

We are pleased to present this book entitled "Medicinal Plants and Management of Lifestyle Diseases". Ratnesh Kumar Rao, Secretary, Mahima Research Foundation and Social Welfare are not new to Ayurvedic and Modern Medicine students. With his vast experience in Academic activities, he has dealt this complex subject and edited, with practical approach and simple language, to meet the requirement of the students and teachers of Ayurveda and Modern Medicine.

The need of basic sciences in Ayurvedic research is extremely needed for evidence based Ayurveda. The core Ayurveda fraternity needs to be analyzed in terms of extended benefits of putting an evidence basis to the practice of Ayurveda, primarily for a prospectively better and dependable health care and secondarily for the prospective growth of Ayurveda as a contemporary science. An evidence basis is required to be adopted at every level of health-care practice from diagnostics to the therapeutic decision making. Ayurveda requires a thorough work to bring out an evidence basis to its diagnostics primarily to support its fundamentals and to create a sound scientific and logical basis upon which a decision of therapeutic intervention can be made.

Integrative medicine thus offers, in theory at least, the opportunity to combine the "best" of Conventional medicine and Complementary Alternative Medicine (CAM) and thereby produce better patient care, measured in terms of symptom relief, functional status, patient satisfaction and perhaps cost-effectiveness. Integrative medicine is necessarily "holistic" in the sense that somatic, emotional and spiritual health is considered integral to overall health.

Though this book is mainly deals with the diagnostics and treatment of Ayurveda and Modern Medicine, it will also be very handy for those who desire to start a Translational Researches in Ayurvedic Medicine.

We are sure this will be accepted very much by the students, teachers, scientist and viadya of Ayurveda and Modern Medicine all over the India. We solicit your encouragement in this endeavour.



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Chief Editor
Ratnesh Kumar Rao



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PREFACE

Lifestyle diseases characterize those diseases whose occurrence is primarily based on the daily habits of people and are a result of an inappropriate relationship of people with their environment. The main factors contributing to lifestyle diseases include bad food habits, physical inactivity, wrong body posture, and disturbed biological clock. A report, jointly prepared by the World Health Organization (WHO) and the World Economic Forum, says India will incur an accumulated loss of \$236.6 billion by 2015 on account of unhealthy lifestyles and faulty diet. According to the report, 60% of all deaths worldwide in 2005 (35 million) resulted from non-communicable diseases and accounted for 44% of premature deaths. What's worse, around 80% of these deaths will occur in low and middle-income countries like India which are also crippled by an ever increasing burden of infectious diseases, poor maternal and perinatal conditions and nutritional deficiencies. According to a survey conducted by the Associated Chamber of Commerce and Industry (ASSOC-HAM), 68% of working women in the age bracket of 21-52 years were found to be afflicted with lifestyle ailments such as obesity, depression, chronic backache, diabetes and hypertension.

The study 'Preventive Healthcare and Corporate Female Workforce' also said that long hours and working under strict deadlines cause up to 75% of working women to suffer from depression or general anxiety disorder, compared to women with lesser levels of psychological demand at work. The study cited scientific evidence that healthy diet and adequate physical activity - at least 30 minutes of moderate activity at least five days a week - helped prevent NCDs. In India, 10% of adults suffer from hypertension while the country is home to 25-30 million diabetics. Three out of every 1,000 people suffer a stroke. The diet [or lifestyle] of different populations might partly determine their rates of cancer, and the basis for this hypothesis was strengthened by results of studies showing that people who migrate from one country to another generally acquire the cancer rates of the new host country, suggesting that environmental [or lifestyle factors] rather than genetic factors are the key determinants of the international variation in cancer rates.

Some of the common diseases encountered because of occupational lifestyle are Alzheimer's disease, arteriosclerosis, cancer, chronic liver disease/cirrhosis, chronic obstructive pulmonary disease (COPD), diabetes, hypertension, heart disease, nephritis/CRF, and stroke. Occupational lifestyle diseases include those caused by the factors present in the vicinity like heat, sound, dust, fumes, smoke, cold, and other pollutants. These factors are responsible for allergy, respiratory and hearing problems, and heat or cold shock. So, A healthy lifestyle must be adopted to combat these diseases with a proper balanced diet, physical activity and by giving due respect to biological clock. To decrease the ailments caused by occupational postures, one should avoid long sitting hours and should take frequent breaks for stretching or for other works involving physical movements.

In recent decades, the prevalence of non-communicable diseases has risen, an increase attributable to historic and projected demographic shifts of the world's population, together with urbanization and accompanying lifestyle changes. Countries of low and middle income now have a large burden of non-communicable disease, which overlaps with the unfinished agenda of communicable diseases; the risk factors of poverty, unhealthy lifestyles, tobacco use, and alcohol misuse are common to both categories of disease. People living with chronic communicable diseases such as tuberculosis and HIV/AIDS are most likely to develop co-morbidity with non-communicable diseases. Moreover, coexisting communicable and non-communicable diseases augment the risk or effect of the other. Health-care systems in resource-limited settings are poorly equipped to deal with this double burden of disease, and disease-specific health-care approaches do not represent the most efficient response and therefore, traditional approaches to global health need to be reassessed, with greater emphasis on multidisciplinary collaboration and integrated strategies. Chronic non-communicable diseases are rapidly increasing in importance as a global public health problem. An emerging epidemic of non-communicable diseases is closely related to lengthening life expectancy in developed and many developing countries, profound and frequently unhealthy changes in lifestyles, and adverse physical and social environments.

By the end of the twentieth century, non-communicable diseases were estimated to have contributed more than 60% of deaths in the world and almost half of the global burden of disease. The problem is universal and low- and middle-income countries suffer the severe and growing impact of

non-communicable diseases, which creates tremendous difficulties for public health services in areas where human and technical resources are extremely limited.

Chronic non-communicable diseases now pose the greatest threat to health in both industrialized and developing countries. Health or epidemiological transition results in the changing pattern of health by which poor countries inherit the problems of the rich, and leads to the “double burden” of disease in the developing world because of the continuing weight of endemic infectious diseases.

There is an important commonality to the risk factors for non-communicable diseases and many of these risk factors are preventable. At the same time, most chronic non-communicable diseases cannot be easily cured and almost every instance carries a burden of expensive and long-term treatment and, frequently, a supportive social environment of care. Therefore, a realistic response is demanded for the feasible and effective control of non-communicable diseases. Emphasis must be placed on preventing the premature onset of non-communicable diseases, delaying their development in later life, reducing the suffering they cause, and providing social and medical rehabilitation for those they disable.

Addressing the major risk factors should be given the highest priority. Risk factors related to lifestyle, such as tobacco smoking, heavy alcohol consumption, inappropriate diet, and inadequate physical activity, are to some extent within the control of well-informed individuals. Therefore, health education as an essential component of any comprehensive program for the control of non-communicable diseases cannot be overestimated. However, the individual has little control over numerous other risk factors, such as the effects of poverty, poor reproductive and maternal health, genetic predisposition, occupational hazards, unhealthy living, and stressful conditions.

Control, in the broadest sense, of non-communicable diseases (NCD), amongst them diseases of the cardiovascular system, cancer, diabetes mellitus, mental disorders, and many other determinants of chronic ill health, has become an integral and important part of health services in many countries.

The holistic approach of integrative medicine overcomes the traditional wall of silence between complementary and alternative medicine (CAM) and conventional practice, reducing the risk of adverse interactions or gaps in care. At the level of primary prevention, an array of integrative modalities can be effective in health promotion, including lifestyle counseling, dietary guidance, stress mitigation techniques, interventions to improve sleep quality, and use of nutraceuticals and herbal supplements for health promotion. At the level of secondary prevention, stress management and nutritional supplementation can reduce risk factors for chronic disease. At the level of tertiary prevention, the full range of CAM modalities pertains to such goals as pain management, symptom control, stress relief, disease management, and risk reduction. Integrative medicine offers knowledgeable guidance to tailored therapies across the full spectrum of both conventional and CAM practice, thereby providing any given patient more options and more opportunities for success in the pursuit of personal health. This must be weighed against the inherent risks in making use of therapeutic practices for which the scientific evidence base is often at best incomplete. The goal of integrative medicine should be to make the widest array of appropriate options available to patients, ultimately blurring the boundaries between conventional care and CAM. Both disciplines should be subjected to rigorous scientific inquiry so that interventions that work are systematically distinguished from those that do not. Integrative medicine is a framework for this reconciliation, and practiced judiciously, offers the promise of better patient outcomes.

Medicinal plants have a vast array of bioactivities and are used in the management of infectious to lifestyle diseases from the dawn of civilization. Chronic diseases like obesity, diabetes, heart diseases, and cancer are a global problem today. However, most of these diseases were largely preventable. Though the emergency medicine saves thousands of lives every day, the preventive medicine on the other hand can help to prevent chronic diseases from occurring, rather than trying to treat after it is too late.

The proposed conference will undoubtedly result in stimulating the thought in these areas and provide a platform for exchange of the knowledge for scientific validation and improvement of human health. At the same time it would explore the increasing application of medicinal plants & Ayurvedic medicine in various stages of Lifestyle diseases. It would bring about innovative approaches in health care delivery and develop strategies to address related challenges of access, quality and affordability

through new and creative approaches. It is commonly felt that the health care environment must foster innovation, not just allowing it but actively encouraging it to happen anywhere and at every level in health care and medicine-from the laboratory, to the operating room, bedside, and clinics. This book would result in bringing together scientist, academicians, R & D of pharmaceutical concerns for healthy deliberation and presentation of their findings of recent researches and their utility for the present day ailing humanity. This would also help in developing the leads for future researches by the scientific based on the clinical experiences of the Ayurvedic physicians and researchers.

It would initiate a process of developing integrated packages of disease-specific interventions that incorporate primary and secondary prevention, timely detection, diagnosis, treatment, and rehabilitation for the most prevalent chronic non-communicable diseases/life style disorders by nurturing a new relationship in which specialists, experts, and policy makers in various fields would look beyond their own professional boundaries and develop broad partnership for the great cause.

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PERSPECTIVE ON ETHNOMEDICINE: A CASE STUDY FROM SIKKIM HIMALAYAS

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Sikkim a 22nd state of India is located at the foothills of the eastern Himalayas. It has distinct diversity with respect to its topography, climate and vegetation due to its vast variation in altitude within very short amplitudes (ranging from around 300 m to 8598 m asl with timberline at around 4000 m asl in between) thus covering wide range of ecological zones viz. subtropical, temperate, sub alpine and alpine, making it one of the richest biodiversity spot in the world. The geographical area of the state is 7096km², and lies between the latitude 27° 4' 46" to 28° 7' 48" and 88° 00' 58" to 88° 55' 25" longitude and shares its borders with Nepal in the west, Tibet to the north-east and Bhutan in the south-east. There is a sharp climatic variation in each ecological zone of the state leading to diverse floral species (Singh *et al.*, 2002), therefore more than 400 plant species possessing therapeutic properties are reported from Sikkim (Srivastava *et al.*, 1990). This small state has vast reserve of medicinal plant, rich and distinct traditional legacy in folk medicine making it a "medicinal hub of the nation". Sikkim is a home to 20 hill tribes major ones being Lepchas, Bhutias, Nepalese, Limboos, Tibetians and even more sub tribes and each of this tribe has its own traditional knowledge regarding medicinal plants and large number of traditional healers are present in the region- Dhami, Jhakri, Phendongba and Bombo in the Nepali community, Pow and Nejum in the Bhutia community and Bunthing in the lepcha community.

Some important plants which are frequently used by traditional healers for curing purposes are *Aconitum heterophyllum*, *Aconitumbisma* used for diarrhoea, dysentery, and cold cough. *Alnusnepalensis*, *Brideliaretusa* are used to treat wounds and cuts. *Artemesiaindica* is used as a natural insecticide, antispasmodic, purgative and helmentic. *Astilberivularis*, *Betulaalnoides* as an analgesic, *Clematis buchananian* for sinusitis and food poisoning, *Equisitumdiffusum* is used while treating kidney stones etc. The medicinal plants found in Sikkim Himalaya are not only used for treating lesser diseases but plants like *Abroma augusta*, *Acoruscalamus*, *Campylandraaurantiacae*, *Cinnamomumtamalad*, *Costus speciosus*, *Cissampelospareira* are reported on having anti-diabetic properties (Das *et al.*, 2003; Wu *et al.*, 2009; Kirtikaret *et al.*, 1975; Polunin *et al.*, 1984). *Picrorhizakurroa* is used against heart complaints, piles, malarial fever, paralysis, jaundice and anemia (Panda *et al.*, 2010; Hussain *et al.*, 2007), *Stephaniaglabra*, *Curcuma aromatica* are reported on having anticancer properties (Chauhan *et al.*, 2001). Here mentioned names of medicinal plants are just a glimpse as many species are still undocumented in the Sikkim Himalayas, making the state a virgin biodiversity which needs further explorations and investigations. Scientific authentication of the medicinal plants found in the Sikkim Himalayas has become a necessity.

Methodology

Overall process in investigation of bioactive compounds can be divided into two broad categories 1) Preliminary procedure: which involves initial steps before extraction e.g. selecting the plant species, its cleaning and drying, grinding procedures. 2) Analytical procedure: this involves the experimentation techniques involving extraction, qualitative and quantitative test for bioactive compounds using HPLC, LC-MS, and GC-MS etc.

1. Plant Selection and Sample Preparation

1.1. Strategy for Choosing a Plant Species: The selection of medicinal plant is one of the important criteria which will set the course of work and its impact on all points of view. Preliminary studies on a plant must be carried out for its selection using secondary information from literature, field surveys and interaction with the local healers. Plant to study can be selected through its genomics, metabolomics and ecological, taxonomic and epidemiological based studies (Cullea *et al.*, 2008) but this is a complex approach, there are other basic approaches for the selection of a medicinal plant like the random selection, the ethnological based selection, the chemotaxonomic which is also known as phylogenetic or chemosynthetic, the ethno directed or ethno oriented selection and also selection through exploration of promising biological results (Elizabethsky *et al.*, 1994; Albuquerque *et al.*, 2006).

Some of the basic approaches are given below: (a) The randomized approach: Here the plant is selected through random process depending on the availability of the plant mostly laying down forest plots. This process when carried out in the area of high diversity and endemism, the probability of finding plants having novel compounds, bioactive or not increases (b) The ecological approach: this approach is carried out through field observation of interactions between organism and their environment, inducing to potential biological activity (antifungal, antibacterial, agrototoxic, pesticide) (Guiraud *et al.*, 2008). (c) The chemosystematic approach: the system consists of isolating groups of compounds present in plant considering taxonomic organisation of these plants. The plant which is studied or understood on the basis of its structural analogy of the substances present in it with other known active substances present in different botanical family, genus or species we can infer that this strategy is based on chemosystematics (Gottlieb *et al.*, 1982). (d) Ethno oriented approach: this selection approach indicates species population groups emphasizing locally built knowledge on the natural resources and their application on health care systems. Species are surveyed qualitative-quantitative ways, relating the species response to the certain diseases and how it's used and communities using them.

1.2. Collection of Plant Material: Plants are collected either randomly or by following leads supplied by local healers in geographical areas where the plants are found. Plants under consideration are usually collected from the wild, because of its advantage of being devoid of any pesticides (Banuet *et al.*, 2015). Plant based natural constituents can be derived from any part of the plant like barks, leaves, flowers, roots, fruits, seeds etc i.e. any part of the plant may contain active components.

1.3. Cleaning and Drying of Plant Material: Both fresh and dried parts of the plant can be used for the experimentation. Cleaning process involves 1) Stripping the plant into its various parts (stem, leaf, flower, bark, root etc.), 2) washing the plant parts with distilled water and tween 20. Drying is done to remove water content from the plant parts for long storage, therefore the plants have to be dried immediately after cleaning as to eliminate any spoilage of plant material. Drying can be done either through natural process which involves sun drying of the plant with the help of drying frames or stands. The time of drying depends on the temperature and humidity of the area. To reduce the drying time most researchers prefer for artificial drying where the plant materials are dried in the oven in which the temperature is maintained manually usually at 40°C (Tiwari *et al.*, 2011; Banuet *et al.*, 2015).

1.4. Powdering: When the sample is devoid of its moisture content it is considered to be fully dried. The dried sample has to be powdered for further analysis. The sample can be easily powdered using a motor or pestle manually and samples which are not easily powdered can be crushed using artificial crushers or grinders. The sample powder can be packed and sealed in poly bags and to be stored in a cool dry place.

1.5. Choice of Solvent: The precise determination of bioactive compounds from plant species is largely dependent on the type of solvent used in the extraction procedure. A good solvent should be of low toxicity, should easily evaporate, promote rapid extraction of the bioactive materials and should not interfere in the bioassay. Some of the important solvent used in extraction are (a) water which is a most simple of the solvent and are used by traditional healers but has disadvantages that are overcome by organic solvents, (b) acetone is a useful extractant for antimicrobial studies as it is highly volatile, has low toxicity and dissolves many hydrophilic and lipophilic compounds, (c) alcohol is mostly used as an extractant for polyphenols extraction. Higher amount of bioactive flavonoid can be extracted using hydroethanolic mixture because of increased polarity than pure ethanol. Methanol has high polarity than other organic solvents but is reported on hindering with the bioassays. Other solvents which are less frequently used but are equally good extractant are chloroform, ether and dichloromethanol (Eloff, 1996; Cowan, 1999; Bimakret *et al.*, 2010; Wanget *et al.*, 2010; Das *et al.*, 2010).

2. Analytical Procedure

2.1. Extraction: Extraction is the separation of medicinally active plant metabolites from inert plant materials. The purpose of standardisation of extraction procedures are to obtain therapeutically desired portion and to eliminate the inert material by treatment with a selective solvent known as menstrum. The extracted compounds can be purified from its co-extractives through simple crystallisation of compound from crude extract or through chromatographic methods in order to separate the compounds in different fractions with respect to its acidity, polarity, molecular size etc. There are many ways through which extraction of biomolecules are possible depending on their bioactivity and some of them are listed as below.

Types of Extraction: Plant tissue homogenisation: this process is extensively used by the researchers. The dry or the wet plant parts are powdered in a blender and treated with a certain quantity of solvent of choice and shaken vigorously for 5-10 minutes and kept for 24 h after which the extract is filtered mostly through centrifugation, this is repeated thrice to maintain the concentration (Das *et al.*, 2010).

Serial exhaustive extraction: successive extraction with solvent of increasing polarity from a non polar (hexane) to more polar solvent (methanol) is carried out so that compounds of wide polarity could be extracted (Das *et al.*, 2010).

Hot continuous extraction (soxhlet extraction): the extraction is carried out in a soxhlet apparatus. Extraction through this procedure is usually carried out when the targeted compounds have low solubility. This is a continuous process and takes place until a drop of solvent from the apparatus does not leave residue when evaporated (Nikhalet *al.* 2010, Handa SS *et al.* 2008).

Maceration: In this process whole or coarsely powdered crude plant material is placed in a suitable solvent for a period of 2-3days with frequent shaking until the soluble material is dissolved (Banuet *al.*, 2015; Tiwari *et al.*, 2011; Handa *et al.*, 2008).

Infusion: This process first involves maceration of the crude material with cold or boiling water which dilutes the macerated solution.

Digestion: This is a kind of a maceration process which is used when bioactive compound to be extracted is not thermolabile. This extraction process involves gentle heating which inturn increases the solvent efficiency.

Decoction: This process involves boiling of the crude material in a specified volume of water with the ratio of 1:4 or 1:6 and the volume is brought down to one fourth of its original volume, it is then cooled, filtered and strained. Many ayurvedic extracts namely “quath” or “kwath” is prepared using this procedure (Banuet *al.*, 2015; Tiwari *et al.*, 2011; Handaet *al.*, 2008).

Percolation: In this process a percolator (a narrow cone shaped vessel open at both ends) is used for the extraction. The crude material is moistened in menstium for about 4 h in a closed container after which the mass is packed and the top of the percolator is closed. Additional menstium is added to form a shallow layer above the mass, and the mixture is allowed to macerate in the closed percolator for 24 h. The outlet of the percolator then is opened and the liquid contained is then allowed to drip slowly. Additional menstium is added as required,until the percolate measures about three-quarters of the required volume. The mass is then pressed and the extracted liquid is added in the percolate, sufficient menstium can be added to produce the required volume. The mixture is then clarified by filtration or just for letting it stand followed by decantation (Banuet *al.*, 2015; Tiwari *et al.*, 2011; Handaet *al.*, 2008).

Sonication: This process uses ultrasound with frequencies ranging from 20 kHz to 2000 kHz; this increases the permeability of cell walls leading to cavitation and thereby releasing the desirable constituent (Banuet *al.*, 2015; Tiwari *et al.*, 2011; Handa, 2008).

Aqueous Alcoholic Extraction through Fermentation: this process involves soaking of crude material in the form of powder or decoction for a specific period of time during which it undergoes fermentation and generates alcohol in situ which act as a natural preservative and also facilitates the extraction of active constituents. Adaption of this process is usually seen in many medicinal ayurvedic preparations like “asava” and “arisa” which are usually carried out in an earthen vessel. This process is not yet standardized but with advancement in technology involved in fermentation methods standardization can be done (Handa, 2008).

Counter Current Extraction: in this process fine slurry of the crude material is made using toothed disc disintegrators, this slurry is kept in a cylindrical extractor and is moved in one direction where it comes in contact with the extracting solvent, further the starting material moves more concentrated the extract becomes. Extraction is completed when the quantities of solvent and material and their flow rates are optimized (Handa, 2008).

Supercritical Fluid Extraction: This process is an alternative sample extraction method with general goals of reduced organic solvent. It is one of the technologically advanced extraction system (Patilet *al.*, 2010) which involves use of gases usually CO₂ which is compressed to form dense liquid. CO₂ has low polarity so frequent addition of organic solvent is required to achieve high rate polarity. Argon is being used lately because it's an expensive and more inert with recover rates at 500 atm and 150°C. Super critical fluid extraction finds extensive application inthe extraction of pesticides, environmental samples, foods and fragrances, essential oils, polymers and natural products (Handa, 2008).

Phytonics process: a new technology of extraction where the solvent used is hydrofluorocarbon-134a, this process was developed as a replacement for chlorofluorocarbons unlike CFC's it's not flammable or toxic to the ozone layer. The processing of the plant is totally sealed so that the solvents are continually recycled and fully recovered at the end of each production cycle. The technique is highly selective, offering a choice of operating conditions and hence a choice of end products. Process is carried out entirely at neutral pH and, in the absence of oxygen; the products never suffer acid hydrolysis damage or oxidation (Handa, 2008).

2.2. Identification, Quantification and Characterisation: Various spectrophotometric, chromatographic and chromato-spectrophotometric methods are used for identification, quantification and characterization of the phytoconstituents present in the plants. Chromatographic techniques such as TLC, HPTLC, HPLC are mainly used for identification and quantification of known compounds, like the compound present in the extract have already been identified through literature or phytochemical screening. With the advancement in technology superior chromatographic techniques for e.g. LC-MS, LC-MS-NMR, and GC-MS are generated, these techniques not only identify and quantify the phytochemical constituents but also structural elucidation of the compounds are carried out for both known and unknown phytochemical constituents.

Conventional Techniques: Simple spectrophotometric assays: this method is commonly used for quick screening and quantification of phytoconstituents. Total plant phenolics are quantified by two widely used spectrophotometric methods namely the Folin-Denis and Folin-Ciocalteu methods (Laporniket *et al.*, 2005; Naczket *et al.*, 2006). These methods are based on chemical reduction reaction. Total flavanoids, proanthocyanins and hydrolysable tannin can also be quantified using colorimetric methods. Total flavanoids can be measured by treating it with $ALCL_3$ (Hwang *et al.*, 2009; Fernandes *et al.*, 2012). DMCA and vanillin assays provide information about the degree of polymerisation and hydroxylation pattern and stereochemistry of flavan-3-ol subunits and therefore help in quantifying proanthocyanins. This procedure has many demerits therefore; other methods such as the bovine serum albumin (BSA) and butanol-HCl methods are generally used for proanthocyanidin quantification (Naczket *et al.*, 2004; Abeynayake *et al.*, 2011; Hartzfeld, 2002). Another spectrophotometric method used to quantify flavonones and dihydroflavonols is based on their interaction with acidic 2,4-dinitrophenylhydrazine (Jun *et al.*, 2007). Pinocembrin is the standard used in this assay and the absorbance is measured at 486 nm (Margthas *et al.*, 2010). However, spectrophotometric techniques are easily relatable they give an estimation of the phytocompounds concentration to a certain minimum level and fails to quantify these compounds individually. For individual quantification and characterisation of the compounds various chromatographic and chromate spectrophotometric methods are brought into the process for additional precision and accuracy.

Thin Layer Chromatography (TLC): It is one of the simple and inexpensive chromatographic techniques for phytochemical evaluation of herbal drugs with minimum sample clean-up requirement providing qualitative and semi quantitative information of the resolved compounds. Preparative TLC with the thickness of 1mm is prepared using stationary and mobile phases. Further test engages a procedure where the separated compounds are sprayed with phytochemical screening reagents which leads to production of a certain colour depending on the phytochemicals present in the plant extract or when viewed under UV light, finally the areas identified are scraped or eluted using certain solvent, this can be used for further identification of the phytocompounds using more complex chromatographic techniques like HPLC, LC-MS etc.

High Pressure Liquid Chromatography (HPLC): this is a type of column chromatography where separation of the compounds is carried out on the basis of interaction with solid particles which are tightly packed in the column. The examples of normal phase silica columns are Kromasil 10 μ m, Kromasil 16 μ m and Chiralcel AS 20 μ m whereas for reverse phase are Chromasil C18, Chromasil C8 and YMC C18 (Oleszek, 2000; Philipson, 2007). High pressure up to 400 bars is required to release the analyte through the column before passing through the detector (Banu *et al.*, 2015). HPLC includes recording of the chromatograms, retention time of the individual peaks and adsorption spectra with different mobile phase. This procedure provides both quantitative and qualitative analysis in a single operation. With the merger of HPLC with spectrometry High Performance Liquid Chromatography–Diode Array Detection (HPLC–DAD), Gas Chromatography–Mass Spectroscopy (GC-MS), Capillary Electrophoresis–Diode Array Detection (CE-DAD), High-Performance Liquid Chromatography–Mass

Spectroscopy (HPLC-MS) and High-Performance Liquid Chromatography–Nuclear Magnetic Resonance Spectroscopy (HPLC-NMR) hyphenated approaches are created for not only qualitative and quantitative analysis but also for structural elucidation of phytocompound (Doughari, 2012).

High Performance Thin Layer Chromatography (HPTLC): This is a modified version of TLC where separation of sample components is carried out on high performance layers and the data can be recorded using scanner which includes the chromatogram, retardation factor values, the colour of separated bands, the absorption spectra, V_{max} and shoulder inflections of all resolved bands. High performance layers are pre-coated with a sorbent of particle size 5-7 microns and a layer thickness of 150-200 microns. The reduction in the thickness of the layer and the particle size, results in increasing the plate efficiency along with nature of separation. HPTLC is suitable for qualitative, quantitative and micro-preparative chromatography (Banu et al., 2015).

Optimum Performance Laminar Chromatography (OPLC): This process is a combination of TLC and HPLC together separating almost about 10-15 mg samples, with simultaneous processing of up to 4 or 8 samples at a time depending on the model of the instrument. This process implements the use of a pump which forces a liquid mobile phase through a stationary phase in a flat planar housing columns which is pressurized up to 50 bars, where the mobile phase is pumped via solvent delivery pump at constant linear velocity. The whole separation station includes 96 well plated sample holders, an automated sampling system that withdraws sample from each well and places it on the OPLC planar solvent delivery system which has a mobile phase degasser and a pump, OPLC purification unit, a four channel diode array detector to monitor the eluent and fraction collector for six 96-well plates. This process is very effective for the separation of the compound sample of interest.

Gas Chromatography: This process is appropriate for quantitative analysis of volatile compounds. Here gas is mobile phase and the liquid is stationary phase. This method divides extract between a gas and a liquid phase. The rate of migration depends on the distribution pattern of the chemical species/extract into liquid and gas phase, higher the % of the material in gaseous phase faster will be the migration. The chemical species/ extract which distribute itself 100% in a stationary phase will not migrate and the sample which distributes itself in both phases will migrate at an intermediate rate. Some of the gases used in this process are argon, helium, nitrogen, hydrogen etc.

Hyphenated Techniques Used in Phytochemical Analysis: Hyphenated techniques are the methods involved in accurate identification, quantification and characterisation of the isolated compounds with combination of chromatographic techniques with online spectroscopic detection technology. Hyphenated chromatographic techniques commonly achieve separation by liquid chromatographic (LC) or gas chromatography (GC) with detection via photo diode array (PDA) or mass spectrometer (MS). The structural information gained through photo diode array (PDA) or more specialized detectors like evaporative light scattering detectors (ELSD), fluorescent detectors (FLD) are very limited whereas MS and nuclear magnetic resonance (NMR) detection are valuable because of its high sensitivity, selectivity and accuracy (Patel *et al.*, 2010).

Liquid Chromatography–Mass Spectroscopy (LC-MS): The LC-MS is equipped by combining the power of liquid chromatography with the ability of mass spectrophotometry. A switching valve helps in making a working combination of these two techniques. Information obtained about the structure of the compound from single LC-MS run is rather poor as they use soft ionization techniques; this problem has been tackled by the introduction of tandem mass spectroscopy (LC-MS-MS). Recent advances include electro spray, thermospray and ion spray ionization techniques which offer exclusive advantages of high detection and specificity. The quality of the response from this system strongly depends on various factors like nature of the sample, the compounds to be analyzed, mobile phase used, its flow rate and type of interface used. It is very difficult to optimize the ionization conditions for all different types of compounds which need the analysis of the extract in different ionization modes which is very tedious (Wolfender *et al.*, 1994; Patel *et al.* 2010).

Liquid Chromatography-Fourier Transform Infrared Spectroscopy (LC-FTIR): This is a hyphenated technique coupling liquid chromatography (esp. HPLC as its one of the most powerful separation technique available) with IR or FTIR. This spectroscopic technique is useful for the identification of organic compounds as the mid IR region of the organic compounds have many absorption bands that are characteristic of particular functionalities e.g. –OH, –COOH etc. When the absorption of the mobile phase happens it induces the interference of the detection of sample component, but some transparent region of mid –IR region produces detection possibility e.g.

deuterated solvent like water or predeuterated methanol, are used as mobile phase. IR can monitor many organic compounds that have C-H structures in the extract. The solvent elimination approach with two types of surface interferences such as diffuse-reflectance infrared Fourier transform (DRIFT) approach and buffer-memory technique is preferred option for most of the LC-IR operations (Jinno *et al.*, 1982; Patel *et al.*, 2010).

Liquid Chromatography–Nuclear Magnetic Resonance (LC-NMR): This is one of the most effective chromatographic techniques for the separation and structural elucidation of unknown compound and mixtures. A classical HPLC-NMR work station is established on a conventional HPLC system with binary, ternary or quaternary pumps, RP-columns with UV or PDA detector the chromatograph is coupled online with the NMR spectrometer generating a requirement for appropriate flow-probe design. Online LC-NMR allows continuous registration of time changes as they appear in the chromatographic run automated data acquisition and processing improving its sensitivity and detection (Daffre *et al.* 2008). This equipment is usually supplemented with a parallel MS detector to provide additional chromatographic traces (total ion current, extracted ion chromatogram, etc.) and complementary structural data (molecular ions and their fragments). Introduction of pulsed field gradient technique in high resolution NMR have improved the NMR techniques for structural elucidations and molecular weight information of usually light and oxygen sensitive compounds.

Gas Chromatography–Fourier Transform Infrared Spectrometer (GC-FTIR): similar to LC-FTIR coupling capillary column gas chromatographs with fourier transform infrared spectrometer provides a potent means for separating and identifying the components of different mixtures (Doughari *et al.*, 2012).

Gas Chromatography-Mass Spectrometry (GC-MS): GC-MS is a hyphenated technique developed from the coupling of gas chromatography with mass spectrometry. Mass spectra obtained from this technique provide structural information based on the interpretation of fragmentations. These fragment items with different relative abundances can be compared with the library spectra. The equipment used for GC-MS generally consists of an injection port at one end of the metal column which is often packed with sand like material to promote maximum separation and detector (MS) at other end of the column. The sample is injected into the injection port of the device which is then vaporized, separated in the column and analyzed by the detector (Patel *et al.*, 2010), the flow rate from the capillary is usually low enough therefore the column output can be fed directly into the ionization chamber of MS. The simplest mass detector in GC is the Ion Trap Detector (ITD) (Doughari *et al.*, 2010). Compounds that are sufficiently volatile, small, and stable in high temperatures are easily analyzed by such technique. Sometimes, polar compounds esp. those with the number of hydroxyl groups needs to be derivatized usually by conversion of the analyte to its trimethylsilyl derivative (Patel *et al.*, 2010)

Supercritical Fluid Chromatography (SFC): this process combines the technique of both gas and liquid chromatography and permits separation and determination of a group of compounds that are not dealt appropriately by either gas or liquid chromatography. The compounds that forgo in this process are non volatile or thermally labile so that GC procedures are inapplicable or contain no functional group that makes the spectroscopic or electrochemical techniques detect compounds.

3. Conclusion and Future Prospects: Diverseness of Sikkim paints it multicolour when it comes to its culture, climate, flora, fauna etc, making it a gemstone which beautifies, exemplifies, the crown i.e. the Indian Himalayan Region (IHR). Like elsewhere on the IHR region local people of Sikkim rely on large extent on native plant species for obtaining various raw materials. Ethno medicinal practise is one of the most important traditional legacies, a pioneer component of traditional trend which is followed by communities and tribes of the state. The rural inhabitants possess incredible knowledge of a number of plant based formulations which served as medicines from centuries. In high altitude state like Sikkim, traditional health care system is only obtainable or reachable form of medicine for majority of the population thus, making medicinal herbs the main ingredients of local medicines. With resurgence in the use of phytomedicines for cure of acute and chronic diseases, the medicinal plants which are being used for this purpose by the local healers should be analysed, screened for its bioactive components so in depth studies could be made for its scientific authentication, which could further be employed for drug development.

Drug discovery has always been time consuming therefore, faster and better methodologies will pace up the whole process. This area of research can provide a variety of opportunities for uplifting the state economy. The government of state should identify the importance of authenticating the local medicinal herb. New and improved policies and strategies for investigation of medical and economical potential of local medicinal plants should be implemented. The experiments applied for this purpose are mostly instrumentalized therefore, high tech- instruments for development of novel and sensitive techniques can be brought to the picture so that the whole process i.e. detection, isolation, purification and structural characterization of active constituents can be done with accuracy and precision. Emphasizing the medicinal plant drug discovery should be done in such a way that its status in the natural environment is not hampered in the future. Medicinal plant cultivation is cited as one of the model process through which the overall objective can be achieved with minimal impairment to its natural habitat.

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CLASSICAL & CONTEMPORARY OVERVIEW ON AMALAKI (*Emblica officinalis* Gaertn.) W.S.R. TO ITS HEALING POTENTIAL

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Amla literally means 'sour'; it is the Hindi word for a fruit tree (*Emblica officinalis* or *Phyllanthus emblica*) that grows throughout India and bears sour-taste. Amla is also known by the Sanskrit name 'Amalaki'. Other Sanskrit nicknames for amla—names meaning mother, nurse, and "immortality. These names denotes to the healing capacity of its fruits. Amla has been used in Ayurveda and other Asian medicinal practices for thousands of years. It is considered as the most effective rejuvenative, immune promoting and disease-fighting agent in the plant kingdom. In *Atharvaveda* canto IV/chapter-VII/12, it has been suggested as useful remedy for *Kushtha roga*. In *Pauranic* literature *Amala* has been attributed to have originated from divine sources and its flower were used in high esteems for offering in worship of Gods and Goddesses.

Amalaki has been used in Ayurveda since thousands of years. It is one of the richest legacies of any fruit known today. The ancient texts of Ayurveda describe more than 5,000 herbs and fruits in great detail and among those *Amalaki* are one of the popularly known and widely used plants. It is a holy plant in old Indian culture and due to this fact it is generally planted in the temple, gardens and house courtyards. It is considered the most effective rejuvenative, immune promoting and disease fighting agent in the plant kingdom. In the classical text it is referred to as *Dhatri*, meaning the "mother" or "nurse," a tribute to the fruit as the ultimate caregiver, sustainer and healer. It is highly regarded for promoting *Ojas* i.e. immune power; in body, which leads to radiant health, shining eyes, skin and hair, and youthful aging. Recent researchers of contemporary science have been drawn the merit of its immune enhancer, anti-oxidant, anti-diabetic, and hypolipidemic properties.

Among all fruits, which are available in the Nature, *Amalaki* fruit is the most concentrated and bio-available source of Vitamin C. its fruit has 20 times more Vitamins C than oranges. It is the second richest source of Vitamin C after Cherries. Beside this, the fruit is the source of powerful cellular antioxidants (super oxide dismutase), polyphenols, tannins, bioflavanoids, amino acids, trace minerals and other beneficial phytonutrients (Pandey & Singh, 2002)

Cultural and Religious Significance: The tree is considered sacred by Hindus as God Vishnu is believed to dwell in it. The tree is worshiped on *Amalaka Ekadashi*. In other Hindu beliefs, *Amalaki* is said to have originated from the drops of *Amrit* which spilled on earth accidentally, because of the fight of Gods and Demons after *ksheera sagar manthana*. And hence also this religious belief makes claims that it almost cures every disease and is also good in extending the longevity of life. In the Sanskrit Buddhist tradition half an amalaka fruit was the final gift to the Buddhist *sangha* by the great Indian emperor Ashoka. This deed became so famous that a *stupa* was created to mark the place of the event in modern-day Patna and was known as the *Amalaka stupa*. According to Hindu tradition, Adi Shankara of Kerala composed and recited the *Kanakadhara stotram* in praise of *Mahalakshmi* to make a poor Brahmin lady get wealth, in return for a single *amla* presented to him as *bhiksha* on an auspicious *dwadashi* day. Contemporary poet/philosopher Ravi Teja Yelamanchili wrote a book titled *Amalaki*. The book is based on *Advaita Vedanta* of Sri Adi Shankaracharya. According to a Tamil legend, Avvaiyar (Tamil) female poet, ethicist and political activist of the *Sangam* period was gifted with one *amla* by King Athiyaman to give her long life. In Theravada Buddhism, this plant is said to have been used as the tree for achieving enlightenment, or *Bodhi* by twenty first Lord Buddha.

Amalaki Mentioned in Classical Triad (*Brihatrayi*): In *Charaka Samhita* (C. Ci. 6/22, 26, 28, 30, 36, 40, 41, 46, 48), it is mentioned in *Kushthaghna*, *Virecanopaga*, *Kasahara*, *Jvarahara mahakashaya*, among *Sangrahaniya Dravyas*. It is praised as the best among *Vayaisthapana Dravyas*. It is mentioned as an ingredient of various *Rasayana* and *Vajikarana Yogas*. It is advocated in various diseases including *Prameha*, *Kasa*, *Shvasa*, *Hikka* and *Kushtha roga* (Dash and Sharma 1998). In *Sushruta Samhita* (S.S.Ci-II/8, 9, 12/10-11), it is mentioned in *Amlavarga*, *Mustadigana*, *Amalakayadigana*. It is important ingredient of *Triphla*; which is *Kaphapittahara*, *Chakshushya*

Dipana, Pramehaghna, Kushthaghna, and Vishamajvarahara. Its fruits are *Amala, Madhura, Tikta, Kashaya, Katu* in *Rasa* and *Tridoshashamaka* properties. It is advocated in all types of *Premea* and *Prameha Pidikas*. It is an ingredient of some *Rasayana* and *Vajikarana Yogas* (Shastri, 2003)

In Ashtanga Sangraha (A.S.Ci.-14/12,14,15, 16, 20, 21, 25, 27, 40, 44, 45, 50), it is mentioned in *Kushthghna, Javaraghna* and *Vayahsthapana ganas* and the best among *Vayahsthapana Dvavyas*. It is mentioned in *Amla* and *Kasaya rasa Skandha*. It is praised the best among *Amla Dravyas*. It is specially indicated in *PramehaI* (Murthy, 1997) In Ashtanga Hridaya (A.H.V. 40/48), it is mentioned in *Parushakadi, Mushkakadi, Mustadigana* and *Amlavarga dravyas*. It is an ingredient of *Atisthaulyahara yoga* and also used in *Mithyayoga* of *Vaman karma*. *Dhatri* and *Haridra* are stated as the best among *Pramehara-Dravyas* (Meheshu-Dhatrinishe– A.H.U.40/48). It is praised as the best drug for *Vayahsthapana* (*Vayah-sthapane Dhatri* – A. H. U. 40/56) (Gupta & Upadhyaya, 1982)

Sanskrit Name/Synonyms: *Amalaki / Shriphala, Dhatrika-nurse, Am ta-ambrosia, Shita, Gayatri, Vrishya, Rochani, Tishyaphala, Pancharasa, Vayahstha-* retaining youth, *Shiva*-beneficial to all nature.

Common Name: Indian gooseberry

Botanical Name: *Embelica officinalis*

Family: Euphorbiaceae

Brief Botanical Description: It is found in both cultivated (*Gramya*) and wild (*Vanya*) state. It is small to medium sized tree growing throughout India up to 1500 meter of altitude. It is quite common in dry and deciduous forest. The tree is small to medium size, reaching 8 to 18 meter in height. The fruit is nearly spherical, light greenish yellow, quite smooth and hard on appearance, with 6 vertical stripes. Ripening in autumn to spring season (February-March). The taste of Indian gooseberry is sour, bitter and astringent, and is quite fibrous (Nadkarni, 1976; Sharma, 1981). The botanical outlook of *Amalaki* is given below.



Amalaki Plant (Image 1).



Amalaki fruits and powder (Image-2)

Chemical Constituents: Fruit pulp contains moisture 81%, protein .5%, fat .1%, mineral matter .7%, fiber 3.4%, carbohydrates 14%, calcium .05%, and potassium .02%, iron 1/2mg/100gms nicotinic acid.2mg/100g and vitamin C 600mg/100g. Fruit is high in pectin, phyllembelin is there. Fresh *Amla* contains about 20 times more vitamin C than orange juice and equal in antiscorbutic value to 1-2 oranges. Dried fruit have tannins and 3-4 colloidal complexes. Other components are phyllemblic acid, lipids, gallic acid, emblicol, mucic acid, ellagic acid, glucose. Seeds contain a fixed oil, phosphatides, some essential oil with linolenic, linoleic, oleic, stearic, palmitic, myristic acids. Proteolytic and lipolytic enzymes are in seeds⁶. The Tannoid Principles of the fruits of *Amalaki* comprising of emblicanin A, emblicanin B, Punigluconin and Pedunculagin have been reported (Bhattacharya *et al.*, 2000)

Ayurvedic Pharmacodynamic

Rasa / Tastes: Five-*Amala, Madhura, Katu, Kashaya, Tikta*, except *Lavana*; sour, sweet, bitter, astringent, pungent except sour.

Guna / Attributes: *Lahgu, Ruksha, Shita*; light, dry, cold.

Virya / Potency: *Shita*; cooling effect.

Vipaka / Post-digestive effect: *Madhura*; sweet.

Prabhava/ Specific potency: diuretic, purgative, digestive, longevity.

Doshakarma: It is *Tridosahara*, especially *Pittashamaka*.

- *Vata* due to *Amala rasa*.

- *Pitta* due to *Madhura rasa* and *Shita virya*.
- *Kapha* due to *Ruksha gu* a and *Ka* haya *rasa*.

Useful Part: usually fruits and some time seeds, leaves, flowers and root bark.

Doses: *Amalaki* fruit *churna*- 3 to 6 gms, Juice- 10 to 20 ml bid after meal.

According to Ayurveda, *Amalaki* balances all three *doshas*. *Amalaki* is unusual in that it contains five out of the six tastes recognized by Ayurveda. The mode of action is mostly recognize through its *virya* i.e. potency, and *vipaka* i.e. post-digestive effect. Considered in this light, *amalaki* is particularly helpful in reducing *pitta* because of its cooling energy i.e. *sheet virya*. It also balances both *pitta* and *vata* by virtue of its sweet taste. The *kapha* is balanced primarily due to its drying action. It may be used as a *rasayana* (rejuvenative) to promote longevity and traditionally to enhance digestion (*dipanapachana*), treat constipation (*anuloma*), reduce fever (*jvaraghna*), purify the blood (*raktaprasadana*), reduce cough (*kasahara*), alleviate asthma (*svasahara*), strengthen the heart (*hridya*), benefit the eyes (*chakshushya*), stimulate hair growth (*romasanjana*), enliven the body (*jivaniya*), and enhance intellect (*medhya*). In Ayurvedic polyherbal formulations, it is a common constituent, and most notably is the primary ingredient in an ancient herbal *rasayana* called *Chyawanprash*. This formula, which contains 43 herbal ingredients as well as clarified butter, sesame oil, sugar cane juice, and honey, was first mentioned in the Charaka Samhita as a premier rejuvenative compound for the prevention of aging and management of various ailments (Pandey & Singh, 2003; Pandey, 2014).

Pharmacological Action of Amalaki in Ayurveda

Nervous System: It is *Medhya*-nervine tonic.

Digestive System: It is *Rochana*-appetizer, *Dipana*-promote digestive bio-fire, *Anulomana*-laxative, *Yakriduttejaka*-promote liver function, and *Plihahita*-beneficial for spleen.

Circulatory System: It is *Hridya*-cardio tonic, *Shonitasthapana*-erythrogenic, *Raktastambhaka*-hemostatic, *Raktaprasadana*-blood purifier.

Respiratory System: It is *Kaphaghna*-beneficial in all kinds of respiratory troubles.

Urinary System: It acts as *Mootrala*-diuretic, *Pramehaghna*-anti-diabetic. Hence it is useful in urinary disorders including diabetes mellitus.

Reproductive System: It acts as *Vrishya*-improves sexual potency, *Vajikarana*-aphrodisiac, and *Prajasthapana*-promoting reproduction.

Imperative: It acts as *Javaraghna*-anti pyretic and *Daha prashamana*-refrigerant. *Medohara*-reduces fat.

On Assimilation: It acts as *Rasayana* (immuno enhancer and rejuvenator).

External: It acts as *Daha prashamana*, *Keshya*-beneficial for hairs, *Chakshushya*-beneficial for eyes (Nadkarni, 1976; Pandey, 2008; Pandey & Byadgi, 2013).

Therapeutic Indications of Amalaki in Classical Texts: It is indicated in variety of clinical conditions in the Ayurvedic texts as given below.

S. No.	Clinical Condition	Modern correlate	Textual references
1.	<i>Prameha</i>	Urinary disorders including Diabetes mellitus	A.H.U- 40/48, C.S.Ci.- 6/22, S.S. Ci. - 11/8, V.M - 35/16
2.	<i>Mutraghata</i>	Urinary obstruction	S.S.U.-58/39-404/ V.M- 32/8, B.P. Ci. 35/32
3.	<i>Tavagvikara</i>	Skin Diseases	R.M.- 81, V.M- 51/34, 52/53, 52/8.
4.	<i>Vatarakta</i>	Gout	C.S.Ci.- 5/10
5.	<i>Jalakagardabha</i>	Acute spreading inflammation	C.S.Ci.- 12/100, A.H.U.-32/6, A.S.V.37/8
6.	<i>Rasayana</i>	Immuno-modulator and rejuvenator	C.S.Ci.- 1-2/8, 1-1/58-74, 1-2/4, 1-3/9-13, S.S.Ci.- 40/56, 39/ 149-150, V.M- 69/19.
7.	<i>Vrishya</i>	Aphrodisiac.	S.S.Ci.- 26/24 and V.M.- 70/8-9
8.	<i>Pradara</i>	Gynecological problem	S.S.Ci.- 30/117, B.P.G- 69/10, V.M.-2/9
9.	<i>Soma roga</i>	Excessive Urination	GN.- 6-1/69
10.	<i>Udarda</i>	Allergic manifestation (urticaria)	V.M.- 52/53, 52/8
11.	<i>Javara</i>	Pyrexia	S.S.Ci.- 3/230, C.S.Ci.- 3/187
12.	<i>Arsha</i>	Piles	S.S.Ci.- 14/148-45; 14/158-68, S.S.Ci.- 14/202, 6/13
13.	<i>Pandu</i>	Anemia	S.S. Ci.- 44/27, 44/8
14.	<i>Kamala</i>	Jaundice	C.S.Ci.-16/100-101,16/111-113, 16/114
15.	<i>Raktasrava</i>	Hemorrhage	C.S.Ci.- 4/57-58, V.M.- 9/30, S.G-3/11-61
16.	<i>Amalapitta</i>	Hyper acidity	B.S.- <i>Amlapitta</i> - 49
17.	<i>Hridaroga</i>	Heart diseases	C.S.Ci.- 26/99
18.	<i>Svarabheda</i>	Hoarseness of voice	R.M -10/3
19.	<i>Udarashula</i>	Abdominal pain	B.P.Ci.- 30/78, B.S.- <i>Parinamshula</i> - 95
20.	<i>Palitya</i>	Graying of hairs	V.M- 57/91

21.	<i>Netraroga</i>	Eye diseases	C.S.Ci.- 26/250, R.M- 3/10, V.M- 61/172, B.S. <i>Netraroga</i> – 34
22.	<i>Balaroga</i>	Children diseases	B.S. <i>Balaroga</i> -122
23.	<i>Udavarta</i>	Upward movement of <i>Vayu</i>	S.S.U.-55/22

Pandey & Singh, 2002

Besides, *Amalaki* used in inks, shampoos and hair oils, the high tannin content of Indian gooseberry fruit serves as a mordant for fixing dyes in fabrics. *Amla* shampoos and hair oil are traditionally believed to nourish the hair and scalp and prevent premature grey hair. In Kerala, well beds are lined with *Emblica* timber to get clean and sweet water for drinking and cooking.

Different Formulations of *Amalaki*: *Dhatriauha*, *Dhatri rasayana*., *Chyavanaprasha*, *Bramhrasayana*, *Amarasundari vati*, *Asvakanichukirasa*, *Arogyavardhani vati*, *Ekangavirarasa*, *Kamdhenurasa*, *Kamalahararasa*, *Kushtha Kuthararasa*, *Chandramritarasa*, *Nashtaputpantaka rasa*, *Vataraktantaka rasa*, *Laksamivilasa rasa*, *Harishankara rasa*, *Chandrakali vati*, *Chandanadi vati*, *Mehamudagara vati*., *Sanjivani vati*, *Navayas lauh*, *Triphala guggulu*, *Triphala churna*, *Amalyakyadyavaleha*, *Avipatikara churna*, *Nimbadi churna*, *Triphlarishta*, *Takrarishta*, *Phalarishta*, *Mahariphala Ghrita*, *Panchagunataila*, *Triphladi Kvatha* (Nadkarni, 1976; Mishra, 1980; Nadkarni, 1976).

Contemporary Pharmacological & Clinical Studies

- The alcoholic extract of the fruit of *Amalaki* was found to have antiviral properties (Dhar *et al.*, 1968).
- An earlier human study also showed a decrease in cholesterol with *Amala*. However, two weeks after discontinuing *Amala* fruit, cholesterol levels rise again. (Jacob *et al.*, 1988).
- The combination of extracts of *C. longa* and *E. officinalis* exhibit good reduction in blood sugar level. In normal fasting as well as alloxan induced diabetic rats (Singh *et al.*, 1991)
- Fresh juice of *Amala* fruit reduced the atherosclerotic effects of a high-fat, high-cholesterol diet in rabbits, as illustrates by the regression of aortic plaques. Hence the juice of *Amala* is an effective hypolipidemic agent (Mathur, 1996).
- Experiments conducted at the Niwa Institute of Immunology in Japan have shown *amla* to be a potent scavenger of free radicals. The studies showed that *amla* preparations contained high levels of the free-radical scavenger, superoxide dismutase (SOD), in the experimental subjects (Goshal *et al.*, 1996).
- In another study, a group of mice that received dietary supplementation of *Amala* fruit along with a known carcinogen experienced a significant reduction in cell poisoning when compared to mice that received only the carcinogen (Nandi *et al.*, 1997).
- Tannin compounds found in *Amala* fruit were tested for their effects in the brains of rats on the important free radical scavenging enzymes. Levels of these enzymes were increased, and there was a parallel decrease of oxidative stress (Bhattacharya *et al.*, 1999). This illustrates that the antioxidant activity of *Amala* is due to more than its high vitamin C.
- Daily administration of a water extract of *Amala* fruit protected laboratory mice from arsenic damage (Biswas *et al.*, 1999, 2001), while another study confirmed that *Amala* fruit strengthened bodily defense mechanisms against stress-induced free radical damage.
- Decoctions of the leaves and seeds of *Amalaki* (*E. officinalis*) are used in the treatment of diabetes mellitus (Treadway *et al.*, 1994).
- *Amala* may also possess cancer-fighting properties, as illustrated by several studies. Extracts of three Ayurvedic herbs, *Amala* fruit, *Tamalaki* (*Phyllanthus amarus*) and *Katuki* rhizome (*Picrorrhiza kurroa*) significantly inhibited the ability of carcinogenic chemicals to induce liver cancer. Without the herbs, the incidence of tumors was 100% (Jeena *et al.*, 1999). Studies have also indicated an ability to protect against elevated cholesterol levels and the resultant arterial damage.
- Fruit extract of *Emblica officinalis* ameliorates hyperthyroidism and hepatic lipid peroxidation in mice (Panda & Kar, 2003).
- The immunomodulatory properties of *amla* (*Emblica officinalis*) and *shankhpushpi* (*Evolvulus alsinoides*) were evaluated in adjuvant induced arthritic (AIA) rat model. Injecting Complete Freund's Adjuvant (CFA) in right hind paw of the animals induced inflammation. The crude extracts of both the herbs were administered intraperitoneally following a repeated treatment profile. These observations suggest that both the herbal extracts caused immunosuppression in

AIA rats, indicating that they may provide an alternative approach to the treatment of arthritis (Gunju *et al.*, 2003).

- One clinical study on type 2 diabetes mellitus signifies that powder of *Amalaki* & *Haridra churna* in a dose of 4gms each along with Cap. *Shilajatu* were found significant reduction in lowering blood sugar- F/PP, cholesterol as well as TG level without any unwanted effect on liver and renal parameter. Besides it also improve the Agni status and Ojas status on their respective parameters (Pandey & Singh, 2002).
- The antioxidant properties of amla extracts and their effects on the oxidative stress in streptozotocin-induced diabetes were examined in rats. Amla in the form of either the commercial enzymatic extract SunAmla (Taiyo Kagaku Co. Ltd., Yokkaichi, Japan) (20 or 40 mg/kg of body weight/day) or a polyphenol-rich fraction of ethyl acetate extract (10 or 20 mg/kg of body weight/day) was given orally for 20 days to the streptozotocin-induced diabetic rats. Amla extracts showed strong free radical scavenging activity. Amla also showed strong inhibition of the production of advanced glycosylated end products. The oral administration of amla extracts to the diabetic rats slightly improved body weight gain and also significantly alleviated various oxidative stress indices of the serum of the diabetic rats. The elevated serum levels of 5-hydroxymethylfurfural, which is a glycosylated protein that is an indicator of oxidative stress, were significantly reduced dose-dependently in the diabetic rats fed amla. Similarly, the serum level of creatinine, yet another oxidative stress parameter, was also reduced. Furthermore, thiobarbituric acid-reactive substances levels were significantly reduced with *amla*, indicating a reduction in lipid peroxidation. In addition, the decreased albumin levels in the diabetic rats were significantly improved with *amla*. *Amla* also significantly improved the serum adiponectin levels. These results form the scientific basis supporting the efficacy of *amla* for relieving the oxidative stress and improving glucose metabolism in diabetes (Rao *et al.*, 2007)
- Mehata and associates and reported that *E. officinalis* exerts good glycemic control in animal model. This study signifies the anti-diabetic potential of selected plant along with other secondary benefits (Mehata *et al.*, 2009).
- Effect of *Amala* fruit (*Embolica officinalis* Gaertn.) on blood glucose and lipid profile of normal subjects and Type 2 diabetic patients was found significant result in trial subjects on FBS & PPBS and lipid profile (Shoaib Akhtar *et al.*, 2011).

Conclusion: *Amalaki* is the single most important fruit of Nature's, have capacity to promote cellular rejuvenation, enhance immune function and increased vitality. It is richest source of vitamin C. Vitamin C content of *Amalaki* increases in the sun dried *amalaki* for example if 100 gms. of fresh *Amalaki* gives out 600 mgs of Vitamin C, then when it is sundried, its content increases to 1500 to 1600 mg. It is abundant sources of antioxidants. Number of phyto-chemical such as tannins, flavonoids, terpenoids and alkaloids are reported to indicate several pharmacological properties such as anti-diabetic, antioxidant, anticancer, antitumor, anti-genotoxic, and ant carcinogenic effects. It is considered to be a safe herbal medicine without any adverse effects (Singh *et al.*, 2011). So, it can be concluded that *Amalaki* is considered the most powerful *Rasayana* drug of Ayurveda, which is clinical proven fruit for both its application and efficacy.

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CRITICAL EVALUATION OF VRANA

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Contrary to the modern concepts surgery was pioneered by *Ayurveda* in ancient India. *Shalya Tantra* is a significant branch of *Ayurveda*. The name of the sage-physician *Sushruta* is synonymous with surgery. Many surgical and para-surgical techniques have been described for the management of various diseases. *Vrana* is one of them which have been managed by human being from starting of civilization. Under the circumstances the first thing which the man came across was the injury from different sources which was causing *Vrana* (wound). Wounds are inescapable events of life which arise due to physical injury, chemical injury or microbial infections. Wound is very common in both developed and developing countries. It is a breach in the normal tissue continuum, resulting in a variety of cellular & molecular sequelae wound is a major health problem because the incidence of severe complications is high & financial resources are limited.

Vrana is an important chapter of *Shalya Tantra* due to its involvement in many surgical conditions. A broad classification of *Vrana*, *Shuddha Vrana*, *Nadi Vrana*, *Sadhya Vrana*, *Dagdha Vrana* etc. and their management in the form of sixty *Upakramas* which are from *Apatarpana* to *Rakshavidhana* are given in the text. In this chapter some aspect of the physiology and pathology of *Vrana* and its healing has been discussed in detail.

Etymology of *Vrana*: The word *Vrana* is derived from *Dhatu Vru- vrunoti, vrunute. Vrut- varayat-khadayat-aacchadayat*; it means to cover, to conceal and to envelope respectively (Sharma, 2013).

Definition of *Vrana*: A pathology in which there is consumption (destruction) of body tissue and formation of scar after healing that remains for a lifetime is called as a *Vrana* (Sharma, 2013). Definition of *Vrana* according *Sushruta* is very broad. Formations of scar after tissue destruction can either due to extrinsic factor (wound) or it can be due to intrinsic aetiology (ulcer). A phenomenon in which there is discolouration of *Gatra* (synonym used for *Anga* i.e. Human body) (Sharma, 2013).

Sites of *Vrana*: Sites of *Vrana* are termed as *Vrana Vastu* or *Vrana Adhishtana* in *Ayurveda* (Sharma, 2013). These are mainly on basis of involvement of body structures which are categorized mainly under eight sites viz- skin, muscle, vessels, ligaments, bones, joints, abdominal and thoracic viscera, and some vital parts of the body like brain.

Aetiology of *Vrana*: *Sushruta* classified *Vrana* broadly in two categories (Sharma, 2013): 1. *Nija* (Due to intrinsic causes), 2. *Agantuja* (Due to extrinsic causes).

Table 1: Aetiology of *Vrana*

<i>Nija Vrana</i>	<i>Agantuja Vrana</i>
Caused by vitiation of basic elements (<i>Doshas</i>) of body <i>Vata, Pitta, Kapha, Rakta</i> and their various combinations.	<ul style="list-style-type: none">• Inflicted by human beings, animals, birds, beasts, reptiles etc• Due to falls, compression, blows, caustic agents, thermal blow, poisons, irritant and corrosive drugs• Sharp piece of wood, clay horns• Injuries produced by different kinds of weapons as wheels, arrow, axe, trident, spear, kunta etc.• Mantra (<i>Charaka</i>)

Pathogenesis of *Vrana*

***Nija Vrana*:** *Sushruta* described pathogenesis of all disease in six stages which are together called as *Shada Kriyakala*. There is alteration of *Doshas* in all six steps that produce respective features according to stage of disease. These are accumulation, aggravation, spread, localisation at abnormal site that produce prodromal features, manifestation of disease, sequel, and complications (Sharma, 2013).

Table 2: Pathogenesis of *Nija Vrana* explained in the pattern of *Shad Kriyakala*.

1	<i>Sanchaya</i>	Accumulation of <i>Doshas</i>
2	<i>Prakoopa</i>	Vitiated <i>Doshas</i> , stage of aggravation of <i>Doshas</i>

3	Prasara	Spread of aggravated <i>Doshas</i> in body
4	Sthanasanshraya	Specific localisation of <i>Doshas</i> at weak organ (<i>Vrana Shopha</i>)
5	Vyakti	Formation of <i>Vrana</i>
6	Bheda	<i>Vrana</i> types and complications

Agantuja Vrana: Aetiology mentioned in table 1 causes destruction of body tissue followed by vitiation of *Doshas*. *Agantuja Vrana* after a span of 7 days converted into *Nija Vrana*.

Classification of Vrana: *Vrana* is mainly divided into two categories- *Nija* and *Agantuja*. Further classification of *Vrana* on different basis given in table 3

Table 3: Showing classification of *Vrana*

Etiological (2) (Sharma, 2016)	On basis of clinical features (4)	On basis of prognosis (4)	According to site (8)	
1. <i>Nija</i>	1. <i>Dushta</i>	1. <i>Sukha sadhya</i>	1. <i>Twaka</i>	5. <i>Asthi</i>
2. <i>Agantuja</i>	2. <i>Shuddha</i>	2. <i>Kashta sadhya</i>	2. <i>Mamsa</i>	6. <i>Sandhi</i>
	3. <i>Ruhyamana</i>	3. <i>Yapya</i>	3. <i>Sira</i>	7. <i>Koshta</i>
	4. <i>Rudha</i>	4. <i>Asadhya</i>	4. <i>Snayu</i>	8. <i>Marma</i>

Nija Vrana is further classified into 16 types on basis of involvement of *Doshas*:

Table 4: Showing 16 types of *Nija Vrana* (Sharma, 2013)

1. <i>Vataja</i>	2. <i>Pittaja</i>	3. <i>Kaphaja</i>	4. <i>Raktaja</i>
5. <i>Vatapittaja</i>	6. <i>Vatakaphaja</i>	7. <i>Vataraktaja</i>	8. <i>Pittakaphaja</i>
9. <i>Pittaraktaja</i>	10. <i>Kapharaktaja</i>	11. <i>Vatapittaraktaja</i>	12. <i>Vatakapharaktaja</i>
13. <i>Pittakapharaktaja</i>	14. <i>Vatapittakaphaja</i>	15. <i>Sannipataja</i>	16. <i>Shuddha</i>









As discussed earlier, *Agantuja Vrana* results from accidents, trauma from blunt or sharp objects, burns, corrosives like poison, caustics. *Vrana* due to sudden injury like accidents, trauma by blunt or sharp objects is called as *sadyovrana*. It is a subtype of *Agantuja Vrana*. Various types of *sadyovrana* are mentioned in different ayurvedic texts are mentioned in table no. 5









Table 5: Showing different types of *Agantuja Vrana* (*Sadyovrana*) (Sharma, 2013)

S.S.(6)	A.H.(7)	A.S.(15)		Sh. S.(8)
1. <i>Chinna</i>	1. <i>Patita</i>	1. <i>Chhinna</i> (i) <i>Ghrista</i>	2. <i>Viddha</i> (i) <i>Anubhinna</i>	1. <i>Chhinna</i>
2. <i>Bhinna</i>	2. <i>Bhinna</i>	(ii) <i>Avakrita</i>	(ii) <i>Bhinnatundita</i>	2. <i>Bhinna</i>
3. <i>Viddha</i>	3. <i>Viddha</i>	(iii) <i>Vicchinna</i>	(iii) <i>Atibhinna</i>	3. <i>Viddha</i>
4. <i>Kshata</i>	4. <i>Pravilambita</i>	(iv) <i>Vilambita</i>	(iv) <i>Nirbhinna</i>	4. <i>Vilambita</i>
5. <i>Picchita</i>	5. <i>Ghrista</i>	(v) <i>Patita</i>	(v) <i>Anuviddha</i>	5. <i>Aviklapita</i>
6. <i>Ghrista</i>	6. <i>Avkrita</i>	3. <i>Picchita</i> (i) <i>Savrana</i>	(vi) <i>Nirbhinna</i>	6. <i>Ghrista</i>
	7. <i>Vicchinna</i>	(ii) <i>Avrana</i>	(vii) <i>Atividhha</i>	7. <i>Nipatita</i>
			(viii) <i>Nirvidhha</i>	8. <i>Prachalit</i>

Instead of this *Charaka* also mentioned 20 different of *Vrana* on basis of various clinical features viz.

Table 6: Types of *Vrana* according to *charaka* (Sharma and Das, 2016)

1. Kritya - treated by surgical measures like excision, debridement; other meaning in <i>Sushruta</i> is curable <i>Vrana</i>		2. Utkritya - treated by dressing material like <i>Ropana Kashaya</i> , varti etc; other meaning in <i>Sushruta</i> is incurable <i>Vrana</i>	
3. Dushta - infected wound		4. Adushta - clean wound	
5. Marmashita -on vital organs		6. Amarmashrita - not on vital organs	
7. Samvrutta - with narrow opening		8. Vivrutta - with broad opening	

9. <i>Daruna</i> - with hard floor and swelling		10. <i>Mridu</i> - with soft floor and swelling	
11. <i>Stravi</i> - with excessive exudates		12. <i>Astravi</i> - without discharge	
13. <i>Savisha</i> - caused due to poisons		14. <i>Nirvisha</i> - not due to poison	
15. <i>Samasthita</i> - regular shape, floor, edge		16. <i>Vishamasthita</i> - irregular shape, floor, edge	
17. <i>Utsangi</i> - thick margins due to abscess cavity underneath		18. <i>Anutsangi</i> - thin margins	
19. <i>Utsanna</i> - hyper granulation tissue		20. <i>Anutsanna</i> - depressed floor	

Clinical features of Vrana

1. *Nija Vrana*: The specific signs and symptoms of 16 types of *Nija Vrana* vary according to characteristics features produced by respective vitiated *Doshas*.

Table 7: Clinical features of *Nija Vrana* (Sharma, 2013)

Type of <i>Nija Vrana</i>	<i>Vedana</i> (pain)	<i>Varna</i> (colour)	<i>Strava</i> (discharge)	<i>Gandha</i> (smell)	Other special characters
<i>Vataja</i>	Throbbing, stretching, pricking, piercing	Black, red	Cold, slimy, less discharge	Pungent	Tendency to crack; less granulation tissue
<i>Pittaja</i>	Burning sensation	Yellow, blue	Warm, light red coloured	Sharp	Tendency to suppurate, pustules
<i>Kaphaja</i>	Constant, excessive itching	Pallor	Whitish, cold, sodden, slimy	Smell like raw meat	Rigid floor, Thick margins, membranous covering of veins and ligamentous tissue
<i>Raktaja</i>	Like <i>pittaja Vrana</i>	Like coral spouts (with black blister)	Blood	Like horse stable, iron like	Tendency to bleed
<i>Sannipatataja</i>	Different kinds	Different colours	Different types	Different types	All <i>doshas</i> signs +++
<i>Vatapittaja</i>	Pricking burning, fuming	Yellowish red	Yellowish red	Fried paddy	
<i>Vatakaphaja</i>	Itching, pricking		Cold, slimy, less	Linseed oil	Hard
<i>Vataraktaja</i>	Pricking+++	Red	Blood, red		Numbness
<i>Pittakaphaja</i>	Burning		Yellowish white, warm	Sesamm oil	
<i>Pittaraktaja</i>		Like upper layers of melted butter milk	Black	Water of fish washing	Soft, spreading
<i>Kapharaktaja</i>	Itching	Red, shiny	Reddish pale		Slimy, fixed
<i>Vatapittaraktaja</i>	Pricking, burning, fuming		Yellow, thin		With pulsation

<i>Vatakaparakhtaja</i>	Itching, burning	White, thick, blood	With pulsation
<i>Pittarakhtakaphaja</i>	Itching, burning	White, thick, blood	Tendency to suppurate
<i>Vatapittakaphaja</i>	Mixture of signs of <i>Vataja</i> , <i>pittaja</i> , <i>kaphaja</i>		

2. Agantuja Vrana: These are different kinds of wound inflicted on different parts of the body caused by weapons of various types of edges and shapes. Rectangular, quadrangular, triangular, circular, semi-lunar, extensive depressed in centre as a saucer and raised in the centre as a barley grain; these are various shapes of traumatic wounds or of *Nija Vrana* which burst spontaneously. The ancient clinicians broadly classified these wounds into six types as follows:

Table 8: Types and characteristics of *sadyovrana* (Sharma, 2013)

1. Chinna	Excised	Associated with separation of part of body
2. Bhinna	Stab injury	Injury to body cavities resulting in discharge
3. Viddha	Punctured	Body cavity pierced by sharp pointed weapon
4. Kshata	Lacerated	Neither excessively excised nor excessively incised
5. Picchita	Crushed	Due to severe blow and pressure
6. Ghrista	Abrasion	Skin gets peeled off due to rubbing injury

Apart from this, there is detailed description of type of *Strava* from *Vrana* on the basis of involvement of *Doshas* and according to site of *Vrana*. *Charaka* also mentioned 14 different types of *Strava* of *Vrana* without any correlation to *Dosha* or site of *Vrana*.

Table 9: Nature of discharge according site of *Vrana*

<i>Vrana Vastu</i>	Nature of discharge
1) <i>Twaka</i>	Yellowish watery discharge; smell of a raw meat
2) <i>Mamsa</i>	Thick, white, slimy discharge like butter milk
3) <i>Sira</i>	If vessels gets torn, there is excessive bleeding Suppuration-copious pus discharge that is thin, slimy, blackish and looks like a frost
4) <i>Snayu</i>	Greasy, thick; similar to mucoid nasal discharge and mixed with blood
5) <i>Asthi</i>	Like water shell of an oyster, mixed with marrow and with greasy blood discharge
6) <i>Sandhi</i>	No discharge on applying pressure; discharge on sudden movements; sticky, slimy and appears as if churned with blood.
7) <i>Koshtha</i>	Secretion mixed with blood, urine, faecal matter, pus and water
8) <i>Marma</i>	Depending upon involvement of organs

Among these eight sites, there are some important sites *Vrana* that needs special attention and ignorance of discharge from these sites can turn fatal. Surgeon should always keen to observe these features. Some of these sites along with nature of discharge that is indicative of poor prognosis are mentioned in table 10.

Table 10: Incurable nature of discharge (Sharma, 2013)

Site	Nature of discharge
1. <i>Pakwashaya</i> (intestines)	Rice water like discharge
2. <i>Raktashaya</i> (liver and spleen)	Like Alkaline water.
3. <i>Amashaya</i> (stomach)	Pea (type of pulse) water like
4. <i>Triksandhi</i> (pelvic organs)	Pea (type of pulse) water like

Further *Sushruta* described various kinds of discharge according to site and *Doshic* involvement. Discharge from all *Vrana Vastu* mentioned except *Marma*; as earlier mentioned that discharge from *Marma* resembles that according to involvement of other *Vrana vastu* like skin, muscle etc.

Table 11: Types of discharge according to *Doshas* and site of *Vrana*

<i>Dosha</i>	<i>Twaka</i>	<i>Mamsa</i>	<i>Sira</i>	<i>Snayu</i>	<i>Asthi</i>	<i>Sandhi</i>	<i>Koshtha</i>
Vata	Rough	Blackish	Like frost	Yoghurt water	Alkaline water	Washing of meat	Rice water
Pitta	Zircon gem like	Cow's urine	Ash like	Powder of conch shell	Astringent water	Madhvika- a type of bear	Oil like
Rakta	Same as <i>pitta</i> dosha, specially smells like raw meat						
Kapha	Butter like	Like green vitriol	Marrow	Rice cake	Sesamum seed	Coconut water	Fat of pig
Sannipataja	Coconut water	Cucumis utilissimus soup	Clear vinegar	Water of catechu bark	Panic seed like	Liver like	Juice of phaseolus tribolus

Prognosis of Vrana: *Sushruta* classified *Vrana* depending upon prognosis mainly in two types: *Kritya* (curable) and *Akritya* (Incurable). Description regarding prognosis on the basis of patient's age,

strength, site of *Vrana*, nature of *Vrana*, associated disease, nature of discharge, smell of *Vrana* described in *Sushruta samhita*.

Vrana of patients who are young, good physique, powerful and have control on habits are curable. In the young *Vrana* heals faster because of potency body tissues regenerate faster. In patients with good physique, the muscle being firm and well developed use of sharp instruments is not likely to damage important structures like vessels, ligaments etc. In powerful patients, even after pain fatigue not develops due to regulations in dietary habits. In patients having control on their habits, even after surgical procedures they have no complaints.

Table 12: Prognosis of *Vrana* (Sharma, 2013)

On the basis	<i>Sukhasadhya</i>	<i>Kashtasadhya</i>	<i>Yapya</i>
Meaning	Easily curable	Curable with difficulty	On stoppage of treatment, patient dies
<i>Vranavastu</i>	Skin	Rest seven <i>Vrana Vastu</i>	
Sites	Lower part of Gluteal, perianal, genitalia, forehead, cheek, lips, ear pinna, back, abdominal wall, root of neck	Eyes, gums, nose, temporal region, ear, umbilicus, perineal raphe, upper part of gluteal, sides of loin, trunk, axilla, breast, <i>Vrana</i> on joints	
<i>Vrana</i> in disease		Blind external fistula	Paraphimosis, phimosis, anal stenosis, glandular swelling with ulceration and maggots, ulcer in nose due to rhinitis, septic gums, tonsillitis
Associated disease		Skin disease, diabetes, tuberculosis, poisoning	Crystalluria, leprosy like skin disease

Apart from types mentioned above, *Vrana* which are not at all curable called as *Asadhya Vrana*. These *Vranas* presents typical features like head injury with discharge that like cerebrospinal fluid. *Agantuja Vrana* having discharge like fatty tissues, bone marrows, CSF are incurable. Abdominal injuries discharging yellowish black urine and stool through *Vrana* are incurable. Emaciated persons with *Vrana* discharging excessive pus mixed with blood and having complications such as indigestion, respiratory tract infection shows very poor response to treatment i.e. Poor prognosis. *Vrana* having smell and discharge other than those explained in *Doshic* types have bad prognosis. *Vrana* heals faster in patients who do not sleep in the day, lives in a house protected from environmental pollution (especially air pollution), and follows instruction of the surgeon (Sharma, 2013).

In case of abdominal injury, patient of internal haemorrhage if showing clinical features like pallor, cold extremities and face, cold breath, red eye and decreased output (urine, stool, sweat) should be discarded for the treatment. Patient of visceral injury survives if he shows no complications like fever, abdominal distension and his faeces, urine, flatus coming out of their respective passage (Sharma, 2013).

Concept of wound healing in Ayurveda: *Ropana* is the *sanskrita* word used to denote healing. *Vrana ropana* literally means healing of wound and ulcer. *Sushruta* described that no specific medical intervention required for healing of clean wounds, as they heal from body's own response. Instead of this, *Charaka* says that *Vrana* which is not very red, not very pale, not very brownish black, not associated with excruciating pain, no hyper-granulation, or pus pockets suitable for healing of *Vrana*. There are three steps in healing of *Vrana* viz.

1. *Dushta* awastha (stage of inflammation) (Sharma, 2013).
2. *Shuddha* awastha (stage of granulation tissue) (Sharma, 2013).
3. *Ruhyamana* awastha (stage of maturation and remodelling) (Sharma, 2013).
4. *Rudha* awastha (stage of contraction) (Sharma, 2013).

These are four stages in healing of *Nija Vrana*. In *Agantuja Vrana*, first stage is *Shuddha* awastha and rest it follows four stages in healing of *Nija Vrana*.

1) *Dushta Vrana*: The word *Dushta* literally means bad, wicked, offensive, and culpable. (MONIER-WILLIAMS, M. (1851). A dictionary, English and Sanscrit. London, W.H. Allen and Co. p= 488,3] [L=94751] *Dushta Vrana* is defined as *Vrana* in vitiation of all four *doshas* causes chronicity of *Vrana* and presenting with features like excessive exudates, foul smell, signs of inflammation etc. In other words, *Vrana* not showing features of *Shuddha Vrana* is called as *Dushta Vrana*.

2) **Shuddha Vrana:** The *Vrana* that is free from three vitiated *Doshas* or any complications, has blackish white margins due to pure blood supply, granulation tissue at surface level, and without any pain or discharge is said to be *shuddha Vrana*.

3) **Ruhyamana Vrana:** The *Vrana* with pigeon coloured (grey) margin without any exudates and showing partial layer of skin epithelium (*shveta* called as *charmacheli* or *chipitika*) are called as *ruhyamana Vrana*.

4) **Rudha Vrana:** The *Vrana* whose floor has healed completely, which is not indurated or swollen or painful, and is of same colour and level of skin is said to be *Rudha Vrana*.

Factors affecting *Vrana Ropana* (Sharma and Das, 2016)

1. **Age:** *Vrana* heals faster in young patients compared to old patients due to good metabolic rate and tendency of body cells to regenerate faster.
2. **Addiction:** *Sushruta* mentioned that patients who have control over their habits such as alcoholism are ideal patients for healing of *Vrana*.
3. **Site:** *Vrana* on buttocks, genitalia forehead, cheek etc heals faster and with less complication. Whereas *Vrana* on eyes, gums, ear, umbilicus, perineal raphe, axilla are difficult to treat.
4. **Bandaging:** improper bandaging causes delay in healing of *Vrana*.
5. **Maggots:** maggots in *Vrana* cause delay in healing.
6. **Foreign Body:** *Charaka* mentioned that *Vrana* with foreign body or poison delays healing.
7. **Associated Disease:** *Vrana* associated with diabetes, skin disorders, tuberculosis, poisoning heals with difficulty.
8. **Nutrition:** *Sushruta* mentioned that those patients who are emaciated and having *Dushta Vrana* are incurable. He also mentioned patients having dietary regulations are easy to cure.
9. **Food:** *Vrana* heals rapidly of one who takes boiled rice of an old crop, bland as vegetable, semisolid diet in small amount, meat of wild animals, raddish, pomegranate, Indian goose berry fruit. *Charaka* mentioned that over eating, intake of mutually contradictory ingredients of food, intake of unwholesome food cause delay in healing of *Vrana*. Indigestion also causes delay in healing.
10. **Sleep:** Patients who take regular sleep at night and do not sleep in day are easily curable.
11. **Emotions:** excessive grief and anger causes delay in healing.
12. **Sex:** sex causes delay in healing *Vrana*. *Sushruta* explained that sex during *Vrana* healing can cause death also.
13. **Place of Patient:** if patient is kept in *Vranitagara* (ward for patients protected from draughts and hot sun, situated at good place, kept neat and clean) are curable

Complications of *Vrana*: Complications of *Vrana* can be classified under two categories (Sharma, 2013; Sharma and Das, 2016): 1. Local complications, 2. Systemic complications

Table 13: Complications of <i>Vrana</i>	
Local	Systemic
- Various kinds of smell, discharge, pain, colour, shape, size, margins, edge explained in different types of <i>Doshic Vrana</i>	- fever, diarrhoea, fainting, hiccough, vomiting, loss of taste, indigestion, dyspnoea, cough, increased thirst -erysipelas, hemiplegia (in case of head injury), convulsions, unconsciousness, schizophrenia (in case of head injury, animal bite like dog), jaw lock

Concept of wound infection in *Ayurveda*: Multiple textual evidences observed in *Sushruta* samhita shows knowledge of infection and contagious disease 3000 years ago. Biggest evidence about knowledge spread of contagious disease at *Sushruta*'s period is description of mode of transmission given by *Sushruta*. Skin diseases, various diseases causing fever, tuberculosis, conjunctivitis and other infectious disease like chicken pox spread from human to human due to sexual intercourse, eating together, sharing same bed, clothing, garlands, cosmetics etc and due to breath (Droplet infection) (Sharma, 2013).

Patient suffering from *Vrana* should keep his nails pared and hairs short, remain clean, wear white dress, and should be particular about pacification and suspicious rites and be devoted to god. If patient doesn't follow these instructions, then maliciously virulent organisms namely *Pasupati*, *Kubera*, *Kumara* who are liable to human blood and muscle enters tissue of *Vrana* from outside and causes sequel that can lead to death. Today, wound science study shows that micro-organisms from environment or wound margins or skin enters wound and causes wound infection. Thus it clearly shows that awareness of wound infection persisted from ancient period (Sharma, 2013).

Treatment of Vrana: Although much progress has been made in management of wound in past few years, management of *Vrana* has been remaining significant health related issue ever since period of *Sushruta*. Number of procedures performed for various steps of healing of *Vrana*. Among these, *shuddha Vrana* is been treated by *ropana* remedies, whereas *Dushta Vrana* is managed on the basis of involvement of vitiated *doshas*, site of *Vrana*, excessive putrifaction, and inflammatory changes. *Sushruta* described sixty different types of management of *Vrana* in general (Sharma, 2013).

Out of sixty procedures mentioned in table 15, forty procedures mentioned in top four categories deals with converting *Dushta Vrana* into *shuddha Vrana*. These include measures to control vitiated *doshas*, controlling inflammation, surgical measures, and measures for non healing wounds. Wound bed preparation in today's practice is very much similar to this concept which was elaborated in very much detail *Sushruta* 3000 years back.

Table 15: Sixty procedures for management of *Vrana* (Sharma, 2013)

Types	No	Names
1. Control of vitiated <i>Doshas</i>	10	1) nasal medication 2) use of errhines 3) gargling 4) smoking with medicinal drugs 5) enema 6) douching 7) purgation 8) emesis 9) bloodletting 10) internal oleation
2. Control of inflammation	8	1) food abstinence 2) application of local paste 3) irrigation 4) Anointing 5) fomentation 6) gentle massage 7) application of poultice 8) methods to induce suppuration
3. Surgical measures	13	1) excision 2) incision 3) bursting by medication 4) scraping 5) probing 6) extraction 7) puncturing 8) drainage 9) suturing 10) wound edge approximation 11) squeezing out by application of drug 12) haemostasis 13) instrumentation
4. For non healing wounds	9	1) covering with leaves 2) depilation 3) cauterisation 4) application of caustics 5) hardening 6) softening 7) removal of over granulation 8) encouraging granulation tissue formation 9) warming application
		Instead of these, seven cleansing procedures by use of decoctions, wicks, pastes, medicated butter milk and oil, thickened extract, dusting powder also comes under this category
5. For clean wound	9	1) bandaging 2) application of honey and butter milk 3) seven healing procedures by use of decoctions, wicks, pastes, medicated butter milk and oil, thickened extract, dusting powder
		Suturing and edge approximation mentioned in surgical measures.
6. For pain management	2	1) fumigation of <i>Vrana</i> 2) cooling application
7. Restoring normalcy of scar	4	1) pigmenting procedure 2) depigmenting procedure 3) restoration normal skin colour 4) encouraging hair growth
8. Dietary regimen	2	1) restorative measures 2) light, warm, demulcent, appetizing diet
9. Protective	1	1) protecting from invisible creatures
10. Miscellaneous	2	1) removal of maggots 2) neutralizing poison

Wound bed preparation is new paradigm in wound care all over world. It is defined as management of wound to accelerate endogenous healing or to facilitate effectiveness of therapeutic measures. In other words, to create viable wound bed by removing barriers of healing. Wound bed preparation addresses the five clinical observations summarized by the acronym-TIMES which unites the cellular and clinical components of wound healing. These are Tissue (non-viable), Infection or Inflammation, Moisture imbalance, non-advancing Edge of the wound, surrounding skin (Mulder, 2009).

1. Management of Tissues: it is defined as removal of non-viable tissue and encouragement of viable and well vascularised tissues to grow. It is achieved by process of debridement. In *Ayurveda*, debridement can be categorized as surgical, mechanical and chemical. Surgical debridement causes minimal damage to surrounding tissue and fastest way to remove debris and necrotic material from wound bed. Surgical measures mentioned in table 15 used depending upon extent of slough present on wound bed. Excision, incision, drainage are mainly applied in surgical debridement. To arrest bleeding during debridement four haemostatic measures applied: *Sandhana* (applying astringent lotions to vessels that cause vasoconstriction), *Skandana* (coagulation by cold application), *Pachana* (application of drug causing arrest of bleeding), and *Dahana* (thermal cauterization). *Parisheka* is a type of wound irrigation mentioned in *Ayurveda* comes under mechanical debridement. *Kshara* (caustics) are used as a chemical debridement agent.

2. Control of Inflammation and Infection: Procedures mentioned in table 15 for controlling inflammation in *Vrana*. These comprise local measures which reduce local inflammatory reactions

and promote healing. It also includes some systemic measures like bloodletting, purgation, emesis etc that helps in excretions of toxins out of the circulation. To control infection, number of *Ayurvedic* formulations described in various forms which not only converts *Dushta vrana* into *Shuddha Vrana* but also accelerates healing of *Vrana*. Patient is advised to maintain hygiene to avoid invade of organisms in wound.

3. For Moisture Imbalance: Use of cleansing application in various forms like decoctions, wicks, pastes, medicated butter milk and oil, thickened extract, dusting powder helps to balance moisture of the *Vrana*. Also a procedure such as covering with leaves according to vitiated *Doshas* helps to control moisture of *Vrana*.

4. Management of Non-advanced Edge of the Wound: Various procedures mentioned table 15 like scrapping, depilation, hardening, softening, and removal of over granulation, encouraging granulation tissue formation, warming application, edge approximation used for management of non-advanced edge of the wound.

5. Protection of Surrounding Skin: Bandaging and application of leaves keep dressing in place and prevent skin damage. Instead of procedures for wound bed preparation, some procedures mentioned for removal of maggots, pain management, healing measures like suturing, use of healing drugs in various forms are used for faster healing of *Vrana*. Subsequently, for restoration of normalcy of scar - various methods employed like pigmenting procedure, depigmenting, and skin colour restoration, for encouraging hair growth. *Sushruta* also given detail about type of diet patient should take and behavior of the patient should be during day and night time.

Conclusion: Wounds have been occurring as long as existence of life. The earliest reference to *Vrana* is found in the *Rigveda* in context of war injuries. Basic concept of wound cleansing, closure and splinting has been also translated from Egyptian hieroglyphics. Wound care has been documented since 3000 B.C., during pyramid age when Imhotep recorded knowledge of wound case of his patients.

Non healing wounds are one of the major health issues in health care system. There are several factors that causes delayed wound healing. Wound infection is one of the important factors that significantly impair healing of wound. In these cases, systemic anti-microbial drugs have their own limitation due to poor blood supply to wound site. Topical anti-microbial agent plays important role in controlling wound infections. Different forms silver are amongst effective dressing agent used now a day in wound care practice all over world. The main problem in using anti-microbial agents is their tissue toxicity. Instead of being effective topical anti-microbial agent, silver is not popularly used in due high cost. In India, about 40% of population lies below poverty line, use of such drug is practically impossible. *Acharya Sushruta* is the person of surgical discipline and disciple of *Acharya Dhanwantri* has given a great importance to wound or *Vrana* as he has given the term *Vrana Vinischayartham* in the definition of *Shalya Tantra* itself, which reflects that all the *Shalya Tantra* moves around *Vrana*. Not only this he has given a very elaborative description of *Vrana* in six chapter in *Sutra Sthana* and two in *Chikitsa Sthana* and one chapter for description of useful drug only. He has enumerated 60 types of procedure (*Shashti Upakrama*) for its management, which includes not only the treatment of wound but also covers the area of cosmetic surgery i.e. which minimises the scars e.g. *Romasanjanana*, *Vaikritapaham*, *Romapharana*, *Krishnakarma*, *Pandukarma* etc. and devoted a separate chapter for the management of traumatic wound.

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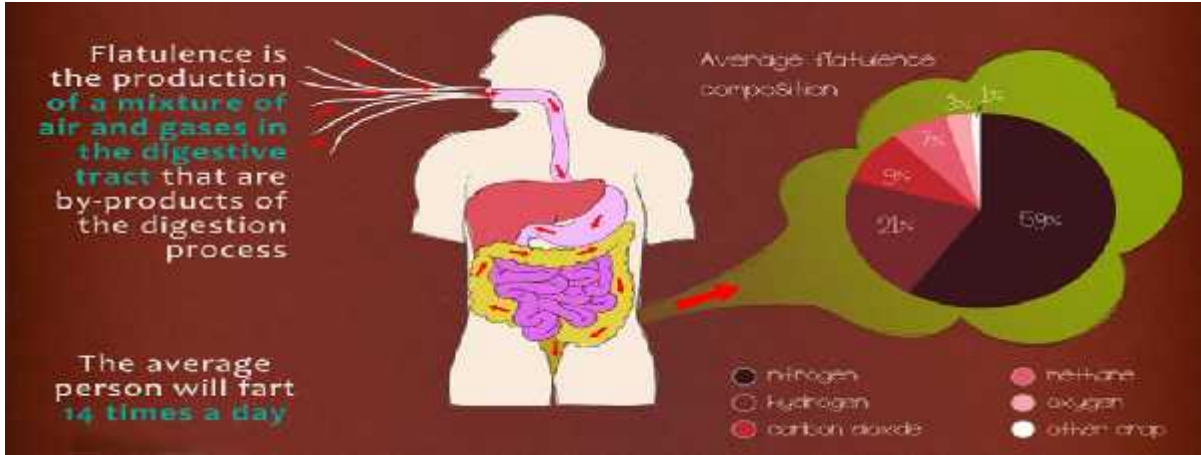
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HERBAL MANAGEMENT OF ADHYAMAAN (FLATULENCE)

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Flatulence is a disease of the digestive System as a whole. It's Include the stomach, abdomen, intestine and the colon. It is gas in the alimentary canal (herbpathy.com/Herbal-Treatment-for-Flatulence-Cid18). Passing gas is actually a perfectly normal bodily function, but in some cases its severity becomes so high that it can be termed as a disease. About 30 to 40% of all people worldwide suffer from problems with flatulence (www.ayushveda.com/health/flatulence.htm). Flatulence is passing gas from the digestive system out of the back passage. It's more commonly known as "passing wind", or "farting". Flatulence is a normal biological process and is something everyone experiences regularly. Some people pass wind only a few times a day, others a lot more, but the average is said to be about 5 to 15 times a day (www.nhs.uk/Conditions/Flatulence/Pages/Treatment.aspx). According to ayurveda *Adhyamaan* is the Sanskrit word for flatulence. It is a Specific condition that has similar to Udavarta and Aanaha. Acharya Bhavmishra include Adhyamaan in 80 types of vat vyadhi. Intestinal gas is generally considered to be a condition of weak digestion, fundamentally a Vata disorder in samana vayu, one of the five subtypes of Vata dosha.



General Name: Flatulence

Medical Name: Flatus

Hindi & Ayurvedic Name: Adhovayu, Udarvayu, Adhyamaan.

Definition

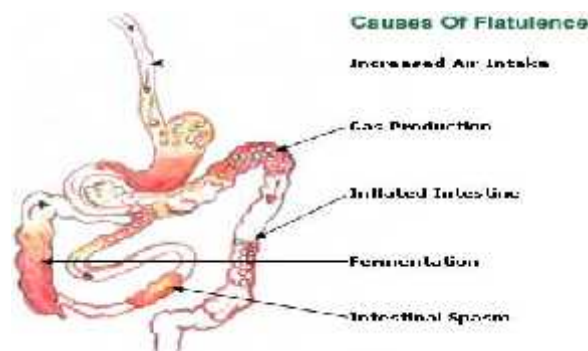
वायुना कुपितेन नाभेरधः सशूलमापूर आध्मानः । (अ.ह.सू.5/8)
साटोपमत्युग्रहरुजमाध्मातमुदरं भृशम् । (सु.नि. 1/88)

Due to aggravation of vata dosha pain arises in below the abdomen is called adhyamaan. According to Ayurveda, flatulence is compared with Adhyamaan. Colon is the main seat for vata dosha in the human body (Tripathi, 2007). If due to some reasons like eating vata aggravating foods, cold weather, anxiety, sleeplessness and other factors, vata dosha increases in the colon creates flatulence, distension and discomfort (Shastri, 2007). It is also believed that flatulence is caused due to the imbalance of vata and pitta dosha in the body. Pitta dosha functions by controlling the digestive fire in the body that helps in the digestion of the food. Low pitta dosha and aggravated vata dosha in the body results in the low digestive fire thus decreasing the digestion process and leading to the formation of gas. The ama dosha thus formed aggravates the vata dosha (www.chandigarhayurvedcentre.com/herbal-remedies-for-flatulence/jun 27,2016). The gas that is expelled during *adhyamaan* is called as a flatus.

According to modern science- The definition of flatulence or intestinal gas is the state of having excessive stomach and/or intestinal gas (waste gas produced during digestion) that is usually released from the anus with sound and/or odor. Common complaints arising from its presence

of excess amounts of gas in gastro-intestinal tract (Error! Hyperlink reference not valid. disorder centre>digestives disorder az list jun1,2016).

Causes



In medical terms, flatulence is caused due to the inability of digesting all the food that is consumed by the person. The food that remains undigested is passed on to the colon. Here the fermentation of the left over carbohydrates is carried out by the colonic bacteria, which leads to the formation of intestinal gas. People also swallow air directly during different activities that they perform. Whenever you eat or drink anything, you also take in a fair amount of air. This air passes out as wind. Generally such air that passes out is odorless and noiseless. Some foods contain more gas producing capacity than others. Beans are notorious in this aspect.

The complex sugars contained in the beans are not digestible by the intestines. The undigested part passes out as wind throughout the day. There are many people who are lactose intolerant. These people cannot digest the lactose sugars in milk and other milk products. Hence the undigested lactose accumulates in the person's stomach as gas, along with other problems such as bloating of the stomach, cramps and even diarrhea. Many medicinal drugs are the cause of flatulence. Antibiotics like narcotics, calcium channel blockers, etc. can cause flatulence in the person (www.ayushveda.com/health/flatulence.htm).

1. Irritable bowel syndrome.
2. Hyperacidity
3. Non ulcer dyspepsia.
4. Psychological problems like anxiety, fear and grief. .
5. Chewing food very rapidly.
6. Rapid drinking leads to Swallowing of excess air thereby causing flatulence.
7. Consuming carbonated drinks in excess.
8. Deficiency of lactose in the body also causes the formation of gas.
9. Due to hyper-salivation.
10. Fermentation in the gastro-intestinal tract due to inadequately cooked starchy foods.
11. Some other causes are old colic, gallbladder disease, colon cancer, diverticulosis, gall stones and food allergies.

According to Ayurveda Causes of Adhyamaan: According to *Ayurvedic* beliefs, *adhyamaan* is caused due to abnormal *agni* in a person. *Agni* means fire, and in *Ayurvedic* language, a person with normal *agni* is a healthy person and a person with abnormal *agni* is an unhealthy person.

1. Vega-vidhaaran.
2. Ruksha-aanaapaan.
3. Indigestion of food.
4. Pitta –kshya.(fir {k;)
5. Distortion of the intelligence of the person, i.e. *prajnaparadha*;
6. Wrong coordination of sense organs and their objects, i.e. *asatmyendriyarth samayoga* and
7. Vagaries of weather and time, i.e. *kaala parinama* (www.ayushveda.com/health/flatulence.htm)

Symptoms

According to Ayurveda

1. Aatoopa (Tympanitis)
2. Pain in abdomen
3. Distention of abdomen (feeling of fullness in the stomach)

4. Inflammation in large intestine
5. Restlessness
6. Passing of wind in excess
7. Loss of appetite
8. Belching
9. Headache

In Modern Science

1. Belching
2. Gas formation
3. Frequent Farting
4. Abdominal Bloating
5. Abdominal pain & discomfort
6. Fart is odoriferous and noise producing.

Treatment: In *Ayurveda*, there is a three-fold treatment method for the problem of *adhyamaan*. The three principals involved are:

आध्माने त्वपतर्पणपाणितापदीपनचूर्णफलवर्तिक्रियापाचनीयदीपनीयबस्तिभिरुपाचरेत् । (सु.चि.5 / 26)

- *Deepana* , i.e. treatment by the use of carminatives;
- *Paachana* , i.e. treatment by the use of digestives and
- *Vaatanulomana* , i.e. treatment by the use of gas-expellers.(Shastri, 2007)

Herbal Management of Adhyamaan: There are a large number of herbs ascribed in *Ayurveda* with curative properties for flatulence

1. Deepana (Carminative)

पचेत् न आमं वह्निं च दीपनं तद्यथा मिशिः । (शा.सं.पू.ख.अ.4 / 1)

A carminative, also known as carminativum, is an herb or preparation intended to either prevent formation of gas in the gastrointestinal tract or facilitate the expulsion of said gas, thereby combating flatulence (<https://en.wikipedia.org/wiki/Carminative>). Carminative are substance that have antispasmodic properties to treat cramps within the abdomen. This Reduce the pain during flatulence (www.ayushveda.com/health/flatulence.htm).

Examples—Chavya, Chitraka, Sunthi, Sounf, Marich, Pipali

2. Paachana (Digestives)

पचति आमं न वह्निं च कुर्यात् तद् हि पाचनम् ।
नागकेशरवत् विद्याद् । (शा.सं.पू.ख.अ.4 / 2)

Digestives break down the complex foodstuffs to simpler molecules leading to better digestion. Example- Mustaka, Nagakeshar, Chitraka etc

3. Gas-expellers

कृत्वा पाकं मलानां यद् भित्वा बन्धम् अधोनयेत् ।
तत् च अनुलोमनम् ज्ञेयं यथा प्रोक्ता हरीतकी ।। (शा.सं.पू.ख.अ.4 / 2)

Gas-expellers help in expelling the gas rapidly and in voluminous amounts in one go, which normalizes the problem of flatulence for some time.

Such Herbs with their Action of the Human Body with Anti-flatulent Property-Ajowan (Yavani)



Latin Name: *Trachyspermum ammi*

English Name: Bishop's Weed

Family Name: Umbrelliferae

Gana: Sheet-prashamana(Charak) (Sharma, 2006)

Mode of Action: *Ajowan* is a wonderful carminative. It is one of the prime remedies *Ayurveda* doctors prescribe for curing flatulence. It have antispasmodic properties to treat cramps within the abdomen. This Reduce the pain during flatulence.

A Research Data: *T. ammi* would increase the secretion of gastric acid; the addition of *T. ammi* to the infusion increased the amount of gastric acid. Gastric acid secretion was increased nearly four-fold by *T. ammi* (Vasudevan *et al.*, 2000). In experimental rats *in vivo*, the addition of *T. ammi* to the diet reduced food transit time and also enhanced the activity of digestive enzymes and/or caused a higher secretion of bile acids (Platel and Srinivasan, 2001).

The Seed oil shows characteristic aromatic odour and pungent taste, used as antispasmodic, stimulant, tonic, carminatives, Flatulence, diarrhea and pile (Anilkumar *et al.*, 2009).

Used Part: Fruit

Doses: Churna- 1-3 gm.

Ajamoda

Latin Name: *Apium graveolens*

English Name: Celery

Family: Umbelliferae

Gana: Shool-prashamana, Deepaniya (Charak), Piplyadi (Sushurata)

Mode of Action: Celery is a alimentary herb. Ajmoda has a powerful carminative property. The oil extracted form the seeds of the ajmoda reduces spasms in the digestive tract. Celery has the ideal quantites of iron and magnesium to stop oncological disease from progressing. The juice extracted form the petioles can be used for oedema, rheumatic tendencies, gout, flatulence (Ahmed and Mehmood, 1998).



Used Part: Fruit

Doses: Churna- 1-3 gm

Fenugreek (Methika, Methi)

Latin Name: *Trigonella Foenum*

English Name: Fenugreek

Family: Leguminoseae

Gana: Chaturbeej (Bhava-prakash)

Mode of Action: Make a tea by adding one tablespoon fenugreek seed in one cup of boil water. Steep for 10-15 minute. Strain and drink with every meal (herbpathy.com/Herbal-Treatment-for-Flatulence-Cid18).



Used Part: Seed

Doses: 1-3 gram.

Haritaki

Latin Name: Terminalia chebula

English Name: Chebulic myrobalan

Family: Combretaceae

Gana: Triphala, Aamlakyadi (Sushurta)

हरस्य भवने जाता हरिता च स्वभावतः ।
हरते सर्वरोगांश्च तस्मात् प्रोक्ता हरीतकी ॥ (मा.नि.)



Harad is a good carminative and gas-exPELLERS. It also has laxative and stomachic properties that aid digestion. Gastrointestinal Disorders, Clear bowels, Flatulence, Dysentery:- Fruits are soaked overnight in water followed by drinking the water the following morning on an empty stomach. It will digest the undigested residue of food material, including/ restoring normal peristaltic movement of intestine by governing vata. It either prevents formations of gas in the gastrointestinal tract or facilitates the expulsion of said gas, thereby combating flatulence. Its fruit has digestive, anti-inflammatory, anthelmintic and restorative properties with additional benefit in flatulence, constipation and piles (Tamhane *et al.*, 1997).

Used Part: Fruit

Doses: Churna- 3-6 gm

Camphor (Karpur)

Latin Name: Cinnamomum camphora

English Name: Camphor

Family: Lauraceae

चीनकः कटुकस्तिक्तो हृद्यः शीतकफापहः ।
कण्ठदोषहरो मेध्यः पाचनः कृमिनाशनः ॥



Mode of Action: A herbal preparation obtained from the bark of cinnamomum species. It is used as an astringent in the treatment of diarrhea and flatulence. Cinnamon oil, sometimes used as a name for cassia oil, has similar activity, but contains cinnamaldehyde, which has been associated with hypersensitivity reactions (www.henriettes-herb.com/eclectic/felter/cinnamomum-camp.html). In small doses camphor warms the stomach, stimulates secretion, increases peristalsis, and expels flatus.

Used Part: Niryaas (Satva)

Doses: 125-375 mg.

Sowa (Satapushpa)

Latin Name: Anthum sowa.

English Name: Indian Dill

Family: Umbelliferae

शतपुष्पा लघुस्तीक्ष्णा पित्तकृदीपनी कटुः ।
उष्णा ज्वरानिलश्लेष्मघ्नशूलक्षिरोगहृत् ॥ (भा.प्र.)

Mode of Action: Indian dill is an excellent carminatives. This action is due to the presence of carvone in its mericarp. Its fruit have been used for medicinal purpose in the relief of digestive problem and to stimulate milk for nursing mothers (Howard *et al.*, 1985).

Used Part: Fruit

Doses: Churna- 1-3 gm



Anthum Sowa

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EFFECT OF MEDITATION ON THE SLEEP PATTERN OF INTERNET USERS

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Internet is being widely used all around the world. The number of users is increasing day by day. The internet is a new tool that is used as an essential part of everyday life all over the world and its use increases especially among young people. In spite of the widely perceived merits of this tool, psychologists have been aware of the negative impacts of its use, especially the over or misuse and the related physical and psychological problems (Greenfield, 2000).

The computer and the internet are becoming major influences in adolescents' lives. Because of the dramatic increase in internet use among adolescents in recent years, some warning voices have been raised on the possible negative impacts of excessive internet use on sleep (Young, 1996; Ryu *et al.*, 2004). The term "internet addiction" was introduced for the first time in 1996. The Internet addiction symptoms as described by Young (1996) Internet addiction leads to different social, psychological and physical disorders. The people addicted to internet face physical side effects like sleep disturbance, back strain, eye strain, etc. Such persons also experiences family, academic and social problems (American Society of Addiction Medicine, 2012).

Sleep has an important role in humans' lives not only for general health but also for mental health and quality of life. Because of the ongoing growth of body systems, the importance of sleep is even much greater for children and adolescents.

Meditation: The National Center for Complementary and Alternative Medicine defines meditation as a "mind-body" method. This category of complementary and alternative medicine includes interventions that employ a variety of techniques that facilitate the mind's capacity to affect bodily function and symptoms. In meditation, a person learns to focus attention. Some forms of meditation instruct the student to become mindful of thoughts, feelings, and sensations, and to observe them in a nonjudgmental way. Many believe this practice evokes a state of greater calmness, physical relaxation, and psychological balance (Pagé *et al.*, 2012).

Meditation is actually the seventh stage in the classical eight stages to reach a stage of final mental liberation described in traditional yoga texts (Taimini, 1986). Meditation has been shown to reduce stress and increase feelings of peace and calm (Oman *et al.*, 2008). This suggests several applications and possible benefits related to practicing meditation.

"OM Mantra or AUM is the highest sacred symbol or say word in Hinduism. It is finite as well as infinite. It contains everything from Vedas. AUM is the name of symbol of God (ishwara, Brahman). The basic mantra is OM or Aum, which is Hinduism, is known as the 'Pranava mantra', the source of all mantras.

So the purpose of present study was to examine the effect of meditation (AUM chanting) on sleeping pattern among university going internet users and also find out the result of meditation on sleeping pattern in 1st to 3rd months with the help of follow- up.

Methodology

Problem: Is there any effect of meditation (AUM chanting) on sleeping pattern of university going internet users.

Objective: To study the effect of meditation (AUM chanting) on sleeping pattern of university going internet users.

Hypothesis: There is a significant positive effect of meditation (AUM chanting) on sleeping pattern of university going internet users.

Variables:

- **Independent variable:** Meditation (AUM chanting)
- **Dependent variable:** Sleeping Pattern
- **Relevant variable**

Age: 17 to 25 years of age

Sex: Both male and female students were taken

Educational Qualification: at least intermediate pursuing

Inclusion Criteria: In order to study the effect of Meditation (AUM chanting) on the sleeping pattern of the students, only those students were considered who are willing to participate in meditation (AUM chanting).

Sample: Convenient sampling technique was used. The total sample of 180 students ranging in age from 17 to 25 years was selected from Banaras Hindu University, Varanasi for this research work. 197 students filled the self-reported questionnaires. However, only 180 questionnaires were considered for the data analysis because of the incompleteness of questionnaires.

Procedure: After selecting the subjects on the basis of purposive sampling the internet addiction scale and sleeping pattern scale was administered. Information on the study was provided to selected students via researcher. Students were briefed about the nature and the purpose of the current study. Prior to the administration of the scale the students were acknowledged about the utility of the study. The guide line was also provided to the participants for filling the given option in questionnaire. Students were being requested, to answer truly and mark the most appropriate option among those given in the scale for each question. They were requested not to leave any of the items unanswered. Students were assured about the confidentiality of the data. Responses of the despondence were collected individually.

After that students are carefully inquired for the presence and absence of general symptom of sleeping pattern, all the three groups are advised to do practice of meditation (*AUM chanting*) for three months. And the resultant sleeping pattern changes were recorded and correlated with the available concepts.

Statistical Analyses: All analysis was performed using the SPSS software package version 16.0. Effects of meditation on levels of internet addiction and sleeping pattern were analyzed using chi-square test and Friedman test.

Observation Table no. 1: Showing the distribution of students in different groups.

Name of Group	Non Internet Users	Normal Internet Users	Addicted Internet Users	Total
No of Students	20	113	47	180
Percentage of Students	11.11%	62.78%	26.11%	100%

This observation table no. 1 shows that out of total 180 students, the students divided into 3 groups on the basis of use of internet. The table depicts that 20 students (11.11%) were belong to non internet users group, 113 students (62.78%) belong to normal internet users group and 47 students (26.11%) belong to addicted internet users group.

Observation Table no. 2: Showing the effect in terms of Sleep pattern in *Dhyan*, in different groups initially and at follow-ups.

Groups initially and at follow ups.								Within the group comparison (Friedman Test)
Group	Grade	Sleep Pattern No. and % of Students						
		Before Treatment		Follow Up -1		Follow Up -2		
Group 1	Normal	12	60%	14	70%	20	100%	² =13.000 p=0.002 HS
	Disturbed	8	40%	6	30%	0	0%	
Group 2	Normal	87	77%	91	80.5%	101	89.4%	² =19.500 p=0.000 HS
	Disturbed	26	23%	22	19.5%	12	10.6%	
Group 3	Normal	10	21.3%	19	40.4%	32	68.1%	² =29.360 p=0.000 HS
	Disturbed	37	78.7%	28	59.6%	15	31.9%	
Between the group comparison Chi square test		² =43.140 p=0.000 HS		² =24.924 p=0.000 HS		² =15.777 p=0.000 HS		

G-1=Non internet users, G-2=Normal internet users, G-3=Addicted internet users

On the basis of above table no. 2 clearly depicts that the severity of sleeping pattern in non internet users, normal internet users and addicted internet users, decrease with each follow up.

In group-1 initial number of students with presence of disturbed sleep pattern was 40% which become 0% after 2nd follow up. And the normal sleep pattern was 60% which become 100% after 2nd follow up.

In group-2 initial number of students with presence of disturbed sleep pattern was 23% which become 10.6% after 2nd follow up. And the normal sleep pattern was 77% which become 89.4% after 2nd follow up.

In group-3 initial number of students with presence of disturbed sleep pattern was 78.7% which become 31.9% after 2nd follow up. And the normal sleep pattern was 21.3% which become 68.1% after 2nd follow up.

There is some improvement in each follow up in sleeping pattern. The intra group comparison of sleeping pattern was found statistically highly significant in each group. Intergroup comparison of sleeping pattern grade was found statistically highly significant at 2nd follow up. At 2nd follow up, in group-1, group-2 and group-3 (100%, 89.4% and 68.1% respectively) students were in normal sleeping pattern and in group-1, group-2 and group-3 (0%, 10.6% and 31.9% respectively) students were in disturbed sleeping pattern. It depicts better results in addicted internet user group.

Discussion: The internet using is as a serious problem in different countries all over the world. The internet has become an integral part of modern society. The use of internet becomes a daily activity for many people of all age. Unfortunately some people are over dependent on the internet in their daily life activities. At one hand it is a most important and useful need of modern people while at other hand people are sickly addicted to it. In this study, (Table no.1) showed that out of total 180 students, 20 students (11.11%) cases belong to Non internet user's group. 113 students (62.78%) cases belong to Normal internet Users group. And 47 students (26.11%) cases belong to Addicted internet users group. Similarly, Ramzan Jahanian and Zeina Seifery (2013) conduct the study; the results reveal that there is a significant and inverse relationship between Internet addiction and students' mental health. In addition, the obtained results indicate that regarding the occurrence of addiction to the Internet 36.6% of the subjects were slightly addicted to the Internet; 55.3% of the subjects were respectively addicted to the Internet; 7.3% of the subjects were moderately addicted to the Internet and 0.6% of the subjects were severely addicted to the Internet.

Sleep has an important role in humans' lives not only for general health but also for mental health and quality of life. Because of the ongoing growth of body systems, the importance of sleep is even much greater for children and adolescents. Adolescents' sleep habits vary with age, lifestyle issues and socio-cultural influences.

The observation table no.2 clearly depicts that the severity of the poor sleep duration in non internet users, normal internet users and addicted internet users, decrease with each follow up.

Sleep problems are commonly reported in adolescents with an estimated prevalence between 27% and 40% (Bailly *et al.*, 2004; Liu *et al.*, 2008).

National Sleep Foundation's 2006 Sleep in America Poll have reported that almost one-third of U.S. adolescents had a computer and one-fifth of them had internet access in their bedroom. Therefore, the possible association between internet use and sleep habits may not be surprising. A handful of recent studies have found a relationship between excessive computer and internet use and sleep problems in adolescents (Van den Bulck, 2004; Dworak *et al.*, 2007; Shochat *et al.*, 2010). Meditation has been shown to reduce stress and increase feelings of peace and calm. This suggests several applications and possible benefits related to practicing meditation. One of them is possibly an improvement in sleep.

This result was in tune with that of the findings reported (Yen *et al.*, 2007) used a self-report questionnaire to assess symptoms of internet addiction and found pathological internet use related with shorter total sleep times and insomnia symptoms. Similarly, Canan *et al.*, 2013 studied internet addiction among adolescents and to examine the correlation between problematic Internet use and sleep disturbance symptoms. The study was conducted among students. Results showed that the students with Internet addiction were more likely to have difficulty in falling asleep and night awakenings. It indicated an association between the Internet addiction and impaired sleep.

Conclusion: Internet addiction, which is a public health problem in youth, appears to be related with problematic sleep habits and sleep problems. Health care providers must be aware of the possible negative impact of excessive and uncontrolled internet use on adolescents' sleep habits. Careful evaluation of the exposure of adolescents to internet and their sleep habits and day time functioning will help to identify the adolescents who are under the risk of internet addiction and sleep problems. A great percentage of youths in the population suffer from the adverse effects of Internet addiction. It is

necessary for psychiatrists and psychologists to be aware of the sleep problems caused by Internet addiction.

This paper focused on exploring the effect of meditation on sleep pattern of students. The result shows that there is a significant positive effect of meditation on sleeping pattern of university going internet user's students.

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MEDICINAL PLANTS - ITS IMPORTANCE AND ANTIMICROBIAL PROPERTIES—A BOOK REVIEW

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India has a rich inheritance of knowledge on the plant based drugs which is used for both in preventive and curative medicine. Because of the wide variations in soil and climate, India is suitable for cultivation of large number of medicinal and aromatic plants which can be used as raw materials for pharmaceutical, perfumery, cosmetics, flavour food and agrochemical industries. For the treatment of diseases, use of medicinal plants and its products could be traced as old as the beginning of human civilization. The traditional therapies which are gaining importance in outside world demands more scientific, technical, and logical evidence for the principles behind therapies and for effectiveness of medicines (Patwardhan *et al.*, 2005). Increasing use and utilization of medicinal plants significantly contribute to the disclosure of their therapeutic properties. Therefore, it is found to be important to describe medicinal plant as any plant which contains substances that can be used for therapeutic purposes present in one or more of its organs, or which are precursors for chemo-pharmaceutical semi-synthesis. When a plant is designated as medicinal, it is implied that the said plant is useful as a drug or therapeutic agent or an active ingredient of a medicinal preparation. Medicinal plants includes wide variety of plants used in herbalism and some of these plants have antifungal, antibacterial and antifungal properties. More than 3.3 billion people utilize medicinal plants and its products on a regular basis for treatment of various diseases in the less developed countries, Therefore, These plants are found to be the “backbone” of traditional medicine for less developed countries. Besides that these plants considered as a rich resources of ingredients which can be used in drug development and synthesis and found to play an important role in the development of human cultures around the whole world.

The indiscriminate use of commercial antimicrobial drugs results in development of multiple drug resistance against many microbial infections (Service, 1995; Iwu *et al.*, 1999). Besides these, antibiotics are sometimes associated with adverse effects on the host including undesirable toxicity or side effects, hypersensitivity, immune-suppression and allergic reactions. Therefore, there is a demand to search various other alternative sources of medicines for the treatment of infectious diseases, such as plants (Cordell, 2000). Natural products of higher plants may be a new source of antimicrobial agents possibly with novel mechanisms of action (Barbour *et al.*, 2004). To reduce the risk in modern era these chemical based antibiotics are less attempted and the uses of medicinal herbs are promoted.

Historical Background: The literature of herbs dates back over 5,000 years to the Sumerians, they created lists of hundreds of medicinal plants (such as myrrh and opium) along with preparations of clay tablets. The information on over 850 plant medicines including garlic, juniper, cannabis, castor bean, aloe, and mandrake given by the Ancient Egyptian Ebers Papyrus in 1500 BC (Sumner, Judith 2000.)

In India, Ayurvedic medicine has used many herbs including turmeric possibly as early as in 1900 BC. (Aggarwal *et al.*, 2007). The Rig Veda, and Atharva Veda (Earliest Sanskrit writings) are some of the earliest available documents detailing the medical knowledge that formed the basis of the Ayurveda system.

During Early Middle Ages, Benedictine monasteries were found to be the primary source of medical knowledge in Europe and England. The herb gardens of these monasteries provided the raw materials for simple treatment of common disorders. Therefore, these monasteries thus became local centers of medical knowledge in early middle ages. Herbals, medical texts and translations of the classics of antiquity filtered in from east and west. (Collins, 2000). Al-Dinawari described more than 637 plant drugs in the ninth century. (Fahd, Toufic 1996). The 15th, 16th, and 17th centuries were called the great age of herbals, many of the literature of medicinal plants were available for the first time in English and other languages rather than Latin or Greek. But the second millennium resulted in the beginning of a slow erosion of the greatest position held by plants as sources of therapeutic effects.

In 18th century, Paracelsus introduced the use of active chemical drugs (like arsenic, copper sulfate, iron, mercury, and sulfur) (Edward *et al.* 1986). In modern era, The currently available pharmaceuticals to physicians have a long history of their earlier usage as herbal remedies, including opium, aspirin, digitalis, and quinine. According to the estimates of World Health Organization (WHO) about 80 percent of the population of some Asian and African countries presently use herbal medicine for some aspect of primary health care.

The dietary supplements derived from plants made the use and search for making drugs have accelerated in recent years. Approximately 25% of modern drugs used in the United States have been derived from medicinal plants according to a report of World Health Organisation. At least 7,000 medical compounds in the modern pharmacopoeia are derived from plants. ("Summary Report for the European Union). To promote herbal drugs in modern era it is important that great attention must be paid to choose soil and cropping strategies, to obtain satisfactory yields of high quality and best-priced products, respecting their safety and nutritional value. (Carrubba *et al.*, 2012).

Classification of Medicinal Plants: Classification of medicinal plants is organized in different ways depending on the criteria used. According to their active principles present in the storage organs of plants, these medicinal plants are classified, various storage organs may include roots, leaves, flowers, seeds and other parts of plant. These plants parts are valuable in the treatment of diseases.

Herbs are classified in many ways. Some of them are:

1. According to the usage;
2. According to the active constituents;
3. According to the period of life;
4. According to their taxonomy;
5. According to their habitat

Anti Microbial Properties of Medicinal Plants: The presence of active ingredients in medicinal plants made the use of these plants as raw material for synthesis of different drugs. Antimicrobials of plant origin have enormous therapeutic potential. Rehman *et al.* reported that *Azadirachita indica* an important medicinal plant have antimicrobial activity against *Microsporum canis*, *Aspergillus fumigatus*, *Candida albicans*, *Escherichia coli* and *Staphylococcus aureus* found in its aqueous and ethanolic extracts when separated by disc diffusion method. This finding is also supported by (Junaid *et al.*, 2006) in different medicinal plant where he reported that the fresh and dried leaf extracts of *Ocimum gratissimum* during phytochemical analysis revealed the presence of antimicrobial principles such as resins, tannins, glycosides, alkaloids, flavonoids saponin, anthraquinone, cardiac glycoside, steroidal ring, steroidal terpenes and carbohydrates at different concentrations.

Derwich (2010) proposed that antimicrobial properties of essential oil obtained from *Mentha longifolia* and *Mentha arvensis* were tested invitro in a bioassay on nine bacterial strains: *Escherichia coli*, *Staphylococcus aureus*, *Staphylococcus intermedius*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Streptococcus mutans*, *Micrococcus luteus*, and *Proteus mirabilis* and were evaluated. This finding is in line with (Lemma, 1991) where he found that the Extracts from the plant of *Phytolacca dodecandra*, commonly known as *endod*, are used as an effective molluscicide to control schistosomiasis. Uma and Sasikumar stated that different organic and alcoholic extracts of *Calotropis gigantea*, *Justica adhatoda*, *Moringa oleifera* and *Piper betle* have antimicrobial activity against certain bacterial pathogens *Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis* and *Klebsiella pneumoniae* and fungal strains of *Aspergillus niger* and *Rhizopus sp.* the rhizome and leaf extracts of *Acorus calamus* when obtained with different solvents viz., petroleum ether, chloroform, hexane and ethyl acetate have found the presence of antimicrobial properties (Devi and Ganjewala, 2009). The table shows some of the medicinal plants having their active components and plant parts studied (Krishnaiah *et al.*, 2011)

Name of plant	Part Studied	Active component(s)
<i>Acorus calamus</i>	Rhizomes	Alkaloids
<i>Andrographis paniculata</i>	Whole plant	Diterpenes, Lactones
<i>Aloe vera</i>	Leaf	Vitamin A,C,E, Carotenoids
<i>Carica papaya</i>	Leaves	Terpenoids. Saponins, Tannins
<i>Cassia fistula</i>	Bark	Flavonoids
<i>Curculigo orchioides</i>	Rhizomes	Alkaloids, Flavonoids
<i>Cyperus rotundus</i>	Rhizomes	Saponin, Sesquiterpenoids
<i>Dalbergia sisoo</i>	Leaves and flower	Tannins

<i>Embllica officinalis</i>	Seeds	Vitamin C, Tannins
<i>Ficus bengalensis</i>	Aerial root	Flavonoids, Tannins
<i>Hemidesmus indicus</i>	Stem	Alkaloids, Glycosides
<i>Magnifera indica</i>	Stem bark	Reducing sugar, Flavonoids
<i>Moringa olifera</i>	seeds	Glycosides
<i>Plumbago zeylanica</i>	Root	Alkaloids, Glycosides
<i>Solanum nigrum</i>	Fruit	Carotenoids, Ascorbic acid

Medicinal Plants may act as

- Synergic medicine- All the ingredients of plants may interact simultaneously, so their uses can complement or damage others or neutralize their possible negative effects.
- Preventive medicine- It has been proven that the component of the plants may also characterized on the basis of their ability to prevent the appearance of some diseases. This will further results in reduction in use of the chemical remedies which will be applied when the disease is already present i.e., reduce the side effect of synthetic treatment.

Importance of Medicinal Plants: Medicinal plants are found to be rich in secondary metabolites such as alkaloids, glycosides, coumarins, flavonoids, steroids etc. and are potential source of drugs. There is great demand of medicinal plants in the country or abroad and India is one of the few countries where almost all the known medicinal plants can be cultivated in some part of the country or the other. Among them mostly demanded in other countries are opium poppy, tropane alkaloid bearing plants, sapogenin bearing yams, senna, cinchona and ipecac. The importance of medicinal plants is increasing in a progressive manner in developing countries. It is estimated about 80% of population in Pakistan and 40% in China depend on these for treatment. In Japan there is more demand for medicinal plants. The treatment of complex diseases in some cases may require the support of the medicinal properties of plants or derivatives that provide them.

- Herbs such as black pepper, cinnamon, myrrh, aloe, sandalwood, ginseng, red clover, burdock, bayberry, and safflower are used to heal wounds, sores and boils. Sandalwood and Cinnamon are great astringents apart from being aromatic. Sandalwood has good curative power in arresting the discharge of blood, mucus etc.
- Herbs such as root and leaves of marshmallow serves as antacids are used to neutralize the acid produced by the stomach. These are helpful in proper digestion.
- Many herbs are used as blood purifiers to alter or change a long-standing condition by eliminating the metabolic toxins. These are also known as 'blood cleansers'. Certain herbs improve the immunity of the person, thereby reducing conditions such as fever.
- Certain medicinal herbs destroys disease causing germs. They may acts as disinfectants They also inhibit the growth of pathogenic microbes that cause communicable diseases.
- Certain aromatic plants such as Aloe, Golden seal, Barberry and Chirayata are used as mild tonics. The bitter taste of such plants reduces toxins in blood. They are helpful in destroying infection as well.
- Certain herbs are used as stimulants to increase the activity of a system or an organ, for example herbs like Cayenne (Lal Mirch, Myrrh, Camphor and Guggul).

Future Prospects: Medicinal plants have a promising future because there are about half million plants around the world, and most of them have antifungal, antimicrobial, antibacterial and various other medical activities, which have not investigated yet, and their medical activities could be decisive in the treatment of present or future studies.

Conclusion: Because of our techno-savvy lifestyle, we are moving away from nature, while we will never escape from nature because we are part of nature. Medicinal plants are free from side effects, they are natural products and comparatively they are safe, eco-friendly and locally available. There are lots of different types of medicinal plants used for the ailments related to different seasons. So the present need to promote them to save the human lives. These herbal products are today are the symbol of safety in contrast to the synthetic drugs, that are regarded as unsafe to human being and environment. From the above information it is imperative to conclude that, to reduce the pathogenic effects of bacterial and fungal human pathogens various studies on antimicrobial activity of medicinal plant had done which showed usefulness of solvent extracts extracted from various parts of medicinal plants. Recent and renewed results of various herbal researchers also indicated that scientific studies carried out on medicinal plants having traditional claims of effectiveness might warrant fruitful

results. These plants could serve as primary source of new antimicrobial agents. As a result of such developments, access to indigenous peoples and cultures concerning medicinal plants are greatly facilitated. Furthermore, the active participation of such natural custodians and practitioners of valuable knowledge is guaranteed in the generation of research focusing on screening programmers dealing with the isolation of bioactive principles and the development of new drug.

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PROTECTION OF PLANT VARIETIES & FARMER'S RIGHTS

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Plant Genetic Resources (PGRs) are the foundation for the development of a food and nutritionally secure society. In addition, plants have many uses, including feed, fibre, medicine and industrial applications. PGRs were treated as the 'heritage of mankind' and were shared freely among nations, till the concerns for conservation of biological diversity were raised by the Convention on Biological Diversity (CBD), which came into force in 1993. The conservation and sustainable utilization and access to biological diversity were considered as national sovereignty by CBD. Consequently, many issues regarding the rights of the conservers, users, breeders, farmers and intellectual property have emerged. During 2001, significant developments have taken place with respect to the realization of the rights of breeders, farmers and local communities. The protection of Plant Varieties and Farmers' Rights Act (PPVFR) was passed by the Indian Government. The present article is an attempt to critically analyse the provisions of the legislations for their effective implementation.

The Genesis of the Indian Legislation: In India, agricultural research including the development of new plant varieties has largely been the concern of the government and public sector institutions. Earlier, India did not have any legislation to protect the plant varieties and, in fact, no immediate need was felt. However, after India became signatory to the Trade Related Aspects of Intellectual Property Rights Agreement (TRIPs) in 1994, such a legislation was necessitated. Article 27.3 (b) of this agreement requires the member countries to provide for protection of plant varieties either by a patent or by an effective *sui generis* system or by any combination thereof. Thus, the member countries had the choice to frame legislations suiting their own system and India exercised this option. The existing Indian Patent Act, 1970 excluded agriculture and horticultural methods of production from patentability. The *sui generis* system for protection of plant varieties was developed integrating the rights of breeders, farmers and village communities, and taking care of the concerns for equitable sharing of benefits. It offers flexibility with regard to protected genera/species, level and period of protection, when compared to other similar legislations existing or being formulated in different countries. The Act covers all categories of plants, except microorganisms. The genera and species of the varieties for protection shall be notified through a gazette, after the appropriate rules and by-laws are framed for the enforcement of the Act.

Objectives: The objectives of the Act are as follows:

1. To provide for the establishment of an effective system for protection of plant varieties.
2. To provide for the rights of farmers and plant breeders.
3. To stimulate investment for research and development and to facilitate growth of the seed industry.
4. To ensure availability of high quality seeds and planting materials of improved varieties to farmers.

The printed version of the Act is published in the Newsletter of Seed Association of India². The Act has 11 chapters and is divided in 97 clauses. The first chapter has title, and the definitions used in context of the Act. The last chapter is on miscellaneous clauses. The other nine chapters deal with PPVFR authority, registration of plant varieties, duration and effect of registration and benefit sharing, surrender and revocation of certificate, farmer's rights, compulsory licence, plant varieties protection appellate tribunal, finance, accounts, audit, infringement, offences and penalties, etc.

Some Important Definitions: Some of the important definitions in the context of the Act include the following:

Variety: A plant grouping except microorganisms within a single botanical taxon of the lowest known rank, which can be

1. Defined by the expression of the characteristics resulting from a given genotype of a plant of that plant grouping

2. Distinguished from any other plant grouping by expression of at least one of the said characteristics
3. Considered as a unit with regard to its suitability for being propagated, which remains unchanged after such propagation and includes propagating material of such variety, extant variety, transgenic variety, farmers' variety and essentially derived variety.

Extant Variety: A variety available in India which is

1. notified under section 5 of Seeds Act, 1966, or
2. farmers' variety, or
3. a variety about which there is common knowledge, or
4. any other variety which is in public domain.

Essentially Derived Variety: A variety shall be said to be essentially derived when it:

1. Is predominantly derived from such initial variety, or from a variety that itself is predominantly derived from such initial variety, while retaining the expression of the essential characteristics that result from the genotype or combination of genotypes of such initial variety.
2. Is clearly distinguishable from such initial variety.
3. Conforms (excepting for the differences which result from the act of derivation) to such initial variety in the expression of the essential characteristics that result from the genotype or combination of genotypes of such initial variety.

Farmer

Any person who

- (i) Cultivates crops by cultivating the land himself, or
- (ii) Cultivates crops by directly supervising the cultivation of land through any other person, or
- (iii) Conserves and preserves, severally or jointly, with any person any wild species or traditional varieties, or adds value to such wild species or traditional varieties through selection and identification of their useful properties.

Farmers' Variety: A variety which

- (i) Has been traditionally cultivated and evolved by the farmers in their fields
- (ii) Is a wild relative or land race of a variety about which the farmers possess common knowledge.

Salient Features of the Act

Authority: The Central Government shall establish an Authority to be known as the Protection of Plant Varieties and Farmers' Rights Authority. It shall consist of a chairperson and fifteen members as representatives of different concerned ministries and departments, seed industry, farmers organizations, tribal communities and State-level women's organization, etc.

Eligibility: For a variety to be eligible for registration, it must conform to the criteria of novelty, distinctiveness, uniformity and stability (NDUS), as described below [Section 15 (1)–(3)]. For the purposes of the Act, a new variety shall be deemed to be: (a) *Novel*, if, at the date of filing of the application for registration for protection, the propagating or harvested material of such a variety has not been sold or otherwise disposed of by or with the consent of its breeder or his successor for the purposes of exploitation of such variety (i) in India, earlier than one year, (ii) or outside India, in the case of trees or vines earlier than six years, or, in any other case, earlier than four years, before the date of filing such applications. Provided that a trial of a new variety which has not been sold or otherwise disposed off shall not affect the right to protection. Provided further that the fact that on the date of filing the application for registration, the propagating or harvested material of such variety has become a matter of common knowledge other than through the aforesaid manner shall not affect the criteria of novelty for such variety. (b) *Distinct*, if it is clearly distinguishable by at least one essential characteristic from any other variety whose existence is a matter of common knowledge in any country at the time of filing of the application. (c) *Uniform*, if subject to the variation that may be expected from the particular features of its propagation, it is sufficiently uniform in its essential characteristics. (d) *Stable*, if its essential characteristics remain unchanged after repeated propagation or, in the case of a particular cycle of propagation, at the end of each such cycle. The variety will be subjected to such distinctiveness, uniformity and stability tests as shall be prescribed.

Application Form: Every application for registration will have to be accompanied with the following information [Section 18 (a–h)]: (a) denomination assigned to such variety by the applicant (b) an affidavit sworn by the applicant that such variety does not contain any gene or gene sequence involving terminator technology (c) the application should be in such form as may be specified by

regulations (d) a complete passport data of the parental lines from which the variety has been derived along with the geographical location in India from where the genetic material has been taken and all such information relating to the contribution, if any, of any farmer, village community, institution or organization in breeding, evolving or developing the variety. (e) a statement containing a brief description of the variety, bringing out its characteristics of novelty, distinctiveness, uniformity and stability as required for registration (f) such fees as may be prescribed (g) contain a declaration that the genetic material or parental material acquired for breeding, evolving or developing the variety has been lawfully acquired. (h) such other particulars as may be prescribed. The conditions stated above (a–h), shall not apply in respect of application for registration of farmers' varieties.

Period of Protection: The certificate of registration issued under section 24 or sub-section 98 of section 23 shall be valid for nine years in the case of trees and vines and six years in the case of other crops, and may be reviewed and renewed for the remaining period on payment of such fees as may be fixed by the rules made on this behalf subject to the conditions that the total period of validity shall not exceed—(i) in the case of trees and vines, eighteen years from the date of registration of the variety; (ii) in the case of extant varieties, fifteen years from the date of the notification of that variety by the Central Government under Section 5 of the Seed Act, 1996, and (iii) in the other case, fifteen years from the date of registration of the variety.

Payment of Annual Fee: The Authority may, with the prior approval of the Central Government, by notification in the Official Gazette, impose a fee to be paid annually, by every breeder of a variety, agent and licensee thereof registered under this Act determined on the basis of benefit or royalty gained by such breeder, agent or licensee, as the case may be, in respect of the variety, for the retention of their registration under this Act [Section 35(1)].

Breeders' Rights: The certificate of registration for a variety issued under this Act shall confer an exclusive right on the breeder or his successor or his agent or licensee, to produce, sell, market, distribute, import or export of the variety [Section 28 (1)].

Researchers' Right: The researchers have been provided access to protected varieties for bona fide research purposes [Section 30]. This Section states, 'Nothing contained in this Act shall prevent (a) the use of any variety registered under this Act by any person using such variety for conducting experiments or research; and (b) the use of a variety by any person as an initial source of a variety for the purpose of creating other varieties provided that the authorization of the breeder of a registered variety is required where the repeated use of such variety as a parental line is necessary for commercial production of such other newly developed variety'.

Farmers' Rights: The farmers' rights of the Act define the privilege of farmers and their right to protect varieties developed or conserved by them. Farmers can save, use, sow, resow, exchange, share and sell farm produce of a protected variety except sale under a commercial marketing arrangement (branded seeds) [Section 39 (1), (i)–(iv)]. Further, the farmers have also been provided protection of innocent infringement when, at the time of infringement, a farmer is not aware of the existence of breeder rights [Section 42 (1)]. A farmer who is engaged in the conservation of genetic resources of landraces and wild relatives of economic plants and their improvement through selection and preservation, shall be entitled in the prescribed manner for recognition and reward from the Gene Fund, provided the material so selected and preserved has been used as donor of genes in varieties registrable under the Act. The expected performance of a variety is to be disclosed to the farmers at the time of sale of seed/propagating material. A farmer or a group of farmers or an organization of farmers can claim compensation according to the Act, if a variety or the propagating material fails to give the expected performance under given conditions, as claimed by the breeder of the variety.

Communities Rights: The rights of the communities as defined, provide for compensation for the contribution of communities in the evolution of new varieties in quantum to be determined by the PPVFR Authority [Section 41 (1)].

Registration of Essentially Derived Varieties: The breeder of the essentially derived variety shall have the same rights as the plant breeder of other new varieties, which include production, selling, marketing and distribution, including export and import of the variety. The other eligibility criteria for award of registration are also the same as for new variety registration under the Act [Section 23(1), (6)].

Compulsory License: The authority can grant compulsory license, in case of any complaints about the availability of the seeds of any registered variety to public at a reasonable price. The license can

be granted to any person interested to take up such activities after the expiry of a period of three years from the date of issue of certificate of registration to undertake production, distribution and sale of the seed or other propagating material of the variety [Section 47(1)].

Benefit Sharing: Sharing of benefits accruing to a breeder from a variety developed from indigenously derived plant genetic resources has also been provided [Section 26(1)]. The authority may invite claims of benefit sharing of any variety registered under the Act, and shall determine the quantum of such award after ascertaining the extent and nature of the benefit claim, after providing an opportunity to be heard, to both the plant breeder and the claimer.

National Gene Fund: The National Gene Fund to be constituted under the Act shall be credited there to: (a) The benefit sharing from the breeder. (b) The annual fee payable to the authority by way of royalties. (c) By the compensation provided to the communities as defined under Section 41(1). (d) Contribution from any national and international organization and other sources.

The fund will be applied for disbursing shares to benefit claimers, either individuals or organization, and for compensation to village communities. The fund will also be used for supporting conservation and sustainable use of genetic resources, including *in situ* and *ex situ* collection and for strengthening the capabilities of the panchayat in carrying out such conservation and sustainable use [Section (45)].

Plant Variety Protection Appellate Tribunal: The Tribunal will be established by a gazette notification by the Government to exercise jurisdiction, powers and authority conferred on it under this Act. The Tribunal will consist of Judicial as well as Technical members.

Consideration for Effective Implementation of the Act: India has opted for a *sui generis* system of protection of plant varieties and has provided for farmers' rights, breeders' rights, researchers' rights and equity concerns in the same legislation. All these provisions in one legislation make it a unique Act, when compared to similar legislations in other countries. Although a few countries have provided for farmers' rights, all types of rights for farmers, viz. as breeder, conservator, seed producer and consumer have not been considered elsewhere in the world. It is this uniqueness of the Act which poses many challenges for its effective implementation. The balance between breeders' rights and farmers' right could be tough to strike. A critical analysis of the provisions in the Act is therefore essential for its effective implementation.

Notification of Crops Species: As a first step towards implementation of the Act, the Government shall have to notify the crops in order to establish the system of listing of plant varieties for the purpose of registration. The criteria for selecting the crops could be the crops on which we are dependent for food and nutritional security, including major cereals, pulses, oilseeds, vegetables and fruits crops. Crop species important for India in the world trade, species of Indian origin, crops where India could benefit from introduction of new germplasm and foreign investment, could be the other priorities for consideration.

Awareness Generation: There is a need to create awareness among scientists, policy makers and breeders as well as farmers, village communities and the private seed sector. Wide circulation of the provisions of the Act may be done in all research organizations directly or indirectly involved in development of new crop varieties. For farmers and village communities, awareness generation and information empowerment is a must through vernacular press, radio, television and the Internet. A standing committee on awareness generation and information empowerment under the Plant Varieties and Farmers' Rights Protection Authority may be set-up for ensuring the effective spread of credible information concerning the rights of plant breeders and farmers as cultivators, breeders and conservers³. In order to ensure that the farmer as a breeder and conservator secures the recognition and reward provided under the Act, there is need to establish resource centres for farmers' rights and entitlements.

Institutional Structures for Effective Implementation: The PPVFR Authority proposed to be established under the Act has a crucial role to play for effective implementation of the Act. The duty of the Authority is to promote, by such measures as it may think fit, the encouragement for the development of new varieties of plants and to protect the rights of the farmers and breeders [Section 8 (1)]. In particular, the authority is to provide measures for: (a) The registration of extant and new plant varieties subject to such terms and conditions and in the manner as may be prescribed. (b) Developing characterization and documentation of varieties registered under this Act. (c) Documentation, indexing and cataloguing of farmers' varieties. (d) Compulsory cataloguing facilities for all varieties

of plants. (e) Ensuring that seeds of the varieties registered under this Act are available to the farmers and providing for compulsory licensing of such varieties, if the breeder of such varieties or any other person entitled to produce such variety under this Act does not arrange for production and sale of seed in the manner as may be prescribed. (f) Collecting statistics with regard to plant varieties, including the contribution of any person at any time in the evolution or development of any plant variety, in India or in any other country, for compilation and publication. (g) Ensuring the maintenance of the Register of plant varieties. The Authority has the responsibility to provide for all the activities mentioned through appropriate institutional structures. There could be three options for the Authority to undertake all the activities: (a) The Authority can appoint an independent organization directly under its control to devise assessment procedures for candidate varieties and other institutional mechanisms. (b) The Authority can take advantage of the existing facilities and infrastructure available at ICAR crop-based institutions, State Agricultural Universities, Krishi Vigyan Kendras and All India Coordinated projects. (c) The ICAR as an organization can establish a suitable system independently.

Any one of the proposed institutional mechanisms has however a single objective of effective implementation. The assessment of candidate varieties should be fair to provide a level playing field to all categories of breeders such as institutions, breeders, farmers and the private sector. The effective implementation of the Act hinges on the DUS testing and the Authority should ensure trust, transparency, accountability and efficiency for carrying out such tests. Suitable farm and other infrastructure facilities for DUS testing, including seed storage facilities need to be created. It is advisable to carry out DUS testing in at least two locations in each major-agro climatic region relevant to the crop for at least two successful years⁴. Such an evaluation procedure would create acceptance when followed for all types of varieties among all the stakeholders. It is imperative to define essential and additional characters for DUS testing (morphological, biochemical and molecular characters), and identification of possible reference varieties for each crop species. The scope for using UPOV guidelines on DUS testing, available for various crops as possible templates for formulation of DUS guidelines that may suit specific requirements in harmony with our legislation may also be considered. In order to test the novelty, a database of the existing varieties may have to be developed with effective linkages with other such database available internationally. The Authority may also have to decide about the minimum passport data required to be submitted with the application. Many germplasm accessions used for the development of new varieties, even when accessed from gene banks/breeders collection may not have full recorded passport data. In such a case, acknowledging the source of parental material, may be considered sufficient.

Further, information regarding parental lines as required under section 18(e), needs to be restricted to immediate parents. The term parental line is ambiguous here since all the varieties developed by traditional methods may be having many parental lines. It could be appropriate to include information on immediate parents, specifically in case of hybrids only. It would be difficult to ascertain uniformity criteria for composites, synthetics, multilines and multiparent hybrids. Such consideration may have to be included in the DUS guidelines for testing of these particular types of varieties. In addition to DUS test centres and database development, attention should be paid to the role of the National Gene Bank at the National Bureau of Plant Genetic Resources as a National repository, and to the establishment of recognized DNA fingerprinting centres for conflict resolution.

Storage of Reference Samples: The storage of 'reference samples' is an important component of this Act. It requires enough and appropriate storage infrastructure. The Authority would, therefore, have to create appropriate infrastructure for providing storage facilities at selected locations in the country. Since the storage of vegetatively propagated materials requires specialized techniques and competence, scientific personnel need to be trained accordingly and specific centres would have to be identified and equipped for this purpose. The facilities and technical expertise available with the National Gene Bank at National Bureau of Plant Genetic Resources, New Delhi and its regional stations could also be utilized.

Farmers' Rights: A farmers who has bred or developed a new variety shall be entitled for registration and any other protection as a breeder. Since the definition of an extant variety according to section 2(j) includes a farmers' variety also, which may be landrace or a wild relative about which farmers possess common knowledge, the uniformity criteria in case of registration of these varieties is difficult to ascertain. Such consideration may have to be included in the DUS guidelines for testing of

these particular types of varieties. Further, there could be innumerable farmers' varieties (landraces for registration and their data are scattered and sometimes overlapping). A technical questionnaire to bring out unique characters and area of adaptability could be developed initially to document these varieties. The time-frame to be provided for documentation of information relevant for registration of extant varieties (farmers' varieties or released varieties) under Section 15(2) may be restricted to three years.

A farmer/farmer's organization [Section 39(2)] can claim compensation if a variety fails to give the expected performance under given conditions. Such a claim may have to be paid by the breeder as directed by the Authority after giving due hearing to both the parties, namely the farmer and the breeder. Since the variety is to be tested for DUS by the Authority at the time of registration, and if the performance of the variety is not found to be as claimed by the breeder, the Authority can deal with claims of failure of performance and could decide about such claims independently, instead of the courts. Section 42 regarding protection to farmers for innocent infringement is also not clear as to how to define innocent infringement. Such a clause may not stand in the court of law in view of the other laws where ignorance is not a reason to have protection from legal obligations.

Lawfully Acquired Parental Material: Section 18(j) regarding information to be submitted along with an application, requires the applicant to certify that the genetic or parental material used for breeding the variety has been lawfully acquired. Such declaration would be difficult in cases where the passport information relating to the material has not been recorded. Further, it would not always be possible for a breeder to get information relating to the contribution of a farmer, village community, etc. since there may not be an authentic source of such information. Such information, if not available, may be left to the Authority to decide, which can invite claims later through media/public notices, etc.

Integrated Implementation: There is a need for the effective and integrated implementation of various new acts/bills concerning biodiversity, environment and seed, which have some interphases because of the common commodity that is the 'seed'. These are in the area of benefit-sharing mechanisms for conservers of agro-biodiversity and the establishment of a fund for claims of benefit sharing.

CRITICAL EVALUATION AND THERAPEUTIC EFFECT OF SHIRODHARA

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Ayurveda is a holistic science of life. It is the art of living which conveys specific life style to achieve *Sukha*. In definition of Ayurveda it has not been considered only as science of medicine but it has been defined as science of *Sukha* and *Dukha* which are result of *Hita* and *Ahita* respectively i.e. Ayurveda has projected a specific life style to maintain the normal status of body and mind (Sharma and Das, 2016). *Shirodhara* is one of the many special types of treatment widely practiced in Kerala for psychic diseases and psychosomatic diseases. The etymology of *Shirodhara* is from *Shira* (Head) and *Dhara* (a steady flow). *Shira* is considered as *Uttamanga* as it is the important and major part of the body (Sharma and Das, 2016). *Shirodhara* is the process in which medicated oil, milk, buttermilk or *Kvatha* is poured in a continuous stream of drip on the head, especially on the forehead in a specific manner. Depending upon the drug components, *Dhara* is known by different names viz. *Takradhara*, *Kshiradhara*, *Tailadhara*, *Kvathadhara* and *Jaladhara* (Pavana and Sankarnarayana, 2018). This procedure induces a relaxed state of awareness, which result in a dynamic psycho-somatic balance. A total feeling of wellness, mental clarity, and comprehension is experienced in this process. *Shirodhara* is an amazing effective *Panchakarma* treatment for balancing the *Dosha* and improve the function of brain, there by reliving the *shirahshula*, anxiety, stress. Pouring of liquied on head in *Shirodhara* is designed to relieve the psychological stress and mental fatigue. *Acharya Vagbhata* has considered it under the broad heading of *Moordha Taila*. He recommended it for the prevention of *Khalitva*, *Palitya*, etc. disorders (Murthy, 2014). A variety of material is used for the *Shirodhara* procedure depending on the disease and involved pathological factors.

Method of *Shirodhara*: It can be divided into three stages for descriptive purpose—(a) *Purvakarma*, (b) *Pradhanakarma*, (c) *Paschatkarma*

***Purvakarma*:** It is related with the preparation of *Shirodhara*. First it should be examined that whether the patient is fit for *Shirodhara* or not. Then the patient is advised to pass his/her natural urges and then patients pulse, temperature and blood pressure should be recorded. Afterwards, he/she lie down in supine position on the *Droni*. The eyes and ears are covered with cotton so that liquid may not enter in them. His /her head is rested in slightly elevated position, preferably on soft cotton pad (Acharya, 2006).

***Droni*:** In *Shirodhara*, a special type of wooden table is used which is known as *Droni*. The edge of *Droni* should be raised at all the four sides so that the poured material may not flow out (Acharya, 2006).

***Dhara Patra*:** It is a vessel in which liquids used for *Shirodhara* are filled in. The mouth of vessel is wide and sides are tapering gradually to a central point in the bottom. At this point a hole is made approximately of little finger size. The depth of vessel is about 5 to 6 inches with a capacity of 2½ liters. Nowadays a nozzle having the provision to stop and open cork is fitted to control the flow (Acharya, 2006). *Dharapatra* is suspended three *Angul* (4 inches) above the forehead (Pavana and Sankaranarayana, 2008).

Medicament for *Shirodhara*: It can be performed with various liquid medicaments like *Jala*, *Kwatha*, *Takra*, *Taila*, *Kshira* etc., depending on the involvement of *Dosha*, *Dushya*, *Kala* etc. pathophysiological factors in the disease (Gangavishnu, 1973). Drugs specifically indicated in certain diseases are (Sharma, 2002):

- *Vataja Roga*: *Bala taila*, *Dashmula Kwatha* and *Ghrita* etc.
- *Pittaja Roga*: *Chandana*, *Ushira Kwatha*, *Takra*, and *Jala* etc.
- *Kaphaja Roga*: *Nagara*, *Mustaka* and *Madhuyasti Kwatha*.

As per the recommendation of *Dharakalpa*, *Sneha* is taken for *Shirodhara* according to the condition of *Doshas* (Pavana and Sankaranarayana, 2008).

- *Vata Dosha: Taila*
- *Pitta Dosha: Ghrita*
- *Kapha Dosha: Taila*
- *Rakta Dosha: Ghrita*
- *Vata + Pitta + Rakta: Ghrita + Taila* in equal portion
- *Vata + Kapha + Rakta: ½ part Ghrita + 1 part Taila*)

Pradhanakarma: The medicament fills in the *Dharapatra* and pours continuously, neither very fast nor very slow on the forehead of the patient. When the liquid starts pouring then the vessel is moved in the pendulum manner starting from one lateral side to the other lateral side. The poured liquid is collected in another vessel and is used to refill the vessel before it become empty (Acharya, 2006).

Dharakala: As *Shirodhara* is one type of *Bahya Snehana Karma*, it can be done in the morning on empty stomach or after 3 hours of taking food. According to *Dharakalpa*, patient having dryness and *Pittanubandhit Vata*, the period of *Shirodhara* is $2\frac{1}{2}$ *Prahara* or 2 *Prahara* while in *Snigdha Kaphanubandhit Vata*, it is one *Prahara* or it should be up to initiation of perspiration (Pavana and Sankaranarayana, 2008). *Dhara* process can be done for half an hour to 90 minutes in the morning up to 21 days. It is believed that through this irrigation method of head, the effect of medications can be achieved up to the limbs and entire body within 21 days. Usually *Dhara* process is performed in different course of 7 days, 14 days or 21 days like wise (Acharya, 2006).

Period for Changing the Liquid¹³: When milk or water is used for *Parisechana*, it should be changed everyday, whereas *Dhanyamla* can be used up to three days. The oil also should be changed every third day, but it can be reused. In seven days of *Tailadhara* course, for the first three days half of the oil is used and for next three days later half of oil is utilized. While on the seventh day, remaining oil of first and second half are mixed together and used, then it should be discarded (Pavana and Sankaranarayana, 2008).

Paschatkarma: After *Shirodhara*, oil on the head is wipeout and advised rest for a short duration. Followed by massage of the body including head is given. Then a bath with lukewarm water is suggested (Acharya, 2006).

Pariharyani: The patient should avoid physical exertions, mental excitement such as anger, grief, sexual desire and exposure to cold, sun, dew, wind, smoke or dust. Riding, excessive walking, travelling, speaking too long or loudly and such other acts that give strain to the body must be avoided. Sleeping during daytime and standing continuously for long period must also be avoided. It is also advisable to use a pillow which is neither very high nor very low, during sleep at night (Pavana and Sankaranarayana...2008..Year?).

Pariharakala: The patient should follow *Pathya Ahara-Vihara* and remain as *Jitendriya* during the *Dharakarma* (Pavana and Sankaranarayana, 2008).

Mechanism of Shirodhara: Clinically the efficacy of *Shirodhara* is proved; still it is a difficult task to understand the mode of action of *Shirodhara*. Generally, *Shirodhara* is effective in following ways.

Procedural effect of Shirodhara: In *Ayurvedic* texts, there are four type of technics of *Moordha Tail* have been described. It includes *Shirah: Abhyanga, Seka, Pichu* and *Basti* and said that “*Uttarottara Gunaprada*” (Murthy, 2014). It means that each has different effect as each performed with different method, which indicates that there is a specific mechanical effect of therapy. The plain water without having chemical or therapeutic properties is observed effective. In *Jaladhara* due to its procedural effect (Dharaiya, 2004). The liquid is poured on a forehead in *Shirodhara*, induces the somatoautonomic reflex through thermo-sensors or pressure sensors of the skin or hair follicles via trigeminal cranial nerve and provides physiological effect of therapy (Dharaiya, 2004).

Effect of Shirodhara on Blood circulation: Due to warm effect of the oil used for *Shirodhara*, there is local vasodilatation. *Shirodhara* lasts for 45 minutes. The continuous flow of warm fluid on the forehead for such a long period will cause mild vasodilatation. The region where *Shirodhara* is performed overlies mainly cortex arterial branches, venous sinuses, and venous reservoir of the brain, superior sagittal and cavernous venous sinuses. *Shirodhara* improves the circulation in these areas and helps in regularizing the blood supply of brain (Ogiso, 2002).

Effect of Shirodhara on Neuro Transmitters: *Shirodhara* may have sedative effect on hyperactive limbic system, caused by stress. It leads to facilitate the inhibitory presynaptic action of GABA and also reduces high level of noradrenaline, which are found high in anxious state of mind (Tank, 2006).

Effect of Shirodhara on Tridosha: Stress and tension causes imbalance of *Prana*, *Udana* and *Vyana Vayu*; *Sadhaka Pitta* and *Tarpaka Kapha*. *Shirodhara* reestablishes the functional integrity between these three subtypes of *Dosha* through its positive effect (Patel, 2009).

Therapeutic Effect of the Medicament Used for Shirodhara: The maximum absorption of drug is in the skin of scalp and oil is better absorbed compare water (<http://www.thedermreview.com/water>). It suggests that the medicament used for *Dhara* is definitely absorbed.

Effect of Shirodhara as per Yogic Science: *Shirodhara* is performed in *Savasana* position, which is used for relaxation in Yogic science. During *Shirodhara* patients concentrate where *Dhara* is poured on the forehead. As the patient concentrates on a particular place, the thought process decreases and thus entire psycho-physiology relaxes (<https://en.wikipedia.org/wiki/Shavasana>).

Effect of Shirodhara on Shada Chakra: *Dhara* poured on *Agna Chakra* (space between two eyebrows), is the seat of pituitary and pineal gland. *Shirodhara* regulates their stimulation and helps to bring hormonal balance (Parasania, 2001). It also normalised elevated cortisone & adrenaline, synchronizes the brain wave (alpha waves), strengthens the mind and this continues even after the relaxation (<http://www.watkinspublishing.com/bro w-chakra-meditation-third-eye>).

Effect of Shirodhara as per Marma Science: In forehead region, mainly *Sthapani*, *Utkshap* and *Avarta Marma* are located. As mentioned earlier it is also a place of *Agna Chakra*. According to *Acharya Bhela*, the location of *Chitta (Mana)* is *Bhramadhya* and same is place of *Sthapani Marma* (Shastri, 2003). *Shirodhara* makes the patient concentrate on this area by which the stability arrives in the functions of mind.

Effect of Shirodhara on Manomaya Kosha: *Shirodhara* works primarily on the mental sheath or "*Manomaya Kosha*" as it is referred to in Ayurveda (<http://ayurveda-for you.com/panchakarma /shirodhara.html>).

Indication of Shirodhara

- Stress and psychosomatic disorders such as irritable bowel syndrome
- Neurological disorders–Headache, epilepsy etc.
- Psychiatric disorders–psychosis, neurosis, insomnia etc.
- Convulsive disorders
- Psoriasis
- Eczema
- Hypertension
- Alcoholism,
- *Vata Vyadhi*
- Facial palsy
- Neuropathy
- Loss of memory

Contra- Indication

- *Kaphaja Vikara*

Shirodhara and Anidra: On the basis of the clinical manifestations and the symptoms produced, insomnia may be correlated with the term *Anidra* or *Nidranasha*. The person of age group between 30-60 years is more prone for *Anidra* (Insomnia) (Pokharel and Sharma, 2010). Amongst various causative factors of *Anidra* the most common causes are:

- Mental Stress or *Manasika Nidanas* like *Chinta*, *Bhaya*, *Krodha* etc.
- Improper sleep timings
- Vitiating of *Vata* and *Kapha Dosha* & Reduction in *Tamoguna* and increased *Rajoguna*.

Shirodhara procedure with luke warm milk is very effective in the management of *Anidra*. *Anidra* patient treated with only *Shirodhara* the symptoms *Jrumbha*, *Tandra*, *Angamarda* & *Angasada*, *Arati* & *Klama*, *Shirashoola*, *Manodourbalya*, *Smritidourbalya*, *Ajirna* & *Agnimandya*, *Malabaddhata* and *Dhatukshaya* showed highly significant result.

Jaladhara and Anxiety: Anxiety disorder is a group of mental disorder, which include many disorder like generalized anxiety disorder, panic disorder, social anxiety disorder, agoraphobia, specific type of phobia (American Psychiatric Association, 2013). Each one of them is having its own characteristics and symptoms but they all have common symptoms of anxiety (Michael et al., 2005). The anxiety and fear both are characteristic symptoms of anxiety disorder (American Psychiatric

Association, 2013) Here the anxiety means worry about future and fear means reaction to current events (American Psychiatric Association, 2013). *Chittodvega* is mentioned as a *Manasa Vikara* by *Charaka* (Agnivesha, 2000). It is considered as an appropriate word for the status of anxiety (Parasania and Singh, 2001). *Ayurvedic* literature has described *Chittodvega* and its influence on a body while describing other diseases also. On the basis of above thoughts, it can be stated that *Chittodvega* is a minor mental disorder. In modern parlance also, the neurotic disorders including anxiety disorder are studied as a minor mental disorder as per Diagnostic and Statistical Manual of Mental Disorders (<http://users.ipfw.edu/abbott/120/PsychDisorders.html>).

Raja and *Tama* are the main *Dosas* of any *Manasa Vikara* including *Chittodvega* (Agnivesha, 2000). *Prana* (Vagbhata, 2012), *Udana* (Vagbhata, 2012) and *Vyana Vayu* (Vagbhata, 2012); *Sadhaka Pitta* (Vagbhata, 2012) and *Tarpaka Kapha* (Vagbhata, 2012) also play a major role in the pathogenesis of *Chittodvega*, due to their functions pertaining to *Manasa*. *Hridaya* is also vitiated due to *Ashraya-Ashrayi Bhava* of *Manasa* (Agnivesha, 2000). *Manovaha Srotasa* is also vitiated due to transportation channel of *Manasa* (Agnivesha, 2000). All these factors involved in the pathophysiology of disease are caused by stress and tension. *Shirodhara* is a type of *Panchakarma* therapeutic measures, recommended to calm the mind. *Jaladhara* is one of the types of *Shirodhara*, which useful to alleviate stress, anxiety etc. Moreover, it is also indicated in '*Dharakalpa*' for psychic condition (Gangavishnu, 1973). Therefore *Jaladhara* has enough potency to relieve the anxiety disorder.

Conclusion: On the basis the review article concluded can be drawn that *Shirodhara* is having significant procedural effect, which can be further improvised with adding therapeutic effect of medicament used in it. The pharmacophysio-psychologic action of *Ayurvedic Shirodhara* treatment may be understood from the aspect of *Ayurveda*, mechanical, *Marma*, *Chakra* and *Yoga* science. In totality it seems that the effect seen in these cases under the influenced of *Shirodhara* is largely *Dhara*, effects not really pharmacological or medicinal effects. The *Dhara* might be producing some kind of biophysical impact such as micro-vibration of the skull. This could have been transmitted to the brain substance helping in resynchronization of neurons. Another important compartment underlying the mechanism of *Dhara* effect is the relaxation response, and the meditative action which could be responsible for therapeutic response. However till date there is no real robust evidence to substantiate this mechanism. Further studies are required.

It is imperative to mention that the *Shirodhara* treatment is classically used in *Ayurvedic* practice in India always using some are the other kind of medicated oil. While in the present scenario we used water on uniformly regulated temperature and pressure instead of oil.

This alternative option of the *Dhara* material was considered in ordered to make the treatment more cost effective and user friendly. This decision is also motivated by the past experience investigator. However it cannot be overemphasized. That traditionally oil is used in *Dhara* treatment because oil *Dhara* is much more smooth and well formed as compare *Jaldhara*. We think that use of costly oil for *Dhara* treatment may not have significant pharmacotherapeutic effect. However in future it is advisable to undertake a controlled comparative study between *Tail Dhara* and *Jaladhara*.

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SIGNIFICANCE OF PRANAYAMA W.S.R. TO BHRAMARI PRANAYAMA ON PHYSICAL AND MENTAL HEALTH

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Yoga is the science of right living and, as such, is intended to be incorporated in daily life. It works on all aspects of the person: the physical, vital, mental, emotional, psychic, and spiritual. Yoga aims at bringing the different bodily functions into perfect coordination so that they work for the good of the whole body (Neethi & Chidambara, 2012). Accordingly, the *Shiva Samhita* states: *Pranayama* gives purity, and the light of knowledge shines forth. There is no purificatory action greater than *pranayama*. The karma that covers the light and binds one to repeated births becomes ineffective and is eventually destroyed by the perfection of *pranayama*. A yogi measures the span of life by the number of breaths, not by the number of years. According to Swami Sivananda Breathing is a natural process and the normal rate is 15 breaths per minute, 900 breaths per hour and 21,600 breaths per 24 hours. When the breathing rate is increased, longevity is decreased. Correct breathing profoundly improves one's physical and mental wellbeing. Therefore, the first prerequisite of *pranayama* is conscious breathing, whereby it becomes possible to correct the breathing habits. In order to develop conscious breathing, one must free the mind from emotional tension. The breath is perhaps the only physiological process that can be either voluntary or involuntary. One can breathe consciously and control the breathing process or one can breathe reflexively or unconsciously. Father of nation, Mahatma Gandhi considered education to be “an all-round drawing out of the best in the child and man—body, mind and spirit” (Gandhi, 2015). Ancient Indian practices have been oriented towards the wholesome development of one's mind and body. The physical and mental health in modern life is basically governed by the various stresses and life situations in which we are compelled to live, we cannot run away from it. Broadly speaking these would be the age and sex of the individual, social and political group of individuals, economic status of a specific person, religion background and ideas determining the attitude and motivations of the individual, cultural settings and for social background and last but not the least personal biases and prejudices. The *pranayama* perseveres in towards stressors of body and mind. The medical researchers conducted on these tools, natural remarkable psychophysical and biological changes in this body occurring during its practices (Sivananda, 1999).

According to the Gita: *Apāne juhvati prāṇam prāṇapāṇam tathāpare; Prāṇapāṇagatē ruddhva prāṇayamāparāyaṇaḥ* (Gita, Ch. IV-29.). Others offer Prana (outgoing breath) in Apana (incoming breath) and Apana in Prana, restraining the passage of Prana and Apana, absorbed in Pranayama. Pranayama is a precious Yajna (sacrifice) of generating good quality of Prana inside the body. In some practice the kind of Pranayama called Puraka (filling in), while in some practice the kind of Pranayama called Rechaka (emptying). Further, in some are engaged in the practice of Pranayama called Kumbhaka, by impeding the outward passage of air, through the nostrils and the mouth, and by impeding the inward passage of the air, in the opposite direction.

“uddhameti yad sarvaṃ na d chakram mal kulam
Tadaiva j yate yog pr nasamghrahaṇe kshamaḥ”

When the whole system of nāḍīs which is full of impurities, is cleaned, then the Yogî becomes able to control the Prāṇa (Swami, 1987).

According to Sri Sankaracharya: “Pranayama is the control of all life-forces by realizing naught but Brahman in all things as the mind, etc. “The negation of the Universe is the outgoing breath. The thought: ‘I am Brahman’ it is called the incoming breath. The permanence of that thought thereafter is the restrained breath. This is the Pranayama of the wise, while the pressing of the nose is only for the unknowing. According to Sh. Yogananda yoga suggests an integral approach to man with “Chittha” as the basic factor and treats man as a body-mind complex. But one should be very careful in practicing yoga. It must be practiced under trained and experienced instructor with proper guidance.

Health: It is a condition or quality of human organs expressing the adequate. Physical Health- It conceptualizes healthy biologically as a state in which every cells and every organ is functioning at optimum capacity and in perfect harmony with the rest of the body.

Mental Health: Mental health is not mere the absence of mental illness. Good mental health is the ability to respond to the many aried experience of life with flexibility and a sense of purpose. Mental health is a relatively enduring state wherein the Person is well adjusted, has a rest for living and is attaining self actualization or self realization. It is a positive state and not mere absence to mental disorder. "Mental health is the ability to get along with one self and with others and to be independent in most things but at the same time, to realize how dependent we are on others in our present day complicated society. A mentally healthy person can with stand, adversity, without becoming depressed and can rise up and try again. He is not self entered but is interested in other and helps others without expecting any reward (Sherry, 2010).

Types of Pranayama: Many types of Pranayama are used in yoga practice such as Chand Bhegana Pranayama, Nadisodhana Pranayama, Ujjayi Pranayama, Sheetali Pranayama, Sheetkari Pranayama, Bharmari Pranayama, Bhastrika Pranayama and Moorchha Pranayama (Saraswati, 2009).

Historical Background of Pranayama: Thousands of years ago, the yogis living in the shadow of the Himalayas fathomed the inherent quality of motion in creation and they called it prana. One may roughly translate the word prana as 'energy' or 'vital force', but neither definition offers a precise equivalent of the Sanskrit term that emerged from higher states of contemplation. The word prana assumes the quality of 'livingness'. From the yogic point of view, the entire cosmos is alive, throbbing with prana. Prana is ever present in every aspect of creation. The prana within every created object gives existence and material form, whether it is a planet, an asteroid, a blade of grass or a tree. If there were no prana, there would be no existence. If prana were withdrawn from the universe, there would be total disintegration. All beings, whether living or non-living, exist due to prana. Every manifestation in creation forms part of a never-ending matrix of energy particles, arranged in different densities, combinations and variations. The universal principle of prana may be in a static or dynamic state, but it is behind all existence on every plane of being from the highest to the lowest. Prana is the simplest as well as the most profound concept propounded by the seers. A stone worshipped sincerely may have a finer quality of prana than the force of a leopard in full flight. The tangible strength that enables the movement of one's hand is prana and the intangible force invoked through a complex fire ritual is also prana. The wind blows and rivers flow because of prana. Aircrafts, trains and cars move because of prana; laser beams and radio waves travel because of prana. Every object in creation is floating in the vast, all-encompassing sea of prana, and receiving everything they need to exist from it. It is said in the Kapanishad. This whole world - whatever there is - vibrates having originated from prana. This cosmic prana, also called mahaprana, came into being at the time of creation. Thus, in order to fully understand prana, one must go back to the beginning of creation. All yogic practices purify the pranas, but pranayama is considered the principal among these. In the Yoga Sutras Maharshi Patanjali states, "thence the covering of the light is destroyed", with reference to the effects of pranayama. This covering is the residue of Tamas and Rajas, and through pranayama the sattwic nature of the chitta shines forth. Tamas and Rajas exist in the form of blockages in the nadis. These blockages may be caused by disease, tension, accumulation of impurities, negative thoughts or samskaras, mental patterns lodged in the subcon-scious and unconscious. Just as the nadis are not physical but pranic entities, the blockages too are pranic and may be experienced, but not quantified. When all the pranas are balanced, the body and mind are in a state of optimized harmony. However, this is not usually the case. Due to overuse and misuse, the pranas of most people are in a state of imbalance. In the course of daily life, worry and stress use maximum prana, so that the pranic fields become exhausted and discharged. This in turn causes fatigue, depression, and inefficient digestion and circulation. As this vicious cycle continues, the body does not have the strength to walk, work or think, and the smallest disturbance causes nervousness and anxiety. In order to remedy this, the pranas need to be charged constantly, so their functioning is optimized and balance is maintained. This is the first objective of pranayama, which charges and replenishes the pranas through the practices. When the pranas are sufficiently charged, they are awakened (Singh & Chattopodhyaya, 2010).

Aim of Pranayama: Prana is the vital life force that acts as a catalyst in all our activities and Ayama the expansion or control of this force. Thus, Pranayama can be defining as the science of controlled,

conscious expansion of Prana in our energy body/sheath, the Pranayama kosha. Gurus of Vedic times placed great importance on Pranayama and advocated its practice in order to revive the hidden potential energy known as the Kundalini Shakti. Indian culture has always laid great emphasis on Prana and Pranayama and ancient texts say, “God is breath” as well as “Breath is life and life is breath”. Atarva Vedleven states, “Prana is the fundamental basis of whatever is, was and will be”. In the Prasno upanishad we can find the following statement. All the exists in this worlds is under the governance of Prana”. It is sad in the Shiva-Svarodaya, “The Prana (life force) verily is one’s greatest friend, companion and there is on grater kinsman that the life force.” In Yoga-Vashistha, it is written that when the energy of the life for (Prana) is restricted, then the mind dissolves, like a shadow of a thing when thing is absent. The word Pranayama is made of the combination of two words: Prana + Ayama (Pranayama). Prana may be called the energy inside everything in the universe. It literally means the air one takes while breathing. Breath is the external manifestation of Prana, the vital force. Ayama means to control. By exercising control over one’s breathing, one can control the subtle Prana inside. Control of Prana means control of Mind. Thus, Pranayama can be understood as a method by which vital energy can be stimulated and increased. The aim of Pranayama is Udghata or awakening of the dormant Kundalini. Pranayama intends to bring the spontaneous functions of the respiratory mechanism under human control. If one can assume control over one’s external breath, he or she can also be in command of the inner vital force is Prana. By pranayama one can remove the impurities of the body and the senses by blowing his lungs. Regulation of breathing is a natural process. This natural process of intake and outflow of the breath goes on involuntarily and human life depends on this spontaneous process. The difference between this natural process and the 'Pranayama' is that in the former the inhalation and exhalation is not necessarily connected with the mind. The inhalation and the exhalation are not of any set duration. For some people, the inhalation may take a longer time than the exhalation and vice verca. In Pranayama, however, there is a systematic regulation of both the inhalation and exhalation. Hence, the duration of inhalation and exhalation has to be controlled. The result of this controlled process has a more helpful impact on the body and mind⁷. Pranayama is the pause in the movement of inhalation and exhalation when that is secured. Inhalation and exhalation are methods of inducing retention. Retention is the key because it allows a longer period for the assimilation of prana, just as it allows more time for the exchange of oxygen and carbon dioxide in the cells. As the breath is also intimately connected with various functions and organs of the body as well as the mind, by controlling the breath we also influence all these dimensions. At the pranic level, in their initial stages the practices of pranayama clear up the nadis, energy pathways in the body. The scriptures say there are over 72,000 nadis or pathways of prana in the pranic body and six main chakras. However, in the average individual, many of these pathways are blocked and the chakras release energy only partially. In other words, we do not utilize our full potential in terms of energy, mind and consciousness. The negative conditions we experience, whether physical or mental, are the causes as well as the consequence of the blockages. The state of our nadis and chakras are defined by our samskaras, conditionings carried in seed form, as well as purushartha, self-effort and anugraha, grace. With the practice of pranayama, these pathways of energy are gradually freed so that prana moves through them smoothly. At higher levels of practice, the direction of the panics flows is influenced and a greater quantum of energy is released from the chakras. As these processes are activated, many new experiences unfold. Expert guidance is essential to steer the practitioner through these stages (Karambelkar, 2005).

Pranayama for Transformation: In the practice of pranayama, prana unites with apana and the united prana-apanas is directed upwards to the head. At this time, prana leaves the passages of ida and pingala and travels through the channel of sushumna. When prana passes through sushumna, the light of jnana is kindled and the kundalini is awakened. The mind enters a thoughtless region. All the karmic seeds of the yogi are burnt away. The oblation of the senses is offered into the fire of prana. As the practitioner undergoes this process, the sleeping centres of the brain are awakened. Usually the brain and the mind are trained through the perceptions available and intelligible to the senses. Yoga, however, has a completely different view of mind control. It says isolate the mind and consciousness from the pathways of sensory stimulation. The brain, mind and consciousness can function independent of the senses. By isolating the brain and mind, the consciousness enters a more powerful state of understanding and realization, and this is the beginning of yoga. The practice of pranayama has a direct effect on the functioning of the intricate, sophisticated functions of the brain. When the

yogis investigated the possibility of an independent method to develop the silent areas of the mind and brain in order to transcend the limiting barriers of the human personality, they discovered pranayama (Saraswati, 1999).

Units of Pranayama: In a systematic practice of pranayama, the first criterion is a balanced ratio of the breath. Timing has a deep effect on the mind and prana. "If one is able to practise five rounds of nadi shodhana with absolute precision in timing, then the laya state of samadhi will come," Swami Satyananda said while explaining the science of pranayama to yoga teachers in Spain during 1979. The ancient yogis who propounded the practices of pranayama were extremely mindful of this fact, and devised various methods to measure the units of pranayama, in the absence of devices such as clocks. Each time unit was called a matra. The following physical actions provide a guideline for understanding the notion of matra. Each denotes one matra (Karel, 1977):

- Twinkling of an eye
- Time taken to pronounce a short vowel
- Time necessary for touching one's knee thrice followed by a clap
- Time occupied by one normal respiration

Bhramari Pranayama: Bhramari word has originated from Sanskrit word 'bhramar' which means humming bee. The name suggests in this method of pranayama, humming sound is created so is the name. The most conspicuous effect is that it relaxes the brain if done regularly. It can have positive effect on stress, fatigue and high blood pressure. The cerebral cortex sends impulses directly to the hypothalamus which controls the "pituitary" gland the master of all glands. The resonance of the brains metaphysical thinking is taken out and this enhances capacity of brain. It consists of three parts: Pooraka, Kumbhaka and rechaka.

Pooraka: Take breath from both nostrils and start inhaling.

Kumbhaka: when the pooraka is completed both the nostrils are closed with pranav mudra. In this situation all the three bands are fixed and kumbhaka is performed. There is no sound in kumbhaka.

Rechaka: Start exhaling while making bee like humming sound. While exhaling, practitioner concentrates the mind on the breathing and sound of breath. First do pooraka and then do Rechaka. The sound created during this will seem hoarse but with gradual practice it becomes like humming bee after some time. This breath is but instead of a hissing sound is accompanied by a humming sound, like a bee makes (bhramari). The classic texts describe the sound of the bee in detail: The sound on inhalation resembles a female bee and on exhalation a male bee. This form of pranayama has been reported to be beneficial in the treatment of insomnia. A cooling breath, bhramari increases prana, pacifies pitta, and may aggravate vata and kapha. The cooling action of the pranayama prevents a rapid rise in tejas. While pranayama can be practiced in many postures, siddhasana is the most highly regarded. Still, any posture that keeps the spine erect is considered adequate for practice. While different ratios of inhalation to exhalation and retention have been mentioned, it is often recommended to begin simply by equalizing the lengths of inhalation, exhalation, and retention. This is called sama-vritti pranayama. A person may first have to keep retention following inhalation to a lesser amount, slowly building up over time until it is equal to inhalation and exhalation. Retaining the breath after exhalation, or bahya-kumbhaka, is not recommended for beginners. Once the student is competent in sama-vritti pranayama, bahya-kumbhaka can be added beginning with a lesser amount of time and working up to an amount equal to the other phases. Another way to practice pranayama is with ratios that are not equal. Called vishama-vritti pranayama, the standard approach is to work toward a ratio of 1:4:2:1, that is, inhalation, inner retention, exhalation, and outer retention respectively (Wilber Ken, 2001). By doing Bhramari pranayama one can cure ailments like: Ears, Nose, Throat, Eyes, Nervous system

In the Yoga Sutras Maharshi Patanjali says: Pranayama is the pause in the movement of inhalation and exhalation when that is secured. Yoga Yajnavalkya Samhita also equates pranayama with retention, describing three grades of pranayama, depending on the periods of breath holding: i) adhamā pranayama (produces sweating), ii) madhyama pranayama (produces tremors in addition to sweat) and iii) uttama pranayama (produces levitation). Kumbhaka is difficult for a beginner, but it becomes easier, smoother and longer by systematic and regular practice. Breath retention may come more easily for those who have followed other yogic practices. The rare few, who are blessed with an awakened kundalini, may experience kevala kumbhaka (spontaneous retention) at their very first

attempt at pranayama. However, it is of paramount importance for all Just as the impurities of mountain minerals are burnt by the blower, so the stains caused by the sensory organs are burned by controlling the prana. The effect of prana nigraha is evidenced by a lightness and vitality in the body and a calm, relaxed mind, and then comes the strength and ability to practice pranayama (Pandey, 2015).

Pranayama Abhyasa: Sit in any comfortable posture *Sukhasanas* with erect spine with their eyes closed. At this position, they were asked to take slow and deep inhalation through both the nostrils followed by deep and slow exhalation in the same way 15 seconds approx. While exhaling, First inhale deeply one has to make a sound from the throat via the nose as if there is a humming of a black bee in performing this pranayama. Then simulate the sound of humming through the neck. Keep the continuation of humming as long as it is possible depending on the capacity of containing the breath. Do not continue making an un.....un.....un.....un.....sound unnecessarily, if the breath gets exhausted. Keep the sound neither too high nor too low depending on the sound produced in vocal cord and bring the sound out through the nose. At the time of bhrumari pranayama the speed of blood circulation increases. The practice of bhrumari pranayama is helpful in the pain connected with all the joints. It is definitely possible to control diabetes by triple action of proper medical advice, proper diet and necessary exercises. But all these three occupy their special importance. So far as the pranayama abhyasa is concerned if one practice all the pranayama that one knows, it is helpful to a control the insulin and maintain the glucose level to a certain extent. Even then it is essential that one should start practice of pranayama under direct supervision of a yoga teacher who has medical knowledge as well as knowledge of science of yoga. Gradually and in proper order one should practice bhrumari pranayama have good effects on internal secretory glands. A habit of daily drinking water in the morning can have long lasting effects morning water should be taken on empty stomach. Water need not be too cold or too hot. Drinking four or more glasses of potable water and then performing bhrumari pranayama for four or six repetitions will render blood purified. One who practices Pranayama will have good appetite, exuberance, handsome figure, good strength, courage, and enthusiasm, a high standard of health, vigor and vitality and good concentration of mind. One can take in a certain amount of energy or Prana from the atmospheric air along with each breath. Vital capacity is the capacity shown by the largest quantity of air a man can inhale after the deepest possible exhalation. Pranayama leads to better functioning of lungs, heart, diaphragm, abdomen, intestines, kidneys and pancreas. Pranayama practice provides freedom from negative and harmful mental conditions like anger, depression, lasciviousness, greed for money, arrogance etc (Swami & Jha, 1980).

Benefits of Bhrumari Pranayama: Bhrumari pranayama are very helpful in decreasing the stress level for person and in turn providing them with mental health. My study is carried keeping all those things in mind, that how our brothers can be benefited from it. How this particular package can help us to reduce our stress level and thus to increase our vitality, immunity so to revitalize and rejuvenate ourselves to fight against the external antigens as well as internal antigens of selves. Today, in our world, we need two items to make our lives a complete success. The first item which we lack is “vitality”, which is not physical strength, but inner strength, will power, clarity of mind and the ability to perform every action, with perfection. The second item we lack is Tranquility. A healthy person is not only a boon to himself, but also to his nation and world at large. But now a day’s life is becoming so fast & hectic that every person faces annoying situation in their home, work place & academic life. During pranayama one does not absorb a larger quantity of oxygen. In fact, the amount of oxygen absorbed during a round of pranayama is less than the amount absorbed during normal respiration. The average person inhales about 7,000 cc of air in one minute during normal inspiration; during pranayama, one inhales about 3,700 cc in one minute. The total intake of air being smaller in pranayama, the absorption of oxygen is also smaller. However, the practices allow more time for oxygen to mix with the blood flow and for the system to eliminate waste through the breath and blood. The training given to the respiratory organs and muscles during the pranayama practice prepares them to work efficiently all through the day. Similar benefits are received by the organs of digestion, absorption and elimination. The stomach, pancreas, liver, bowels and kidneys are all exercised in pranayama through the massage given to them by the diaphragm and the abdominal muscles. This happens in normal respiration as well, but during pranayama the movement of the muscles and the resulting massage is greatly accentuated. All the associated muscles and nerves are

toned up and rendered healthier. Constipation is removed and all the organs function better. Absorption also becomes more efficient with a well-functioning digestive and eliminatory system so that the blood is enriched with nutritive elements (Karpal & Shankar, 2005).

The brain, spinal cord, cranial and spinal nerves benefit from a richer and more liberal blood supply received through pranayama. In addition, the actions of the diaphragm and the abdominal muscles during extended inhalation pull up the lower part of the spinal column. The pulling up of the vertebral column as whole tones the roots of the spinal nerves and gives a strong peripheral stimulus to the whole nervous system. If pranayama is combined with all the three bandhas, the high intra-thoracic, intra-pulmonary and intra-abdominal pressures gives peripheral stimulus to the different nerve plexuses situated in the abdomen and thorax. Respiration also controls fluctuating moods, which are subtle behaviors of the mind. The neurotics' memory of the brain influences the projection of moods. However, the neurons fire more rhythmically and the electrical interactions between the different brain centres become more regulated when one breathes slowly and deeply in a systematic and coordinated manner (Gore, 2007).

Health benefits from regular pranayama that should be emphasized and reinforced by every mental health professional to their patients include the following.

- Improved sleep
- Relief from stress
- Improvement in mood
- Increased energy and stamina
- Reduced tiredness that can increase mental alertness
- Reduced cholesterol and improved cardiovascular fitness
- Increased blood circulation to the vital organs.

Mental health service providers can thus provide effective, evidence-based pranayama interventions for individuals suffering from serious mental illness. Further studies should be done to understand the impact of combining such interventions with traditional mental health treatment including psychopharmacology and psychotherapy. Pranayama practices in school can train the youth in achieving a sound bodily and mental health together. Pranayama can make a man sound both physically and mentally in their career (Dennis Taylor, 1989).

Conclusion: *Bhramari pranayama* is practice improves the cardiovascular parameters through parasympathetic dominance in adolescents and it can be practiced routinely for the reduction of stress induced cardiovascular risk in their future. In today's modern industrial societies most of the children and adolescents are not having proper physical activity and this lead to an increased risk of cardiovascular and other lifestyle-related diseases later in their adulthood yoga is currently being accepted as a part of academic curriculum in some school programs and is gaining more awareness not only in teachers but also among the parents. Obesity among the adolescents is increasing because of their sedentary nature, yoga remains as the only ideal option and alternative form of physical therapy that is beneficial both for their body and mind. It has strong effects on physiological system in improving the physical fitness along with their performance by enhancing the cognitive function. *Pranayama* are not only performed as preventive tools for the prevention of ailment to all but can also be performed for curative reasons. By gently massaging the internal organs and toning the nerves throughout the body, many diseases, even the co-called "incurable" can be eliminated or eased. It has a deeper significance and value in the development of the physical and mental personality. Pranayama has been practical form thousands of years for keeping human body free from diseases. Pranayama in fact is a scientific system of physio-therapy. Many incurable and long standing diseases can be cured through pranayama. All occupational groups of all ages can perform it. Everybody can practice it with economy of time, space, as well as money.

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APPLICATION OF BIOTECHNOLOGICAL TOOLS IN MEDICINAL PLANTS

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Medicinal plants contain properties or compounds that can be used for therapeutic purposes or those that synthesize metabolites to produce useful drugs. Medicinal plants constitute an important component of flora and are widely distributed in India. The pharmacological evaluation of substances from plants is an established method for the identification of lead compounds which can lead to the development of novel and safe medicinal agents. Plants have been an important source of medicine for thousands of years. Even today, the World Health Organization estimates that up to 80 per cent of people still rely mainly on traditional remedies such as herbs for their medicines. Plants are also the source of many modern medicines. It is estimated that approximately one quarter of prescribed drugs contain plant extracts or active ingredients obtained from or modeled on plant substances. The most popular analgesic, aspirin, was originally derived from species of *Salix* and *Spiraea* and some of the most valuable anti-cancer agents such as paclitaxel and vinblastine are derived solely from plant sources (Katzung *et al.*, 1995 and Roberts, 1988).

The biotechnological tools are important to select, multiply and conserve the critical genotypes of medicinal plants. In-vitro regeneration holds tremendous potential for the production of high-quality plant-based medicine. Cryopreservation is a long-term conservation method in liquid nitrogen and provides an opportunity for conservation of endangered medicinal plants. In-vitro production of secondary metabolites in plant cell suspension cultures has been reported from various medicinal plants. Bioreactors are the key step towards commercial production of secondary metabolites by plant biotechnology. Genetic transformation may be a powerful tool for enhancing the productivity of novel secondary metabolites; especially by *Agrobacterium rhizogenes* induced hairy roots. The achievements and advances in the application of tissue culture and genetic engineering for the *in-vitro* regeneration of medicinal plants from various explants and enhanced production of secondary metabolites.

Biotechnological Tools: Biotechnological tools are important for multiplication and genetic enhancement of the medicinal plants by adopting techniques such as: 1. Tissue culture (In-vitro regeneration), 2. Genetic transformations.

Tissue Culture (In-vitro Regeneration): Tissue culture is the culture and maintenance of plant cells, tissues or organs (explants) in sterile, nutritionally (synthetic media) and environmentally (controlled) supportive conditions (*in vitro*).

Basic Requirements

- Aseptic Conditions
- Control of Temperature
- Proper culture medium
- Sub-culturing

Plant Cells are Totipotent: ability of a cell or tissue or organ to grow and develop into a fully differentiated organism (Fig 1).

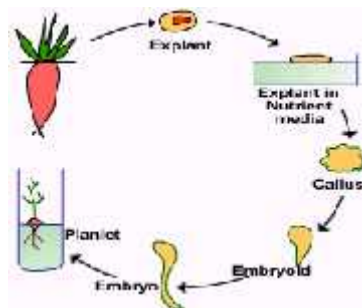


Fig 1. Diagrammatic representation of Totipotent cell in medicinal plants.

Genetic Transformations: Genetic transformation would be a powerful tool for enhancing the productivity of novel secondary metabolites of limited yield. There are two types of genetic transformation

Indirect/Vector Mediate Gene Transformation

Agrobacterium mediated

Direct Gene Transformation

Microinjection

Electroporation

Particle gun method

Role of Biotechnological Tools in Medicinal Plants

- Micropropagation
- Callus-mediated organogenesis
- Regeneration through somatic embryogenesis
- Cryopreservation
- Secondary metabolites
- Transformation

Micropropagation

- It is useful in rapid and mass multiplication of plant materials which are difficult to propagate sexually and rate of multiplication is slow (Table 1).
- It can yield faster than the conventional methods of breeding.
- production of pathogen-free material

Table 1. Micropropagation in medicinal plants

<i>Plants</i>	<i>Explant used</i>	<i>Medicinal value</i>	<i>Response Observed</i>	<i>Reported by</i>
<i>Santalum album</i>	Nodes	Essential oil	Plantlets	Laxmi, Sita (1986)
<i>Datura innoxia</i>	Anther	Anticholinergic	Plantlets	Shrivastava <i>et al</i> (1993)
<i>Delonix regia</i>	Leaves	Agglutination	Plantlets	Gupta <i>et al</i> (1996)
<i>Artemisia annua</i>	Nodes	Antimalarial	Plantlets	Gulati <i>et al</i> (1996)
<i>Catharanthus roseus</i>	Stem	Antileukaemia	Plantlets	Dutta and Shrivastava (1997)

Callus-mediated Organogenesis

- Satheesh and Bhavanandan (1988) have reported the regeneration of shoots from callus of *Plumbago rosea* using appropriate concentrations of auxins and cytokinins.
- Plant regeneration has been achieved from leaf callus of *Cephaelis ipecacuanha* on *Murashige and Skoog* medium supplemented with 4.5 mg/L kinetin and 0.1 mg/L α -Naphthaleneacetic acid (NAA).

Regeneration through Somatic Embryogenesis

- Plant regeneration via somatic embryogenesis from single cells, that can be induced to produce an embryo and then a complete plant, has been demonstrated in many medicinal plant species.
- Ghosh and Sen (1994) reported regeneration and somatic embryogenesis in *Asparagus cooperi* on MS medium.

Cryopreservation

- It is an important application of tissue culture.
- The cell and tissue can be preserved in liquid nitrogen (-196°C) for long term.
- For example, low temperature storage has been reported to be effective for cell cultures of medicinal and alkaloid producing plants such as *Rauvolfia serpentina*, *D. lanalta* and *A. belladonna*.

Secondary Metabolites

- The production of secondary metabolites in plant cell suspension cultures has been reported from various medicinal plants.
- The production of solasodine from calli of *Solanum eleagnifolium*, and pyrrolizidine alkaloids from root cultures of *Senecio* sp. are examples.

Transformation: The recent advances and developments in plant genetics and recombinant DNA technology have helped to improve and boost research into secondary metabolite biosynthesis. A major line of research has been to identify enzymes of a metabolic pathway and then manipulate these enzymes to provide better control of that pathway. Transformation is currently used for genetic manipulation of more than 120 species of at least 35 families, including the major economic crops,

vegetables, ornamental, medicinal, fruit, tree and pasture plants, using *Agrobacterium*-mediated or direct transformation methods (Birch, 1997).

- Shi and Kintzios (2003) have reported the genetic transformation of *Pueraria phaseoloides* with *Agrobacterium rhizogenes* and puerarin production in hairy roots.

Conclusion

- Tissue culture is useful for multiplying and conserving the species, which are difficult to regenerate by conventional methods and save them from extinction.
- Genetic transformation may provide increased and efficient system for in-vitro production of secondary metabolites. The improved in-vitro plant cell culture systems have potential for commercial exploitation of secondary metabolites.

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MULTIDIMENSIONAL THERAPEUTIC EFFECTS OF HARIDRA (*Curcuma longa*)

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Haridra consists of the dried and cured rhizome of the *Curcuma longa* (Family: Zingiberaceae). It is a perennial herb extensively cultivated in all the states of the India. Crop is harvested after 9-10 months when lower leaves turn yellow rhizomes are dug up carefully with handpicks between October-April and cured by boiling and drying. Rhizomes ovate, oblong or pyriform, often short branched, 2-5cm long and about 1-1.8 cm thick, externally yellowish to yellow-brown with root scars and annulations of leaf bases; fractured surface is orange to reddish brown; central cylinder twice as broad as cortex; odour and taste characteristic. Transverse section of rhizome shows epidermis with thick-walled cubical cells of various dimensions. The cortex characterized by the presence of mostly thin-walled rounded parenchyma cells with scattered collateral vascular bundles and a few layer of cork developed under epidermis and scattered oleoresin cells with brownish contents. The cork generally composed of 4-6 layers of thin-walled birch shaped parenchyma cells of the ground tissue, which contain starch grains of 4-15 micron in diameter and oil cells with suberised walls containing either orange-yellow globules of volatile oil or amorphous resinous matter. Rhizome contains essential oil, colouring matter curcumin beta-turmenone, demethoxy curcumin, bis- demethoxy curcumin, dihydrocurcumin, and neutral polysaccharides are chief component. Other chemicals present in rhizome are borneol, Camphor, camphene, Procurcumadiol and procurcumenol (The Ayurvedic pharmacopeia of India, 2001).

According to its morphology and therapeutic application Acarya Bhavmishra have given following synonyms- Kancani, Pita, Nisha, Varavardini, Krimighni, Haladi, Yoshitpriya and Hattavilasini (Bhavprakash samhita 6/196).

Properties of Haridra are; Ras- Tikta & Katu, Guna- Ruksha, Virya- Usna, Vipaka- Katu and Karma are Kaphapittanut, Visaghna, Varnya, Kusthaghna, Krimighna, and Pramehanasaka (Bhavprakash samhita 6/196).

Therapeutic uses of Haridra in Ayurveda: Prameha is a disease having twenty types. Classification is based on color, odour, taste and specific gravity of urine discharged. Susruta coated that taste of urine in prameha is madhur rasa and when treatment

1. *Haridra* is best drug for treatment of *Prameha*. (Prof.K.R. Srikantha Murthy 2009 of A.Sa.Su. 30/22)
2. Powder or juice with *Amalaki* is highly useful in diabetes mellitus. (Prof.K.R. Srikantha Murthy 2010 of SS.Ci.11/8)
3. Externally, powder is antibiotic, heals up the ulcers, and acts as a fungicidal agent.
4. It is used as an anti-inflammatory agent.
5. Powder is inhaled in Asthma.

The action of Haridra is due to active principle Curcumin present in it. A majority of researches are going on to find out the function of curcumin on different organ system of body, some of them have proved that it is a potent drug producing many therapeutic and biological action on body when administered. These are following-

Anti-inflammatory Activity: There is a great number of papers in the literature relating the activity of compounds extracted from *C. longa* L. being potent inhibitors of inflammation. These substances can be classified as curcuminoids analogues of diarylheptanoids. There are two models of inflammation to be studied: chronic models (cotton pellet and granuloma pouch), where the inflammation and granulomas develop during a period of time (several days), indicating the proliferative phase of inflammation; and acute models, where acute effects of anti-inflammatory agents can be studied, testing their inhibitory action on the development of rat paw edema.

Demonstrated the activity of curcumin and other semi-synthetic analogues (sodium curcumin, diacetyl curcumin, triethyl curcumin and tetrahydro curcumin) in carrageenin- induced

rat paw edema and cotton pellet granuloma models of inflammation in rats (Mukopadhyay et al. 1982).

Antioxidant Activity: Studied the antioxidative properties of curcumin and its three derivatives (demethoxy curcumin, bisdemethoxy curcumin and diacetyl curcumin) (Unnikrishnan and Rao, 1995). The authors demonstrated that these substances provide a protection of hemoglobin from oxidation at a concentration as low as 0.08 mM, except the diacetyl curcumin which has little effect in the inhibition of nitrite induced oxidation of hemoglobin.

The effect of curcumin on lipid peroxidation has also been studied in various models by several authors. Curcumin is a good antioxidant and inhibits lipid peroxidation in rat liver microsomes, erythrocyte membranes and brain homogenates. The lipid peroxidation has a main role in the inflammation, in heart diseases, and in cancer. Turmeric can lower lipid peroxidation by maintaining the activities of antioxidant enzymes like superoxide dismutase, catalase and glutathione peroxidase at higher levels. These enzymes play an important role in the regulation of lipid peroxidation. Observed that curcumin is capable of scavenging oxygen free radicals such as superoxide anions and hydroxyl radicals, which are important to the initiation of lipid peroxidation (Pulla and Lokesh, 1992).

Anti-protozoal Activity: The first work to relate the activity of curcumin and some semi-synthetic derivatives in the literature against tripanosomatids was studied in promastigotes (extracellular) and amastigotes (intracellular) forms of *Leishmania amazonensis*. The authors showed that curcumin (a phenolic curcuminoid) in experiments in vitro has an excellent activity (LD50 = 24 μ M or 9 mg/ml) and the semi-synthetic derivative, methylcurcumin (a non-phenolic curcuminoid), has the best action with a LD50 < 5 μ g/ml and LD90 = 35 μ M against promastigotes forms. This derivative was tested in vivo in mice and showed a good activity with 65.5% of inhibition of the lesion size of the footpad of the animals, when compared with the group inoculated with the parasites alone (Cheng *et al.*, 2001).

Nematocidal Activity: Curcuma oil was studied on *Paramecium caudatum* in different concentrations, varying from 1 in 2,000 to 1 in 5,000. The ciliates became sluggish and ultimately died (Chopra et al. 1941). Demonstrated the activity of fractions (methanolic and chloroformic) of turmeric against *Toxocara canis* (Kiuchi *et al.*, 1993).

Antivenom Activity: Potent antivenom was tested against snakebite. The fraction consisting of ar-turmerone, isolated from *C. longa* L., neutralized both the hemorrhagic activity and lethal effect of venom in mice. In this study ar-turmerone was capable of abolishing the hemorrhagic activity of *Bothrops* venom and about 70% of the lethal effect of *Crotalus* venom. Ar-turmerone can act as an enzymatic inhibitor in the case of venom enzymes, with proteolytic and hemorrhagic activities (Ferreira *et al.*, 1992).

Clinical Studies of Curcumin

Curcumin has Anti-inflammatory and Antirheumatic Activity: In the first clinical trial of curcumin's efficacy as an antirheumatic, investigators compared its antirheumatic potential with that of phenylbutazone in a short-term, double-blind, crossover study involving 18 relatively young patients (age range, 22–48 years) (Deodhar, *et al.*, 1980). Each subject received a daily dose of either curcumin (1200 mg) or phenylbutazone (300 mg) for 2 weeks. At the dose used, curcumin was well tolerated, had no side effects, and exerted an antirheumatic activity comparable to that of phenylbutazone. Meanwhile, in a study of curcumin's anti-inflammatory properties, (Satoskar *et al.*, 1986) evaluated curcumin's effects on spermatic cord edema and tenderness in 46 men between 15 and 68 years old who had just undergone surgical repair of an inguinal hernia and/or hydrocele. After surgery, subjects were randomly assigned to receive curcumin (400 mg), phenylbutazone (100 mg), or placebo (250 mg lactose) three times a day on postoperative days 1–5. As in a previous study by Deodhar et al., curcumin was deemed quite safe and, along with phenylbutazone, elicited much better anti-inflammatory responses than placebo did.

Curcumin has Potential as Palliative Therapy for Cancerous Skin Lesions: External sebaceous neoplasms (e.g., actinic keratosis, superficial basal cell carcinoma, and external genital warts) have traditionally been treated topically with corticosteroid creams. In a study curcumin's efficacy when applied as either an ethanol extract of turmeric or as an ointment to external cancerous skin lesions was evaluated in 62 patients (Kuttan *et al.*, 1987). Regardless of the application, curcumin provided remarkable symptomatic relief that was in many cases relatively durable (lasting several months) and in all cases (except for a single adverse reaction in one subject) extremely safe. Its effects included

less itching in almost all cases, reduced lesion odor in 90%, dry lesions in 70%, and smaller lesion size and pain mitigation in 10%.

Curcumin Lowers Serum Cholesterol and Lipid Peroxide Levels in Healthy Individuals: While investigating the mechanisms of curcumin's chemopreventive effects, in another study, Kuttan and coworkers (Soni, Kuttan, 1992) monitored curcumin's effect on serum cholesterol and lipid peroxide levels in 10 healthy volunteers. Daily administration of curcumin (500 mg) for 7 days led to a significant 33% decrease in serum lipid peroxides, a 29% increase in serum HDL cholesterol, and a nearly 12% decrease in total serum cholesterol. Together, these striking findings suggest a potential chemopreventive role for curcumin in arterial diseases. In concordant with these findings are results of another study in which curcumin (10 mg) administered twice a day for 28 days lowered serum LDL and increased serum HDL levels in patients with atherosclerosis (Ramirez *et al.*, 2000).

Curcumin may Prevent Gallstone Formation: Curcumin has been evaluated for its ability to induce gall bladder emptying and thus reduce gallstone formation, a potential risk factor for gall bladder cancer. Agents that can induce the gall bladder to contract and empty itself (e.g., erythromycin, fatty meals, and amino acids) have been shown to reduce gallstone formation. In a randomized, double-blind, crossover study involving 12 healthy volunteers (Rasyid and Lelo, 1999), 20 mg curcumin produced a positive cholekinetic effect that led to 29% contraction of the gall bladder. A subsequent study indicated that doses of 40 and 80 mg curcumin produced 50% and 72% contraction of the gall bladder volume, respectively. Together, these results suggest that curcumin can effectively induce the gall bladder to empty and thereby reduce the risk of gallstone formation and ultimately gall bladder cancer.

Curcumin is Effective in Patients with Chronic Anterior Uveitis and Idiopathic Inflammatory Orbital Pseudotumors: Curcumin's anti-inflammatory effect has also been evaluated in two rare inflammatory diseases—chronic anterior uveitis (CAU) and idiopathic inflammatory orbital pseudotumors (IIOTs). In a study involving patients with CAU, curcumin was administered orally at a dose of 375 mg three times a day for 12 weeks (Lal *et al.*, 1999). Patients were segregated into two groups: 18 patients who received curcumin alone and 14 patients who, in addition to CAU, had a strong reaction to a PPD tuberculosis test and so received antitubercular treatment in addition to curcumin. Patients in both groups began showing improvement after 2 weeks of treatment, although those in the combination therapy group had a better response rate of 86%. Moreover, at 3 years of follow-up, the recurrence rate was much lower in the combination therapy group than in the group treated with curcumin only (36% versus 55%). Although approximately one in five patients in each treatment group lost their vision in the follow-up period because of various complications of the primary disease (e.g., vitritis, macular edema, central venous block, cataract formation, and glaucomatous optic nerve damage), none reported any side effects of the curcumin therapy. In fact, in terms of safety and efficacy, curcumin compared favorably with the only current standard treatment for CAU (i.e., corticosteroid therapy).

Curcumin Safely Exerts Chemopreventive Effects against Multiple Human Cancers: Apparently, curcumin can also safely exert chemopreventive effects on premalignant lesions. In a prospective phase I dose escalation study, (Cheng *et al.*, 2001) examined the safety, efficacy, and pharmacokinetics of curcumin in 25 patients with a variety of high-risk. Precancerous lesions (i.e., recently resected urinary bladder cancer ($n = 2$), arsenic Bowen's disease of the skin ($n = 6$), uterine cervical intraepithelial neoplasia [CIN] ($n = 4$), oral leukoplakia ($n = 7$), and intestinal metaplasia of the stomach ($n = 6$)). Curcumin was administered to the first three patients at a starting dose of 500 mg/day for 3 months and, if no grade 2 or higher toxicities were observed, was increased to 1000, 2000, 4000, 8000, and finally 12,000 mg/day. Curcumin was not toxic at doses of 8000 mg/day or lower, reaching peak serum concentrations at 1–2 h (0.51 ± 0.11 mM at 4000 mg, 0.63 ± 0.06 mM at 6000 mg, and 1.77 ± 1.87 mM at 8000 mg) and being gradually eliminated (principally through nonurinary routes) within 12 h. Although frank malignancies occurred despite curcumin treatment in one patient each with CIN and oral leukoplakia, a remarkable number of patients (i.e., one patient with recently resected bladder cancer, two with oral leukoplakia, one with intestinal metaplasia of the stomach, one with CIN, and two with Bowen's disease) showed histologic improvement of their precancerous lesions.

Curcumin Helps Reduce Symptoms of Irritable Bowel Syndrome: There is evidence that curcumin may help relieve symptoms of the extremely common gastric disorder known as irritable

bowel syndrome (IBS). This chronic condition is characterized by abdominal pain, alterations in bowel habits and stool frequency, and poor quality of life and appears to be causally associated with antibiotic use and inflammatory infection. In a partially blinded, randomized, pilot study in which 207 healthy adults were randomly assigned to receive either one or two tablets of standardized turmeric extract daily for 8 weeks, IBS symptoms improved significantly after treatment (Bundy *et al.*, 2004).

Curcumin Improves Early Renal Graft Function: Curcumin has also been shown to beneficially influence early kidney graft function, presumably due to its known ability to induce the activity of the antioxidant hemoxygenase-1. In a randomized, placebo-controlled trial, a combination of curcumin 480 mg and quercetin 20 mg was administered orally in capsule form to cadaveric kidney transplant recipients for 1 month, starting immediately after transplantation. The trial's 43 subjects were randomly assigned to placebo (control), lowdose (one capsule + one placebo), or high dose (two capsule) regimens. Graft function was assessed in terms of delayed graft function (i.e., the need for dialysis in the first week after transplantation) and slowed graft function (i.e., serum creatinine >2.5 mg/dL by post-transplantation day 10). The investigators consequently observed much better early graft function in treated patients than in controls (71% [lowdose] versus 93% [high-dose] versus 43% [controls]), no delayed graft function in any treated patients but delayed function in 14% (2/14) of controls, and significantly lower serum creatinine levels in treated patients after 2 and 30 days of treatment. They also noted significantly higher levels of urinary HO-1 in the two active treatment groups. Interestingly, however, when compared with both the low-dose and control regimens, only the high-dose regimen appeared to lower the incidence of acute graft rejection at 6 months post transplantation (0% versus 14.3%) and reduce the incidence of tremors (13% versus 46%).

Conclusion: Curcumin's diverse array of molecular targets affords it great potential as a therapeutic agent for a variety of inflammatory conditions and cancer types. Consequently, there is extensive interest in its therapeutic potential as evidenced by the number of ongoing phase II and III clinical trials. The primary obstacle to utilizing curcumin therapeutically has been its limited systemic bioavailability, but researchers are actively investigating a number of different curcumin compounds and analogs that may be more effective and better absorbed. Results from completed clinical trials are encouraging and trials currently being conducted for both inflammatory conditions and cancer should clarify curcumin's value as a therapeutic agent and confirm some of the mechanisms responsible for its efficacy.

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GROW ROSE ORGANICALLY WITH BIO-ENHANCERS

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Roses are known for their exquisite flowers, attractive colours and most delightful fragrance. Amongst different flower crops, roses come in priority list as being the top ranking cut flower in the world flower trade. It is the best symbol of beauty, love, innocence and other virtues, thus, it deserves to be acclaimed as 'Queen of Flowers'. Rose gives its name to the family Rosaceae. They were used as confetti at celebrations, for medicinal purposes and as a source of perfume. Roses are the flower of great importance and have many uses. As a loose flower, rose is commercially viable and popular crop among the growers all around the world. Roses are grown as shrub or bush to create excellent mass effect in a rose or flower garden. It plays an important role in vertical landscaping as climber and Rambler. Rose hedges remain full of life and colour and give protection due to the presence of thorns. Hardy miniature and pompon cultivars are being used in rockery. Miniature roses increase the beauty of house and garden as being grown in the pot and hanging baskets. Rose oil obtained from petals of the *Rosa damascena* and *R. Barboniana* has huge demand in perfumery industry throughout the world. In global oil extraction industry rose ranked first and rose oil is the most precious one. Rose water is also one of the most important products of rose and it has property to cooling the body, commonly used as an ingredient of medicines, perfumes, eye lotion, eye drops and confectionary. Rose petals are also preserved for direct consumption by making *gulkand* prepared by mixing equal parts of petals and white sugar. *Gulkand* is considered both as a tonic and laxative. Dried rose petals are called as *Pankhuri* used for sweetened cold drinks. *Gul-roghan* is used as hair oil prepared from rose petals with wet sesame seed. Rose fruits (hips) are the rich source of ascorbic acid. Besides, rose is used as an ingredient for preparation of pot-pourri, rose petal wine and rose jam after processing.

Globally more than 150 countries are involved in cultivation of flower crops. The global floriculture trade stands at US \$ 60 billion with an annual growth rate of 10-15%. The extensive use of pesticides especially in greenhouse grown crops is threatening workers health and safety, besides disturbing environment and may also affect consumer health. Gaston Dorren and Niala Maharaj, authors of 'The Game of the Rose' noted that floriculture consumes more pesticides than any other agriculture sector. Floral workers suffer the brunt of the trades' pesticides use. About 60% of the Colombian flower workers suffer from headaches, nausea, impaired vision, rashes and asthma (Pesticides Action Network, North America). A study published by 'Ministry of Social Affairs and Employment' the Netherlands reports that Dutch floral workers are exposed to pesticides concentration up to 60 times the amount considered safe. Dr. Marion Moses of the San Francisco based Pesticide Education Center says that many of the pesticides in use are highly toxic. According to 1997 Environment Working Group (EWG), California-grown roses have 1000 times the level of cancer causing pesticides as compared to food products. Consumers are buying roses that, toxicity level suggest, should be handled by workers wearing protective gear. Testing the leaves and petals of rose from California, New Hampshire, Colorado, Canada and Colombia EWG found two probable human carcinogens, three category I pesticides (the most hazardous) and three neurotoxins at up to 50 times the amount allowed in food. The Netherlands which is long famous as global 'Flower capital' has heavily contaminated water and air in its flower growing region. Organic production of flower crops has many benefits of the soil, human, society and environment welfare. Organic certification is the public's assurance that flowers have been grown and handled according to strict procedure without persistent chemical inputs. Organically grown flowers meet stringent standards that have better return potential. Organic floriculture is one way to prevent anymore of these chemicals from getting into the air, earth and

water that sustain us. It reduces health risks. The elimination of the polluting chemicals and nitrogen fertilizers, done in combination with soil conservation, protects and conserves water resources. Organic floriculture builds healthy soil. Organic floriculture respects the balance demanded of a healthy ecosystem. Growers may get 2-3 times more price of flowers and bouquets which are organically produced.

Indian knowledge systems have the answer to many problems of humanity. Our forefathers had propounded and practiced those systems directed towards attainment of a healthy body and sound mind. But humanity was lured by chemical technology and it abandoned the ancient wisdom generated during the past. The importance of organic manures in agriculture is known since ancient times and they find mention in ancient Hindu religious scriptures (*Rig Veda* 1,161, 10,2500-1500 BC, *Atharva Veda* II 8.3). The Holy *Quran* mentions that at least one third of what you take out from the soil must be returned to it. *Vrikshayurveda* is a treasure trove of information on agriculture and as such could lend support to organic agriculture. In organic production systems, there is always challenge of how to improve soil fertility, crop productivity, management of pests by organic techniques. Use of organic liquid preparations has been an age old practice in India. On farm produced *Kunapajala*, prepared by fermenting animal flesh along with herbal products used to be an established technique in ancient India. As alternative, number of organic farmers devised organic boosters as their own techniques based on local experiences and given specific names such as *Amritpani*, *Panchagavya*, *Bijamrita*, *Jiwamrita*, etc. Similarly in other organic farming systems, few effective preparations such as BD-500, BD-501, Cow Pat Pit, BD-liquid manures and in Homa Organic Farming *Agnihotra* ash enriched water and Biosol are effective tools being used by number of organizations. It is interesting to note that in all these preparations, the basic ingredients are cow based products. In order to give generic name, henceforth, these are named as “Bio-enhancers”. Review of available literature with bio-enhancer indicates that there is immense scope for its promotion in agriculture. Bio-enhancers are organic preparations, obtained by active fermentation of animal & plant residues over specific duration. These are rich source of microbial consortia, macro and micronutrients and plant growth promoting substances including immunity enhancers. In general, these are utilized to treat seeds/seedlings, enhance decomposition of organic materials thereby enrich soil and induce better plant vigour.

Panchgavya has been one such piece of wisdom, meant to safeguard all the human beings, animals, plants and microorganisms that dwell on the earth's surface. It is a special bio-enhancer prepared from five products obtained from cow i.e. dung, urine, milk, curd and ghee. When these are properly mixed, incubated for recommended period and ready fermented solution has miraculous effect on crops. Preparation is rich in nutrients, auxins, gibberellins, and microbial fauna and acts as tonic to enrich soil, induce plant vigour with quality production. Its positive effect on growth and productivity of crops has been reviewed and documented by many workers. Due to presence of macro (N, P, K and Ca) and micro (Zn, Fe, Cu and Mn) nutrients and bio-agents such as *Azospirillum*, *Azotobacter*, *Phosphobacteria* and *Pseudomonas*, growth promoting enzymes along with essential plant nutrients *Panchgavya* is now gaining attention as an efficient organic growth promoter. Presence of aerobic heterotrophic bacteria, lactic acid bacteria, yeast, fungi and anaerobic bacteria. In a study, highest microbial load was recorded in 7 days old preparation has been observed. Though, a gradual reduction in the microbial load was observed up to 50 days and population reduced significantly after 30 days. The preparation is rich in nutrients, auxins, gibberellins and microbial fauna and acts as tonic to enrich the soil to induce plant vigour with quality production.

Jivamrita is also pronounced as *Jiwamrita*, *jivamruta*, *Jeevamrutha*, etc. in India. The meaning of *Jivamrita* is the ‘Nectar of life’. *Jivamrita* popularized by Shri Subhash Palekar, is considered to be a panacea for the prosperity of small farmers. It is important to provide a congenial environment to microorganisms that help in making available the essential nutrients for plant growth viz., nitrogen, phosphorus and potassium to the plants. *Jivamrita* provides an

environment to beneficial microbes. Application of *Jivamrita* to soil improves the soil considerably. It also encourages microbial activity in the soil. It can be used at 15 to 30 days interval through irrigation water coupled with mulching (green/dry {monocot + di-cot}) and proper soil aeration. *Jivamrita* is a rich bio-formulation containing consortia of beneficial microbes. This formulation is used within 3-7 days of preparation.

Vermiwash is a liquid leachate obtained by excess water to saturate the vermi composting substrate. It is collection of excretory products and mucus recreations of earthworm along with nutrients from the soil organic molecules. In fact, vermiwash is an enriched bio-enhancer prepared from the heavy population of earthworms reared in earthen pots/plastic or cement containers. It contains hormones (gibberellins and cytokinins) secreted by the earthworms. Vermiwash microflora contains *Azotobacter*, *Agrobacterium*, and *Rhizobium* and phosphate solubilizing microbes. Eco Science Research Foundation, observed in 2006, that presence of these microbes makes available inorganic nitrogen, amino acids and inorganic phosphate to plants through ammonification and nitrification process. Besides these, vermiwash also contains total heterotrophs i.e; *Nitrosomonas* 10.1×10^3 , *Nitrobacter* 1.12×10^3 and total fungi, 1.46×10^3 . Protease in soils helps in seed germination, while amylases help in availability of simple carbon source for enhancement of plant vigour and productivity as well. Soil born microflora is essential for growth of plants because organic nitrogenous compounds and phosphorus are decomposed and mineralized by fixing and phosphate solubilizing bacteria. Presence of large number of beneficial microorganisms protects from a number of pathogen in the field. Repeated spray of vermiwash has been found effective even in management of thrips and mites in chilies. If needed, vermiwash may be mixed with cow urine (1:1:8 ratio, vermiwash, cow urine and water) and used as foliar spray for nutrients and pesticidal properties. Vermiwash can be used for better growth, yield and quality production.

The commercial cultivation of rose plants requires intensive care and management. In many places, the conventional methods of cultivation are being followed. Under conventional cultivation practices, rose plants are grown with chemical farming system. The excessive use of chemical fertilizers, herbicides, pesticides and fungicides leads to the destruction of all beneficial soil micro organisms, frequent change in soil pH, contaminates the air and water, kills the beneficial insect and other members of the natural ecosystem and pesticide residue in our foods cause cancer and other health problems. The Horticulture Research Station, Ooty, Bangalore has developed a suitable organic farming system approach for sustainable production of flower crops. It includes application of cattle manure, green manure, foliar spraying with biodynamic /biostimulants like *Panchgavya*, *Dasgavya*, *Agni-hotra*, manchurian mushroom tea, vermicompost, vermiwash, *Pranic Healing*, biofertilizers, biocontrol agents and biodynamic compost. Use of biofertilizers and biostimulants as a source of nutrients along with or without inorganic fertilizers seems to have great possibility in avoiding or substituting the use of chemical fertilizers. Biofertilizers are bio-inoculants or preparations containing microorganisms that supply nutrient to the plants from the sources which these plants cannot tap themselves.

In commercial cultivation of rose plants, the conventional chemical farming system leads to the problem of deterioration of quality also. But these problems can be nullified through the organic cultivation methods. The WTO agreement also pushes the growers to cultivate the cut flowers by organic farming to improve their income. In addition, the organically grown cut flowers can get the premium price of even up to 3 times more than the normal price. Hence, there is an urgent need for development of organic modules and promoting organic cultivation technologies of cut flowers. Bio-enhancer is the answer for this kind of problems.

A combination of these bio-enhancer viz. *Panchgavya*, *Jivamrita* and vermiwash was used in various concentration to observed growth flowering, yield and vase life of a promising thorn-less variety of rose Grand Gala. *Panchgavya*, *Jivamrita* and vermiwash consisting of three levels of each treatment were used and replicated thrice. *Panchgavya* at 0% (P_0), 3% (P_1) and 6% (P_2) and *Jivamrita* at 0% (J_0), 20% (J_1) and 30% (J_2) were drenched while vermiwash was sprayed

on the plants at 0 (V_0), 1:5 (V_1) and 1:10 (V_2) times dilution with a total of 27 treatment combinations. Results revealed that treatment 6% *Panchgavya* + 1:5 times dilution of vermiwash + 30% *Jivamrita* was found most superior than other treatments and resulted in higher plant height, larger leaf area, longer leaf length, higher number of leaves per plant, leaf colour, maximum chlorophyll content (a, b and total) and number of shoots per plant. This treatment also showed improved flowering traits like days to first bud initiation, flower bud length, number of flowers/plant, flower diameter, number of petals/flower and weight of petal, days to flowering, flower yield/m², flower stem length, flower stem thickness, duration of flowering (days), days taken for withering and insect-pest, disease attack intensity than rest of the treatments. The significant differences were obtained in post-harvest traits including initial diameter of bud at harvesting stage, final diameter of flower in vase, initial weight of bud at harvesting stage, final weight of flower in vase, volume of water absorbed by per stem, days taken to obtain full size of flower and vase life of flowers in the combined applied bio-enhancer i. e. 6% *Panchgavya* + 1:5 times dilution of vermiwash + 30% *Jivamrita* treatment.

Treatment	Plant height (cm)	Number of leaves per plant	Number of shoots per plant	number of flowers per plant	flower bud length (cm)	flower yield /m ²	vase life (days)
T ₁ P ₀ V ₀ J ₀	72.50	31.21	1.89	1.80	3.12	15.20	6.56
T ₂ P ₀ V ₀ J ₁	75.30	34.21	2.45	2.40	3.21	12.50	7.85
T ₃ P ₀ V ₀ J ₂	77.13	34.66	2.16	2.10	3.25	11.32	7.58
T ₄ P ₀ V ₁ J ₀	78.12	33.52	2.22	2.20	3.32	12.52	7.86
T ₅ P ₀ V ₁ J ₁	78.89	35.15	2.34	2.30	3.58	13.12	8.15
T ₆ P ₀ V ₁ J ₂	83.12	35.56	2.24	2.20	3.86	13.42	8.21
T ₇ P ₀ V ₂ J ₀	78.56	35.25	2.12	2.00	3.33	12.35	7.23
T ₈ P ₀ V ₂ J ₁	76.14	36.43	2.36	2.40	3.54	13.02	7.56
T ₉ P ₀ V ₂ J ₂	75.45	38.24	2.48	2.40	3.55	13.34	7.85
T ₁₀ P ₁ V ₀ J ₀	78.45	34.25	2.50	2.40	4.20	13.52	8.20
T ₁₁ P ₁ V ₀ J ₁	79.54	38.56	2.56	2.50	4.20	13.65	8.30
T ₁₂ P ₁ V ₀ J ₂	80.24	40.25	3.12	2.50	4.30	13.81	8.75
T ₁₃ P ₁ V ₁ J ₀	81.76	40.41	2.82	2.70	4.31	14.15	8.56
T ₁₄ P ₁ V ₁ J ₁	82.42	40.55	2.83	2.90	4.32	14.28	9.20
T ₁₅ P ₁ V ₁ J ₂	81.47	40.85	3.10	2.90	4.62	14.43	9.30
T ₁₆ P ₁ V ₂ J ₀	77.50	41.12	3.10	2.80	4.52	14.21	9.00
T ₁₇ P ₁ V ₂ J ₁	85.65	40.14	3.00	3.10	4.65	14.12	8.60
T ₁₈ P ₁ V ₂ J ₂	81.12	40.28	2.84	3.50	4.46	14.34	8.80
T ₁₉ P ₂ V ₀ J ₀	84.30	40.86	3.14	3.10	4.62	14.85	8.80
T ₂₀ P ₂ V ₀ J ₁	87.27	42.12	3.24	3.20	4.85	14.86	9.00
T ₂₁ P ₂ V ₀ J ₂	86.14	43.22	3.32	3.30	4.52	15.02	8.90
T ₂₂ P ₂ V ₁ J ₀	92.15	43.25	3.45	3.50	4.67	15.21	10.25
T ₂₃ P ₂ V ₁ J ₁	93.15	48.43	3.85	3.80	4.85	15.41	11.56
T ₂₄ P ₂ V ₁ J ₂	102.45	52.15	4.12	4.50	4.85	16.54	12.54
T ₂₅ P ₂ V ₂ J ₀	92.40	48.56	3.56	3.60	4.81	15.42	11.24
T ₂₆ P ₂ V ₂ J ₁	89.75	50.24	3.64	3.80	4.82	15.86	11.25
T ₂₇ P ₂ V ₂ J ₂	94.15	48.25	3.86	4.00	4.82	16.21	11.58



Organically produced rose in full bloom



Drenching with *Panchgavya*



Treatment 6% *Panchgavya* + 1:5 times dilution of vermiwash + 30% *Jivamrita*



Control

Effect of Bio-enhancers on Vegetative Growth



Treatment 6% *Panchgavya* + 1:5 times dilution of vermiwash + 30% *Jivamrita*



Control

Effect of Bio-enhancers on Flowering



Treatment 6% *Panchgavya* + 1:5 times dilution of vermiwash + 30% *Jivamrita*



Control

Effect of Bio-enhancers on post harvest life

A REVIEW: DIABETES MILLETUS AND MEDICINAL PLANTS IN ITS TREATMENT

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Diabetes Mellitus is a metabolic disorder characterized by hyperglycemia due to defect in insulin secretion, insulin action or both. Over the last century human life style and food habits have drastically changed which lead to various chronic diseases. Diabetes milletus is one such disease which is causing serious problems to human health (Kumar and Clark, 2002). Around 200 million people around the world are being diagnosed with diabetes according to WHO statistics diabetes is the sixth leading cause of disease-related death in the world. On long standing it leads to many micro and macro vascular complications. The microvascular complications of diabetes include nephropathy, retinopathy, and neuropathy. In type-1 diabetes the first signs of these complications may develop during adolescence, particularly if insulin is insufficient in the body. Similar complications may occur in the later life of patients with type-2 diabetes. They frequently occur during the time of diagnosis (Beverley and Eschwège, 2003).

History of Diabetes: Diabetes disease is prevalent since approximately 1550BC. An Egyptian doctor defined a unknown rare disease as a disease that causes the patient to lose weight rapidly and urinate frequently. This is considered to be the first definition to the diabetes milletus. The name diabetes was coined by the Greek Physician Aretaeus (30-90AC) (Moran, *et al.*, 2004). He recorded the disease with symptoms such as constant thirst (polydipsia), loss of weight and excessive urination (polyuria). He named the condition 'diabetes', which means 'a flowing through'. After this period, diabetes name is rarely mentioned. Indeed, it seems to have a mystery or incredibly during the Middle Ages. The first reference to the disease came from Avicenna, the famous Arabian Physician. He described the complications of the disease in detail, and how it got progressed (Amos *et al.*, 1997). Around this period, uroscopy' came into existence as a way of identifying disease (Betterley *et al.*, 1983). The colour, and odour of the urine were examined to establish the disease of the patient. Some physicians even tasted the urine of patients, and this apparently lead how to the second name, mellitus, meaning 'honey' in Latin (Huang *et al.*, 2002).

During the early 19th Century, chemical tests have been devised through which it was possible to detect excess sugar in the urine. Despite many therapies had been proposed, in the absence of a cause, they proved unsuccessful. In 1920 an American called Moses Barron linked the Langerhans cells with the basis of diabetes mellitus (Shukla *et al.*, 2003). Based up on the research of Barron, a doctor called Frederick Banting conducted critical experiments linking the pancreas and diabetes. Banting discovered an essential hormone named insulin, named after the 'islands' of cells described by Langerhans. Banting and one of his colleagues were recognised for their achievement and were awarded Nobel Prize. Throughout the 20th century, treatment of the disease has advanced drastically. Although prevention and management remains difficult for diabetes milletus, the life of an average diabetic is becoming both longer and easier due to advanced treatments which are being used now a days (King *et al.*, 1998).

Diabetes Milletus Occurance in the World: Diabetes milletus is estimated to increase from 4.0 percent in the year 1995 to 5.4 percent by the year 2025. The number of people with diabetes milletus in the world will incresase from 135 million in 1995 to 300 million in the year 2025. According to statistics, there will be a 42 percent increase, from 51 million to 72 million, in the developed countries and 70% increase, from 84 to 228 million, in the developing countries. There are three major types of diabetes.

1. Type-I (Insulin dependent diabetes mellitus).
2. Type-II (Non-insulin dependent diabetes mellitus).
3. Gestational diabetes mellitus.

Type –I / Insulin Dependent Diabetes Mellitus: In insulin dependent diabetes mellitus, insulin is completely absent because the pancreas lacks cells or contains defective cells. This condition occurs in genetically susceptible individuals from an autoimmune response that selectively destroys pancreatic cells. Their life spans are drastically reduced up to one third as a result of degenerative complications like kidney dysfunction, nerve impairment, and cardiovascular complications as well as blindness (Lindberg *et al.*, 2004).

This arises from the metabolic control provided by periodic insulin injection. The usual rapid onset of the indications of insulin dependent diabetes mellitus suggested that the autoimmune attack on the pancreatic cells is responsible for the shorter duration of this disease. However the disease persists for several years as the immune system slowly destroys the pancreatic cells. When >80% of these pancreatic cells have been destroyed it leads to classic symptoms of diabetic disease.⁵ It usually occurs after 30 years of age, but Peak incidence occurs during puberty, around 12-14 years in boys and 10-12 years of age in girls. The main signs and symptoms include hyperglycemia, increased thirst and hunger, frequent urination, weight loss, ketoacidosis (Seki *et al.*, 2004).

Type-II or Non-insulin Dependent Diabetes Mellitus: Non insulin dependent diabetes mellitus is characterized by reduced insulin secretion in response to glucose levels and Insulin resistance which leads to the inefficient absorption of glucose into the cell for energy. It is present in 90% of the diagnosed cases of diabetes and affects 18% of the population above 65 years of age, usually occurs in obese individuals. These individuals have normal or even greatly elevated insulin levels. Perhaps, the elevated insulin production results from overeating (obesity is almost always the result of overeating). It eventually suppresses the synthesis of insulin receptor (a plasma membrane bound glycoprotein). This hypothesis concludes that diet alone is usually sufficient to control this type of diabetes (Wallace *et al.*, 2002).

Gestational Diabetes Mellitus: Gestational diabetes mainly develops during the time of pregnancy. It results due to the hormonal changes in pregnancy which can change the body ability to use insulin leading to carbohydrate intolerance. It results in hyperglycemia of variable severity. It usually disappears after the birth of child, and does not clarify that the child will be born with diabetes (CDCP, 2003).

Diabetic Complications: Diabetes mellitus also causes "microvascular" complications leading to the small blood vessels damage. Diabetic retinopathy, affects blood vessel formation in the retina of the eye, can lead to problems in vision like reduced vision, and potential blindness (Svensson *et al.*, 2004). Diabetic nephropathy, the complication of diabetes on the kidneys can lead to drastic changes in the kidney tissue, loss of progressively larger amounts of protein in the urine, and gradually leading to chronic kidney disease requiring dialysis. Diabetic neuropathy is the complication of diabetes affecting the nervous system, most commonly causing numbness, and pain in the feet and also increasing the risk of skin damage due to altered sensation (Saely *et al.*, 2004). Diabetic neuropathy is a vascular disease affecting circulation of blood in the legs, contributing to the risk of diabetes-related foot problems (such as diabetic foot ulcers) that are difficult to treat and occasionally require amputation (Amos *et al.*, 1997).

Importance of Medicinal Plants in the Treatment of Diseases: Nature always stands as a golden mark to exemplify the outstanding phenomena of one race depending on other for food. Natural products from plant, animal and minerals have been the basis of the treatment of human disease from the times immemorial. Today it is estimated that about 80 % of people in developing countries are still depending on traditional medicine based largely on species of plants and animals. Herbal medicines are currently in demand and their necessity is increasing eventually. About 500 plants with medicinal use are mentioned in ancient literature by Theophrastus and 800 plants have been used in indigenous systems of medicinal system (Chatterjee *et al.*, 2006). India is rich depositories of medicinal plants are used in traditional medical treatments. The various indigenous systems of medicine such as Siddha, Ayurveda, Unani and Allopathy use several plant species to treat different diseases. The use of plant medicines is becoming popular due to toxic and side effects of allopathic drugs. This led to sudden increase in the number of herbal drug industries (Chatterjee *et al.*, 2004). Herbal medicines are the major remedy in traditional system of medicine have been used in medical practices since ages. The practices are continuing till today because of its biomedical benefits as well as its cultural beliefs in many parts of world. It have made a great contribution towards maintaining human health care system (Chopra *et al.*, 1956).

In India around 20,000 medicinal plant species have been recorded but more than 500 traditional plant communities use about 800 plant species for curing different diseases. Currently 80% of the world population relies on plant-derived medicine for the first line of primary health care because it has no side effects. Plants are important sources of medicines. Presently about 25% of pharmaceutical prescriptions in the United States contain at least one plant-derived ingredient. In the 20th century, roughly 121 pharmaceutical products were formulated based on the traditional knowledge obtained from various pharmacopeias (Dhar *et al.*, 1973). There are many evidences that many herbal plants are used for the treatment of diabetes mellitus. Plant families which are confirmed to show hypoglycemic activity include: Leguminosae, Lamiaceae, Liliaceae, Cucurbitaceae, Asteraceae, Moraceae, Rosaceae, Euphorbiaceae, Araliaceae, Polygalaceae, Asclepidaceae, Meliaceae etc. (Farnsworth and Bingel, 1977). Many clinical studies have confirmed the therapeutic importance of medicinal plants in the treatment of diabetes mellitus disease. The effect of the medicinal plants may delay the diabetic complications and rectify the metabolic abnormalities. However during the past few decades new bioactive compounds are being isolated from the hypoglycemic plants. They showed hypoglycemic activity with more efficacy and are used in effective treatment of diabetes mellitus ((Farnsworth *et al.*, 1967)).

Disruption of Plants Used for the Treatment of Diabetes Mellitus

***Artemisia pallens*:** It is commonly called as davana belonging to family Compositae. Methanolic extract of aerial parts of plants are responsible for anti diabetic activity. In glucose fed hyperglycemic rats and also in alloxan induced diabetic rats methanolic extract (100mg/ kg given orally) reported antihyperglycemic activity. Cadinol, -Curarine, -eudesmol, -cubebene are responsible for anti-diabetic activity. They inhibit glucose-reabsorption or increase peripheral glucose utilization (Gupta *et al.*, 2005).

***Aegle marmelos*:** It is commonly called holy fruit tree belonging to family Rutaceae. Antihyperglycemic activity of aqueous leaf extract in streptozotocin induced diabetic rats. Each group of animals were treated for 14 days orally. Aegelin and sitosterol marmelosin, marmesin are the constituents responsible for anti diabetic activity. The extract given at a dose of 10mg / kg orally reported effective hypoglycemic activity. It increases utilization of glucose either by direct glucose stimulation or by acting like insulin for glucose uptake (Kumari *et al.*, 1995). Many bioactive compounds have been isolated from this plant (Banerjee, 1980). extensive chemical investigations on various parts of the tree have been carried out and more than 100 compounds have been isolated. Many of these compounds including skimmianine, aegelin, lupeol, cineole, citral, citronellal, cuminaldehyde (4-isopropylbenzaldehyde), eugenol, marmesinin, mannelosin, luvangetin, aurapten, psoralen, mannelide, fagarine, maimin and tannins have been proved to be biologically active against various major and minor diseases including cancer, malaria and gastroduodenal disorders. The presence of Aeglin, lupeol, eugenol, marmesinin constituents were found to be cause of its property of preventing myocardial damage due to diabetes mellitus. The antioxidant property of the *A.marmelos* leaf, play a vital role in delaying, intercepting or preventing oxidative reactions, catalysed by free radicals. This antioxidant activity might be due to the presence of phenolic compounds such as flavonoids, phenolic acids and phenolic diterpenes (Sharma, 1977).

***Allium cepa*:** It is commonly called as onion belonging to family Liliaceae. Hypoglycemic activity reported in ether soluble fraction of onion (0.25mg/kg/p.o) in streptozotocin induced rabbits. The bulb part contains S-methyl cysteine sulfoxide, S-allyl cysteine sulfoxide has anti diabetic activity. It lowers blood glucose levels and has potent anti oxidant activity which may account for hypoglycemic potential. Seven compounds were isolated from the ethanol extract of the seeds of *Allium cepa*, their structures were elucidated by physico-chemical properties and spectroscopic analysis as tianshichic acid, N-trans-feruloyl tyramine, beta-sitosterol-3-O-beta-glucopyranoside-6'-palmitate, sitosterol, daucosterol, tryptophane and sadenine riboside (Bayer *et al.*, 1989). The major biochemical constituents of onion extraction are identified as quercetin, allicin (S-oxodiallyl disulfide), alliin (S-allyl L-cysteine S-oxide) 12, diallyl disulfide (allyl disulfide) 12, S-methyl L-cysteine S-oxide (3-methyl sulfanyl alanine) 12, propanethial S-oxide (thiopropional S-oxide) and 3-mercapto-2-methylpentan-1-ol.

Clinical trials and animal research support the use of *Allium cepa* for anti asthmatic, anti diabetic, anti viral, anti thrombotic, hypo cholesteremic, anti inflammatory, anti oxidant, aphrodisiacs,

cardiotonic, diuretic, expectorant, stimulant, anti cancer (Sharma *et al.*, 1977), platelet aggregation inhibitor⁷⁵ and insecticidal properties.

***Mucuna pruriens*:** It is commonly called velvet bean belonging to family Leguminosae. Alcoholic extract of plant (100, 200, 400mg/kg/day) is given to alloxanized rats reported significant glucose lowering effect. Hypoglycemic activity of plant extract (200mg/kg) reported on daily oral feeding of extract for 40 days in streptozotocin induced diabetic mice. Mucunine, mucunidine, sitosterol, possibly act through stimulation of release of insulin or by direct insulin like action due to presence of trace elements like manganese, zinc etc (Vats *et al.*, 2004a). The main plant chemicals found in *Mucuna pruriens* include alkaloids, alkylamines, arachic acid, behenic acid, beta carboline, beta sitosterol, bufotenine, cystine, dopamine, fatty acids, flavones, galactose D, gallic acid, genistine, glutamic acid, glutathione, glycine, histidine, hydroxyl genistein, 5- hydroxyl tryptamine, isoleucine, L- dopa, linoleic acid, linolenic acid, lysine, mannose D, methionine, 6- methoxyharman, mucunadine, mucunain, mucunine, miristic acid, niacin, nicotine, oleic acid, palmitic acid, palmitoleic acid, phenylalanine, prurienidine, pruriene, riboflavin, saponins, serine, serotonin, stearic acid, stizolamine, threonine, trypsin, tryptamine, tyrosine, valine and vernolic acid (Murugan, 2009; Singh *et al.*, 2011). *Mucuna pruriens* is used for facial paralysis and nervous disorders, purification of blood, asthma, cough and stone in bladder and improves vitality. It is also used for treating fevers, edema, elephantiasis, for treating parkinsonism disease, impotency, intestinal gas and aphrodisiac, nerve tonic and diuretic (Bhaskar *et al.*, 2008). It is locally applied to ulcers, used for remedying worms, dysentery, diarrhea, snake bite, sexual debility, tuberculosis, rheumatic disorder, muscular pain, sterility, gout, menstrual disorder, diabetes and cancer.

***Ocimum sanctum*:** It is commonly called belonging to family Lamiaceae. Leaf power extract (200mg/kg for 30 days) has plasma glucose lowering activity in streptozotocin induced diabetic animals revealing the effect of the extract on three enzymes of carbohydrate metabolism namely glucokinase, hexokinase, and phosphofructokinase. Eugenol, carvacrol, linalool, caryophyllene, sitosterol has potent hypoglycemic hypolipidemic effects in normal and diabetic rats.

Administration of leaf extract lead to decrease in plasma glucose level by 24.6% (Sachdewa, and Khemani, 1999). *Ocimum sanctum* Linn. contains major essential oils such as eugenol, carvacrol, nerol and eugenolmethylether. Leaves have been reported to contain ursolic acid, apigenin, luteolin, apigenin-7-O-glucuronide, luteolin-7-O-glucuronide, and molludistin. The ethanol extract (90%) of the leaves showed hepatoprotective effect against paracetamol-induced liver damage (Huang *et al.*, 2007). Endophytes have been found virtually in every plant studied, where they colonize the internal tissues of their host plant and can form a range of different relationships including symbiotic, mutualistic, commensalistic and trophobiotic. Most endophytes appear to originate from the rhizosphere or phyllosphere; however, some may be transmitted through the seed. Endophytic bacteria can promote plant growth and yield and also can act as biocontrol agents. Endophytes can also be beneficial to their host by producing a range of bioactive compound that could be harnessed for potential use in medicine, agriculture or industry (Gangadevi *et al.*, 2008). Endophytic microorganisms from medicinal plants are a potential source of a diverse array of bioactive metabolites which can be used for the development of some potent drugs. Many authors have isolated endophytic microbes from various medicinal plants with antioxidant, antibacterial, antimicrobial, anticancer, antidiabetic, immune suppressant activity. Further many more examples in which endophytes producing various secondary metabolites such as taxol, aspergillase, camptothecin, as anticancer compounds and artemisinin as antimalarial etc. Endophytes are also discovered with some novel potent molecules such as antibiotics, alkaloids and antidiabetics showing insulin mimetic effect by oral route (Peter *et al.*, 1997).

***Hibiscus rosa chinensis*:** It is commonly called china rose belonging to family malvaceae. Alcoholic leaf extract (250mg/kg/p.o) given for seven consecutive days has shown hypoglycemic activity in hyperglycemic rats. Hypoglycemic activity of single dose of ethanol extract of plant in glucose loaded rats at 120 min and blood glucose lowering effect after repeated administration for seven consecutive days at 30, 90, and 120 min after glucose loading. Stimulates insulin secretion from pancreatic beta cells and increases utilization of glucose either by direct stimulation of glucose uptake or the mediation of enhanced insulin secretion (Banerji and Kumar, 1998).

***Trigonella foenum graecum*:** It is commonly known as “Fenugreek” in English and “Methi” in Hindi, is a member of family Fabaceae. The plant is grown throughout India. It is a medicinal plant claim to

posses number of therapeutic uses. Leaves and seeds are used as antidiabetic (Lindberg *et al.*, 2004), anti inflammatory and antipyretic. Fenugreek seeds contains only minute quantities of an essential oil. Furthermore, n-alkanes, sesquiterpenes, alkanols and lactones were reported. The dominant aroma component in fenugreek seeds is a hemiterpenoid γ -lactone, Among the non-volatile components of fenugreek seeds, the furostanol glycosides are probably responsible for the bitter taste. Among the several more compounds yet identified, sterols and diosgenin derivatives (of potential interest for the pharmaceutical industry) and trigonellin (N-methyl-pyridinium-3-carboxylate, 0.4%) are most worth noting. Trigonella foenum graecum has antidiabetic activity in which the hypoglycemic effect has been confirmed by several investigators (Ahmadiani *et al.*, 2001). From the seeds of T. foenum graecum an unusual amino acid, 4-hydroxyisoleucine, has been isolated, which significantly decreased the plasma triglyceride levels. Fenugreek is a food with traditional medicinal use in diabetes.

Beneficial effects have been demonstrated in diabetic animals and both insulin-dependent and non-insulin-dependent diabetic subjects. In vitro effect of fenugreek extracts on intestinal sodium-dependent glucose uptake and hepatic glycogen phosphorylase A. The aqueous and alcoholic extracts of Trigonella foenum-graecum leaf were tested for hypoglycaemic activity in normal and alloxan-diabetic rats. Apart from these activities immunomodulatory, anti-inflammatory and antipyretic activity are also found. This traditional Indian Anti-Diabetic Plants Attenuate Progression of Renal Damage (Nayampalli *et al.*, 1988).

***Tinospora cordifolia*:** *Tinospora cordifolia* belonging to the family Menispermaceae is commonly known as “Guduchi” and “Giloya” in Hindi. It is found throughout tropical India, ascending to an altitude of 1000 ft. The stems are rather succulent with long Filiform fleshy aerial roots from the branches. The bark is grey, brown and warty. The leaves are membranous and cordate, the flowers, small, yellow and seeds are curved. Main chemical constituents are berberine, Giloin, tinosporaside, tinosporin, tinosporic acid and tinosporol (Grover *et al.*, 2002). It is used in venereal disease and as antiperiodic, anti-inflammatory, diuretic (Aiyer and Kolamall, 1963), antiallergic and anti-diabetic. The extract of stem is useful in skin diseases. Dry barks of *T. cordifolia* have antispasmodic, antipyretic and leprotic properties. A definite blood glucose lowering effect within two weeks has been confirmed in alloxan diabetic albino rats. Blood glucose values are brought down close to normal fasting level using herbal samples, twice or thrice daily, as needed. While evaluating comparative hypoglycaemic activity of the experimental herbal samples, significant blood glucose lowering activities are observed. The stem of the *Tinospora cordifolia* is one of the constituents of several Ayurvedic preparations. The root and stem of *T. cordifolia* are prescribed in combination with other drugs as an antidote of snake bite and scorpion sting (Ryan *et al.*, 2008).

***Momordica charantia*:** It is commonly called as kugua, karela bitter gourd belonging to family cucurbitaceae. It is a popular herbal resource to treat diabetes. It increases the mitosis of pancreatic cells and partially recovers the destroyed cells. Various medicinal properties are claimed for *Momordica charantia* namely antidiabetic, abortifacient, anthelmintic, contraceptive, antimalarial and laxative and also in galactagogue, jaundice, leprosy, pneumonia and rheumatism. Charantin (mixture of sterol glycosides), vicine (pyrimidine nucleotide) and p-insulin (polypeptide) are reported as the active ingredients. Additionally, alkaloids, glucoside, saponins and mucilage are the other reported contents. It has shown hypoglycemic activity in hyperglycemic rats. Hypoglycemic activity of single dose of ethanol extract of plant in glucose loaded rats at 120 min and blood glucose lowering effect after repeated administration for seven consecutive days at 30, 90, and 120 min after glucose loading. Stimulates insulin secretion from pancreatic beta cells and increases utilization of glucose either by direct stimulation of glucose uptake or the mediation of enhanced insulin secretion (70).

***Gymnema sylvestre*:** *Gymnema sylvestre* commonly called podapatri belonging to family Asclepidaceae. It is a large woody, much branched climber with pubescent young parts in dry forest up to 600 m height. *Gymnema sylvestre* (400mg/day) is given to alloxan induced diabetic rats. Its leaf has been widely used in Ayurvedic traditional medicine and is bitter, acrid, thermogenic, anti-inflammatory, anodyne, digestive and liver tonic. It is also known for its antidiabetic, anticancer and antimicrobial properties. It is rich in phytochemicals such as alkaloids, flavonoids, saponins, carbohydrates and phenols with highest concentration of saponins being 5.5% (Iwu *et al.*, 1990).

***Azadirachta indica*:** It is commonly called as neem belonging to the family meliaceae. *Azadirachta indica* is the most useful medicinal plant in India. It possesses anti-inflammatory, antibacterial, antiarthritic, hypoglycemic, antiulcer, antifungal, antimalarial, antitumour and diuretic properties (Rajasekaran *et al.*, 2004). The phytochemical constituents reported are alkaloids, tannins, coumarin, proteins, stigmasterol, flavonoids, polyphenols, saponins and sugars (Yoshikawa *et al.*, 1996).

Conclusion: Diabetes milletus is a chronic disease which leads to various complications on long standing. Allopathic medicines are not effective in treating the disease leading to various adverse effects. Hence medicinal plants are the best alternative for the treatment of diabetes milletus. The plant species have proved their efficacy in reducing blood glucose levels. Discovery of novel compounds can be developed through extensive research work on bioactivity of various constituents. In near future herbal plants will play a crucial role in modern system of medicine.

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EFFECT OF ASANA ON RUJA (PAIN) IN POST STROKE HEMIPLEGIC PATIENTS

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Lifestyle diseases are symptomatic of everything that is wrong with today's lifestyle. Although the term was once used interchangeably with 'longevity diseases', this no longer holds true, as lifestyle diseases are no longer age specific. Diseases that are linked with lifestyle choices such as those caused primarily by the consumption of junk food and processed food, lack of physical activity, work stress and other factors have now begun to affect young adults and children as well. Lifestyle diseases are a result of an inappropriate relationship of people with their environment. The onset of these lifestyle diseases is insidious, they take years to develop, and once encountered do not lend themselves easily to cure (<http://naturalhealthperspective.com/home/civilization.html>).

Lifestyle diseases are different from other diseases because they are potentially preventable, and can be lowered with changes in diet, lifestyle, and environment.

- Until the present era, death was caused by sudden onset conditions. Sudden Onset conditions are easily curable by Allopathic Medicine.
- Today, conditions that slowly develop over many years as we age cause more deaths. These insidious diseases do NOT lend themselves to a quick fix by Allopathic Medicine.

Lifestyle diseases account for a majority of the diseases that are common around the world today. Some of the common lifestyle diseases are Obesity, Diabetes, Arteriosclerosis, Heart disease, Stroke, Hypertension, Liver cirrhosis, Nephritis, Cancer, Chronic obstructive pulmonary disease (COPD), Allergies, Hearing problems, Heat shock, Cold shock, Depression, Anxiety disorders, Alzheimer's disease, Chronic backache etc.

Stroke is one of them. It is a condition due to the lack of oxygen to the brain that may lead to reversible or irreversible paralysis. Stroke is linked to advanced age, high blood pressure, previous attacks of poor circulation, cigarette smoking, heart disorders, embolism, family history of strokes, use of birth-control pills, diabetes mellitus, lack of exercise, overweight, high cholesterol, and hyperlipidemia (<http://www.ayujournal.org/article.asp,issn0974,8520;year2011;volume32; issue3; spage427; epage431;aulastGupta>). According to Ayurveda stroke (the biomedical cerebrovascular condition) is correlated with Pakshaghata, is a vatavyadhi. The lakshanas include, ruja, vakstambha, etc. Its types are kaphanubandha and pittanubandha. Amongst the various symptoms in the present study ruja symptom was taken. Pain is found in the whole limb to the side which involved in hemiplegia. Ruja means pain and any kind of pain is always associated with vayu. 'Santat ruk' has been mentioned as a symptom in Asthimajja gata vata. In pakshaghat there is involvement of snayu and sira. When vayu gets aggravated in sira, manda ruja is produced. Pittaavrita prana vayu also results in ruja ([http://ijapc.com/volume4-first-issue/v4-i1-\(v3-i3\)-33-190-199.pdf](http://ijapc.com/volume4-first-issue/v4-i1-(v3-i3)-33-190-199.pdf)).

The management of pakshaghata being reported in this paper is the cases of ischemic stroke. While implementing the asana in patients it has been mentioned that the patient has taken their allopathic treatment as usual.

Materials and Methods

For clinical study total 60 cases were registered from OPD of Neurology, S.S. Hospital and Department of Rachana Sharira, IMS, BHU and were randomly selected diagnosed cases of Pakshaghata (Post Stroke Hemiplegia). Patients of group were randomly selected. The patient group again divided into two subgroups (1) control and (2) intervention group consisting of 30 cases in each. In the present study, a set of selected Asanas formed the independent variables. They are listed below:

1. Hasttothanasana
2. Trikonasana
3. Utthanpadaasana
4. Pavanmuktaasana
5. Bhujanga-Asana

6. Sava- Asana

On the basis of the guidance of Dr. Mangalagowri V. Rao, Assistant Professor, Department of Swasthavritta and Yoga Faculty of Àyurveda, IMS, BHU, Varanasi and with reference to the advantages and disadvantages of various Yogic exercises for the patients of poststroke hemiplegia of age group 15-65, it was advisable to select the above set of yogic exercises for the study. Control group was received no Yogic Asana practice and the intervention group was received Yogic Asana practices for the period of 5 months.

Observation and Results

After the course of asana implement which lasted 5 months there was considerable decrease in Ruja symptom. The recovery was promising and worth documenting. The results and discussion will be described later. Observational table no.1 showing the effect in term of ruja (pain) in Asanas, in different groups initially and at follow ups:

Group	Grade	Ruja Number and % of cases			Within the group comparison Friedman test
		BT	F1	F2	
Patient control	No pain	2 (6.7%)	3 (10.0%)	8 (26.7%)	$\chi^2=38.830$ p= 0.000
	Only after some extension	2 (6.7%)	13 (43.3%)	19 (63.3%)	
	Less frequently	19 (63.3%)	14 (46.7%)	2 (6.7%)	
	Very frequently	7 (23.3%)	0 (0.0%)	1 (3.3%)	
Patient intervention	No pain	0 (0.0%)	2 (6.7%)	19 (63.3%)	$\chi^2=55.514$ p=0.000
	Only after some extension	5 (16.7%)	15 (50.0%)	10 (33.3%)	
	Less frequently	13 (43.3%)	13 (43.3%)	1 (3.3%)	
	Very frequently	12 (40.0%)	0 (0.0%)	0 (0.0%)	
Between group comparison		$\chi^2=5.727$	$\chi^2=0.380$	$\chi^2=8.608$	
Chi- square		p=0.126	p=0.827	p=0.035	

The above table clearly depicts that the severity of pain in control and intervention group decreases with each follow up. In control group initial number of patients with no pain was 6.7% which becomes 26.7% after 2nd follow up and patient presenting with the very frequently pain symptom was 23.3% which become 3.3% after 2nd follow up.

In intervention group initial number of patients with presenting symptom no pain was 0.0% which becomes 63.3% after 2nd follow up and the very frequently pain symptom was 12% which becomes 0% after 2nd follow up. There is some decrease in pain in each group. The intra group comparison of pain was found statistically highly significant in each group. The inter group comparison of pain symptom was found statistically significant (p<0.05) at the end of 2nd follow up which was initially insignificant (p>0.05).

The decreasing in severity of symptoms was more pronounced in the intervention group in comparison to the control group as the percentage of patients with no pain symptom was significantly higher in the intervention group initially and at the end of 2nd follow up 0.0% & 63.3% respectively, in comparison of control group initially and at the end of 2nd follow up 6.7% & 26.7% respectively. These findings clearly show that there was significant relief in the pain symptom in the intervention group who were practicing asanas regularly. It depicts better result in intervention group.

Discussion

The results of the present study suggested that the intervention of a planned yoga program led to significant improvement in the quality of health decreased the disability and pain for the patients who were diagnosed to have pain in the affected limb. Several reasons exist to explain the efficacy of Yoga in the therapy for pain. Asanas and pranayama activates the Parasympathetic system, by increasing the local blood flow, which influences the endocrine system and nerve plexuses, affecting the neuronal flow (Vallath, 2010). Deep yogic breathing with prolonged exhalation relaxes most of the skeletal muscles (Nespor, 1989). Asanas and pranayama initiate a 'relaxation response' (Benson, 1996) in the neuroendocrinal system that harmonizes the physiological system (metabolic, respiratory, cardiovascular, musculoskeletal, and neural) resulting in decreased myofascial tension (Lazar *et al.*, 2000). Meditation and pranayama, along with relaxing asanas can help individuals deal with the reactive aspects of chronic pain, reducing anxiety and depression effectively (Kim *et al.*, 2005).

A study entitled Effect of yoga on the Myofascial Pain Syndrome of neck carried out by D Sharan, M Manjula, D Urmi, PS Ajeesh, Academics Department, RECOUP Neuromusculoskeletal Rehabilitation Center, Bangalore, India, showed that the outcome variables were Disability of Arm,

Shoulder and Hands (DASH) score, Neck Disability Index (NDI), Visual Analogue Scale (VAS), Pressure Pain Threshold (PPT) for Trigger Points etc. improved significantly after intervention.

In the present study also similar results were found, which were measured with subjective responses. Apart from pain reduction, there was a significant improvement in the functional capacity and quality of health. Therefore, it was considered that a planned yoga program for patients who were suffering from hemiplegic pain in limbs resulted in significant improvement in pain levels, which in turn could lead to improved quality of treatment. The sample size of the present study was only sixty. Therefore, a further study is required to generalize the result of the present study on a larger sample size.

Conclusion: While modern medicine has the ability in many cases to heal physical diseases and alleviate psychological disorders, it is argued that a purely medical approach is far less effective in healing the emotional, intellectual, and personality layers of the human entity. The discipline of yoga offers individuals a timeless and holistic model of health and healing and although it may not result in the complete elimination of physical diseases and/ or adverse conditions from the body it offers a holistic path of healing.

It also significantly improves the activities of daily living of patients like Sitting from lying down, Standing from sitting, Walking down stair, Increase in walking capacity and Hand grip power. The associated symptoms like Tiredness, Gaurava, Vivandha, Sotha, Bhrama, Shaitya and Shirashula also shows significant improvement. Looking to the chronicity and deep seated nature of the disease longer duration of therapy may be required to obtain better results. The above mentioned protocol to manage chronic cases of pakshaghata is unique. The recovery was promising and worth documenting.

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SCENARIO OF INSECT-PESTS OF MEDICINAL PLANTS

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Medicinal plants used all over the India to cure specific ailments have been in vogue from ancient period. Our Indian traditional system of medicine namely ayurvedic, sidha and unani have been in existence for several centuries. Kumar (2007) recorded eight species of phytophagous insect pests on Ashwagandha, these have been categorized as defoliators (4 species), sucking insects (3 species) and flower & fruit feeder (1 species) based on their feeding habit. Same author recorded 11 species of phytophagous insects attacking coleus and these have been categorized as defoliators (6 species) and sucking insects (4 species) based on their feeding habit. (Ramanna *et al* 2010)

Status of Medicinal and Crop Plants

Medicinal and Aromatic Crop Plants: The medicinal plants contribution in industry developing at the rate of 7-15% annually. According to estimate of conservation, the medicinal plants value in India trade of about Rs 5,000 crores per annum, while the world trade is about 62 billion US dollars. The current international situation in the production and business of essential oils and aromatic chemicals is very complex and vibrant. No doubt, in a world production developing countries have a dominant position, but still the competition from developed countries remains very strong. (Sharma *et al* 2014)

The developing countries world production of about 55% followed by developed countries (10%). 1.16. The Indian ancient scholar has identified approx 1500 medicinal plants, and more than 500 species are used in the preparation of drugs. The medicinal plants share to attend 80% of the raw materials used in the preparation of drugs. The effectiveness and their performance of these drugs mainly based upon the proper use and sustained availability of virtual raw materials.

Our Indian drug industries required medicinal plants (more than 90%) are still collected from wild sources. Medicinal plants mostly cross pollinated; these cannot ensure consistent quality due to lot of genetic variability found in the natural populations. Moreover, the collection of plants from the wild has many disadvantages like improper supply, unreliable botanical identification, expensive post harvest handling and higher chances of adulteration and substitution. 1.17. Paradoxically, there is hardly any reliable data available on area, production and productivity of cultivated medicinal species since these are not recorded. (Sharma *et al* 2014)

All medicinal plant species are considered as one commodity and sometimes data are taken by some states. The medicinal plants area of 2, 72,150 ha are estimated on the basis of consolidation made from the fragmented information available in literature. National Medicinal Plant Board (NMPB) has identified 32 prioritized medicinal plants.

Insect Pest Fauna of Medicinal Crop Plants: The cultivation of these plants in the large scale in state may face the problem of sudden appearance of large populations of various insect pests in a single crop. Like other plants, medicinal plants too have to bear the devastating effects of injurious insect-pests, those are not only harmful for the plant but also, deteriorate the quality of the produce, thus hampering its medicinal value. The information regarding the occurrence of insect-pests on medicinal and aromatic plants of the state is scanty. Hence this studies were undertaken to record the insect-pests related with important medicinal plants in the state. In India, use of different parts of several medicinal plants to cure specific diseases. (Sharma *et al* 2014)

The indigenous system of medicine namely ayurvedic, sidha and unani have been in existence for several centuries. Kumar *et al* (2007) recorded eight species of phytophagous pests on Ashwagandha, these have been categorized as defoliators (4 species), sucking insects (3 species) and flower & fruit feeder (1 species) based on their feeding habit. Same author recorded 11 species of phytophagous insects attacking coleus and these have been categorized as defoliators (6 species) and sucking insects (4 species) based on their feeding habit. Survey was undertaken to know different insect pests on selected medicinal plants viz., Ashwagandha, Coleus, Shathavari, Amruthaballi and Solanum viarum were recorded during cropping season in KRCCCH, Arabhavi (Belgaum district) from August 2008 to March 2009. (Sharma *et al* 2014)

Different pests population was assessed by numbering of insects per leaf or per pod based upon the level of pest incidence. different pests recorded on randomly selected medicinal plants such as Ashwagandha, Coleus, Amruthaballi, Sathavari and Solanum viarum. Eleven species of phytophagous pests on Ashwagandha belonging to different orders viz., Hemiptera (5 species), Coleoptera (3 species), Lepidoptera (3 species) and Acarina (1 species). (Sharma *et al* 2014)

These have been categorized as defoliators (5 species), sucking pests (5 species) and flower and fruit feeders (1 species) based on their feeding habit. Groups of Hemiptera recorded maximum number of species (4 species) followed by Lepidoptera (3 species), Coleoptera (3 species) and Acarina (1 species).

***Rauwolfia serpentina* Benth. ex Kurz (Sarpagandha):** At Herbal garden, Jogindernagar, mango mealy bug, *Drosicha mangiferae* (Green) (with a population of 35.8/plant) were found damaging leaves and apical twigs of the plants. The adults/nymphs were recorded on inflorescence, apical stem and leaves. The population of mealy bugs was concentrated on apical portion of the plant, covering the plant with cottony mass and gradually resulted in drying up of the plant. The mango mealy bug is widely distributed in the Indo-Gangetic plains from Punjab to Assam. Besides mango, it also attacks 62 other host plants including trees like jack fruit, the banyan, guava, papaya, citrus, jamun etc. (Atwal and Dhaliwal, 2005).

***Withania somnifera* Dunal (Ashwagandha):** Approx Seven insect pests species were collected from *Withania somnifera* in various locations of Himachal Pradesh. The leaf feeding beetle (hadda beetle), *Henosepilachna vigintioctopunctata* (Fabr.) was recorded at Baldook (Hamirpur) with a population of 3.5 beetles per plant.

The Coleopterian beetles and grubs were appeared on the epidermal layer of leaves, which presented a web-like appearance. *H. vigintioctopunctata* in general is reported to be a pest of Solanaceae and Cucurbitaceae in South East Asia (Shirai and Katakura, 1999). The occurrence of *H. vigintioctopunctata* on *W. somnifera* has also been reported by Parjhar *et al.*, (1997). Sap sucking bugs viz., green potato bug, *Nezara viridula* (Linn.), red cotton bug, *Dysdercus cingulatus* (Fabr.) and one unknown pentatomid bug were recorded feeding on *W. somnifera* at Baldook (Hamirpur) with population of 1.3, 1.2 and 1.4 adults per plant, respectively (Sharma *et al* 2014).

The nymphs and adults of *N. viridula* and *D. cingulatus* were observed damaging leaves and inflorescence by sucking the cell sap. Some of the leaves on the plant were observed drying up gradually. The unknown pentatomid was also recorded on *W. somnifera* at Shilly (Solan) with the comparative high population (3.3 adults/plant). This species, however, was recorded feeding on leaves and the developing seeds of the plant. There is no report on the occurrence of these three bugs on *W. somnifera* in literature.

The green potato bug *N. viridula* is, however, reported to be regular pest of cotton, soybean, potato (Willrich *et al.*, 2004; Panizzi, 2002; Vivan and Panizzi, 2002). The larvae of polyphagous insect pest, gram pod borer, *Helicoverpa armigera* (Hübner) were recorded on *W. somnifera* in farmer's field at Berthin (Bilaspur) with population of 1.4 larvae per plant. The pod borer, *H. armigera* was found to cause low degree of damage to *W. somnifera* leaves and flower buds. *H. armigera* is a established serious pest of cotton, chickpea, pigeonpea, groundnut, cowpea, *Vigna sp.*, okra, tomato, castor, sunflower, maize, sorghum and many more crops in the entire South Asian region (Fitt, 1991). At Palampur, a chrysomelid beetle, *Podagrica bowringi* Baly was also observed to be associated with this plant for short period of time. The adults (3 beetles/plant) were observed damaging the leaves by biting round holes. (Sharma *et al* 2014)

***Aegle marmelos* (Correa Ex. Roxb.) (Bael):** Bael plant having a trifoliate leave and they are highly affected by various leaf feeder insect pests. The bael plants at Panthaghati (Shimla) were found a affected by *Papilio sp.* (3 larvae/plant). The larvae damaged the leaves from the margins and. The larvae of *Papilio sp.* were recorded feeding on leaves of *A. marmelos* in medium intensity. The larvae of citrus butterfly have been reported all over the citrus growing area in India and cause very hug damage in all varieties of Rutaceae family plants (Atwal and Dhaliwal, 2005). Its other food plants include curry leaf which are daily used in Indian kitchen, *A. marmelos* and *Psoralea crylifolia* (David, 2001), (Sharma *et al* 2014).

***Saussurea costus* (C.B. Clarke) (Kuth):** Four species of insect pests were found on *Saussurea costus*, to be founded at different locations in Himachal Pradesh. Among these, semilooper, *Thysanoplusia orichalcea* was recorded at three locations i.e. Panthaghati (Shimla), Shilly (Solan),

Brundhar (Kullu) with a population of 1.53, 0.8 and 1.7 larvae per plant, respectively. The different instars of the pests were observed feeding on leaves by biting round holes. *T. orichalcea* was found associated with Kuth at four different locations in the state damaging the leaves of the plants in low intensity. The occurrence of this pest has not been reported on this plant so far and hence appears to be a new record. However, *T. orichalcea* has been observed to feed on large number of crops viz., cole crops (Bhatia et al., 1995), potato (Dharpure, 2002), exotic vegetables (Sharma and Sharma, 1999) and Kalazira (Sharma, 1998). (Sharma et al 2014)

Angelica glauca Edgew (Smooth Angelica): The semilooper, *T. orichalcea* was found damaging the leaves of Chura plant at Panthaghati (Shimla) with a population of 1.20 larvae per plant. The early instar larvae were observed feeding on lower surface of leaves by nibbling, while late instar larvae were observed biting round holes in leaves. (Sharma et al 2014)

Digitalis lanata (Ehrh.) (Woolly foxglove): A scale was found unidentified species associated with foxglove, *D. lanata* plants at Panthaghati (Shimla) with a population of 25.4 nymphs per plant. Leaves lower portion affected by sucking insect pests they suck cell sap. Affected leaves were observed to be brownish and gradual drying. The association of scale, *Coccus sp.* on *Digitalis* has already been reported (www.fao.org). *Aphis nerri* is a hemipterus sucking pest was also found associated with this plant in some localities. (Sharma et al 2014)

Picrorhiza kurroa Royle ex Benth (Kutki): Semilooper, *T. orichalcea* was found to be associated with *P. kurroa* at Shilly (Solan). The larvae (1.33 larvae/plant) were observed in low intensity feeding on leaves by cutting round holes. The pest, being polyphagous, feeds on large number of hosts (Sharma et al 2014).

Celastrus paniculatus (Wild) (Mal-kangani): Pyrrhocorid bug was observed damaging this plant at Jogindernagar. The eggs were observed to be laid in groups and nymphs on hatching started feeding on plants gregariously. Later instar nymphs and adults damaged leaves and developing seeds. The pest population was observed to be 2.0 adults per plant.

Bacopa monerii (Linn.) (Brahmi): Tobacco caterpillar, *Spodoptera litura* (Fabr.) were observed on brahmi, *Bacopa monerii*, the damaging the leaves at Jogindernagar with a population of 1.6 larvae per plant (Fig.1g). *S. litura* is a polyphagous pest occurring throughout the country. It is mainly a pest of tobacco but it also attacks tomato, potato, gram, legumes, groundnut, jute, castor, jowar, maize, cabbage, etc.

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RECORDS ON THE ACTIVITY PHOTOTECTIC INSECTS IN MEDICINAL CROPS

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India having rich and traditional knowledge on plant and their bio products. Our ancient scholar like—Charak, Sushastra, Patanjali they described the important, composition and properties of medicinal plants. Medicinal plants have played an important role of primary health care system. Out of 1500 species of flowers plants found in India, about 17% have their medicinal velu (1-2) several species (1,745) are from the Indian Himalaya region (Ram, 2014).

Madhya Pradesh having a good diversity of medicinal herbs which are being used in human health remedies in India traditional system of medicine like Ayurved, Unani, Siddha. These medicinal plants, shrubs, roots leaves, tubers of enormous medicinal value are a great many found in Satpura, Vindhya, Amarkantak, Pachmari, Kalakund Patalpani, Nimar tribal zone and patalkoot areas. In MP medicinal and aromatic crops are grown in 22,900 hectares area with production of 0.137 million metric tons and productivity of 6 metric tons. When large level cultivation of these medicinal plants in the our Madhya Pradesh they may encounter the various biotic & abiotic problems, sudden appearance the various type of insect pest. Infestation of insect pest on the medicinal plants reduced the yield and their quality and quantity and these problem can be overcome by using insecticides. We are also known the use of insecticides to create the environment pollution. The non judicious and indiscriminate application of pesticide to develop the deleterious affect on natural ecosystem. These chemical pesticides which are deposited on the medicinal plant and their product which are directly consume by the patient. Hence there is a very essential to reduce the pesticides consumption and use to non chemical approach which are nature friendly and economical.

Light trap is one of the most novel approaches. Phillipins reported 25 to 100 % reduction chemical insecticides after using light trap in vegetable crop and mango (Solsoloy *et al.*, 2011). Light trap can use monitoring and management of insect pest population in agro ecosystem. Light trap exploit the phototropic behavior and phototactic response of insect and these are being largely used to monitor the pest status and effectively check the pest.

The main theme of this experiment was to reorganization of phototectic insect pests of medical crops , light trap help us to describe the insect pest complex on the basis of taxonomic and economic importance and provide theoretical basis for the preparation of forecasting module for eco friendly management.

Materials and Methods

The experiment on records on the activity phototectic insects in medicinal crops was conducted at JNKVV research farm Jabalpur during 2012-13. The climatic conditions prevalent in Jabalpur are essentially semi-arid and sub-tropical. It is situated at 23.9°N latitude, 79.58° E longitude and at an altitude of 411.78 m above the mean sea level.

Light Trap Design: The experiment was conducted by using the new economic hanging type of light trap having attracting device made up of 24 gauge iron sheet and collection device made of raxine. The trap was hanged on inverted 'L' shape angle iron rod. Mercury vapor lamp of 80 W. was used as light source. The insects collected in the collection bag of light trap are killed by the exposure of Dichlorvos 76 EC vapor (as fumigating agent) which is directly placed in collection bag.

Observation and Data Analysis: Light trap was operated every night but collection of single day per week was recorded from November 2012 to April 2013 (Table-1). In order to study the population dynamics, daily trap catches of all the major phototropic insect pests were observed and converted into monthly totals.

Table 1: Taxonomic distribution of insect pests of medicinal crop plants collected in light trap

S.No.	Name of the species	Family	Season's total trap catch*	Host crops
(A)	ORDER:LEPIDOPTERA			
1.	<i>Spodoptera litura</i> (Fabricius)	Noctuidae	489	Brahmi, Glory lilly
2.	<i>Plusia orichalcea</i> Fab.	Noctuidae	573	Babchi, Beal
3.	<i>Earias</i> spp.	Pyraustidae	365	Sarpgandha

4.	<i>Spilosoma obliqua</i> Walk.	Arctiidae	159	Sarpgandha, Sedasuhegan
(B) ORDER: HEMIPTERA				
5	<i>Nephotettix virescens</i> (Distant)	Cicadellidae	11743	Babchi, Beal
6.	<i>Nezara viridula</i> (Linn.)	Pentatomidae	269	Sarpgandha, Pudina
7.	<i>Dysdercus koenigii</i> (Fabricius)	Pyrrhocoridae	421	Muskdana, Sarpgandha
(C) ORDER: ORTHOPTERA				
8.	<i>Trilophidia cristata</i> S.	Acrididae	804	Lemon grass
9.	<i>Gryllotalpa orientalis</i> Burmeister	Gryllotalpidae	282	Safed mushli
10.	<i>Gryllus bimaculatus</i> De Geer	Gryllidae	1276	Beal
(D) ORDER: COLEOPTERA				
11.	<i>Mylobris pustulata</i> T.		215	
12.	<i>Aulacophora foveicollis</i> (Lucas)	Chrysomelidae	333	Muskdana

*Light trap catches from November to April

Results and Discussion

Result of the present investigation entitled “Records on the activity phototectic insects in medicinal crops.” Conducted during 2012 to 2013. Experimental season total trap catch manifested the eventuate of 12 positive phototropic insect pest species were recorded throughout the from November 2012 to April 2013. As per the taxonomic analysis these species belong to 4 order and 10 family based on number of species collected. Insect pest species collected based on manually counted number lepidoptera (4 species) was the maximum number of count order followed by order Hemiptera (3 species), orthoptera (3 species) and coleopteran (2 species). A total number of 38 species of insect pest belonging to 7 orders and 14 families on various medicinal crop plants and aromatic plants in Bulgaria (Lecheva *et al.*, 1996). Similarly also reported a record of 62 species belonging to 11 order and 36 family from light trap catch largest order was lepidoptera having a 31 species followed by Hemiptera (13 species), Coleoptera (11 species) and Orthoptera (6 species) (Sharma *et al.*, 2010). Govindraj (2007a & 2007b) also reported the per cent distribution of light trap catches [Lepidoptera (38.8%), Coleoptera (27.7%), Hemiptera (20.0%) and Orthoptera (18.2%)]

Lepidoptera order was the largest with 2 families and 4 species. Among these, *Spodoptera litura* (Linnaeus) (489), *Plusia orichalcea* (Fabricius) (573) and *Earias* spp.(365) belongs to family noctuidae. All these species activity recorded during November to April with monthly peak in March with exception of *Earias* spp. which recorded monthly peak during April. Also reported these noctuids as major pests of medicinal crops (Sharma *et al.*, 2014; Ramanna, 2010). *Spilarctia obliqua* Walker (150), family Arctiidae, also had the highest peak during April. Reported *Spilarctia obliqua* (Arctiidae) as pest of *Coleus*, *Costus speciosus* Linn (Hanumanthaswamy *et al.*, 1993). Several research workers reported these species through light trap catches (Vaishampayan and Vaishampayan, 1995; El-Mezayyen *et al.*, 1997; Butler *et al.*, 2001; Sharma *et al.*, 2006).

After Lepidoptera, Hemiptera was the next highest order of pest species in trap catch with 3 families and 3 species. The family Cicadellidae was represented by *Nephotettix virescens* (Distant) with maximum trap catch of 11,743 hoppers with peak catches in November followed by *Dysdercus koenigii*, Fabricius (421 bugs) and *Nezara viridula* Linnaeus (269 bugs) with monthly peaks in December and March respectively. Recorded both nymphs and adults of Cicadellids on tender parts of Ashwagandha (*Withania somnifera*) (Hanumanthaswamy, 1992). Recorded *Nezara viridula* as pest of *Withania somnifera* (Tripathi *et al.*, 2005). Also observed the population densities of 92 hemipterous insect species belonging to 58 genera of 16 families including Cicadellidae pyrrhocoridae and pentatomidae by using Robinson light trap at Al-Arish city, North Sinai during 1994-96 (Salem *et al.*, 1999).

Orthoptera order was represented by 3 families and 3 species. Among these highest trap catch was of field cricket, *Gryllus bimaculatus* De Geer (1276 crickets) followed by short horn grass hopper, *Trilophidia cristata* S. (804 hoppers) and Mole cricket, *Gryllotalpa orientalis* Burmeister (282 crickets). *G. bimaculatus* De Geer and *T. cristata* registered peak catches during March. Also reported *Trilophida* sp. as pest Ashwagandha (Hanumanthaswamy, 1992). In accordance with the present findings Sharma and Bisen (2012) reported that order Orthoptera was represented by 3 families in which highest trap catch was of *Gryllus* sp. (3854) (fam. Gryllidae) followed by grass hoppers, *Trilophidia cristella* S. (311) & *Gastrimargus transversus* T. (387) and *Gryllotalpa gryllotalpa* Linn. (213) through light trap at Jabalpur. Similarly reported that the nocturnal Orthopteraus were represented by six families including Gryllidae, Gryllotalpidae and Acrididae in

light trap catches (Singh and Ramaneek, 2007). Gryllidae was found dominant as compared to other families.

Coleoptera order was represented by 2 families and 2 species. In terms of relative size of trap catch red pumpkin beetle, *Aulacophora foveicollis* (Lucas) had the highest trap catch of (333 beetles) followed by blister beetle *Mylobris pustulata* T. (215 beetles). Also recorded highest trap catch of *Aulacophora foveicollis* (451 beetles) among coleopterous at Jabalpur (Sharma *et al.*, 2010). Reported that coleopterans dominate the light catches, followed by hemipterans, hymenopterans and lepidopterans (Ramamurthy *et al.*, 2010). Population dynamics of *H. armigera* and *A. ipsilon* in relation to ecological weather factors.

Conclusion: The present investigation has provided voluble information on presence occurrence, distribution and population dynamics of 12 phototropic insect pests in medicinal crops at Jabalpur. The present study also reveal the effect of ecological (weather factors) effect on activity of phototectic insects in medicinal crops ecosystem. This will serve as base line data, useful at present and in future for surveillance and monitoring of insects for forecasting and also in use of light trap as Integrated Pest Management tool against these pests of medicinal crops as light trap can overcome the problem linked to the use of chemical insecticides and cementing the strength of medicinal crops as potential therapeutic mile stone.

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MOLECULAR BASIS OF INSECT RESISTANCE TO TRANSGENIC CROPS

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The introduction of gene technology has added a new dimension to pest management. The global losses due to insect pests after introduction of transgenic crops (and other advances in crop protection) have declined from 13.6 to 10.8 per cent and the corresponding losses in Indian agriculture have declined from 23.3 to 17.5 per cent (Dhaliwal *et al.*, 2010). The global area under transgenic crops has increased from 1.7 million ha in 1996 to 134 million ha in 2009. This represents 80-fold increase, indicating the fastest adoption of technology in the recent history of agriculture. Of the 14 million farmers growing transgenic crops in 25 countries, over 90% (13 million) are small and resource poor farmers from developing countries. It is estimated that by 2015, transgenic crops would be grown on 200 million ha in about 40 countries or even more (James, 2009). Such a large scale adoption of transgenic crops has raised several ecological, economical, sociological and ethical issues. One of the concerns is the evolution of resistance in insect pests to transgenic plants.

Laboratory-Evolved Resistance: Laboratory-evolved (or laboratory-selected) resistance occurs when exposure to a toxin in the laboratory causes a heritable decrease in susceptibility of a laboratory strain. The ability of arthropods to develop resistance depends on the genetic variability of insects used in the selection, presence of resistance alleles, selection pressure, and duration of selection over the generations. Resistance to *Bacillus thuringiensis* var. *kurstaki* was first reported in Indian meal moth, *Plodia interpunctella* (Hubner). A 100-fold resistance was recorded after 15 generations and reaches 250-fold after 36 generations of exposure to Dipel. However, resistant colony was still susceptible to a strain of *Bt* expressing toxin proteins different than Cry1A. The resistant colony was 800-fold resistant to Cry1Ab, but 4-fold more susceptible to Cry1Ca. However, selection for resistance to Dipel in another colony increased resistance to Cry1Ab, without increasing susceptibility to Cry1Ca (Sharma, 2009).

Apart from *P. interpunctella*, at least 16 other insect species have been selected for resistance to *Bt* toxins under laboratory conditions. These include *Aedes aegypti* (Linnaeus), *Cadra cautella* (Walker), *Choristoneura fumiferana* (Clemens), *Chrysomela scripta* Fabricius, *Culex quinquefasciatus* (Say), *Ephestia cautella* (Walker), *E. kuehniella* Zeller, *Helicoverpa armigera* (Hubner), *Heliothis virescens* (Fabricius), *Homoeosoma electellum* Hulst, *Leptinotarsa decemlineata* (Say), *Ostrinia nubilalis* (Hubner), *Pectinophora gossypiella* (Saunders), *Plutella xylostella* (Linnaeus), *Spodoptera exigua* (Hubner), *S. littoralis* (Boisduval) and *Trichoplusia ni* (Hubner) (Dhaliwal and Koul, 2010).

Selection under laboratory conditions has resulted in up to 1000-fold resistance in *P. xylostella* and the resistant colony displayed high levels of resistance to Cry1 toxins. Over 90 per cent of the larvae from the resistant colony survived on transgenic canola expressing *cry1Ac*. Selection under laboratory conditions with Cry1Ca, and later on transgenic broccoli expressing *cry1ca*, increased resistance levels to 12,400-fold, suggesting that *P. xylostella* has the capability to develop resistance against several *Bt* proteins in a short span of time. *H. armigera* has also shown potential to develop resistance to Cry1Ac under selection pressure; 31-fold after six generations and 76-fold after nine generations. It has also been reported to develop 43-fold resistance to *Bt* cotton over 16 generations of selection on the basis of mean concentration for 50 per cent weight loss of larvae. In another study, resistance in *H. armigera* was detected after 12 generations on transgenic cotton using a leaf-feeding method (Sharma, 2009).

Field-Evolved Resistance: Field-selected resistance is a genetically based decrease in susceptibility of a population to a toxin caused by exposure of the population to the toxin in the field. Extensive and intensive exposure of insect pests to *Bt* toxins through transgenic crop plants or other tactics may lead to development of resistance to *Bt*. Development of resistance to *Bt* under field conditions may not be

a serious issue since the Bt and the insect pests have co-evolved for millions of years under natural conditions. The rate of development of resistance under natural conditions may not be high, because of limited exposure and several toxins produced by Bt. In transgenic plants, the insects are continuously exposed to the exotic genes, and there are possibilities of development of resistance in the target insects (Sharma, 2009).

There are two species of insects that have been reported to develop resistance to Bt sprays under field conditions. The reports of development of resistance in the field populations of *P. xylostella* are essentially from the countries where Bt is extensively used, viz. China 1000 tonnes, Philippines 300 tonnes, Malaysia 250 tonnes, and North America about 1000 tonnes per annum. The highest levels of resistance recorded have been 30-fold. Recently, *T. ni* populations from commercial vegetable greenhouses in British Columbia have been reported to develop resistance. Bt resistance levels were directly correlated to the amount of Bt applied, and Bt resistance was observed to evolve repeatedly within one year as a consequence of grower spray programmes. The application of high doses of Bt generally intensified the rates of resistance evolution. It is likely that the greenhouse environment plays a significant role in contributing to the development of resistance to Bt. The favourable environmental conditions and longer growing season in greenhouse increase the exposure period of *T.ni* to Bt, thus increasing the selection intensity for Bt resistance (Dhaliwal and Koul, 2010).

Recently, Tabashnik *et al.* (2008,2009) reviewed the status of field-evolved pest resistance to Bt crops, based on monitoring data from seven countries testing responses of field populations of 11 species of lepidopteran pests to four toxins produced by Bt cotton and maize (Cry1Ab, Cry1Ac, Cry1AF and Cry2Ab). Strong evidence of field-evolved resistance to Bt toxins in transgenic crops has been reported for some populations of three targeted noctuid moths, i.e. *Spodoptera frugiperda* (J.E. Smith); *Busseola fusca* (Fuller) and *Helicoverpa zea* (Boddie). Field-evolved resistance of *S. frugiperda* to Bt maize producing Cry1F occurred in four years in the United States territory of Puerto Rico, making it the fastest documented case of field-evolved resistance to a Bt crop. This is also the first case of resistance leading to withdrawal of a Bt crop from the market. Monitoring data also show that field-evolved resistance to Bt maize producing Cry1Ab occurred in a population of *B. fusca* in South Africa in eight years or less. Similarly, the field-evolved resistance to Cry1Ac, the first Bt toxin produced by transgenic cotton, occurred in as little as 7-8 years in some populations of *H. zea* in the southwestern United States (Arkansas, Mississippi and Georgia).

Nine species of lepidopteron pests have exhibited sustained susceptibility to transgenic cotton (Cry1Ac and Cry2Ab) and maize (Cry1Ab) after exposure for various periods in the field in different countries. These include *P. gossypiella* (cotton: 7 years, USA), *H. armigera* (cotton: 3 years, Australia; 6 years, China), *Helicoverpa punctigera* (Wallengren) (cotton: 4 years, Australia), *H. zea* (cotton: 2 years, North Carolina-USA), *Heliothis virescens* (Fabricius) (cotton: 10 years, USA), *Sesamia nonagrioides* Lefebvre (maize: 3 years, Spain), *Diatraea grandiosella* (Dyar) (maize: USA), *Diatraea saccharalis* (Fabricius) (maize: 2 years, USA), and *O. nubilalis* (maize: 10 years, USA; 3 years, Spain). Five studies from China and India reported ambiguous evidence about resistance of *H. armigera* to Cry1Ac in Bt cotton. The results were not considered to be dependable either due to anomaly in experimental methodology or lack of reaction of a concurrently tested susceptible strain. (Tabashnik *et al.*, 2009).

In India, the changes in variability of *H. armigera* susceptibility levels to Cry1Ac toxin have been monitored during 2001-2007. The collections were made from 53 cotton growing districts of India, including 26 from central, 17 from south and 10 from north India. The data clearly indicated a decrease in the proportion of susceptible individuals. For example, the proportion of populations exhibiting LC₅₀ values of less than 0.1µg Cry1Ac per ml of diet were 22-38 per cent between 2002 and 2004, which decreased to 5-12 per cent during 2005 to 2007. It has been estimated that when 40 per cent of the total area under cotton would be covered with Bt cotton, it would take 11 years for resistance gene frequency to reach 0.5 in *H. armigera* populations if no pest control measures are adopted. If control operations cause 90 per cent mortality, then it would take 45 years for resistance allele frequency to reach 0.5. Similarly, it has been shown that resistance allele frequency of *H. armigera* to Cry1A toxin will increase from 0.001 to 0.5 after 38 generations (9 years) in a typical cropping system in China, where maize fields act as a natural refuge for Bt cotton. If the whole area in

a region is cropped with Bt cotton, the expected time for field failure of Bt cotton will be only 26 generations (7 years) (Sharma, 2009; Dhaliwal and Koul, 2010)

Mechanisms of Resistance: Some possible mechanisms can be envisaged to explain the development of resistance in insects to Bt transgenic crops (Dhaliwal and Koul, 2007).

Lower Level of Toxin Activation: The most important mechanism is the slower activation of the protoxins by gut proteinases. The proteolytic processing of protoxins into toxins is essential for the insecticidal activity of Bt formulations. It is also required by some transgenic plants expressing combinations of Bt toxins as fusion proteins or toxins extending beyond the protease activation site. This mechanism of resistance was first described in the Indian meal moth, *P. interpunctella*. The Bt resistant strains of *P. interpunctella* displayed slower processing and activation of Cry1 protoxins. The slower protoxin activation of the resistant strain led to a reduced quantity of toxin resulting in a survival advantage. Some of the resistant strains lacked a major trypsin-like gut enzyme, and absence of the gut protease and resistance to the toxin were genetically linked. Similarly, a Bt-resistant strain of *H. virescens* exhibited a slower activation of the protoxin as well as a faster rate of degradation of the toxin by midgut extracts.

Reduced Binding to Midgut Membrane: The second most frequently observed mechanism of resistance among insect pests is the modification of the receptor site. This mechanism has been studied extensively on a large range of insect species and toxins, and most of these studies pointed out a change in the level of affinity of the receptor for the toxin or to a decreased number of receptor sites. Several studies have provided convincing evidence that in *P. interpunctella* and *P. xylostella*, resistance is partly due to changes in the binding affinity of receptors on the brush border membrane of the insect midgut. The first study of mechanism of resistance in a field-evolved Bt resistant strain was made using a colony of *P. xylostella* from the Philippines. In the resistant strain, a loss of specific binding to Cry1Ab suggested that the resistance was due to a change in the Cry1Ab binding site. A field collected strain of *P. xylostella* from Florida selected for resistance to HD-1 was highly resistant to Cry1Aa, Cry1Ab and Cry1Ac, but not to Cry1B, Cry1c and Cry1D. Analysis of binding characteristics of biotinylated toxins on brush border membrane vesicles showed a loss of binding to Cry1Ab in the resistant strain, whereas binding properties of Cry1B and Cry1C remained unchanged. Recent studies implicate the binding site receptor to be aminopeptidase-N in *P. xylostella* and *Lymantria dispar* (Linnaeus), and N-acetylgalactosamine in *Manduca sexta* (Johannsen).

Management Strategies: The strategies for managing insect resistance to toxins in transgenic crops are comparable to those used for managing resistance to conventional insecticides, with only a few exceptions (Sharma, 2009)

- Expression of toxins at very high levels is one of the strategies to slow down the adaptation by insects to a toxin and prevent/ delay the evolution of strains capable of surviving on the transgenic crops.
- Pyramiding two or more genes will help in expanding the spectrum of insecticidal activity of the transgenic cultivar, thereby providing more effective control of insect pests and also reduce the possibility of development of resistance.
- A refuge composed of non- transgenic plants of the same crop or other susceptible hosts of the target pest can be used to produce insects that have not been exposed to or selected for resistance to the transgenic product.
- Specific gene promoters could be used to express genes only in the most important tissue (tissue specific expression) or critical growth periods (temporal specific expression).
- Transgenic crops can be rotated with non-transgenic crops in the following year or season. This strategy would work better if resistance in insect populations is not stable and breaks down when selection pressure is removed.
- Several agronomic practices like removal of alternate hosts and destruction of carryover population by ploughing or flooding the fields immediately after crop harvest, destruction of stems or burning of stubbles of insects with larvae and pupae, will help in reducing the density of the pest. Low to moderate levels of insect populations can be effectively controlled by the transgenic crop.
- The most important approach to manage resistance to transgenic crops is to diversify pest management techniques and resistance management techniques. Developing knowledge-based

strategies aimed at achieving long life of transgenic crops should be commensurate with the integrated crop management.

Conclusions: Transgenic crops have been remarkably successful since their commercial introduction about 15 years ago. The use of crop protection traits through transgenics will continue to expand in the future. The expanded use of transgenic crops for insect control will likely include more varieties with combinations of two or more Bt toxins, novel Bt toxins such as vegetative insecticidal proteins, and modified Bt toxins that have been genetically engineered to kill insects resistant to standard Bt toxins. Increasing use of transgenic crops with a broadening range of genetically modified crops and target insect pests, is likely. Therefore, the early detection and proactive management of resistance is essential to prolong the life of transgenic cultivars. A detailed understanding of the mechanisms, insect biology and plant molecular biology can be used to tailor expression of genes in transgenic plants in future. The use of integrated pest management and other strategies from the very beginning is crucial to delay the development of insect resistance to transgenic crops and increase their utility in sustainable crop protection.

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GAMMA RAY AND EMS INDUCED GENETIC VARIABILITY FOR SEED TRAITS IN TRADITIONAL AROMATIC RICE (*Oryza sativa* L.) IN M₂ GENERATION

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Rice is the staple warm season extensively grown food crop ranking at 2nd in area and production in world (Anonymous, 2007) place after wheat; it is India has largest area under paddy in the world and ranks second in the production after China. Since rice is a diploid and self-pollinated crop, it possess enormous possibilities properties of improvement through mutation breeding. The present investigation was undertaken has been taking up with two genotypes of rice, which included *Kalanamak* (Medium Slender Grain) and *Badshahbhog* (Short and flattened grain) in order to study the nature and amount of variation induced by gamma rays and EMS, singly and in combination have been studied in five seed characters. Since rice is a diploid and self-pollinated crop it possess enormous possibilities of improvement through mutation breeding; significant achievements have been made in developing new rice varieties with desirable characters through mutation breeding. This approach was followed to create genetic variability in IR8 (semi-dwarf coarse variety) through gamma-ray for selecting new genotypes with improved grain quality and high yield potentials (Singh *et al.*, 2004; Bughio *et al.*, 2007 and Domingo *et al.*, 2007).

Materials & Methods

Two thousand pure, healthy and dry seeds (moisture, 12%) were sealed in polythene bags to of the two rice varieties, namely, *Kalanamak* and *Badshahbhog* were irradiated with 10, 20, 30 and 40 kR doses of 60Co. gamma rays at National Botanical Research Institute, Lucknow, Uttar Pradesh. Irradiated and unirradiated seed lots of each variety were divided into two equal parts (one thousand each). First lot was used as gamma rays treatment alone and other for combined treatment of gamma rays + Ethyl methane sulphonate (0.2%) and EMS (0.2%) alone. For chemical mutagen treatment, the seeds were submerged soaked for six hours, in distilled water to insure complete hydration of the seeds at 30 °C in incubator. Soaked seeds were blotted and transferred for removing surface water before transferring them into Ethyl methane sulphonate (0.2%) prepared with phosphate buffer solution having the (pH 7.0) for a period of 6hrs. in incubator (25°C) with and were given intermittent shaking. throughout the period of treatment to maintain uniform concentration. After EMS treatment, the seeds were then thoroughly washed in running tap water for 6 hrs to remove residual chemicals.

For micro mutational studies, all the twenty M₁ plants having 60% pollen fertility or more (minimum being twenty plants per treatment were advanced to raise M₂ generation following the procedure adapted by (Gaul, 1964), for which they Seeds of twenty M₁ plants, selected on the basis of pollen fertility as described above, were sown separately in the nursery during rainy season of 2006-2007. Twenty one days old seedlings of all the twenty M₁ plants selected from each treatment were transplanted in plots arranged in the well puddled field, in Randomized Block Design with three replications. Agronomic practices were the same to that of M₁ generation. Data on five competitive normal looking plants from each M₂ families were taken randomly to record the observations on five seed characters, namely, recorded for 100-seed weight (g), kernel length (mm), kernel breadth (mm), and L/B ratio and grain yield/plant. Since the minimum number of promising micro-mutants in M₂ families for any one of the treatments was twenty 20, five normal looking plants were selected at random from each of these 20 families. Since numbers of micro- mutations were variable in each treatment, only top twenty micro mutants were sown on raised nursery beds during the rainy (Kharif) season of 2006. The 21 days old seedling of all the twenty M₂ plant progenies were transplanted in well puddle field at the distance of 20 cm × 10 cm from row to row and plant to plant, respectively as has been done in M₂ generation. Randomized Block Design with three replications was followed for transplanting. Each micro mutant was transplanted in three rows of 4 meters in length. Recommended agronomic practices were followed to raise good crop. The quantitative and quality traits studied in

the M_2 was on five normal looking plants selected at random from each mutant families in each treatment in both the varieties.

Results and Discussion

100-Seed Weight: The significant shift in mean values as compared to control coupled difference in 100 seed weight due to mutations was observed with high variability, as evident from the range and CV, in M_2 generation was noted in *Kalanamak* (Table 1), all the treatments except 10kR gamma-ray, 20kR gamma-ray, EMS and 10kR gamma-ray+EMS. While positive shift in mean was noted only in treatment 20kR gamma-ray+EMS in both the varieties in M_2 generation. Mutants with high seed weight, as compared to control, were noted in all the treatments except 10kR gamma-ray, 20kR gamma-ray, EMS, and 10kR gamma-ray+EMS in both the generations. In *Badshahbhog* (Table 1), all the treatments except 10kR gamma-ray, EMS, 10kR gamma-ray+EMS and 20kR gamma-ray+EMS caused significant shift in mean 100-seed weight in M_2 generation. The shift in mean toward positive direction i.e., higher 100-seed weight was noted in treatment with 30kR gamma-ray in M_2 . The mutants with increased 100-seed weight, as evident from upper values of range as compared to control, were noted in due to the treatments with 40kR gamma-ray and 40kR gamma-ray+EMS in the M_2 generation.

Table 1: Range, Values of mean and coefficient of variation (CV) for 100 -seed weight and Kernel length (L) in M_2 generatio

Treatment	100 -seed weight						Kernel length (L)					
	Kalanamak			Badshah Bhog			Kalanamak			Badshah Bhog		
	Range	Mean	CV	Range	Mean	CV	Range	Mean	CV	Range	Mean	CV
Control	1.69-1.99	1.85	6.65	1.66-2.11	1.83	5.68	4.93-5.69	5.51	4.18	3.79-4.18	4.14	3.84
Gamma-ray												
10kR	1.65-2.01	1.80	7.07	1.63-2.13	1.79	9.09	4.82-5.71	5.47	4.43	3.66-4.19	4.12	3.96
20kR	1.64-2.09	1.91	8.98	1.56-2.14	1.71*	10.17	4.80-5.84	5.79*	4.66	3.60-4.36	4.11	4.19
30kR	1.41-2.19	1.73*	11.87	1.58-2.19	1.95*	12.07	4.76-5.86	5.31*	4.71	3.59-4.40	4.25*	4.62
40kR	1.52-2.21	1.74*	12.08	1.55-2.26	1.70*	13.50	4.70-5.90	5.38*	5.24	3.51-4.41	4.09	5.11
EMS												
0.2%	1.64-2.09	1.79	8.16	1.65-1.99	1.74	11.19	4.86-5.64	5.51	4.48	3.70-4.31	4.10	4.01
Gamma-ray +EMS												
10kR+EMS	1.58-2.06	1.77	9.19	1.45-2.16	1.75	9.10	4.86-5.64	5.47	4.69	3.60-4.25	4.11	4.06
20kR+EMS	1.53-2.17	1.96*	11.64	1.50-2.16	1.92	11.50	4.71-5.80	5.76*	4.81	3.53-4.42	4.24*	4.39
30kR+EMS	1.50-2.17	1.74*	12.81	1.49-2.21	1.66*	12.21	4.64-5.86	5.25*	4.96	3.61-4.34	4.02*	4.69
40kR+EMS	1.43-2.29	1.73*	15.97	1.42-2.36	1.65*	13.41	4.60-5.9	5.20*	5.31	3.49-4.54	3.98*	5.21
S.Em±		0.048			0.048			0.056			0.043	
CD at 5%		0.100			0.101			0.118			0.091	

Kernel Length (L): In *Kalanamak* and *Badshahbhog* (Table 1), treatments 30kR and gamma-ray, 40kR gamma-ray, and their combinations with EMS caused significant reduction in kernel length in M_2 generation. The significant positive shift in mean values was noted in treatments 20kR gamma-ray and 20kR gamma-ray+EMS in the M_2 as compared to control. It was remarkable to note mutants with increased kernel length in most of the treatments in M_2 generation. While in *Badshahbhog*, treatments 30kR gamma-ray+EMS and 40kR gamma-ray+EMS caused significant reduction in mean kernel length in both M_2 generation. Two treatments, 30kR gamma-ray and 20kR gamma-ray +EMS showed increase in mean values kernel length as compared to control. Mutants with large kernel length, as evident from upper values of range, in certain treatments were remarkable.

Kernel Breadth (B): In *Kalanamak* and *Badshahbhog* (Table 2), only three treatments, (30kR gamma-ray, 30kR gamma-ray+EMS and 40kR gamma-ray+EMS) caused significant increase in kernel breadth as compared to control in the M_2 . None of the treatments showed significant decline in kernel breadth. It was remarkable to note the occurrence of desirable mutants with reduce kernel breadth in the treatments 40kR gamma-ray + EMS and 40kR gamma-ray as compared to control. In *Badshahbhog*, all the treatments except 10kR gamma-ray, 20kR gamma-ray, 40kR gamma-ray, EMS and 10kR gamma-ray+EMS showed shift in mean kernel breadth in the M_2 generation. Shift in mean towards negative side in kernel breadth was noted in the treatments 30kR gamma-ray and 20kR gamma-ray+EMS in the M_2 generation.

Table 2 : Range, Values of mean and coefficient of variation (CV) for Kernel breadth (B) and L/B ratio in M₂ generation

Treatment	Kernel breadth (B)						L/B ratio					
	Kalanamak			Badshah Bhog			Kalanamak			Badshah Bhog		
	Range†	Mean	CV	Range†	Mean	CV	Range†	Mean	CV	Range†	Mean	CV
Control	1.89-2.04	1.89	4.13	1.90-2.10	1.95	4.20	2.58-3.61	2.91	3.89	1.97-2.28	2.14	4.11
Gamma ray												
10kR	1.80-2.06	1.88	4.26	1.89-2.11	1.97	4.80	2.36-3.28	2.92	3.99	1.86-2.53	2.11	4.30
20kR	1.76-2.11	1.86	4.39	1.86-2.18	1.95	4.96	2.50-4.01	3.11*	4.02	1.83-2.50	2.11	4.49
30kR	1.71-2.21	1.96*	4.96	1.80-2.19	1.86*	5.61	1.99-3.12	2.71*	4.81	1.77-2.98	2.28*	4.64
40kR	1.60-2.13	1.92	5.19	1.89-2.19	1.97	4.22	2.28-3.47	2.81	5.31	1.65-2.75	2.09	5.09
EMS												
0.2%	1.81-2.10	1.87	4.30	1.88-2.10	1.94	4.40	2.4-3.30	2.95	4.21	1.66-2.45	2.12	4.50
Gamma ray+ EMS												
10kR+0.2%	1.74-2.12	1.91	4.34	1.85-2.10	1.94	4.88	2.36-3.31	2.86	4.19	1.85-2.62	2.11	4.71
20kR+0.2%	1.70-2.15	1.87	4.48	1.84-2.20	1.88*	5.61	2.28-3.10	3.09*	4.36	1.95-2.84	2.27*	4.82
30kR+0.2%	1.69-2.24	1.96*	5.11	1.82-2.20	2.02*	5.89	1.20-3.21	2.67*	5.19	1.54-2.42	2.01*	4.98
40kR+0.2%	1.51-2.23	1.99*	5.32	1.80-2.21	2.03*	6.09	1.71-3.25	2.61*	5.24	1.48-2.28	1.98*	5.35
S.Em±		0.027			0.029			0.050			0.050	
CD at 5%		0.056			0.059			0.105			0.104	

L/B Ratio: In *Kalanamak* and *Badshahbhog* (Table 2), all but 10kR gamma-ray, 40kR gamma-ray, EMS and 10kR gamma-ray+EMS treatments showed significant shift variation in mean L/B ratio. The desirable significant shifts towards high values of ratio were noted in 20kR gamma-ray and 20kR gamma-ray+EMS in M₂ generation. The magnitude of variability, as judged from the range towards desirable side i.e. positive shift in mean for L/B, was high in 20kR treatment in the M₂. In genotype *Badshahbhog*, the treatments 30kR gamma-ray, 20kR gamma-ray+EMS, 30kR gamma-ray+EMS and 40kR gamma-ray+EMS produced significant shift in mean; positive shift in mean, as judged from increased L/B ratio, was noted in treatments 30kR gamma-ray and 20kR gamma-ray+EMS in M₂ generation. Mutants with high L/B ratio as compared to control were noted in treatments 30kR gamma-ray and 20kR gamma-ray+EMS in the M₂ generation.

Grain Yield Per Plant: In *Kalanamak* (Table 3), all the treatments except 10kR gamma-ray, 20kR gamma-ray, EMS and 10kR gamma-ray + EMS caused significant shift variation in mean values as compared to control in M₂ generation. positive shift in mean was noted in the treatments in 20kR gamma-ray+EMS in M₂ generation. It was remarkable to note mutants with increased grain yield per plant, as judged from upper values of range, in most of the treatments in both M₂ generation. While in *Badshahbhog*, all treatments except 10kR gamma-ray, EMS, 10kR gamma-ray+EMS and 20kR gamma-ray+EMS caused significant shift in mean grain yield per plant as compared to control the M₂ generation; positive shift in mean was noted only in treatment 30kR gamma-ray. Combined treatments with 30kR gamma-ray and 40kR gamma-ray were more drastic in reducing grain yield per plant in M₂ generation in both the genotype, *Kalanamak* and *Badshahbhog*. Mutants with high grain yield as compared to the control, in most the treatments were remarkable to note.

The use of physical and chemical mutagens, or a combination of both, has been an important tool for the increase of variability in agronomic traits (Jana and Roy, 1973; Rao and Rao, 1983; Siddiqui, and Singh, 2010). Their potentiality of ionizing radiation and chemical mutagens is different and their ability to induce mutation varies from crop to crop and genotype to genotype. Therefore, it is desirable to have the appropriate treatment schedule before under taking the mutagenesis. Gaul (1961) and other recommended selection of normal looking plants at random in from M₂ generation to raise M₃ 'families'.

In general, mutagenic treatments had resulted in decreased mean coupled with enhanced variability in both genotypes in M₂ generation as compared to their respective control, though the magnitude of variation differed of shift in mean varied with the treatment, genotype and trait. The results are in agreement with those reported earlier in decline in means of treated population was demonstrated in rice (Jana and Roy, 1973; Awan *et al.* 1980; Siddiqui and Singh, 2010) and The decrease in means of mutagen treated population might be due to greater frequency of mutations with detrimental effects or due to difference in magnitude of induced individual change. The shift in mean

was not found to be unidirectional nor equally in both directions in all the treatments. Similar findings have been observed in bread wheat soyabean, urdbean and grass pea (Singh *et al.* 1979; Mehetre *et al.* 1999; Singh *et al.* 200; Waghmare *et al.* 2000).

Table 3: Range, Values of mean and coefficient of variation (CV) for Grain yield per plant in M₂ generation

Treatment	Grain yield per plant					
	Kalanamak			Badshah Bhog		
	Range	Mean	CV	Range	Mean	CV
Control	11.98-16.41	12.76	15.77	11.21-17.99	13.06	17.51
Gamma ray						
10kR	5.66-18.61	12.66	28.80	4.78-19.86	12.78	26.41
20kR	4.41-19.98	13.02	30.89	4.53-20.13	11.82*	31.36
30kR	4.12-20.16	9.69*	35.85	2.98-21.62	14.23*	37.87
40kR	3.55-21.18	10.98*	43.44	2.36-22.37	10.37*	46.81
EMS						
0.2%	6.13-17.99	11.95	29.13	4.36+19.61	12.08	28.57
Gamma ray+ EMS						
10kR+0.2%	5.10-18.61	12.34	30.28	4.68-20.61	12.23	35.77
20kR+0.2%	4.99-19.80	14.13*	37.39	3.98-21.65	13.66	40.33
30kR+0.2%	3.09-21.42	11.62*	42.49	3.64-22.14	11.14*	43.33
40kR+0.2%	2.17-22.14	8.82*	48.56	2.84-23.19	9.12*	48.69
S.Em±		0.49			0.496	
CD at 5%		1.03			1.04	

The present investigation had clearly demonstrated the high potentials of combined treatments (gamma-ray + EMS) in releasing desirable variability for yield traits. Treatments 40kR gamma-ray+EMS followed by 40kR gamma-ray and 30kR gamma-ray+EMS were found to be most useful in releasing variability in desired directions in most of the characters in both the genotypes and generations. In few treatments, mean higher values of the productive traits than control were observed in 30kR gamma-ray in *Badshahbhog* and 20kR gamma-ray + EMS in *Kalanamak* in M₂ generation. Similar results of increased mean than the control were also reported in rice (Jana and Roy, 1973; Siddiqui and Singh, 2010).

In general, there was reduction in variability, as indicated by the values of judged from range and CV in M₂ generations in all the treatments and traits in both the genotypes as was Similar observations were also found by several workers (Scossiroli, 1965; Jana and Roy, 1973; Siddiqui and Singh, 2010). The reduction in CV might have been due to increased in the frequency of genetic death due to homozygosity because of the homogygosity of harmful genes in M₃ generation. Scossiroli (1968) after an extensive study, had reported that genetic variability in M₂ remained in the latent conduction, which in the heterozygosity but it was exposed in later subsequent generation due to increase in homozygosity at different loci.

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