Application of Herbal Medicine and Essential Oils in New Era

Shazia Perveen[1,*], Sumaira Kanwal[2], Summia Muneer[1], Samina Aslam[3], Qurat ul ane Gillani[1], Iram Qadeer[4], Rehmana Rashid[5] and Abida Aziz[6]

[1]Department of Zoology, The Women University, Mattital campus, Multan, 66000, Punjab, Pakistan
[2]Department of Biosciences, COMSATS University Islamabad, Sahiwal Campus, Multan, 66000, Punjab, Pakistan
[3]Department of Chemistry, The Women University, Kutchary campus, Multan, 66000, Punjab, Pakistan
[4]Department of Zoology, Govt.Sadiq College Women University, Bahawalpure, Punjab, Pakistan
[5]Department of Pharmacy, The Women University, Mattital campus, Multan, 66000, Punjab, Pakistan
[6]Department of Botany, The Women University, Mattital campus, Multan, 66000, Punjab, Pakistan
*Corresponding author: drshazia.zool@wum.edu.pk

Abstract

Herbal medicine is currently prevailing over traditional medicine; with an enormous number of medicinal plants are being used as a whole or their parts for therapy. Herbs and their extracts, like essential oils, are rich sources of secondary metabolites that are produced from a variety of plant species. They can also be employed as antioxidants and preservatives in medicinal, food, cosmetic, and agricultural goods. For this reason, they possess antibacterial and antifungal, antiviral, insect repellent and, allopathic character depending on the presence of one or more active substance. These abilities can be utilized to enhance the accuracy of the products, extend their age. Scientists started analyzing these medicinal herbs chemically more recently and the results were priceless. Memory loss, cardiovascular problems, osteoarthritis, arthritis, diabetes, respiratory and digestive disorders, reproductive issues, skin conditions, neurological disorders, hypertension, various cancers and many more have all been effectively treated by using this treatment. The field is in a critical stage of development. In order to sustain and regulate the processes occurring in raw material assessment, herbal remedy manufacture, branding and marketing and sustainable utilization, research and regularity policies are required. This chapter provides a thorough overview of the published studies on medicinal applications.

Keywords: Herbal Medicine, Plant Extracts, Essential oils, phytochemicals, Secondary Metabolites, Advances in traditional medicine, Applications

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Introduction

A plant or its tissues are used for its fragrance, taste, or healing properties is called herb. Herbal medicines comprised completely on plants or their extracts. They are then marketed in various forms such as tablets, capsules, powders, tea forms as well as fresh or dried plant. The treatment procedures differ one country to another and from one region of the world to the other. Also, different types of traditional medicine may be used in a single region because the people living in that region are of different origins migrated from different parts of the world. Based on the WHO in traditional gained as the sum total of the knowledge, techniques and practices involving those theories beliefs and experiences inherent to various culture groups, irrespective of the efficiency or inexpability. It is used in the promotion, identification, amelioration or cure of bodily and mental disorders and the preservation of health (Udagama & Udalamaththa, 2018). Currently, herbal medicine has trumped all forms of traditional medicine including the Indian tradition medicine, the Sri Lankan tradition medicine, the Chinese tradition medicine, the Arabic tradition medicine, the African and South American Indian tradition medicine respectively. Herbs are being used by 75% of the global population for their basic healthcare need.

According to World Health Organization, herbs or herbal material or herbal preparations or final products and active compounds derived from plant materials (Palazzolo et al., 2013). Petrovska studied in detail the historical events on the use of herbals (Petrovska, 2012). Different plant-based treatments for the same disease may be used in different states, primarily relying on local plant species. Over thousands of years, traditional knowledge has been passed down to successive generations (Parikh et al., 2014). But in the last few decades these thoughts about herbal medicine turned into positive one after isolating many different efficient drugs from the plant material. Due to their cost and *in vivo* instability, mostly synthetic drugs are being replaced (Udalamaththa et al., 2016). Constant use of synthetic drugs may cause toxicity (Alzu'bi et al., 2024). From the list of pharmaceutically approved herbal drugs the anticancer drugs (Jenča et al., 2024), antidiabetic drugs (Albratty & Halawi, 2024), and skin care products (Modi et al., 2024) have retained their pinnacle since long. Obesity is becoming major cause of diseases and a socio-economic burden in global population (Chen et al., 2024). In the last 20 years, 25% of the cancer therapy drugs were derived from plant material (Jenča et al., 2024), in the last 10 years, 49% of the antidiabetic drugs were plant derived (Albratty & Halawi, 2024). Due to the

acceptance of the herbal products among the users, there are many weight loss supplements selling in a great amount even without clinical approval. Therefore, researches are being conducted for anti-obesity herbal preparations as these would 'take 'multimillion-dollar business opportunities in the global market (Chen et al., 2024).

Leaves, flowers, fruits, roots, seeds, wood, barks, twigs, buds, peels, rhizomes and herbs of plants can contain needed essential oils that are highly concentrated, oily, explosive liquids (Hamada Saoud et al., 2024). The therapeutic effects of many aromatic plants are generally associated with the presence of essential oils. Essential oils are typically responsible for the therapeutic benefits of aromatic plants. Numerous secondary metabolites from plants make up these essential oils. Because essential oils have a strong aroma, their application has mostly been associated with food flavoring, cosmetics, and perfumes. In addition, ongoing studies have shown the enormous actions of essential oils and the chemical compounds that make them up in the treatment, prevention, and curing of a number of human illnesses (Wang et al., 2024). The applications of essential oils in aromatherapy and phytomedicine have drawn a lot of interest throughout the past three or four decades. As a result, fundamental researchers have extensively investigated essential oils, particularly their anticancer, antibacterial, and antioxidant properties. In general, essential oils are made up of a variety of chemical combinations that contain 10-100 different types of molecules, primarily a mixture of terpenes and benzene derivatives. A lot of individuals thought they both had comparable functions. Although there is some misconception regarding whether essential oils and terpenes are the same or distinct due to their similarities, they are not (Alzu'bi et al., 2024). The market for these items is always increasing because of the growing number of users and their interest in the food and pharmacological. They are being taught the reasons for health choices with regard to aromatic, medicinal herbs and plant metabolites (Alzu'bi et al., 2024). Almost all the plants of these areas synthesize essential oils which are among the secondary metabolites. Further research is required to examine specific constituents or various essential oil extracts for use in agriculture, human health, and the environment (Jenča et al., 2024). Figure 1 shows the overview of process of herbs to final market product.

Fig. 1: schematic representation from herbs to essential oils and then herbal medicine as final market product

Without producing the same side effects, essential oils could be investigated as functional complements or replacements for synthetic chemicals used in the chemical industry. Before conducting clinical trials, it is crucial to use experimental platforms to examine the various activities of plant-derived extracts. Over 53,000 species are reportedly applied worldwide in herbal treatment (Udagama & Udalamaththa, 2018), few of them are being investigated and known with scientific evidence of their biological activity. To create innovative medications that assist patients, it is imperative to combine the expertise of traditional herbal medicine with state-of-the-art scientific methods. Researching the routes and mechanisms of action triggered by herbal extracts is essential since it will help validate these items scientifically before they are put on the market. In order to provide scientific evidence of anti-disease action, this chapter will describe recent studies that have used herbal formulations, extracts and bioactive chemicals produced from plants.

2. Biological Activity of Essential Oils

In an effort to find potential alternative medicine, the pharmacological uses of essential oils have been thoroughly examined. Essential oils have been thoroughly investigated for their potential function in a variety of biological systems during the last few decades. Scientific evidence of anti-disease effectiveness was produced using extracts and bioactive chemicals derived from plants (Önder et al., 2024). Here is the overview of biological activity of medicinal plants in (Figure 1)

2.1. Antioxidant Activity

The antioxidant potentials of essential oils remain among the most researched of their attributes. Some diseases which are caused by cells damage and metabolic disarrays that take place due to oxidation of biological entities include diabetes, Alzheimer's disease, inflammation, Parkinson's disease, arthritis, and cancer among others (Jayawardana et al., 2019). There has been a lot of research on the EO's potential to prevent oxidative damage due to their high antioxidant content (Alirezalu et al., 2019). The present study provides evidence of antioxidant and prooxidative effects of the essential oil volatile components, which modulate cellular redox potential and injure intracellular biomolecules. Most of the essential oils are prooxidative and they can bring oxidation change in DNA and proteins at the cellular level.

Antioxidant activity is attributed to the phenolic element of essential oils out of which some are briefly described below. The extract from *Melissa officinalis L.* (lemon balm) has also been pointed out as having antioxidant activity higher than that of Butylated hydroxytoluene (BHT). The major components were geranial 23.4 %, neral 16.5 % and citronellal 13.7 % respectively as reported by (Lorenzo et al., 2018).

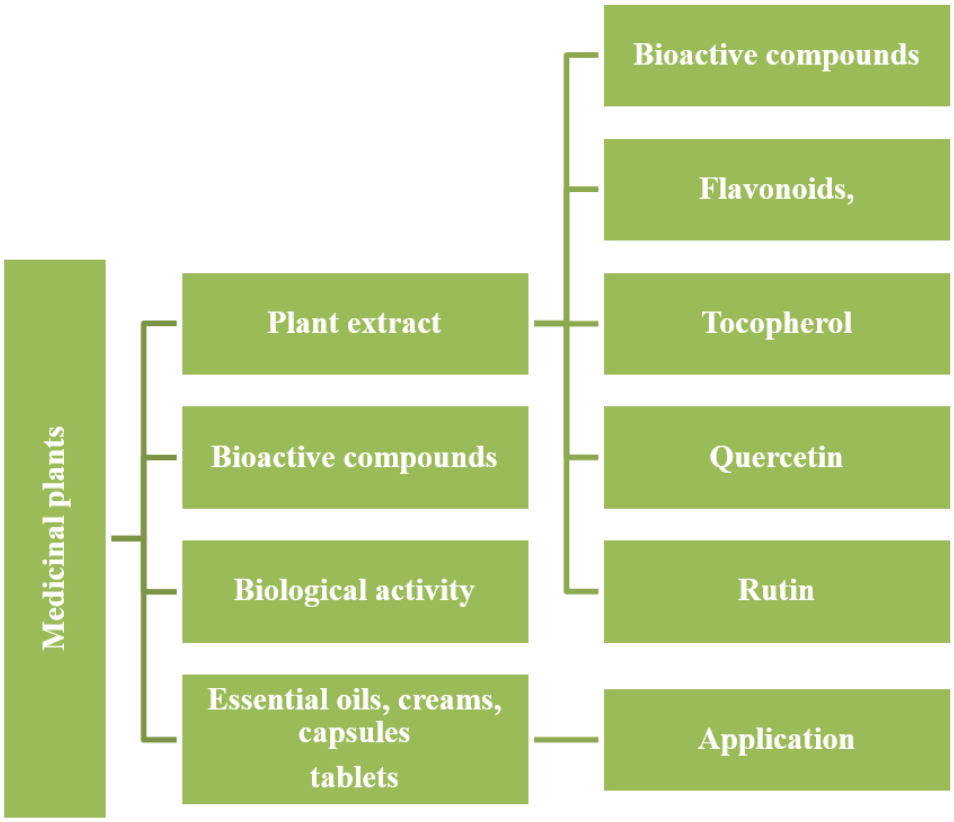

Fig. 2: Biological activity of medicinal plants

2.2. Anticancer Activity

This disease affects more than 18.1 million patients every year. Cancer is the main cause of mortality, as 9.6 million people die in 2018. Out of these 70% of deaths occur in developing countries (Domínguez et al., 2020). Taxol, Camptothecine, Vincristine and Vinblastine are some chemotherapeutic drugs used in cancer treatment (Hu et al., 2018). They have concluded that anticancer activity of essential oils has been a subject of significant research and literature. About 500 works were devoted to EO's anticancer activity (Jenča et al., 2024).

ROS is directly associated with inflammation and oxidation; essential oils also have anticancer effects. Moreover, essential oils have been demonstrated to have considerable anti-inflammatory potential (Jenča et al., 2024). The effect of the seeds extract of *Nigella sativa L.* (black cumin) in form of its essential oil also possess anti proliferative activity against A- 549 and DLD- 1 cancer cell lines with IC 50 of 43.0 and 46.0 µg/mL. Regarding human cancer cells, there are three types of cell lines: On SK-OV-3, HO-8910 and Bel-7402 cell lines, the IC50 of the essential oils are, respectively, 0.025% (v/v), 0.076% (v/v) and 0.013 % (de Souza et al., 2017).

2.4. Anti-inflammatory Activity

Several analyses reveal that the necessary oils contain high inflammation-eradicating characteristics. Many of them were applied in treating inflammatory and oxidative diseases after they were discovered. While *Cymbopogon citratus* has been the most utilized herb, it has been used as an analgesic and anti-inflammatory. The study revealed that this essential oil worked through the suppression of COX- 2 enzyme forms. The main component of this essential oil was citral, Cyclooxygenase-2 enzyme and stimulation of Peroxisome proliferator-activated receptors α and γ (Pongkitwitoon et al., 2024).

2.6. Essential Oils Antiviral Activity and Their Chemical Constituents

Optimal concentrations of essential oils own possess strong antiviral properties against diverse viruses; RNA and DNA detection coxsackievirus B-1, poliovirus, human's adenotype 3 influenza virus, dengue virus type 2 and junivirus (Mancini et al., 2015). Viral illnesses are of major significance to human health, globally. Since just a handful of medications have been proven to be effective against several viruses to date, there is a need for lead medications or compounds with potent antiviral properties. Some authors have pointed out that the some of the oils from oregano and clove possess extraordinary antiviral activities regarding different non enveloped RNA and DNA viruses; and including the coxsackie virus B-1, and polio virus as well to the adeno virus type-3 (Semerdjieva et al., 2020a). Antivral activity of some important essential oils is shown in table 1.

3. Active Herbal Ingredients Applications in the Food Industry

In most cases, therapeutic plants are deployed as complementary solutions in beverages, foods, and dietaries. In the past, these spices have been used mostly for their tastes as well as flavors in our food products because they make foods tastier. Food varieties' security are inclined to microbial decay and oxidative change. These responses decrease the dietary benefit of the items because of the deficiency of their parts and effect their security and organoleptic qualities (Yuan et al., 2016).

3.1. Essential Oils Applications in Food Preservation

Essential oils are employed due to their efficacy in fighting bacteria, fungi, and oxidative stress (Walasek-Januszet al., 2024). These compounds can enhance the food preservation by synthesizing natural food preservatives. The beneficial and non-beneficial impacts of these oils have to be closely assessed to ensure their edibility in foods. The compounds include thymol, carvacrol, linalool, cinnamaldehyde, and vanillin, which help the oil act as an antioxidant and antibacterial (Sweet et al., 2024).

Table 1: Some Potential Essential Oils Antiviral activity

Essential oils of medicinal plants	Chemical constituents	Activity against viruses	Citations
Melaleuca alternifolia oil	Terpinene-4-ol, trans-isolimonene	tobacco mosaic virus (TMV)	(Ahmed et al., 2024)
Sinapis arvensis L	monoterpenes	HSV-1	(Sharifi-Rad et al., 2017)
Melissa officinalis	phenylpropane, sesquiterpene, triterpene	HSV-2	(Benson et al., 2019).
Eupatorium patens and *Artemisia douglasiana*	terpenes, terpenoid	Dengue virus (DENV)	(Benson et al., 2019).
Lippia turbinate and *Lippia junelliana*	triterpenes	Junin virus	(Catalán et al., 2021)
Pogostemon cablin	patchouli alcohol	H2N2 influenza-A virus	(Ramburrun et al., 2024)
Melissa officinalis	monoterpenaldehydes citral a, citral b	H9N2 virus	(Pourghanbari et al., 2016)

3.2. Plant Extracts Applications in Preservation of Meat and Meat Products

Lipid oxidation is one of the most significant factors that lead to meat quality deterioration during food processing. It forms several metabolites that highly influence meat fiber (Domínguez et al., 2019). These synthetic antioxidant compounds were utilized to decrease or avoid lipid oxidation. Because synthetic antioxidants may be toxic or possibly toxic, they were shunned by consumers (Jayawardana et al., 2019). It can be seen that the extract plants possess higher antioxidant potential than the artificial (Jayawardana et al., 2019). Because of their activity, natural antioxidants can in general prevent the oxidation processes of biological cells by ROS (Lorenzo et al., 2018). Meat industry employs green bioactive compounds that include polyphenols chancellor to flavonoids and anthocyanins together with tannins and EOs with the terpenes. Another flavoring plant used in many countries in its various foods is oregano, scientifically known as *Origanum vulgare L.* (Drabova et al., 2019). Among these, the following bioactive compounds were reported from oregano; luteolin-7-o-rutinoside, phenyl ß-D-glucopyranoside, catechin, and rosmarinic acid (Fernandes et al., 2017). *Camellia sinensis* in its various forms includes; drink, dry leaves, tablet, thick capsule, and so on. Green tea leaves carry phenolic compounds, but the most bioactive is epigallocatechin-3-gallate (EGCG) (Koch et al., 2019). In the package of lamb nuggets, cassia, clove and thyme, the use of EOs and other essences to store the nuggets led to decreased level of lipid oxidation after refrigeration (at 4 °C for 30 days under aerobic condition) (Vermeiren et al., 1999). To stabilize meat products Guarana seed extract helps. Pythanganism leaves contain biologically active compounds that are used in meat products preservation. In those meat samples that were stored for eighteen days at 2°C, investigations have shown that this extract at 250, 500 and 1000 mg/kg was followed by improvement in the anti-lipoprotein oxidation. Investigations showed employing black cumin ethanol extract to minimize the yeast and coliform contamination when preparing salmon marinade from fish (Lorenzo et al., 2018).

4. Essential Oils and Plant Extracts Applications in the Agriculture Industry

4.1. Essential Oils and Plant Extracts Applications as Insecticides

Insect infestations that occur postharvest have been controlled with synthetic insecticides for several years (Bora et al., 2018), while postharvest bacterial contaminants have been controlled through the use of chemical bactericides (Pateiro et al., 2019). Hygienic, farming and glasshouse pest control is with Neem Tree Extract together with oils of mint Cinnamon, Clove, Rosemary, lemon thyme etcores. Semerdjieva et al. (2021) tested bio activity of EOs of four Juniper species as a prospective bio pesticide. *Curcuma longa* or commonly known as turmeric which has antibacterial; insect repellent; can be used a bio insecticide. Moreover, some previous studies have substantiated the truth stated here that the *J. virginiana* EO possesses insect and pathogenical activities (Hassan et al., 2024). Semerdjieva et al. (2020b) noted that Satureja pilosa EO possessed larvicides as well as repellent features on Aedes aegypti, from which new product can be derived to control such mosquitoes.

4.2. Essential Oils and Plant Extracts Applications as Herbicides

The organic way to control weeds in agriculture is through the use of allelochemicals. These chemicals are secondary plant metabolites established as allelochemicals such as alkaloids and glycosides as another mechanism for weeds eradication. For instance, *J. exselsa* and *J. sabina* could prevent weed seeds germination of to a certain degree (**Zheljazkovet al., 2024**).

4.3. Effects and Applications of Plant Extracts, Allelopathy, and Essential Oils on the Germination of Seeds

In modern agriculture, they show that allelopathy can be practically used with the help of direct plant EOs. One of the practices that preharvest vivipary counts in present agriculture is in wheat or barley for instance (Yang et al., 2007). A recent study showed that germination and growth of seeds of wheat and barley could be managed by allelopathic effects of EOs from the selected hyssop, lavender, English Thyme, costmary, lovage, cumin and lavender which could be used to formulate commercial commodities (Zheljazkov et al. 2022). In given experiments, researchers proved that oils of lavender, castor oil, cumin and hyssop could be potentially to reduce infestation of aphids (Behbahani, 2024). The study also revealed that *Lavandula angustifolia* has inhibitory impacts on the growth of the related weeds for instance, *Amaranthus retroflexus, Portulaca oleracea*, in tomato plant none of which was negatively affecting the tomato plant.

4.4. Essential Oils and Plant Extracts Application as Antibacterial and Antifungal Agents

To influence storage durability of vegetables and results to high losses Bacteria are known for this. To eradicate the disease agents, medicinal plants are found to be most efficient and have a major use in those which check Monocytes and insects. Despite its shortcomings, the standard Clevenger apparatus and SCom water distilled EOs of *J. oxycedrus L.* exhibit moderate to high inhibition only to the following fungi: *Botrytis cinerea, Fusarium spp., Rhizoctonia solani, Colletotrichum spp.,* and *Cylindrocarpon pauciseptatum* according to Semerdjieva et al. (2020a).

5. Essential Oils and Plant Extracts Applications in Cosmetics Industry

Among all the working for cosmetics, the herbal extract and essential oils receive much attention from people. Cosmetics and fragrances were gained with help of active substances of plants. India and China used medicinal plants for beauty products among other findings, Egypt used pyramids while Iran used remains. Over eighty per cent of global populace caters their health requirement from plant extracts (Foroughi, 2022). For herbal oil extraction, ancient Egyptian used steaming method and on the other hand the Roman and Greeks to extract the herbal used the distillation Method. Camphor an aromatic compound is present in EO isolated from the aerial parts of *Cedrus libani, Ocimum kilimandscharicum, Artemisia annua*, the twigs and leaves of *Acacia vestita*, the stem and leaves of *Piper angustifolium*, the stem bark of *Sassafras albidum* and the leaves of *Rosmarinus officinalis* species. It has been employed in Europe and Asia mostly as an antiseptic as well as in food preparations and for cosmetic purposes (Zheljazkov et al., 2022). Herbal cosmetics is environment friendly as well as renewable in nature. Just recently "natural cosmetics" substantiated a sizeable chunk of the cosmetics market is estimated by 2021 it was, about Forty billion, which amounts to 10% of the global cosmetics market.

They are employed in products including creams, lotions and washes in cosmetic industry specifically in skin care. Facial creams and toiletries, lipsticks and perfumes all employ beauty products, shampoos and conditioners masks or anti-dandruff agents (Guzmán & Lucia, 2021). One can accommodate EOs into shampoos, hence EOs can reach the scalp as soon as they are put on the hair and the hair roots gain a feed and moisture while at the same time eradicating the detrimental molecules that exclude the skin pores (Abelan et al., 2022). Mentha piperita also known as EOs aids in halting hair loss and even encourages hair growth (Benson et al., 2019). Preventing acne from occurring can be made with help of the ability of EOs contain Propioni bacterium acnes (Ramburrun et al., 2024).

Because 290 and 400 nm UV rays can penetrate deeply EOs can be added to creams that prevent wrinkles, sun burn, aging and other skin diseases. *Calendula officinalis* EO added to a cream showed in the laboratory that it possessed protective action from the sunlight from the result obtained (El-Otmani et al., 2024). There are some important skin care oroducts obtained from essential oils shown in table 2.

Table 2: Some Potential Application of essential oil in skincare Product

Application Essential Oil Plant	Common name of Plant	Scientific name of Plant	Citation
Anti-Acne	citronella grass	*Cymbopogon nardus*	(Nareswari at al., 2023)
	Artemisin	*Artemisia annua*	(Perez et al., 2021)
	Geranium	*Geranium rotundifolium*	(Litt, 2019)
	Rosehip	*Rosa canina*	(Oargă et al., 2024)
Skin aging	Lemon	*Citrus lemon*	(Singh et al., 2022)
	Sage	*Salvia officinalis*	(Gupta et al., 2023)
	Citronella	*Cymbopogon nardus*	
Ant wrinkle	Clove	*Syzygium aromaticum*	(Das et al., 2021)
	Chamomile	*Matricaria chamomilla*	(Varothai et al., 2013)
Moisturizer	sandalwood	*Santalum spicatum*	(Giri, et al., 2024)

6. Herbal Medicine and New era

Modern medicine and medication development have its roots in herbal medicine. New treatments in the clinic and effective medications to combat novel ailments are still fostered by routines and relevant knowledge. Drugs and natural ingredients are important in the high number of infected patients. Thus, it is inevitable that herbal medicine has to be integrated into modern medicine research and clinical exercises.

A good amount of work has been contributed in the past on natural chemical medications. However, western medical philosophy forms the basis of most of these endeavors and processes. Microbiologically derived, plant and animal bases chemical drugs are responsible for more than half of the chemical drugs used in western markets and economies. All the accomplishments indicate that there are still many questions that need to be answered.

However, as of right now, no particular drug development system has been extensively utilized and relied upon. It is inevitable that medication development procedures will be updated. Low toxicities and drug cocktail (combination ingredients) are the advantages of natural chemical medications over manufactured chemotherapeutic treatments. The drug combinational guidelines that are often utilized in China may be crucial for managing late-stage cancer and a number of new deadly virus infections, which requires effective global paradigm propagation (Wang et al., 2023). In order to facilitate the development of natural chemical drugs, it is necessary to investigate novel concepts and viewpoints. In the clinic, certain medical publications and articles can also draw interest and prompt feedback.

Conclusion

Herbal therapy has been popular for a long time now starting from the ancient civilization only. Perhaps the answer that researcher and medical professionals may have been looking for in the form of 'missing link' could be the lack of integration of herbal medicine or linked treatment approaches in the allopathic medicine practice, or in another type of therapy that incorporates modern technology. Notwithstanding

this, the integrated approaches based on new state-of-art technologies and the classical approaches of traditional medicine are yielding good positive results that beneficial to the patients. It is acknowledged that this chapter's examples provide an indication of current research. Essential oils and extracts (EOs) are complex organic compounds generated from a diverse host of plant genera. They can also be employed as antioxidants and preventions in medicinal product, food, cosmetic, and agricultural products.

Furthermore, it is vital to check the components in EOs and extracts because they include many bioactive substances. In order to find new bioactivities of EOs, efforts must be focused on using automation and high throughput screening. Additionally, vivo tests and extensive clinical research are required to validate the vast amount of data produced by in vitro studies.

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