table–3 : TLC data of the alcohol extract

Solvent system	R_f Values		
Toluene : Ethyl acetate (1 : 1.3)	UV 254nm	UV 366nm	V. S. Reagent
	0.83 Pale pink	0.91 Greenish Blue	0.91 Grey
	0.76 Pale pink	0.73 Light blue	0.84 Blue
	0.71 Pale pink	0.56 Light blue	0.71 Violet
	0.65 Pale pink		0.66 Yellowish green
	0.61 Pale pink		0.60 Brown
	0.46 Pale pink		0.48 Blue
			0.26 Blue

Table–4 : Microbial load

S. No.	Parameter Analyzed	Results		WHO Limits
		Chennai	Hyderabad	
1	Total Bacterial Count	2300 CFU/gm	1900 CFU / gm	105 CFU/gm
2	Total Fungal Count	100 CFU/gm	150 CFU / gm	103 CFU/gm
3	Enterobacteriaceae	Absent	Absent	103 CFU/gm
4	*Salmonella* Spp.	Absent	Absent	Nil
5	*Staphylococcus aureus*	Absent	Absent	Nil

Table–5 : Heavy metals

S. No.	Parameter Analyzed	Results		WHO & FDA Limits
		Chennai	Hyderabad	
1	Arsenic	Nil	Nil	10 ppm
2	Cadmium	Nil	Nil	0.3 ppm
3	Lead	0.026ppm	0.019ppm	10 ppm
4	Mercury	Nil	Nil	1.0 ppm

Table–6 : Estimation of Aflatoxins

S. No.	Aflatoxins	Results		Detection Limit
		Chennai	Hyderabad	
1	B_1	Not detected	Not detected	DL 1.0 ppb
2	B_2	Not detected	Not detected	DL 0.5 ppb
3	G_1	Not detected	Not detected	DL 1.0 ppb
4	G_2	Not detected	Not detected	DL 0.5 ppb

Conclusion

The pharmacognostical studies shows the presence of epidermal cells with occasional anomocytic stomata, mesocarpic parenchyma cells, stone cells upto 100µ, druses of calcium oxalate crystals upto 35µ and cotyledonary parenchyma cells. The safety parameters were found to be within the permissible limit. The evaluated pharmacopoeial study will help to lay down the scientific standards of the drug for inclusion in Unani Pharmacopoeia.

Acknowledgement

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Ethnomedicines in the Khordha Forest Division, Odisha

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Abstract

Based on an ethnopharmacological survey of Khordha forest division of Khordha district in Odisha, conducted during September-October 2012, the paper presents some 54 contemporary folk recipes comprising 43 taxa of folk medicinal plants used by *Kondh, Sabra, Naik* tribes of the study area, for treatment of various common and chronic diseases and conditions. Botanical name, family in bracket, locality with field book number, local name, Unani name, part(s) used, name of the disease against which used, mode of administration are given for each recipe discussed in the text. The need for their phytochemical and pharmacological investigations in the context of claims reported has been re-stressed in an effort to discover Therapeutic agents of natural origin for many of the diseases and conditions for which there are no satisfactory cure in modern medicine, thus far.

Key Words: Ethnopharmacological survey, Traditional Medicine, Khordha, Odisha.

Introduction

Although the identification of pharmacologically active plants and plant derivatives is far from complete, it is already very extensive. Science can continue to learn and profit from the practices of the folk healers, provided we do not allow this rich source of knowledge to disappear (Thomson and Schultes, 1983). Based on this rationale, an ethnopharmacological survey of Khordha forest division of Khordha district in Odisha was undertaken between September 2012 and October, 2012 and first-hand information on folk medicinal uses of plants for treatment of various diseases and conditions were recorded. Khordha district lies between 84^0 55' and 86^0 50' East longitude and 19^0 40' and $20^0$25' North latitude. It is bounded by Cuttack district in north, Nayagarh district in west, Puri district in the east and Ganjam district in the south. Khordha district has a geographical area of 2813 sq. kms. The hilly systems of the district are located in Khordha sub-division. Khordha district is situated in the southwest of the state. Also it touches the 'Chilika Lake' in the south. The specific sites visited include Mangrajpur, Shaktihal, Banpur, Pratap, Pratap, Salia Dam, Dyke Chhak, Kumaripari, Bheruambadi, Kadudibadi, Bhaliapada, Dhuanali, Khariabandho, Jodamdosahi, Badasuda, Kulthodih, Odagaon, Banpur, Manglasahi, Berbera, Barkul, Bhejiput, Langleswar, Gorapalli, Badopalli of Khordha forest division. The study presents 54 folklore recipes comprising 43 taxa of medicinal plants prevalent among the inhabitants

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of the area surveyed. Most of the uses recorded are first-hand and less known. The area had not been investigated exhaustively earlier in this direction, except for some fragmentary reports on medicinal uses of plants (Ali *et al*., 2010; Anonymous, 2001; 1995; Ambasta, 1994; Behera *et al*., 2008; Chopra *et al*., 1980; Girach *et al*., 2011; Jain 1981, 1991; Jain & Rao, 1967; Kirtikar & Basu, 1935; Mukesh *et al.,* 2010, 2011, Tribedi *et al.,* 1982; Yesodharan & Sujana, 2007).

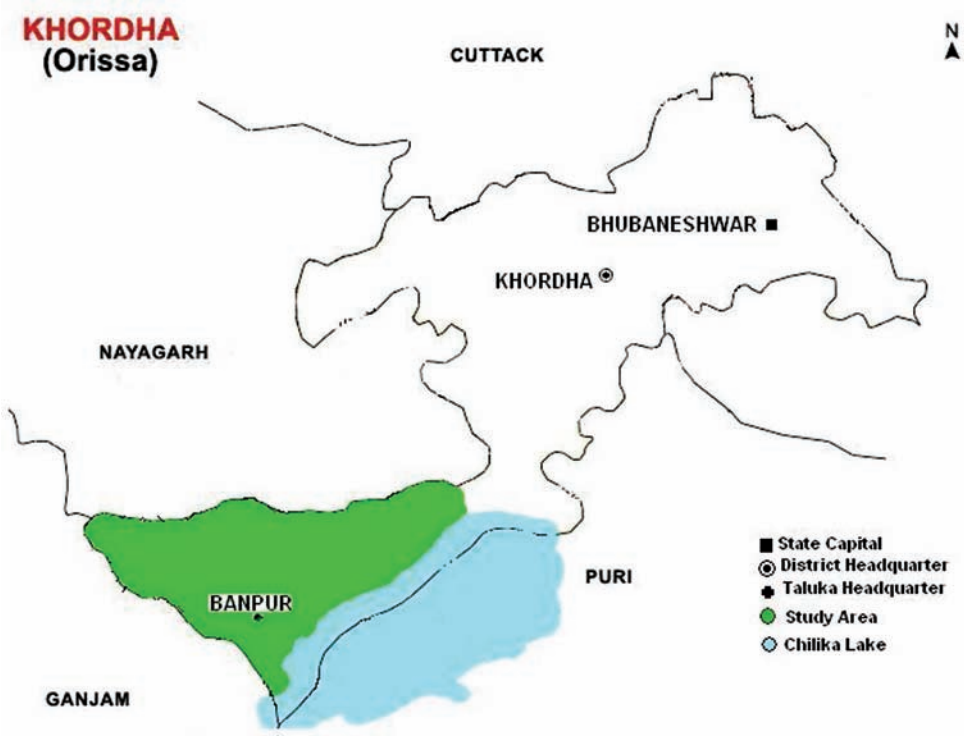

Fig. 1 : Map showing study area

Methodology

An ethnopharmacological survey of Khordha forest division of Khordha district (Fig. 1) in Odisha was conducted during September and October, 2012 with a view to study the medicinal herbs of the area and also to record the folk-wisdom of the tribals known as 'Kondh'. The data on folk medicinal uses of plants were collected from the old villagers and herbalists (medicine men) through direct field interviews, who often accompanied the survey team in the field and have long been prescribing the herbs for treatment of various diseases. Information about the efficacy of the herbs was also verified through cross-checks in other localities of the area surveyed as well. Plant specimens of the present study were mostly identified with the help of the "Flora of Orissa" (Saxena & Brahmam, 1994-1996) and Botany of Bihar and Orissa (Haines,

1921-25). Voucher herbarium specimens of all folk drugs reported have been prepared and deposited in the herbarium of Survey of Medicinal Plants Unit, Regional Research Institute of Unani Medicine, Bhadrak, for future references and study.

Enumeration of Folk Medicinal Species

The medicinal plants used as folk medicine in the study area are arranged by their botanical names in alphabetical order. Each entry gives the information: Plant's scientific name with family (in bracket), locality with Field Book No., local name(s), Unani name (wherever available), part(s) and method of usage.

Achyranthes aspera L. (Amaranthaceae); Mangrajpur-9256; Apamarango; Chirchita; Root; Dental care; Root is used as tooth stick to strengthen gum.

Abrus precatorius L. (Fabaceae); Salia Dam-9292; Kaincho; Ghungchi; Fruit; Diarrhoea (VM); ½ fruit is given to cattles with fodder to treat diarrhorea.

Adhatoda zeylanica L. (Acanthaceae); Shaktihal-9265; Basango; Aroosa; Leaf; Post Natal Care, Cough/Cold, Fever; A handful of leaves boiled in 500 ml water, cooled and filtered. Resultant water is prescribed for taking bath to subside body swelling after delivery. A few flowers fried in ghee and mixed with desired amount of honey, is given to treat cough/cold. A handful of leaves with pippli (*Piper longum*) is boiled in water to make a decoction. 30 ml of the decoction is given twice a day with honey to treat fever.

Aerva lanata (L.) Juss. *ex* Schults. (Amaranthaceae); Kumaripari-9297; Paunsia Sago; Biseri Buti; Root; Diarrhoea; 1-2 g of root paste is given with rice water to treat infantile diarrhoea.

Amaranthus spinosus L. (Amaranthaceae); Mangrajpur-9261; Kanta Marish; Chaulai Khardar; Root; Jaundice; A handful of dried roots are made into fine powder. 3-5 g powder is given twice a day with sufficient water to treat jaundice.

Amorphophallus paeoniifolius (Dennst.) Nicolson (Araceae); Kadudibadi-9326; Oal; Rhizome; Edible, Filariasis; Rhizome are cooked and eaten as vegetable. Rhizome paste is applied locally on oedematous swelling for 7 days to treat filariasis.

Andrographis paniculata (Burm.f.) Wall. *ex* Nees (Acanthaceae); Bheruambadi-9305; Bhunimbo; Kiryat; Leaf; Malarial Fever, Skin Disease, Diabetes; 30 ml leaves decoction are given thrice daily for 5-7 days to treat

Malarial fever. Leaf paste with golmirch (*Piper nigrum*) is made into a sharbat and drunk to treat skin diseases. 50 ml leaves decoction is given with 3 golmirch (*Piper nigrum*) to treat diabetes.

Argyreia nervosa (Burm.f.) Boj. (Convolvulaceae); Kadudibadi-9319; Mundanoi; Samandersokh; Leaf; Fever; Jada oil applied on leaf and bandaged on forehead to treat fever.

Asparagus racemosus Willd. (Liliaceae); Bheruambadi-9312; Chhatuary; Satwar; Root; Spermatorrhoea; Powdered root with sugar candy juice is given 20 g/dose once at bed time to treat Spermatorrhoea (Dhaturogo).

Averrhoea carambola L. (Averrhoeaceae); Shaktihal-9266; Karmanga; Khamraq; Skin diseases; Fruits are eaten raw when ripe. Root paste is applied locally on skin diseases.

Azadirachta indica A. Juss. (Meliaceae); Kulthodih-9353; Nimbo; Neem; Leaf, Twig; Skin Diseases, Dental care; Leaves decoction is used by the local inhabitants to treat kanchokundia (Skin diseases). Twigs are used as tooth stick to strengthen gums.

Bridelia retusa (L.) Spreng. (Euphorbiaceae); Kadudibadi-9322; Kassi; Stem bark; Diarrhoea; 10 g of stem bark paste is given twice daily with sufficient water to check diarrhoea.

Cardiospermum helicacabum L. (Sapindaceae); Mangrajpur-9258; Bishphutka; Habb-ul-Qilqil; Leaf; Wounds; Leaf paste is applied locally on children head to treat wounds.

Cassia occidentalis L. (Caesalpiniaceae); Pratap-9275; Kasundra; Kasondi; Root; Eczema; Root paste is applied locally on eczematous patches to treat eczema.

Cassytha fifliformis L. (Lauraceae); Bheruambadi-9304; Nirmuli; Whole Plant; Loose motions; A handful of plant made into paste is taken orally in case of loose motions in children.

Chloroxylon swietiana DC (Rutaceae); Bheruambadi-9311; Bheru; Leaf; Wounds; Leaf paste is applied locally on wounds to expel worms.

Chromolaena odorata (L.) King. & Rob. (Astearaceae); Dyke Chhak-9293; Pokosunga; Root, Leaf, Plant; Cuts, animal wounds (VM), Skin diseases; Root paste is applied locally on skin diseases. A handful of leaves boiled in mustard oil and cooled and applied locally on skin infections. Leaf juice is applied locally

on fresh cuts to check bleeding. Plant paste is applied locally on wounds of animals for healing.

Cleistanthus collinus (Roxb.) Benth. *ex* Hook.f. (Euphorbiaceae); Bheruambadi-9315; Korada; Fruit; Skin diseases; Purified fruits are boiled in mustard oil, cooled and filtered. Resultant medicated oil is applied on scabies and other skin diseases.

Costus speciosus (Koenig.) Sm. (Zingiberaceae); Banpur 9272; Gai Gendalia; Rhizome; Headache, Giddiness, Cattle diarrhoea; Rhizome made into paste is applied on the forehead of cattles to treat headache and get relief from giddiness. Rhizome is chopped and mixed with cattle-feed is given in cases of diarrhoea among domestic animals.

Crinum asiaticum L. (Amaryllidaceae); Bhaliapada-9329; Arsa/Sukra; Leaf; Joint Pain; Leaf paste is boiled in jada oil and applied on joints to treat joint pain.

Croton bonplandianus Baill (Euphorbiaceae); Kulthodih-9368; Banomircho; Plant Sap; Cuts; Plant sap is applied locally on cuts to check bleeding.

Curculigo orchioides Gaertn. (Hypoxydaceae); Bheruambadi-9318; Talmuli; Musli Siyah; Root; Spermatorrhoea; Root of this species with roots of Satabari (*Asparagus racemosus*) are made in to powder and 10 g of this powder is given with cow's milk twice a day for one month to treat spermatorrhoea.

Datura metel L. (Solanaceae); Salia Dam-9282; Dudura Dhoda; Dhatura; Leaf; Boils, Inflammation; Leaves warmed with jada oil (*Ricinus communis* L.) and tied locally on boils. Leaf paste warmed in jada oil (*Ricinus communis* L.) is applied on affected part of the body to treat inflammation.

Dillenia indica L. (Dillaneaceae); Shaktihal-9267; Chalta; Flower; Wounds; Flowers powdered and mixed with coconut oil. This preparation is applied locally on wounds for healing.

Dioscorea bulbifera L. (Dioscoreaceae); Kadudibadi-9321; Pita Alu; Tuber; Constipation; 5-10 g powdered tuber is given once every morning with warm water as laxative to treat constipation.

Eclipta prostrata (L.) L. (Asteraceae); Banpur-9269; Bhrangraja; Bhangra; Leaf; Cuts, Madness; Crushed leaves are directly applied on fresh cuts to check bleeding. A handful of leaves and fresh pulp of *Aloe vera* (Ghrita kumari) leaves are made into paste with water and applied on forehead to treat madness.

Elephantopus scaber L. (Asteraceae); Kadudibadi-9328; Mayurchulia; Whole Plant; Diarrhoea, Dysentery; 5-10 g root powder is taken two times daily with sufficient water to treat diarrhoeal problems. Plant is also used as fodder in this area.

Erythrina variegata L. (Fabaceae); Bhaliapada-9330; Paladhua; Leaf; Anthelmintic; Leaf juice with 1g turmeric powder is given to children to expel worms.

Ficus racemosa L. (Moraceae); Kulthodih-9365; Dimiri; Gular; Latex, Stem Bark; Spermatorrhoea, Wounds; 5-7 drops of latex is given in the morning on empty stomach to treat spermatorrhoea. Stem bark decoction is used for washing wounds and fast healing.

Gloriosa superba L. (Liliaceae); Pratap-9274; NaNangalia; Muleem; Root; Veterinary Medicine; Root is cut into small pieces and given with fodder to treat mums in cattles.

Glycosmis pentaphylla (Retz.) DC (Rutaceae); Kadudibadi-9320; Chauldhua; Twig; Dental Care; Twigs are employed as tooth brush to check bleeding from gums and strengthening teeth.

Helicteres isora L. (Sterculiaceae); Salia Dam-9287; Mudi; Marorphali; Fruit; Rickets like complaint in infants; A handful of fruits are boiled in mustard oil, cooled and filtered. Resultant medicated oil is massaged gently on affected legs of children. The remedy is quite popular in many places of the study area among rural population.

Ipomoea carnea Jacq. (Convolvulaceae); Mangrajpur-9262; Amari; Behaya; Plant sap; Cuts, Wounds; Plant sap is applied locally on minor cuts to check bleeding and healing wounds.

Jatropha gossypifolia L. (Euphorbiaceae); Badasuda-9345; Gabo; Latex; Diarrhoea; 2-3 drops of the latex is given with water to children to check diarrhoea.

Lantana camara L. (Verbenaceae); Pratap-9280; Nageswar; Leaf; Cuts, Swelling; Leaf juice is applied locally on cuts to check bleeding. Leaves paste is applied locally on sprain to reduce swelling & pain.

Martynia annua L. (Martyniaceae); Pratap-9276; Baghnakha; Kalabichua; Leaf; Cuts; Leaves juice are applied locally on cuts to check bleeding.

Mimosa pudica L. (Mimosaceae); Salia Dam-9301; Lajkoli; Lajjalu; Root; Cold & Fever; Root paste is given in required quantity with honey to treat common cold and fever.

Nyctanthes arbor-tristis L. (Oleaceae); Kulthodih-9356; Gangaseoli; Harsingar; Leaf; Fever, Cough & Cold; Leaves juice with equal quantity of honey is given twice a day for 4-5 days to treat fever, cough & cold.

Pedilanthus tithymaloides (L.) Poit. (Euphorbiaceae); Odagaon-9377; Khiro Gachho; Latex; Cuts; Latex is applied locally on cuts to check bleeding & healing wounds.

Plumeria rubra L. (Apocynaceae); Salia Dam-9281; Kathchampa; Flower; Swelling; Leaves are boiled in jada (*Ricinus communis*) oil and applied locally on swollen part to reduce swelling.

Scoparia dulcis L. (Scrophulariaceae); Dhuanali-9332; Madhusmita; Leaf; Spermatorrhoea; 100 ml Leaf juice with 'misri' is given every morning on empty stomach for seven days to treat spermatorrhoea (dhaturogo).

Tephrosia purpurea (L.) Pers. (Fabaceae); Salia Dam-9283; Bano Kulthia; Sarphonka; Root; Stomachache; Root is chewed raw for the treatment of stomachache.

Woodfordia fruticosa (L.) Kurz (Lythraceae); Bheruambadi-9314; Dhai; Gul-e-Dhawa; Flower; Blood dysentery; A handful of dried flowers are made into powder and 5-10 g of this powder is taken twice daily with sufficient water to check dysentery with blood.

Averrhoea carambola L. (Khamraq)

Elephantopus scaber L. (Mayurchulia)

Cardiospermum helicacabum L. (Habb-ul-Qilqil)

Gloriosa superba L. (Muleem)

Mimosa pudica L. (Lajjalu)

Tephrosia purpurea (L.) Pers. (Sarphonka)

Fig. 2 : Common folk-medicinal plants used by tribals of Khordha district, Odisha

Discussion

The intrinsic potential of ethnobotanical knowledge as a key resource for developing new kinds of pharmaceuticals and other chemicals of industrial importance has been increasingly realized. In the present study some traditional therapeutic methods employed by the natives of Khordha forest division of Khordha district have been discussed. Out of 160 taxa of medicinal plants collected and identified from the study area. 43 are used in folk medicine by Kondh, Sabra, Naik etc., suggesting that these plants may cure satisfactorily certain ailments. Although, they do not have as high prestige as modern

medicines, these folk drugs are relatively un-expensive and easily available to locals at their door steps. For some problems such as eczema, jaundice, fever, diarrhoea, diabetes, wounds etc. these crude therapeutic methods are recognized as equal or superior to biomedicines; for other diseases there are readily available satisfactory cure; viz. diarrhoea, cold and fever, menstruation problems, wounds, skin diseases, nervous system disorders etc.

The data on folk medicinal uses have been compared with available literature and it is found that many of the uses are already reported (Jain, 1981; 1991). However, their modes of application, part(s) used are different. Therefore, present study represents contemporary folk uses of medicinal plants of the area investigated. It would, therefore, be worthwhile to subject all these folk drugs to scientific testing in the context of claims reported herein. It is likely through such investigations new drugs of natural origin may be discovered for treatment of many of the diseases and conditions for which there seems to be no satisfactory cures in modern medicine, thus far.

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