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# Medicinal and Aromatic Plant Production Technologies

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**ABSTRACT:** Medicinal and aromatic plants occupy an important position in the sociocultural, health care and spiritual arena of rural people of India. Medicinal plants contributed significantly to the rural livelihoods. Globally, medicinal and aromatic plants (MAPs) constitute one of the integral parts of the biodiversity, ecosystem and biological heritage. Medicinal and aromatic plants are being used since ancient time for the treatment of many diseases in traditional and recognized systems of healthcare and for therapeutic, fragrance and flavoring products in pharmaceutical and cosmetic industries besides as sources of natural dye, fat, essential oil, bio-pesticide, resin, protein, vitamin, condiment, spice, timber, fiber and other useful substances. These plants are also considered to be the prime source of drug and aroma molecules and their precursors in modern medicine. Medicinal and aromatic plants (MAP)-based livelihood systems are often mediated by the market forces and/ related directly to employment and income of the poor people. Based on the research work carried out by International Development Research Centre (IDRC) in South Asia, MAP and other biodiversity-based livelihoods can not only become poverty reducing they can also be made socially equitable and gender balanced. MAP-based livelihoods can be easily mainstreamed with other components to enhance human welfare, especially among farmwomen . Medicinal plants are the natures' gift for the mankind. According to the World Health Organization, 80% of people from developing countries depend mainly on traditional medicine for primary health care. Traditionally, women have been the main producers of plant based medicinal products. Women conserve economically important plant species (such as plants used for food, traditional medicine, dye and soil stabilization). India one of the worlds' richest sources of medicinal plants comprises of nearly 45,000 species, but only 60 species of them find major commercial use as per the National Medicinal Plant Board. Medicinal plants provide crucial livelihood options for millions of rural peoples in the world especially tribal peoples and women.

**KEYWORDS:** medicinal, aromatic, plants, processing, technologies, development, production

## I. INTRODUCTION

The collection, simple processing and trading of medicinal plants contribute significantly to the family income of poor in general and of women in particular. Traditional knowledge (TK) associated with medicinal herbs and cultivation, innovation and preservation of medicinal herbs is a highly gendered activity in most countries. With the day –to –day all round progress, we have invited certain unavoidable troubles for our health. Presently 1/4th of adults in our country and 7.6 crore population are suffering from high blood pressure and diabetes. Medical treatment is very costly and many people are unable to afford the cost of the treatment. In this way medicinal plants are playing crucial role in reducing the cost and maintain health. The addiction to chemical-based medicines causes a number of side- effects in our body in the long run. Whereas in the ancient time our ancestors used to take only plant –based medicine resulting they were healthier without any further deterioration in their health. [1,2,3]The use of medicinal and aromatic plants still has the same efficacy if taken properly. But over- exploitation and indiscriminate use of medicinal plants is threatening our natural resources which are immense importance. Therefore, conservation and utilization of the biodiversity of medicinal plants is the demand of the day. Since women are the first victims of this shrinking resource base so they should involved in collecting , conserving, processing and value addition activities of medicinal and aromatic plants. Besides to the above, , they are not accessible to recent advances in science, which can help them generate more income and in turn improve of quality of their life. Cultivation of medicinal plants especially high value medicinal plants is creating new dimension in the field of agriculture. For women having marginal land holding, it will be beneficial if they cultivate high value medicinal plants and process them. Post harvest storage and processing are the major activities done by the women must be standardized. If considerable research efforts are made to conserve their biodiversity and popularize for proper utilization. Rural women are very much associated with various types of medicinal plants and using for curing of various types of ails since time immemorial[4,5,6]. It has been observed that

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small and marginal farmer particularly women are collecting some common used and easily available medicinal plants such as Aloevera, tulsi, mint, brahmi etc from nearby and using them for curing of different types of ails. They also planted these herbs in their homesteads for future use. In areas where there is out-migration of men leading to the feminization of agriculture, women tend to conserve a wide range of food and medicinal plants for ensuring household food and health security. Hence, cultivation of medicinal plants are very important in many ways thus, there is need to popularize them about the utility and value of medicinal plants among farm women for improving health and livelihoods. Scope for medicinal and aromatic plants: India has different agro-ecological zones suitable for growing different medicinal and aromatic plants, which are in great demand. However, systematic efforts will need to push this particular sector agro-ecological zone wise. The plant species will have to be identified and their package of practices will be developed. Identification of species will be important criteria for marketing. Therefore, planting material of identified varieties from standard source will be important for farming.

## II. DISCUSSION

Throughout South Asia, the use of medicinal plants in meeting family's primary health care and nutrition needs is traditional and imbedded in all cultures — a practice dating back to at least four thousand years in many countries (Fransworth & Soejarto, 1991). In this respect - it needs no introduction for acceptability regarding familiarity with the usage of plant products, methods of cultivation of many commonly grown plants and technologies required for processing into items of common household uses and value. Medicinal plants[7,8,9] are socially acceptable employment avenues for women. Traditionally, women have been the mainstays of medicinal plants-based activities and micro-enterprises because the products and activities thereof easily fit within the average daily needs of women. Medicinal plants have also been used to develop family-based health and livelihood oriented enterprises in rural areas. Many traditional healers have been running MAP-based health care system to earn their livelihoods. Arya Vaidya Sala (AVS), Kottakal in Kerala is an excellent example of business and traditional medicine service combined. Such industries not only strengthen the social fabric, but also help: a) preserve the traditional medical knowledge, and b) provide easily adaptable enterprising opportunities for unemployed youth and rural poor who can learn the trade from their parents and peers and earn not only their livelihood but also contribute to the society (Karki, 2000). Protection of Traditional Knowledge The urgency and need to protect the fast disappearing medicinal plants-based traditional knowledge, which is still abundant in the hills and valleys of South Asia cannot be overemphasized. In fact, the sacred mountains of Himalayas (popularly known as Dev Bhumi or abode of God) are widely believed to be the source of the age-old traditional system of medicine called Ayurveda. The indigenous people of Himalayas have a rich local health traditions and a large number of traditional healers have been practicing indigenous medicine for hundreds of years (Bordekar, 2000). If proper values can be added to the traditional medical knowledge-based health practices and subsistence-oriented MAP applications, a large number of jobs can be created in the rural areas. Even at current level of conversion of traditional medicinal knowledge into economic opportunities, enterprise-based application can account for thousands of jobs in rural areas. Thus, medicinal plants have high potential[10,11,12] in creating jobs and pushing economic growth in resource-constrained areas suffering from limited educational opportunities, mountain-specific marginalities and lack of infrastructure, and underdeveloped medicinal plants-based trade and commercial activities. The conversion of socio-cultural traditions and indigenous knowledge into livelihood means and economic opportunities also has the advantage of preserving the rapidly eroding cultural knowledge and practices which are increasingly threatened due to globalization and homogenization of people and communities. As the Himalayas are recognized to be the treasure trove of biological and cultural diversity - the product of millions of years of evolution – there is a need to protect indigenous knowledge and cultural diversity on an urgent basis. In the uplands of Northeast Himalayas, especially in the areas predominated by shifting cultivation and marginal agriculture, the means of achieving this may be by providing economic value to traditional and indigenous knowledge (Ramakrishnan, 1992). Environmental Perspective The growing apathy toward products made from chemical products and unsustainably harvested forest products becoming ethically unacceptable consumer goods have created new markets for quality, certified and organic herbal products. Medicinal plants have the potential to fill these needs as they provide green health alternatives and a number of other ecofriendly products of domestic and industrial usage (Bordeker, 2002, Temptesa & King, 1994). Found as trees, shrubs, grasses and vines, these plant species abundantly growing in South Asia. Its entry into the world food and drug market as the environment friendly botanical products is looked upon as an emerging and new opportunity that can help save environment by promoting community-based conservation. The

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development of medicinal plants-based economic incentives is being increasingly applied to enlist greater participation of people in conservation of forest ecosystem. Medicinal Plants and Human Health South Asia is home to many rich, traditional systems of medicine[13,14,15] (TSM). Ayurvedic system dates back to 5000 B.C. Along with the Unani, Siddha and Tibetan systems, these TSMs remain important source of everyday health and livelihood for tens of millions of people. Himalayan sage scholars of Traditional Medicine have said "Nanaushadhi Bhootam Jagat Kinchit" i.e. `there is no plant in the world, which does not have medicinal properties.' The ancient scholars are estimated to know the medicinal properties of hundreds of species of plants. It is therefore, no exaggeration to say that the uses of plants for human health are probably as old as human beings themselves. Medicinal plants are accessible, affordable and culturally appropriate sources of primary health care for more than 80% of Asia's population (WHO). Poor and marginalized, who cannot afford or access formal health care systems, are especially dependent on these culturally familiar, technically simple, financially affordable and generally effective traditional medicines. As such, there is widespread interest in promoting traditional health systems to meet primary health care needs. This is especially true in South Asia, as prices of modern medicines spiral and governments find it increasingly difficult to meet the cost of pharmaceutical-based health care. Gender Perspective Traditionally, women have been the main producers of plant-based medicinal products through household micro-enterprises. Women often can procure and assemble ingredients as part of their established routines and work schedules. At least 25 percent of the drugs in modern pharmacies are derived from plants, and ingredients of many others are synthetic replacements built on related plant compounds. Medicinal and aromatic plants provide crucial livelihood options for millions of rural people in South Asia, especially tribal peoples and the very poor, many of whom are women. The collection, simple processing, and trading of medicinal plants contribute significantly to the cash income of the poor in general and of women in particular, in all countries of South Asia. Many communities in Latin America rely on herbal medicines for health care and traditional women healers. The production and processing of medicinal plants provide many jobs and economic benefits in poor areas, which lack educational opportunities, infrastructure, and health care facilities. In certain rural areas of Costa Rica, the industrialization of medicinal plants has created job opportunities for women, which has contributed to increased family income. The Convention on Biological Diversity recognizes the role of women in the conservation and sustainable use of biodiversity resources and reaffirms the need to guarantee their full participation at all levels of policy making and execution. Nevertheless, women's ethnobotanical knowledge and medicinal knowledge are often unexplored and undervalued. Special attention should be paid[16,17,18] to the significant value of the ancestral knowledge possessed by women. Local medicine specialists and herbalists are often women, especially in Africa and Asia. When the knowledge and contributions made by women are clearly acknowledged and valued, will be possible if we promote effective participation of women in decision-making processes regarding the conservation of biodiversity of medicinal plants at the local and national levels. Information gaps on gender roles and biodiversity management There is a widespread awareness of women's roles and gender-differentiated responsibility in managing biodiversity but there has been no systematic study to document situation-specific gender roles in biodiversity management, nor is there a database on the women who contribute to biodiversity management. Current scenario According to the M.S. Swaminathan Research Foundation (MSSRF), available literature on gender and biodiversity provides the following indications: Men and women have different kinds of knowledge and information about plants, in• part because they have different tasks in farming and providing income and goods for their households. In many societies, women are mainly responsible for seed selection and storage,• exchanging seed and ensuring that local agro-biodiversity is preserved. Both men and women preserve their native plant species. The motivating factors,• however, may differ. Men tend to be more interested in the market value of the species, while women may be more interested in their cooking and nutritional value. In areas where there is out-migration of men leading to the feminization of• agriculture, women tend to conserve a wide range of food and medicinal plants for ensuring household food and health security. The management of herbal gardens is carried out by both men and women in the Jeypore tract at Koraput, Orissa. However, Apatani women in Arunachal Pradesh seem less knowledgeable about medicinal plants or less willing to share information. On the basis of interviews with ten women and ten men, it became clear that both women and men of Lakshadweep Islands are conscious of the use of medicinal plants. Women take care to grow medicinal plants on their household premises. Both women and men of the Kurichiya tribal community in Kerala have maintained the habitat for several species of medicinal plants through[19,20] the preservation of sacred groves and associated areas. Equity and Gender Both men and women play an important and distinct role in production and marketing of MAPs. While men do harvesting, carrying, trade and transport, the harvesting of products, drying, women do sorting and packing. Most MAP-based communities are poor villagers and therefore, a significant portion of the income earned

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goes to the disadvantaged sections of the society. In Khasi society women have the right over the resources but it is the men who manage the forests business. The large chunks of forestlands belong to the government or rich forest owners while the poorer inhabitants are usually employed as labourers by the landowners and forest departments. Employment Potential Cultivation and gathering of MAPs has a great employment potential. From these vast group of plants, medicine, nutritive food, essential oil and natural dyes can also be extracted which can be exploited by setting up micro-enterprises for processing of the raw materials and value addition locally. This would provide more employment to the local people. For example, in a small community in Meghalaya, Bay leaf production is providing employment opportunities for the local people in the form of labourers and traders. Stake holder's participation Local communities, especially weaker and marginalized groups including farmwomen need to be involved in medicinal and aromatic plant cultivation The NGOs and GOs should consult and work with community based organizations and evolved them into participatory process for collection, production and marketing so that technologies will be peculated to the end users. Enterprise Development The demand for medicinal and aromatic plants in India to meet both domestic and export market - comprising 162 species, is expected to increase at about 15 to 16% between 2002 and 2005 (CRPA, 2001). Medicinal and aromatic plants cultivation and management can become highly remunerative both in financial and economic terms for the small-scale growers in general and for farmwomen in particular.

## III. RESULTS

Preparation of medicinal plants for experimental purposes is an initial step and key in achieving quality research outcome. It involves extraction and determination of quality and quantity of bioactive constituents before proceeding with the intended biological testing. The primary objective of this study was to evaluate various methods used in the preparation and screening of medicinal plants in our daily research. Although the extracts, bioactive fractions, or compounds obtained from medicinal plants are used for different purposes, the techniques involved in producing them are generally the same irrespective of the intended biological testing. The major stages included in acquiring quality bioactive molecule are the selection of an appropriate solvent, extraction methods, phytochemical screening procedures, fractionation methods, and identification techniques. The nitty-gritty of these methods and the exact road map followed solely depends on the research design. Solvents commonly used in extraction of medicinal plants are polar solvent (e.g., water, alcohols), intermediate polar (e.g., acetone, dichloromethane), and nonpolar (e.g., n-hexane, ether, chloroform). In general, extraction procedures include maceration, digestion, decoction, infusion, percolation, Soxhlet extraction, superficial extraction, ultrasound-assisted, and microwave-assisted extractions. Fractionation and purification of phytochemical substances are achieved through application of various chromatographic techniques such as paper chromatography, thin-layer chromatography, gas chromatography, and high-performance liquid chromatography. Finally, compounds obtained are characterized using diverse identification techniques such as mass spectroscopy, infrared spectroscopy, ultraviolet spectroscopy, and nuclear magnetic resonance spectroscopy. Subsequently, different methods described above can be grouped and discussed according to the intended biological testing to guide young researchers and make them more focused.[18,19,20]

Medicinal plants are extracted and processed for direct consumption as herbal or traditional medicine or prepared for experimental purposes. The concept of preparation of medicinal plant for experimental purposes involves the proper and timely collection of the plant, authentication by an expert, adequate drying, and grinding. This is followed by extraction, fractionation, and isolation of the bioactive compound where applicable. In addition, it comprises determination of quantity and quality of bioactive compounds.[1,2,3,4,5] Recently, plant as a source of medicine is gaining international popularity because of its natural origin, availability in local communities, cheaper to purchase, ease of administration, and perhaps less troublesome. Also, herbal medicine may be useful alternative treatment in case of numerous side effects and drug resistance.[1,2,3,4,5] Extraction of medicinal plants is a process of separating active plant materials or secondary metabolites such as alkaloids, flavonoids, terpenes, saponins, steroids, and glycosides from inert or inactive material using an appropriate solvent and standard extraction procedure. Plant materials with high content of phenolic compounds and flavonoids were found to possess antioxidant properties, and hence are used to treat age-related diseases such as Alzheimer's disease, Parkinsonism, anxiety, and depression.[2,5] Several methods were used in the extraction of medicinal plants such as maceration, infusion, decoction, percolation, digestion and Soxhlet extraction, superficial extraction, ultrasound-assisted, and microwave-assisted extraction. In addition, thin-layer chromatography (TLC), high-performance liquid chromatography (HPLC), paper chromatography (PC), and gas

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chromatography (GC) were used in separation and purification of the secondary metabolites.[1,2,3,4,5] The choice of an appropriate extraction method depends on the nature of the plant material, solvent used, pH of the solvent, temperature, and solvent to sample ration. It also depends on the intended use of the final products.[1,2,3,4,5] This study aimed to assess various solvents of extractions, methods of extraction, fractionation, purification, phytochemical screening, and identification of bioactive compounds in medicinal plants.

Medicinal plant. It refers to a plant comprising active ingredients or secondary metabolites that possess biological activity. A whole plant may be medicinally active or plant parts.[4,6,7] Herbal medicine. These are medicinal preparations comprising active ingredients obtained from the herbal plant. The product can be made from the whole plant or any part. Preparations from by-product herbal plants such as oils, gums, and other secretions are also considered as herbal medicine.[4,6,7] Menstruum. It is a liquid or a suitable solvent chosen for an effective extraction process.[2,3] Marc. It is an insoluble or inert drug material that is left behind at the end of the extraction process.[2,3] Micelle. It is the mixture of both the extracted drug material and the solvent of extraction.[2,3] Primary plant constituents. These are mainly nutritional components of plants such as common sugars, amino acid, proteins, and chlorophyll. These have little or no medicinal properties.[6,7] Secondary plant constituents. These are also known as secondary metabolites such as alkaloids, terpenoids, saponins, phenolic compounds, flavonoids, and tannins. These are responsible for many biological or pharmacological activities.[6,7] Bioassay-guided fractionation. It involves extraction of plant material followed by testing for biological activity. Once the extract tested is found to be biologically active, the next step is to proceed with fractionation. Subsequently, various fractions obtained are tested for biological activity. Also, the most productive portion is then taken for compound isolation. Finally, the compound isolated is identified and tested for biological activity.[1,5,8] Bioautography. It is a process that uses both TLC and antimicrobial testing to establish the identity of a compound extracted as well as its antimicrobial activity.[5,9] Finger printing in medicinal plants. It involves the use of chromatographic techniques, identification techniques, and chemical analysis to characterize a pharmacologically active compound from a medicinal plant.[4,5] Immunoassay. It is a process of identification of bioactive molecule as well as its biological activity via immune reaction, receptor binding, and enzyme-mediated reactions. The extract and low-molecular-weight secondary metabolites first interact with monoclonal antibody to detect drug–receptor binding. This is followed by application of enzyme-linked immunoassay (ELISA) to determine its enzymatic activities.[5]

SOLVENTS OF EXTRACTION

The solvent used for the extraction of medicinal plants is also known as the menstruum. The choice of solvent depends on the type of plant, part of plant to be extracted, nature of the bioactive compounds, and the availability of solvent. In general, polar solvents such as water, methanol, and ethanol are used in extraction of polar compound, whereas nonpolar solvents such as hexane and dichloromethane are used in extraction of nonpolar compounds.[3,5,10] During liquid–liquid extraction, the conventional way is to select two miscible solvents such as water–dichloromethane, water–ether, and water–hexane. In all the combinations, water is present because of its high polarity and miscibility with organic solvent. The compound to be extracted using liquid–liquid extraction should be soluble in organic solvent but not in water to ease separation.[11] Furthermore, solvent used in extraction is classified according to their polarity, from n-hexane which is the least polar to water the most polar.[3,5,10] The following are 11 various solvents of extractions arranged according to the order of increasing polarity[3,9]:

| | Solvents | Polarity |
|---|---|---|
| 1. | n-Hexane | 0.009 |
| 2. | Petroleum ether | 0.117 |
| 3. | Diethyl ether | 0.117 |
| 4. | Ethyl acetate | 0.228 |
| 5. | Chloroform | 0.259 |

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| | Solvents | Polarity |
|---|---|---|
| 6. | Dichloromethane | 0.309 |
| 7. | Acetone | 0.355 |
| 8. | n-Butanol | 0.586 |
| 9. | Ethanol | 0.654 |
| 10. | Methanol | 0.762 |
| 11. | Water | 1.000 |

During fractionation, the selected solvent is added according to the order of increasing polarity, starting from n-hexane, the least polar to water with the highest polarity.[3,9] If a researcher wishes to select five solvents during fractionation, the usual practice is to choose two solvents with low polarity (n-hexane, chloroform), two with medium polarity (dichloromethane, n-butanol), and one with the highest polarity (water).

## IV. CONCLUSION

(i) Water. It is the most polar solvent and is used in the extraction of a wide range of polar compounds.[9,12] Advantages. It dissolves a wide range of substances; it is cheap, nontoxic, nonflammable, and highly polar.[9,12] Disadvantages. It promotes bacterial and mold growth; it may cause hydrolysis, and a large amount of heat is required to concentrate the extract.[9,12]

(ii) Alcohol. It is also polar in nature, miscible with water, and could extract polar secondary metabolites.[9,12] Advantages. It is self-preservative at a concentration above 20%. It is nontoxic at low concentration, and as small amount of heat is required for concentrating the extract.[9,12] Disadvantages. It does not dissolve fats, gums, and wax; it is flammable and volatile.[9,12]

(iii) Chloroform. It is a nonpolar solvent and is useful in the extraction of compounds such as terpenoids, flavonoids, fats, and oils.[3,12,13] Advantages. It is colorless, has a sweet smell, and is soluble in alcohols. It is also well absorbed and metabolized in the body.[3,12,13] Disadvantages. It has sedative and carcinogenic property.[3,12,13]

(iv) Ether. It is a nonpolar solvent and is useful in the extraction of compounds such as alkaloids, terpenoids, coumarins, and fatty acids.[3,12,13] Advantages. It is miscible with water, has low boiling point, and is tasteless in nature. It is also a very stable compound and does not react with acids, bases, and metals.[3,12,13] Disadvantages. It is highly volatile and flammable in nature.[3,12,13]

(v) Ionic liquid (green solvent). This is a unique solvent of extraction and is highly polar and extremely heat stable. It can remain in a liquid state even at 3,000oC and usable where high temperature is applicable. It has extreme miscibility with water and other solvent and is very suitable in the extraction of polar compounds.[14] Advantages. It has excellent solvent that attracts and transmit microwave, and hence it is suitable for microwave-assisted extraction. It is nonflammable and is useful for liquid-liquid extraction and highly polar.[14] Disadvantage. It is not ideal for preparation of tinctures.[14]

Factors to be considered in selecting solvents of extraction

Various factors enumerated below should be taken into consideration when choosing a solvent of extraction.[3,9,15] (i) Selectivity. The ability of a chosen solvent to extract the active constituent and leave the inert material. (ii) Safety. Ideal solvent of extraction should be nontoxic and nonflammable. (iii) Cost. It should be as cheap as possible. (iv) Reactivity. Suitable solvent of extraction should not react with the extract. (v) Recovery. The solvent of extraction should be quickly recovered and separated from the extract. (vi) Viscosity. Should be of low viscosity to allow ease of penetration. (vii) Boiling temperature. Solvent boiling temperature should be as low as possible to prevent degradation by heat.[3,9,15][20]

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## REFERENCES

1. Ingle KP, Deshmukh AG, Padole DA, Dudhare MS, Moharil MP, Khelurkar VC. Phytochemicals: Extraction methods, identification, and detection of bioactive compounds from plant extracts. J Pharmacogn Phytochem. 2017;6:32–6. [Google Scholar]
2. Azwanida NN. A review on the extraction methods use in medicinal plants, principle, strength, and limitation. Med Aromat Plants. 2015;4:196. [Google Scholar]
3. Pandey A, Tripathi S. Concept of standardization, extraction, and pre-phytochemical screening strategies for herbal drug. J Pharmacogn Phytochem. 2014;2:115–9. [Google Scholar]
4. Doughari JH. Phytochemicals: Extraction methods, basic structures, and mode of action as potential chemotherapeutic agents, phytochemicals—a global perspective of their role in nutrition and health. In: Venketeshwer R, editor. A Global Perspective of Their Role in Nutrition and Health. InTech; 2012. [Last accessed 2019 Jun. 10]. Available from: www.intechopen.com . [Google Scholar]
5. Sasidharan S, Chen Y, Saravanan D, Sundram KM, Yoga Latha L. Extraction, isolation and characterization of bioactive compounds from plants' extracts. Afr J Tradit Complement Altern Med. 2011;8:1–10. [PMC free article] [PubMed] [Google Scholar]
6. Rungsung W, Ratha KK, Dutta S, Dixit AK, Hazra J. Secondary metabolites of plants in drugs discovery. World J Pharm Res. 2015;4:604–13. [Google Scholar]
7. Sofowora A. The present status of knowledge of the plants used in traditional medicine in western Africa: A medical approach and a chemical evaluation. J Ethnopharmacol. 1980;2:109–18. [PubMed] [Google Scholar]
8. Rimando AM, Olofsdotter M, Dayan FE, Duke SO. Searching for rice allelochemicals: An example of bioassay-guided isolation. Agron J. 2001;93:16–20. [Google Scholar]
9. Das K, Tiwari RK, Shrivastava DK. Techniques for evaluation of medicinal plant products as antimicrobial agents: Current methods and future trends. J Med Plants Res. 2010;4:104–11. [Google Scholar]
10. Altemimi A, Lakhssassi N, Baharlouei A, Watson DG, Lightfoot DA. Phytochemicals: Extraction, isolation, and identification of bioactive compounds from plant extracts. Plants. 2017;6:42. [PMC free article] [PubMed] [Google Scholar]
11. Majekodunmi SO. Review of extraction of medicinal plants for pharmaceutical research. MRJMMS. 2015;3:521–7. [Google Scholar]
12. Tiwari P, Kumar B, Kaur M, Kaur G, Kaur H. Phytochemical screening and extraction: A review. Int Pharm Sci. 2011;1:98–106. [Google Scholar]
13. Cowan MM. Plant products as antimicrobial agents. Clin Microbiol Rev. 1999;12:564–82. [PMC free article] [PubMed] [Google Scholar]
14. Bhan M. Ionic liquids as green solvents in herbal extraction. Int J Adv Res Dev. 2017;2:10–2. [Google Scholar]
15. Eloff JN. Which extractant should be used for the screening and isolation of antimicrobial components from plants? J Ethnopharmacol. 1998;60:1–8. [PubMed] [Google Scholar]
16. Ujang ZB, Subramaniam T, Diah MM, Wahid HB, Abdullah BB, Rashid AA, Appleton D. Bioguided fractionation and purification of natural bioactive obtained from Alpinia conchigera water extract with melanin inhibition activity. J Biomater Nanobiotechnol. 2013;4:265–72. [Google Scholar]
17. Hossain MA, Al-Hdhrami SS, Weli AM, Al-Riyami Q, Al-Sabahi JN. Isolation, fractionation and identification of chemical constituents from the leaves crude extracts of Mentha piperita L grown in sultanate of Oman. Asian Pac J Trop Biomed. 2014;4:S368–72. [PMC free article] [PubMed] [Google Scholar]
18. Harborne JB. Phytochemical methods: A guide to modern techniques of plant analysis. 3rd ed. New York, NY: London, UKThomson Science; 1998. p. 219. [Google Scholar]
19. Beena P, Rajesh KJ, Arul B. Preliminary phytochemical screening of Cicer arietinum in folklore medicine for hepatoprotection. J Innov Pharm Biol Sci. 2016;3:153–9. [Google Scholar]
20. Trease GE, Evans WC. Textbook of pharmacognosy. 13th ed. London, UK; Toronto, Canada; Tokyo, Japan: Bailiere Tindall; 1989. pp. 200–1. [Google Scholar]