ISSN: 0976-7126
Lalwani *et al.*, 15(10):1-9, 2024

International Journal of Pharmacy & Life Sciences
Open Access to Researcher

Role of Herbs as Sources of Therapeutic Agents for Innovative Drug Discovery

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Article info

Received: 11/07/2024

Revised: 27/08/2024

Accepted: 30/08/2024

www.ijplsjournal.com

Abstract

For many years, natural products have been recognised as an essential source of active components for medicinal medicines. Specifically, the application of active substances originated from plants and utilised in microbial natural goods dates back to a time before modern medicine. Natural product chemistry, biochemistry, and synthetic activities have long been linked to the effectiveness of natural products. Hence, the special qualities of these natural products are being utilised in light of scientific advancements in contemporary molecular and cellular biology, analytical chemistry, and pharmacology. The goal is to take advantage of the chemical and structural diversity, as well as the biodiversity, of these types of products in relation to their potential therapeutic effects. Rearranging chemical entities or structural isomers of naturally existing products to create new compounds is a common strategy used by drug design units to create novel molecules of interest that may be developed into therapeutics with potential.

Key-words: Herbs, Natural Products, Drug Discovery, Therapeutics, Application

Introduction

A natural product is a substance that is created by a naturally existing living thing and has pharmacological qualities that might be useful in the design and development of new drugs. Unusual and structurally varied chemical components can be found in crude substances that are taken from the bodies of medicinal plants, animals, microbes, or microorganism fermentation broths. Since many contemporary medications are either derived from or naturally occurring chemicals, natural products have played a crucial role in the biotechnology and pharmaceutical sectors. Generally speaking, the medicinal substances that are injected, swallowed, and breathed are mixtures of intricate medicinal substances.

Advantages of herbal ingredients

Natural products

By their very name, herbal products imply that they are all-natural and devoid of any potentially dangerous synthetic compounds. These products, including aloe-vera gel and coconut oil, use various plant materials and plant extracts in place of conventional synthetic ones. They also include organic nutrients like vitamin E, which maintains one's beauty, health, and radiance. Aloevera, for instance, is a naturally occurring and widely accessible herbal plant species that belongs to the Liliaceae family [1]. Growing numbers of customers are demanding more natural products devoid of dangerous chemicals and emphasizing the qualities of botanicals, due to concerns about substances like synthetic chemicals and mineral oils [2].

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Safe to use

Natural products are safer to use than conventional products. Dermatologists have tested and confirmed that they are hypo-allergenic and safe to use at any time or location. They are composed of natural substances, so there's no need to worry about skin irritation or rashes. For instance, two closely related synthetic antioxidants that are employed as preservatives in lipsticks and moisturizers are called BHA (Butylated Hydroxyanisole) and BHT (Butylated Hydroxytoluene) [3]. Skin allergy responses can be brought on by BHA and BHT [4]. BHA is categorized as a potential human carcinogen by the International Agency for Research on Cancer [5]. Natural antioxidants like vitamin C can be found in herbal cosmetics [6].

A wide selection of choices

For instance, although natural cosmetics are still relatively new in the beauty business, there is already an absurdly large selection of beauty products available. There are numerous naturally formulated foundations, eye shadows, lipsticks, blushes, mascaras, concealers, and much more available. Additionally, one can discover natural cosmetics made locally or cosmetics created by internationally recognized designers. Herbal extracts come in a wide range of varieties; some examples are Andrographis Paniculata (Kalmegh), Asparagus Racemosus (Shatawari), Boswellia Serrata (Salai Guggal), Asphalt (Shilajit), etc. [8].

Fits your budget

The cost of natural items is quite low. Certain of these products are really less expensive than synthetic ones. During the sale, they are sold at a reduced price and are offered at a discounted rate. All it takes to find good bargains is to complete enough surveys. According to a WHO estimate, 80% of people on the planet rely on natural goods for their medical needs due to the negative effects and growing expense of conventional treatment. Due to their accessibility, affordability, and relative safety, traditional herbal remedies are being encouraged and recommended by the World Health Organization in natural health care programs [9].

Not conducted on animals

To make sure they are safe and effective for people, several products undergo early testing on animals. But testing natural products on animals is not necessary. Experts evaluate these natural mixtures in lab settings with cutting-edge machinery without employing any animals [10].

No adverse reactions

Products made of synthetic materials may produce adverse effects including skin irritation. They may impact the body and be malignant. These are not a concern with natural products. Anyone can use the natural components at any time, anyplace, as there is no guarantee of any negative consequences. Herbal cosmetics, for instance, are free of parabens, the most common preservative in cosmetics that can pierce the skin [11]. It may cause endocrine disruption, or the interference with hormone function [3].

Current uses of natural product drugs

The following criteria can be used to assess the significance of natural products used in the treatment and prevention of human diseases: The number of ailments these various chemicals treat, their rate of usage in the treatment of diseases, and the introduction of novel, chemically diverse entities with their application as patterns for semi-synthetic and total synthetic alteration (12). Pharmaceutical research still focuses on natural products because alternative approaches to drug discovery have not been successful in producing many lead molecules for important therapeutic areas like metabolic and anti-infective illnesses. Natural product research keeps coming up with new ways for the pharmaceutical sector to find lead chemicals for drugs. It is now undeniable that natural products have been and will continue to be important sources of novel pharmacological therapeutic agents. The drug metabolites derived from synthetic drug sources have less negative side effects and less therapeutic effects. Small chemical building blocks, known as synthetic therapeutic agents, are created by computer-based research techniques like computational chemistry and by utilizing a variety of chemical sources, including the anti-malaria medication arterolane (13). These building blocks are not present in nature.Natural sources of medicinal substances, on the other hand, may not have adverse effects because they have pharmacological and physiological impacts on live cells. Furthermore, a greater range of molecular characteristics, including a smaller molecular mass, a partition coefficient, and structural diversity, are present in

natural products (14). Additionally, natural products interact with other biological molecules, proteins, and enzymes more frequently. Moreover, compared to synthesized compounds and combinatorial libraries, natural products have higher molecular stiffness and fewer heavy metals (3).

Herbal Plants for Treatment of Various Ailments

Tulsi

Ocimumtenuiflorum, botanically known as holy basil, tulsi, or tulasi, is a fragrant perennial plant in the Lamiaceae family that is native to the Indian subcontinent and widely grown as a crop across the tropical regions of Southeast Asia. Because of its many therapeutic benefits, tulsi has been a mainstay of ayurveda medicine for thousands of years.The foundational text of ayurvedic medicine, the Charaka Samhita, mentions it by Charaka. Tulsi is regarded as an adaptogen, helping the body adjust to stresses and harmonizing various bodily functions. Characterized by a potent scent and sharp flavor, it is considered a type of "elixir" of life in Ayurveda and is thought to extend life. Ayurvedic treatments for common colds, headaches, stomach disorders, inflammation, heart disease, different poisonings, and malaria include the use of tulsi extracts. Traditionally, Tulsi is consumed in a variety of ways, such as dried powder for herbal tea, fresh leaves, or blended with ghee, an essential oil derived from kapoor. The main uses of tulsi are in herbal cosmetics and medicine.Driedtulsi leaves have been used with grains that have been preserved for millennia to ward against insects. Dulsi is commonly used in skin preparation because to its antibacterial action. Recent research indicates that because tulsi contains a significant amount of eugenol (1-hydroxy-2-methoxy-4-allyl benzene), it may be a COX-2 inhibitor, similar to many contemporary painkillers.Research has also indicated that Tulsi can effectively treat diabetes by lowering blood glucose levels. Interestingly, a study conducted on Tulsi also found that it significantly lowered total cholesterol. According to a different study, tulsi's antioxidant qualities contribute to its positive effects on blood glucose levels. Additionally, tulsi showed some promise in preventing cataracts and radiation sickness.

Turmeric

GSC Biological and Pharmaceutical Sciences Native to tropical South Asia, turmeric (Curcuma longa) is a rhizomatous herbaceous perennial plant of the ginger family (zingiberaceae). Some Indian women use turmeric paste to keep their hair unnecessary, and in certain regions of the country, brides and grooms apply turmeric paste before getting married. Turmeric is also utilized in the formulation of some sunscreen products.Bangladesh and Pakistan, where turmeric is thought to give skin a sheen and keep some dangerous microorganisms out of the body. The Thai government is sponsoring a study to separate and extract tetra hydrocurcuminods (THC) from turmeric. THCs, which should not be confused with tetra hydrocannabinol, are colorless compounds that may be used to treat skin conditions and have antioxidant and skin-lightening effects. These compounds can also be used in cosmetic formulations. They have antibacterial, anti-inflammatory, and anti-cancer properties. Skin diseases include psoriasis, alopecia, atopic dermatitis, acne, and photoaging of the face. Turmeric's antioxidants shield skin cells from the damaging effects of free radicals and hasten the healing of wounds of any kind [15,16,17].

Sandalwood

The most well-known and valuable woody flowering plant species is sandalwood (Sanatlum album L.), of which the Indian sandalwood tree is a species of trees or shrubs. The majority are parasitic root systems that produce their own food but obtain water and inorganic nutrients by sucking on the roots of other plants. Highly aromatic wood is produced by a number of species, most notably S. albumin, and is utilized in herbal medicine and fragrance products. Additionally, it is employed as a flavoring agent in Ayurvedic medicine to control the inflammatory responses that trigger different types of skin problems [18, 19]. Furthermore, it has been employed as an astringent. Uses for it include face packs and masks [20–23].

Henna

The sole species of flowering plant in the genus Lawsoniainermis of the family Lythraceae is henna, often known as hina (Lawasoniainermis, syn L. Alba). It is indigenous to semi-arid regions

of northern Australia, southern Asia, and tropical and subtropical portions of Africa. Lawsone, the dye molecules, is mostly found in leaves and is most abundant in the petioles of leaf petioles. Products marketed as neutral or black henna are not created from henna; instead, they may contain chemicals and unlisted dyes and be derived from indigo (found in the plant Indigofera tinctoria) or Cassia obovata. Since the Bronze Age, henna has been used for hair coloring and body painting.Due to improvements in the cultivation, processing, and application of traditional henna, body art with henna has recently seen a rebirth. Since ancient times, henna flowers have been used to make perfume. Nowadays, henna perfume is making a comeback on the internet. Henna has various traditional and commercial uses. The most common ones are as a hair, skin, and nail color, as well as a dye and fabric preservative. In court documents from India dating back to approximately 400CE, henna was used as a hair color. It was also referenced as a therapeutic tool in the Ebers Papyrus (16th BCE Egypt), and by IBN Qayyim al Jawziyya (14th BCE (Syria and Egypt) during the Roman Empire.[24]

Arnica

Arnica montana, a European blooming plant with a huge yellow capitula range and habitat, is also known as leopard bane, wolf bane, mountain tobacco, and mountain arnica. Arnica montana has been used medicinally for a long time and is occasionally grown in herb gardens. It has a toxin called helenalin, which can be harmful if consumed in high quantities. Contact with the plant can also irritate the skin.Thymol compounds found in the roots are employed as fungicides, preservatives, and may have some anti-inflammatory properties. Applying arnica topically as a gel was reported to relieve hand osteoarthritis symptoms in the same way as NSAIDs (ibuprofen).According to a study, applying tropical arnica to heal skin bruises had no more benefit than giving a placebo. Nowadays, arnica is utilized to prepare liniments and ointments for bruising and strain sprains. Professional athletes often utilize commercial arnica preparations. Clinical studies have demonstrated the efficacious vasodilator properties of the concentrated thymol derivatives found in plant roots on subcutaneous blood capillaries. When used topically, arnica preparation has been shown to have anti-inflammatory properties and promote healthy healing processes by promoting blood flow and reducing fluid retention by dilation of subcutaneous blood capillaries. The toxin helenalin causes severe gastroenteritis and internal bleeding of the digestive tract when consumed internally.

Amla

The tree known as Amla Indian gooseberry (Emblica Officinalis) is indigenous to the Middle East and India. Fresh and dried plant fruits are frequently utilized as ingredients in Ayurvedic medicine. The high tannin content of Indian gooseberry fruit, which is widely used in inks, shampoos, and hair oils, works as a mordant to fix dyes in fabrics and is thought to nourish hair and scalp and delay the onset of gray hair. Amla fruit can be consumed raw or cooked and used in a variety of recipes, including amla murabbah, a sweet delicacy created by soaking the berries in sugar syrup until they become candy, and dal, a preparation of lentils.The inner bark of holat, a traditional fish soup from Sumatra, Indonesia, is utilized to give the broth an astringent, bitter flavor [25].

Aloe vera

Aloe vera belongs to the genus Aloe and is a kind of succulent plant. Aloe is a plant with over 500 kinds that is found all over the world and is regarded as an invasive species in many areas. Traditional medicine uses aloe vera as a skin treatment. Its usage is first documented as early as the fourth millennium BCE [26]. Additionally, the Juliana Anicia Codex from 512 CE mentions it. However, there is little scientific proof about the safety or efficacy of Vera extracts for cosmetic or medical purposes, and the research that is provided is frequently refuted by other studies. Notwithstanding these drawbacks, preliminary research suggests that aloe vera extracts may be helpful in the management of diabetes and high blood counts in people. There is little, and sometimes conflicting, scientific proof supporting aloe vera's medicinal and cosmetic benefits. Despite this, the herbal and cosmetic industries frequently tout the calming, hydrating, and restorative qualities of aloe vera, particularly through online advertisements. Aloe vera is an

extremely bitter and unappealing meal. On the other hand, commercially available yoghurt, drinks, and even sweets contain vera gel as a component. Cosmetic businesses frequently add aloe vera sap or its derivatives to cosmetics, tissues, moisturisers, soaps, sunscreens, incense, razors, and shampoos, among other goods. Aloe vera seeds have also been mentioned as a source of biofuels. Aloe vera extracts are also used in artificial sheep fertilisation, water conservation on small farms, and the diluting of semen for fresh food preservation [26].

Neem

Azadirachta Indica, sometimes referred to as Indian lilac, nimtree, or neem, is a tree belonging to the Meliaceae family of mahogany. The tree goes by several names in India, including "divine tree," "heal all," "nature's drugstore," "village pharmacy," and "panacea for all ailments." Neem is used in products that are anti-helmintic. Neem has been shown to have antifungal, anti-diabetic, antibacterial, antiviral, anti-infertility, and sedative effects. It is regarded as a key component of Ayurvedic treatment and is particularly recommended for skin conditions. Neem as a Herbal Makeup Neem oil is helpful for skin care, including treating acne and maintaining skin suppleness. It is also used to prepare cosmetics, such as soap, shampoo, balms, and lotions. Its application in conventional Indian medicine The neem tree is also very significant because it may prevent desertification and may be an excellent carbon dioxide sink. Traditional Indian medical practitioners advise chicken pox patients to sleep on neem leaves. A wide range of skin care products, body lotions, and beauty care face packs include the oils from seeds and leaves. The mixture is being employed with additional organic components. The booming herbal cosmetics market extends an open welcome to neem oil producers around the globe to supply premium neem oil for the cosmetics sector [26].

Coconut oil

The dried kernel, or copra, which contains between 60 and 65 percent oil, is crushed to create it. Lower chain fatty acid glycerides are abundant in coconut oil. The fruit or seed of the Arecaceae family coconut palm tree, Cocos nucifera, is used to make coconut oil. Since coconut oil melts at 24 to 25°C (75–76°F), it is frequently used in baking and cooking. It may be utilised readily in both liquid and solid form. Coconut oil does wonders for softening and moisturising skin [27].

Jojoba oil

It is a blend of linear, long-chain liquid wax esters that are taken from the seeds of the Simmondsia chinensis desert plant (family Simmondsiaceae). Jojoba oil is frequently used in cosmetics as a moisturiser and as a carrier oil for exotic perfumes. It is readily refined to eliminate any odour and colour, and it is oxidatively stable. Jojoba oil and human sebum are nearly interchangeable. Dry skin and hair occur from sebum, which is meant to protect and hydrate the skin and hair, being removed by chemicals, pollution, the sun, and ageing. Jojoba oil replaces the nutrients lost by skin and hair and brings them back to their optimal pH balance. [28]

Carrot

It is derived from the Apiaceae family plant Daucus carota. Because of its abundance in vitamin A and other important vitamins, this plant has been valued for years. As a revitalising, anti-aging, and rejuvenating agent, carrot seed oil is utilised [27]. Carotene, along with lower levels of α and -carotene, is responsible for the distinctive brilliant orange colour of carrots. Humans partly metabolise beta- and β-carotene to vitamin A [29].

Rhodiola Rosea

Biological and Pharmaceutical Sciences, Rhodiola Rosea GSC, 2022, 19(02), 316–322 It goes by several names, including roseroot, golden root, arctic root, Aaron's rod, king's crown, lignum rhodium, and orpin rose. It has been used in traditional folk medicine to treat fatigue, depression, anaemia, impotence, gastrointestinal disorders, infections, and nervous system disorders. It grows primarily in dry sandy plains at high altitudes in arctic regions of Europe and Asia. It has also been used to promote longevity, physical stamina, and resistance to high altitude sickness [30]. Phenolic chemicals, which are abundant in rhodiola rosea, are well recognised for their potent antioxidant qualities [31].

Natural product drug development

Pharmaceutical corporations have recently either discontinued or significantly curtailed their natural product research, despite the fact that natural goods have been essential in the drug development process [25]. The development of

cutting edge methods like combinatorial chemistry, high throughput screening, and metagenomics is the cause of this. Furthermore, because of their structural complexity and the time and cost involved in the process, not all natural products can be fully synthesised. However, the pharmaceutical and biotech sectors are once again looking to natural products to harness new useful entities or derivatives of these in therapies, thanks to improved drug discovery and enhanced knowledge of medicinal chemistry. This is frequently motivated by the need for therapy in hard-to-treat disease states or clinical circumstances including cancer, obesity, and infections brought on by microorganisms with multiple resistances. In the process of finding new drugs, plants, fungus, bacteria, and microbes have shown to be a rich source of natural compounds. More sophisticated and potent treatment medications are needed to combat the different multi-resistant infections. Out of the 250,000 species of terrestrial plants now in existence, only 5–15% have undergone thorough chemical and pharmacological analysis in a practical manner for usage. In addition, the microbial domain represents 90% of all natural variety; nevertheless, less than 1% have been found [25]. Natural variety is currently in grave danger of disappearing owing to environmental factors including global warming, toxic waste from manufactured chemicals that include heavy metals and cyanides, and multi-drug resistance to conventional treatments. Consequently, it is seen to be especially crucial to demonstrate the value of natural variety and bioresources in order to inform current research methodologies used in big pharmaceutical and biotechnological businesses for the purpose of drug development. The goal of any drug discovery procedure is to identify the most promising lead compounds that have the potential to be therapeutic agents and help cure disorders of the neurological system, infections, cancer, and hypertension Scientists must separate and purify lead compounds from their natural sources in the early phases of the drug design process using a variety of techniques, depending on the structural diversity, stability, and necessary amount of the chemical. The lead compounds have been screened using high throughput screening against predetermined targets. Important pharmacological and biochemical testing are then performed, and the compounds that show promise for the particular targets are chosen. Many lead compounds are not selective enough for their target molecule at this stage of the drug design process. Scientists alter the lead chemical structures according to the predicted structure-activity correlations in an effort to increase their selectivity. The promising compounds proceed to in vitro and in vivo testing in case the alterations improve the selectivity. If the test yields favourable results, researchers must evaluate the compounds' safety to determine how the medicine is absorbed, distributed, metabolised, and eliminated. This procedure, known as pharmacokinetics, reveals the procedures that take place when the medicinal substance enters the body. Lead compounds may develop into viable candidate medications if all of the optimisations and outcomes are favourable [25].

Future directions for natural product drug discovery

The future of medicinal plants is bright, since there are over 500,000 plants in the globe, the majority of which have not yet been studied for their potential health benefits. These untapped resources might play a significant role in current and next research endeavours [34]. Medicinal herbs have been crucial to the evolution of human civilization, as shown in many rites and religions [35]. various of the various types of contemporary medications, like aspirin, are derived indirectly from medicinal plants. Many food crops, like garlic, have therapeutic properties. Understanding plant toxicity and defending people and animals against natural toxins are two benefits of studying therapeutic plants. Plants produce secondary metabolites, which is why they have therapeutic benefits. Taking this into account, there have been surges in interest in the study of natural product chemistry. Numerous factors may contribute to this interest, such as the need for novel therapeutics, the remarkable diversity of naturally occurring secondary metabolites' chemical structures and biological activities, the usefulness of novel bioactive natural compounds as biochemical probes, the development of sensitive and novel methods for identifying biologically active natural products, improved methods for isolating, purifying, and structurally characterising

these active constituents, and advancements in meeting the need for complex natural product supply [36]. In recognition of the value of traditional medicine, the World Health Organisation (WHO) has developed standards, recommendations, and strategies for plant medicines. Agro-industrial technologies must be used for the production of herbal medicines, their processing, and their cultivation [37]. Many current medications are indirectly made from plants, and medicinal plants are a source of novel compounds.

Innovative strategies for drug discovery with natural products

Innovative and interdisciplinary approaches must be developed to fully drive the development of new pharmaceuticals that are utilised in clinics and other medical practices using natural ingredients. Combining these approaches is probably going to provide new medications that can solve today's health problems. It has been demonstrated that the therapeutic value of natural products is diminished by the isolation and assessment of individual compounds as possible drug candidates, as most compounds, such as those found in plants, exhibit synergistic effects. As a result, novel techniques are required to blend and assess chemicals for their potential medicinal benefits. Recently, system biology techniques have been used to natural product medication development, assisting in the understanding of both effectiveness and the lack of of in several compounds [33]. This considers all of the impacts that a substance has on an organism or system, rather than merely analysing individual compounds. Rapid and effective compound screening has been made possible by analysing the impact of natural product molecules using genomes, transcriptomics, proteomics, and metabolomics. This has produced improved medicinal prospects. Compounds Searches for new and better medications have resulted from the deposition of many compounds into both company- and public-molecular libraries of possible therapeutic candidates from natural materials. The majority of pharmaceutical firms are realising the requirement of including combination studies during medication development and are abandoning the reductionist method of isolating and assessing single molecules.

Conclusion

Using an integrated strategy that combines the control of biosynthetic pathways with cutting-edge genomic sequencing might provide a viable and practical method for the future identification of pharmaceutical medication candidates. The effectiveness of natural products in drug development, both historical and contemporary, is largely attributed to their diverse and complex structures and the progress made in our knowledge of how structures function in biomedicine. Targeting the biological variety that nature still provides is crucial, especially in light of the inadequate outcomes of combinatorial approaches. It is envisaged that the environment would keep providing untapped resources, allowing for the rare discovery of cutting-edge defences against emerging illnesses.

Reference

1. Akinyele BO, Odiyi AC. Comparative study of vegetative morphology and the existing taxonomic status of Aloe vera L. Journal of plant Sciences. 2007;2(5):558-63.
2. Vaidiyanathan R, Anand B. Importance of Chemistry in Herbal Cosmetics and Cosmeceuticals Research Journal of Pharmacy and Technology. 2017 Dec 1;10(12):4460-2.
3. Kaur L, Singh AP, Singh AP, Kaur T. A review on herbal cosmetics. International Journal of Pharmaceutics and Drug Analysis. 2021 Sep 30:196-201.
4. Rothe H, Fautz R, Gerber E, Neumann L, Rettinger K, Schuh W, Gronewold C. Special aspects of cosmetic spray safety evaluations: Principles on inhalation risk assessment. Toxicology letters. 2011 Aug 28;205(2):97-104.
5. International Agency for Research on Cancer (IARC) Monographs on the Evaluation of Carcinogenic Risks to Humans (1978) 17: 1-365.
6. KadamVaishali S, ChintaleAshwini GD, DeshmukhKshitija P, NalwadDigambar N. Cosmeceuticals an emerging concept: A comprehensive Review. Int. J. Res. Pharm. Chem. 2013;3:308-16.

7. Winter R. A consumer's dictionary of cosmetic ingredients: complete information about the harmful and desirable ingredients found in cosmetics and cosmeceuticals. Harmony; 2009 Oct 20.
8. Meena AK, Bansal P, Kumar S. Plants-herbal wealth as a potential source of ayurvedic drugs. Asian J Tradit Med. 2009 Aug 20;4(4):152-70.
9. Sharma A, Shanker C, Tyagi LK, Singh M, Rao CV. Herbal medicine for market potential in India: an overview. Acad J Plant Sci. 2008;1(2):26-36.
10. Joshi LS, Pawar HA. Herbal cosmetics and cosmeceuticals: An overview. Nat Prod Chem Res. 2015 Feb 16;3(2):170.
11. Kirchhof MG, de Gannes GC. The health controversies of parabens. Skin Therapy Lett. 2013 Feb 1;18(2):5-7.
12. Rothe H, Fautz R, Gerber E, Neumann L, Rettinger K, Schuh W, Gronewold C. Special aspects of cosmetic spray safety evaluations: Principles on inhalation risk assessment. Toxicology letters. 2011 Aug 28;205(2):97-104.
13. International Agency for Research on Cancer (IARC) Monographs on the Evaluation of Carcinogenic Risks to Humans (1978) 17: 1-365.
14. Kadam Vaishali S, Chintale Ashwini GD, DeshmukhKshitija P, NalwadDigambar N. Cosmeceuticals an emerging concept: A comprehensive Review. Int. J. Res. Pharm. Chem. 2013;3:308-16.
15. Bakht J, Islam A, Ali H, Tayyab M, Shafi M. Antimicrobial potentials of Eclipta alba by disc diffusion method. African Journal of Biotechnology. 2011;10(39):7658-67
16. Bakht J, Ali H, Khan MA, Khan A, Saeed M, Shafi M, Islam A, Tayyab M. Antimicrobial activities of different solvents extracted samples of Linumusitatissimum by disc diffusion method. African Journal of Biotechnology. 2011;10(85):19825-35.
17. Bakht J, Islam A, Shafi M. Antimicrobial potential of Eclipta alba by well diffusion method. Pak. J. Bot. 2011 Dec 1;43:161-6.
18. Christenson PA, Secord N, Willis BJ. Identification of trans- β - santalol and epi-cis- β -santalol in East Indian sandalwood oil. Phytochemistry 1981; 20: 1139-41.
19. Deng S, May BH, Zhang AL, Lu C, Xue CC. Topical herbal medicine combined with pharmacotherapy for psoriasis: A systematic review and meta-analysis. Arch Dermatol Res 2013; 305(3): 179-89.
20. Pal RS, Pal Y, Saraswat N, Wal P, Wal A. Current review on herbs for derma care. The Open Dermatology Journal. 2019 Aug 31;13(1).
21. Alok S, Jain SK, Verma A, Kumar M, Mahor A, Sabharwal M. Herbal antioxidant in clinical practice: A review. Asian Pacific journal of tropical biomedicine. 2014 Jan 1;4(1):78-84.
22. Dragland S, Senoo H, Wake K, Holte K, Blomhoff R. Several culinary and medicinal herbs are important sources of dietary antioxidants. The Journal of nutrition. 2003 May 1;133(5):1286-90.
23. Niwano Y, Saito K, Yoshizaki F, Kohno M, Ozawa T. Extensive screening for herbal extracts with potent antioxidant properties. Journal of clinical biochemistry and nutrition. 2010;48(1):78-84.
24. Bijauliya RK, Alok S, Kumar M, Chanchal DK, Yadav S. A comprehensive review on herbal cosmetics. International Journal of Pharmaceutical Sciences and Research. 2017 Dec 1;8(12):4930-49.
25. Kaur L, Singh AP, Singh AP, Kaur T. A review on herbal cosmetics. International Journal of Pharmaceutics and Drug Analysis. 2021 Sep 30:196-201.
26. Gupta RK, Soni P, Shrivastava J, Rajput P, Parashar S. Cosmeceutical role of Medicinal plants/Herbs: A Review on commercially available Cosmetic ingredients. Himalayan Journal of Health Sciences. 2018 Dec 9:70-3.
27. Gediya SK, Mistry RB, Patel UK, Blessy M, Jain HN. Herbal plants: used as a

cosmetics. J Nat Prod Plant Resour. 2011;1(1):24-32.
28. RabascoÁlvarez AM, González Rodríguez ML. Lipids in pharmaceutical and cosmetic preparations. Grasas y Aceites, 51 (1-2), 74-96.. 2000.
29. Strube M. Naturally Occurring Antitumourigens: Carotenoids except β-carotene. IV. Nordic Council of Ministers; 1999.
30. Brown RP, Gerbarg PL, Ramazanov Z. Rhodiolarosea. A phytomedicinal overview. HerbalGram. 2002;56:40-52.
31. Furmanowa M, Skopińska-Rozewska E, Rogala E, Hartwich M. Rhodiolarosea in vitro culture-phytochemical analysis and antioxidant action. ActaSocietatisBotanicorumPoloniae. 1998 Jan 1;67(1):69-73.
32. International Agency for Research on Cancer (IARC) Monographs on the Evaluation of Carcinogenic Risks to Humans (1978) 17: 1-365.
33. Buriani, A., Garcia-Bermejo, M.L., Bosisio, E., Xu, Q., Li, H., Dong, X., et al., 2012. Omic techniques in systems biology approaches to traditional Chinese medicine research: Present and future. Journal of Ethnopharmacology 140 (3), 535–544.
34. Singh R. Medicinal Plants: A Review. Journal of Plant Sciences. Special Issue: Medicinal Plants. Vol. 3, No. 1-1, 2015, pp. 50-55.
35. Hosseinzadeh, S., Jafarikukhdan, A., Hosseini, A. and Armand, R. (2015). The application of Medicinal Plants in Traditional and Modern Medicine: A Review of Thymus vulgaris. International Journal of Clinical Medicine, 6, 635-642.
36. Clark, A.M. (1996) Natural Products as a Source for New Drugs. Pharmaceutical Research, 13, 1133-1141.
37. WHO (1993) Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines. Manila.

Cite this article as:
Lalwani D., Dwivedi S., Sharma P.K. and Darwhekar G.N. (2024). Role of Herbs as Sources of Therapeutic Agents for Innovative Drug Discovery. *Int. J. of Pharm. & Life Sci.*, 15(10): 1-9.

Source of Support: Nil
Conflict of Interest: Not declared
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