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Archives of Applied Science Research, 2009, 1 (2) 165-177
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0975-508X

Traditional Herbal Medicines: An Overview

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Abstract

Herbal medicine, sometimes referred to as Herbalism, Botanical medicine or Herbology, is the use of plants, in a wide variety of forms, for their therapeutic value. Herb plants produce and contain a variety of chemical compounds that act upon the body and are used to prevent or treat disease or promote health and well-being.Herbal drugs have increasingly been used worldwide during the last few decades as evidenced by rapidly growing global and national markets of herbal drugs. According to WHO estimates, the present demand for medicinal plants is about US $14 billion a year and by the year 2050 it would be about US $ 5 trillion. Now people rely more on herbal drugs because of high prices and harmful side effects of synthetic drugs, and this trend is growing, not only in developing countries but in developed countries too. Unfortunately, the number of reports of people experiencing negative effects, caused by the use of herbal drugs, has also been increasing. There may be various reasons for such problems, like one of the major causes of adverse effects is directly linked to the poor quality of herbal medicines. In addition, thousands of vaidyas have their own miniature manufacturing facilities. About 1200 licensed small manufactures in India are on record. The demand for herbal medicines is increasing and it is estimated that the production of herbal drug may be around Rs.4000 crores in the year 2010 AD. There are 1650 herbal formulation in Indian market and number of major plants involved in their formulation is 540.Medicinal plants have been a major source of cure of human diseases since time immemorial.

Keywords: Herbal Medicine, Drug Interaction, Standardization, Herbal Drug Evaluation

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Introduction

India has the knowledge and skill to develop its Research and Development capabilities. It is the second largest exporter of medicinal plants. Instead of exporting such a large amount of valuable resource with very low returns it can think about developing its own Research and Development capabilities and produce finished goods in the form of modern medicines and health care products derived from plant origin and based on the knowledge of alternative system of medicine.

Standardisation of products is most essential to compete in the world market that India has to lay stress on. The finger printing and marker compound analyses are nowadays gaining momentum for standardization of traditional medicinal formulations. This technique not only helps in establishing the correct botanical identity but also helps in regulating the sanctity of the herb . Accrediting body needs to be set up. Products have to be scientifically validated and a campaign to prove the safety of the products needs to be initiated. The Department of Indian System of Medicine and Homeopathy has been specially dealing with the rules and regulations for the herbals along with the Drugs and Cosmetic Act and has come up with the rules for the implementation of good manufacturing practices in herbals, which will not only help to make quality herbal products but also safeguard the adverse effects of the herbals. With all these, India has to take up the challenge of leading the drug and herbal market while conserving its rich heritage through proper planning and implementation of policies.

Globally, there has been an unparalleled growth in the plant-derived medicinally useful formulations, drugs and health-care products, its market covering more than 60% products derived from plant origin. India exhibits remarkable outlook in modern medicines that are based on natural products besides traditional system of Indian medicines. Almost, 70% modern medicines in India are derived from natural products. Medicinal plants play a central role not only as traditional medicines but also as trade commodities, meeting the demand of distant markets. Ironically, India has a very small share (1.6%) of this ever-growing global market. To compete with the growing market, there is urgency to expeditiously utilize and scientifically validate more medicinally useful plants while conserving these species, which seems a difficult task ahead. This paper begins with an overview of the value of Medicinal and Aromatic Plants and discusses its usefulness in the traditional medicines. Then it briefly assesses the potential of medicinally useful plants and prospects of modern medicines and health care products derived from plant origin and based on the knowledge of alternative system of medicine in India. It thereafter concisely touches upon India's varied biodiversity, comparative Research and Development strength, strong pharmaceutical manufacturing base and traditional wisdom in medicines to improve its market potential. In the conclusion, there are major recommendations to help India evolve as a major drugs and herbal based health care products leader in the world market. In order to withstand competition in the global market, it is necessary to create a brand image, especially in cosmeceuticals and natural products. Crazeamong the people for a slim body, fair skin as a fashion is growing considerably. Out of the Rs.12,000 crores industry, Rs.700 crores belong to skincare products and Rs.100 crores for general cosmetics. Over and above current herbal drugs used in cardio vascular is 27%; respiratory 15.3%, digestive 14.4%; hypnotics and sedatives 9.3%; miscellaneous 12%.

The perfumery industry is also around Rs.700 crores. This potential also needs to be tapped since our country has a lot of medicinal plants, plants with essential oils and the demand in the overseas markets for its concentrates is growing fast. Since the flavourists and perfume experts are facing the challenging tasks of creating and developing complex compositions to meet the present and future consumer demand, it is also necessary to set up world standard research and development facilities in this sector. It is also necessary to integrate modern knowledge with traditional knowledge. The drugs and products of the industry are working on the scientifically defined techniques and explained with modern biological and chemical

definitions and tools, and that alone will give a therapeutically active herbal original drug available for health care worldwide.

Role of pharmacist care of herbal medicine

Herbal medicines are in great demand and are used by approximately 80% of the world's population. Their popularity is due largely to their presumed safety, efficacy, cultural acceptability, and lesser side effects compared with prescription medications; perhaps most important, they are viewed as cost effective and accessible. The past few years in particular have seen a major increase in the use of herbal products. The global market was $5.6 billion by the end of 2006; growing at an average annual growth rate of 1.7%, it is expected to exceed $6.1 billion by 2011.Herbal medicinal products may have therapeutically beneficial effects, but a number of them cause adverse effects and drug interactions similar to conventional agents. The interaction potential of herbs with conventional drugs is an especially critical concern for drugs with narrow therapeutic indexes. Therefore, knowing the efficacy and safety of herbal drugs is crucial.In fact, one of the most serious hazards associated with herbal medicines is that many patients are under the illusion that because herbs are obtained from nature, they are completely safe and have no side effects. Thus, it is important that they be instructed to take proper precautions while using herbal medicines. Unfortunately, few patients inform their primary care providers about their use of herbal products. Pharmacists play a critical role in educating patients and healthcare providers about the available evidence on the efficacy of these products, as well as in making recommendations that are consistent with that evidence. By actively embracing the responsibility for counseling individuals on the appropriate use of herbal products, pharmacists will become recognized experts in this rapidly growing area, and will be able to positively influence the quality of care. Pharmacists can play a key role by asking patients about their use of herbal products, and by discussing this issue with healthcare providers. Pharmacies should stock only those herbal products that meet the Good Manufacturing Practice guidelines.

Pharmacists can help monitor patients who use herbal products for any potential adverse events, and can counsel them to ensure that appropriate results are obtained. Various pharmacist roles are discussed below. Patients often fail to volunteer information about their use of herbal products and other "natural" products. Therefore, pharmacists should ask specific questions about such usage while taking drug histories. They can encourage patients to be open about this by conducting their inquiries in an open, nonjudgmental fashion. Questions should cover the specific healthcare purpose for which the patient is using an herbal product. Pharmacists and other health professionals must be vigilant in detecting and reporting any potential adverse events from herbal medicines. Pharmacists need to stay current on accurate information about herbal medicines and use this expertise when advising patients. They should strive to provide unbiased evaluations and to correct any misconceptions about the benefits and toxicity of these medicines. Pharmacists are in a position to determine whether an herbal therapy used by a patient is appropriate or not. The pharmacist should review a patient's complete drug regimen and disease states, to identify any potential or actual drug-related problems, in addition to evaluating the herbal medicines' efficacy, safety, and cost-effectiveness. Special care should be exercised if the patient is pregnant or has allergies.Pharmacists need to establish rapport with their patients, maintain regular contact and follow-up, and most importantly, encourage the use and continuation of therapeutics that have been proven effective. Pharmacists can be a valuable source of information for both conventional and alternative medical care providers. Ideally, they

should provide regular updates to the healthcare team on commonly used herbal medicines. Pharmacists have the expertise to identify and distinguish between side effects that are induced by conventional agents or by plant-derived products. Pharmacists can also collaborate with other members of the healthcare team on research into the use of herbal medicines, and they should share the responsibility of publishing these results. In addition to integrating information about herbal products across the curriculum, specific courses must be designed to help pharmacists attain higher skill levels in this area. For pharmacists to serve as educators on the use of herbal medicines, they must possess a thorough knowledge of these products. They also need to learn effective oral communication skills and have critical appraisal skills for retrieving and evaluating relevant information on herbal medicines. The use of herbal medicines is growing at an outstanding rate all over the world. Herbal remedies are now available not only in drug stores but also in grocery stores. The basis for pharmacist involvement with herbal products is an extension of their established role in pharmaceutical care, clinical pharmacy practices, and collaborative healthcare teams. To assure that comprehensive care is maintained, patients need to be encouraged to share information with their primary care providers about their herbal medicines, or to allow their pharmacist to inform their providers.

Herb- drug interactions

People are buying herbal remedies for every-thing from migraines to memory preservation to depression. Where once you had to see an herbalist or naturopath to get the daily dose of herbs for what ails you, herbal products now are widely available on drugstore shelves and in health food stores, making the ability to self-medicate greater than ever. But with that opportunity comes a warning: mixing herbal remedies and prescription drugs could be harmful to your health.

Herb Drug Interactions
Dong Quai: taken for menopausal symptom control. Do not mix Dong Quai with warfarin (anticoagulants), St John's Wort and some antibiotics such as sulfonamides, quinolones.
Echinacea: mostly taken as an immune boost to prevent cold and flu. Do not mix Echinacea with some heart medications, antifungal medications, HIV medications and anti-anxiety medications.
Ephedra: A powerful decongestant. Contains ephedrine, which can open up bronchial passages. It's controversial because it's a powerful stimulant that can raise blood pressure, cause insomnia and high blood pressure. Do not mix with heart medications or if you are being treated for high blood pressure, glaucoma or thyroid problems.
Feverfew: taken to reduce the severity of migraines. Do not take with other migraine medications, as, it may raise heart rate and blood pressure. Feverfew has the potential to react with warfarin anti-coagulants, increasing the thinning of blood.
Ginkgo: increases blood flow and circulation throughout the body, can also help improve memory. May interact with anti-coagulant medications such as Aspirin, Coumadin, heparin and warfarin, causing the blood to thin too much, and provoking a serious bleeding disorder. A recent report in the New England Journal of Medicine describes a case of a man who'd been taking Aspirin to prevent a heart attack and had spontaneous bleeding into the eye from the iris

within a week of taking a daily dose of ginkgo.
Garlic: is thought to help lower cholesterol and prevent the formation of blood clots that could lead to heart attacks. Garlic capsules may increase blood thinning if you are already on anti-coagulants. Do not take with diabetes medication because it may cause a decrease in blood sugars.
Ginseng: used to help reduce stress, boost energy and improve stamina, and may also help lower cholesterol. Can cause nervousness and excitation, and overuse can lead to headaches, insomnia and heart palpitations. Can increase blood pressure. Should not be used if you are taking prescriptions for high blood pressure or Coumadin.
Hawthorn: claimed to be effective in helping reduce angina attacks by lowering blood pressure and cholesterol levels. Should not be taken digoxin, a heart medication. The mix may lower heart rate too much.
K**ava:** is used to treat anxiety. It's also used to relieve insomnia and nervousness. Do not take Kava if you have a history of liver problems. Also do not mix with antidepressants, sedatives, and do not mix Kava with alcohol.
Licorice: used to treat coughs, colds and peptic ulcers. High doses can lead to increased blood pressure, water retention and potassium loss. Do not use with diuretics or digoxin because it could lead to further loss of potassium, essential for heart function.
St. John's wort: a natural anti-depressant for mild to moderate depression. Do not take with other anti-depressants, HIV medications, oral contraceptives, some heart/blood thinning medications and Tamoxifen (a cancer drug).
Valerian: a mild sedative with hypnotic effects, used to promote sleep, Should not be taken with alcohol or Valium.

Herbal drug standardization and evaluation

In recent years, there has been great demand for plant derived products in developed countries. These products are increasingly being sought out as medicinal products, nutraceuticals and cosmetics. There are around 6000 herbal manufacturers in India. More than 4000 units are producing Ayurveda medicines. Due to lack of infrastructures, skilled manpower reliable methods and stringent regulatory laws most of these manufacturers produce their product on very tentative basis. In order to have a good coordination between the quality of raw materials, in process materials and the final products, it has become essential to develop reliable, specific and sensitive quality control methods using a combination of classical and modern instrumental method of analysis. Standardization is an essential measurement for ensuring the quality control of the herbal drugs. “Standardization” expression is used to describe all measures, which are taken during the manufacturing process and quality control leading to a reproducible quality. It also encompasses the entire field of study from birth of a plant to its clinical application. It also means adjusting the herbal drug preparation to a defined content of a constituent or a group of substances with known therapeutic activity respectively by adding excipients or by mixing herbal drugs or herbal drug preparations. “Evaluation” of a drug means confirmation of its identity and determination of its quality and purity and detection of its nature of adulteration. Standardization of herbal drugs is not an easy task as numerous factors influence the bio efficacy and reproducible therapeutic effect. In order to obtain quality oriented herbal products, care should be taken right from the proper identification of plants, season and area of collection and their extraction and purification process and rationalizing the combination in case of polyherbal drugs.

The Standardization of crude drug materials includes the following steps:-

1. Authentication:

a) Stage of collection
b) Parts of the plant collected
c) Regional status
d) Botanical identity like phytomorphology, microscopical and histological analysis (characteristic of cell walls, cell contents, starch grains, calcium oxalate crystals, trichomes, fibers, vessels etc).

Various histological parameter studies are:-

1. Leaf constant: - Palisade ratio, Vein islet number, Vein termination, Stomatal number, and Stomatal index.
2. Trichomes.
3. Stomata.
4. Quantitative microscopy.
5. Taxonomical identity.
6. Foreign matter.
7. Organoleptic evaluation.
8. Ash values and extractive values.
9. Moisture content determination.
10. Chrometographic and spectroscopic evaluation.
11. Heavy metal determination.
12. Pesticide residue.
13. Microbial contamination.
14. Radioactive contamination.

The herbal formulation in general can be standardize schematically as to formulate the medicament using raw materials collected from different localities and a comparative chemical efficacy of different batches of formulation are to be observed. The preparations with better clinical efficacy are to be selected. After all the routine physical, chemical and pharmacological parameters are to be checked for all the batches to select the final finished product and to validate the whole manufacturing process.

The stability parameters for the herbal formulations which include physical, chemical and microbiological parameters are as follow:

Physical parameters include color, odor, appearance, clarity, viscosity, moisture content, pH, disintegration time, friability, hardness, flow ability, flocculation, sedimentation, settling rate and ash values.
Chemical parameters include limit tests, chemical tests, chemical assays etc.
Chromatographic analysis of herbals can be done using TLC, HPLC, HPTLC, GC, UV, GC-MS, fluorimetry etc.
Microbiological parameters include total viable content, total mold count, total enterobacterial and their count. Limiters can be utilized as a quantitative or semi quantitative tool to ascertain

and control the amount of impurities like the reagents used during abstraction of various herbs, impurities coming directly from the manufacturing vessels and from the solvents etc.

Guidelines for herbal drug standardization
WHO Guidelines:-

The subject of herbal drug standardization is massively wide and deep. The guidelines set by WHO can be summarized as follows:-

- Reference to the identity of the drug. Botanical evaluation- sensory characters, foreign organic matter, microscopical, histological, histochemical evaluation, quantitative measurements etc.
- Reference to the physicochemical character of the drug. Physical and chemical identity, chromatographic fingerprints, ash values, extractive values, moisture content, volatile oil and alkaloidal assays, quantitative estimation protocols etc.
- Reference to the pharmacological parameters, biological activity profiles, bitterness values, hemolytic index, astringency, swelling factor, foaming index etc.
- Toxicity details- pesticide residues, heavy metals, microbial contamination like total viable count, pathogens like *E.coli, Salmonalla, P.aeroginosa, S. aureus, Enterobacteria* etc.
- Microbial contamination
- Radioactive contamination

Modern herbal ayurvedic monographs
In the modern herbal ayurvedic monographs the standardization parameters are discussed in a comprehensive way. According to the modern ayurvedic monograph the quality control protocols include the following:
The synonyms, publication related to the plant, constituents present, analytical methods.
Descriptive evaluation: Description of the drug, phytomorphological, microscopical, organoleptic evaluation, foreign matter etc.

WHO guidelines monograph title

*Botanical**:*** - Sensory evaluation, Foreign matter, Microscopy measurement.
Physicochemical TLC: - Ash, Extractable matter, Water content and volatile matter, Volatile oils.
*Pharmacological**:*** - Bitterness value, Haemolytic activity, Astringency, Sterling index, Foaming index.
*Toxicological**:*** - Pesticide residue, Arsenic, Metals.
Microbial contamination: - Total viable count, Pathogens, Aflatoxins, Radioactive contamination.

Standardization of herbal drug/products
Commercial production of herbal medicines and their trade are fast growing sector of industry today, due t6o increasing demand of medicinal plants; the supply line is adversely affected leading to the adulteration and substitution for genuine drugs.

1. Fluorescence quenching:- When a plant extract is spotted on a fluorescent silica gel layer and exposed to UV light, it appears as spot on a fluorescent background, thus causing quenching and is directly proportional to concentration of the extract. Silica gel GF plate was used as an

adsorbent for fluorescence quenching. Solvents taken- hexane toluene, ether, ethyl acetate, butanol, methanol and water.

***2. Use of fingerprinting and marker compounds for identification and standardization of botanical drugs*:-** Chemical and chromatographic techniques may be used to aid in identification of an herbal material or extract. Chromatographic technique such as HPLC, TLC, GC and capillary electrophoresis and spectroscopic methods such as IR, NMR, and UV-may also be used for fingerprinting. DNA fingerprinting has been widely used in many species, e.g. DNA fingerprinting of *Panax* species and their adulterants. Marker compounds may be used to help identify herbal materials, set specifications for raw materials, standardize botanical preparations during all aspects of manufacturing processes and obtain stability profiles.

***3. Densitometric thin layer chromatographic determination of aescin in an herbal medicinal product containing Asculum and Vitis dry extract*:-** A TLC method is developed to analyze the total saponin content, also referred to as the aescin content, in an herbal medicinal product containing two dry extract in capsules. After a purification step using C(18) solid phase extraction, the samples are analyzed on a silica gel HPTLC plate with the upper layer of a mixture of acetic acid/water/butanol(10/40/50v/v/v) as the mobile phase. Spots are visualized by spraying with anisaldehyde reagent and heating the plate for 5-10 min.(100-105oc) and measured at a wavelength of 535 nm.

***4. Determination of stigmasterol, beta-sitosterol and stigmastanol in oral dosage forms using HPLC with evaporative light scattering detection*: -** A validated and repeatable HPLC method with online evaporative light scattering was developed for the analysis of two sterols, stegmasterol, beta-sitosterol and a stanol found to be common in many herbal formulations and health care supplements. This method was used to assay commercially available products formulated as oral dosage forms purported to contain African potato and associated sterols and stanol.

***5. Elemental analysis of herbal preparations for traditional medicines by neutron activation analysis with the kO standardization method*: -** Medicinal herb preparations prescribed for specific treatment purposes were purchased from markets and were analysed by instrumental neutron activation analysis with kO standardization. 500-700 mg of each sample was palletized under a pressure of six tones and irradiated together with monitors for alpha and neutron flux ratio determination for about 6h in a thermal flux of 2.29 x 10(12) n/cm2/s.

***6. Liquid chromatography UV-determination and liquid chromatography-atmospheric pressure chemical ionization mass spectrometric characterization of sitosterol and stigmasterol in soyabean oil*:-** A narrow bore HPLC-UV method was developed for the analysis of two of the more abundant naturally occurring phytosterols in vegetable oils: sitosterol and stigmasterol. The method enabled detection of the compounds at a concentration of 0.42 µ/ml and quantization at concentration of 0.52 and 0.54 µ/ml for sitosterol and stigmasterol, respectively.

7. Simultaneous determination of cinnamaldehyde, eugenol and paeonol in traditional Chinese medicinal preparations by capillary GC-FID: - A capillary GC method was established

for simultaneous determination of cinnamaldehyde(CNMD), eugenol(EL) and paeonol(PL) in two traditional Chinese herbal medicinal preparations, Weitongding tablet (WTDT) and Guifu Dihuang pill (GDHP). The assays were based on a programmed temperature GC in a 30 m x 0.53 mm capillary column with nitrogen as carrier and FID detector. Good linearity were obtained over ranges of 0.45-0.452 mg/l CNMD, 0.31-0.625 mg/l EL, and 0.30-610 mg/l PL, respectively.

8. HPTLC fingerprinting of marketed formulation containing Shankhpushpi**:** - These are the important Ayurveda formulations used for perinatal care of mother and child health. Standardization of churnas was carried out by organoleptic study, phytochemical analysis; qualitative organic and inorganic analysis, thin layer chromatography, UV- visible spectrophotometer and HPLC fingerprint studies. Qualitative organic analysis of both the churnas revealed the presence of alkaloids, steroids, phenols, tannins, glycosides, resins, saponins and flavonoids.

Evaluation of herbal drug/products

1. Biological parameter (bioassay):- It is well established that the biological potency of the herbal constituents is due to not one but a mixture of bioactive plant constituents and the relative properties of a single bioactive compound can vary from batch to batch while the biological activity remains within the desirable limits. (1) Some of the examples are:

*a. Evaluation of adaptogenic activity profile of herbal preparation***: -** Adaptogens help the body to come up with stressand enhance general health and performance. AVM is an herbal formulation. Composition- *Emblica officinalis, Withania somnifera, Asparagus racemosus, Ocimum sanctum, Tribulus terrestris* and *Piper longum.* AVM shows significant antistress, immunomodulatory and anabolic activities in different animal models there by proving a promising adaptogen.

b. Evaluation of antioxidant activity of herbal products: **-** A new test method for measuring the antioxidant power of herbal products, based on solid phase spectrophptometry using tetrabenzo-b, f, j, n, l, 5, 9, 13- tetraazacy- clohexadecin- Cu (II) complex immobilized on silica gel is proposed. The method represents an alternative to the mostly used scavenging capacity assays. The method was approved in the analysis of the most popular herbal beverages and drugs Echinacea determined spectrophotometrically.

*c. Evaluation of microbial contamination reduction on plants through technological process of decoction and spray dry***: -** The technological process of raw material has many stages, generally, adverse to microbial growth, but its complete elimination depends on the initial and work condition utilized. The aim of this work was to verify the microbial contamination, such as extractive solution (SE) and spray dried extract (PSA) with the purpose of evaluating the decrease of contamination after the decoction and the spray dry. The microbiological analysis of the products was performed by total plate count and MPN coliform.

d. Evaluation of nitric oxide scavenging activity of selected medicinal plants used in inflammatory diseases: **-** Four traditional medicinal plants, namely Ventilago madraspatana Gaertn., Rubia cordifolia Linn., Lanatana camara Linn. And Morinda citrifolia Linn. Were selected for a study on the inhibition of nitric oxide (NO), a key mediator in the phenomenon of

inflammation, signifying the presence of effective anti-inflammatory constituents therein. Plant samples were extracted with different solvents for evaluation of their inhibitory activity on NO produced in vitro from sodium nitroprusside, and in LPS- activated murine peritoneal macrophages, *ex-vivo*.

e. The lipid peroxidation inhibitory activity:- The reaction mixture contained mice liver homogenate (0.2 ml, 10% w/v) in 0.15 KCl, KCl (0.1 ml, 150 µm), Tris buffer (0.4 ml, Ph 7.5) and various concentration of test extracts. In vitro lipid peroxidation was initiated by addition of Feso4.7H2O (0.1 ml, 10 µm). The reaction mixture was incubated at 37o for 1 h. After the incubation period, reaction was terminated by addition of thiobarbituric acid (TBA-2 ml, 0.8%) and by heating the contents for 15 min. for development of colored complex. The tubes were then centrifuged at 4000 rpm for 10 min. and cooled. The % inhibition of lipid peroxidation was determined by comparing the results of test compound with those of control not treated with extracts by monitoring the color intensity at 532 nm. Gallic acid was used as a positive control.

2. Evaluation of marketed polyherbal antidiabetic formulatios using biomarker charantin: - Charantin is one of the phytoconstituents present in *Momordica charantia*. It is well known to possess antihyperglycaemia, anticholesterol, immunosuppressive, antiulcerogenic, antispermatogenic and androgenic activities. HPTLC method is fast, precise, sensitive and reproducible with good recoveries for standardization of polyherbal formulations. The recovery values of charantin were found to be about 98.89%.

3.* In vivo *and* in vitro *evaluation of hair growth potential of Shoe flower: - The leaves and flowers of Hibiscus *rosa-sinensis* are used as promoters of hair growth and as an aid in healing of ulcers. Petroleum ether extract of leaves and flowers of the plant was evaluated for the potential growth *in vivo* and *in vitro* methods. *In vivo*, 1% extract of leaves and flowers in liquid was applied topically over the shaved skin of albino rats and monitored and assessed for 30 days. The length of hair and different cyclic phases of hair follicles, like anagen and telogen phases were determined at different time periods.*In vitro*, the hair follicles from albino rat neonates were isolated and cultured in DMEM supplemented with 0.01 mg/ml petroleum ether extract of leaves and flowers. It is concluded that the leaf extract, when compared to flower extract, exhibits more potency on hair growth.

4. Clinical evaluation to assess the safety and efficacy of coded herbal medicine "Dysmo-off" versus allopathic medicine "Diclofenac sodium" for the treatment of primary dysmenorrhoea: - The clinical study on primary dysmenorrhoea to comparatively examine the coded herbal drug formulation "Dysmo-off" with authentic allopathic medicine "Diclofenac sodium". A random controlled clinical trial was conducted. These evaluations were based on verbal rating scale so as to ascertain the rate of analgesic effects on dysmenorrhoeic pain. The patients were randomly allocated with the ratio of 1:2 for controlled treatment with (NSAIDS) (n=40) received Diclofenac sodium tablets twice daily for 4 days (50 mg one day prior to and three days after the menstruation), and test treatment with Dysmo-off (n=80) received powdered Dysmo-off twice daily for 4 days (5 g one day prior to and three days after the menstruation). Treatment lasted for 4 consecutive menstrual cycles. Haemoglobin, ESR and ultrasound were measured at baseline during study. All subjects were clinically studied.

***5. Thermographic evaluation*: -** In the present study, the authors used thermography to evaluate the effects of herbal formulations based on "Sho" scientifically. In the cases that were suitable for Keishibukuryogan, the so called Keishibukuryogan Sho, a significant skin temperature rise was observed in the upper half of the body after the intake of Keishibukuryogan. In a case that was suitable for Hochuekkito, a marked elevation of skin temperature spread through the upper trunk. It suggested that thermography is useful for an objective evaluation of Sho in Kampo medicines, and for identification of the action site of the herbal formulation.

***6. Biochemical evaluation*: -** Most of the herbal drugs are a mixture of a number of ingredients. Their cumulative effect increases the efficacy of the drug in curing the diseases. Muthu Marunthu is an herbal formulation comprising of eight various plant ingredients, and has been claimed to possess anticancer effect. It was observed that the growth rate in rats was normal and there was no change in blood parameters such as glucose, urea, proteins, cholesterol and also in the activities of pathophysiological enzymes such as lactate dehydrogenase (LDH), gluconate oxaloacetate transaminase (GOT), glutamate pyruvate transaminase (GPT), alkaline and acid phosphatase after Muthu Marunthu administration. The tumor weight was found to be reduced in methylcholanthrene induced fibrosarcoma rats after Muthu Marunthu treatment.

***7. Evaluation of Kutaj-Ghanavati for alkaloidal principles*:-** Kutaj-Ghanavati is a reputed Ayurvedic preparation used in dysentery and diarrhea. It contains water extract of Kurchi bark and fine powder of aconite roots. It was evaluated quantitatively and qualitatively employing TLC and titrimetric method. In TLC study no interference of Kurchi and Aconite alkaloids with one another in their respective solvent systems. The formulation was found to contain all alkaloids of Kurchi and Aconite.

***8. Organoleptic evaluation*: -** Organoleptic evaluation of food products plays an important role in judging the censoring acceptability or rejection of food items in the market. Effect of various treatments (blanching, pricking, and lye treatment), sugar concentration (50%, 60%, 70%) and storage on the color scores; flavor scores; texture scores of intermediate moisture apricots. The overall acceptability of the products was significantly higher in 70% sugar syrup but these scores decreased as the storage period advanced.

Research and development institutes

Among the industry oriented Research and Development institutes are Dabur Research Foundation, Himalaya Health Care, Zandu pharmaceuticals, Avestha Gengraine Technologies, Reliance Life Sciences, Hamdard, etc.

Dabur Research Foundation carries out research in diverse areas like ayurvedic research which relates traditional knowledge with modern science, pharmaceutical research, phyto-pharmaceuticals, biotechnology, personal care products, new drug and peptide research, food research, clinical research, etc.

The mission of Himalaya Health Care is to satisfy each customer's health needs through well researched, effective and safe remedies harnessed from nature's wealth. The company (claims to be completely research-oriented,) believes that the ideal healthcare system lies in the synergy between ayurveda and modern science.

Zandu's Research and Development activities are dedicated towards, highlighting the usefulness of Ayurvedic herbo-mineral products by scientific studies and promote and establish natural products beyond India, meeting export obligations.

Avestha Gengraine Technologies has chalked out a plan to address global functional food market in the form of 'food for medicine' under which a major thrust is to derive novel molecule and therapeutics from standardized plant extracts and prepare new cocktails for specific disease like diabetics and skin care.

***Reliance Life Science*s** is an emerging company focusing on selected species for research to enhance both the quality and quantities of products of secondary metabolites (like pharmaceuticals, antibodies, anticancer agents, immune-modulators, flavour and fragrances) using Metabolic Engineering.

Apart from these there are several government established Research and Development institutions.Central Institute of Medicinal and Aromatic Plants (CIMAP) is committed to provide global standards for plant based research, processes and products using green technology mode to ensure sustained clientele from agriculture, society and industry. The National Botanical Research Institute (NBRI) has been undertaking both basic and applied research in various aspects of plant sciences for the conservation and sustainable utilization of plant genetic resources for human welfare and sustainable development. One of the major Research and Development activities at Central Drugs Research Institute (CDRI) is the exploration of terrestrial plants, including Indian traditional remedies for novel molecules for drug development. Several Regional Research Laboratories (RRL) are also involved in the regional MAP conservation and proper utilization through Research and Development. RRL-Thiruvananthapuram is involved in search for bioactive/polymer compounds from natural resources and development of new synthetic systems of technological interest; agro-processing of and value addition to spices, coconut, oil palm, cassava, etc. Laboratories at the Indian Institute of Chemical Biology, and the School of Natural Product Studies, Jadavpur University both in Kolkata, Indian Agriculture Research Institute etc. are making major contributions in the field of herbal research.

Conclusion

It is estimated that Europe imports about 400,000 tons of medicinal plants per annum, with an average market value of US$ 1 billion from Africa and Asia. Germany is by far the largest market and within Europe, largest consumer of medicinal plants, spending £ 1.4 billion (US$ 2.2 billion) annually. France is second (£ 116 million) and the United Kingdom third (£ 88 million). Among the importers of botanical drugs, Hong Kong is at the top followed by Japan, Germany and USA. These assessments of international trade in medicinal plants include plants and their parts like roots, tubers, wood extract, bark, leaves, flowers, fruit and seeds. Germany and the USA are among the top four countries in import as well as export, expressing their major role as a turntable for medicinal plant raw materials worldwide India has 2.4% of world's area with 8% of global bio-diversity. It is one of the 12 mega-diversity hot-spot regions of the world, other countries being Brazil, Colombia, China, South Africa, Mexico, Venezuela, Indonesia, Ecuador, Peru, USA and Bolivia. Across the country, the forests of India are estimated to harbour 90% of

India's medicinal plants diversity in the wide range of forest types that occur. Only about 10% of the known medicinal plants of India are restricted to non-forest habitats. Medicinal herbs as potential source of therapeutics aids has attained a significant role in health system all over the world for both humans and animals not only in the diseased condition but also as potential material for maintaining proper health. A major factor impeding the development of the medicinal plant based industries in developing countries has been the lack of information on the social and economic benefits that could be derived from the industrial utilization of medicinal plants. Except for the use of these plants for local health care needs, not much information has been available on their market potential and trading possibilities. Presently, India contributes less than 1% to the global herbal market however it is fast emerging as a key supplier of medicinal plants across the globe. The present value of the entire ayurvedic production in India is estimated around USD 1 bn while annual exports are pegged at USD 100 mn. Of the total exports 60% is crude herbs, 30% is finished product shipped abroad for direct sales to consumers, and the remaining 10% is partially prepared products to be finished in the foreign countries.

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